SAFE CUTS

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Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

MINNESOTA MDH DEPARTMENT OF HEALTH

Minnesota Hospital Association

The ***Safe CUTS* road map** provides evidence-based recommendations/standards for Minnesota hospitals in the development of comprehensive surgical site infection (SSI) prevention programs. The road map and accompanying tool kit were developed as part of the Minnesota SSI Prevention Collaborative which was made possible with funding through the Centers for Disease Control and Prevention (CDC) Epidemiology and Laboratory Capacity Program (ELC) American Reinvestment and Recovery Act (ARRA).

The road map was written with elective, inpatient surgery in mind, and can be adapted for use in other settings such as ambulatory or emergency surgery. However, some of the recommendations clearly will not apply to those situations (e.g., providing smoking cessation services prior to emergency surgery). The road map reflects published literature and guidelines by relevant professional organizations and regulatory agencies (October 2011) as well as best practices identified by the SSI Prevention Collaborative. The road map and tool kit will be reviewed regularly and updated as indicated through published literature.

We would like to thank the following organizations and individuals for sharing their time, expertise and stories which made the road map and tool kit possible.

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	Safe from SSI Component	Specific Action(s)	Audit Questions
S	**SSI Prevention Teams**	1) Provide support and expectations for SSI prevention champions.	1a) A physician champion(s) has been identified (recommend surgeon and/or infectious disease specialist if possible) for SSI prevention. 1b) An operational champion(s) has been identified for SSI prevention (e.g., OR director, infection preventionist). 1c) The facility has a process in place to partner the physician and operational champions. 1d) The facility has defined roles, set expectations and provides support for the champion(s).
		2) Adopt an inter-disciplinary team approach to SSI prevention with a designated coordinator to oversee implementation.	2a) The facility adopts a team approach with an interdisciplinary team to oversee and support SSI prevention work. 2b) The facility has a designated coordinator to oversee SSI prevention implementation (e.g., schedule team meetings, plan staff education). 2c) The designated SSI prevention coordinator has dedicated time to serve in this role. 2d) Individual roles in the SSI prevention steps ('CUTS') are clearly defined and documented.
A	**Access to Information**	1) Verify the completion of the SSI prevention steps.	**Data Collection** The facility has in place: 1a) Documentation of the completion of each SSI prevention step for all interdisciplinary team members involved in the procedure (e.g., a pre-procedure, intra-procedure, and post-procedure checklist).
		2) Audit the completion of the SSI prevention steps.	<u>Pre-, Intra- & Post-Operative (OP):</u> 2a) Chart audits of the completion of SSI prevention steps. 2b) Observational audits of the completion of SSI prevention steps. 2c) Standard criteria for auditors.
		3) Measure the outcomes of the SSI prevention efforts (surveillance).	3a) Standardized collection of SSI data using the National Healthcare Safety Network (NHSN) definitions. 3b) SSI data includes information beyond rates to use in determining possible factors contributing to and/or causing the infection. 3c) SSI data is submitted to NHSN.
		4) Evaluate the SSI prevention efforts for learning opportunities.	**Data Analysis** The facility has a process in place to: 4a) Routinely review and analyze SSI data. 4b) Carry out additional analysis (e.g. case review) for learning and improvement opportunities when rates suggest trends or clusters. On at least a quarterly basis: 4c) Share data within and across teams. 4d) Share data with senior leadership. 4e) Share data with medical staff.

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F	**Facility Expectations**	1) Set expectations for implementation of the SSI prevention steps for any OR procedure.	1a) The facility's policies address SSI prevention steps (i.e. "CUTS") and include expectations for following these steps.
		2) The facility has a clearly defined process for speaking up and "stopping the line" if a potential safety issue has been identified by staff.	**The process clearly outlines:** 2a) When to stop the line. 2b) How to stop the line (e.g., "I need clarity"). 2c) The chain of command to follow if not supported in stopping the line. 2d) Clear communication to staff from managers and leadership that staff will be supported if they speak up.
		3) Set expectations that the patient is optimally physically prepared pre-operatively.	**The facility has clearly communicated to providers that they are expected to address the following:** 3a) Pre-op planning includes assessment of modifiable risk factors and offering education and services for risk reduction (e.g., smoking cessation, weight loss, glucose management). 3b) The facility pre-op physical is in the patient medical record and reviewed by pre-op team prior to surgery. 3c) Pre-op physical includes evaluation for existing infections including, but not limited to, skin, urinary tract, sinus and periodontal. 3d) If identified, infections are treated before elective surgery and surgery is postponed until resolution of infection (excluding emergency surgery).
E	**Educate Staff and Patients**	1) Provide SSI prevention education for all clinical staff involved in surgical procedures or caring for surgical patients.	**SSI prevention education and competencies have been incorporated into new employee orientation:** 1a) For all surgical staff. 1b) For all health care personnel caring for surgical patients. 1c) For surgeons and other providers. 1d) Ongoing SSI prevention education is incorporated into training at least annually for all health care personnel involved in care of surgical patients.
		2) Educate patients, families, and caregivers on their role in SSI prevention.	2a) Pre-op SSI prevention education is provided to patients and families that includes identifying modifiable risk factors (e.g., smoking, obesity, diabetes management), not self-shaving, and instructions on hygiene (e.g., showering, hand hygiene, and pre-op surgical site preparation) prior to the procedure. 2b) Post-op SSI prevention education is provided to patients and families prior to discharge including hygiene (e.g., when to resume showering/bathing, hand hygiene, laundry), wound care, and signs and symptoms of infection to report to provider.

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Patient Care Bundle			
C	**Cleaning Surgical Equipment/ Environ-ment**	1) Appropriate use of immediate use sterilization.	**A standardized process is in place to:** 1a) Limit immediate use sterilization to instances when there are not other viable options (i.e., do not use for convenience, preference or when adequate inventory could eliminate the need for it). 1b) Audit immediate use sterilization. 1c) Review audit data on a quarterly basis. 1d) Follow appropriate preparation methods for immediate use sterilization.
		2) Appropriate cleaning, disinfection and sterilization of surgical instruments and equipment.	2a) Follow manufacturer's instructions for cleaning, disinfection and sterilization. 2b) Follow AAMI guidelines and use Spaulding scale definitions in determining appropriate cleaning, disinfection and sterilization.
		3) Appropriate cleaning and disinfection of the surgical environment.	3a) The hospital has and adheres to a policy for complete and thorough cleaning of the surgical environment that is based on a guideline or guidelines by nationally recognized organizations such as The Joint Commission, AORN and/or HICPAC and incorporates AAMI standards using Spaulding scale definitions. 3b) Responsibility for cleaning and disinfecting each type of equipment and area is clearly defined. 3c) The cleaning and disinfection process is routinely audited and evaluated.
U	**Undergoing Surgery** ***Pre-procedure***	1) Administer antimicrobial prophylaxis.	1a) An evidence-based standardized protocol is in place for the use of prophylactic antibiotics. 1b) Surgeons, pharmacy, infection prevention, infectious disease and anesthesia staff are involved in the protocol development to ensure appropriate timing, selection and duration of antibiotics. 1c) Pre-printed or computerized standard orders are in place specifying antibiotic, timing, dose and discontinuation. Instructions for re-dosing (e.g., related to duration of surgery and blood loss) or special weight considerations, especially for obese patients (body mass index >30) are included. 1d) Roles are clearly assigned for ensuring that antibiotics are administered within one hour prior to surgical incision (2 hours for vancomycin and fluoroquinolones) and for re-dosing if needed. 1e) Verify administration timing (including re-dosing) during "time-out" period or pre-procedural briefing.
		2) Prep Skin/Site.	**A standardized process is in place to prepare the patient's skin and operative site, which includes:** 2a) Leaving surgical site hair in place. If hair removal is necessary, razors or depilatory creams that may irritate skin are not used. 2b) The skin around the surgical site is free of soil, debris, exudates, and transient organisms before application of the antiseptic skin preparation. 2c) Selection of the pre-op skin antiseptic agent is based on FDA approval or clearance. 2d) The pre-op antiseptic agent significantly reduces microorganisms and is broad spectrum, fast-acting and has a persistent effect. Consider use of 2% chlorhexidine gluconate (CHG) with isopropyl alcohol or iodine povacrylex with alcohol (70%) unless contraindicated. 2e) Assess patient for allergies or sensitivities to skin preparation agents. 2f) Any jewelry at or near the surgical site is removed before cleaning the skin.

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			2g) Sterile gloves are worn unless the antiseptic prep applicator is of sufficient length to prevent hand contamination. 2h) Any skin preparation containing alcohol must be allowed to dry before beginning surgery due to flammability of the product.
		3) Check pre-op blood glucose levels on all diabetic patients.	3a) A standardized glucose management protocol is in place for all known diabetic patients. 3b) A baseline blood sugar is established for all patients with known diabetes on the day of surgery.
		4) Pre-warming of patients.	4a) A process is in place to pre-warm the patient's body temperature so that it can be maintained at >96.8° F/ 36° C during surgery.
	During the procedure	1. Keep OR door closed during surgery except as needed for passage of equipment, personnel and the patient.	**Expectations are in place to:** 1a) Keep the OR door closed during surgery except for essential passage of equipment, personnel and patient. 1b) Discuss equipment/supply needs during pre-operative communication prior to the procedure to minimize the need to bring additional equipment/supplies in during the procedure. 1c) Responsibility is assigned to monitor the room once sterile supplies are opened.
		2. Maintain patient normothermia.	2a) A standardized process is in place to maintain patient's body temperature at >96.8° F/ 36° C during surgery. 2b) Patient's temperature will be measured just prior to or shortly after anesthesia has ended.
		3. Control blood glucose for at-risk patients.	3a) Clear expectations are in place for ongoing monitoring and management of blood glucose for diabetic patients during surgery.
		4. Antibiotic re-dosing occurs during surgery as indicated.	4a) If necessary, antibiotic dose is repeated during surgery at the appropriate time.
	Post-procedure	1) Apply sterile surgical wound dressings as appropriate.	**A standardized process is in place to:** 1a) Maintain sterility of surgical environment until sterile dressings have been applied and are secure. 1b) Protect primary closure incisions with sterile dressings as appropriate for 24-48 hours.
		2) Maintain normothermia during the immediate post-operative period.	2a) Maintain normothermia in the post-anesthesia care unit (PACU).
		3) Control blood glucose during the post-operative period.	3a) Baseline and intra-op glucose levels are communicated during post-op hand-offs. 3b) Have protocol in place to maintain post-operative glucose level at <200 mg/dl for 72 hours post-operatively while an inpatient.

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		4) Discontinue antibiotics within 24 hours after end of surgery unless otherwise indicated.	4a) Discontinue antibiotics within 24 hours after end of surgery unless otherwise indicated. (Exceptions: CABG and other cardiac surgery.)
		5) Provide post-procedure education to patient/family.	5a) Post-op SSI prevention education is provided to patients and families prior to discharge. {Refer back to "Education"}
T	**Team Account-ability/ Communi-cation**	1) Communicate using standardized process.	1a) A pre-op team communication process, such as a pre-op briefing, is in place in the OR prior to incision that includes discussion on antibiotic, timing, need for re-dosing; and any special considerations. 1b) A standardized process is in place to track completion of SSI prevention steps (i.e. incorporate into surgical checklist).
S	**Staff**	1) Set expectations for hand hygiene.	**Clear expectations are in place for hand hygiene, illness, and attire for all health care providers including:** 1a) Hand hygiene education is provided for all new employees. 1b) Standardized procedures for hand hygiene are followed by all health care personnel. In the perioperative setting, hand hygiene practices for maintaining healthy skin and fingernail conditions as outlined by AORN guidelines are followed including: 1c) Fingernails are short, clean, and without chipped nail polish. 1d) Artificial nails (any enhancement or resin bonding product including gel and shellac) are not worn. 1e) Rings, watches, and bracelets are removed prior to hand hygiene. 1f) Cuticles, hands and exposed skin are free of cuts, abrasions, open lesions, and new tattoos. 1g) A surgical hand scrub is performed by health care personnel before donning sterile gloves for surgical or other invasive procedures. Hospital-wide: 1h) Hand hygiene and surgical hand scrub products are FDA-approved. 1i) AORN, CDC, and/or WHO guidelines as well as manufacturer's directions are followed when using hand hygiene and surgical hand scrub products. 1j) Hand hygiene audits are conducted for all health care personnel. 1k) The "Just Culture" model will be applied when health care personnel are observed not following facility expectation for appropriate hand hygiene.
		2) Set expectations for staff illness.	2a) Staff who are acutely ill with a communicable infectious disease should be excluded from direct patient care.
		3) Set expectations for surgical attire.	**For staff in restricted and semi-restricted areas:** 3a) Fresh, hospital-laundered surgical attire donned upon arrival before entering the restricted and semi-restricted areas each day. 3b) Surgical attire is changed if it becomes visibly soiled. 3c) Scrubs are not to be worn outside the hospital. This applies to all health care personnel and vendors. 3d) Personal attire is covered by hospital-provided attire.

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			3e) Jewelry that is not covered by surgical attire is removed prior to entering restricted and semi-restricted area. 3f) Scalp and hair is completely covered by disposable caps or caps that are hospital-laundered and changed daily. 3g) Non-scrubbed health care personnel in the OR wear hospital-laundered long-sleeved cover jackets. 3h) The "Just Culture" model will be applied when staff are observed not following facility expectation for appropriate surgical attire.

In addition to SSI, surgical patients are vulnerable to other health care-associated infections. Refer to guides for prevention of catheter-associated urinary tract infections, ventilator-associated pneumonia, central line-associated bloodstream infections, *Clostridium difficile* infection, pressure ulcers, and guidance on judicious antibiotic use for measures to prevent other infections.

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General Information

Moving Toward Elimination of Healthcare-Associated Infections: A call to Action
Infection Control and Hospital Epidemiology, November 2010.

Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals *SHEA/IDSA Practice Recommendation*

Strategies to Prevent Surgical Site Infections in Acute Care Hospitals
SHEA/IDSA Practice Recommendation

Guideline for Prevention of Surgical Site Infection, 1999
Infection Control and Hospital Epidemiology, April 1999

APIC Elimination Guide: Guide to the Elimination of Orthopedic Surgical Site Infections
APIC 2010

SSI Reference Bundles

WHITE PAPER

Moving toward Elimination of Healthcare-Associated Infections: A Call to Action

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INTRODUCTION

Jointly, the Association for Professionals in Infection Control and Epidemiology (APIC), the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), the Association of State and Territorial Health Officials (ASTHO), the Council of State and Territorial Epidemiologists (CSTE), Pediatric Infectious Diseases Society (PIDS), and the Centers for Disease Control and Prevention (CDC) propose a call to action to move toward the elimination of healthcare-associated infections (HAIs) by adapting the concept and plans used for the elimination of other diseases, including infections. Elimination, as defined for other infectious diseases, is the maximal reduction of "the incidence of infection caused by a specific agent in a defined geographical area as a result of deliberate efforts; continued measures to prevent reestablishment of transmission are required."[1(p24)] This definition has been useful for elimination efforts directed toward polio, tuberculosis,[2] and syphilis[3] and can be readily adapted to HAIs. Sustained elimination of HAIs can be based on this public health model of constant action and vigilance. Elimination will require the implementation of evidence-based practices, the alignment of financial incentives, the closing of knowledge gaps, and the acquisition of information to assess progress and to enable response to emerging threats. These efforts must be underpinned by substantial research investments, the development of novel prevention tools, improved organizational and personal accountabilities, strong collaboration among a broad coalition of public and private stakeholders, and a clear national will to succeed in this arena.

The clear consensus among healthcare epidemiologists, infection preventionists, infectious disease physicians, and other clinicians attending the Fifth Decennial International Conference on Healthcare-Associated Infections 2010 is that now is the time to advance the cause of HAI elimination.[4] In this white paper, we embrace the goal of HAI elimination and we identify steps to achieve this goal. We are committed to working together to eliminate HAIs, recognizing that further work is needed to implement the steps identified in this call to action.

HAIs are an increasingly recognized problem. The number of people who are sickened or die and the financial impact from HAIs are unacceptably high.[5] Intrinsic to the problem is the inconsistent implementation of proven preventive measures. Furthermore, we know little about the burden of infections outside hospitals, particularly in long-term care facilities, ambulatory surgical centers, and other outpatient settings, and the burden of infections outside the United States. The World Health Organization has reported that, at any given time, approximately 1.4 million people have an HAI; in developing countries, the risk can be up to 20 times greater than in developed countries.[6] In addition, the emergence of HAIs caused by multidrug-resistant microorganisms is an increasing concern.[7] We recognize the diversity of political, economic, educational, and clinical capacity throughout the world, as well as the success of various HAI prevention efforts. The framework we describe is based primarily on the US experience, but we are optimistic that these principles can be applied to the elimination of HAIs around the globe.

Recently, efforts in several countries have shown remarkable success in preventing some HAIs,[8-11] and there is a growing body of knowledge defining a full range of prevention interventions that can address specific HAIs when consistently applied across settings.[12] As the US population ages and

From the Centers for Disease Control and Prevention (CDC), Division of Healthcare Quality Promotion (DHQP) (D.C.), the Pediatric Infectious Diseases Society (PIDS) (P.H.D.), the Association of State and Territorial Health Officials (ASTHO) (P.H.), the Society of Healthcare Epidemiology of America (SHEA) (N.F.), the Council of State and Territorial Epidemiologists (CSTE) (M.K.), the Association for Professionals in Infection Control and Epidemiology (APIC) (C.L.M.), Infectious Diseases Society of America (IDSA) (R.J.W.). Members of the HAI Elimination White Paper Writing Group are Patrick J. Brennan, MD (IDSA); Jennifer Bright (SHEA); Cecilia Curry, PhD (CDC); Denise Graham (APIC); Belinda Haerum, MPH (ASTHO); Marion Kainer, MD, MPH (CSTE); Keith Kaye, MD, MPH (SHEA); Tammy Lundstrom, MD, JD (SHEA); Chesley Richards, MD (CDC); Lisa Tomlinson (APIC); Elizabeth L. Skillen, PhD (CDC); Stephen Streed, MS, CIC (APIC); Melanie Young (SHEA); and Edward Septimus, MD, FIDSA, FACP, FSHEA (APIC).

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healthcare costs rise, HAI elimination becomes a "best buy" for patient health and healthcare savings. We are now facing a unique and timely opportunity to move toward the elimination of these infections. Political will and investments at the federal, state, and local levels in the prevention of HAIs—such as the Health and Human Services Action Plan to Prevent HAIs, the American Recovery and Reinvestment Act funding,[13] individual state mandates for public reporting,[14] the Deficit Reduction Act,[15] the Patient Protection and Affordable Care Act,[16,17] and consumer expectations for transparency and accountability—provide momentum for success.

LEARNING FROM LOCAL SUCCESSES

Currently, there exists a real opportunity to eliminate specific HAIs, including central line–associated bloodstream infections (CLABSIs). Recent local and regional initiatives have shown 60%–70% overall decreases in the rate of CLABSIs in intensive care units (ICUs), with no CLABSIs for many consecutive months in some ICUs.[18,19] Moreover, these reductions have been sustained for up to 4 years following implementation of CLABSI prevention interventions.[20] The interventions associated with dramatic reductions in the rate of CLABSIs included strategies to increase adherence to existing evidence-based guidelines. Specific strategies to increase adherence to evidence-based guidelines included (1) leadership support at the highest levels of the facility, (2) leadership and guidance from healthcare epidemiologists and experts in infection prevention and control, (3) education and engagement of clinicians, (4) packaging of recommendations in patient-centered "bundles," (5) improvement of the safety culture in healthcare units and facilities, (6) data-driven tools and initiatives to assess impact and to provide feedback to clinicians about progress and challenges, and (7) local and statewide collaborative efforts to broadly share best practices.[18,19,21] These efforts included effective, evidence-based practices, such as immediate and detailed analysis of opportunities to improve the prevention of additional infections after a CLABSI has been detected. An important component of these interventions has been leadership endorsement and support of a culture of safety in the healthcare facility, which has allowed front-line staff to feel empowered to intercede on behalf of patient safety when clinical activities deviated from expected pathways and has likely contributed to improved clinical outcomes.[18,19]

In moving toward sustained improvements in safety culture and HAI elimination, progress has been incremental, following the quality cycle of "plan-do-check-act-repeat."[22] Successful projects have focused on consistent and reliable implementation of practices shown to reduce HAIs. Further progress toward elimination will require continued research that identifies additional effective practices and strategies to prevent HAIs.

IMPERATIVES FOR THE ELIMINATION OF HAIS

On the basis of lessons from recent successes, we propose that the elimination of HAIs will require constant action and vigilance (1) to promote adherence to evidence-based practices through partnering, educating, implementing, and investing; (2) to increase sustainability through the alignment of financial incentives and reinvestment in successful strategies; (3) to fill knowledge gaps to respond to emerging threats through basic, translational, and epidemiological research; and (4) to collect data to target prevention efforts and to measure progress. These efforts must be underpinned by sufficient investment (Figure 1). For example, despite HAIs being among the leading causes of death in the United States, only recently have HAIs been recognized as an important target for prevention. To accelerate progress from recent successes, more support for prevention innovations and training will be needed to accomplish the desired impact in HAI prevention. Important steps for the elimination of HAIs will be characterized by the following imperatives.

1. Implement Evidence-Based Practices

The cornerstone of HAI elimination is to increase adherence to what we already know can be effectively implemented, on the basis of scientific evidence. These recommendations are based on research conducted by experts in prevention and

FIGURE 1. Pillars of HAI elimination. The elimination of HAIs will require (1) adherence to evidence-based practices; (2) alignment of incentives; (3) innovation through basic, translational, and epidemiological research; and (4) data to target prevention efforts and measure progress. These efforts must be underpinned by sufficient investments and resources.

are included in several clinical guidelines (eg, CDC's Healthcare Infection Control Practices Advisory Committee [HICPAC] infection control guidelines,[12] SHEA and IDSA's Compendium of Practical Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals,[23] and APIC's Elimination Guides[24]). Adherence to evidence-based practices will require flexibility to respond to the changing healthcare environment and emerging pathogens. Furthermore, the barriers to adherence are multiple and complex. Although most of the reportedly successful HAI prevention strategies have targeted infections in ICUs, such interventions must move increasingly into non–critical care hospital settings and nonhospital healthcare settings to achieve the best possible outcomes. To identify best implementation strategies, partnerships and collaboration with specific clinical groups (eg, hospitalists, critical care specialists, surgeons, and infectious disease physicians), as well as with healthcare epidemiologists, infection preventionists, patient safety and quality officers, and health service researchers, are needed. In addition, all groups (eg, physicians, nurses, allied health professionals, dieticians, housekeepers, and clerical staff) who impact the daily care of a patient must work as a team to prevent HAIs. As part of the team, each person should understand his or her role in prevention and should be empowered to do the right thing for patients. "Collaboration rather than competition should be the hallmark of elimination efforts."[25]

Successful collaboratives have focused on the development of partnerships outside of single facilities. Partnerships among competing facilities and hospitals, as well as health departments and hospital associations, have allowed sharing of best practices and strategies to overcome barriers to implementation and progress in a nonthreatening manner. Partnering with payers can also create an incentive for facilities to prevent HAIs by rewarding progress toward elimination.

Finally, healthcare epidemiologists, infectious disease physicians, infection preventionists, and public health professionals need to expand and to improve upon current collaborations and partnerships with consumers and legislators to provide the most current science and evidence-based practices on improving HAI prevention. Such efforts can increase the likelihood of legislative mandates that truly support, rather than hinder, progress toward HAI elimination. Public health departments, working with HAI prevention experts, need to establish and to maintain strong programs in HAI elimination.

2. Align Incentives

A thoughtful integration of payment incentives that focuses on prevention is critical in moving toward elimination of HAIs. The combined tools of healthcare payment, oversight and accreditation, and public reporting are emerging ways to increase adherence to HAI prevention practices. Currently, there is political will to identify cost-saving strategies, and HAI prevention strategies provide many opportunities to achieve that goal. Refining and strengthening these tools on the basis of both experience and data must be priorities to achieve elimination goals and to prevent potential unintended consequences. For example, in the United States, experts in healthcare epidemiology and infection prevention join infectious diseases physicians to collaborate with the Joint Commission, the Centers for Medicare and Medicaid Services (CMS), and other certification and accreditation groups to improve evidence-based oversight of infection prevention practices. These collaborations can greatly increase opportunities to improve adherence and to prevent infections. Ideally, payment policies should provide sufficiently broad incentives to catalyze the development of systems of care that are prevention oriented. In such systems, prevention of HAIs would not be an added requirement but would be completely embedded in the processes of care. Ultimately, working with key payment stakeholders—including payers (health plans, insurance companies, and CMS) and providers (hospitals, physicians, vendors of information technology, medical products, and laboratory systems)—to create appropriate incentives to promote system-wide strategies for HAI prevention will be critical to creating sustainable elimination. High standards of accountability also will be needed to make sustained elimination a reality.

A broad, strategic approach toward prevention-oriented healthcare payment is likely to shift the focus from strategies based on individual healthcare encounters (ie, reduced payment for individual HAIs) to performance-modeled payment to providers or groups of providers based on the population-based results (ie, numbers or rates of HAIs among all hospital admissions, all providers' patients, or particular groups of patients).

3. Address Gaps in Knowledge

To develop and to test credible prevention strategies for HAIs, we need to better understand how and why these infections occur. Although there are successful prevention initiatives for some device-associated infections in ICUs,[18-20] research is still needed to develop evidence-based prevention recommendations for many other HAIs. In some cases, additional research is needed to augment a limited understanding of the basic epidemiology of healthcare-associated pathogens (eg, colonization and transmission dynamics), to inform development of rational prevention strategies.

Research is also needed to assess the impact of existing prevention recommendations and policies. Experts in the field propose 5 phases of translational research to address gaps in knowledge: (1) epidemiologic studies, (2) discovery of potential interventions, (3) evaluating promising interventions leading to the development of evidence-based guidelines, (4) moving evidence-based guidelines into health practice, and (5) evaluating the "real world" health outcomes of population health practice.[26] The current level of evidence for HAI pre-

vention varies for each type of infection and also by type of healthcare setting. For example, knowledge of the prevention of CLABSI in ICUs[18,19] is well understood and more adequate to move toward elimination. To expand prevention efforts to other HAIs in all healthcare settings and to move closer to elimination, knowledge gaps need to be addressed. Experts in healthcare epidemiology, in collaboration with stakeholders in prevention, must develop science-based, systematic approaches to the design of studies that will provide definitive answers to the critical questions of HAI prevention.[27]

4. Data for Action and Responding to Emerging Threats

Timely and accurate data on HAI occurrence are necessary to define the scope of the problem (and its variability across locations) and to assess progress toward elimination. Incidence data allow healthcare epidemiologists and infection preventionists to detect HAIs, to inform clinicians about how best to prioritize prevention interventions, and to assess the impact of those interventions. Data also allow public health officials to identify local and regional facilities requiring improvement. Measurement can also provide institutions and the public with information for comparisons across facilities and regions to better understand current risks for HAIs as well as risks over time. With accurate data, both providers and patients can make informed decisions about risks and prevention strategies for HAIs. Investments for timely and high-quality data should be focused on (1) reshaping standard definitions and surveillance methods to fit the new, emerging information system paradigms (eg, electronic health information records and data mining); (2) creating national and global data standards for key HAI prevention metrics; and (3) creating or refining the data analysis and presentation tools available to prevention experts, clinicians, and policy makers at the local, state, national, and international levels.

Healthcare delivery is complex and dynamic. New devices and invasive procedures are developed and introduced at an extraordinary rate, creating the need for prospective assessment of hazards associated with new technology. Experts in healthcare epidemiology, infectious diseases, and infection prevention should identify and should address potential infections associated with these newer technologies and procedures through collaboration with developers and those who test new devices. In addition, new and emerging pathogens and resistance remain an ongoing threat in all healthcare settings. Public health agencies have a unique role to play in HAI prevention. Federal, state, and local public health agencies investigate outbreaks of emerging infections or adverse events, such as inappropriate medical device use, medical product contamination, or unsafe clinical practices. By discovering new or previously unrecognized problems, we gain information on what needs to be measured, and we identify research gaps and educational needs. Through the investigation of these outbreaks, preventable causes of emerging infections can be identified and incorporated into practice guidelines. State and local health departments are in a unique and important position to assess emerging trends or gaps in prevention, particularly given shifts in healthcare delivery from acute care settings to ambulatory and long-term care settings. The public health model's population-based perspective in state and local health departments and its collaboration with other experts in infection prevention and with professional associations will provide increased national capacity to assess emerging risks from HAIs.

CALL TO ACTION

Progress toward the elimination of HAIs is real. The opportunities to build on successes described here and at the recent Fifth Decennial International Conference on Healthcare-Associated Infections 2010 provide momentum to achieve aggressive goals for the elimination of HAIs. The expertise and resourcefulness of healthcare epidemiologists, infection preventionists, infectious disease physicians, and other clinicians together with public health professionals can build on and can accelerate recent progress. We must continue to work together to increase adherence to practices supported by the body of knowledge on existing prevention interventions and toward the alignment of incentives such as institutional and personal accountability to accelerate the elimination of HAIs. We must invest in research to find innovative solutions to combat challenges, such as antimicrobial resistance, the increasing burden of HAIs outside of traditional hospital settings, and the refinement of existing intervention bundles to be the safest and most cost-effective. We must be flexible and responsive to emerging challenges and the changing healthcare environment. Most of all, we must focus on the patient and must challenge ourselves to no longer accept the unacceptable. HAIs are preventable. We must work together to eliminate HAIs for the generations to come.

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SUPPLEMENT ARTICLE: EXECUTIVE SUMMARY

A Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals

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Preventable healthcare-associated infections (HAIs) occur in US hospitals. Preventing these infections is a national priority, with initiatives led by healthcare organizations, professional associations, government and accrediting agencies, legislators, regulators, payers, and consumer advocacy groups. To assist acute care hospitals in focusing and prioritizing efforts to implement evidence-based practices for prevention of HAIs, the Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America Standards and Practice Guidelines Committee appointed a task force to create a concise compendium of recommendations for the prevention of common HAIs. This compendium is implementation focused and differs from most previously published guidelines in that it highlights a set of basic HAI prevention strategies plus special approaches for use in locations and/or populations within the hospital when infections are not controlled by use of basic practices, recommends that accountability for implementing infection prevention practices be assigned to specific groups and individuals, and includes proposed performance measures for internal quality improvement efforts.

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EXECUTIVE SUMMARY

The Centers for Disease Control and Prevention estimates that 1 of every 10-20 patients hospitalized in the United States develops a healthcare-associated infection (HAI). Infection prevention and control efforts have long been focused on monitoring and preventing HAIs, but HAI prevention has recently emerged as a national priority, with initiatives led by healthcare organizations, professional associations, government and accrediting agencies, legislators, regulators, payers, and consumer advocacy groups. Previous guidelines have provided detailed, evidence-based recommendations for detecting and preventing HAIs. In contrast, the accompanying documents go one important step further by presenting practical recommendations in a concise format designed to assist acute care hospitals in implementing and prioritizing their HAI prevention efforts. Four device- and procedure-associated HAI categories are targeted (central line–associated bloodstream infections [CLABSIs], ventilator-associated pneumonia [VAP], catheter-associated urinary tract infections [CAUTIs], and surgical site infections [SSIs]). In addition, 2 organism-specific HAI categories (methicillin-resistant *Staphylococcus aureus* [MRSA] infection and *Clostridium difficile* infection [CDI]) are included because of the increasing incidence and morbidity associated with acquisition of these organisms in the acute care setting.[1,2]

The following is a summary of the strategies to prevent

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HAIs in acute care hospitals presented in this compendium. Criteria for grading the strength of recommendation and quality of evidence are described in Table 1.

Prevention of CLABSI

I. Basic practices for prevention and monitoring of CLABSI: recommended for all acute care hospitals

A. Before insertion

1. Educate healthcare personnel involved in the insertion, care, and maintenance of central venous catheters about CLABSI prevention (A-II).

B. At insertion

1. Use a catheter checklist to ensure adherence to infection prevention practices at the time of central venous catheter insertion (B-II).
2. Perform hand hygiene before catheter insertion or manipulation (B-II).
3. Avoid using the femoral vein for central venous access in adult patients (A-I).
4. Use an all-inclusive catheter cart or kit (B-II).
5. Use maximal sterile barrier precautions during central venous catheter insertion (A-I).
6. Use a chlorhexidine-based antiseptic for skin preparation in patients older than 2 months of age (A-I).

C. After insertion

1. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter (B-II).
2. Remove nonessential catheters (A-II).
3. For nontunneled central venous catheters in adults and adolescents, change transparent dressings and perform site care with a chlorhexidine-based antiseptic every 5-7 days or more frequently if the dressing is soiled, loose, or damp; change gauze dressings every 2 days or more frequently if the dressing is soiled, loose, or damp (A-I).
4. Replace administration sets not used for blood, blood products, or lipids at intervals not longer than 96 hours (A-II).
5. Perform surveillance for CLABSI (B-II).
6. Use antimicrobial ointments for hemodialysis catheter insertion sites (A-I).

II. Special approaches for the prevention of CLABSI: Perform a CLABSI risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital for which outcome data and/or risk assessment suggest lack of effective control despite implementation of basic practices.

1. Bathe intensive care unit (ICU) patients older than 2 months of age with a chlorhexidine preparation on a daily basis (B-II).
2. Use antiseptic- or antimicrobial-impregnated central venous catheters for adult patients (A-I).
3. Use chlorhexidine-containing sponge dressings for central venous catheters in patients older than 2 months of age (B-I).
4. Use antimicrobial locks for central venous catheters (A-I).

III. Approaches that should not be considered a routine part of CLABSI prevention

1. Do not use antimicrobial prophylaxis for short-term or tunneled catheter insertion or while catheters are in situ (A-I).
2. Do not routinely replace central venous catheters or arterial catheters (A-I).
3. Do not routinely use positive-pressure needleless connectors with mechanical valves before a thorough assess-

TABLE 1. Strength of Recommendation and Quality of Evidence

Category/grade	Definition
Strength of recommendation	
A	Good evidence to support a recommendation for use
B	Moderate evidence to support a recommendation for use
C	Poor evidence to support a recommendation
Quality of evidence	
I	Evidence from $\geqslant 1$ properly randomized, controlled trial
II	Evidence from $\geqslant 1$ well-designed clinical trial, without randomization; from cohort or case-control analytic studies (preferably from >1 center); from multiple time series; or from dramatic results from uncontrolled experiments
III	Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

NOTE. Adapted from the Canadian Task Force on the Periodic Health Examination.[3]

ment of risks, benefits, and education regarding proper use (B-II).

Prevention of VAP

I. Basic practices for prevention and monitoring of VAP: recommended for all acute care hospitals

A. Education

1. Educate healthcare personnel who care for patients undergoing ventilation about VAP, including information about local epidemiology, risk factors, and patient outcomes (A-II).
2. Educate clinicians who care for patients undergoing ventilation about noninvasive ventilatory strategies (B-III).

B. Surveillance of VAP

1. Perform direct observation of compliance with VAP-specific process measures (B-III).
2. Conduct active surveillance for VAP and associated process measures in units that care for patients undergoing ventilation who are known or suspected to be at high risk for VAP on the basis of risk assessment (A-II).

C. Practice

1. Implement policies and practices for disinfection, sterilization, and maintenance of respiratory equipment that are aligned with evidence-based standards (eg, guidelines from the Centers for Disease Control and Prevention and professional organizations) (A-II).
2. Ensure that all patients (except those with medical contraindications) are maintained in a semirecumbent position (B-II).
3. Perform regular antiseptic oral care in accordance with product guidelines (A-I).
4. Provide easy access to noninvasive ventilation equipment and institute protocols to promote the use of noninvasive ventilation (B-III).

II. Special approaches for the prevention of VAP: Perform a VAP risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital for which outcome data and/or risk assessment suggest a lack of effective control despite implementation of basic practices.

1. Use an endotracheal tube with in-line and subglottic suctioning for all eligible patients (B-II).
2. Ensure that all ICU beds used for patients undergoing ventilation have a built-in tool to provide continuous monitoring of the angle of incline (B-III).

III. Approaches that should not be considered a routine part of VAP prevention

1. Do not routinely administer intravenous immunoglobulin, white-cell–stimulating factors (filgrastim or sargramostim), enteral glutamine, or chest physiotherapy (A-III).
2. Do not routinely use rotational therapy with kinetic or continuous lateral rotational therapy beds (B-II).
3. Do not routinely administer prophylactic aerosolized or systemic antimicrobials (B-III).

Prevention of CAUTI

I. Basic practices for prevention and monitoring of CAUTI: recommended for all acute care hospitals

A. Appropriate infrastructure for preventing CAUTI

1. Provide and implement written guidelines for catheter use, insertion, and maintenance (A-II).
2. Ensure that only trained, dedicated personnel insert urinary catheters (B-III).
3. Ensure that supplies necessary for aseptic-technique catheter insertion are available (A-III).
4. Implement a system for documenting the following information in the patient record: indications for catheter insertion, date and time of catheter insertion, individual who inserted catheter, and date and time of catheter removal (A-III).
5. Ensure that there are sufficient trained personnel and technology resources to support surveillance of catheter use and outcomes (A-III).

B. Surveillance of CAUTI

1. Identify the patient groups or units in which to conduct surveillance, on the basis of risk assessment, considering the frequency of catheter use and the potential risk factors (eg, types of surgery, obstetrics, and critical care) (B-III).
2. Use standardized criteria to identify patients who have a CAUTI (numerator data) (A-II).
3. Collect information on catheter-days (denominator data) for all patients in the patient groups or units being monitored (A-II).
4. Calculate CAUTI rates for target populations (A-II).
5. Measure the use of indwelling urinary catheters, including the percentage of patients with an indwelling urinary catheter inserted during hospitalization, the percentage of catheter use with accepted indications, and duration of indwelling catheter use (B-II).
6. Use surveillance methods for case finding that are appropriate for the institution and are documented to be valid (A-III).

C. Education and training

1. Educate healthcare personnel involved in the insertion, care, and maintenance of urinary catheters about

CAUTI prevention, including alternatives to indwelling catheters and procedures for catheter insertion, management, and removal (A-III).

D. Appropriate technique for catheter insertion

1. Insert urinary catheters only when necessary for patient care and leave them in place only as long as indications persist (A-II).
2. Consider other methods for management, including condom catheters or in-and-out catheterization, when appropriate (A-I).
3. Practice hand hygiene (in accordance with Centers for Disease Control and Prevention or World Health Organization guidelines) immediately before insertion of the catheter and before and after any manipulation of the catheter site or apparatus (A-III).
4. Insert catheters by use of aseptic technique and sterile equipment (A-III).
5. Use gloves, a drape, and sponges; a sterile or antiseptic solution for cleaning the urethral meatus; and a single-use packet of sterile lubricant jelly for insertion (A-III).
6. Use as small a catheter as possible that is consistent with proper drainage, to minimize urethral trauma (B-III).

E. Appropriate management of indwelling catheters

1. Properly secure indwelling catheters after insertion to prevent movement and urethral traction (A-III).
2. Maintain a sterile, continuously closed drainage system (A-I).
3. Do not disconnect the catheter and drainage tube unless the catheter must be irrigated (A-I).
4. Replace the collecting system by use of aseptic technique and after disinfecting the catheter-tubing junction when breaks in aseptic technique, disconnection, or leakage occur (B-III).
5. For examination of fresh urine, collect a small sample by aspirating urine from the sampling port with a sterile needle and syringe after cleansing the port with disinfectant (A-III).
6. Obtain larger volumes of urine for special analyses aseptically from the drainage bag (A-III).
7. Maintain unobstructed urine flow (A-II).
8. Empty the collecting bag regularly, using a separate collecting container for each patient, and avoid allowing the draining spigot to touch the collecting container (A-II).
9. Keep the collecting bag below the level of the bladder at all times (A-III).
10. Cleaning the meatal area with antiseptic solutions is unnecessary; routine hygiene is appropriate (A-I).

II. Special approaches for the prevention of CAUTI: Perform a CAUTI risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital for which outcome data and/or risk assessment suggest lack of effective control despite implementation of basic practices.

1. Implement an organization-wide program to identify and remove catheters that are no longer necessary, using 1 or more methods documented to be effective (A-II).
2. Develop a protocol for management of postoperative urinary retention, including nurse-directed use of intermittent catheterization and use of bladder scanners (B-I).
3. Establish a system for analyzing and reporting data on catheter use and adverse events from catheter use (B-III).

III. Approaches that should not be considered a routine part of CAUTI prevention

1. Do not routinely use silver-coated or other antibacterial catheters (A-I).
2. Do not screen for asymptomatic bacteruria in catheterized patients (A-II).
3. Do not treat asymptomatic bacteruria in catheterized patients except before invasive urologic procedures (A-I).
4. Avoid catheter irrigation (A-I).
5. Do not use systemic antimicrobials routinely as prophylaxis (A-II).
6. Do not change catheters routinely (A-III).

Prevention of SSI

I. Basic practices for prevention and monitoring of SSI: recommended for all acute care hospitals

A. Surveillance of SSI

1. Perform surveillance for SSI (A-II).
2. Provide ongoing feedback on SSI surveillance and process measures to surgical and perioperative personnel and leadership (A-II).
3. Increase the efficiency of surveillance through the use of automated data (A-II).

B. Practice

1. Administer antimicrobial prophylaxis in accordance with evidence-based standards and guidelines (A-I).
2. Do not remove hair at the operative site unless the presence of hair will interfere with the operation; do not use razors (A-II).
3. Control blood glucose level during the immediate postoperative period for patients undergoing cardiac surgery (A-I).
4. Measure and provide feedback to providers on the rates of compliance with process measures, including antimicrobial prophylaxis, proper hair removal, and glucose control (for cardiac surgery) (A-III).

5. Implement policies and practices aimed at reducing the risk of SSI that meet regulatory and accreditation requirements and that are aligned with evidence-based standards (eg, Centers for Disease Control and Prevention and professional organization guidelines) (A-II).

C. Education

1. Educate surgeons and perioperative personnel about SSI prevention (A-III).
2. Educate patients and their families about SSI prevention, as appropriate (A-III).

II. Special approaches for the prevention of SSI: Perform an SSI risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital for which outcome data and/or risk assessment suggest a lack of effective control despite implementation of basic practices.

1. Perform expanded SSI surveillance to determine the source and extent of the problem and to identify possible targets for intervention (B-II).

III. Approaches that should not be considered a routine part of SSI prevention

1. Do not routinely use vancomycin for antimicrobial prophylaxis; vancomycin can, however, be an appropriate agent for specific clinical circumstances (B-II).
2. Do not routinely delay surgery to provide parenteral nutrition (A-I).

Prevention of MRSA Transmission

I. Basic practices for prevention and monitoring of MRSA transmission: recommended for all acute care hospitals

A. Components of an MRSA transmission prevention program

1. Conduct an MRSA risk assessment (B-III).
2. Implement an MRSA monitoring program (A-III).
3. Promote compliance with Centers for Disease Control and Prevention or World Health Organization hand-hygiene recommendations (A-II).
4. Use contact precautions for MRSA-colonized or -infected patients (A-II).
5. Ensure cleaning and disinfection of equipment and the environment (B-III).
6. Educate healthcare personnel about MRSA, including risk factors, routes of transmission, outcomes associated with infection, prevention measures, and local epidemiology (B-III).
7. Implement a laboratory-based alert system that immediately notifies infection prevention and control personnel and clinical personnel of new MRSA-colonized or -infected patients (B-III).
8. Implement an alert system that identifies readmitted or transferred MRSA-colonized or -infected patients (B-III).
9. Provide MRSA data and other outcome measures to key stakeholders, including senior leadership, physicians, and nursing staff (B-III).
10. Educate patients and their families about MRSA, as appropriate (B-III).

II. Special approaches for the prevention of MRSA transmission: These special approaches are recommended for use in locations and/or populations within the hospital for which outcome data and/or risk assessment suggest lack of effective control despite implementation of basic practices.

A. Active surveillance testing: MRSA screening program for patients

1. Implement an MRSA active surveillance testing program as part of a multifaceted strategy to control and prevent MRSA transmission when evidence suggests that there is ongoing transmission of MRSA despite effective implementation of basic practices (B-II).

B. Active surveillance testing for MRSA among healthcare personnel

1. Screen healthcare personnel for MRSA infection or colonization only if they are epidemiologically linked to a cluster of MRSA infections (B-III).

C. Routine bathing with chlorhexidine

1. Routinely bathe adult ICU patients with chlorhexidine (B-III).

D. MRSA decolonization therapy for MRSA-colonized persons

1. Provide decolonization therapy to MRSA-colonized patients in conjunction with an active surveillance testing program (B-III).

Prevention of CDI

I. Basic practices for prevention and monitoring of CDI: recommended for all acute care hospitals

A. Components of a CDI prevention program

1. Use contact precautions for infected patients, with a single-patient room preferred (A-II for hand hygiene,

A-I for gloves, B-III for gowns, and B-III for single-patient room).

2. Ensure cleaning and disinfection of equipment and the environment (B-III for equipment and B-II for the environment).

3. Implement a laboratory-based alert system to provide immediate notification to infection prevention and control personnel and clinical personnel about patients with newly diagnosed CDI (B-III).

4. Conduct CDI surveillance and analyze and report CDI data (B-III).

5. Educate healthcare personnel, housekeeping personnel, and hospital administration about CDI (B-III).

6. Educate patients and their families about CDI, as appropriate (B-III).

7. Measure compliance with Centers for Disease Control and Prevention or World Health Organization hand-hygiene and contact precaution recommendations (B-III).

II. Special approaches for the prevention of CDI: Perform a CDI risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital for which outcome data and/or risk assessment suggest lack of effective control despite implementation of basic practices.

A. Approaches to minimize *C. difficile* transmission by healthcare personnel

1. Intensify the assessment of compliance with process measures (B-III).

2. Perform hand hygiene with soap and water as the preferred method before exiting the room of a patient with CDI (B-III).

3. Place patients with diarrhea under contact precautions while *C. difficile* test results are pending (B-III).

4. Prolong the duration of contact precautions after the patient becomes asymptomatic until hospital discharge (B-III).

B. Approaches to minimize CDI transmission from the environment

1. Assess the adequacy of room cleaning (B-III).

2. Use sodium hypochlorite (bleach)–containing cleaning agents for environmental cleaning. Implement a system to coordinate with the housekeeping department if it is determined that sodium hypochlorite is needed for environmental disinfection (B-II).

C. Approaches to reduce the risk of CDI acquisition

1. Initiate an antimicrobial stewardship program (A-II).

III. Approaches that should not be considered a routine part of CDI prevention

1. Do not test patients without signs or symptoms of CDI for *C. difficile* (B-II).

2. Do not repeat *C. difficile* testing at the end of successful therapy for a patient recently treated for CDI (B-III).

INTRODUCTION

The US Centers for Disease Control and Prevention estimates that nearly 2 million patients (5%-10% of hospitalized patients) experience an HAI each year; these infections lead to almost 100,000 deaths and $4.5-$6.5 billion in extra costs.[4-6]

The accompanying compendium of HAI prevention strategies is the result of collaboration among professional societies, including the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), the Association for Professionals in Infection Control and Epidemiology, and other organizations committed to improving the safety and quality of patient care, including the Joint Commission and the American Hospital Association. Recognizing the importance of HAI prevention, these organizations worked in partnership to provide acute care hospitals with concise, practical, and evidence-based strategies to enhance their HAI prevention programs.

Healthcare facilities are currently straining to accommodate an increasing number of infection prevention initiatives, regulatory obligations, and requirements for collection and reporting of performance measures. In addition, some recommended practices aimed at HAI prevention require infrastructure that is not currently available at all hospitals, such as surveillance methods that require information technology support. To assist healthcare facilities in focusing and prioritizing their HAI prevention efforts, the recommendations contained within this compendium are prioritized on the basis of the strength of the supporting evidence, the consensus of the authors, and the intensity of resources required for implementation.

The recommendations within this compendium are largely based on previously published HAI prevention guidelines available from a number of organizations, including the Healthcare Infection Control Practices Advisory Committee and the Centers for Disease Control and Prevention, SHEA, the IDSA, and the Association for Professionals in Infection Control and Epidemiology,[7-15] and relevant literature published after these guidelines. They are not meant to supplant these more detailed documents. Rather, the aim of this compendium is to provide acute care hospitals with practical guidance by use of an implementation-focused format.

Despite the existence of guidelines for the prevention of specific types of HAIs, there is often a gap between what is recommended and what is practiced.[16,17] To reduce this gap

TABLE 2. Literature Search Subject Headings and Date Ranges

Topic	Subject headings	Date range
Catheter-associated bloodstream infection	Catheter; central line; central venous; intravascular; bacteremia; bloodstream infection; prevention	2002-2007
Ventilator-associated pneumonia	Pneumonia, ventilator associated; infection AND pneumonia, bacterial; infection control AND pneumonia, bacterial	1950-2007
Catheter-associated urinary tract infection	Catheter AND urinary; urinary tract infection AND catheter; urinary tract infection AND nosocomial AND catheter; urinary tract infection AND nosocomial	1990-2007
Surgical site infection	Wound infection; surgical site infection; postoperative infection; surgical wound; surgical wound infection	1980-2007
Methicillin-resistant *Staphylococcus aureus*	*Staphylococcus aureus*; methicillin resistance; prevention; surveillance	1996-Apr 2008
Clostridium difficile–associated disease	*Clostridium difficile*	2002-2007

and to promote a culture of safety and individual accountability, this compendium aims to promote the establishment of infrastructure required to support these detection and prevention approaches, including adequate staffing of hospitals with trained infection prevention and control professionals, and to assign accountability for implementing effective infection prevention practices to hospital leaders, healthcare providers, and support staff.

Six documents are included, each focused on a category of HAI selected by the task force members (hereafter referred to as the HAI Allied Task Force) on the basis of the frequency of occurrence, impact on the morbidity and mortality of patients hospitalized in acute care facilities, and potential preventability through adherence to evidence-based practices. These categories include

- central line–associated bloodstream infection (CLABSI),
- surgical site infection (SSI),
- ventilator-associated pneumonia (VAP),
- catheter-associated urinary tract infection (CAUTI),
- methicillin-resistant *S. aureus* (MRSA) transmission, and
- *C. difficile* infection (CDI).

References to more detailed information available in previously published guidelines are provided in each article.

Each article contains a statement of concern and a brief summary of previously described detection and prevention methods, recommendations for implementing evidence-based prevention approaches, and proposed performance measures (both process and outcome measures) for internal monitoring.

Each recommendation is ranked on the basis of the strength of recommendation and quality of evidence as required by the IDSA Standards and Practice Guidelines Committee (Table 1). Recommendations are prioritized into (1) evidence-based basic practices that should be adopted by all acute care hospitals and (2) special approaches for use in locations and/or populations within the hospitals when infections are not controlled by use of basic practices. Recommendations that might ordinarily be included in a guideline with a C-level strength of recommendation were excluded from these sections of the compendium and are discussed in the "unresolved issues" sections; this was done to help hospitals to focus their implementation efforts on the most strongly recommended prevention practices. Hospitals can prioritize their efforts by initially focusing on implementation of the prevention approaches listed as basic practices recommended for all acute care hospitals. If HAI surveillance or other risk assessments suggest that there is ongoing transmission despite implementation of basic practices, hospitals should then consider adopting some or all of the prevention approaches listed under the "special approaches" section of each document. These can be implemented within specific locations or patient populations or can be implemented hospitalwide, depending on outcome data, risk assessment, and/or local requirements. Most of the special approaches listed in these documents are supported by studies based on the control of HAI outbreaks and require additional personnel and financial resources for implementation.

METHODS

Panel Composition

SHEA and the IDSA Standards and Practice Guidelines Committee convened experts in the prevention and monitoring of HAIs. The HAI Allied Task Force members are listed at the end of the text of this summary.

Literature Review and Analysis

For this compendium, the HAI Allied Task Force reviewed previously published guidelines and recommendations relevant to each section and performed computerized literature searches using PubMed. Searches of the English-language literature focused on human studies published after existing guidelines through 2007, using the subject headings listed in Table 2.

Process Overview

In evaluating the evidence regarding the prevention and monitoring of HAIs, the HAI Allied Task Force followed a process

used in the development of other IDSA guidelines, including a systematic weighting of the quality of the evidence and the grade of recommendation (Table 1).

Consensus Development

The HAI Allied Task Force met on 17 occasions via teleconference to complete the compendium. The purpose of the teleconferences was to discuss the questions to be addressed, make writing assignments, and discuss recommendations. All members of the HAI Allied Task Force participated in the preparation and review of the draft documents. The compendium was then submitted to a subgroup of the HAI Allied Task Force with implementation expertise that, through a series of additional teleconferences and communications, performed extensive editing and reformatting to create implementation-focused text.

Review and Approval Process

A critical stage in the development process is peer review. Peer reviewers are relied on for expert, critical, and unbiased scientific appraisals of the documents. The SHEA/IDSA employed a process used for all SHEA/IDSA guidelines that includes a multilevel review and approval. Comments were obtained from several outside reviewers who complied with the SHEA/IDSA policy on conflict of interest disclosure. In addition, 8 stakeholder organizations provided comments on the document. Finally, the guideline was reviewed and approved by the IDSA Standards and Practice Guidelines Committee and the Board of Directors of the SHEA and the IDSA prior to dissemination.

Disclosure of Conflicts of Interest

All members of the HAI Allied Task Force and the external peer reviewers complied with the IDSA policy on conflicts of interest, which requires disclosure of any financial or other interest within the past 2 years that might be construed as constituting an actual, potential, or apparent conflict. Members of the HAI Allied Task Force and the external reviewers were provided with the IDSA conflicts of interest disclosure statement and were asked to identify ties to companies developing products that might be affected by promulgation of the compendium. Information was requested regarding employment, consultancies, stock ownership, honoraria, research funding, expert testimony, and membership on company advisory committees. The task force made decisions on a case-by-case basis as to whether an individual's role should be limited as a result of a conflict. Potential conflicts are listed in the Acknowledgments.

Mechanism for Updating the Compendium

At annual intervals, SHEA, the Association for Professionals in Infection Control and Epidemiology, the IDSA Standards and Practice Guidelines Committee liaison advisor, and the chair of the Standards and Practice Guidelines Committee will determine the need for revisions to the compendium on the basis of an examination of current literature. If necessary, the entire task force will be reconvened to discuss potential changes. When appropriate, the panel will recommend revision of the compendium to SHEA, Association for Professionals in Infection Control and Epidemiology, the IDSA Standards and Practice Guidelines Committee, and the boards of directors of these organizations for review and approval.

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SUPPLEMENT ARTICLE: SHEA/IDSA PRACTICE RECOMMENDATION

Strategies to Prevent Surgical Site Infections in Acute Care Hospitals

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PURPOSE

Previously published guidelines are available that provide comprehensive recommendations for detecting and preventing healthcare-associated infections. The intent of this document is to highlight practical recommendations in a concise format designed to assist acute care hospitals to implement and prioritize their surgical site infection (SSI) prevention efforts. Refer to the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America "Compendium of Strategies to Prevent Healthcare-Associated Infections" Executive Summary and Introduction and accompanying editorial for additional discussion.

SECTION 1: RATIONALE AND STATEMENTS OF CONCERN

1. Burden of SSIs as complications in acute care facilities.
   a. SSIs occur in 2%-5% of patients undergoing inpatient surgery in the United States.[1]
   b. Approximately 500,000 SSIs occur each year.[1]

2. Outcomes associated with SSI
   a. Each SSI is associated with approximately 7-10 additional postoperative hospital days.[1,2]
   b. Patients with an SSI have a 2-11 times higher risk of death, compared with operative patients without an SSI.[3,4]
      i. Seventy-seven percent of deaths among patients with SSI are directly attributable to SSI.[5]
   c. Attributable costs of SSI vary, depending on the type of operative procedure and the type of infecting pathogen; published estimates range from $3,000 to $29,000.[4,6-12]
      i. SSIs are believed to account for up to $10 billion annually in healthcare expenditures.[3,4,13]

SECTION 2: STRATEGIES TO DETECT SSI

1. Definitions
   a. The Centers for Disease Control and Prevention National Nosocomial Infections Surveillance System[14] and the National Healthcare Safety Network definitions for SSI are widely used.[14,15]
   b. SSIs are classified as follows (Figure):
      i. Superficial incisional (involving only skin or subcutaneous tissue of the incision)
      ii. Deep incisional (involving fascia and/or muscular layers)
      iii. Organ/space

2. Methods for surveillance of SSI
   a. The direct method, with daily observation of the surgical site by the physician, physician extender, a trained nurse, or infection prevention and control professional

From the Duke University Medical Center, Durham, North Carolina (D.J.A., K.S.K.); the University of Utah, Salt Lake City (D.C.); the Association for Professionals in Infection Control and Epidemiology (K.M.A.) and the National Quality Forum (H.B.), Washington, D.C.; the Joint Commission, Oakbrook Terrace (K.P., R.W.), the Loyola University Chicago Stritch School of Medicine (D.N.G.) and the Stroger (Cook County) Hospital and Rush University Medical Center (R.A.W.), Chicago, and the Hines Veterans Affairs Medical Center, Hines (D.N.G.), Illinois; the Mount Sinai School of Medicine, New York, New York (D.P.C.); the Children's Hospital of Philadelphia and University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania (S.E.C.); the Washington University School of Medicine, St. Louis, Missouri (E.R.D., V.F., J.M.); the Institute for Healthcare Improvement, Cambridge (F.A.G.), and Brigham and Women's Hospital and Harvard Medical School, Boston (D.S.Y., M.K.), Massachusetts; the Hackensack University Medical Center, Hackensack (P.G.), and the University of Medicine and Dentistry–New Jersey Medical School, Newark (P.G.), New Jersey; the Warren Alpert Medical School of Brown University and Rhode Island Hospital, Providence, Rhode Island (L.A.M.); the David Geffen School of Medicine at the University of California, Los Angeles (D.A.P.); the Johns Hopkins Medical Institutions and University, Baltimore, Maryland (T.M.P.); the Ann Arbor Veterans Affairs Medical Center and the University of Michigan Medical School, Ann Arbor, Michigan (S.S.); the Medical University of South Carolina, Charleston (C.D.S.); and the University of Manitoba, Winnipeg, Canada (E.L., L.N.).

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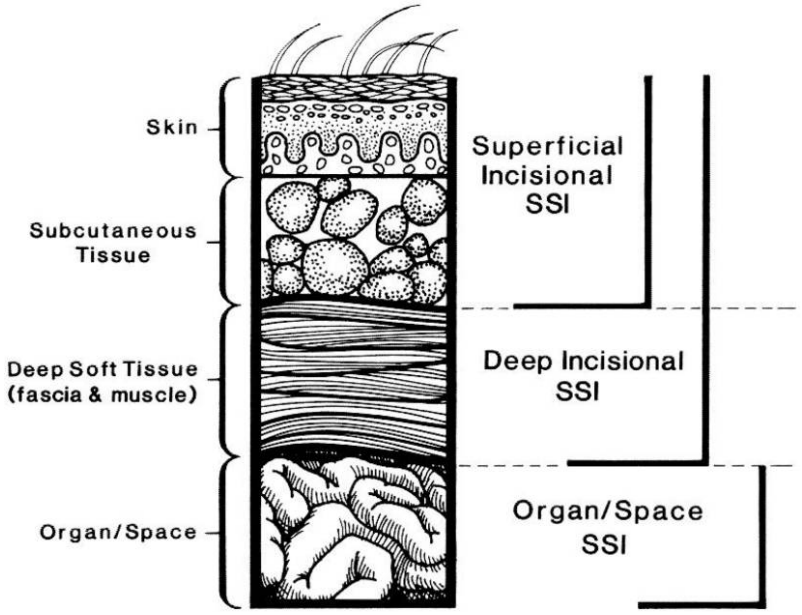

FIGURE. The Centers for Disease Control and Prevention National Healthcare Safety Network classification for surgical site infection (SSI). Reproduced from Horan et al.[14]

starting 24-48 hours after surgery, is the most accurate method of surveillance.[2,16-18]

i. Although the direct method is used as the "gold standard" for studies, it is rarely used in practice because of its resource utilization requirements and impracticality.

b. The indirect method of SSI surveillance consists of a combination of the following:

i. Review of microbiology reports and patient medical records

ii. Surgeon and/or patient surveys

iii. Screening for readmission of surgical patients

iv. Other information, such as coded diagnoses or operative reports

c. The indirect method of SSI surveillance is less time consuming and can be readily performed by infection prevention and control personnel during surveillance rounds.

d. The indirect method of SSI surveillance is both reliable (sensitivity, 84%-89%) and specific (specificity, 99.8%), compared with the "gold standard" of direct surveillance.[19,20]

e. Automated data systems can be used to broaden SSI surveillance.

i. SSI surveillance can be expanded by using hospital databases that include data on administrative claims, days of antimicrobial use, readmission to the hospital, and return to the operating room, and/or by implementing a system that imports automated microbiologic culture data, surgical procedure data, and general demographic information into a single surveillance database.[21-23]

ii. These methods improve the sensitivity of indirect surveillance for detection of SSI and reduce the need for efforts by infection prevention and control professionals.[21]

3. Postdischarge surveillance

a. Surgical procedures have been shifting to the outpatient setting during the past 3 decades.[24]

i. Patients now have shorter postoperative stays.[25]

b. No standardized or reliable method for postdischarge surveillance has been established. Different methods of postdischarge/outpatient SSI surveillance have been employed. Postdischarge surveillance based on surgeon and patient questionnaire results have been shown to have poor sensitivity and specificity. Regardless of which method is used, the overall rate of SSI for an institution typically increases after postdischarge surveillance methods are implemented.[26]

c. SSIs occurring and managed in the outpatient setting are usually superficial incisional infections. In contrast, deep incisional and organ/space infections typically require readmission to the hospital for management.

SECTION 3: STRATEGIES TO PREVENT SSI

1. Existing guidelines, recommendations, and requirements

a. Hospital Infection Control Practices Advisory Committee guidelines

i. The most recently published guidelines for prevention of SSI were released in 1999 by Mangram et al.[5]

ii. The pathogenesis of and likelihood of developing

an SSI involve a complex relationship among the following factors:

(a) Microbial characteristics (eg, degree of contamination and virulence of pathogen)

(b) Patient characteristics (eg, immune status and comorbid conditions)

(c) Surgical characteristics (eg, type of procedure, introduction of foreign material, and amount of damage to tissues)[27]

iii. Risk factors for SSI can be separated into intrinsic, patient-related characteristics and extrinsic, procedure-related characteristics. Table 1 summarizes the risk factors for each of these categories and provides recommendations (when available) to decrease the risk of SSI.

b. Surgical Infection Prevention Collaborative

i. The Centers for Medicare and Medicaid Services created the Surgical Infection Prevention Collaborative in 2002.

ii. After review of published guidelines, an expert panel identified 3 performance measures for quality improvement related to antimicrobial prophylaxis:[33,35]

(a) Delivery of intravenous antimicrobial prophylaxis within 1 hour before incision (2 hours are allowed for the administration of vancomycin and fluoroquinolones)

(b) Use of an antimicrobial prophylactic agent consistent with published guidelines

(c) Discontinuation of use of the prophylactic antimicrobial agent within 24 hours after surgery (discontinuation within 48 hours is allowable for cardiothoracic procedures for adult patients)

iii. The Surgical Infection Prevention Collaborative focuses on 7 procedures: abdominal hysterectomy, vaginal hysterectomy, hip arthroplasty, knee arthroplasty, cardiac surgery, vascular surgery, and colorectal surgery.

iv. Many hospitals that implemented and improved compliance with Surgical Infection Prevention Collaborative performance measures decreased their rates of SSI.[36]

c. Surgical Care Improvement Project

i. The Surgical Care Improvement Project, a multiagency collaboration created in 2003, is an extension of the Surgical Infection Prevention Collaborative.

ii. The Surgical Care Improvement Project, in addition to assessing the 3 performance measures of the Surgical Infection Prevention Collaborative, also focuses on 3 additional evidence-supported process measures to prevent SSI:[35]

(a) Proper hair removal: no hair removal or hair removal with clippers or depilatory method is considered appropriate; use of razors is considered inappropriate

(b) Controlling blood glucose level during the immediate postoperative period for patients undergoing cardiac surgery: controlled 6:00 AM blood glucose level (lower than 200 mg/dL) on postoperative day 1 and postoperative day 2, with procedure day being postoperative day 0

(c) Maintenance of perioperative normothermia for patients undergoing colorectal surgery

d. Institute for Healthcare Improvement

i. The Institute for Healthcare Improvement created a nationwide quality improvement project to improve outcomes for hospitalized patients.[37]

ii. The Institute for Healthcare Improvement recommends the same 6 preventive measures recommended by the Surgical Care Improvement Project and has included these in the 100,000 and 5 Million Lives campaigns.[37]

e. Federal requirements

i. Centers for Medicare and Medicaid Services

(a) In accordance with the Deficit Reduction Act of 2005, hospitals that are paid by Medicare under the acute care inpatient prospective payment system receive their full Medicare Annual Payment Update only if they submit required quality measure information to the Centers for Medicare and Medicaid Services.

(b) The Centers for Medicare and Medicaid Services now requires inclusion of 2 Surgical Care Improvement Project measures (antimicrobial prophylaxis provided within 1 hour before incision and discontinuation of antimicrobial prophylaxis within 24 hours after surgery) in the quality measure set of the inpatient prospective payment system.[38]

(c) Furthermore, the Centers for Medicare and Medicaid Services has proposed that additional Surgical Care Improvement Project measures described above (appropriate antimicrobial prophylactic agent, proper hair removal, perioperative glucose level control, and maintenance of normothermia) be included in the quality measure set in the near future.[38]

2. Infrastructure requirements

a. Trained personnel

i. Infection prevention and control personnel must be specifically trained in methods of SSI surveillance, have knowledge of and the ability to prospectively apply the Centers for Disease Control and Prevention definitions of SSI, possess basic computer and mathematical skills, and be adept at providing feedback and education to healthcare personnel when appropriate.[5]

b. Education

i. Regularly provide education to surgeons and perioperative personnel through continuing education activities directed at minimizing perioperative SSI risk through implementation of recommended process measures.

(a) Several educational components can be com-

TABLE 1. Selected Risk Factors for and Recommendations to Prevent Surgical Site Infections (SSIs)

Risk factor	Recommendation	Grade[a]
Intrinsic, patient related (preoperative)		
Unmodifiable		
Age	No formal recommendation: relationship to increased risk of SSI may be secondary to comorbidities or immune senescence [28-30]	…
Modifiable		
Glucose control, diabetes	Control serum blood glucose levels [5]; reduce glycosylated hemoglobin A1c levels to <7% before surgery, if possible [31]	A-II
Obesity	Increase dosing of prophylactic antimicrobial agent for morbidly obese patients [32]	A-II
Smoking cessation	Encourage smoking cessation within 30 days before procedure [5]	A-II
Immunosuppressive medications	No formal recommendation; in general, avoid immunosuppressive medications in perioperative period, if possible	C-II
Extrinsic, procedure related (perioperative)		
Preparation of patient		
Hair removal	Do not remove unless hair will interfere with the operation [5]; if hair removal is necessary, remove by clipping and do not use razors	A-I
Preoperative infections	Identify and treat infections (eg, urinary tract infection) remote to the surgical site before elective surgery [5]	A-II
Operative characteristics		
Surgical scrub (surgical team members' hands and forearms)	Use appropriate antiseptic agent to perform 2-5–minute preoperative surgical scrub [5] or use an alcohol-based surgical hand antisepsis product	A-II
Skin preparation	Wash and clean skin around incision site; use an appropriate antiseptic agent [5]	A-II
Antimicrobial prophylaxis	Administer only when indicated [5]	A-I
Timing	Administer within 1 hour before incision to maximize tissue concentration[b] [5, 33]	A-I
Choice	Select appropriate agents on the basis of surgical procedure, most common pathogens causing SSI for a specific procedure, and published recommendations [5, 33]	A-I
Duration of therapy	Stop prophylaxis within 24 hours after the procedure for all procedures except cardiac surgery; for cardiac surgery, antimicrobial prophylaxis should be stopped within 48 hours [5, 33]	A-I
Surgeon skill/technique	Handle tissue carefully and eradicate dead space [5]	A-III
Asepsis	Adhere to standard principles of operating room asepsis [5]	A-III
Operative time	No formal recommendation in most recent guidelines; minimize as much as possible [34]	A-III
Operating room characteristics		
Ventilation	Follow American Institute of Architects' recommendations [5]	C-I
Traffic	Minimize operating room traffic [5]	B-II
Environmental surfaces	Use a US Environmental Protection Agency–approved hospital disinfectant to clean surfaces and equipment [5]	B-III
Sterilization of surgical equipment	Sterilize all surgical equipment according to published guidelines; minimize the use of flash sterilization [5]	B-I

[a] See Table 2 for definitions.

[b] Vancomycin and fluoroquinolones can be given 2 hours before incision.

bined into concise, efficient, and effective recommendations that are easily understood and remembered.[39]

ii. Provide education regarding the outcomes associated with SSI, risks for SSI, and methods to reduce risk to all patients, patients' families, surgeons, and perioperative personnel.

iii. Education for patients and patients' families is an effective method to reduce risk associated with intrinsic patient-related SSI risk factors.[40,41]

c. Computer-assisted decision support and automated reminders

i. Several institutions have successfully employed computer-assisted decision-support methodology to improve the rate of appropriate administration of antimicrobial prophylaxis (including redosing during prolonged cases).[42-44]

ii. Computer-assisted decision support, however, is potentially expensive, can be time consuming to implement, and, in a single study, was reported to initially increase the rate of adverse drug reactions.[45]

iii. Institutions must appropriately validate computer-assisted decision-support systems after implementation.

d. Utilization of automated data

i. Install information technology infrastructure to facilitate data transfer, receipt, and organization to aid with the tracking of process and outcome measures.

SECTION 4: RECOMMENDATIONS FOR IMPLEMENTING PREVENTION AND MONITORING STRATEGIES

Recommendations for preventing and monitoring SSIs are summarized in the following section. They are designed to assist acute care hospitals in prioritizing and implementing their SSI prevention efforts. Criteria for grading of the strength of recommendation and quality of evidence are described in Table 2.

I. Basic practices for prevention and monitoring of SSI: recommended for all acute care hospitals

A. Surveillance of SSI

1. Perform surveillance for SSI (A-II).

a. Identify high-risk, high-volume operative procedures to be targeted for SSI surveillance on the basis of a risk assessment of patient populations, operative procedures performed, and available SSI surveillance data.

b. Identify, collect, store, and analyze data needed for the surveillance program.[5]

i. Implement a system for collecting data needed to identify SSIs.

ii. Develop a database for storing, managing, and accessing collected data on SSIs.

iii. Prepare periodic SSI reports (the time frame will depend on hospital needs and volume of targeted procedures).

iv. Collect denominator data on all patients undergoing targeted procedures, to calculate SSI rates for each type of procedure.[39]

v. Identify trends (eg, in rates of SSI and pathogens causing SSIs).

c. Use Centers for Disease Control and Prevention National Healthcare Safety Network definitions of SSI.[14]

d. Perform indirect surveillance for targeted procedures.[19,20,47,48]

e. Perform postoperative surveillance for 30 days; extend the postoperative surveillance period to 12 months if prosthetic material is implanted during surgery.[14]

f. Surveillance should be performed for patients readmitted to the hospital.

i. If an SSI is diagnosed at your institution but the surgical procedure was performed elsewhere, notify the hospital where the original procedure was performed.

g. Develop a system for routine review and interpretation of SSI rates to detect significant increases or outbreaks and to identify areas where additional resources might be needed to improve SSI rates.[47]

2. Provide ongoing feedback on SSI surveillance and process measures to surgical and perioperative personnel and leadership (A-II).

a. Routinely provide feedback on SSI rates and process measures to individual surgeons and hospital leadership.[5]

i. For each type of procedure performed, provide risk-adjusted rates of SSI.

ii. Anonymously benchmark procedure-specific risk-adjusted rates of SSI among peer surgeons.[5]

b. Confidentially provide data to individual surgeons, the surgical division, and/or department chiefs.

3. Increase the efficiency of surveillance through the use of automated data (A-II).

a. Implement a method to electronically transfer operative data, including process measures when available, to infection prevention and control personnel to facilitate acquisition of denominator data and calculation of SSI rates for various procedures.

b. If information technology and infrastructure resources are available, develop automated methods for detection of SSI by use of automated data on readmissions, microbiological test results, and antimicrobial dispensing.[23]

i. Implementation of automated surveillance may improve the sensitivity of surveillance.

B. Practice

1. Administer antimicrobial prophylaxis in accordance with evidence-based standards and guidelines (A-I).[5,49,50]

TABLE 2. Strength of Recommendation and Quality of Evidence

Category/grade	Definition
Strength of recommendation	
A	Good evidence to support a recommendation for use
B	Moderate evidence to support a recommendation for use
C	Poor evidence to support a recommendation
Quality of evidence	
I	Evidence from $\geqslant 1$ properly randomized, controlled trial
II	Evidence from $\geqslant 1$ well-designed clinical trial, without randomization; from cohort or case-control analytic studies (preferably from >1 center); from multiple time series; or from dramatic results from uncontrolled experiments
III	Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

NOTE. Adapted from the Canadian Task Force on the Periodic Health Examination.[46]

a. Administer prophylaxis within 1 hour before incision to maximize tissue concentration.[33,35]

i. Two hours are allowed for the administration of vancomycin and fluoroquinolones.

b. Select appropriate agents on the basis of the surgical procedure, the most common pathogens causing SSI for a specific procedure, and published recommendations.[33,35]

c. Discontinue prophylaxis within 24 hours after surgery for most procedures; discontinue within 48 hours for cardiac procedures.[33,35]

2. Do not remove hair at the operative site unless the presence of hair will interfere with the operation; do not use razors (A-II).[5]

a. If hair removal is necessary, remove it by clipping or by use of a depilatory agent.

3. Control blood glucose level during the immediate postoperative period for patients undergoing cardiac surgery (A-I).[35]

a. Maintain the postoperative blood glucose level at less than 200 mg/dL.

i. Measure blood glucose level at 6:00 AM on postoperative day 1 and postoperative day 2, with the procedure day being postoperative day 0.

b. Initiating close blood glucose control in the intraoperative period has not been shown to reduce the risk of SSI, compared with starting blood glucose control in the postoperative period. In fact, a recently performed randomized controlled trial showed that initiating close glucose control during cardiac surgery may actually lead to higher rates of adverse outcomes, including stroke and death.[51]

4. Measure and provide feedback to providers on the rates of compliance with process measures, including antimicrobial prophylaxis, proper hair removal, and glucose control (for cardiac surgery) (A-III).[35]

a. Routinely provide feedback to surgical staff and leadership, regarding compliance with targeted process measures.

5. Implement policies and practices aimed at reducing the risk of SSI that meet regulatory and accreditation requirements and that are aligned with evidence-based standards (eg, Centers for Disease Control and Prevention and professional organization guidelines) (A-II).[5,35,36]

a. Policies and practices should include but are not limited to the following:

i. Reducing modifiable patient risk factors

ii. Optimal cleaning and disinfection of equipment and the environment

iii. Optimal preparation and disinfection of the operative site and the hands of the surgical team members

iv. Adherence to hand hygiene

v. Traffic control in operating rooms

vi. See Table 1 for a more detailed list.

C. Education

1. Educate surgeons and perioperative personnel about SSI prevention (A-III).

a. Include risk factors, outcomes associated with SSI, local epidemiology (eg, SSI rates by procedure and the rate of methicillin-resistant *Staphylococcus aureus* [MRSA] infection in a facility), and basic prevention measures.

2. Educate patients and their families about SSI prevention, as appropriate (A-III).

a. Provide instructions and information to patients before surgery, describing strategies for reducing SSI risk. Specifically provide preprinted materials to patients.

b. Examples of printed materials for patients are available from the following Web pages:

i. JAMA patient page: wound infections (from the *Journal of the American Medical Association;* available at: http://jama.ama-assn.org/cgi/reprint/294/16/2122)

ii. Surgical Care Improvement Project consumer info sheet (available at: http://www.ofmq.com/Websites/ofmq/Images/FINALconsumer_tips2.pdf)

iii. What you need to know about infections after surgery: a fact sheet for patients and their family members (available at: http://www.ihi.org/NR/rdonlyres/0EE409F4-2F6A-4B55-AB01-16B6D6935EC5/0/SurgicalSiteInfectionsPtsandFam.pdf)

D. Accountability

1. The hospital's chief executive officer and senior management are responsible for ensuring that the healthcare system supports an infection prevention and control program that effectively prevents the occurrence of SSIs and the transmission of epidemiologically significant pathogens.

2. Senior management is accountable for ensuring that an adequate number of trained personnel are assigned to the infection prevention and control program.

3. Senior management is accountable for ensuring that healthcare personnel, including licensed and nonlicensed personnel, are competent to perform their job responsibilities.

4. Direct healthcare providers (such as physicians, nurses, aides, and therapists) and ancillary personnel (such as housekeeping and equipment-processing personnel) are responsible for ensuring that appropriate infection prevention and control practices are used at all times (including hand hygiene; strict adherence to aseptic technique; cleaning and disinfection of equipment and the environment; cleaning, disinfection, and sterilization of medical supplies and instruments; and appropriate surgical prophylaxis protocols).

5. Hospital and unit leaders are responsible for holding personnel accountable for their actions.

6. The person that manages the infection prevention and control program is responsible for ensuring that an active program to identify SSIs is implemented, that data on SSIs are analyzed and regularly provided to those who can use the information to improve the quality of care (eg, unit staff, clinicians, and hospital administrators), and that evidence-based practices are incorporated into the program.

7. Personnel responsible for healthcare personnel and patient education are accountable for ensuring that appropriate training and educational programs to prevent SSIs are developed and provided to personnel, patients, and families.

8. Personnel from the infection prevention and control program, the laboratory, and information technology departments are responsible for ensuring that systems are in place to support the surveillance program.

II. Special approaches for the prevention of SSI

Perform an SSI risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital that have unacceptably high SSI rates despite implementation of the basic SSI prevention strategies listed above.

1. Perform expanded SSI surveillance to determine the source and extent of the problem and to identify possible targets for intervention (B-II).

a. Expand surveillance to include additional procedures and possibly to all National Healthcare Safety Network procedures.[5] Align expanded surveillance with the hospital's strategic plan.

III. Approaches that should not be considered a routine part of SSI prevention

1. Do not routinely use vancomycin for antimicrobial prophylaxis (B-II).

a. Vancomycin should not routinely be used for antimicrobial prophylaxis, but it can be an appropriate agent for specific scenarios. Reserve vancomycin for specific clinical circumstances, such as a proven outbreak of SSI due to MRSA, high endemic rates of SSI due to MRSA, targeted high-risk patients who are at increased risk for SSI due to MRSA (including cardiothoracic surgical patients and elderly patients with diabetes), and high-risk surgical procedures during which an implant is placed.[52]

i. No definitions for "high endemic rates of SSI due to MRSA" have been established.

ii. Studies of the efficacy of vancomycin prophylaxis were published before the emergence of community-acquired MRSA.

b. A recent meta-analysis of 7 studies comparing glycopeptide prophylaxis with β-lactam prophylaxis before cardiothoracic surgery showed that there was no difference in rates of SSI between the 2 antimicrobial prophylaxis regimens.[53]

c. No study has prospectively analyzed the effect of providing both glycopeptide and β-lactam antimicrobials for preoperative antimicrobial prophylaxis. Thus, it is unclear whether treatment with vancomycin, when indicated, should be added to or used in place of standard recommended antimicrobial prophylaxis. Because vancomycin does not have activity against gram-negative pathogens, some experts recommend *adding* vancomycin treatment to standard antimicrobial prophylaxis for the specific clinical circumstances described above.

2. Do not routinely delay surgery to provide parenteral nutrition (A-I).

a. Preoperative administration of total parenteral nutrition has not been shown to reduce the risk of SSI in prospective, randomized controlled trials and may increase the risk of SSI.[54,55]

IV. Unresolved issues

1. Preoperative bathing with chlorhexidine-containing products

a. Preoperative showering with agents such as chlorhexidine has been shown to reduce bacterial colonization of the skin.[56] Several studies have examined the utility of preoperative showers, but none has definitively proven that they decrease SSI risk. A recent Cochrane review[57] evaluated the evidence for preoperative bathing or showering with antiseptics for SSI prevention. Six randomized, controlled trials evaluating the use of 4% chlorhexidine gluconate were included in the analysis, with no clear evidence of benefit noted. To gain the maximum antiseptic effect of chlorhexidine, it must be allowed to dry completely and not be washed off.

2. Routine screening for MRSA or routine attempts to decolonize surgical patients with an antistaphylococcal agent in the preoperative setting

a. A recent double-blinded, randomized, controlled trial involving more than 4,000 patients showed that intranasal application of mupirocin did not significantly reduce the *S. aureus* SSI rate.[58] In a secondary analysis of these data, however, the use of intranasal mupirocin was associated with an overall decreased rate of nosocomial *S. aureus* infection among the *S. aureus* carriers.[58] Mupirocin resistance has been documented.[59]

b. In contrast, other studies have suggested that mupirocin may be effective for particular patient groups, including patients undergoing orthopedic[60,61] or cardiothoracic[62,63] surgery. However, these were not randomized controlled trials.

3. Maintaining oxygenation with supplemental oxygen during and after colorectal procedures

a. Three randomized clinical trials have been published comparing 80% fraction of inspired oxygen (FiO_2) with 30%-35% FiO_2 during the intra- and postoperative periods.

i. Two trials showed a significant decrease in the rate of SSI associated with the higher FiO_2 value,[64,65] and one actually showed a significant increase in the rate of SSI.[66]

ii. Both studies with results showing a beneficial effect of supplemental oxygen included patients who underwent colorectal surgery, whereas the study with results showing a negative effect of supplemental oxygen included all types of patients.

iii. When results of the 3 studies are pooled, the rate of SSI decreases from 15.2% among patients who received 30%-35% supplemental FiO_2 to 11.5% among patients who received 80% FiO_2 during surgery (3.7% absolute risk reduction; $P = .10$).[67]

4. Maintaining normothermia (temperature higher than 36.0°C) immediately after colorectal surgery

a. One randomized trial with 200 patients undergoing colorectal surgery found that infection rates were significantly reduced among patients randomized to have normothermia maintained during surgery.[68]

b. Controversy still exists regarding this recommendation, because of the following:

i. The trial examined the effect of *intraoperative* normothermia, not postoperative normothermia, and did not include risk adjustment for type of procedure.

ii. An observational study showed no impact of normothermia on infection rates.[69]

5. Preoperative intranasal and pharyngeal chlorhexidine treatment for patients undergoing cardiothoracic procedures[70]

a. Although data exist from a randomized, controlled trial to support its usage, chlorhexidine nasal cream is neither approved by the US Food and Drug Administration nor commercially available in the United States.

SECTION 5: PERFORMANCE MEASURES

I. Internal reporting

These performance measures are intended to support internal hospital quality improvement efforts and do not necessarily address external reporting needs.

The process and outcome measures suggested here are derived from published guidelines, other relevant literature, and the opinion of the authors. Report process and outcome measures to senior hospital leadership, nursing leadership, and clinicians who care for patients at risk for SSI.

A. Process measures

1. Compliance with antimicrobial prophylaxis guidelines

a. Measure the percentage of procedures in which antimicrobial prophylaxis was appropriately provided. Appropriateness includes (1) correct type of agent, (2) start of administration of the agent within 1 hour before incision (2 hours allowed for vancomycin and fluoroquinolones) and (3) discontinuation of the agent within 24 hours after surgery (48 hours for cardiac procedures).

i. Numerator: number of patients who appropriately received antimicrobial prophylaxis.

ii. Denominator: total number of selected operations performed.

iii. Multiply by 100 so that the measure is expressed as a percentage.

2. Compliance with hair-removal guidelines

a. Measure the percentage of procedures for which hair removal is appropriately performed (ie, clipping, use of a depilatory, or no hair removal, rather than use of a razor).

i. Numerator: number of patients with appropriate perioperative hair removal.

ii. Denominator: total number of selected operations performed.

iii. Multiply by 100 so that the measure is expressed as a percentage.

3. Compliance with perioperative glucose control guidelines

a. Measure the percentage of procedures for which serum glucose levels are maintained below 200 mg/dL at 6:00 AM on postoperative day 1 and postoperative day 2 after cardiac surgery.

i. Numerator: number of patients with appropriately maintained serum glucose at 6:00 AM on both postoperative day 1 and postoperative day 2 after cardiac surgery.

ii. Denominator: total number of cardiac procedures performed.

iii. Multiply by 100 so that measure is expressed as a percentage.

B. Outcome measures

1. Surgical site infection rate

a. Use National Healthcare Safety Network definitions and risk adjustment methods.[15]

i. Numerator: number of patients with surgical site infections after selected operations.

ii. Denominator: total number of selected operations performed.

iii. Multiply by 100 so that measure is expressed as a percentage.

iv. Risk adjustment: rates of SSI can be risk adjusted by use of one of 2 methods: stratification using the National Nosocomial Infections Surveillance risk index[27] or calculation of the standardized infection ratio.[71]

(a) The National Nosocomial Infections Surveillance risk index is a widely used, operation- and patient-specific, prospectively applied risk score that predicts SSI.[72] This risk index includes 3 predictors of increased risk of SSI: estimators of wound microbial contamination, duration of operation, and markers for host susceptibility.[73] Because rates of SSI published by National Healthcare Safety Network include superficial incisional infections, it is appropriate to collect data on superficial incisional infections for internal benchmarking.

(b) The standardized infection ratio (SIR) is the ratio of the observed number of SSIs *(O)* that occurred to the expected number for surgeons performing a specific type of procedure *(E)* (ie, SIR = *O/E*).[71] The expected number of SSIs can be obtained by multiplying the number of operations done by the surgeon in each procedure risk category by the National Nosocomial Infections Surveillance rate for the same procedure risk category and dividing by 100. Values that exceed 1.0 indicate that more SSIs than expected occurred.

II. External reporting

There are many challenges in providing useful information to consumers and other stakeholders while preventing unintended adverse consequences of public reporting of healthcare-associated infections.[74] Recommendations for public reporting of healthcare-associated infections have been provided by the Hospital Infection Control Practices Advisory Committee,[75] the Healthcare-Associated Infection Working Group of the Joint Public Policy Committee,[76] and the National Quality Forum.[77]

The following is an example of an external performance measure that is currently required by some healthcare stakeholders and regulators.

A. Process measure

1. Compliance with Centers for Medicare and Medicaid Services antimicrobial prophylaxis guidelines (see section 5.I.A.1 above: Performance Measures; Internal Reporting; Process Measures)

a. Measure the percentage of procedures in which antimicrobial prophylaxis was appropriately provided. Appropriateness includes correct type of agent, administration of the agent within 1 hour before incision (2 hours allowed for vancomycin and fluoroquinolones), and discontinuation of the agent within 24 hours after surgery (48 hours for cardiothoracic procedures).[38]

B. State and federal requirements

1. Federal requirements

a. Hospitals that receive Medicare reimbursement must collect and report quality measures required by Centers for Medicare and Medicaid Services (see above).

2. State requirements

a. Hospitals in states that have mandatory reporting requirements must collect and report the data required by the state. For information on state and federal requirements, check with your state or local health department.

3. External quality initiatives

a. Hospitals that participate in external quality initiatives must collect and report the data if required by the initiative.

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GUIDELINE FOR PREVENTION OF SURGICAL SITE INFECTION, 1999

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Special Report

Guideline for Prevention of Surgical Site Infection, 1999

Alicia J. Mangram, MD; Teresa C. Horan, MPH, CIC; Michele L. Pearson, MD; Leah Christine Silver, BS; William R. Jarvis, MD;
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EXECUTIVE SUMMARY

The "Guideline for Prevention of Surgical Site Infection, 1999" presents the Centers for Disease Control and Prevention (CDC)'s recommendations for the prevention of surgical site infections (SSIs), formerly called surgical wound infections. This two-part guideline updates and replaces previous guidelines.[1,2]

Part I, "Surgical Site Infection: An Overview," describes the epidemiology, definitions, microbiology, pathogenesis, and surveillance of SSIs. Included is a detailed discussion of the pre-, intra-, and postoperative issues relevant to SSI genesis.

Part II, "Recommendations for Prevention of Surgical Site Infection," represents the consensus of the Hospital Infection Control Practices Advisory Committee (HICPAC) regarding strategies for the prevention of SSIs.[3] Whenever possible, the recommendations in Part II are based on data from well-designed scientific studies. However, there are a limited number of studies that clearly validate risk factors and prevention measures for SSI. By necessity, available studies have often been conducted in narrowly defined patient populations or for specific kinds of operations, making generalization of their findings to all specialties and types of operations potentially problematic. This is especially true regarding the implementation of SSI prevention measures. Finally, some of the infection control practices routinely used by surgical teams cannot be rigorously studied for ethical or logistical reasons (e.g., wearing vs not wearing gloves). Thus, some of the recommendations in Part II are based on a strong theoretical rationale and suggestive evidence in the absence of confirmatory scientific knowledge.

It has been estimated that approximately 75% of all operations in the United States will be performed in "ambulatory," "same-day," or "outpatient" operating rooms by the turn of the century.[4] In recommending various SSI prevention methods, this document makes no distinction between surgical care delivered in such settings and that provided in conventional inpatient operating rooms. This document is primarily intended for use by surgeons, operating room nurses, postoperative inpatient and clinic nurses, infection control professionals, anesthesiologists, healthcare epidemiologists, and other personnel directly responsible for the prevention of nosocomial infections.

This document does *not:*

- Specifically address issues unique to burns, trauma, transplant procedures, or transmission of bloodborne pathogens from healthcare worker to patient, nor does it specifically address details of SSI prevention in pediatric surgical practice. It has been recently shown in a multicenter study of pediatric surgical patients that characteristics related to the operations are more important than those related to the physiologic status of the patients.[5] In general, all SSI prevention measures effective in adult surgical care are indicated in pediatric surgical care.
- Specifically address procedures performed outside of the operating room (e.g., endoscopic procedures), nor does it provide guidance for infection prevention for invasive procedures such as cardiac catheterization or interventional radiology. Nonetheless, it is likely that many SSI prevention strategies also could be applied or adapted to reduce infectious complications associated with these procedures.
- Specifically recommend SSI prevention methods

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unique to minimally invasive operations (i.e., laparoscopic surgery). Available SSI surveillance data indicate that laparoscopic operations generally have a lower or comparable SSI risk when contrasted to open operations.[6-11] SSI prevention measures applicable in open operations (e.g., open cholecystectomy) are indicated for their laparoscopic counterparts (e.g., laparoscopic cholecystectomy).

- Recommend specific antiseptic agents for patient preoperative skin preparations or for healthcare worker hand/forearm antisepsis. Hospitals should choose from products recommended for these activities in the latest Food and Drug Administration (FDA) monograph.[12]

I. SURGICAL SITE INFECTION (SSI): AN OVERVIEW

A. INTRODUCTION

Before the mid-19th century, surgical patients commonly developed postoperative "irritative fever," followed by purulent drainage from their incisions, overwhelming sepsis, and often death. It was not until the late 1860s, after Joseph Lister introduced the principles of antisepsis, that postoperative infectious morbidity decreased substantially. Lister's work radically changed surgery from an activity associated with infection and death to a discipline that could eliminate suffering and prolong life.

Currently, in the United States alone, an estimated 27 million surgical procedures are performed each year.[13] The CDC's National Nosocomial Infections Surveillance (NNIS) system, established in 1970, monitors reported trends in nosocomial infections in U.S. acute-care hospitals. Based on NNIS system reports, SSIs are the third most frequently reported nosocomial infection, accounting for 14% to 16% of all nosocomial infections among hospitalized patients.[14] During 1986 to 1996, hospitals conducting SSI surveillance in the NNIS system reported 15,523 SSIs following 593,344 operations (CDC, unpublished data). Among surgical patients, SSIs were the most common nosocomial infection, accounting for 38% of all such infections. Of these SSIs, two thirds were confined to the incision, and one third involved organs or spaces accessed during the operation. When surgical patients with nosocomial SSI died, 77% of the deaths were reported to be related to the infection, and the majority (93%) were serious infections involving organs or spaces accessed during the operation.

In 1980, Cruse estimated that an SSI increased a patient's hospital stay by approximately 10 days and cost an additional $2,000.[15,16] A 1992 analysis showed that each SSI resulted in 7.3 additional postoperative hospital days, adding $3,152 in extra charges.[17] Other studies corroborate that increased length of hospital stay and cost are associated with SSIs.[18,19] Deep SSIs involving organs or spaces, as compared to SSIs confined to the incision, are associated with even greater increases in hospital stays and costs.[20,21]

Advances in infection control practices include improved operating room ventilation, sterilization methods, barriers, surgical technique, and availability of antimicrobial prophylaxis. Despite these activities, SSIs remain a substantial cause of morbidity and mortality among hospitalized patients. This may be partially explained by the emergence of antimicrobial-resistant pathogens and the increased numbers of surgical patients who are elderly and/or have a wide variety of chronic, debilitating, or immunocompromising underlying diseases. There also are increased numbers of prosthetic implant and organ transplant operations performed. Thus, to reduce the risk of SSI, a systematic but realistic approach must be applied with the awareness that this risk is influenced by characteristics of the patient, operation, personnel, and hospital.

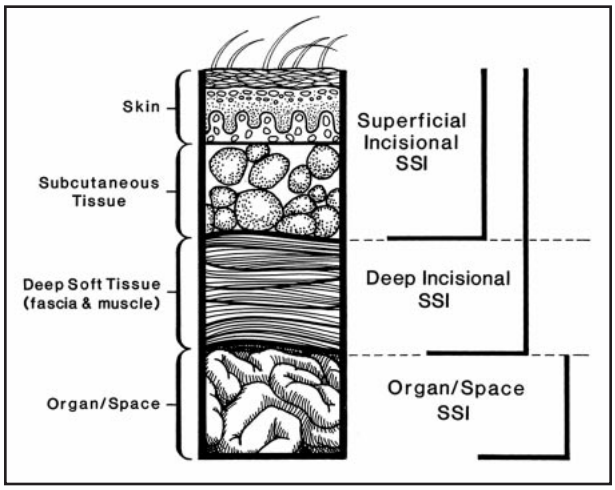

FIGURE. Cross-section of abdominal wall depicting CDC classifications of surgical site infection.[22]

B. KEY TERMS USED IN THE GUIDELINE

1. Criteria for Defining SSIs

The identification of SSI involves interpretation of clinical and laboratory findings, and it is crucial that a surveillance program use definitions that are consistent and standardized; otherwise, inaccurate or uninterpretable SSI rates will be computed and reported. The CDC's NNIS system has developed standardized surveillance criteria for defining SSIs (Table 1).[22] By these criteria, SSIs are classified as being either incisional or organ/space. Incisional SSIs are further divided into those involving only skin and subcutaneous tissue (superficial incisional SSI) and those involving deeper soft tissues of the incision (deep incisional SSI). Organ/space SSIs involve any part of the anatomy (e.g., organ or space) other than incised body wall layers, that was opened or manipulated during an operation (Figure). Table 2 lists site-specific classifications used to differentiate organ/space SSIs. For example, in a patient who had an appendectomy and subsequently developed an intra-abdominal abscess not draining through the incision, the infection would be reported as an organ/space SSI at the intra-abdominal site. Failure to use objective criteria to define SSIs has been shown to substantially affect reported SSI rates.[23,24] The CDC NNIS definitions of SSIs have been applied consistently by surveillance and surgical personnel in many settings and currently are a de facto national standard.[22,25]

TABLE 1
CRITERIA FOR DEFINING A SURGICAL SITE INFECTION (SSI)*

Superficial Incisional SSI

Infection occurs within 30 days after the operation
and
infection involves only skin or subcutaneous tissue of the incision
and at least *one* of the following:

1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat *and* superficial incision is deliberately opened by surgeon, *unless* incision is culture-negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Do *not* report the following conditions as SSI:

1. Stitch abscess (minimal inflammation and discharge confined to the points of suture penetration).
2. Infection of an episiotomy or newborn circumcision site.
3. Infected burn wound.
4. Incisional SSI that extends into the fascial and muscle layers (see deep incisional SSI).

Note: Specific criteria are used for identifying infected episiotomy and circumcision sites and burn wounds.[433]

Deep Incisional SSI

Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation
and
infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision
and at least *one* of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain, or tenderness, unless site is culture-negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopatholog ic or radiologic examination.
4. Diagnosis of a deep incisional SSI by a surgeon or attending physician.

Notes:

1. Report infection that involves both superficial and deep incision sites as deep incisional SSI.
2. Report an organ/space SSI that drains through the incision as a deep incisional SSI.

Organ/Space SSI

Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation
and
infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation
and at least *one* of the following:

1. Purulent drainage from a drain that is placed through a stab wound‡ into the organ/space.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of an organ/space SSI by a surgeon or attending physician.

* Horan TC et al.[22]
† National Nosocomial Infection Surveillance definition: a nonhuman-derived implantable foreign body (e.g., prosthetic heart valve, nonhuman vascular graft, mechanical heart, or hip prosthesis) that is permanently placed in a patient during surgery.
‡ If the area around a stab wound becomes infected, it is not an SSI. It is considered a skin or soft tissue infection, depending on its depth.

2. Operating Suite

A physically separate area that comprises operating rooms and their interconnecting hallways and ancillary work areas such as scrub sink rooms. No distinction is made between operating suites located in conventional inpatient hospitals and those used for "same-day" surgical care, whether in a hospital or a free-standing facility.

3. Operating Room

A room in an operating suite where operations are performed.

4. Surgical Personnel

Any healthcare worker who provides care to surgical patients during the pre-, intra-, or postoperative periods.

5. Surgical Team Member

Any healthcare worker in an operating room during the operation who has a surgical care role. Members of the surgical team may be "scrubbed" or not; scrubbed members have direct contact with the sterile operating field or sterile instruments or supplies used in the field (refer to "Preoperative Hand/Forearm Antisepsis" section).

C. MICROBIOLOGY

According to data from the NNIS system, the distribution of pathogens isolated from SSIs has not changed markedly during the last decade (Table 3).[26,27] *Staphylococcus aureus,* coagulase-negative staphylococci, *Enterococcus* spp., and *Escherichia coli* remain the most frequently isolated pathogens. An increasing proportion of SSIs are caused by antimicrobial-resistant pathogens, such as methicillin-resistant *S. aureus* (MRSA),[28,29] or by *Candida albicans.*[30] From 1991 to 1995, the incidence of fungal SSIs among patients at NNIS hospitals increased from 0.1 to 0.3 per 1,000 discharges.[30] The increased proportion of SSIs caused by resistant pathogens and *Candida* spp. may reflect increasing numbers of severely ill and immunocompromised surgical patients and the impact of widespread use of broad-spectrum antimicrobial agents.

Outbreaks or clusters of SSIs have also been caused by unusual pathogens, such as *Rhizopus oryzae, Clostridium perfringens, Rhodococcus bronchialis, Nocardia farcinica, Legionella pneumophila* and *Legionella dumoffii,* and *Pseudomonas multivorans.* These rare outbreaks have been traced to contaminated adhesive dressings,[31] elastic bandages,[32] colonized surgical personnel,[33,34] tap water,[35] or contaminated disinfectant solutions.[36] When a cluster of SSIs involves an unusual organism, a formal epidemiologic investigation should be conducted.

D. PATHOGENESIS

Microbial contamination of the surgical site is a necessary precursor of SSI. The risk of SSI can be conceptualized according to the following relationship[37,38]:

$$\frac{\text{Dose of bacterial contamination} \times \text{virulence}}{\text{Resistance of the host patient}} = \text{Risk of surgical site infection}$$

Quantitatively, it has been shown that if a surgical site is contaminated with $>10^5$ microorganisms per gram of tissue, the risk of SSI is markedly increased.[39] However, the dose of contaminating microorganisms required to produce infection may be much lower when foreign material is present at the site (i.e., 100 staphylococci per gram of tissue introduced on silk sutures).[40-42]

Microorganisms may contain or produce toxins and other substances that increase their ability to invade a host, produce damage within the host, or survive on or in host tissue. For example, many gram-negative bacteria produce endotoxin, which stimulates cytokine production. In turn, cytokines can trigger the systemic inflammatory response syndrome that sometimes leads to multiple system organ failure.[43-45] One of the most common causes of multiple system organ failure in modern surgical care is intra-abdominal infection.[46,47] Some bacterial surface components, notably polysaccharide capsules, inhibit phagocytosis,[48] a critical and early host defense response to microbial contamination. Certain strains of clostridia and streptococci produce potent exotoxins that disrupt cell membranes or alter cellular metabolism.[49] A variety of microorganisms, including gram-positive bacteria such as coagulase-negative staphylococci, produce glycocalyx and an associated component called "slime,"[50-55] which physically shields bacteria from phagocytes or inhibits the binding or penetration of antimicrobial agents.[56] Although these and other virulence factors are well defined, their mechanistic relationship to SSI development has not been fully determined.

For most SSIs, the source of pathogens is the endogenous flora of the patient's skin, mucous membranes, or hollow viscera.[57] When mucous membranes or skin is incised, the exposed tissues are at risk for contamination with endogenous flora.[58] These organisms are usually aerobic gram-positive cocci (e.g., staphylococci), but may include fecal flora (e.g., anaerobic bacteria and gram-negative aerobes) when incisions are made near the perineum or groin. When a gastrointestinal organ is opened

TABLE 2
SITE-SPECIFIC CLASSIFICATIONS OF ORGAN/SPACE SURGICAL SITE INFECTION*

Arterial or venous infection
Breast abscess or mastitis
Disc space
Ear, mastoid
Endocarditis
Endometritis
Eye, other than conjunctivitis
Gastrointestinal tract
Intra-abdominal, not specified elsewhere
Intracranial, brain abscess or dura
Joint or bursa
Mediastinitis
Meningitis or ventriculitis
Myocarditis or pericarditis
Oral cavity (mouth, tongue, or gums)
Osteomyelitis
Other infections of the lower respiratory tract (e.g., abscess or empyema)
Other male or female reproductive tract
Sinusitis
Spinal abscess without meningitis
Upper respiratory tract
Vaginal cuff

* Horan TC et al.[22]

TABLE 3
DISTRIBUTION OF PATHOGENS ISOLATED* FROM SURGICAL SITE INFECTIONS, NATIONAL NOSOCOMIAL INFECTIONS SURVEILLANCE SYSTEM, 1986 TO 1996

	Percentage of Isolates	
Pathogen	**1986-1989[179] (N=16,727)**	**1990-1996[26] (N=17,671)**
Staphylococcus aureus	17	20
Coagulase-negative staphylococci	12	14
Enterococcus spp.	13	12
Escherichia coli	10	8
Pseudomonas aeruginosa	8	8
Enterobacter spp.	8	7
Proteus mirabilis	4	3
Klebsiella pneumoniae	3	3
Other *Streptococcus* spp.	3	3
Candida albicans	2	3
Group D streptococci (non-enterococci)	—	2
Other gram-positive aerobes	—	2
Bacteroides fragilis	—	2

*Pathogens representing less than 2% of isolates are excluded.

during an operation and is the source of pathogens, gram-negative bacilli (e.g., *E. coli),* gram-positive organisms (e.g., enterococci), and sometimes anaerobes (e.g., *Bacillus fragilis)* are the typical SSI isolates. Table 4 lists operations and the likely SSI pathogens associated with them. Seeding of the operative site from a distant focus of infection can be another source of SSI pathogens,[59-68] particularly in patients who have a prosthesis or other implant placed during the operation. Such devices provide a nidus for attachment of the organism.[50,69-73]

Exogenous sources of SSI pathogens include surgical personnel (especially members of the surgical team),[74-78] the operating room environment (including air), and all tools, instruments, and materials brought to the sterile field during an operation (refer to "Intraoperative Issues" section). Exogenous flora are primarily aerobes, especially gram-positive organisms (e.g., staphylococci and streptococci). Fungi from endogenous and exogenous sources rarely cause SSIs, and their pathogenesis is not well understood.[79]

E. RISK AND PREVENTION

The term *risk factor* has a particular meaning in epidemiology and, in the context of SSI pathophysiology and prevention, strictly refers to a variable that has a significant, independent association with the development of SSI after a specific operation. Risk factors are identified by multivariate analyses in epidemiologic studies. Unfortunately, the term risk factor often is used in the surgical literature in a broad sense to include patient or operation features which, although associated with SSI development in univariate analysis, are not necessarily independent predictors.[80] The literature cited in the sections that follow includes risk factors identified by both univariate and multivariate analyses.

Table 5 lists patient and operation characteristics that may influence the risk of SSI development. These characteristics are useful in two ways: (1) they allow stratification of operations, making surveillance data more comprehensible; and, (2) knowledge of risk factors before certain operations may allow for targeted prevention measures. For example, if it is known that a patient has a remote site infection, the surgical team may reduce SSI risk by scheduling an operation after the infection has resolved.

An SSI prevention measure can be defined as an action or set of actions intentionally taken to reduce the risk of an SSI. Many such techniques are directed at reducing opportunities for microbial contamination of the patient's tissues or sterile surgical instruments; others are adjunctive, such as using antimicrobial prophylaxis or avoiding unnecessary traumatic tissue dissection. Optimum application of SSI prevention measures requires that a variety of patient and operation characteristics be carefully considered.

1. Patient Characteristics

In certain kinds of operations, patient characteristics possibly associated with an increased risk of an SSI include coincident remote site infections[59-68] or colonization,[81-83] diabetes,[84-87] cigarette smoking,[85,88-92] systemic steroid use,[84,87,93] obesity (>20% ideal body weight),[85-87,94-97] extremes of age,[92,98-102] poor nutritional status,[85,94,98,103-105] and perioperative transfusion of certain blood products.[106-109]

a. Diabetes

The contribution of diabetes to SSI risk is controversial,[84-86,98,110] because the independent contribution of diabetes to SSI risk has not typically been assessed after controlling for potential confounding factors. Recent preliminary findings from a study of patients who underwent coronary artery bypass graft showed a significant relationship between increasing levels of HgA1c and SSI rates.[111] Also, increased glucose levels (>200 mg/dL) in the immediate postoperative period (≤48 hours) were associated with increased SSI risk.[112,113] More studies are needed to assess the efficacy of perioperative blood glucose control as a prevention measure.

b. Nicotine use

Nicotine use delays primary wound healing and may increase the risk of SSI.[85] In a large prospective study, current cigarette smoking was an independent risk factor for sternal and/or mediastinal SSI following cardiac surgery.[85] Other studies have corroborated cigarette smoking as an important SSI risk factor.[88-92] The limitation of these studies, however, is that terms like *current cigarette smoking* and *active smokers* are not always defined. To appropriately determine the contribution of tobacco use to SSI risk, standardized definitions of smoking history must be adopted and used in studies designed to control for confounding variables.

c. Steroid use

Patients who are receiving steroids or other immuno-

TABLE 4
OPERATIONS, LIKELY SURGICAL SITE INFECTION (SSI) PATHOGENS, AND REFERENCES ON USE OF ANTIMICROBIAL PROPHYLAXIS*

Operations	Likely Pathogens†‡	References
Placement of all grafts, prostheses, or implants	*Staphylococcus aureus;* coagulase-negative staphylococci	269,282-284,290
Cardiac	*S. aureus;* coagulase-negative staphylococci	251-253,462,463
Neurosurgery	*S. aureus;* coagulase-negative staphylococci	241,249,258,259,261,464,465
Breast	*S. aureus;* coagulase-negative staphylococci	242,248
Ophthalmic Limited data; however, commonly used in procedures such as anterior segment resection, vitrectomy, and scleral buckles	*S. aureus;* coagulase-negative staphylococci; streptococci; gram-negative bacilli	466
Orthopedic Total joint replacement Closed fractures/use of nails, bone plates, other internal fixation devices Functional repair without implant/device Trauma	*S. aureus;* coagulase-negative staphylococci; gram-negative bacilli	60,243-246,254,255,467-473
Noncardiac thoracic Thoracic (lobectomy, pneumonectomy, wedge resection, other noncardiac mediastinal procedures) Closed tube thoracostomy	*S. aureus;* coagulase-negative staphylococci; *Streptococcus pneumoniae;* gram-negative bacilli	240,247,474,475
Vascular	*S. aureus;* coagulase-negative staphylococci	250,463,476,477
Appendectomy	Gram-negative bacilli; anaerobes	263,452,478
Biliary tract	Gram-negative bacilli; anaerobes	260,262,479-484
Colorectal	Gram-negative bacilli; anaerobes	200,239,256,287-289,485-490
Gastroduodenal	Gram-negative bacilli; streptococci; oropharyngeal anaerobes (e.g., peptostreptococci)	256,257,491-493
Head and neck (major procedures with incision through oropharyngeal mucosa)	*S. aureus;* streptococci; oropharyngeal anaerobes (e.g., peptostreptococci)	494-497
Obstetric and gynecologic	Gram-negative bacilli; enterococci; group B streptococci; anaerobes	270-280,435
Urologic May not be beneficial if urine is sterile	Gram-negative bacilli	267

* Refer to "Antimicrobial prophylaxis in surgery," *The Medical Letter,* 1997,[266] for current recommendations of antimicrobial agents and doses.
† Likely pathogens from both endogenous and exogenous sources.
‡ Staphylococci will be associated with SSI following all types of operations.

suppressive drugs preoperatively may be predisposed to developing SSI,[84,87] but the data supporting this relationship are contradictory. In a study of long-term steroid use in patients with Crohn's disease, SSI developed significantly more often in patients receiving preoperative steroids (12.5%) than in patients without steroid use (6.7%).[93] In contrast, other investigations have not found a relationship between steroid use and SSI risk.[98,114,115]

d. Malnutrition

For some types of operations, severe protein-calorie malnutrition is crudely associated with postoperative nosocomial infections, impaired wound healing dynamics, or death.[116-124] The National Academy of Sciences/National Research Council (NAS/NRC),[94] Study on the Efficacy of Infection Control (SENIC),[125] and NNIS[126] schemes for SSI risk stratification do not explicitly incorporate nutritional status as a predictor variable, although it may be represented indirectly in the latter two. In a widely quoted 1987 study of 404 high-risk general surgery operations, Christou and coworkers derived an SSI probability index in which final predictor variables were patient age, operation duration, serum albumin level, delayed hypersensitivity test score, and intrinsic wound contamination level.[117] Although this index predicted SSI risk satisfactorily for 404 subsequent patients and was generally received as a significant advance in SSI risk stratification, it is not widely used in SSI surveillance data analysis, surgical infection research, or analytic epidemiology.

Theoretical arguments can be made for a belief that severe preoperative malnutrition should increase the risk of both incisional and organ/space SSI. However, an epidemiologic association between incisional SSI and malnutrition is difficult to demonstrate consistently for all surgical subspecialties.[118-120,124,127-131] Multivariate logistic regression modeling has shown that preoperative protein-calorie malnutrition is not an independent predictor of

TABLE 5
PATIENT AND OPERATION CHARACTERISTICS THAT MAY INFLUENCE THE RISK OF SURGICAL SITE INFECTION DEVELOPMENT

Patient
Age
Nutritional status
Diabetes
Smoking
Obesity
Coexistent infections at a remote body site
Colonization with microorganisms
Altered immune response
Length of preoperative stay
Operation
Duration of surgical scrub
Skin antisepsis
Preoperative shaving
Preoperative skin prep
Duration of operation
Antimicrobial prophylaxis
Operating room ventilation
Inadequate sterilization of instruments
Foreign material in the surgical site
Surgical drains
Surgical technique
Poor hemostasis
Failure to obliterate dead space
Tissue trauma

Adapted from references 25, 37.

mediastinitis after cardiac bypass operations.[85,132]

In the modern era, total parenteral nutrition (TPN) and total enteral alimentation (TEA) have enthusiastic acceptance by surgeons and critical care specialists.[118,133-137] However, the benefits of preoperative nutritional repletion of malnourished patients in reducing SSI risk are unproven. In two randomized clinical trials, preoperative "nutritional therapy" did not reduce incisional and organ/space SSI risk.[138-141] In a recent study of high-risk pancreatectomy patients with cancer, the provision of TPN preoperatively had no beneficial effect on SSI risk.[142] A randomized prospective trial involving 395 general and thoracic surgery patients compared outcomes for malnourished patients preoperatively receiving either a 7- to 15-day TPN regimen or a regular preoperative hospital diet. All patients were followed for 90 days postoperatively. There was no detectable benefit of TPN administration on the incidence of incisional or organ/space SSI.[143] Administering TPN or TEA may be indicated in a number of circumstances, but such repletion cannot be viewed narrowly as a prevention measure for organ/space or incisional SSI risk. When a major elective operation is necessary in a severely malnourished patient, experienced surgeons often use both pre- and postoperative nutritional support in consideration of the major morbidity associated with numerous potential complications, only one of which is organ/space SSI.[118,124,130,133,137,138,144-149] In addition, postoperative nutritional support is important for certain major oncologic operations,[135,136] after many operations on major trauma victims,[134] or in patients suffering a variety of catastrophic surgical complications that preclude eating or that trigger a hypermetabolic state. Randomized clinical trials will be necessary to determine if nutritional support alters SSI risk in specific patient-operation combinations.

e. Prolonged preoperative hospital stay

Prolonged preoperative hospital stay is frequently suggested as a patient characteristic associated with increased SSI risk. However, length of preoperative stay is likely a surrogate for severity of illness and co-morbid conditions requiring inpatient work-up and/or therapy before the operation.[16,26,65,85,94,100,150,151]

f. Preoperative nares colonization with *Staphylococcus aureus*

S. aureus is a frequent SSI isolate. This pathogen is carried in the nares of 20% to 30% of healthy humans.[81] It has been known for years that the development of SSI involving *S. aureus* is definitely associated with preoperative nares carriage of the organism in surgical patients.[81] A recent multivariate analysis demonstrated that such carriage was the most powerful independent risk factor for SSI following cardiothoracic operations.[82]

Mupirocin ointment is effective as a topical agent for eradicating *S. aureus* from the nares of colonized patients or healthcare workers. A recent report by Kluytmans and coworkers suggested that SSI risk was reduced in patients who had cardiothoracic operations when mupirocin was applied preoperatively to their nares, regardless of carrier status.[152] In this study, SSI rates for 752 mupirocin-treated patients were compared with those previously observed for an untreated group of 928 historical control patients, and the significant SSI rate reduction was attributed to the mupirocin treatment. Concerns have been raised regarding the comparability of the two patient groups.[153] Additionally, there is concern that mupirocin resistance may emerge, although this seems unlikely when treatment courses are brief.[81] A prospective, randomized clinical trial will be necessary to establish definitively that eradication of nasal carriage of *S. aureus* is an effective SSI prevention method in cardiac surgery. Such a trial has recently been completed on 3,909 patients in Iowa.[83] Five types of operations in two facilities were observed. Preliminary analysis showed a significant association between nasal carriage of *S. aureus* and subsequent SSI development. The effect of mupirocin on reducing SSI risk is yet to be determined.

g. Perioperative transfusion

It has been reported that perioperative transfusion of leukocyte-containing allogeneic blood components is an apparent risk factor for the development of postoperative bacterial infections, including SSI.[106] In three of five randomized trials conducted in patients undergoing elective colon resection for cancer, the risk of SSI was at least doubled in patients receiving blood transfusions.[107-109] However, on the basis of detailed epidemiologic reconsid-

TABLE 6
MECHANISM AND SPECTRUM OF ACTIVITY OF ANTISEPTIC AGENTS COMMONLY USED FOR PREOPERATIVE SKIN PREPARATION AND SURGICAL SCRUBS

Agent	Mechanism of Action	Gram-Positive Bacteria	Gram-Negative Bacteria	Mtb	Fungi	Virus	Rapidity of Action	Residual Activity	Toxicity	Uses
Alcohol	Denature proteins	E	E	G	G	G	Most rapid	None	Drying, volatile	SP, SS
Chlorhexidine	Disrupt cell membrane	E	G	P	F	G	Intermediate	E	Ototoxicity, keratitis	SP, SS
Iodine/Iodophors	Oxidation/substitution by free iodine	E	G	G	G	G	Intermediate	Minimal	Absorption from skin with possible toxicity, skin irritation	SP, SS
PCMX	Disrupt cell wall	G	F*	F	F	F	Intermediate	G	More data needed	SS
Triclosan	Disrupt cell wall	G	G	G	P	U	Intermediate	E	More data needed	SS

Abbreviations: E, excellent; F, fair; G, good; Mtb, *Mycobacterium tuberculosis;* P, poor; PCMX, para-chloro-meta-xylenol; SP, skin preparation; SS, surgical scrubs; U, unknown.
Data from Larson E.[176]
* Fair, except for *Pseudomonas* spp.; activity improved by addition of chelating agent such as EDTA.

erations, as many as 12 confounding variables may have influenced the reported association, and any effect of transfusion on SSI risk may be either small or nonexistent.[106] Because of methodologic problems, including the timing of transfusion, and use of nonstandardized SSI definitions, interpretation of the available data is limited. A meta-analysis of published trials will probably be required for resolution of the controversy.[154] There is currently no scientific basis for withholding necessary blood products from surgical patients as a means of either incisional or organ/space SSI risk reduction.

2. Operative Characteristics: Preoperative Issues

a. Preoperative antiseptic showering

A preoperative antiseptic shower or bath decreases skin microbial colony counts. In a study of >700 patients who received two preoperative antiseptic showers, chlorhexidine reduced bacterial colony counts ninefold (2.8×10^2 to 0.3), while povidone-iodine or triclocarban-medicated soap reduced colony counts by 1.3- and 1.9-fold, respectively.[155] Other studies corroborate these findings.[156,157] Chlorhexidine gluconate-containing products require several applications to attain maximum antimicrobial benefit, so repeated antiseptic showers are usually indicated.[158] Even though preoperative showers reduce the skin's microbial colony counts, they have not definitively been shown to reduce SSI rates.[159-165]

b. Preoperative hair removal

Preoperative shaving of the surgical site the night before an operation is associated with a significantly higher SSI risk than either the use of depilatory agents or no hair removal.[16,100,166-169] In one study, SSI rates were 5.6% in patients who had hair removed by razor shave compared to a 0.6% rate among those who had hair removed by depilatory or who had no hair removed.[166] The increased SSI risk associated with shaving has been attributed to microscopic cuts in the skin that later serve as foci for bacterial multiplication. Shaving immediately before the operation compared to shaving within 24 hours preoperatively was associated with decreased SSI rates (3.1% vs 7.1%); if shaving was performed >24 hours prior to operation, the SSI rate exceeded 20%.[166] Clipping hair immediately before an operation also has been associated with a lower risk of SSI than shaving or clipping the night before an operation (SSI rates immediately before = 1.8% vs night before = 4.0%).[170-173] Although the use of depilatories has been associated with a lower SSI risk than shaving or clipping,[166,167] depilatories sometimes produce hypersensitivity reactions.[166] Other studies showed that preoperative hair removal by any means was associated with increased SSI rates and suggested that no hair be removed.[100,174,175]

c. Patient skin preparation in the operating room

Several antiseptic agents are available for preoperative preparation of skin at the incision site (Table 6). The iodophors (e.g., povidone-iodine), alcohol-containing products, and chlorhexidine gluconate are the most commonly used agents. No studies have adequately assessed the comparative effects of these preoperative skin antiseptics on SSI risk in well-controlled, operation-specific studies.

Alcohol is defined by the FDA as having one of the following active ingredients: ethyl alcohol, 60% to 95% by volume in an aqueous solution, or isopropyl alcohol, 50% to 91.3% by volume in an aqueous solution.[12] Alcohol is readily available, inexpensive, and remains the most effective and rapid-acting skin antiseptic.[176] Aqueous 70% to 92% alcohol solutions have germicidal activity against bacteria, fungi, and viruses, but spores can be resistant.[176,177] One potential disadvantage of the use of alcohol in the operating room is its flammability.[176-178]

Both chlorhexidine gluconate and iodophors have broad spectra of antimicrobial activity.[177,179-181] In some comparisons of the two antiseptics when used as preoperative hand scrubs, chlorhexidine gluconate achieved greater reductions in skin microflora than did povidone-iodine and

also had greater residual activity after a single application.[182-184] Further, chlorhexidine gluconate is not inactivated by blood or serum proteins.[176,179,185,186] Iodophors may be inactivated by blood or serum proteins, but exert a bacteriostatic effect as long as they are present on the skin.[178,179]

Before the skin preparation of a patient is initiated, the skin should be free of gross contamination (i.e., dirt, soil, or any other debris).[187] The patient's skin is prepared by applying an antiseptic in concentric circles, beginning in the area of the proposed incision. The prepared area should be large enough to extend the incision or create new incisions or drain sites, if necessary.[1,177,187] The application of the skin preparation may need to be modified, depending on the condition of the skin (e.g., burns) or location of the incision site (e.g., face).

There are reports of modifications to the procedure for preoperative skin preparation which include: (1) removing or wiping off the skin preparation antiseptic agent after application, (2) using an antiseptic-impregnated adhesive drape, (3) merely painting the skin with an antiseptic in lieu of the skin preparation procedure described above, or (4) using a "clean" versus a "sterile" surgical skin preparation kit.[188-191] However, none of these modifications has been shown to represent an advantage.

d. Preoperative hand/forearm antisepsis

Members of the surgical team who have direct contact with the sterile operating field or sterile instruments or supplies used in the field wash their hands and forearms by performing a traditional procedure known as scrubbing (or the surgical scrub) immediately before donning sterile gowns and gloves. Ideally, the optimum antiseptic used for the scrub should have a broad spectrum of activity, be fast-acting, and have a persistent effect.[1,192,193] Antiseptic agents commercially available in the United States for this purpose contain alcohol, chlorhexidine, iodine/iodophors, parachloro-meta-xylenol, or triclosan (Table 6).[176,177,179,194,195] Alcohol is considered the gold standard for surgical hand preparation in several European countries.[196-199] Alcohol-containing products are used less frequently in the United States than in Europe, possibly because of concerns about flammability and skin irritation. Povidone-iodine and chlorhexidine gluconate are the current agents of choice for most U.S. surgical team members.[177] However, when 7.5% povidone-iodine or 4% chlorhexidine gluconate was compared to alcoholic chlorhexidine (60% isopropanol and 0.5% chlorhexidine gluconate in 70% isopropanol), alcoholic chlorhexidine was found to have greater residual antimicrobial activity.[200,201] No agent is ideal for every situation, and a major factor, aside from the efficacy of any product, is its acceptability by operating room personnel after repeated use. Unfortunately, most studies evaluating surgical scrub antiseptics have focused on measuring hand bacterial colony counts. No clinical trials have evaluated the impact of scrub agent choice on SSI risk.[195,202-206]

Factors other than the choice of antiseptic agent influence the effectiveness of the surgical scrub. Scrubbing technique, the duration of the scrub, the condition of the hands, or the techniques used for drying and gloving are examples of such factors. Recent studies suggest that scrubbing for at least 2 minutes is as effective as the traditional 10-minute scrub in reducing hand bacterial colony counts,[207-211] but the optimum duration of scrubbing is not known. The first scrub of the day should include a thorough cleaning underneath fingernails (usually with a brush).[180,194,212] It is not clear that such cleaning is a necessary part of subsequent scrubs during the day. After performing the surgical scrub, hands should be kept up and away from the body (elbows in flexed position) so that water runs from the tips of the fingers toward the elbows. Sterile towels should be used for drying the hands and forearms before the donning of a sterile gown and gloves.[212]

A surgical team member who wears artificial nails may have increased bacterial and fungal colonization of the hands despite performing an adequate hand scrub.[212,213] Hand carriage of gram-negative organisms has been shown to be greater among wearers of artificial nails than among non-wearers.[213] An outbreak of *Serratia marcescens* SSIs in cardiovascular surgery patients was found to be associated with a surgical nurse who wore artificial nails.[214] While the relationship between nail length and SSI risk is unknown, long nails—artificial or natural—may be associated with tears in surgical gloves.[177,180,212] The relationship between the wearing of nail polish or jewelry by surgical team members and SSI risk has not been adequately studied.[194,212,215-217]

e. Management of infected or colonized surgical personnel

Surgical personnel who have active infections or are colonized with certain microorganisms have been linked to outbreaks or clusters of SSIs.[33,34,76,218-237] Thus, it is important that healthcare organizations implement policies to prevent transmission of microorganisms from personnel to patients. These policies should address management of job-related illnesses, provision of postexposure prophylaxis after job-related exposures and, when necessary, exclusion of ill personnel from work or patient contact. While work exclusion policies should be enforceable and include a statement of authority to exclude ill personnel, they should also be designed to encourage personnel to report their illnesses and exposures and not penalize personnel with loss of wages, benefits, or job status.[238]

f. Antimicrobial prophylaxis

Surgical antimicrobial prophylaxis (AMP) refers to a very brief course of an antimicrobial agent initiated just before an operation begins.[239-265] AMP is not an attempt to sterilize tissues, but a critically timed adjunct used to reduce the microbial burden of intraoperative contamination to a level that cannot overwhelm host defenses. AMP does not pertain to prevention of SSI caused by postoperative contamination.[265] Intravenous infusion is the mode of AMP delivery used most often in modern surgical practice.[20,26,242,266-281] Essentially all confirmed AMP indications pertain to elective operations in which skin incisions are closed in the operating room.

TABLE 7
SURGICAL WOUND CLASSIFICATION

Class I/Clean: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

Class II/Clean-Contaminated: An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

Class III/Contaminated: Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered are included in this category.

Class IV/Dirty-Infected: Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

Garner JS[1] and Simmons BP.[2]

Four principles must be followed to maximize the benefits of AMP:

- Use an AMP agent for all operations or classes of operations in which its use has been shown to reduce SSI rates based on evidence from clinical trials or for those operations after which incisional or organ/space SSI would represent a catastrophe.[266,268,269,282-284]
- Use an AMP agent that is safe, inexpensive, and bactericidal with an in vitro spectrum that covers the most probable intraoperative contaminants for the operation.
- Time the infusion of the initial dose of antimicrobial agent so that a bactericidal concentration of the drug is established in serum and tissues by the time the skin is incised.[285]
- Maintain therapeutic levels of the antimicrobial agent in both serum and tissues throughout the operation and until, at most, a few hours after the incision is closed in the operating room.[179,266-268,282,284,286] Because clotted blood is present in all surgical wounds, therapeutic serum levels of AMP agents are logically important in addition to therapeutic tissue levels. Fibrin-enmeshed bacteria may be resistant to phagocytosis or to contact with antimicrobial agents that diffuse from the wound space.

Table 4 summarizes typical SSI pathogens according to operation type and cites studies that establish AMP efficacy for these operations. A simple way to organize AMP indications is based on using the surgical wound classification scheme shown in Table 7, which employs descriptive case features to *postoperatively* grade the degree of intraoperative microbial contamination. A surgeon makes the decision to use AMP by anticipating *preoperatively* the surgical wound class for a given operation.

AMP is indicated for all operations that entail entry into a hollow viscus under controlled conditions. The most frequent SSI pathogens for such clean-contaminated operations are listed in Table 4. Certain clean-contaminated operations, such as elective colon resection, low anterior resection of the rectum, and abdominoperineal resection of the rectum, also require an additional preoperative protective maneuver called "preparation of the colon," to empty the bowel of its contents and to reduce the levels of live microorganisms.[200,239,256,268,284,287] This maneuver includes the administration of enemas and cathartic agents followed by the oral administration of nonabsorbable antimicrobial agents in divided doses the day before the operation.[200,288,289]

AMP is sometimes indicated for operations that entail incisions through normal tissue and in which no viscus is entered and no inflammation or infection is encountered. Two well-recognized AMP indications for such clean operations are: (1) when any intravascular prosthetic material or a prosthetic joint will be inserted, and (2) for any operation in which an incisional or organ/space SSI would pose catastrophic risk. Examples are all cardiac operations, including cardiac pacemaker placement,[290] vascular operations involving prosthetic arterial graft placement at any site or the revascularization of the lower extremity, and most neurosurgical operations (Table 4). Some have advocated use of AMP during all operations on the breast.[80,242,264]

By definition, AMP is not indicated for an operation classified in Table 7 as contaminated or dirty. In such operations, patients are frequently receiving therapeutic antimicrobial agents perioperatively for established infections.

Cephalosporins are the most thoroughly studied AMP agents.[284] These drugs are effective against many gram-positive and gram-negative microorganisms. They also share the features of demonstrated safety, acceptable pharmacokinetics, and a reasonable cost per dose.[242] In particular, cefazolin is widely used and generally viewed as the AMP agent of first choice for clean operations.[266] If a patient is unable to receive a cephalosporin because of penicillin allergy, an alternative for gram-positive bacterial coverage is either clindamycin or vancomycin.

Cefazolin provides adequate coverage for many clean-contaminated operations,[268,291] but AMP for operations on the distal intestinal tract mandates use of an agent such as cefoxitin (or some other second-generation cephalosporin) that provides anaerobic coverage. If a patient cannot safely receive a cephalosporin because of allergy, a reasonable alternative for gram-negative cover-

TABLE 8
PARAMETERS FOR OPERATING ROOM VENTILATION, AMERICAN INSTITUTE OF ARCHITECTS, 1996

Temperature	68-73°F, depending on normal ambient temperatures
Relative humidity	30%-60%
Air movement	From "clean to less clean" areas
Air changes	Minimum 15 total air changes per hour Minimum 3 air changes of outdoor air per hour

American Institute of Architects.[299]

age is aztreonam. However, an agent such as clindamycin or metronidazole should also be included to ensure anaerobic coverage.

The aminoglycosides are seldom recommended as first choices for AMP, either as single drugs or as components of combination regimens.[242,264] References cited in Table 4 provide many details regarding AMP choices and dosages, antimicrobial spectra and properties, and other practical clinical information.

The routine use of vancomycin in AMP is not recommended for any kind of operation.[242,266,283,292] However, vancomycin may be the AMP agent of choice in certain clinical circumstances, such as when a cluster of MRSA mediastinitis or incisional SSI due to methicillin-resistant coagulase-negative staphylococci has been detected. A threshold has not been scientifically defined that can support the decision to use vancomycin in AMP. The decision should involve consideration of local frequencies of MRSA isolates, SSI rates for particular operations, review of infection prevention practices for compliance, and consultation between surgeons and infectious disease experts. An effective SSI surveillance program must be operational, with careful and timely culturing of SSI isolates to determine species and AMP agent susceptibilities.[80]

Agents most commonly used for AMP (i.e., cephalosporins) exhibit time-dependent bactericidal action. The therapeutic effects of such agents are probably maximized when their levels continuously exceed a threshold value best approximated by the minimal bactericidal concentration value observed for the target pathogens in vitro. When the duration of an operation is expected to exceed the time in which therapeutic levels of the AMP agent can be maintained, additional AMP agent should be infused. That time point for cefazolin is estimated as 3 to 4 hours. In general, the timing of a second (or third, etc.) dose of any AMP drug is estimated from three parameters: tissue levels achieved in normal patients by a standard therapeutic dose, the approximate serum half-life of the drug, and awareness of approximate MIC_{90} values for anticipated SSI pathogens. References in Table 6 should be consulted for these details and important properties of antimicrobial agents used for AMP in various specialties.

Basic "rules of thumb" guide decisions about AMP dose sizes and timing. For example, it is believed that a full therapeutic dose of cefazolin (1-2 g) should be given to adult patients no more than 30 minutes before the skin is incised.[242,285] There are a few exceptions to this basic guide. With respect to dosing, it has been demonstrated that larger doses of AMP agents are necessary to achieve optimum effect in morbidly obese patients.[293] With respect to timing, an exception occurs for patients undergoing cesarean section in whom AMP is indicated: the initial dose is administered immediately after the umbilical cord is clamped.[266,272,273] If vancomycin is used, an infusion period of approximately 1 hour is required for a typical dose. Clearly, the concept of "on-call" infusion of AMP is flawed simply because delays in transport or schedule changes can mean that suboptimal tissue and serum levels may be present when the operation starts.[242,294] Simple protocols of AMP timing and oversight responsibility should be locally designed to be practical and effective.

3. Operative characteristics: Intraoperative issues

a. Operating room environment

(1) Ventilation

Operating room air may contain microbial-laden dust, lint, skin squames, or respiratory droplets. The microbial level in operating room air is directly proportional to the number of people moving about in the room.[295] Therefore, efforts should be made to minimize personnel traffic during operations. Outbreaks of SSIs caused by group A beta-hemolytic streptococci have been traced to airborne transmission of the organism from colonized operating room personnel to patients.[233,237,296,297] In these outbreaks, the strain causing the outbreak was recovered from the air in the operating room.[237,296] It has been demonstrated that exercising and changing of clothing can lead to airborne dissemination of group A streptococci from vaginal or rectal carriage.[233,234,237,297]

Operating rooms should be maintained at positive pressure with respect to corridors and adjacent areas.[298] Positive pressure prevents airflow from less clean areas into more clean areas. All ventilation or air conditioning systems in hospitals, including those in operating rooms, should have two filter beds in series, with the efficiency of the first filter bed being $\geq$30% and that of the second filter bed being $\geq$90%.[299] Conventional operating room ventilation systems produce a minimum of about 15 air changes of filtered air per hour, three (20%) of which must be fresh air.[299,300] Air should be introduced at the ceiling and exhausted near the floor.[300,301] Detailed ventilation parameters for operating rooms have been published by the American Institute of Architects in collaboration with the U.S. Department of Health and Human Services (Table 8).[299]

Laminar airflow and use of UV radiation have been suggested as additional measures to reduce SSI risk for certain operations. Laminar airflow is designed to move particle-free air (called "ultraclean air") over the aseptic operating field at a uniform velocity (0.3 to 0.5 µm/sec), sweeping away particles in its path. Laminar airflow can be directed vertically or horizontally, and recirculated air is usually passed through a high efficiency particulate air (HEPA)

filter.[302,303] HEPA filters remove particles ≥0.3μm in diameter with an efficiency of 99.97%.[64,300,302,304] Most of the studies examining the efficacy of ultraclean air involve only orthopedic operations.[298,305-311] Charnley and Eftaknan studied vertical laminar airflow systems and exhaust-ventilated clothing and found that their use decreased the SSI rate from 9% to 1%.[305] However, other variables (i.e., surgeon experience and surgical technique) changed at the same time as the type of ventilation, which may have confounded the associations. In a multicenter study examining 8,000 total hip and knee replacements, Lidwell et al. compared the effects of ultraclean air alone, antimicrobial prophylaxis alone, and ultraclean air in combination with antimicrobial prophylaxis on the rate of deep SSIs.[307] The SSI rate following operations in which ultraclean air alone was used decreased from 3.4% to 1.6%, whereas the rate for those who received only antimicrobial prophylaxis decreased from 3.4% to 0.8%. When both interventions were used in combination, the SSI rate decreased from 3.4% to 0.7%. These findings suggest that both ultraclean air and antimicrobial prophylaxis can reduce the incidence of SSI following orthopedic implant operations, but antimicrobial prophylaxis is more beneficial than ultraclean air. Intraoperative UV radiation has not been shown to decrease overall SSI risk.[94,312]

(2) Environmental surfaces

Environmental surfaces in U.S. operating rooms (e.g., tables, floors, walls, ceilings, lights) are rarely implicated as the sources of pathogens important in the development of SSIs. Nevertheless, it is important to perform routine cleaning of these surfaces to reestablish a clean environment after each operation.[180,212,300,302] There are no data to support routine disinfecting of environmental surfaces or equipment between operations in the absence of contamination or visible soiling. When visible soiling of surfaces or equipment occurs during an operation, an Environmental Protection Agency (EPA)-approved hospital disinfectant should be used to decontaminate the affected areas before the next operation.[180,212,300-302,313-315] This is in keeping with the Occupational Safety and Health Administration (OSHA) requirement that all equipment and environmental surfaces be cleaned and decontaminated after contact with blood or other potentially infectious materials.[315] Wet-vacuuming of the floor with an EPA-approved hospital disinfectant is performed routinely after the last operation of the day or night. Care should be taken to ensure that medical equipment left in the operating room be covered so that solutions used during cleaning and disinfecting do not contact sterile devices or equipment.[316] There are no data to support special cleaning procedures or closing of an operating room after a contaminated or dirty operation has been performed.[300,301]

Tacky mats placed outside the entrance to an operating room/suite have not been shown to reduce the number of organisms on shoes or stretcher wheels, nor do they reduce the risk of SSI.[1,179,295,301]

(3) Microbiologic sampling

Because there are no standardized parameters by which to compare microbial levels obtained from cultures of ambient air or environmental surfaces in the operating room, routine microbiologic sampling cannot be justified. Such environmental sampling should only be performed as part of an epidemiologic investigation.

(4) Conventional sterilization of surgical instruments

Inadequate sterilization of surgical instruments has resulted in SSI outbreaks.[302,317,318] Surgical instruments can be sterilized by steam under pressure, dry heat, ethylene oxide, or other approved methods. The importance of routinely monitoring the quality of sterilization procedures has been established.[1,180,212,299] Microbial monitoring of steam autoclave performance is necessary and can be accomplished by use of a biological indicator.[212,314,319] Detailed recommendations for sterilization of surgical instruments have been published.[212,314,320,321]

(5) Flash sterilization of surgical instruments

The Association for the Advancement of Medical Instrumentation defines flash sterilization as "the process designated for the steam sterilization of patient care items for immediate use."[321] During any operation, the need for emergency sterilization of equipment may arise (e.g., to reprocess an inadvertently dropped instrument). However, flash sterilization is not intended to be used for either reasons of convenience or as an alternative to purchasing additional instrument sets or to save time. Also, flash sterilization is not recommended for implantable devices(*) because of the potential for serious infections.[314,320,321]

Flash sterilization is not recommended as a routine sterilization method because of the lack of timely biologic indicators to monitor performance, absence of protective packaging following sterilization, possibility for contamination of processed items during transportation to operating rooms, and use of minimal sterilization cycle parameters (i.e., time, temperature, pressure).[319] To address some of these concerns, many hospitals have placed equipment for flash sterilization in close proximity to operating rooms and new biologic indicators that provide results in 1 to 3 hours are now available for flash-sterilized items.[322-325] Nevertheless, flash sterilization should be restricted to its intended purpose until studies are performed that can demonstrate comparability with conventional sterilization methods regarding risk of SSI. Sterilization cycle parameters for flash sterilization are shown in Table 9.

b. Surgical attire and drapes

In this section the term *surgical attire* refers to scrub suits, caps/hoods, shoe covers, masks, gloves, and gowns. Although experimental data show that live microorganisms are shed from hair, exposed skin, and mucous membranes of operating room personnel,[75,181,326-330] few controlled clinical studies have evaluated the relationship between the use of surgical attire and SSI risk. Nevertheless, the use of barriers seems prudent to minimize a patient's exposure to the skin, mucous membranes, or hair of surgical team mem-

** According to the FDA, an implantable device is a "device that is placed into a surgically or naturally formed cavity of the human body if it is intended to remain there for a period of 30 days or more."[321]*

TABLE 9
PARAMETERS FOR FLASH STERILIZATION CYCLES, ASSOCIATION FOR THE ADVANCEMENT OF MEDICAL INSTRUMENTATION

Gravity-Displacement	**Minimum Exposure Time and Temperature**
Nonporous items	3 min at 132°C (270°F)
Nonporous and porous items	10 min at 132°C (270°F)
Prevacuum	**Minimum Exposure Time and Temperature**
Nonporous items	3 min at 132°C (270°F)
Nonporous and porous items	4 min at 132°C (270°F)

Association for the Advancement of Medical Instrumentation.[321]

bers, as well as to protect surgical team members from exposure to blood and bloodborne pathogens (e.g., human immunodeficiency virus and hepatitis viruses).

(1) Scrub suits

Surgical team members often wear a uniform called a "scrub suit" that consists of pants and a shirt. Policies for laundering, wearing, covering, and changing scrub suits vary greatly. Some policies restrict the laundering of scrub suits to the facility, while other facilities have policies that allow laundering by employees. There are no well-controlled studies evaluating scrub suit laundering as an SSI risk factor.[331] Some facilities have policies that restrict the wearing of scrub suits to the operating suite, while other facilities allow the wearing of cover gowns over scrub suits when personnel leave the suite. The Association of Operating Room Nurses recommends that scrub suits be changed after they become visibly soiled and that they be laundered only in an approved and monitored laundry facility.[212] Additionally, OSHA regulations require that "if a garment(s) is penetrated by blood or other potentially infectious materials, the garment(s) shall be removed immediately or as soon as feasible."[315]

(2) Masks

The wearing of surgical masks during operations to prevent potential microbial contamination of incisions is a longstanding surgical tradition. However, some studies have raised questions about the efficacy and cost-benefit of surgical masks in reducing SSI risk.[328,332-338] Nevertheless, wearing a mask can be beneficial since it protects the wearer's nose and mouth from inadvertent exposures (i.e., splashes) to blood and other body fluids. OSHA regulations require that masks in combination with protective eyewear, such as goggles or glasses with solid shields, or chin-length face shields be worn whenever splashes, spray, spatter, or droplets of blood or other potentially infectious material may be generated and eye, nose, or mouth contamination can be reasonably anticipated.[315] In addition, a respirator certified by the National Institute for Occupational Safety and Health with protection factor N95 or higher is required when the patient has or is suspected of having infectious tuberculosis.[339]

(3) Surgical caps/hoods and shoe covers

Surgical caps/hoods are inexpensive and reduce contamination of the surgical field by organisms shed from the hair and scalp. SSI outbreaks have occasionally been traced to organisms isolated from the hair or scalp (*S. aureus* and group A *Streptococcus)*,[75,76] even when caps were worn by personnel during the operation and in the operating suites.

The use of shoe covers has never been shown to decrease SSI risk or to decrease bacteria counts on the operating room floor.[340,341] Shoe covers may, however, protect surgical team members from exposure to blood and other body fluids during an operation. OSHA regulations require that surgical caps or hoods and shoe covers or boots be worn in situations when gross contamination can reasonably be anticipated (e.g., orthopedic operations, penetrating trauma cases).[315]

(4) Sterile gloves

Sterile gloves are put on after donning sterile gowns. A strong theoretical rationale supports the wearing of sterile gloves by all scrubbed members of the surgical team. Sterile gloves are worn to minimize transmission of microorganisms from the hands of team members to patients and to prevent contamination of team members' hands with patients' blood and body fluids. If the integrity of a glove is compromised (e.g., punctured), it should be changed as promptly as safety permits.[315,342,343] Wearing two pairs of gloves (double-gloving) has been shown to reduce hand contact with patients' blood and body fluids when compared to wearing only a single pair.[344,345]

(5) Gowns and drapes

Sterile surgical gowns and drapes are used to create a barrier between the surgical field and potential sources of bacteria. Gowns are worn by all scrubbed surgical team members and drapes are placed over the patient. There are limited data that can be used to understand the relationship of gown or drape characteristics with SSI risk. The wide variation in the products and study designs make interpretation of the literature difficult.[329,346-350]

Gowns and drapes are classified as disposable (single use) or reusable (multiple use). Regardless of the material used to manufacture gowns and drapes, these items should be impermeable to liquids and viruses.[351,352] In general, only gowns reinforced with films, coatings, or membranes appear to meet standards developed by the American Society for Testing and Materials.[351-353] However, such "liquid-proof" gowns may be uncomfortable because

they also inhibit heat loss and the evaporation of sweat from the wearer's body. These factors should be considered when selecting gowns.[353,354] A discussion of the role of gowns and drapes in preventing the transmission of bloodborne pathogens is beyond the scope of this document.[355]

c. Asepsis and surgical technique

(1) Asepsis

Rigorous adherence to the principles of asepsis by all scrubbed personnel is the foundation of surgical site infection prevention. Others who work in close proximity to the sterile surgical field, such as anesthesia personnel who are separated from the field only by a drape barrier, also must abide by these principles. SSIs have occurred in which anesthesia personnel were implicated as the source of the pathogen.[34,231,234,356-358] Anesthesiologists and nurse anesthetists perform a variety of invasive procedures such as placement of intravascular devices and endotracheal tubes, and administration of intravenous drugs and solutions. Lack of adherence to the principles of asepsis during such procedures,[359] including use of common syringes[360,361] and contaminated infusion pumps,[359,362-364] and the assembly of equipment and solutions in advance of procedures,[316,360] have been associated with outbreaks of postoperative infections, including SSI. Recommendations for infection control practices in anesthesiology have been published.[212,365-367]

(2) Surgical technique

Excellent surgical technique is widely believed to reduce the risk of SSI.[26,49,179,180,368,369] Such techniques include maintaining effective hemostasis while preserving adequate blood supply, preventing hypothermia, gently handling tissues, avoiding inadvertent entries into a hollow viscus, removing devitalized (e.g., necrotic or charred) tissues, using drains and suture material appropriately, eradicating dead space, and appropriately managing the postoperative incision.

Any foreign body, including suture material, a prosthesis, or drain, may promote inflammation at the surgical site[94] and may increase the probability of SSI after otherwise benign levels of tissue contamination. Extensive research compares different types of suture material and their presumed relationships to SSI risk.[370-379] In general, monofilament sutures appear to have the lowest infection-promoting effects.[3,94,179,180]

A discussion of appropriate surgical drain use and details of drain placement exceed the scope of this document, but general points should be briefly noted. Drains placed through an operative incision increase incisional SSI risk.[380] Many authorities suggest placing drains through a separate incision distant from the operative incision.[283,381] It appears that SSI risk also decreases when closed suction drains are used rather than open drains.[174] Closed suction drains can effectively evacuate postoperative hematomas or seromas, but timing of drain removal is important. Bacterial colonization of initially sterile drain tracts increases with the duration of time the drain is left in place.[382]

Hypothermia in surgical patients, defined as a core body temperature below 36°C, may result from general anesthesia, exposure to cold, or intentional cooling such as is done to protect the myocardium and central nervous system during cardiac operations.[302,383,384] In one study of patients undergoing colorectal operations, hypothermia was associated with an increased SSI risk.[385] Mild hypothermia appears to increase incisional SSI risk by causing vasoconstriction, decreased delivery of oxygen to the wound space, and subsequent impairment of function of phagocytic leukocytes (i.e., neutrophils).[386-390] In animal models, supplemental oxygen administration has been shown to reverse the dysfunction of phagocytes in fresh incisions.[391] In recent human experiments, controlled local heating of incisions with an electrically powered bandage has been shown to improve tissue oxygenation.[392] Randomized clinical trials are needed to establish that measures which improve wound space oxygenation can reduce SSI risk.

4. Operative Characteristics: Postoperative Issues

a. Incision care

The type of postoperative incision care is determined by whether the incision is closed primarily (i.e., the skin edges are re-approximated at the end of the operation), left open to be closed later, or left open to heal by second intention. When a surgical incision is closed primarily, as most are, the incision is usually covered with a sterile dressing for 24 to 48 hours.[393,394] Beyond 48 hours, it is unclear whether an incision must be covered by a dressing or whether showering or bathing is detrimental to healing. When a surgical incision is left open at the skin level for a few days before it is closed (delayed primary closure), a surgeon has determined that it is likely to be contaminated or that the patient's condition prevents primary closure (e.g., edema at the site). When such is the case, the incision is packed with a sterile dressing. When a surgical incision is left open to heal by second intention, it is also packed with sterile moist gauze and covered with a sterile dressing. The American College of Surgeons, CDC, and others have recommended using sterile gloves and equipment (sterile technique) when changing dressings on any type of surgical incision.[180,395-397]

b. Discharge planning

In current practice, many patients are discharged very soon after their operation, before surgical incisions have fully healed.[398] The lack of optimum protocols for home incision care dictates that much of what is done at home by the patient, family, or home care agency practitioners must be individualized. The intent of discharge planning is to maintain integrity of the healing incision, educate the patient about the signs and symptoms of infection, and advise the patient about whom to contact to report any problems.

F. SSI SURVEILLANCE

Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk.[16,399,400] A successful surveillance program includes the use of epidemiologically sound infection definitions (Tables 1 and 2) and effective

TABLE 10
PHYSICAL STATUS CLASSIFICATION, AMERICAN SOCIETY OF ANESTHESIOLOGISTS*

Code	Patient's Preoperative Physical Status
1	Normally healthy patient
2	Patient with mild systemic disease
3	Patient with severe systemic disease that is not incapacitating
4	Patient with an incapacitating systemic disease that is a constant threat to life
5	Moribund patient who is not expected to survive for 24 hours with or without operation

* Reference 406.
Note: The above is the version of the ASA Physical Status Classification System that was current at the time of development of, and still is used in, the NNIS Risk Index. Meanwhile, the American Society of Anesthesiologists has revised their classification system; the most recent version is available at http://www.asahq.org/profinfo/physicalstatus.html.

surveillance methods, stratification of SSI rates according to risk factors associated with SSI development, and data feedback.[25]

1. SSI Risk Stratification

a. Concepts

Three categories of variables have proven to be reliable predictors of SSI risk: (1) those that estimate the intrinsic degree of microbial contamination of the surgical site, (2) those that measure the duration of an operation, and (3) those that serve as markers for host susceptibility.[25] A widely accepted scheme for classifying the degree of intrinsic microbial contamination of a surgical site was developed by the 1964 NAS/NRC Cooperative Research Study and modified in 1982 by CDC for use in SSI surveillance (Table 7).[2,94] In this scheme, a member of the surgical team classifies the patient's wound at the completion of the operation. Because of its ease of use and wide availability, the surgical wound classification has been used to predict SSI risk.[16,94,126,401-405] Some researchers have suggested that surgeons compare clean wound SSI rates with those of other surgeons.[16,399] However, two CDC efforts—the SENIC Project and the NNIS system—incorporated other predictor variables into SSI risk indices. These showed that even within the category of clean wounds, the SSI risk varied by risk category from 1.1% to 15.8% (SENIC) and from 1.0% to 5.4% (NNIS).[125,126] In addition, sometimes an incision is incorrectly classified by a surgical team member or not classified at all, calling into question the reliability of the classification. Therefore, reporting SSI rates stratified by wound class alone is not recommended.

Data on 10 variables collected in the SENIC Project were analyzed by using logistic regression modeling to develop a simple additive SSI risk index.[125] Four of these were found to be independently associated with SSI risk: (1) an abdominal operation, (2) an operation lasting >2 hours, (3) a surgical site with a wound classification of either contaminated or dirty/infected, and (4) an operation performed on a patient having ⩾3 discharge diagnoses. Each of these equally weighted factors contributes a point when present, such that the risk index values range from 0 to 4. By using these factors, the SENIC index predicted SSI risk twice as well as the traditional wound classification scheme alone.

The NNIS risk index is operation-specific and applied to prospectively collected surveillance data. The index values range from 0 to 3 points and are defined by three independent and equally weighted variables. One point is scored for each of the following when present: (1) American Society of Anesthesiologists (ASA) Physical Status Classification of >2 (Table 10), (2) either contaminated or dirty/infected wound classification (Table 7), and (3) length of operation >T hours, where T is the approximate 75th percentile of the duration of the specific operation being performed.[126] The ASA class replaced discharge diagnoses of the SENIC risk index as a surrogate for the patient's underlying severity of illness (host susceptibility)[406,407] and has the advantage of being readily available in the chart during the patient's hospital stay. Unlike SENIC's constant 2-hour cut-point for duration of operation, the operation-specific cut-points used in the NNIS risk index increase its discriminatory power compared to the SENIC index.[126]

b. Issues

Adjustment for variables known to confound rate estimates is critical if valid comparisons of SSI rates are to be made between surgeons or hospitals.[408] Risk stratification, as described above, has proven useful for this purpose, but relies on the ability of surveillance personnel to find and record data consistently and correctly. For the three variables used in the NNIS risk index, only one study has focused on how accurately any of them are recorded. Cardo et al. found that surgical team members' accuracy in assessing wound classification for general and trauma surgery was 88% (95% CI: 82%-94%).[409] However, there are sufficient ambiguities in the wound class definitions themselves to warrant concern about the reproducibility of Cardo's results. The accuracy of recording the duration of operation (i.e., time from skin incision to skin closure) and the ASA class has not been studied. In an unpublished report from the NNIS system, there was evidence that overreporting of high ASA class existed in some hospitals. Further validation of the reliability of the recorded risk index variables is needed.

Additionally, the NNIS risk index does not adequately discriminate the SSI risk for all types of operations.[27,410] It seems likely that a combination of risk factors specific to patients undergoing an operation will be more predictive. A

few studies have been performed to develop procedure-specific risk indices[218,411-414] and research in this area continues within CDC's NNIS system.

2. SSI Surveillance Methods

SSI surveillance methods used in both the SENIC Project and the NNIS system were designed for monitoring inpatients at acute-care hospitals. Over the past decade, the shift from inpatient to outpatient surgical care (also called ambulatory or day surgery) has been dramatic. It has been estimated that 75% of all operations in the United States will be performed in outpatient settings by the year 2000.[4] While it may be appropriate to use common definitions of SSI for inpatients and outpatients,[415] the types of operations monitored, the risk factors assessed, and the case-finding methods used may differ. New predictor variables may emerge from analyses of SSIs among outpatient surgery patients, which may lead to different ways of estimating SSI risk in this population.

The choice of which operations to monitor should be made jointly by surgeons and infection control personnel. Most hospitals do not have the resources to monitor all surgical patients all the time, nor is it likely that the same intensity of surveillance is necessary for certain low-risk procedures. Instead, hospitals should target surveillance efforts toward high-risk procedures.[416]

a. Inpatient SSI surveillance

Two methods, alone or together, have been used to identify inpatients with SSIs: (1) direct observation of the surgical site by the surgeon, trained nurse surveyor, or infection control personnel[16,97,399,402,409,417-420] and (2) indirect detection by infection control personnel through review of laboratory reports, patient records, and discussions with primary care providers.[15,84,399,402,404,409,418,421-427] The surgical literature suggests that direct observation of surgical sites is the most accurate method to detect SSIs, although sensitivity data are lacking.[16,399,402,417,418] Much of the SSI data reported in the infection control literature has been generated by indirect case-finding methods,[125,126,422,425,426,428-430] but some studies of direct methods also have been conducted.[97,409] Some studies use both methods of detection.[84,409,424,427,431] A study that focused solely on the sensitivity and specificity of SSIs detected by indirect methods found a sensitivity of 83.8% (95% CI: 75.7%-91.9%) and a specificity of 99.8% (95% CI: 99%-100%).[409] Another study showed that chart review triggered by a computer-generated report of antibiotic orders for post-cesarean section patients had a sensitivity of 89% for detecting endometritis.[432]

Indirect SSI detection can readily be performed by infection control personnel during surveillance rounds. The work includes gathering demographic, infection, surgical, and laboratory data on patients who have undergone operations of interest.[433] These data can be obtained from patients' medical records, including microbiology, histopathology, laboratory, and pharmacy data; radiology reports; and records from the operating room. Additionally, inpatient admissions, emergency room, and clinic visit records are sources of data for those postdischarge surgical patients who are readmitted or seek follow-up care.

The optimum frequency of SSI case-finding by either method is unknown and varies from daily to ⩽3 times per week, continuing until the patient is discharged from the hospital. Because duration of hospitalization is often very short, postdischarge SSI surveillance has become increasingly important to obtain accurate SSI rates (refer to "Postdischarge SSI Surveillance" section).

To calculate meaningful SSI rates, data must be collected on all patients undergoing the operations of interest (i.e., the population at risk). Because one of its purposes is to develop strategies for risk stratification, the NNIS system collects the following data on all surgical patients surveyed: operation date; NNIS operative procedure category;[434] surgeon identifier; patient identifier; age and sex; duration of operation; wound class; use of general anesthesia; ASA class; emergency; trauma; multiple procedures; endoscopic approach; and discharge date.[433] With the exception of discharge date, these data can be obtained manually from operating room logs or be electronically downloaded into surveillance software, thereby substantially reducing manual transcription and data entry errors.[433] Depending on the needs for risk-stratified SSI rates by personnel in infection control, surgery, and quality assurance, not all data elements may be pertinent for every type of operation. At minimum, however, variables found to be predictive of increased SSI risk should be collected (refer to "SSI Risk Stratification" section).

b. Postdischarge SSI surveillance

Between 12% and 84% of SSIs are detected after patients are discharged from the hospital.[98,337,402,428,435-454] At least two studies have shown that most SSIs become evident within 21 days after operation.[446,447] Since the length of postoperative hospitalization continues to decrease, many SSIs may not be detected for several weeks after discharge and may not require readmission to the operating hospital. Dependence solely on inpatient case-finding will result in underestimates of SSI rates for some operations (e.g., coronary artery bypass graft) (CDC/NNIS system, unpublished data, 1998). Any comparison of SSI rates must take into account whether case-finding included SSIs detected after discharge. For comparisons to be valid, even in the same institution over time, the postdischarge surveillance methods must be the same.

Postdischarge surveillance methods have been used with varying degrees of success for different procedures and among hospitals and include (1) direct examination of patients' wounds during follow-up visits to either surgery clinics or physicians' offices,[150,399,402,404,430,436,440,441,447,452,455] (2) review of medical records of surgery clinic patients,[404,430,439] (3) patient surveys by mail or telephone,[435,437,438,441,442,444,445,448,449,455-457] or (4) surgeon surveys by mail or telephone.[98,428,430,437-439,443,444,446,448,450,451,455] One study found that patients have difficulty assessing their own wounds for infection (52% specificity, 26% positive predictive value),[458] suggesting that data obtained by patient questionnaire may inaccurately represent actual SSI rates.

Recently, Sands et al. performed a computerized search of three databases to determine which best identified SSIs: ambulatory encounter records for diagnostic, testing, and treatment codes; pharmacy records for specific antimicrobial prescriptions; and administrative records for rehospitalizations and emergency room visits.[446] This study found that pharmacy records indicating a patient had received antimicrobial agents commonly used to treat soft tissue infections had the highest sensitivity (50%) and positive predictive value (19%), although even this approach alone was not very effective.

As integrated health information systems expand, tracking surgical patients through the entire course of care may become more feasible, practical, and effective. At this time, no consensus exists on which postdischarge surveillance methods are the most sensitive, specific, and practical. Methods chosen will necessarily reflect the hospital's unique mix of operations, personnel resources, and data needs.

c. Outpatient SSI surveillance

Both direct and indirect methods have been used to detect SSIs that complicate outpatient operations. One 8-year study of operations for hernia and varicose veins used home visits by district health nurses combined with a survey completed by the surgeon at the patient's 2-week postoperative clinic visit to identify SSIs.[459] While ascertainment was essentially 100%, this method is impractical for widespread implementation. High response rates have been obtained from questionnaires mailed to surgeons (72%->90%).[443,444,446,455,459-461] Response rates from telephone questionnaires administered to patients were more variable (38%,[444] 81%,[457] and 85%[455]), and response rates from questionnaires mailed to patients were quite low (15%[455] and 33%[446]). At this time, no single detection method can be recommended. Available resources and data needs determine which method(s) should be used and which operations should be monitored. Regardless of which detection method is used, it is recommended that the CDC NNIS definitions of SSI (Tables 1 and 2) be used without modification in the outpatient setting.

G. GUIDELINE EVALUATION PROCESS

The value of the HICPAC guidelines is determined by those who use them. To help assess that value, HICPAC is developing an evaluation tool to learn how guidelines meet user expectations, and how and when these guidelines are disseminated and implemented.

II. RECOMMENDATIONS FOR PREVENTION OF SURGICAL SITE INFECTION

A. RATIONALE

The Guideline for Prevention of Surgical Site Infection, 1999, provides recommendations concerning reduction of surgical site infection risk. Each recommendation is categorized on the basis of existing scientific data, theoretical rationale, and applicability. However, the previous CDC system for categorizing recommendations has been modified slightly.

Category I recommendations, including IA and IB, are those recommendations that are viewed as effective by HICPAC and experts in the fields of surgery, infectious diseases, and infection control. Both Category IA and IB recommendations are applicable for, and should be adopted by, all healthcare facilities; IA and IB recommendations differ only in the strength of the supporting scientific evidence.

Category II recommendations are supported by less scientific data than Category I recommendations; such recommendations may be appropriate for addressing specific nosocomial problems or specific patient populations.

No recommendation is offered for some practices, either because there is a lack of consensus regarding their efficacy or because the available scientific evidence is insufficient to support their adoption. For such unresolved issues, practitioners should use judgement to determine a policy regarding these practices within their organization. Recommendations that are based on federal regulation are denoted with an asterisk.

B. RANKINGS

Category IA. Strongly recommended for implementation and supported by well-designed experimental, clinical, or epidemiological studies.

Category IB. Strongly recommended for implementation and supported by some experimental, clinical, or epidemiological studies and strong theoretical rationale.

Category II. Suggested for implementation and supported by suggestive clinical or epidemiological studies or theoretical rationale.

No recommendation; unresolved issue. Practices for which insufficient evidence or no consensus regarding efficacy exists.

Practices required by federal regulation are denoted with an asterisk (*).

C. RECOMMENDATIONS

1. Preoperative

a. Preparation of the patient

1. Whenever possible, identify and treat all infections remote to the surgical site before elective operation and postpone elective operations on patients with remote site infections until the infection has resolved. *Category IA*

2. Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation. *Category IA*

3. If hair is removed, remove immediately before the operation, preferably with electric clippers. *Category IA*

4. Adequately control serum blood glucose levels in all diabetic patients and particularly avoid hyperglycemia perioperatively. *Category IB*

5. Encourage tobacco cessation. At minimum, instruct patients to abstain for at least 30 days before elective operation from smoking cigarettes, cigars, pipes, or any other form of tobacco consumption (e.g., chewing/dipping). *Category IB*

6. Do not withhold necessary blood products from surgical patients as a means to prevent SSI. *Category IB*

7. Require patients to shower or bathe with an antiseptic agent on at least the night before the operative day. *Category IB*

8. Thoroughly wash and clean at and around the incision site to remove gross contamination before performing antiseptic skin preparation. *Category IB*

9. Use an appropriate antiseptic agent for skin preparation (Table 6). *Category IB*

10. Apply preoperative antiseptic skin preparation in concentric circles moving toward the periphery. The prepared area must be large enough to extend the incision or create new incisions or drain sites, if necessary. *Category II*

11. Keep preoperative hospital stay as short as possible while allowing for adequate preoperative preparation of the patient. *Category II*

12. No recommendation to taper or discontinue systemic steroid use (when medically permissible) before elective operation. *Unresolved issue*

13. No recommendation to enhance nutritional support for surgical patients solely as a means to prevent SSI. *Unresolved issue*

14. No recommendation to preoperatively apply mupirocin to nares to prevent SSI. *Unresolved issue*

15. No recommendation to provide measures that enhance wound space oxygenation to prevent SSI. *Unresolved issue*

b. Hand/forearm antisepsis for surgical team members

1. Keep nails short and do not wear artificial nails. *Category IB*

2. Perform a preoperative surgical scrub for at least 2 to 5 minutes using an appropriate antiseptic (Table 6). Scrub the hands and forearms up to the elbows. *Category IB*

3. After performing the surgical scrub, keep hands up and away from the body (elbows in flexed position) so that water runs from the tips of the fingers toward the elbows. Dry hands with a sterile towel and don a sterile gown and gloves. *Category IB*

4. Clean underneath each fingernail prior to performing the first surgical scrub of the day. *Category II*

5. Do not wear hand or arm jewelry. *Category II*

6. No recommendation on wearing nail polish. *Unresolved Issue*

c. Management of infected or colonized surgical personnel

1. Educate and encourage surgical personnel who have signs and symptoms of a transmissible infectious illness to report conditions promptly to their supervisory and occupational health service personnel. *Category IB*

2. Develop well-defined policies concerning patient-care responsibilities when personnel have potentially transmissible infectious conditions. These policies should govern (a) personnel responsibility in using the health service and reporting illness, (b) work restrictions, and (c) clearance to resume work after an illness that required work restriction. The policies also should identify persons who have the authority to remove personnel from duty. *Category IB*

3. Obtain appropriate cultures from, and exclude from duty, surgical personnel who have draining skin lesions until infection has been ruled out or personnel have received adequate therapy and infection has resolved. *Category IB*

4. Do not routinely exclude surgical personnel who are colonized with organisms such as *S. aureus* (nose, hands, or other body site) or group A *Streptococcus,* unless such personnel have been linked epidemiologically to dissemination of the organism in the healthcare setting. *Category IB*

d. Antimicrobial prophylaxis

1. Administer a prophylactic antimicrobial agent only when indicated, and select it based on its efficacy against the most common pathogens causing SSI for a specific operation (Table 4) and published recommendations.[266,268,269,282-284] *Category IA*

2. Administer by the intravenous route the initial dose of prophylactic antimicrobial agent, timed such that a bactericidal concentration of the drug is established in serum and tissues when the incision is made. Maintain therapeutic levels of the agent in serum and tissues throughout the operation and until, at most, a few hours after the incision is closed in the operating room. *Category IA*

3. Before elective colorectal operations in addition to d2 above, mechanically prepare the colon by use of enemas and cathartic agents. Administer nonabsorbable oral antimicrobial agents in divided doses on the day before the operation. *Category IA*

4. For high-risk cesarean section, administer the prophylactic antimicrobial agent immediately after the umbilical cord is clamped. *Category IA*

5. Do not routinely use vancomycin for antimicrobial prophylaxis. *Category IB*

2. Intraoperative

a. Ventilation

1. Maintain positive-pressure ventilation in the operating room with respect to the corridors and adjacent areas. *Category IB*

2. Maintain a minimum of 15 air changes per hour, of which at least 3 should be fresh air. *Category IB*

3. Filter all air, recirculated and fresh, through the appropriate filters per the American Institute of Architects' recommendations.[299] *Category IB*

4. Introduce all air at the ceiling, and exhaust near the floor. *Category IB*

5. Do not use UV radiation in the operating room to prevent SSI. *Category IB*

6. Keep operating room doors closed except as needed for passage of equipment, personnel, and the patient. *Category IB*

7. Consider performing orthopedic implant operations in operating rooms supplied with ultraclean air. *Category II*

8. Limit the number of personnel entering the operating room to necessary personnel. *Category II*

b. Cleaning and disinfection of environmental surfaces

1. When visible soiling or contamination with blood or other body fluids of surfaces or equipment occurs during an operation, use an EPA-approved hospital disinfectant to clean the affected areas before the next operation. *Category IB**

2. Do not perform special cleaning or closing of operating rooms after contaminated or dirty operations. *Category IB*

3. Do not use tacky mats at the entrance to the operating room suite or individual operating rooms for infection control. *Category IB*

4. Wet vacuum the operating room floor after the last operation of the day or night with an EPA-approved hospital disinfectant. *Category II*

5. No recommendation on disinfecting environmental surfaces or equipment used in operating rooms between operations in the absence of visible soiling. *Unresolved issue*

c. Microbiologic sampling

1. Do not perform routine environmental sampling of the operating room. Perform microbiologic sampling of operating room environmental surfaces or air only as part of an epidemiologic investigation. *Category IB*

d. Sterilization of surgical instruments

1. Sterilize all surgical instruments according to published guidelines.[212,299,314,321] *Category IB*

2. Perform flash sterilization only for patient care items that will be used immediately (e.g., to reprocess an inadvertently dropped instrument). Do not use flash sterilization for reasons of convenience, as an alternative to purchasing additional instrument sets, or to save time. *Category IB*

e. Surgical attire and drapes

1. Wear a surgical mask that fully covers the mouth and nose when entering the operating room if an operation is about to begin or already under way, or if sterile instruments are exposed. Wear the mask throughout the operation. *Category IB**

2. Wear a cap or hood to fully cover hair on the head and face when entering the operating room. *Category IB**

3. Do not wear shoe covers for the prevention of SSI. *Category IB**

4. Wear sterile gloves if a scrubbed surgical team member. Put on gloves after donning a sterile gown. *Category IB**

5. Use surgical gowns and drapes that are effective barriers when wet (i.e., materials that resist liquid penetration). *Category IB*

6. Change scrub suits that are visibly soiled, contaminated, and/or penetrated by blood or other potentially infectious materials. *Category IB**

7. No recommendations on how or where to launder scrub suits, on restricting use of scrub suits to the operating suite, or for covering scrub suits when out of the operating suite. *Unresolved issue*

f. Asepsis and surgical technique

1. Adhere to principles of asepsis when placing intravascular devices (e.g., central venous catheters), spinal or epidural anesthesia catheters, or when dispensing and administering intravenous drugs. *Category IA*

2. Assemble sterile equipment and solutions immediately prior to use. *Category II*

3. Handle tissue gently, maintain effective hemostasis, minimize devitalized tissue and foreign bodies (i.e., sutures, charred tissues, necrotic debris), and eradicate dead space at the surgical site. *Category IB*

4. Use delayed primary skin closure or leave an incision open to heal by second intention if the surgeon considers the surgical site to be heavily contaminated (e.g., Class III and Class IV). *Category IB*

5. If drainage is necessary, use a closed suction drain. Place a drain through a separate incision distant from the operative incision. Remove the drain as soon as possible. *Category IB*

3. Postoperative incision care

a. Protect with a sterile dressing for 24 to 48 hours postoperatively an incision that has been closed primarily. *Category IB*

b. Wash hands before and after dressing changes and any contact with the surgical site. *Category IB*

c. When an incision dressing must be changed, use sterile technique. *Category II*

d. Educate the patient and family regarding proper incision care, symptoms of SSI, and the need to report such symptoms. *Category II*

e. No recommendation to cover an incision closed primarily beyond 48 hours, nor on the appropriate time to shower or bathe with an uncovered incision. *Unresolved issue*

4. Surveillance

a. Use CDC definitions of SSI (Table 1) without modification for identifying SSI among surgical inpatients and outpatients. *Category IB*

b. For inpatient case-finding (including readmissions), use direct prospective observation, indirect prospective detection, or a combination of both direct and indirect methods for the duration of the patient's hospitalization. *Category IB*

c. When postdischarge surveillance is performed for detecting SSI following certain operations (e.g., coronary artery bypass graft), use a method that accommodates available resources and data needs. *Category II*

d. For outpatient case-finding, use a method that accommodates available resources and data needs. *Category IB*

e. Assign the surgical wound classification upon completion of an operation. A surgical team member should make the assignment. *Category II*

f. For each patient undergoing an operation chosen for surveillance, record those variables shown to be associated with increased SSI risk (e.g., surgical wound class, ASA class, and duration of operation). *Category IB*

g. Periodically calculate operation-specific SSI rates

** Federal regulation: OSHA.*

stratified by variables shown to be associated with increased SSI risk (e.g., NNIS risk index). *Category IB*

h. Report appropriately stratified, operation-specific SSI rates to surgical team members. The optimum frequency and format for such rate computations will be determined by stratified case-load sizes (denominators) and the objectives of local, continuous quality improvement initiatives. *Category IB*

i. No recommendation to make available to the infection control committee coded surgeon-specific data. *Unresolved issue*

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An APIC Guide

2010

Guide to the Elimination of Orthopedic Surgical Site Infections

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APIC's mission is to improve health and patient safety by reducing risks of infection and other adverse outcomes. The Association's more than 13,000 members have primary responsibility for infection prevention, control, and hospital epidemiology in healthcare settings around the globe. APIC's members are nurses, epidemiologists, physicians, microbiologists, clinical pathologists, laboratory technologists, and public health professionals. APIC advances its mission through education, research, consultation, collaboration, public policy, practice guidance, and credentialing

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On the Cover:
Cover image courtesy of CDC/ Jeff Hageman, M.H.S.
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This 2005 scanning electron micrograph (SEM) depicted numerous clumps of methicillin-resistant *Staphylococcus aureus* bacteria, commonly referred to by the acronym, MRSA; Magnified 2381x.

Recently recognized outbreaks, or clusters of MRSA in community settings have been associated with strains that have some unique microbiologic and genetic properties, compared with the traditional hospital-based MRSA strains, which suggests some biologic properties, e.g., virulence factors like toxins, may allow the community strains to spread more easily, or cause more skin disease. A common strain named USA300-0114 has caused many such outbreaks in the United States. See PHIL 7823 for a black and white version of this micrograph.

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Guide Overview

The purpose of this guide is to provide practical tools, strategies and resources for infection preventionists (IPs), care providers, surgical staff and quality improvement teams to use in their efforts to eliminate surgical site infections (SSIs) in orthopedic surgery.

Scope

This guide focuses on orthopedic surgeries in clean, primarily elective cases, with a major emphasis on joint replacements. However, the tools, protocols and general information are also applicable to a variety of other orthopedic surgeries in both inpatient and outpatient settings. Because orthopedic surgery is performed in a variety of inpatient and outpatient settings, the need for increased vigilance, strict adherence to aseptic technique, attention to adequacy of reprocessing, and management of intraoperative breaches of sterile technique are vitally important to ensure a safe and consistent standard of care. Breaches of sterile technique, inadequate sterilization of equipment and lack of adherence to aseptic technique have been associated with outbreaks of SSIs.[1]

Several references and regulatory issues discussed in this guide pertain to the United States. However, many of the principles and practices are applicable to the global setting. Discussion of products outside the U.S. should comply with that jurisdiction's relevant licensing and regulatory authority requirements, which may be different from those of the U.S. Food and Drug Administration (FDA).

Key Concepts

An effective facility-wide infection prevention and control program is composed of many components and interventions that can reduce the risk of infection in surgery patients. This includes an understanding of the surgical population and the associated risk factors, effective methods for case finding, expertise in the analysis of data, effective communication of outcomes, and implementation of evidenced-based strategies to improve outcomes. Central to this theme is collaboration. In order to ensure patient safety and optimum patient outcomes, IPs, surgeons, perioperative staff, nurses, and all members of the healthcare team must work together to implement evidence-based practices that minimize the risk of infection.

Background

Klevens and others reported that in 2002, approximately 20% of total healthcare-associated infections (HAIs) were SSIs, making this the second most common HAI in U.S. hospitals. This report also estimates that 8,205 deaths occur from SSIs annually.[2] The Agency for Healthcare Research and Quality (AHRQ) reported that more than one million knee and hip arthroplasty surgeries were performed in hospitals in the United States in 2008.[3] This number, along with other orthopedic procedures, represents a significant number of bone and joint surgeries done in the United States each year. The most recent National Healthcare Safety Network (NHSN) report includes data from 2006 to 2008. This report published knee replacement postoperative infection rates ranging from 0.68% to 1.60%, depending on patient risk, and hip replacement infection rates from 0.67% to 2.4%.[4] If these rates were applied to all of the hip and knee replacements done in the U.S., we could estimate that somewhere between 6,000 and 20,000 SSIs occur annually in hip and knee replacements alone. Estimates of the total number of patients who have SSIs following all orthopedic surgery is somewhere between 31,000 and 35,000. One study estimated that orthopedic SSIs prolong total hospital stays by a median of two weeks per patient, approximately double readmission rates, and increase healthcare costs by more than 300%. Moreover, patients with orthopedic SSIs have substantially greater physical limitations and significant reductions in their quality of life.[5] Infectious complications may range from superficial infections to deep and organ-space infections, many of which may be associated with increased mortality.

State and Federal Initiatives

Consumer demand for public reporting of healthcare quality data has increased since the 1999 publication of the Institute of Medicine's *To Err is Human: Building a Safer Health System*.[6] The report was based upon analysis of multiple studies by a variety of organizations and concluded that between 44,000 to 98,000 people die each year as a result of preventable events such as medication errors, surgical complications and infections. Subsequently, there was demand for greater transparency and a concerted effort to reduce and eliminate HAIs . The development of an HAI is no longer considered an inevitable consequence of healthcare.

After years of debate on both the federal and state levels, mandatory public reporting of HAIs has become a reality in an increasingly large number of states. Additionally, the department of Health and Human Services (HHS) has set specific five-year targets for reducing the incidence of selected HAIs in acute care hospitals. These targets, along with a series of proposed action steps, were published in the *HHS Action Plan to Prevent Healthcare-Associated Infections*. (www.hhs.gov/ophs/initiatives/hai/actionplan/index.html). The campaign targeted the four categories of infections that account for approximately three-quarters of HAIs in the acute care hospital setting:

1. SSIs
2. central line-associated bloodstream infections (CLABSIs)
3. ventilator-associated pneumonia (VAP)
4. catheter-associated urinary tract infections (CAUTI)

Clostridium difficile disease (CDAD) and methicillin-resistant *Staphylococcus aureus* (MRSA) have also been added to the priority list. Additionally, further work will include Ambulatory Surgery Centers (ASCs) as part of the Tier Two Action Plan.

On July 30, 2010, a rule released by the Centers for Medicare & Medicaid Services (CMS) laid out HAI reporting requirements for Medicare eligible hospitals that participate in CMS's pay-for-reporting program. More than 3,500 hospitals will be required to use the U.S. Centers for Disease Control and Prevention (CDC)'s NHSN to report CLABSI and SSI data to CMS. The SSI reporting will begin October 2012 for 2014 payment. Specifics related to procedures have not yet been determined. Nevertheless, it is clear that prevention of SSIs is a top clinical, administrative and political priority, and that orthopedic infections comprise a large portion of these infections.

Incidence, Scope & Epidemiology

Incidence of SSIs Following Hip, Knee, and Spine Procedures

According to the NHSN report, a large U.S. database for HAI aggregation and comparison report titled: "Data Summary for 2006 through 2008," issued December 2009, SSI rates for hip replacement, knee replacement, open fracture reduction, spinal fusion, and laminectomy procedures are as follows:

Table 1: Pooled means of SSI rates by operative procedure and risk index categories, 2006 through 2008[7]

Procedure	Inpatient or Outpatient	Risk Index Category	Number of Procedures	Number of SSIs	Pooled Mean
Spinal fusion	Inpatient	0	20,059	140	0.70
Spinal fusion	Inpatient	1	16,640	306	1.84
Spinal fusion	Inpatient	2,3	4,511	187	4.15
Open reduction of fracture	Inpatient	0	3,600	40	1.11
Open reduction of fracture	Inpatient	1	5,629	100	1.78
Open reduction of fracture	Inpatient	2,3	1,249	42	3.36
Hip prosthesis	Inpatient	0	49,576	334	0.67
Hip prosthesis	Inpatient	1	65,046	938	1.44
Hip prosthesis	Inpatient	2,3	15,769	379	2.40
Knee prosthesis	Inpatient	0	70,675	409	0.58
Knee prosthesis	Inpatient	1	79,653	786	0.99
Knee prosthesis	Inpatient	2,3	20,855	333	1.60
Laminectomy	Inpatient	0	20,972	150	0.72
Laminectomy	Inpatient	1	15,054	166	1.10
Laminectomy	Inpatient	2,3	4,051	93	2.30
Knee prosthesis	Outpatient	0,1,2,3	16	0	0.00
Laminectomy	Outpatient	0,1,2,3	901	7	0.78

Research Related to Incidence, Morbidity, Mortality, and Cost

SSIs following clean orthopedic procedures, such as joint replacement and certain spinal procedures, have become increasingly rare since evidence-based practices related to skin preparation, surgical technique, and antibiotic prophylaxis have become the accepted standard of care in orthopedic surgery.

However, the adverse outcome of SSIs related to a clean orthopedic surgical procedure continues to be associated with significant morbidity, cost, and even mortality. The patient's functional status may also be adversely affected by an orthopedic SSI.

Various researchers have published data related to incidence, morbidity, mortality, and cost. Many reports describe outcomes for a specific orthopedic procedure, but some include a variety of procedures in their study.

Pollard et al. determined that hip fracture patients, treated with either fixation or hemiarthroplasty, developed infection-accrued costs three times greater than those of non-infected control patients ($38,000 versus $11,255). Costs were also higher for infections caused by MRSA as opposed to methicillin-susceptible strains. Although not

statistically significant, there was a decreased likelihood of patients with infection surviving to discharge from the hospital. Of borderline significance was the finding that patients with infection were less likely to return to their pre-fracture residence.[8]

Using a multivariate logistic regression analysis, Veeravagu et al. studied patients undergoing spinal decompression and fusion. In a study of 24,774 patients' data from the Veteran's Administration Surgical Care Improvement Project (SCIP) database, an incidence rate of 3.04% was calculated. Other findings included an extended hospital stay (7.12 days for infected patients versus 4.20 days for non-infected controls), increased 30-day mortality rate (1.06% versus 0.5%), increased complication rate (1.24% versus 0.05%) and an increased return to surgery rate (37% versus 2.45%).[9]

Kuper, in 2008, published a literature review of research articles related to total knee and hip replacement SSIs. His findings include an annual cost of total joint replacement infections in the U.S. of $250 million. Cost of revision of a total joint due to infection is 2.8 times higher than cost of revision for aseptic loosening, and 4.8 times higher than costs associated with primary total hip arthroplasty. The cost of total knee arthroplasty revision due to infection ranges from $15,000 to $30,000. Total hip arthroplasty revision due to infection results in significantly more hospitalizations, total length of stay, number of operative procedures, outpatient visits and charges, and additional complications than revision due to aseptic loosening of the prosthesis.[10]

Lee et al. studied outcomes for a variety of orthopedic procedures, including hip and knee replacement, open reduction of fracture, other joint replacement, spinal fusion and laminectomy. Patients older than 64 years of age were included in her two-nested case control study, and infections were either deep incisional or organ space, per CDC definitions, requiring operative debridement. Of the 15,218 procedures reviewed, 169 infections were studied. There were 171 controls. Statistically significant findings included a higher one-year postoperative mortality (17% versus 4%), increased length of stay, including readmission within 90 days of surgery (13 versus four days), and a mean of 9.31 days of hospitalization attributable to infection.[11]

Olsen et al. conducted a retrospective case control study of patients who had either laminectomy or spinal fusion procedures. Forty-one patients with SSI or meningitis were compared to 178 uninfected patients. Of the patients with SSI, all received additional antibiotic therapy, 30 (77%) underwent re-operation due to their infection, and 30 (77%) were re-hospitalized at least once for wound care treatment. The mean readmission length of stay was 8.5 days (mean 6 days, range 0-45 days).[12]

Whitehouse et al. studied patients undergoing a variety of orthopedic procedures, including open reduction of fracture, fusion, laminectomy and joint replacement. The methodology used was a pairwise matched (1:1) case-control study within a cohort. Of 59 case patients, 11 (19%) were patients who had undergone joint replacement surgery. Findings that reached statistical significance included increased median initial length of stay, total number of hospitalizations, number of surgical procedures, total length of stay, and cost. Although the mortality rate was higher among patients who experienced infection, that finding did not achieve statistical significance. Whitehouse also addressed the quality of life issue, using a questionnaire that was completed by 62% of study participants. Patients with SSIs reported substantial reductions in the quality of life measures one year after the initial procedure, compared to non-infected control patients.[13]

Partanen studied deep wound infections in patients who underwent hip procedures, including repair with screws, hemiarthroplasty, total arthroplasty, and gamma nail repair. Of 2,276 patients older than 50 years of age, 29 (1.3%) experienced deep infection requiring surgical revision. These cases were matched with controls who did not experience infection. Greater rates of impaired function and mortality were noted, although neither of these findings achieved statistical significance.[14]

Lentino reported an estimated cost of treating an infected arthroplasty of more than $50,000 and a mortality rate that was double that of uninfected patients during the first three months following arthroplasty.[15]

Wilson reviewed infection rates in 125 English hospitals from April 2004 through March 2005 and noted an infection rate of 1.26% following total hip replacement procedures and a rate of 4.06% following hemiparthroplasty. Of statistical significance was the finding that SSI risk was greater following revision procedures than following the primary operation.[16]

Epidemiology of, and Risk Factors for, Orthopedic SSI

Epidemiology is defined as the study of health-related events in defined populations, observing specific illnesses and conditions and the exposures and host factors that may be associated with their occurrence. The diseases or conditions may be infectious or non-infectious.[17] Epidemiologic investigations of infectious diseases can lead to a better understanding of the pathogenesis of infection, and ultimately to improved and evidence-based prevention and control strategies.

The rates of SSI following various orthopedic procedures appear to be increased when certain risk factors are present. Risk factors can be either patient- or procedure-specific, and may be modifiable or non-modifiable.

With regard to clean spinal procedures, risk factors that have been associated with increased SSI include estimated blood loss of greater than one liter, previous SSI at the operative site, diabetes, obesity, longer procedure times (more than five hours), current smoking, ASA score of three or more, weight loss, dependent functional status, preoperative hematocrit of less than 36, disseminated cancer, elevated preoperative or postoperative serum glucose level, suboptimal timing of antibiotic prophylaxis, and two or more surgical residents participating in the operative procedure. Additionally, posterior approach or combined anterior/posterior approach were associated with higher rates of infection.[18,19,20,21]

For knee replacement procedures, factors associated with increased risk of postoperative wound infection include male gender, rheumatoid arthritis or fracture as indication for arthroplasty, low volume of cases performed by the operating surgeon, morbid obesity, and diabetes.[22,23,24]

Risk factors associated with higher rates of infections following clean hip procedures include undergoing arthroplasty surgery in a hospital with low volumes of arthroplasty procedures and prolonged wound drainage following the procedure.[25,26] Edwards, in a 2008 study conducted in England, found no statistically significant preoperative risk factors for infection following hip surgery.[27]

Various researchers have studied infection rates in both hip and knee procedures. The factors identified that are associated with increased risk of infection in either of these procedures are diabetes and greater number of medical comorbidities (at least three).[28,29]

A 2010 study of orthopedic procedures in general demonstrated that nasal carriage of *Staphylococcus aureus* increases the risk of *Staphylococcus aureus* wound infection following orthopedic surgery[30] and that admission from a healthcare facility increases the risk of orthopedic SSI.[31]

In summary, a variety of patient or host- and procedure-associated factors appear to be associated with increased risk of infection following orthopedic surgery. The following table summarizes those factors, including potential for modification of each factor:

Table 2: Modifiable and Non-Modifiable Host- and Procedure-Related Orthopedic SSI Risk Factors

	Modifiable	Non-Modifiable
Host-specific	Obesity Current smoking Hematocrit < 36 Elevated preoperative or postoperative serum glucose Nasal carriage of *Staphylococcus aureus* (as risk factor for *Staphylococcus aureus* infection)	Diabetes Male gender Rheumatoid arthritis ASA score of 3 or greater Recent weight loss Dependent functional status Disseminated cancer Admission from a healthcare facility
Procedure-specific	Estimated blood loss of > 1 liter* Longer procedure time* Suboptimal timing of prophylactic antibiotic Two or more surgical residents participating in procedure Prolonged wound drainage* Spinal procedure via the posterior or the anterior/posterior approach	Estimated blood loss of > 1 liter* Longer procedure time* Previous infection at site Prolonged wound drainage* Low volume of procedures performed at hospital Low volume of procedures performed by surgeon

*These factors may be modifiable if related to surgical technique or non-modifiable if related to a specific and discrete operation. For example, if a particular surgeon consistently has surgical procedure times that are significantly longer than the NHSN average for that procedure, the risk factor of procedure time could be modifiable with changes in the surgeon's practice. However, if the procedure duration of one discrete operation is prolonged due to intraoperative complications, then the risk factor of longer procedure time would be considered non-modifiable for that particular operation.

Most infections at orthopedic surgical sites are diagnosed within the first two postoperative years. Indeed, to be considered an SSI according to CDC NHSN guidelines, the diagnosis must be made within 12 months of the procedure.

Kurtz et al. reviewed a sample of Medicare patients who underwent total knee replacement surgery and noted an infection incidence rate of 1.55% within the first two years after surgery; between years two and 10, the incidence rate was 0.46%.[32]

The same research group reported similar findings in total hip arthroplasty patients a year earlier, using Medicare data as well. The two-year infection rate among this population was 1.63%; for years two through 10, the rate fell to 0.59%.[33]

Pathogenesis

Pathogenesis and Microbiology of SSIs, including Clean Orthopedic Procedures

For all surgical procedures, infection at the operative area has always been recognized as a potential complication. With the advent of antibiotics in the 1940s, this dreaded adverse outcome became less common (or more treatable) and, with recent advances in infection prevention measures, including standardized antimicrobial prophylaxis protocols, even greater reductions in SSI rates have resulted. Nevertheless, infection at the operative site remains a potentially devastating, even fatal, event.

An SSI is similar to all infections, in that it is typically multi-factorial in origin. The occurrence of a postoperative infection is dependent upon the interaction of patient- or host-related factors, such as host immunity, nutritional status, comorbid conditions; procedure-related factors, including the presence of foreign bodies and tissue trauma associated with the procedure; microbial properties, such as ability to adhere to tissue or foreign bodies and innate virulence, and appropriate and timely antimicrobial prophylaxis.

Surgical wounds are classified by the degree of bacterial contamination (or microbial load) at the time of the procedure. Greater microbial loads result in increased infection risk. The CDC classifies wounds as clean, clean-contaminated, contaminated, or dirty in the NHSN patient safety component, SSI data collection. Orthopedic surgical wounds addressed in this document would almost always be classified as clean.

Table 3: Surgical Wound Classification[34]

Classification	Wound Parameters
Clean	• An uninfected operative wound in which no inflammation is encountered and there is no entry into the respiratory, alimentary, genital, or urinary tract • Clean wounds are closed primarily and, if necessary, drained with closed drainage
Clean-contaminated	• Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination • No evidence of infection is encountered or major break in technique occurs
Contaminated	• Open, fresh accidental wounds • Operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract • Incisions in which acute, non-purulent inflammation is encountered
Dirty or infected	• Old traumatic wounds with retained devitalized tissue • Existing clinical infection or perforated viscera is encountered • This definition suggests that the organisms causing postoperative infection were present in the operative field prior to the procedure

Contamination of the surgical wound is almost unavoidable despite the best efforts of the surgical team. The goal in surgical antisepsis is minimization of the bacterial load to the greatest degree possible. Lack of adherence to asepsis by scrubbed personnel or those in close proximity to the sterile field can be a risk factor for development of an SSI.[35] Quantitatively, it has been shown that if a surgical site is contaminated with >105 (100,000) microorganisms per gram of tissue, the risk of SSI is markedly increased. However, the dose of contaminating microorganisms required to produce infection may be much lower when foreign material (i.e.,implants or sutures) is present at the site (i.e., 102 or 100 microorganisms per gram of tissue).[36]

Preparation of the patient's skin is a significant intervention taken to reduce bacterial contamination. However, since as much as 20% of the skin's bacteria are resident (living beneath the epidermal layer of skin, in appendages such as hair follicles and sebaceous glands), any incision made through the skin has the potential of carrying some of this bacterial load directly to the operative site.[37,38] According to the 1999 CDC Guideline for Prevention of Surgical Site Infections, for most SSIs, the source of pathogens is the endogenous flora of the patient's skin, mucous membranes or hollow visera (gastro-intestinal tract). Bacteria can be found on all areas of the body, but are found in significantly higher numbers in those moist areas that include the axilla, skin folds, webs of the feet, perineal area, and peri-anal area.[39]

Environmental factors in the operating environment can play a role in the pathogenesis of infection. The microbial load in the surgical suite is directly proportionate to the number of people in the room.[40] Additionally; nasal carriage of S. aureus has been identified as a major risk factor for wound infections after both orthopedic total joint and cardiac surgery. A study published in 2004 by Wertheim, et al demonstrated that genotyping revealed that 80 percent of S. aureus bacteremia infections were caused by the patient's own clonal nasal flora.[41] In a study done in 2002 by Kalmeijer, et al, it was determined that high-level nasal carriage of S. aureus was the most important and only significant independent risk factor for developing SSI with S. aureus following orthopedic surgery with prosthetic implants.[42]

Investigation of an outbreak of SSIs in knee replacement surgeries in a single operating room, described by Babkin et al. in 2007, implicated environmental factors, including multiple entrances to the operating room with frequent movement through them during procedures; non-standardized horizontal-flow air conditioning installed above the main door to the room; and utilization of a washing sink just beyond the main door for cleaning of instruments during procedures. When the sink was removed, the air conditioning unit was disconnected, and the door was locked during procedures, the infection rate fell from 5.6% to 2.2%.[43] Likewise, issues such as contamination or inadequate sterilization of instruments, are also an important risk factor for development of infection. Inadequate sterilization of surgical instruments has resulted in SSI outbreaks.[44]

Microbiologic and Virulence Factors

Orthopedic surgery frequently involves placement of a foreign body, either a prosthetic joint, joint components, or hardware used to stabilize bony structures or repair fractures. These implants can facilitate infection by either locally introduced contamination or by hematogenous spread of microorganisms. Locally introduced contamination occurs during the perioperative period. Hematogenous spread of microorganisms is typically an event that happens following the perioperative period, and is associated with primary bacteremia or infection at a distant site with secondary bacteremia, leading to microbial seeding of the prosthetic joint.

Infections that arise due to local contamination are the result of an infection adjacent to the prosthesis or to contamination during the surgical procedure. Delay in wound healing predisposes a patient to wound infection. Ischemic necrosis, infected wound hematomas, superficial wound infection, and suture abscesses may be precursors of deeper SSI. Physical barriers that normally protect the deep joint are interrupted during the surgical procedure, increasing the risk of infection.

Bloodstream infection can result in joint replacement wound infection via the hematogenous route. Thus, a primary bacteremia or an infection at a distant site with secondary bacteremia creates a risk for periprosthetic SSI. It is estimated that 20% to 40% of prosthetic joint infections arise via the hematogenous route.

One researcher cited an SSI rate following total knee replacement surgery attributed to hematogenous spread of at least 50%.[45] For infections that develop more than one year after the procedure, the hematogenous route of infection should be strongly considered.[46]

The specific microbiology of an orthopedic wound infection has an impact on the severity, onset, and even the outcome of infection due to differences in rates of growth, ability to survive in the host environment, and virulence. Biofilm plays a significant role in the pathogenesis of infection, including orthopedic SSIs. Once microorganisms have made contact and formed an attachment with a living host or non-living surface or object, development of a biofilm can take place.[47] Bacteria living in a biofilm can have significantly different properties from free-floating bacteria, as the dense extracellular matrix of biofilm and the outer layer of cells may protect the bacteria from antibiotics and normal host defense mechanisms of the white blood cells, such as phagocytosis.

Microorganisms may contain or produce toxins and other substances that increase their ability to invade a host, produce damage within the host, or survive on or in host tissue. Characteristics of the specific infecting microorganism, particularly related to virulence as well as the ability to adhere to a foreign object such as an implantable device, play a role in the presentation of infection. *Staphylococcus aureus*, one of the most common organisms associated with orthopedic SSIs, can possess a high degree of virulence due to its ability to produce toxins and to develop resistance to many classes of antimicrobial agents. Infections caused by this organism are associated with more rapid onset and poorer outcomes.

Coagulase-negative *Staphylococcus*, another common agent associated with orthopedic infection, readily develops antimicrobial resistance, but often presents later in the postoperative period.

Pseudomonas aeruginosa may be introduced into the bone or joint via direct inoculation during the surgical procedure, hematogenous spread, or spread from a contiguous infection. *Pseudomonas* infection often has a delayed presentation and may become a chronic infection following fracture repair.

Gram-positive organisms predominate in orthopedic SSIs, with coagulase-negative *Staphylococcus* historically being the most common microorganism, followed by *Staphylococcus aureus*, both methicillin-resistant and susceptible. Other organisms that have been isolated from surgical wounds include *Pseudomonas*, *Proteus spp.*, coliforms, enterococci, Group C *Streptococci*, *Serratia marsescens*, corynebacterium, micrococcus, propionibacterium, anaerobes, yeast, mycobacterium, *Listeria*, bacillus, and other gram-negative bacteria. Candida is a rare causative agent in orthopedic SSIs, accounting for approximately 1% of infections.

Distribution of pathogens related to orthopedic surgery is summarized below:
From table 5 Distribution of Selected Pathogens Associated with Cases of Surgical Site Infection Reported to the National Healthcare Safety Network, January 2006-October 2007, by type of Surgery. NHSN Update on Antimicrobial Resistance 2006-2007;1001.[48]

Pathogen	Orthopedic surgery (N = 963)	Pathogen	Orthopedic surgery (N = 963)
Coagulase-negative Staphylococcus	173 (15.3)	Escherichia coli	34 (3.0)
Staphylococcus aureus	548 (48.6)	Pseudomonas aeruginosa	38 (3.4)
Enterococcus Species		Klebsiella pneumoniae	14 (1.2)
E. faecalis	57 (5.1)	Enterobacter species	37 (3.3)
E. faecium	13 (1.2)	Acinetobacter baumannii	10 (0.9)
Not specified	34 (3.0)	Klebsiella oxytoca	5 (0.4)
Candida Species		Total number of pathogenic isolates by surgery type	1,128
Candida albicans	2 (0.2)		
Other or not specified	2 (0.2)		

Staphylococcus aureus was also identified as the major pathogen in hip replacement surgery, as reported in the New York State 2009 Hospital-Acquired Infection Report. There were 186 isolates of *Staphylococcus aureus* reported. This organism accounted for 59.8% of the total isolates. Of these 186 isolates, 102 were methicillin-resistant (55% of all staph, and 32.8% of total pathogens).[49]

Surgical Wound Definitions and Diagnosis

SSIs are well defined by the CDC's NHSN. Surgical procedures can be classified as either inpatient or outpatient. For inclusion in the NHSN database, the surgical procedure must involve an incision through skin or mucous membrane, be performed in an operating room, and be included in the list of NHSN operative procedures. These classifications, although confined to the U.S. NHSN system, have been adapted and widely adopted globally.

Wounds following surgical procedures are classified as superficial incisional, deep incisional, or organ/space, depending upon the tissue or body part involved.

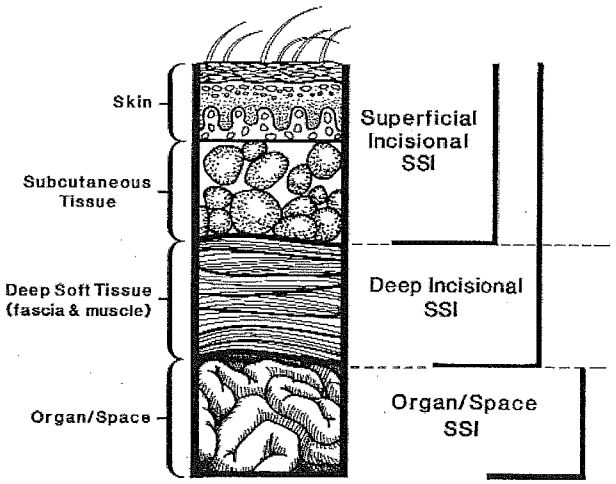


Figure 1: Layers of skin and deep space.

Superficial incisional SSIs must meet the following criteria:

infection occurs within 30 days after the operative procedure
and
involves only skin and subcutaneous tissue of the incision
and
patient has at least one of the following:

a. purulent drainage from the superficial incision
b. organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision
c. at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness or heat, and superficial incision is deliberately opened by surgeon, and is culture-positive or is not cultured (a culture-negative finding does not meet this criterion)
d. diagnosis of superficial incisional surgical by the surgeon or attending physician

Deep incisional SSIs must meet the following criteria:

infection occurs within 30 days after the operative procedure if no implant is left in place, or within one year if implant is in place and the infection appears to be related to the operative procedure
and
involves deep soft tissues (e.g., fascial and muscle layers of the incision)
and
patient has at least one of the following:

a. purulent drainage from the deep incision but not from the organ/space component of the surgical site

b. a deep incision spontaneously dehisces or is deliberately opened by a surgeon and is culture-positive or not cultured when the patient has at least one of the following signs or symptoms: fever (>38°C), or localized pain or tenderness (a culture-negative finding does not meet this criterion)
c. an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination
d. diagnosis of a deep incisional SSI by a surgeon or attending physician

An organ/space SSI must meet the following criteria:

infection occurs within 30 days after the operative procedure if no implant is left in place, or within one year if implant is in place and the infection appears to be related to the operative procedure
and
infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure
and
patient has at least one of the following:

a. purulent drainage from a drain that is placed through a stab wound into the organ/space
b. organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space
c. an abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination
d. diagnosis of an organ/space SSI by a surgeon or attending physician

Diagnosis of SSI related to clean orthopedic surgical procedures is a complex process, using clinical signs and symptoms, laboratory data, and radiologic findings and /or surgeon or medical officer confirmation or diagnosis.

The clinical presentation of infection is dependent on the properties of the infectious agent (i.e. innate virulence), the nature of host tissue at the site of infection, and the route of infection (locally introduced versus hematogenous spread from a distant site or bloodstream). Inflammatory signs may be variable. Typically, progressive joint pain is a patient complaint, with or without presence of a sinus tract (or tracts) with drainage.

A fulminant presentation is suggestive of infection with a virulent organism, such as *Staphylococcus aureus* or β-hemolytic streptococci. Less virulent, coagulase-negative *Staphylococcus*-related infections present a more delayed course.

Properties of affected tissue affect the clinical presentation due to their ability to support microbial growth. The ability of bacteria to flourish is enhanced in wound hematomas, fresh operative wounds, ischemic wounds, and the tissue of diabetic patients or those on long-term steroid therapy. Size of the infectious inoculum also affects the clinical presentation, with a larger inoculum producing a more toxic picture.

Joint pain is the principal symptom of deep tissue infection, regardless of the mode of presentation. It suggests either acute inflammation of periarticular tissue or loosening of the prosthesis as a result of subacute erosion of the bone at the bone-cement interface. Acute inflammation may present earlier in the postoperative course, while subacute erosion may be associated with later onset infections.

Clinical manifestations of joint pain, swelling, erythema, and warmth all reflect an underlying inflammatory process, but are not specific for infection.

If the presentation of pain at the joint includes fever or purulent drainage from the overlying cutaneous sinuses, infection may be presumed. More often, though, infection must be differentiated from aseptic and mechanical

problems, which are more common causes of pain and inflammation in orthopedic surgical patients. Constant pain or pain at night or rest is indicative of infection (or malignancy); pain of sudden onset that occurs with motion or weight bearing suggests another cause, such as prosthetic loosening. A history of postoperative hematoma or delayed wound healing suggests that joint pain is infection-related.

Laboratory findings of erythrocyte sedimentation rate (ESR) elevation beyond six months after surgery is suspicious for infection. Fulminant infection or infection with secondary bacteremia is more likely to result in the typical infection-related laboratory findings of elevated white blood cell count. Culture of joint aspirate is inconsistently predictive of infection. Barrack and Harris reviewed 270 cases in which aspiration of the hip joint was performed prior to revision surgery. They discovered 32 false-positive aspirations. Of six infected hips, only two aspirations were positive (there were four false-negative aspiration specimens).[50]

In summary, the incidence of orthopedic postoperative SSI varies by the type of surgery and may be influenced by both modifiable and non-modifiable risk factors. Understanding the risks associated with these infections will help the IP and all members of the healthcare team develop strategies to prevent postoperative infections in orthopedic surgeries.

The Infection Prevention Program

An effective infection prevention program for orthopedic surgery has many components. Implementation of, and consistent adherence to, evidence-based practices to reduce the risk of SSI is key to success. However, it is important to conduct a thorough risk assessment and to collect and analyze surveillance data to drive improvements. Surveillance data can provide measurable results to evaluate the effectiveness of infection prevention interventions.

The Risk Assessment

A risk assessment is a systematic evaluation for identifying risks in the healthcare setting. Infection Control assessment identifies risks for acquiring or transmitting infections, and includes strategies for prioritizing and mitigating those risks.
A risk assessment can be either quantitative or qualitative, and can include both process and outcome measures.

Steps for Performing the Risk Assessment:

Create the risk assessment team, ensuring input from key support and clinical departments. The team should gather organizational information and set a timeline for assessment.[51] Current literature and past trends should be evaluated. Example: No less than annually and whenever new risks or procedures are identified.

Questions to consider:

What is the volume of orthopedic surgery?

What are the major procedures performed?

What is the frequency of infections in orthopedic surgery?

What are the major pathogens identified? What is the proportion of multiple drug-resistant organisms?

Are there any new procedures performed?

What is the frequency of readmissions related to postoperative SSIs in orthopedic surgery?

Evaluation of Process Measures:

Are antibiotic prophylaxis criteria, including preoperative timing, antibiotic selection and postoperative duration, part of standing orders and pathways?

Are there standardized procedures for preoperative preparation of the skin that specify the appropriate antiseptic agent(s), and correct application?

Do patients and families receive instructions as to their preoperative, perioperative and post-discharge roles in prevention of SSIs?

Do healthcare workers and licensed independent practitioners receive education upon hire and annually related to prevention of SSIs?

Risk Assessment Type and Template

Example:

Joan directs an infection prevention program in a mid-size community teaching hospital. She has collected data on total joint replacement surgeries using NHSN for the past two years.

Last year, 357 total hip replacements and 240 total knee replacements were performed at her facility. There were seven postoperative hip infections and one knee infection.

Of the seven postoperative hip infections, the pathogens isolated were:

- 5 methicillin-resistant *Staphylococcus aureus* (MRSA)
- 1 coagulase-negative *Staphylococcus*
- 1 methicillin-sensitive *Staphylococcus aureus* (MSSA)

The pathogen associated with the one postoperative total knee infection was also MSSA.

Of the seven hip infections and one knee infection in joint replacement surgery, there were five (5) deep or organ space infections that required surgical intervention. All five SSIs were hip replacements.

There are 10 orthopedic surgeons on staff, but the majority of total joint replacement procedures were performed by seven surgeons who each perform approximately 75-80 procedures annually. The infections are not attributable to a single surgeon and occur sporadically throughout the year.

Appropriate antibiotics are ordered 100% of the time. Timing demonstrates that 98% of patients receive antibiotics in the appropriate time frame. Only 88% of patients have antibiotics discontinued within the recommended 24 hours.

Joan and the team review current literature on prevention practices. A perioperative nurse from the orthopedic service is added to the team.

The risk assessment can be either qualitative or quantitative.

Qualitative Risk Assessment:

The qualitative risk assessment uses an approach that assesses the risk based upon written descriptions. One example is described below:

Sample Gap Analysis – Total Hip Replacement

Areas/ Topic	Current Status	Goals	Identified Gap	Actions	Priority
SSIs in hip replacements	7 actual Infections versus 3.7 expected (NHSN) SSI rates twice the mean in the first two risk categories 5 of the patients required further surgical intervention	Reduce SSIs in hip replacements by at least 30% Improve adherence to discontinuing antibiotics within 24 hours to at least 95%	No standard order sets or pathways for discontinuing antibiotics Knowledge deficits by nursing when IV infiltrates or is interrupted during immediate postoperative period MRSA incidence increased from previous year No standard protocols for addressing patients who may be colonized with MRSA preoperatively	Incorporate orthopedic prophylactic antibiotic protocols into order sets and pathways Develop MRSA screening program for orthopedic surgery Engage stakeholders to develop standard prep procedure	HIGH (rates have doubled since last year)

(continued)

Areas/ Topic	Current Status	Goals	Identified Gap	Actions	Priority
			No standard perioperative prep procedure No standardized practices for warming patients	Incorporate temperature management protocol using active warming, such as forced-air warming, to maintain patient normothermia including prewarming, intraoperative and post-operative warming.	

Source: Linda R. Greene, RN, MPS, Rochester General Hospital, Rochester, N.Y.

Quantitative Risk Assessment

A quantitative risk assessment is one in which a number is assigned to specific pre-determined criteria.[52]

SSIs	Benchmark	High Risk	High Volume	National Initiative	Financial Initiative	Risk Rating
Hip replacement						

Template provided by Shannon Oriola, RN, COHN, CIC, Sharp Metropolitan Medical Center, San Diego, California.

Relative Risk 0-3
3 = High Risk
2 = Moderate Risk
1 = Minimal Risk
0 = No Risk
Score 10 or above = High priority

Using the Tool

The following is a hypothetical example of how the tool may be used, based upon the information obtained in the risk assessment example described above:

1. **Benchmark** – Rates of SSIs in hip replacement surgery are above the NHSN mean, but not by a statistically significant difference. This was considered a moderate risk. Risk score = 2
2. **High Risk** procedure or activity – Patients who develop SSIs may require removal of the prosthesis. Only 88% of patients have antibiotics discontinued within the recommended 24 hours, and there is a high proportion of MRSA in patients who develop an SSI. This was considered high risk. Risk score = 3
3. **High Volume** – Hip replacements are a high-volume procedure in this organization. It is the third highest volume procedure performed, and therefore was identified as a high risk. Risk score = 3
4. **Potential Negative Outcome** – SSIs in hip replacements are associated with increased morbidity, mortality and length of stay. Five patients last year developed deep or organ space infections requiring surgical intervention. Risk score = 3

5. **National Initiative** – At the time of the risk assessment, there is not a national initiative associated with outcome measures in orthopedic surgery. Risk score = 0
6. **Financial Incentive** – The cases involved an average of 7-10 days increased length of stay and an excess average cost per case of $ 32,000. Risk score = 3

SSIs	Benchmark	High Risk	High Volume	Potential Negative Outcome	National Initiative	Financial Initiative	Risk Rating
Hip Replacement	2	3	3	3	0	3	14

Evaluation

Since this procedure is above the 10-point risk priority ranking, it will be part of the annual infection prevention plan. It is important to set goals and expectations as well as strategies for achieving the goals.

Set Goals and Expectations

Reduce SSI in total hip replacements by at least 30%.

Improve adherence to discontinuing antibiotics within 24 hours to at least 95%.

Actions

Develop MRSA screening program for orthopedic surgery.

Engage stakeholders to develop standard prep procedure.

Incorporate orthopedic prophylactic antibiotic protocols into order sets and pathways.

The above risk assessments use NHSN surveillance criteria. Organizations that do not use NHSN may use overall data collected from surveillance activities. As an alternative, if no surveillance data exists, administrative data may be utilized to assist in case findings. This data cannot be compared to NHSN means, but may be helpful to assist in determining the overall scope of the issues. Likewise, microbiology data may be helpful in determining pathogen frequency and occurrence.

Surveillance

Surveillance is a systemic and ongoing method of data collection, presentation and analysis, which is then followed by dissemination of that information to those who can improve the outcome.

In a healthcare setting, information obtained from surveillance of HAIs can be extremely important in the context of continuous quality improvement as objective data is used to improve patient outcomes.

Surveillance helps to:

- determine baseline rates of adverse events (including HAIs);
- detect changes in the rates or distribution of these events;
- facilitate investigation of significantly increased rates of infection;
- determine the effectiveness of infection prevention and control measures;
- monitor compliance with established hospital practices;
- evaluate changes in practice;
- identify areas where research would be beneficial.

There are many factors to consider when designing an orthopedic surgery surveillance program. The first steps are defining the population at risk and determining the resources available. For example, based upon the risk assessment, consider whether all orthopedic surgeries will be monitored or if just selected procedures such as total hip surgeries or total knee surgeries will be followed. Often, if opportunities for improvement are identified in one procedure, such as total hip replacements, then process improvement activities that are identified can be applied to the service as a whole. Criteria used to conduct surveillance must remain consistent.

Case Finding Methodology

The case finding methodology may depend on what resources are available and may include:

1. wound culture reports
2. operating room reports
3. admission and readmission diagnosis
4. antibiotic lists
5. administrative data; coding data associated with infection codes
6. medical record reviews
7. data obtained from healthcare providers, i.e., surgeon or nursing reports
8. post-discharge surveillance data

Surgical Surveillance

- The numerator for the rate calculation is the number of SSI events.
- The denominator for the rate calculation is the number of surgical cases during that same time frame.

SSI Surveillance Denominator

A count of the specific surgical procedures performed per month is necessary to calculate the SSI rate in a facility. Electronic medical record documentation and operating room records can generally provide a report of the number of patients each month. If this is not available, a manual count must be done of the number of patients undergoing the specific surgical procedure.

SSI Surveillance Numerator

All patients having a selected procedure are monitored for signs of SSI. This surveillance can be done prospectively and retrospectively at the time that criteria is reviewed and evaluated.

SSI Surveillance Methods

The primary methods for determining a baseline rate of SSI is to utilize the NHSN methodology and definitions for SSI. By using NHSN methodology to determine the rate of SSI, cases are risk-stratified by the type of surgery and are also compared to the rates of participating NHSN hospitals.

NHSN Denominator Data

A description of the NHSN surgical component can be accessed at: www.cdc.gov/nhsn/PDFs/pscManual/9pscSSIcurrent.pdf

The following provides a brief description:

An NHSN procedure is one which:

- — is performed on a patient who is an NHSN inpatient or an NHSN outpatient
- — takes place during an operation where a surgeon makes at least one incision through the skin or mucous membrane, including laparoscopic approach, and closes the incision before the patient leaves the operating room
- — includes one of the NHSN procedure categories:

Example of select orthopedic operative procedure categories:

Procedure	Description	ICD 9 codes
Knee prosthesis	Arthroplasty of knee	00.80-00.84, 81.54, 81.55
Hip prosthesis	Arthroplasty of hip	00.70-00.73, 00.85-00.87, 81.51, 81.53
Open reduction of fracture	Open reduction of fracture or dislocation of long bones that requires internal or external fixation; does not include placement of joint prosthesis	79.21, 79.22, 79.25, 79.26, 79.31, 79.32, 79.35, 79.36, 79.51, 79.52, 79.55, 79.56

Specific denominator information for the operative procedure includes demographic and procedure information, such as patient identifier, date of birth, date of procedure, procedure code or ICD 9 code, surgical wound class, length of time for surgical procedure, ASA score, trauma, emergency or elective case.

NHSN surgical methodology is:

- active
- patient-based
- prospective

- retrospective
- priority-directed
- risk-adjusted, incidence rates

NHSN Risk Stratification:

> The index used in NHSN assigns surgical patients into categories based on the presence of three major risk factors:
>
> 1. Operation lasting more than the duration of cut point hours, where the duration cut point is the approximate 75th percentile of the duration of surgery in minutes for the operative procedure, rounded to the nearest whole number of hours.
> 2. Contaminated (Class 3) or Dirty/infected (Class 4) wound class.
> 3. ASA classification of 3, 4, or 5.
>
> The patient's SSI risk category is simply the number of these factors present at the time of the operation.

The collection of infection data should be overseen by a trained or certified IP and/or by an infectious disease physician. The IP shall seek out infections during the patient's stay by screening various data sources (i.e. micro reports, patient records, clinical notes, etc.).

As NHSN methodology requires that surveillance for SSIs is done for up to 30 days following the procedure, and up to one year for surgeries involving implantables, post-discharge surveillance is needed.

Orthopedic SSI Worksheet

Procedure _____

Patient name_____ Medical record or ID _____

Type of infection? Superficial_____ Deep _____ Organ space_____

Radiological evidence of infection _____

Date of surgery_____ Surgeon _____

Purulent drainage? Yes/No. Antibiotic therapy? Yes/No. Antibiotic_____

Pain _____ Redness_____ Other symptoms_____

Type of implant if applicable_____ Blood loss_____ Transfusion? Yes/No.

Date of infection_____ Date of admission to hospital_____

Culture data # 1 date_____ Pathogen_____ Other culture data_____

Date of readmission if applicable _____ Readmission diagnosis _____

Opened at bedside or I and D by surgeon _____

Return to surgery? Yes/No. Date _____

Physician diagnosis of SSI? Yes/No.

If yes, by whom: Surgeon Medical Attending Hospitalist ED Physician Other

Notes _____

Medical history_____ History of MDRO _____
Diabetes? Yes/No. Smoker? Yes/No. BMI_____ Other risk factors_____
Drains (list) _____

Process measures:

Preoperative antibiotic _____ Dose _____
Administered within 1 hour (2 hours for vancomycin) Y_____ N_____
Time _____
Tourniquet time (if applicable) _____
If not on time: Not documented_____ Early _____ Late _____
Antibiotic discontinued within 24 hours? Yes/No. If no, why? _____
Pre-op shower or skin cleaner: identify _____
Hair removal Yes/No. If yes, clip? Yes/No.
Postoperative temperature Greater than or = to 36 degrees C _____
Documentation of patient education on SSI prevention? Yes/No.
Identified opportunities for improvement _____

Worksheet provided by L.Greene RN, MPS,CIC and M. Vignari, RN,CIC Rochester General Hospital Rochester, NY

Electronic Surveillance

Although it is beyond the intent of this guide to discuss electronic surveillance or data mining, a number of facilities rely heavily on these systems to assist in case findings. These systems have the ability to pull essential clinical information for individual patients from hospital data sources throughout the facility. A number of commercial and facility programs interface with a pharmacy database to track antibiotic usage as well.[53] Some commercial programs have the capability to allow the IP to upload denominator and numerator data into NHSN.

NHSN requires that surgical denominator data as well as numerator data be entered into the database to allow for appropriate risk adjustment. The NHSN will allow importation of procedure data in an ASCII comma delimited text file format. The reports can be obtained from different external sources, such as databases or hospital information systems, and imported into NHSN. Steps are described in NHSN and can be accessed at: www.cdc.gov/nhsn/PDFs/ImportingProcedureData_current.pdf.

Data Collection

Criteria used to define the outcome should reflect generally accepted definitions. The best way to determine whether an infection has occurred is to use NHSN criteria, regardless of whether the facility participates in NHSN reporting. This methodology is widely accepted as the gold standard for surveillance and is validated and reliable. NHSN definitions were discussed in a previous section. It is important that strict adherence to definitions be followed, especially when data is used for public reporting purposes in order to ensure consistency across organizations. Additional clinical findings may be appropriate for care and treatment decisions but are not appropriate for surveillance purposes due to variations among healthcare providers and organizations.

Post-discharge Surveillance

There is no gold standard for post-discharge surveillance. Most cases of healthcare- associated SSIs appear after discharge from the hospital. Rates of post-discharge SSI between 2% and 14% have been reported in a number of articles suggesting that organizations with active post-discharge surveillance systems will report higher rates of infection. The 2009 New York State Report for Hospital-Acquired Infections notes that post-discharge surveillance rates are highly variable and are dependent upon resources, technology, and the time frame in which data is collected.

Since most deep and organ space infections require readmission, the 2009 state report does not include any infections detected by post-discharge surveillance that do not require readmission to a hospital. They note that this issue needs further evaluation.[54] Platt described automated surveillance methods based on pharmacy and financial claims data and reported that they are more sensitive for detection of post-discharge SSI.[55] Prospero et al. concluded that certain procedures, such as breast surgery, hernia repair and other endocrine surgery may be at higher risk for post-discharge SSI, and that post-discharge surveillance should be targeted at specific procedures.[56] One major challenge relates to free-standing ASCs and the new CMS requirements. With increasing numbers of orthopedic procedures performed in ASCs, the new CMS requirement to "identify infections" means that all ASCs must implement a working surveillance system for SSIs if one is not already in place. Such surveillance in ASC facilities, by definition, means post-discharge surveillance.

Methods utilized by facilities include:

1. line lists of patients undergoing surgical procedures who are sent to respective surgeons and returned on a regular basis (usually monthly)
2. follow-up phone calls to patients
3. outpatient culture reports
4. readmission data to hospital or to another hospital
5. self reporting by surgeons
6. outpatient reports of antibiotic usage data

Example: Surgeon Post-discharge List
Month: January 2010
Surgeon: John Smith

Name	DOB	Procedure	Procedure date	Infection Y/ N	Antibiotic Y/N (list)	Comment
Doe, John	12/11/54	Total knee	1/4/10			

Please complete last three columns.
Return to Infection Prevention Department, Rosewood General Hospital.

Example: Phone call to patient

Instructions:
The hospital call center will contact the patient between the hours of 11 a.m. and 7 p.m. A phone call is made 30 days after surgery. Three attempts will be made to contact the patient.

Patient Name: Jane Doe
MR: 111111
Date of Surgery: 01/25/10
Procedure: Laminectomy
Phone Number : (xxx) xxx-xxxx

1. Have you followed up with your doctor?

2. Has he or she prescribed any antibiotics for you? If so, what was the reason for the antibiotics?

3. Did you have any drainage from the incision?

4. Describe the drainage.

5. Any pain or redness? Fever?

6. Were you admitted to the hospital or any other hospital since your last surgery? If so, why?

7. Did your surgeon open or drain your incision in his office?

Patient: Return to Infection Prevention Department.

Infection Prevention Department: Evidence of purulent drainage, antibiotics to treat suspected infection, deliberate opening of wound, or readmission to another hospital with complications of surgery will require follow-up with surgeon.

Infection Prevention Department to Complete:

Meets criteria: Y N
If yes, complete postoperative case report.

Outcome Reports

Infection Rate

The numerator (the number of SSIs) and the denominator (the total number of procedures performed) should be calculated on a routine basis and expressed as a percentage by x number of procedures. It is important that the numerator includes all cases performed in a given timeframe and the denominator includes all cases in that same time frame. The surgery date, rather than the infection date, is used for the numerator data. Although some organizations continue to calculate rates based on degree of wound contamination (all class 1) or by service, the most accurate data is SSI calculated by procedure type.

Example:

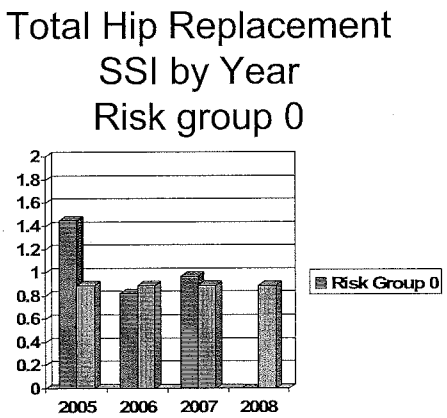
There were 104 total knee replacements performed in January; 160 in February; 120 in March; and 118 in April. There was one SSI in knee replacement surgery identified during those four months. The case is described below:

Mrs. X was admitted on April 15 with fever and purulent drainage from her knee. Her original surgery was performed on January 16. Radiological results show a collection of fluid around the prosthesis and a possible abscess. The surgeon has documented that she has a postoperative infection and she is taken to surgery for debridement and removal of her prosthesis on April 17. In this example, the monthly SSI rate would be calculated as follows:

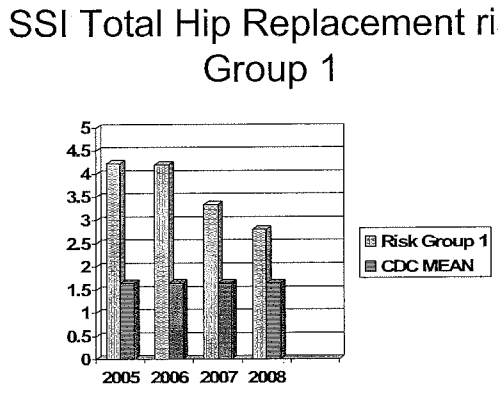
Knee Replacements

Month (2010)	Number of surgeries performed	Number of infections	Rate
January	104	1*	1%
February	160	0	0
March	120	0	0
April	118	0	0

* Although the infection was identified in April, the surgery was performed in January.



Risk group zero means that patient had
No comorbidities that would put them at
increased risk of infection



Risk Group 1 denotes that patient had one
or more comorbidities
or excess time in surgery

Figure 2

Standardized Infection Ratio (SIR)

This indirect standardization method accounts for differences in the risk of SSIs among a group of procedures.[57]

An SIR is the number of observed infections divided by the number of predicted infections. The expected number is based on the national average, the number of procedures performed by a hospital, and historical data for those procedures. This method is helpful when small numerators and denominators are present.[58]

- An SIR of **1.0** means the observed number of infections is equal to the number of expected infections.
- An SIR **above 1.0** means that the infection rate is higher than that found in the "standard population." For HAI reports, the standard population comes from data reported by the hundreds of U.S. hospitals that use the NHSN system. The difference above 1.0 is the percentage by which the infection rate exceeds that of the standard population.
- An SIR **below 1.0** means the infection rate is lower than that of the standard population. The difference below 1.0 is the percentage by which the infection rate is lower than that experienced by the standard population.

Example: Total Hip Replacement

Year	Number of infections	Number of infections expected	SIR calculation
2007	7	3.74	7/3.74 = 1.87
2008	6	3.7	6/3.70 = 1.49
2009	1	3.8	1/3.80 = 0.26

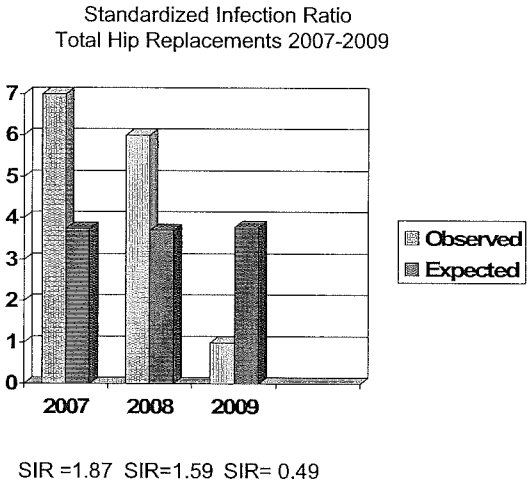


Figure 3

Disseminating Data

One of the most important aspects of surveillance data is the analysis and dissemination of data. Line lists are helpful in providing nursing staff, surgeons and other members of the healthcare team with valuable information. Case information should be disseminated as soon as possible to allow for case reviews. Many organizations post infection rates in prominent areas. One method of displaying data is to calculate the number of cases between infections. Although this method is not useful for inter-hospital comparisons, it provides a useful tool, which is easily understandable by staff. Goals can be set based upon the volume of cases. Process control charts, bar charts and other visual feedback provide methods to display data.

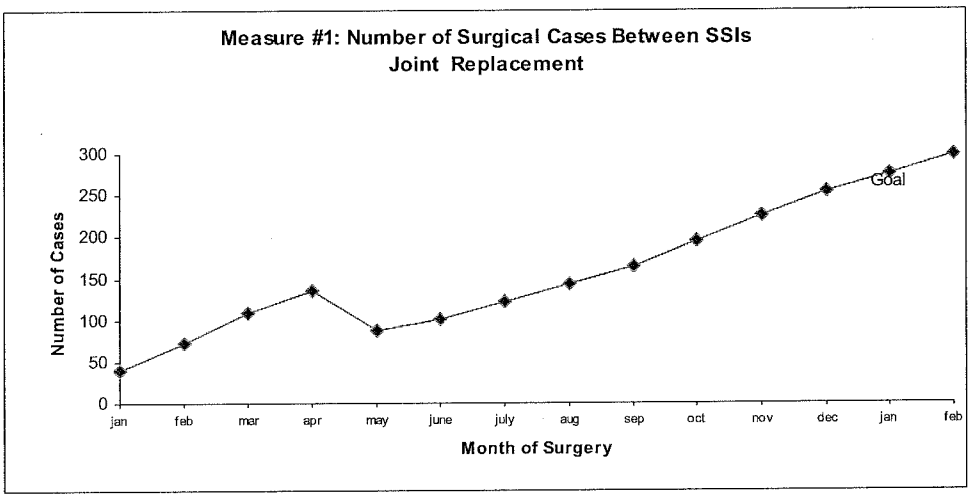

Measure #1: Number of Surgical Cases Between SSIs
Joint Replacement
Number of Cases
300
250
200
150
100
50
0
Goal
jan
feb
mar
apr
may
june
july
aug
sep
oct
nov
dec
jan
feb
Month of Surgery

Figure 4

Surgical Care Improvement Project (SCIP) & CMS Value-Based Purchasing

In 2006 in the U.S., SCIP was launched as a national initiative to reduce postoperative morbidity and mortality by 25% by the year 2010. SCIP is a national partnership of organizations committed to improving the safety of surgical care through the reduction of postoperative complications. Initiated by CMS and the CDC, the SCIP partnership is coordinated through a steering committee of 10 national organizations. More than 20 organizations provide expertise to the steering committee through a technical expert panel. The project's steering committee is composed of members from the following national organizations:

- Agency for Healthcare Research and Quality
- American College of Surgeons
- American Hospital Association
- American Society of Anesthesiologists
- Association of periOperative Registered Nurses
- Centers for Disease Control and Prevention
- Centers for Medicare & Medicaid Services
- Department of Veterans Affairs
- Institute for Healthcare Improvement
- The Joint Commission on

The SCIP was initially composed of four prevention modules: infection, venous thromboembolism (VTE), cardiac and respiratory. The infection prevention component addressed six separate core measures, including delivery of prophylactic antibiotic within one hour prior to incision, appropriate prophylactic antibiotic selection, antibiotic discontinuation within 24 hours post-op (cardiac surgery was given a 48-hour window), glycemic control in cardiac patients (measured by controlled 6 a.m. postoperative serum glucose), appropriate hair removal and normothermia. In order to meet the current CMS Normothermia Measure (SCIP-Infection-10), active warming must be used intraoperatively or achieve the target temperature of ≥36°C within 30 minutes before or 15 minutes immediately after anesthesia end time. This measure applies to all acute care surgical patients, regardless of age, undergoing general or neuraxial anesthesia for 60 minutes or longer.[59]

1. Specifications Manual for National Hospital

CMS is continuing to implemented incentives for acute care hospitals to collect and report levels of adherence with SCIP measures. In 2011 CMS will encourage hospitals to report certain HAI events, i.e. CLABSI as part of their Hospital Inpatient Quality Reporting Program (formerly Reporting Quality Data for Annual Payment Update (RQDAPU) Facilities that choose not to report select events would accept a 2% reduction in reimbursement by CMS. In 2012 this incentive will include SSIs following select procedures. The roster of procedures remains in development but may include certain orthopedic procedures. Prior to the SCIP initiative, the antibiotic measures were part of the Surgical Infection Prevention (SIP) initiative; they have long been thought to be the cornerstone of good surgical infection prevention.

However, a recent investigation using a retrospective analysis of 405,720 patients from 398 hospitals failed to document an association between adherence to selective SCIP process measures and occurrence of postoperative SSIs. Furthermore, the authors documented an increase in SSIs, despite an improvement in SCIP compliance over a two-year study period.[60] However; adherence measured through an "all-or-none" composite infection prevention score was associated with a lower probability of developing a postoperative infection. This would suggest that the complexity of the surgical procedure requires a comprehensive team-based approach that is inclusive but not limited to a few process measures. Of note, this investigation used claims/administrative data to define SSI. Claims data is not as precise as epidemiologic criteria such as that used by NHSN or NSQIP. Therefore one remaining question is whether in significant reduction in SSI rates using epidemiologic SSI criteria.

The following strategies are examples of methods to increase compliance to antibiotic prophylaxis:

1. provide visual reminders, checklists, and antibiotic prophylaxis as part of the "time out." A study by Wax et al. demonstrated very high rates of compliance when a visual electronic interactive reminder was added to the anesthesia electronic record.[61]
2. incorporate documentation of prophylaxis into electronic documentation forced field functions.
3. incorporate antibiotic selection and duration into order sets and pathways.
4. provide feedback to care providers, on both an individual and overall aggregate level.

Examples of Feedback:

SHARP Memorial Hospital

September 5, 2010

_____, M.D.
Anesthesiology Service Medical Group
3626 Ruffin Road
San Diego, CA 92123

Dear Dr. _____,

The Medical Executive Committee has requested that the Infection Prevention Department monitor the administration of preoperative prophylactic antibiotics for total hip/knee arthroplasty procedures and provide feedback to surgeons and anesthesiologists should our department identify missed opportunities for the optimal use of prophylactic antibiotics.

Enclosed is a copy of the Anesthesia Record (MR# _____) and Visit #(_____) that documents the administration of cefazolin 2 grams at 0804 with the operative procedure start time of 0851 and completed at 1242.

Generally, if an operative procedure exceeds the half-life of the antibiotic, then a repeat dose is given. The half live of cefazolin is 3-4 hours; therefore, a repeat dose before 1204 would have been ideal. It is the time that the antibiotic is initially given and not the incision time that determines when the antibiotic is redosed.

Thank you for your attention to this matter. We appreciate your efforts to further minimize the risk of post-operative surgical site infections.

Sincerely,

Hospital Epidemiologist

Example provided by Shannon Oriola , RN, COHN, CIC Sharp Memorial Hospital, San Diego, California.

Providing individuals with feedback related to process measures is an important component. The following example provides process measure feedback:

SHARP Memorial Hospital

SHARP Memorial Hospital

July 19, 2010

Doctor
Address
San Diego, CA

Dear Dr. xxx :

The Peer Review Oversight Committee of the Medical Executive Committee has requested that the Infection Prevention Unit produce annual surgeon-specific data on adherence to the recommended choice of pre-operative prophylactic antibiotic and to duration of antibiotic administration for designated surgical procedures. This information will be reviewed as part of the re-credentialing process. Optimal use of prophylactic antibiotics decreases the risk of post-operative surgical site infections[1,2]. Infection Prevention is reporting data on hip and knee arthroplasties performed between January 1, 2009 and December 31, 2009.

For this report, the choice of cefazolin, clindamycin or vancomycin was considered appropriate and the presence or absence of allergies was not considered.

Listed below are yours rates (number of cases adhering to guidelines/total number of opportunities) and compared to the rates for 2009 SMH surgeons performing these procedures.

Quality Measure	Your Rates 2008	Your Rates 2009	SMH Surgeons 2009
ABX Choice			99.8% 617/618
Duration ≤ 24hrs			99.7% 616/618
Preop Nasal Screening			98.5% 609/618

Surgeon specific information: **[cases that feel out]**

The following are accepted guidelines:

For initial preoperative prophylaxis:

- Infuse cefazolin 2 grams within 1 hour of the incision.
- For cephalosporin allergic individuals, those with type I hypersensitivity reactions to penicillin, or those colonized with MRSA, use vancomycin 15mg/kg given over 60– 90 minutes and within 2 hours of incision.
- For patients allergic to cephalosporins and vancomycin, use clindamycin 600mgs infused within 1 hour of incision.

If the procedure is longer than 3-4 hours after initial antibiotic **infusion, NOT incision,** 1-2 grams of cefazolin, or for allergic individuals, 600mgs of clindamycin is recommended.

The duration of prophylaxis should be ≤ 24 hours from initial dose.

Thank you for your cooperation. If you need clarification, please contact us at raymond.chinn@sharp.com or judith.vargo@sharp.com.

Sincerely,

Robert Tonks, M.D.
Chief, Orthopedic Supervisory Committee

Raymond Chinn, MD
Hospital Epidemiologist

cc: Peer Review Oversight Committee

[1] Classen DC, Evans RS, Pestotnik SL, Menlove RL and Burke JP, The Timing of Prophylactic Administration of Antibiotic and the Risk of Surgical-Wound Infection. NEJM 326:281-286
2 Bratzler DW, Houck PM. Antimicrobial Prophylaxis for Surgery: An Advisory Statement from the National Surgical Infection Prevention Project. Clin Infect Dis June 15, 2004;38:1706-1715

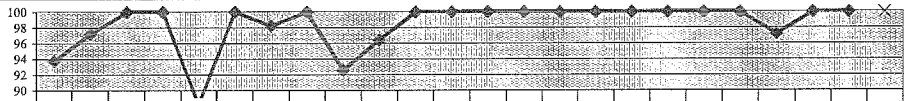
Figure 5

09/10/2010

X = Preliminary Data Only. Actual value may change

Surgical Care Improvement Project (SCIP) - Abx for Knee Procedures

Antibiotic within 1 Hour of Surgical Incision (Percent %)

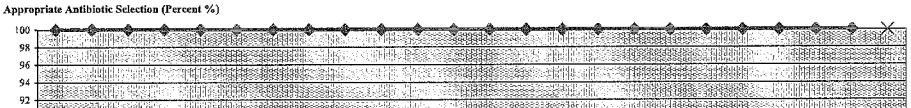


	7/08	8/08	9/08	10/08	11/08	12/08	1/09	2/09	3/09	4/09	5/09	6/09	7/09	8/09	9/09	10/09	11/09	12/09	1/10	2/10	3/10	4/10	5/10	6/10
N	30	35	22	43	30	25	56	32	25	27	38	29	29	33	42	49	45	39	44	38	35	49	48	32
D	32	36	22	43	34	25	57	32	27	28	38	29	29	33	42	49	45	39	44	38	36	49	48	32

Antibiotic discontinued within 24/48 hours Post-op (Percent %)

	7/08	8/08	9/08	10/08	11/08	12/08	1/09	2/09	3/09	4/09	5/09	6/09	7/09	8/09	9/09	10/09	11/09	12/09	1/10	2/10	3/10	4/10	5/10	6/10
N	31	35	21	43	33	25	57	32	27	28	38	29	29	33	40	48	45	37	44	37	36	48	47	32
D	31	36	22	43	34	25	57	32	27	28	38	29	29	33	40	49	45	39	44	37	36	49	48	32

Appropriate Antibiotic Selection (Percent %)



	7/08	8/08	9/08	10/08	11/08	12/08	1/09	2/09	3/09	4/09	5/09	6/09	7/09	8/09	9/09	10/09	11/09	12/09	1/10	2/10	3/10	4/10	5/10	6/10
N	31	37	22	43	34	25	57	32	27	28	38	29	30	33	41	49	45	39	44	38	36	49	48	32
D	31	37	22	43	34	25	57	32	27	28	38	29	30	33	41	49	45	39	44	38	36	49	48	32

N = Numerator (# of visits that pass the indicator) **D = Denominator (# of visits eligible to be evaluated for the indicator)**

Figure 6

Hair removal

Preoperative shaving of the surgical site the night before an operation is associated with a significantly higher SSI risk than other methods of hair removal or no hair removal at all.[62] The increased SSI risk associated with shaving has been attributed to microscopic cuts in the skin that provide a portal of entry for bacteria and a focus for bacterial multiplication. The hair removal methodology should be reviewed with the perioperative staff. The timing of the hair removal and the removal with the use of clippers versus razors are important processes. If hair is removed, it should be as close to the incision as possible. One of the most effective strategies is to remove razors from the OR. In many cases, no hair removal is needed. However, the decision to remove surgical site hair should include consideration of the potential for access to the surgical site and the field of view. Female patients who are undergoing knee replacements, hip replacements or other lower leg surgeries should be instructed not to shave their legs prior to surgery for the reason described above.

Perioperative Normothermia

Several studies specifically address the importance of normothermia in orthopedic surgery. Perioperative hypothermia is physiologically stressful because it elevates blood pressure, heart rate and plasma catecholamine concentration, which may increase the risk of cardiac complications, bleeding, wound infection, and post-anesthesia care unit stay.[63] In the OR, surgical patients are exposed to factors that may alter their thermoregulatory mechanism, leading to postoperative hypothermia. These factors may include cold OR rooms, IV fluids, skin preparations and various forms of anesthesia. One randomized control study of total knee replacements found that forced air warming was more effective than cotton or reflective blankets for preventing hypothermia.[64] Other studies have concluded that active warming is beneficial, does not increase contamination, and decreases the potential for postoperative infections.[65] Studies of the impact of hypothermia on the incidence of wound infection have shown that the hypothermic patient is at an appreciably greater risk for wound infection than a normothermic patient.[66] Intraoperative hypothermia triggers thermoregulatory vasoconstriction, decreasing the partial pressure of oxygen in the tissues, thereby lowering resistance to infection. A reduction in core temperature of 1.9°C has been shown to triple the incidence of surgical wound infections after colon resection and to increase length of hospital stays.[67] A number of organizations have standing protocols for active warming of patients whose core temperature is at or below 36 degrees Centigrade.

Global Initiatives

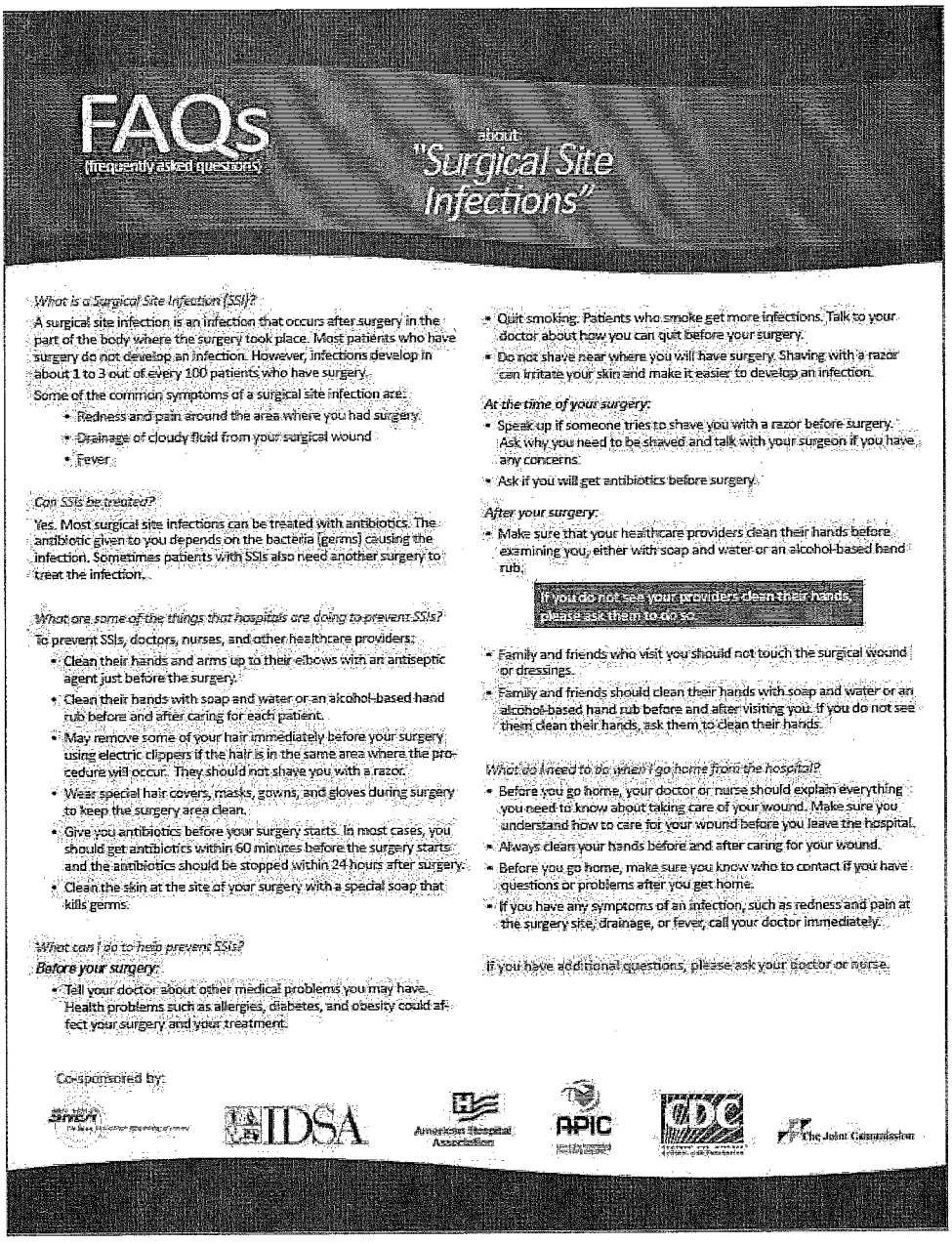
The World Health Organization (WHO) has undertaken several initiatives aimed at safe surgical care. International experts around the world convened to review the literature on patient safety and to identify key areas for improvement. One of WHO's major initiatives focused on improved surgical safety by reducing surgical deaths and complications during surgery in four ways:[68]

- by providing information on the role and patterns of surgical safety in public health to clinicians, hospital administrators and public health officials;
- by defining a minimum set of uniform measures, or "surgical vital statistics," for national and international surveillance of surgical care;
- by identifying a simple set of surgical safety standards that are applicable in all countries and settings and are compiled in a checklist for use in operating rooms;
- by initially evaluating and disseminating the checklist and surveillance measures at pilot sites in every WHO region, and then to hospitals worldwide

Preoperative Preparation

Patients who undergo elective surgery should ideally enter the hospital on the day of surgery. Patients who have a prolonged length of stay prior to surgery will be at greater risk for infection due to the likelihood of exposure to infectious organisms, including resistant pathogens, and possible use of invasive devices prior to surgery.

In the preoperative setting, it is important to evaluate patients for medical conditions, encourage them to stop smoking, and instruct them not to shave near the surgical site prior to surgery. Instruction sheets and videos may be useful.



FAQs
(frequently asked questions)
about
"Surgical Site Infections"

What is a Surgical Site Infection (SSI)?

A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Most patients who have surgery do not develop an infection. However, infections develop in about 1 to 3 out of every 100 patients who have surgery.

Some of the common symptoms of a surgical site infection are:

- Redness and pain around the area where you had surgery
- Drainage of cloudy fluid from your surgical wound
- Fever

Can SSIs be treated?

Yes. Most surgical site infections can be treated with antibiotics. The antibiotic given to you depends on the bacteria (germs) causing the infection. Sometimes patients with SSIs also need another surgery to treat the infection.

What are some of the things that hospitals are doing to prevent SSIs?

To prevent SSIs, doctors, nurses, and other healthcare providers:

- Clean their hands and arms up to their elbows with an antiseptic agent just before the surgery.
- Clean their hands with soap and water or an alcohol-based hand rub before and after caring for each patient.
- May remove some of your hair immediately before your surgery using electric clippers if the hair is in the same area where the procedure will occur. They should not shave you with a razor.
- Wear special hair covers, masks, gowns, and gloves during surgery to keep the surgery area clean.
- Give you antibiotics before your surgery starts. In most cases, you should get antibiotics within 60 minutes before the surgery starts and the antibiotics should be stopped within 24 hours after surgery.
- Clean the skin at the site of your surgery with a special soap that kills germs.

What can I do to help prevent SSIs?

Before your surgery:

- Tell your doctor about other medical problems you may have. Health problems such as allergies, diabetes, and obesity could affect your surgery and your treatment.
- Quit smoking. Patients who smoke get more infections. Talk to your doctor about how you can quit before your surgery.
- Do not shave near where you will have surgery. Shaving with a razor can irritate your skin and make it easier to develop an infection.

At the time of your surgery:

- Speak up if someone tries to shave you with a razor before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.
- Ask if you will get antibiotics before surgery.

After your surgery:

- Make sure that your healthcare providers clean their hands before examining you, either with soap and water or an alcohol-based hand rub.

If you do not see your providers clean their hands, please ask them to do so.

- Family and friends who visit you should not touch the surgical wound or dressings.
- Family and friends should clean their hands with soap and water or an alcohol-based hand rub before and after visiting you. If you do not see them clean their hands, ask them to clean their hands.

What do I need to do when I go home from the hospital?

- Before you go home, your doctor or nurse should explain everything you need to know about taking care of your wound. Make sure you understand how to care for your wound before you leave the hospital.
- Always clean your hands before and after caring for your wound.
- Before you go home, make sure you know who to contact if you have questions or problems after you get home.
- If you have any symptoms of an infection, such as redness and pain at the surgery site, drainage, or fever, call your doctor immediately.

If you have additional questions, please ask your doctor or nurse.

Co-sponsored by:

SHEA IDSA American Hospital Association APIC CDC The Joint Commission

Figure 7

Preoperative Skin Preparation

The goal of preoperative preparation of the patient's skin is to reduce the risk of postoperative SSI by removing soil and transient microorganisms from the skin; reduce the resident microbial count to subpathogenic levels in a short period of time, with the least amount of tissue irritation; and inhibit rapid, rebound growth of microorganisms.

The 1999 Hospital Infection Control Practices Advisory Committee (HICPAC) guidelines for prevention of SSIs recommend that patients be required to shower or bathe with an antiseptic agent at least the night before the operative day.[69,70]

A systematic review of the evidence for preoperative bathing or showering with antiseptics for prevention of an SSI was conducted.[71] A total of six randomized controlled trials were included in the review. Chlorhexidine gluconate (CHG) 4% solution was compared to a placebo, to unmedicated soap, or to nothing (no wash), administered at various times preoperatively to all types of patients undergoing all types of surgeries. In two studies, washing was performed after hospital admission. In the other four studies, it was not clear if the antiseptic washes were administered at home or in the hospital. Compared to a placebo or soap, washing with CHG did not result in a reduction in SSI. Results were mixed when comparing CHG to no wash. One study found that the CHG wash, when compared to no wash, resulted in a statistically significant reduction in the number of patients with a SSI. Conversely, another study found no difference in the SSI rate between patients who washed with CHG and those who did not wash preoperatively. Finally, in one study, total body washing showed a statistically significant reduction in SSI compared with partial body wash. The authors concluded that there is no clear evidence to support the practice of preoperative showering or bathing with CHG.

Preoperative showering with agents such as CHG has been shown to reduce bacterial colonization of the skin, despite the fact that the evidence is inconclusive as to its link to prevention of SSIs. The act of washing and rinsing removes microorganisms from the skin. Some organisms may be difficult or impossible to kill with the application of CHG alone. *Staphylococcus aureus* is the most common organism causing SSIs and, in 2004, 63% of HAIs were from methicillin-resistant *Staphylococcus aureus*.[72] Many SSIs result from colonization of the surgical site with the patient's own flora, and colonization with *Staphylococcus aureus* is a known risk factor for SSIs.[73] Clinical trials support the use of preoperative antiseptic showers to reduce the number of microorganisms on the skin, including *Staphylococcus aureus*. However, to gain maximum antiseptic effect, it must be allowed to dry completely and not be washed off.[74]

A rinse-free cloth has been introduced as an alternative to CHG showers, and some data suggests ease of use and improved patient compliance as well as reduced rates of SSI.[75] One advantage of the cloth is that CHG is allowed to remain on the skin rather than being washed off. Edminston et al. compared the 2% CHG-impregnated cloth with 4% CHG as topical antiseptic for preparation of the skin prior to surgery, noting greater microbial reductions with the 2% cloth.[76] Further studies are needed to better evaluate the effectiveness of the rinse-free cloth in preventing SSIs.

One strategy to ensure compliance to organizational protocols is a comprehensive tool kit that includes interventions, references, product order information and patient education tools.

See appendix for sample policies

Nasal Decolonization

SSIs continue to be an important complication of orthopedic surgery. *Staphylococcus aureus*, particularly MRSA, remains a significant pathogen in postoperative orthopedic SSIs. A 2000 study that reviewed multiple risk factors

for SSIs following orthopedic surgery identified *Staphylococcus aureus* as the most important and independent risk factor for developing a postoperative infection.[77] An article published in the *New England Journal of Medicine* by Perl and colleagues studied whether preoperative intranasal application of mupirocin ointment would decrease the rate of infections at surgical sites. Results of this randomized control study concluded that use of mupirocin did decrease *Staphylococcus aureus* HAIs but not necessarily SSIs. However, authors suggested that the use of mupirocin was safe and cost-effective for patients with *Staphylococcus aureus* carriage.[78] A recently produced expert guidance document indicated that the role of decolonization therapy to prevent SSIs remains an unresolved issue.[79]

A recent publication by Lee et al. used a computerized model to evaluate the cost-effectiveness of routine preoperative screening and decolonization of orthopedic surgery patients who were colonized with MRSA. They concluded that this routine preoperative screening and decolonization of orthopedic surgery patients may save hospitals and third-party payers money while reducing postoperative infections, even in populations where there is low prevalence of MRSA.[80] A number of organizations report that they routinely screen for MRSA preoperatively and decolonize patients who carry MRSA, using mupirocin nasal ointment. Although organizations may vary in their approaches, it is important that protocols and strategies be standardized. Including these protocols in order sets and pathways is one method of standardization. Most recently Bode and others found that preoperative screening for S. aureus and then cleansing with CHG and intranasal mupirocin were effective in preventing SSI. This investigation did include patients undergoing orthopedic procedures. [see Bode LG, et al. NEJM 2010;362:9-17] One of the concerns with the use of intranasal mupirocin ointment, because it is an antibiotic, is development of resistance. Mupirocin resistance has been documented.[81] Protocols for decolonization in the home or outpatient setting may also be appropriate.

See appendix for sample protocol

The Perioperative Setting

The term "perioperative" encompasses the entire continuum of care for a patient undergoing an elective invasive procedure. While prevention of infection is the goal for all surgical patients, it is a primary concern for orthopedic surgery patients.[82] One of the expected outcomes for surgical intervention is that the patient is free from signs and symptoms of infection, such as pain, foul odor, purulent drainage, and/or fever through 30 days following the procedure.[83] Throughout the patient's perioperative journey, infection prevention requires the application of the principles of microbiology and aseptic practice,[84] as well as effective teamwork.

Preoperative Period

There are several aspects of care that reduce the risk for the development of an SSI in the preoperative period. As noted above, it is important to preoperatively evaluate patients for pre-existing medical conditions. A thorough assessment of the patient's susceptibility and risk factors for infection is a key nursing activity in the preoperative period. This assessment should include identification of the patient's specific risk factors, such as health problems and situations predisposing the patient to infection by:[85]

- identifying pathophysiological risk factors, including, but not limited to, altered gastrointestinal system; anatomic abnormality; autoimmune diseases; blood dyscrasias; chronic diseases; immunodeficiency disorders; impaired circulation; periodontal disease; obesity; sleep deprivation
- identifying treatment-related risk factors, including, but not limited to, chemotherapy; dialysis; medications (i.e., antacids, antibiotics, antifungal agents, antiviral agents, immunosuppressants, steroids); organ transplants; presence of implants; presence of invasive lines; radiation therapy; recent blood transfusions; surgery
- identifying personal and environmental risk factors, such as bites; exposure to contagious agents (healthcare-associated or community-acquired); history of infections; lack of immunizations; personal hygiene factors; malnutrition; moist skin areas; prolonged immobility; smoking; stress; thermal injuries; trauma
- identifying patients at high risk for transmitting HAIs, e.g., persons with antibiotic- or medication-resistant microorganisms, prion diseases, tuberculosis, preoperative colonization of *Staphylococcus aureus*
- identifying maturational risk factors, including but not limited to:
    - newborn: lack of maternal antibodies; lack of normal intestinal flora; open wounds; immature immune system
    - infant or child: lack of immunizations
    - elderly: debilitated, diminished immune response, friable tissues and chronic diseases
- identifying recent history of travel inside or outside the United States
- noting the ASA physical status classification system
- using Spaulding's wound classification system
- determining if the patient is at high risk for infection from endogenous or exogenous sources
- identifying those individuals at high risk for HAIs; a person is considered to be at high risk if he/she has one or more contributing factors or one or more predictors.

Assessment parameters include:

- infection predictors: length and type of procedure; presence of other devices or instruments
- confounding factors: age, nutritional status, health status.

In the ambulatory surgery practice setting, the preoperative nursing assessment is often performed on the day of surgery. Assessments for special populations, such as pediatric patients, older adult patients, high-risk patients, and patients with special needs, may require additional preparation.[86]

Reinforcement of patient education is another vital component in preventing an SSI. When the patient arrives in the preoperative area, a nurse should verify that all preoperative protocols were followed (e.g., preoperative shower or skin cleansing, etc.). Other points to emphasize include questioning the patient as to any skin irritation or hypersensitivity in prior surgical experiences or any new skin conditions, such as boils, eruptions, or rashes.

Hand hygiene, recognized as the single most important method of decreasing HAIs,[87] is a key infection prevention strategy in the preoperative period. Since there are many opportunities for contact in the preoperative setting, organisms that are present on a patient's skin, or shed onto inanimate objects in close proximity to a patient, may be transferred to the hands of caregivers. If hand hygiene is inadequate or omitted entirely, the contaminated hands of the care provider may come in direct contact with another patient. To mitigate the risk of cross contamination, care providers must perform hand antisepsis before and after contact with a patient or objects in close proximity to the patient. If hands are visibly soiled, they should be washed with soap and water for a minimum of 10-15 seconds. The basic principles of antisepsis are especially important, given the volume of orthopedic procedures performed in ambulatory surgery settings where large volumes of patients are often seen in a very short time span.

Intraoperative Period

Skin Antisepsis

Once the patient is placed securely on the OR bed and monitoring devices are applied, the specific type of anesthesia, e.g., general, regional, or monitored anesthesia care (MAC), is administered. The patient is then positioned to accommodate the type of procedure that will be performed. Once the patient is properly positioned, the surgical team then determines the type of skin preparation that will be used. The selection of the preoperative skin antiseptic agent should be based on patient assessment for any allergy or sensitivity to skin preparation agents. The preoperative antiseptic agent should:[88]

- significantly reduce microorganisms on intact skin
- contain a non-irritating antimicrobial preparation
- be broad spectrum and fast acting
- have a persistent effect.

Perioperative personnel must be aware of the clinical considerations regarding the various types of skin antiseptic agents. Some skin preparations that are used include:

- PCMX (has been proven to be minimally effective in the presence of organic matter. The FDA has classified PCMX as a category III; it is still being evaluated.Povidone iodine is an aqueous based prep that is safe and effective in concentrations from 5-10% (0.5-1% available iodine). It has bactericidal activity against gram-positive and gram-negative bacteria. It is also active against mycobacteria, fungi and viruses. Warnings include: avoid "pooling" beneath the patient; prolonged exposure may cause irritation or, rarely, severe skin reactions; and, do not heat prior to application.
- Contraindications in the form of aqueous solutions include irritation and toxicity. If left on the skin for extended periods, it can cause "burning" of tissue.
- Aqueous Chlorhexidine gluconate (CHG) antiseptics are available in 2% or 4% concentrations. CHG exhibits excellent activity against gram-positive and good activity against gram-negative vegetative

organisms and fungi. CHG is also known to have excellent persistent activity.[89] Warnings include avoidance of use on the head or face, the genital area or contact with the meninges.

- Two types of skin preparations available for use appear to have superior efficacy in terms of antimicrobial properties. These include but are not limited to iodophor based compounds with alcohol and Chlorhexidine with alcohol. The results of a randomized, double-blind, placebo-controlled trial published in January 2010 in the *New England Journal of Medicine* in clean-contaminated surgery identified CHG with alcohol as superior to iodoform-based compounds.[90] This study did not compare iodophor based compounds with alcohol to chlorhexidine with alcohol. An observational study published by Swenson, et al. compared the effects of different skin preparation solutions on surgical-site infection rates. An iodine preparation with alcohol was associated with the lowest infection rate. However both the iodine with alcohol and the povidone iodine followed by alcohol were associated with significantly lower infection rates than the CHG in alcohol group.[91]

Two additional observational trials among patients undergoing orthopedic procedures offer additional support for CHG in alcohol.[92,93] There is also indirect supportive evidence from preparation of skin prior to insertion of central lines that demonstrates CHG-IPA is more effective than povidone iodine in preventing catheter-related bloodstream infection. Still a definitive randomized trial comparing the iodine in alcohol to CHG in alcohol is needed.

- Any skin preparation using alcohol MUST be allowed to dry before beginning surgery due to the flammability of the product. Special care must be taken to allow the prep to dry completely especially before use of electro-surgical equipment.
- The National Quality Forum has recommended use of an antiseptic that contains a combination of CHG or iodine in combination with alcohol in their safe practices for surgery. Conclusions could be drawn that the rapid bactericidal activity of alcohol may be key to successful skin prep and that dual agent skin preps are superior. It is important to note that any product containing alcohol must have a second active ingredient:such as those described above.

Skin flora, particularly *Staphylococcus aureus* and coagulase-negative *Staphylococcus*, are the most common pathogens found in SSIs following orthopedic surgery. Bacteria can enter the wound through the surgical incision. If an implanted prosthesis is present, bacteria can lodge in or near the prosthesis. Because the skin is the easiest access to the wound, adequate skin preparation is a vitally important process.[94]

Surgical Hand Antisepsis

Surgical hand antisepsis, performed before donning sterile gloves, is another important factor in SSI prevention. The purpose of a surgical hand antisepsis is to reduce transient and resident microorganisms on the hands and maintain the bacterial level below baseline, as this may reduce HAIs.[95] In the U.S., a standardized surgical hand scrub or rub should be performed, using either an antimicrobial surgical agent or an alcohol-based antiseptic surgical hand rub with documented persistent and cumulative activity that has met the U.S. FDA regulatory requirements for surgical hand antisepsis. Outside the U.S., products should comply with that jurisdiction's relevant licensing and regulatory authority requirements, which may be different than those of the FDA.

A Cochrane review found alcohol-based rubs to be as effective as aqueous solutions for preventing SSIs in patients.[96] Other investigators reported that the use of scrub brushes had no positive effect on asepsis and may actually increase the risk of infection as a result of skin damage.

Antibiotic Prophylaxis

As part of The Joint Commission's Universal Protocol for Preventing Wrong Site, Wrong Procedure, and Wrong Person Surgery™, the surgical time-out, performed immediately before starting the invasive procedure or making

the incision, is now a standard of care in surgical settings.[97] Many facilities include antibiotic prophylaxis as a routine part of the time-out. An important consideration in total knee replacements is the infusion of the antibiotic prior to inflation of the tourniquet.

Other Intraoperative Factors

Air Quality

The most common method by which bacteria can gain access into a wound is when the wound is open during the intraoperative period. The quality of air entering the OR should be carefully controlled.[98] Operating room air may contain microbial-laden dust, lint, skin squames, or respiratory droplets.[99] The risk of contamination can be minimized by providing consistent adequate air flow. There are increased numbers of orthopedic cases performed in ambulatory centers which do not operate on a 7 day a week schedule. However, the need to have uninterrupted air flow is vitally important. If airflow is interrupted, rapid air turbulence can stir settled particles, enabling them to become airborne thus increasing the risk for wound contamination.[100] Additional infection prevention measures such as laminar flow in the operating room and body-exhaust surgical suits are other techniques that have been used to prevent infection.[101] Laminar air flow refers to systems that produce little or no turbulence. It is not clear that these measures are essential. As an example, prospective and controlled studies demonstrated a decrease in rates of surgical site infections in total hip and knee prosthesis procedures when laminar airflow technology was used.[102] However, the value and cost-effectiveness of laminar airflow is questionable when surgery occurs in modern facilities that have high rates of air exchange and antimicrobial prophylaxis is given.[103,104] In a case control study of 26,505 patients undergoing total hip or knee replacement, the infection rate was 1.8 percent and laminar flow ventilation was not a significant factor in reducing infections in a univariate analysis. Computational fluid dynamic (CFD) modeling has been used to assess impact of variations in heating, ventilation and air conditioning (HVAC) parameters on air quality in the OR. This analysis found that vertical, unidirectional, low velocity supply air with returns at various heights in opposite corners was optimal for removal of airborne particulates in an OR. This model has been adopted in the Facility Guideline Institute's Guidelines for Design and Construction of Healthcare Facilities.

Recommendations [ANSI/ASHRAE/ASHE Standard 170: *Ventilation of Health Care Facilities* :

The ceiling in the OR should be monolithic

- air entering the OR should be sequentially filtered through two filters: the first of which should be rated at 30% efficient; the second at 90% efficient.
- The OR should be maintained in positive pressure
- a minimum of 20 air exchanges per hour, with 4 of these from outside air are recommended.
- The airflow should be unidirectional, downwards, with an *average velocity* of the 25 to 35 cfm/ft2 (127 L/s/m2 to 178 L/s/m2) delivered by non-aspirating diffusers. The diffusers should provide an airflow pattern over the patient and surgical team.
- Details on temperature, humidity, etc., are provided in the 2010 FGI Guidelines.
- There should be at least two returns low on sidewalls or at opposite corners with the bottom of these installed approximately 8 in. (203 mm) above the floor.

Double Gloving

The orthopedic literature contains a number of articles on glove use and double gloving. Most experts agree that the addition of a second pair of surgical gloves significantly reduces perforations to innermost gloves and provides a protective barrier to both the patient and surgeon.[105] Therefore, healthcare practitioners should double glove during invasive procedures; a practice supported by AORN, the CDC, the American College of Surgeons, and AAOS.[106]

Traffic Patterns

Studies have also shown that the number of individuals in the operating room and the amount of movement of these individuals within the OR both increase the number of colony-forming units as measured by settle plates within the room.[107] Olsen et al. reported that two or more residents participating in the operative procedure was an independent risk factor for SSIs in spine surgery.[108] Therefore, it is important that movement of personnel is kept to a minimum while invasive procedures are in progress.

Furthermore:[109]

- the doors to the OR should kept closed except during movement of patients, personnel, supplies and equipment, in order to maintain positive pressure; and
- talking and the number of people present in the OR should be minimized during procedures since movement, talking, and uncovered skin areas can contribute to airborne contamination.

Gowns and Drapes

The materials used in gowns and drapes are protective barriers against the transfer of microorganisms, particulates, and fluids to minimize strikethrough and the potential for personnel contamination. Microorganisms can be transferred through barrier materials by wicking of fluids and/or pressure or leaning on a flooded area of the product. Mechanical action such as pressure can result in both liquid and dry penetration of microbes if the pressure exceeds the maximum level of resistance that the material provides.[110] Surgical gowns and drapes should be resistant to tears, punctures, and abrasions. The inability to withstand tears, punctures, and abrasions may allow for passage of microorganisms, particulates, and fluids between sterile and nonsterile areas and expose patients to exogenous organisms.

Bone Cement

Another relevant intraoperative factor in total joint arthroplasty (TJA) is the use of methyl methacrylate, or bone cement. Initially, bone cement was used as a spacer to maintain the joint space and soft-tissue tension for subsequent reconstruction; when antibiotics were added to the cement, they were found to elute into involved tissue area, thus aiding in the eradication of an infection.[111] Antibiotic laden cement (ABLC) was released for commercial distribution in the United States in May 2003, specifically for the treatment and reimplantation of infected arthroplasties. In Europe, Australia and likely other settings, ABLC has been available for many years. The indications and scientific evidence for its use have expanded to primary arthroplasty; however, the use of ABLC for this purpose remains controversial in the United States. Since its release, a variety of cements, cement preparation methods, antibiotics, and doses have been used with varying outcomes. It is important for the OR team to keep in mind that that the current principles of bone cement preparation do not apply in the treatment of infection.

Although the addition of more than 2 g of antibiotic per 40 g of cement reduces the antibiotic's mechanical strength, this is irrelevant to the treatment of infection. Vacuum mixing decreases the cement's porosity, thereby reducing elution of the antibiotic; for this reason, vacuum mixing is contraindicated. Homogeneous, commercial mixing of the antibiotic in cement results in better mechanical strength, but potentially less elution. Using what is considered to be a traditionally poor mixing technique, i.e., "whipping" of the mixture, may actually *improve* elution. Hand mixing, without fully crushing the antibiotic crystals, may also improve elution. Normally, cement is used only in powder form because the liquid reduces mechanical strength. In this application, however, the liquid may increase the elution rate of the antibiotic.

Sterility Assurance

Inadequate sterilization of surgical instruments has resulted in SSI outbreaks.[112] Sterilization processes should be monitored to detect potential failure modes with the goal of improving patient outcomes. A variety of monitoring tools are used to help ensure sterility, such as physical monitors, chemical indicators and biological indicators. These monitoring tools are used to help ensure that instruments and supplies being used on patients are free from microorganisms. Biological indicators have the ability to detect conditions that are not able to kill spores.

The importance of routine inspection of sterile supplies cannot be underestimated. Event-Related Sterility refers to the maintenance of the sterility of packages until they are used. This is based upon the concept that contamination of a sterile item is event-related, and the probability of its occurrence increases over time and with increased handling, storage or environmental conditions. All items should be inspected immediately before being placed on the sterile field and should be visually inspected for proper packaging, processing, package integrity, and inclusion of the sterilizer indicator. If an expiration date is provided, the date should be checked before the package is opened and not used if the item is outdated. The Association for Advancement of Medical Instrumentation (AAMI) has revised the former term "flash sterilization" to immediate use steam sterilization as "the process for steam sterilization of patient care items for immediate use."[113] Although the need for emergency sterilization of any equipment may arise during a surgical case, this process should not be used for convenience or as an alternative to purchasing additional equipment. Flash sterilization is not recommended for implantable equipment such as screws, plates or wires frequently used in orthopedic surgery. Biological indicators (BI) within Process Challenge Devices should be used to monitor every load containing implants. Implants should be quarantined until the results of the BI testing are available.[114]

See Appendix for a sample perioperative nursing care plan.

The Surgical Team: The Importance of Teamwork

In the dynamic and often hectic surgical practice environment, the importance of teamwork as a factor in infection control and prevention must be recognized. There is increasing evidence that teamwork and collaboration are essential to improved patient outcomes. However, because the word "team" has been used so loosely and for so long in healthcare, in many ways it has lost its true meaning. For example, six individuals in a room, each performing his or her own job, can be called a group, but not necessarily a team, since a team is defined by its members' interactions, interdependence, and shared goals.[115]

A team is defined as a group of two or more individuals who must interact and adapt to achieve a common objective.[116] There are two important aspects of the nature of teamwork: the individual's ability to function as a member of the team; and the entire team's ability to function as an efficient collective entity. There are several factors that influence the team's performance, such as task demands, team composition, and the organizational context. Teams must be able to accomplish tasks as a unit, although team members may have individual tasks that change from member to member and from day to day. Consequently, each team member must possess general team competencies and skills that can be transferred from task to task and from team to team. One primary objective in team training is encouraging participation from individual team members, while developing the knowledge and skills necessary to successfully perform as a group member. As a result, team training, involving perioperative staff, surgeons and other members of the surgical team, has become routine in many organizations throughout the country.

In the surgical practice setting, the traditional hierarchical culture has been blamed for the failure of individuals to function as teams in this environment.[117] In this setting, as with all of healthcare, there is a close correlation between communication and safe care.[118] An ethnographic study of OR functioning classified 30% of procedurally

relevant communications between team members as communication failures; more than one-third of these communication failures led immediately to noticeable and potentially dangerous effects on system processes, such as inefficiency, team tension, resource waste, work- around, delay, patient inconvenience, and procedural error.[119] Poor teamwork and communication are latent human failures that must be addressed to achieve an effective safety program within an organization.[120]

Successful surgical intervention depends on interdisciplinary teamwork, which consists of both technical and non-technical skills, defined as follows:[121]

- technical skills consist of knowledge of anatomy, pathology, dexterity, hand-eye coordination, and technical proficiency
- non-technical skills include significant cognitive and interpersonal skills of health care professionals, such as communication, teamwork, leadership, situational awareness, and decision-making.

It has been shown that many of the underlying causes of errors stem from the non-technical aspects of care, rather than a lack of technical expertise. Further, it is stated that improving non-technical skills could reduce the number of errors during surgery, thereby improving patient safety and reducing the risk for SSI.[122]

An example of effective teamwork in the OR is the surgical time-out noted above, which is a key component of The Joint Commission's Universal Protocol for Preventing Wrong Site, Wrong Procedure, and Wrong Person Surgery.™ In addition to confirming appropriate antibiotic prophylaxis, for orthopedic surgical patients, it is also important to:

- identify all items that are required for the procedure and use a standardized list to confirm their availability; these items include:[123, 124, 125]
  - relevant documentation (e.g., history and physical, signed procedure consent form, nursing assessment, and pre-anesthesia assessment)
  - labeled diagnostic and radiology test results (e.g., radiology images and scans, or pathology and biopsy reports) that are properly displayed
  - any required blood products, implants, devices, and/or special equipment for the procedure; items that are to be available should be matched to the patient in the procedure area
- agree, at a minimum, on the:
  - correct patient identity
  - correct site, including laterality and the implant to be used (the site should be marked and visible)
  - procedure to be done
  - need to administer antibiotics or fluids for irrigation purposes
  - necessary safety precautions, based on patient history or medication use
- confirm sterility indicators
- identify and address any equipment issues or concerns.

Documentation of the completion of the time-out should include: the correct patient; correct site and side; agreement to procedure; correct patient position; and implants and/or special equipment or special requirements available. See the ASC success story below for an example of teamwork in promoting patient safety related to antibiotic prophylaxis.

Teamwork in Action: An ASC Success Story

A busy ASC developed an effective process for preoperative administration of antibiotics for orthopedic surgery patients in an effort to streamline patient preparation and reduce medication errors as a result of its performance improvement initiatives and SCIP requirements.

In that system, the pharmacy prepares the antibiotic per the physician's order. Upon admission to the pre-op holding area, the RN verifies the patient's allergies and the physician order, and then tapes the prepared antibiotic to the IV solution bag. The CRNA then administers the antibiotic when the patient is being transported to the OR. This process allows the antibiotic to be administrated within one hour prior to the incision. During the pre-procedure time-out, the OR team – RN, CRNA, and surgeon – ask if the antibiotic has been administered. Antibiotic administration is then documented in the electronic record. If the patient requires vancomycin, the preadmission testing RN calls the patient to request that he/she arrive two hours prior to the scheduled surgery time to allow adequate time for administration of the antibiotic.

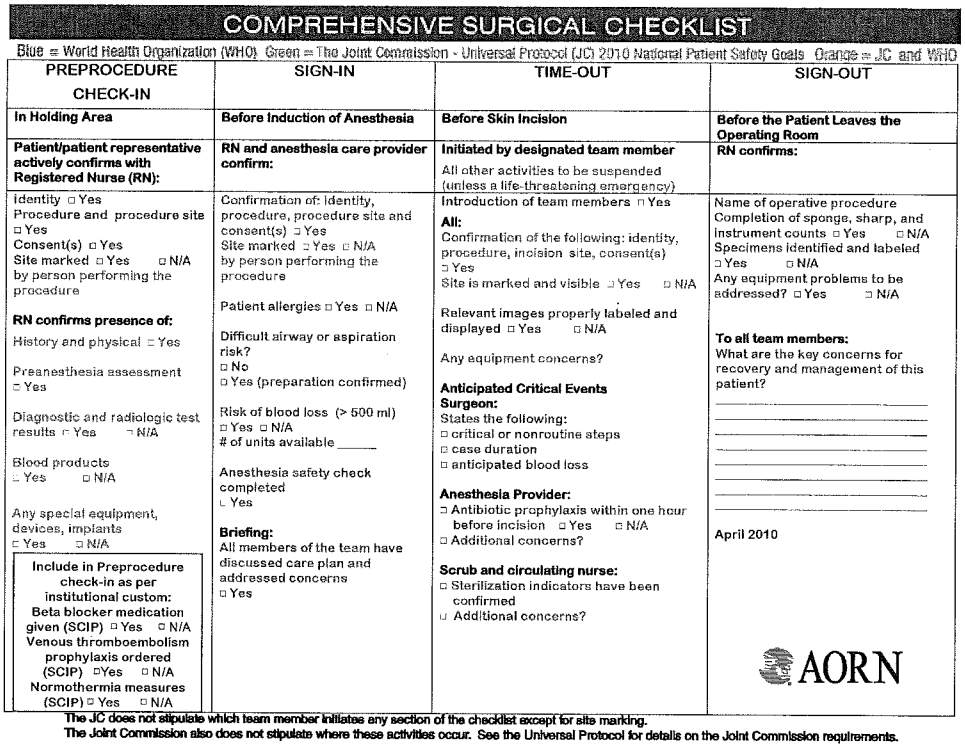
Example provided by Donna Bowers, RN, Executive Director Asheville Surgery Center, Asheville,

Teamwork in Action: An Inpatient Success Story

The infection prevention team, in collaboration with surgeons, nursing and perioperative staff, developed a comprehensive approach towards reduction of SSIs on the orthopedic service. Noting that more than 50% of the orthopedic SSIs were caused by MRSA, and that overall rates of SSI in total joint replacements were higher than the NHSN mean, a comprehensive orthopedic infection elimination program was instituted. This program consisted of skin preparation with CHG cloths the night before and morning of surgery, preoperative screening for MRSA colonization, addition of intravenous vancomycin prophylaxis to the standard antibiotic prophylaxis protocol for identified carriers, and administration of intranasal mupirocin ointment to all patients, regardless of colonization status for five days, beginning the day before surgery. This comprehensive approach required extensive teamwork and collaboration. Preoperative prophylaxis protocols and mupirocin decolonization therapy was added to order sets and pathways. Surgeons, perioperative and postoperative staff received extensive education. To showcase progress and motivate staff, results were displayed prominently on the post-op unit. The service has not had a MRSA SSI in a year, and overall SSI rates on orthopedics decreased by 60%.

Example provided by Michelle Vignari, RN, CIC, Rochester General Hospital, Rochester,

Checklists, which can be customized by each facility, have also been developed to assist the perioperative team in conducting and documenting the surgical time-out. See below for a sample checklist developed by AORN.



COMPREHENSIVE SURGICAL CHECKLIST

Blue = World Health Organization (WHO) Green = The Joint Commission - Universal Protocol (JC) 2010 National Patient Safety Goals Orange = JC and WHO

PREPROCEDURE CHECK-IN	SIGN-IN	TIME-OUT	SIGN-OUT
In Holding Area	**Before Induction of Anesthesia**	**Before Skin Incision**	**Before the Patient Leaves the Operating Room**
Patient/patient representative actively confirms with Registered Nurse (RN):	**RN and anesthesia care provider confirm:**	**Initiated by designated team member** All other activities to be suspended (unless a life-threatening emergency)	**RN confirms:**
Identity ☐ Yes Procedure and procedure site ☐ Yes Consent(s) ☐ Yes Site marked ☐ Yes ☐ N/A by person performing the procedure **RN confirms presence of:** History and physical ☐ Yes Preanesthesia assessment ☐ Yes Diagnostic and radiologic test results ☐ Yes ☐ N/A Blood products ☐ Yes ☐ N/A Any special equipment, devices, implants ☐ Yes ☐ N/A **Include in Preprocedure check-in as per institutional custom:** **Beta blocker medication given (SCIP) ☐ Yes ☐ N/A** **Venous thromboembolism prophylaxis ordered (SCIP) ☐ Yes ☐ N/A** **Normothermia measures (SCIP) ☐ Yes ☐ N/A**	Confirmation of: Identity, procedure, procedure site and consent(s) ☐ Yes Site marked ☐ Yes ☐ N/A by person performing the procedure Patient allergies ☐ Yes ☐ N/A Difficult airway or aspiration risk? ☐ No ☐ Yes (preparation confirmed) Risk of blood loss (> 500 ml) ☐ Yes ☐ N/A # of units available _____ Anesthesia safety check completed ☐ Yes **Briefing:** All members of the team have discussed care plan and addressed concerns ☐ Yes	Introduction of team members ☐ Yes **All:** Confirmation of the following: identity, procedure, incision site, consent(s) ☐ Yes Site is marked and visible ☐ Yes ☐ N/A Relevant images properly labeled and displayed ☐ Yes ☐ N/A Any equipment concerns? **Anticipated Critical Events** **Surgeon:** States the following: ☐ critical or nonroutine steps ☐ case duration ☐ anticipated blood loss **Anesthesia Provider:** ☐ Antibiotic prophylaxis within one hour before incision ☐ Yes ☐ N/A ☐ Additional concerns? **Scrub and circulating nurse:** ☐ Sterilization indicators have been confirmed ☐ Additional concerns?	Name of operative procedure Completion of sponge, sharp, and instrument counts ☐ Yes ☐ N/A Specimens identified and labeled ☐ Yes ☐ N/A Any equipment problems to be addressed? ☐ Yes ☐ N/A **To all team members:** What are the key concerns for recovery and management of this patient? _____ _____ _____ _____ _____ _____ _____ April 2010 AORN

The JC does not stipulate which team member initiates any section of the checklist except for site marking.
The Joint Commission also does not stipulate where these activities occur. See the Universal Protocol for details on the Joint Commission requirements.

Figure 8

The Universal Protocol is implemented most successfully in facilities with a culture that promotes teamwork and where all individuals feel empowered to protect patient safety.[126] A just culture is an environment where actions are analyzed to ensure that individual accountability is established and appropriate actions are taken; such a culture will provide an atmosphere where perioperative team members can openly discuss patient safety or infection control issues, such as errors or system issues, without fear of reprisal.[127,128] Because analyzing medical errors is an integral part of improving patient safety, analytical methods are ineffective if team members are bound by a "code of silence" or are fearful of retribution. Creating a just culture promotes both professional accountability and reporting of medical errors by fostering a professional milieu that includes reporting systems and processes for improving patient safety through organized analysis.

Patient hand-off is also an important aspect of care related to infection prevention and communication in the perioperative setting. Patient hand-off is defined as the point at which a patient is transferred, either physically to a different part of the healthcare facility or administratively when a new member of the care team takes responsibility; this is a period of high risk to the patient, because the hand-offs usually occur in a chaotic environment.[129] The surgical patient is more susceptible to hand-off errors because of the numerous checkpoints and transitions that occur throughout the patient's perioperative journey, e.g. shift change or break relief; report to the post-anesthesia care unit (PACU) nurse; hand-off to the inpatient unit.[130] The failures in communication and teamwork associated with hand-offs may be among the most important contributors to preventable adverse events in healthcare. Initiatives are underway in many organizations to improve communication within and between healthcare teams to ensure that patient care information is communicated consistently during all patient hand-offs and other patient care transitions. For example, pertinent information related to the patient's medical history, allergies, the operative procedure, and administration of antibiotic therapy throughout all phases of perioperative care must be communicated accurately at all patient hand-offs in order to reduce the risk for SSI and adverse effects.

Another essential aspect of teamwork in the care of the orthopedic surgery patient is effective collaboration between the perioperative nurse and the IP. Both of these professionals possess knowledge of surgical procedures and infection prevention protocols, including literature findings and practice guidelines; additionally, they both have a broad range of communication and leadership skills (see Table Y).[131] Today, successful utilization of these skills requires an evolving set of new skills due to the change in reporting structures, treatment practices, job responsibilities, and work force composition. For example, as noted above, the traditional hierarchical culture, i.e., the flow of power and authority from the "top down," is being replaced by horizontal, lateral interactions among staff members with equal power and authority. As a result, both perioperative nurses and IPs may find that they need to influence the behavior of other team members over whom they have no direct authority. These new roles encourage interdepartmental teamwork by sharing information about safety, for the wellbeing of both patients and coworkers.

Table Y: Comparison of Expertise of the Perioperative Nurse and IP

Perioperative Nurse	IP
• Clinical expertise; in-depth knowledge of perioperative clinical needs • Knowledge of findings in nursing and perioperative literature • A patient care focus: both patient safety and infection prevention • Ability to prioritize patient needs, surgeon preferences, costs • Representation to achieve consensus within the surgical team • A "surgical conscience" • Knowledge of regulations and compliance in perioperative areas identified by the state health department, The Joint Commission, and CMS	• Clinical expertise on infection risk, control, and prevention • Knowledge of findings in infection control and prevention literature • Experience of compliance with policies, procedures, and accepted practices • A focus on patient and healthcare worker safety; identifying infection safety risks both to patients and staff members, with an emphasis on control and prevention • An understanding of compliance with regulations set forth by OSHA, U.S. FDA, and CDC • Ability to apply national guidelines in a cost-effective manner • A "facility conscience"

This collaboration is particularly relevant in the selection, use, and standardization of products and medical devices. The goals of product standardization and value analysis processes are to select functional and reliable products that are safe, cost-effective, and promote quality care. A multidisciplinary committee, with representation by IPs, should be assembled in order to select the most appropriate products and medical devices.[132] Together, perioperative nurses and IPs not only offer leadership in product evaluation, selection, and introduction into clinical practice, they can also integrate this process into established practices based on standards of safety and quality of patient care. Ultimately, this results in the incorporation of new products and technology efficiently and correctly, without compromising the quality of patient care.[133]

Collaboration between perioperative personnel and IPs is also valuable in the ambulatory surgery setting. As previously noted, in the U.S., additional work by the HHS will include ASCs as part of the Tier Two Action Plan to prevent HAIs.[134] The new infection prevention and controlrequirements set forth by CMS will help to ensure that ASCs develop infection prevention policies based upon nationally recognized guidelines and that the policies are under the direction of a professional trained in infection control.

However, the ultimate accountability for HAI prevention and safe care rests with the ASC itself. ASCs need to proactively embrace a culture of safety and make staff allocation of resources and education for HAI risk reduction

a priority. Understanding where and in what ways the risks and hazards associated with infections are embedded in the process and structure of care within ASCs is vital to the development of safe practices for HAI prevention. Moreover, ASCs may benefit from regular access to an individual trained or certified in infection prevention, who could provide more customized education for the staff and therefore meet the specific needs of the facility better than the more generalized information provided by non-customized educational sessions on infection prevention and control.

Postoperative Period

Upon completion of the procedure, a sterile dressing is applied to the wound and secured with tape, based on patient characteristics such as skin condition, allergies, amount of strength and elasticity required, and anticipated frequency of dressing changes.[135] For wounds that are primarily closed, the sterile dressing should remain in place for 24-48 hours postoperatively. There is some debate over occlusive versus absorptive dressings. Hutchinson and McGuckin reviewed 111 studies and found that the rate of infection under occlusive dressing was lower than under non-occlusive dressings (2.6% compared with 7.1%)[136] A 2003 review of dressings recommended three layers: a non-adhering layer, an absorptive layer and an occlusive dressing.[137]

In the PACU, all surgical dressings should be checked for drainage and closure.[138] The PACU nurse should measure the patient's temperature upon admission and apply active warming measures, such as forced-air warming, until the patient reaches a temperature of ≥36°C. Because patients undergoing orthopedic surgery can suffer dire consequences from an infection, strict asepsis in changing dressing and handling drains is required. If drains are present to minimize blood accumulation and the potential for infection, care must be taken to ensure that these drains maintain suction. The characteristics of wound drainage, e.g., type, consistency, amount, and color should be observed and evaluated for signs of infection; additional PACU interventions include:[139]

- assess the wound if the patient has signs or symptoms of infection, such as a fever, unusual wound pain, redness and heat at the wound site, or edema
- examine and compare the characteristics of the incision regularly, observing for well-approximated incision edges and signs of infection (e.g. heat, redness, swelling, unusual pain, odor), dehiscence, or evisceration.

The PACU nurse should also assess the patient for the development of compartment syndrome as an infection prevention measure. Compartment syndrome develops when swelling or bleeding occurs within a compartment, i.e., the fascial sheath that encloses bone, muscle, nerves, blood vessels and soft tissue.[140,141] Because the fascia does not stretch, the increased pressure placed on the capillaries, nerves, and muscles in the compartment causes circulatory compromise, which leads to diminished function of the limb and tissue necrosis. The two primary causes of increased pressure in the compartment are constriction from the outside, such as a cast or bandage that reduces the size of the compartment; or increased pressure from within the compartment, e.g., swelling. The characteristic symptoms of compartment syndrome are intense pain that is unrelieved by conventional methods, paresthesia, and sharp pain on passive stretching of the middle finger of the affected arm or the large toe of the affected leg. Progressive symptoms include decreased strength, sensation, and capillary refilling; peripheral pulses are not usually compromised. In order to prevent tissue damage and reduce the risk for infection, a nurse must intervene immediately by elevating the extremity, applying ice, and releasing the restrictive dressing.

At the time of discharge, written postoperative and follow-up care instructions should be provided to the patient. These instructions should reflect the patient's individual informational needs specific to home care, response to unexpected events, and physician follow-up.[142] It is important that the patient be compliant with postoperative instructions. The patient must watch for signs and symptoms of infection after surgery that include, but are not limited to, fever, malaise, erythema of incision site, and drainage from incision site. Comorbidities that are detrimental to healing include, but are not limited to, obesity, immunosuppression, use of steroids, chronic illness, diabetes, and advanced age.

Summary of Key Points[143,144]

Key Point	Recommendation
Vertical, Unidirectional Flow at low velocity over the OR table	A minimum of 20 air changes/hour
Body Evacuation Suits	Generally recommended for total joint arthroplasty
Surgical Hand Antisepsis	Use either an antimicrobial surgical scrub agent or an alcohol-based surgical hand rub with documented cumulative and persistent activity. Use of alcohol product immediately reduces resident flora by 95% and continues to act for hours
Hair Removal	Hair removal: either no hair removal or removal with clippers immediately before surgery; razors are not appropriate and are associated with an SSI rate of 3.1%-20%
Skin Prep	Preoperative skin cleansing (CHG) Surgical prep Use a dual agent with alcohol and active ingredient (CHG, iodine povacrylex, povodine iodine) Allow prep to dry completely Avoid pooling of the prep.
Drains	Controlled studies show no benefit Meta-analysis: shows increased transfusions and no benefit in total knee or hip
Antibiotic Cement	Norwegian Arthroplasty Register 2006: evidence of effectiveness; now widely used in primary surgery in Europe FDA-approved in the U.S. for revision surgery
Traffic Control	Multiple studies support limiting the number of and movement of OR personnel
Maintenance of Body Temperature	Active warming of patients whose core temperature is at or below 36 degrees C
Universal Protocol/Time-Out	Identify all items required for the procedure: • relevant documentation • labeled diagnostic and radiology test results are properly displayed • any required blood products, implants, devices, and/or special equipment for the procedure; match the items to the patient in the procedure area • use a standardized list to confirm availability Agree on the: • correct patient identity • correct site (site is marked and visible) • procedure to be done Confirm sterility indicators Identify and address any equipment issues or concerns Document the time-out

Future Trends

Although the use of antimicrobial sutures is not a routine practice, the benefits are becoming increasingly apparent. Recent evidence-based clinical studies have demonstrated both the clinical and economic benefit of this technology.[145] Future studies may prove useful. Likewise, advances in antimicrobial coatings for products such as implants, instruments, equipment and the environment may provide additional support to reach the goal of zero SSIs.[146] The practice of prescreening selected patients for MRSA prior to surgery is controversial. However, future trends could incorporate this as a recommended practice, as part of a comprehensive program to eliminate SSIs in orthopedic surgery, especially in cases involving an implantable device. Future trends in preoperative preparation will likely include standardized protocols for preoperative showers and state-of-the-art skin cleansing, which will become the recommended standard of practice. Innovative techniques for postoperative care, including optimal dressing materials and techniques, will most likely become the standard of care.

Targeting Zero

As healthcare has attempted to move from silos of care driven by specialized groups to collaborative groups and integrated systems, it is imperative that both processes and products are designed and implemented in the most effective and efficient manner to achieve desired outcomes. Central to this theme is the philosophy of targeting zero. Targeting Zero is the philosophy that every healthcare institution should be working toward a goal of zero HAIs. While not all HAIs are preventable, APIC believes that all organizations should set the aspirational goal of elimination and strive for zero infections. Every HAI impacts the life of a patient and a family, and even one HAI should be considered too many.

To improve our results, it is important to collaborate with all stakeholders in the development of a culture that holds each other accountable for adhering to proven infection prevention measures and practices. Essential components include a focus on patient-centered care, an engaged and committed leadership, teamwork and communication. Several organizations critically evaluate each individual event to identify gaps and opportunities in developing and fostering a culture that even one infection is "one too many."

(A sample critical event analysis is included in the Appendix.)

LESSONS LEARNED

- In today's surgical practice environment, challenged by newly recognized pathogens and well-known pathogens that have become resistant to current therapeutic modalities, all members of the healthcare team must remain aware of the impact of HAIs in orthopedic surgical patients and must implement evidence-based prevention strategies to reduce the incidence of HAIs.
- Given the associated unnecessary morbidity and mortality that could be prevented, the suffering that could be eliminated, and the money that could be saved, no healthcare organization can risk ignoring the benefits of effective strategies aimed at preventing HAIs.
- Effective teamwork and communication among all members of the surgical team is an important factor in improving patient outcomes.
- Various tools and checklists, which can be customized by the facility, have been developed to assist in preventing SSIs in orthopedic surgical patients.
- Perioperative personnel and IPs are in a unique position to provide leadership in improving the quality and safety of patient care; by forming an alliance, they can be effective change agents in product evaluation and selection, thereby promoting positive patient outcomes.

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Appendices

Infection Control and Prevention
Surgical Services Audit Checklist

Patient Name: _____ MRN #: _____ Admit date: _____

Surgery Date: _____ Day of week: _____

Scheduled Time: _____ First case/Last case/Other (circle one)

OR Pavilion: _____ OR Room: _____ Surgeon: _____

Scheduled Procedure: _____ Emergent Case: Y/N

Actual Procedure: _____

IC Time in: _____ IC Time out: _____ Total minutes of observation: _____

Time of incision: _____ Time of closure: _____ Duration of case: _____

Case #:
Patients initials:
Observer initials:

Intraoperative Observation	Performed Y/N/ND	Detail	Instructions and Comments
Environment—Environmental Services observed cleaning between cases			
Environment—room has been terminally cleaned			For first case only
Environment – General Cleanliness			
Environment – Equipment Clean			Anesthesia equipment, cords, lights
Environment – Room temperature/ humidity		_____F° _____C° Relative humidity _____% Time observed: _____	
Environment – Ventilation			Confirm appropriate pressure settings
Pre-Op Skin Prep—Hair removal		Performed prior to OR or Performed in the OR or NA	Circle one
Pre-Op Skin Prep—Hair removal method		Clipper Razor Depilatory cream	Circle one

Case #:
Patients initials:
Observer initials:

Intraoperative Observation	Performed Y/N/ND	Detail	Instructions and Comments
Pre-Op Skin Prep		Product Used: Detail Procedure:	
OR Personnel—number present	Surgeon: Resident: Medical Student: Anesthesia: Circulating RN: Scrub RN/Tech: Vendor: Other: Unknown: Total:		Tick mark for each individual present during observation
Scrub Procedure—role of personnel observed		#1: #2: #3:	
Scrub Procedure—nail pick used		#1: #2: #3:	If first case
Scrub Procedure—hand wash		#1: #2: #3:	

Case #:
Patients initials:
Observer initials:

Intraoperative Observation	Performed Y/N/ND	Detail	Instructions and Comments
Scrub Procedure—products used		#1: Avaguard Brush Brush Type: #2: Avaguard Brush Brush Type: #3: Avaguard Brush Brush Type:	Brushes by color: • Ultradex (blue package) • Povidone Iodine (brown package) • Detergent Free (green package)
Scrub Procedure—technique		#1: Correct sequence: Y/N Correct duration: Y/N #2: Correct sequence: Y/N Correct duration: Y/N #3: Correct sequence: Y/N Correct duration: Y/N	
Sterile Tray Set Up		Integrity of wrapping: Indicator Check: Integrator Check:	
Sterile Tray—closing tray for dirty cases			
Sterile Field Maintained			
Environment—Frequency of door opening		Door to core: Door to semi-restricted corridor: Door to substerile:	Tick mark for each door opening
Time Out Performed		Y/N	Circle one
Surgical attire—cap/hood		Worn by all present? Y/N Appropriate use? Y/N Removed at end of procedure? Y/N/not observed	
Surgical attire—mask		Worn by all present? Y/N Appropriate use? Y/N Removed at end of procedure? Y/N/not observed	
Surgical attire—gown		Worn by all present? Y/N Appropriate use? Y/N Removed at end of procedure? Y/N/not observed	
Surgical attire—safety shields		Worn by all present? Y/N Appropriate use? Y/N Removed at end of procedure? Y/N/not observed	
Surgical attire—shoe covers		Worn by all present? Y/N Appropriate use? Y/N Removed at end of procedure? Y/N/not observed	

Case #:
Patients initials:
Observer initials:

Intraoperative Observation	Performed Y/N/ND	Detail	Instructions and Comments
Surgical attire—gloves		Appropriate use? Y/N Changed with tears? Y/N Removed at end of procedure? Y/N/not observed	
Surgical attire—gloves changed for dirty cases			Change before closing?
Surgical attire—name badges			
Surgical attire—jewelry		Rings removed? Y/N? Other jewelry removed or totally confined under attire? Y/N Comments:	Other jewelry – watches, earrings, bracelets, necklaces
Surgical attire--fingernails		Excess fingernail length? Y/N/ND Comments: Artificial nails: Y/N/ND Comments:	Excess=greater than ¼ inch.
Flash Performed		Reason and Item/s Flashed:	
Pt Temp		Temp monitoring?: Y/N/ND Warming Performed? Y/N/ND Location (geographic): Location (anatomic): Method:	
General Observations			

Case #:
Patients initials:
Observer initials:

Retrospective Review	Performed Y/N/ ND	Detail	Comments
Wound class—recorded in Surginet			
Wound class—IC assessment			If different than above
ASA score			
Pre-op Antiseptic showering			
Pre-op nares cultures (for sternotomies)			
Peri-op mupirocin (for sternotomies)			
Pre-op oral decontamination (for colorectal surgery only)		Agent used: Times administered: Time of incision: Meets guidelines: Y/N	1 g of neomycin plus 1 g of erythromycin at 1 PM, 2 PM and 11 PM **OR** 2 g of neomycin plus 2 g of metronidazole at 7 PM and 11 PM the day before an 8 AM operation
Antimicrobial Prophylaxis—timing		Time of infusion: Time of incision: Meets guidelines? Y/N	Cefazolin/Ancef: 0-60 min. prior to incision. Vanco/fluoroquinolone: 60-120 min. prior to incision.
Antimicrobial Prophylaxis—choice		Agent used: Allergies: Consistent with NMH guidelines?: Y/N	
Antimicrobial Prophylaxis—redose		Was a second dose of cefazolin administered for cases > 4 hours? Y/N	
Estimated blood loss			
# Units PRBC			If transfused
Intraoperative—euglycemia (for cardiac surgery)			
Intraoperative—Drains placed		Y/N	
Intraoperative—Drains placed		# of drains: Type of drains:	
Post-operative—Timing of drain removal		POD:	

Guideline to Attempt Decolonization from MRSA

Published studies have shown below procedures often effective. Guidance from large scale clinical trials is not available. In response to increasing MRSA, both from the community (CA-MRSA) as well as health care associated MRSA, below consensus recommendations have been created.

Experienced clinicians may vary in their treatment approach

Basic principles of therapy:

- *Staph aureus* is a very common organism. We all are exposed.
- Colonization of the nose, and subsequently on the skin, is frequent. Approximately 60% of people are intermittently colonized, 20% always colonized, 20% never.
- Colonization with a certain strain of bacteria can persist for years.
- Spread between people is by skin contact (shaking hands, etc.) and sometimes on equipment (eg. hospital bedrail, gym workout equipment, home utensils, cups, TV remote, computer keyboards, stethoscopes).

Decolonization procedure:

1. **All active skin infection sites must be resolved before decolonization becomes feasible.** Boils must be drained. Antibiotics may be needed. Soaks or warm compresses are appropriate.
2. **Ideally, no chronic intravenous device is present** (e.g. Hickman, PICC line, etc.), and urinary catheters should be avoided.
3. **Colonization eradication should be attempted at home,** not in the hospital.
4. **Chlorhexidine or hexachlorophene antiseptic soap:**
   - Wash whole body (from scalp to toes) once daily. A big lather is not necessary! Skin moisturizer may be applied for dry skin after bathing.
   - Remove all artificial nails and all fingernail polish.
   - Scrub fingernails for one minute with nail brush twice daily.
   - **Duration: 7 days**
5. **Mupirocin 2% ointment**
   - Apply inside each nostril twice daily for 7 days, using a cotton tipped swab. No need to put deep into the nose. One Rx enough for all.
   - **Duration: 7 days**
6. **Oral antibiotics:**
   - Are not required for decolonization
   - May be used to decrease gastrointestinal colonization, and may include clindamycin, doxycycline, or TMP-SMZ, occasionally with rifampin
7. **Encourage treatment of all household members (and regular sexual contacts) with chlorhexidine/ hexachlorophene and mupirocin during the same time period.**
8. Post-treatment nasal culture for surveillance is optional and not encouraged.

Patient Information for Decolonization (trying to get rid) of MRSA (a strain of staphylococcus "staph" aureus)

Approved by Chiefs of Infectious Disease and Dermatology, August 2006

MRSA, a resistant staph bacteria, is causing more infections throughout the country, often not associated with hospitals or health care. This strain, as well as hospital strains of MRSA, spread easily from person to person.

- **They may look like spider bites, but probably are not.**
- Anyone can get this new strain, it does not mean you were not keeping clean.
- Some people may be colonized without having symptoms.

Basic principles of therapy:

- ***Staph aureus* is a very common organism. We all are exposed.**
- Colonization of the nose, and subsequently on the skin, is frequent. Approximately 60% of people are intermittently colonized, 20% always colonized, 20% never.
- **Everyone should wash their hands after touching their nose or face.**
- Colonization with a certain strain of bacteria can persist for years.
- **Spread between people is by skin contact** (shaking hands, etc.) and sometimes on equipment (eg. hospital bedrail, gym workout equipment, home utensils, cups, TV remote, computer keyboards, door knobs, stethoscopes)
- Infection **may** continue to recur until the new strain is removed from your body, and for that decolonization has been recommended to you. Please follow the steps below.

Decolonization procedure:

All active skin infection sites must be resolved before decolonization becomes feasible. Boils must be drained. Antibiotics may be needed. Soaks or warm compresses are appropriate.

Colonization eradication should be attempted at home, not in the hospital.

Chlorhexidine or hexachlorophene antiseptic soap:

- Wash whole body (from scalp to toes) once daily. A big lather is not necessary! Apply skin moisturizer for dry skin after bathing.
- Remove all artificial nails and all fingernail polish.
- Scrub fingernails for one minute with nail brush twice daily.
- Pay special attention to washing your armpits, groin, and by your rectum. Dry with a clean towel, and always put on clean clothes. Change bed sheets frequently.
- **Duration: 7 days**

Mupirocin 2% ointment

- Apply inside each nostril twice daily for 7 days, using a cotton tipped swab. No need to put deep into the nose. One Rx enough for all.
- **Duration: 7 days**

Oral antibiotics are not required for decolonization, but may be used in some settings.

Household members (and regular sexual partners) should be treated with chlorhexidine or hexachlorophen and mupirocin during the same time period (because they may be asymptomatic carriers; this is safe for children).

SURGICAL SITE INFECTION (SSI) PREVENTION:

IHI How To Guide: http://www.IHI SSI Prevention How To Guide

1. Appropriate use of antibiotics
2. Appropriate use of prophylactic antibiotics
3. Appropriate hair removal

ADDITIONAL OR "PLUS" MEASURES TO OPTIMIZE INFECTION RISK REDUCTION:

Intervention	References	Product Order Info	Tools
Chlorhexidine (CHG): 1. Skin Prep: Chlorhexidine/alcohol 2. Pre-op antiseptic bathing 3. Pre-op CHG oral rinse night before and morning of surgery to reduce the risk of post op pneumonia for those to receive general anesthesia 4. Post op antiseptic bathing	1. C:\Documents and Settings\DNSSAB\My 2. C:\Documents and Settings\DNSSAB\My; C:\Documents and Settings\DNSSAB\My; C:\Documents and Settings\DNSSAB\My; C:\Documents and Settings\DNSSAB\My 3. C:\Documents and Settings\DNSSAB\My 4. C:\Documents and Settings\DNSSAB\My 5. C:\Documents and Settings\DNSSAB\My	Skin Prep: Order Number CHG impregnated wash cloths: CHG oral rinse (pre op)	Pt instructions: Kaiser Sunnyside Preop Skin Prep Patient Teaching **4 min video:** pre/ post op CHG cloths, oral rinse, oral care:
5. OR traffic control	C:\Documents and Settings\DNSSAB\My	**N/A**	**Traffic counters:** C:\Documents and Settings\DNSSAB\My

SSI Prevention continued:

Intervention	References	Product Order Info	Tools
6. Hair removal: • Avoid if possible • By clipper instead of razor immediately before surgery (in pre op **not** OR) • Sterilization of clipper hand piece between cases • Removal clipped hair from skin • Patient teaching: e.g. ensure female patients do not shave legs one week before total knee replacement	C:\Documents and Settings\DNSSAB\My	• Clipper kit • clipper blades blade for sensitive skin	**Patient education:** Kaiser Sunnyside Patient Teaching SSI First do do harm patient info: http:// www.SSI Prevention education Safe Care patient info: http://www.safe care campaign

Intervention	References	Product Order Info	Tools
7. Formal observations in OR looking for infection prevention related issues	Bardowski L et al "Direct observation in the OR: First step to best practice" APIC conference June 2009 #18-201	N/A	C:\Documents and Settings\DNSSAB\My C:\Documents and Settings\DNSSAB\My
8. Ensure for ortho cases that pre op antibiotic is infused 20 minutes prior to tourniquette application.			
9. Antiseptic dressings post op	C:\Documents and Settings\DNSSAB\My C:\Documents and Settings\DNSSAB\My C:\Documents and Settings\DNSSAB\My		N/A
10. Decolonization - MRSA prior to high risk procedures; schedule MRSA+ infected patients at end of day if possible	C:\Documents and Settings\DNSSAB\My C:\Documents and Settings\DNSSAB\My		C:\Documents and Settings\DNSSAB\My
11. Glucose level: minimizing the extremes of glucose during perioperative care	C:\Documents and Settings\DNSSAB\My C:\Documents and Settings\DNSSAB\My		N/A
12. Normothermia other than colon procedures	C:\Documents and Settings\DNSSAB\My		N/A
13. Covering implants/grafts on OR table with sterile, non-linting towel if unwrapped ahead of time.	C:\Documents and Settings\DNSSAB\My		N/A
14. Change surgical mask between cases/breaks (after 90 minutes can measure nasopharyngeal shedding).	Recommended by one content expert: Charles Edmiston, PhD: **cedmisto@mcw.edu**		N/A
15. Routine schedule for ultrasonic scrubbing/cleaning of OR equipment including tables, guerneys and IV poles.			
16. Routine ventilation check to ensure HEPA filters changed per schedule and OR rooms are positive pressure minimum of 15 ACH/hr			

2010 OR OBSERVATION CHECKLIST for Assessment of Infection Prevention Efforts

Date of observation: _____ **Time: from** _____ **to** _____ **OR#** _____ **Observer:** _____
Procedure(s): _____

OR/PATIENT STANDARDS	Compliant: YES	Compliant: NO	NA	DESCRIPTION/COMMENTS
OR Environment:				
OR appears clean, dust free, uncluttered				
OR facility in good repair e.g. no holes in walls, floors or ceiling				
Solid ceiling – no tiles				
Interim (between cases) environmental cleaning performed – directionally from top to bottom				
Doors closed, traffic in and out of room kept to minimum during case				# door openings/hour
Number personnel in room kept to a minimum				# personnel in room during case
Perioperative Patient Care:				
Pre-op antibiotic given by anesthesia personnel within 60 minutes prior to incision				
IV injection ports swabbed prior to access				
Hair removal: performed **before** entering OR room (planned hair removal - occasionally additional hair must be clipped or done in the OR)				
Pre-op skin prep: ⇨ Dual agent prep used (Chloraprep or Duraprep)				Name antiseptic
⇨ Application technique (from center out)				Describe application method
Attire: (for any person entering semirestricted and restricted areas of surgical suite)				
Properly tied surgical masks				
Surgical caps/hood cover **all** head hair				
Chest and beard hair fully covered				
For all staff, no artificial nails, natural nails short				
Dress code followed				
⇨ No rings. Other jewelry (watches, earrings, bracelets, necklaces, piercing) should be removed or totally confined within scrub attire				
⇨ No fanny packs				
⇨ All wear long sleeves (approved cover jacket)				
⇨ No turtlenecks				
⇨ Shirts tucked				
⇨ No fleece				
Sterile Field:				
Sterile items left open no > than 60 minutes prior to patient entering room and should be constantly monitored during that time period				

OR Observation Checklist
Developed by KP Periop/IC based on a tool shared by Gwenda Felizardo, RN, BSN, CIC, Group Health Cooperative, Tacoma, Washington

OR/PATIENTS STANDARDS	Compliant YES	Compliant NO	N/A	DESCRIPTION/ COMMENTS
Scrubbed persons maintain sterility of sterile gown, gloves, supplies				
Hands remain above waist				
Items introduced into sterile field opened, dispensed, transferred by methods to maintain sterility/integrity				
Items/devices dropped below level of the OR table are considered contaminated				
Surgical equipment (e.g. cables, tubing) should be secured to sterile field with non-perforating devices.				
Nonsterile equipment (e.g. mayo stands, C arms) should be covered with sterile barrier materials. Only sterile items should touch sterile surfaces. Sterile barrier material should be applied to any equipment adjacent to the sterile field.				
All personnel moving in/around sterile field do so in manner to maintain sterility – e.g.. ⇨ Staff do not turn back to sterile field ⇨ Scrubbed personnel pass front to front or back to back ⇨ Separation of sterile team from non-sterile team maintained ⇨ Unscrubbed personnel do not pass between two sterile fields				
Anesthesiology:				
Drainage bags (e.g. foley) kept off the floor				
Aseptic practice used for IV tubing, fluids, medications – injection ports swabbed prior to access				
Sterile equipment including IV solution/tubing is assembled **immediately** prior to use				
Aseptic practice used for all invasive procedures: (epidurals, blocks, IV insertion)				
Anesthesia cart appears clean - degermer readily available				
Re-usable personal equipment (e.g. stethoscope) cleaned between cases				
OSHA/Bloodborne Pathogen Standard:				
Appropriate eye protection used				
Sharps containers not overfull				
Sharps are passed in a basin or by using neutral zone rather than by hand				
Sharps safety devices utilized where available				Devices used:
General Infection Prevention and Control:				
Sterile team removes gloves and washes hands at end of case				
Personnel appear free from communicable disease (no open skin lesions on hands/face/forearms)				
Clean, sterile, and soiled items are kept separate				
Used sterile instruments/equipment ransported to CSP for decontamination and sterilization				

SAMPLE PLAN OF CARE: INFECTION PREVENTION FOR PATIENTS UNDERGOING ORTHOPEDIC SURGERY

Nursing Diagnosis: Risk for Infection

Outcome: The patient will be free from signs and symptoms of postoperative surgical site infection.

Interventions:

- Confirm patient compliance with preoperative skin preparation (as appropriate)
- Implement strict aseptic practices for:
  - Establishing and maintaining the sterile field:
    - Opening supplies and equipment for the procedure
    - Draping the patient and equipment
  - Preparing the patient's skin; removing hair, as necessary
  - Controlling traffic patterns in the OR
  - Ensuring perioperative environmental sanitation
  - Adhering to standard and transmission-based precautions
  - Dressing wound at completion of the procedure
  - Caring for incision sites, invasive-devices sites, urinary drainage systems, and other drainage systems
- Protect from cross-contamination
- Initiate traffic control
- Prepare for pulsatile lavage or irrigation, as needed
- Initiate antibiotic therapy preoperatively and/or intraoperatively per physician's orders; verify medication allergies prior to antibiotic administration
- Establish a normothermia maintenance plan.
- Implement procedure-specific activities, such as using body evacuation suits and pulsatile lavage
- Anticipate equipment needs
- Check equipment function
- Implement safety precautions when using equipment
- Sterilize instruments according to facility policy and procedure and the manufacturer's guidelines:
  - Minimize the use of flash sterilization; use only in selected clinical situations and in a controlled manner
  - Flash sterilization should *not* be used for implantable devices except in cases of emergency when no other option is available
- Handle implants according to the manufacturer's recommendations
- Classify surgical wound according to the CDC
- Monitor for signs and symptoms of infection
- Minimize the length of invasive procedure by planning care
- Maintain continuous surveillance to detect and prevent potential adverse clinical events
- Administer care to wound sites
- Administer care to invasive device sites
- Evaluate factors associated with increased risk for postoperative infection at the completion of the procedure

Infection event analysis

WHAT CAN WE LEARN FROM THIS?

The Patient

Describe patient history.

The Course
Describe clinical course of patient and the hospital-acquired infection detail.

Review: Invasive devices, insertion dates and other contributing factors, (pre-op antibiotics if surgical patient)

Review: Any recalls or devices that may have been associated with infection. Report any association with recalled devices or products

Identify : patient characteristics that may be associated with course
Summarize; Modifiable and non-modifiable patient risk factors

Positive Findings
Summarize documentation or observed compliance with infection prevention measures :

Opportunities for Improvement
Summarize infection prevention measures that could have prevented Infection :

Lessons Learned
Share lessons learned from this patient and how compliance or procedure changes may prevent infection in other patients.

Glossary of Terms

Ambulatory Surgery Center (ASC) : An ASC is a health care facility that specializes in providing surgery, including certain pain management and diagnostic (e.g., colonoscopy) services in an outpatient setting in which the patient does not require an overnight hospital stay.

Fulminanat: Occurring or flaring up suddenly and with great severity. A potentially fatal complication.

Hematogenous: Originating in or spread by the blood.

Implant: A nonhuman-derived object, material, or tissue that is permanently placed in a patient during an operative procedure and is not routinely manipulated for diagnostic or therapeutic purposes. Examples include: porcine or synthetic heart valves, mechanical heart, metal rods, mesh, sternal wires, screws, cements, and other devices

Pathogenesis : The origination and development of disease

Perioperative: The period of time immediately before, during and after surgery.

Phagocytosis: The engulfing and destruction of phagocytes which serves as an important defense mechanism against infection by microorganisms

Phagocyte: A white blood cell that consumes and destroys foreign material (such as microorganisms) and debris

Post discharge surveillance: The process used to seek out infections after patients have been discharged from the hospital. It includes screening a variety of data sources, including re-admissions and emergency department visits.

Toxin: One of a number of poisons produced by certain plants, animals, and bacteria. Frequently used to refer specifically to a particular protein produced by some higher plants, animals and pathogenic (disease-causing) bacteria

Work Around: A workaround is a method, sometimes used temporarily, for achieving a task or goal when the usual or planned method isn't working or is difficult or time consuming to implement.

SSI Reference Bundles

This document contains references for Surgical Site Infection Prevention resources from accredited health organizations throughout the world. The documents, presentations and toolkits are available at each individual site listed below.

100k Lives Washington
Prevent Surgical Site Infections One-page Summary
http://www.100kliveswashington.org/changes-ssi.htm#resources

Centers for Disease Control and Prevention: Healthcare-Associated Infections
Surgical Site Infection (SSI) Toolkit
http://www.cdc.gov/HAI/recoveryact/stateResources/toolkits.html

Health Protection Scotland, Infection Control Team
SSI Prevention Bundle
http://www.hps.scot.nhs.uk/haiic/ic/SSIPreventionBundle.aspx

Institute for Healthcare Improvement
Power Point Presentation with Facilitator Notes
http://www.ihi.org/IHI/Programs/Campaign/SSI.htm

State Government of Victoria, Australia, Department of Health
Preventing Surgical Site Infections Toolkit
http://www.health.vic.gov.au/sssl/interventions/surgical.htm

Minnesota Department of Health
Infectious Disease Epidemiology, Prevention, and Control Division
651-201-5414, www.health.state.mn.us
10/2010

SAFE CUTS

S – SSI Teams

Protecting 5 Million Lives from Harm: Getting Started Kit: Prevent Surgical Site Infections How-to Guide. Cambridge, MA: Institute for Healthcare Improvement; 2008

Key Persons to Include in Your Team
Gillette Children's Specialty Healthcare

Getting Started Kit:
Prevent Surgical Site Infections

How-to Guide

A national initiative led by IHI, the 5 Million Lives Campaign aims to dramatically improve the quality of American health care by protecting patients from five million incidents of medical harm between December 2006 and December 2008. The How-to Guides associated with this Campaign are designed to share best practice knowledge on areas of focus for participating organizations. For more information and materials, go to www.ihi.org/IHI/Programs/Campaign.

This How-to Guide is dedicated to the memory of David R. Calkins, MD, MPP (May 27, 1948 – April 7, 2006) -- physician, teacher, colleague, and friend -- who was instrumental in developing the Campaign's science base. David was devoted to securing the clinical underpinnings of this work, and embodied the Campaign's spirit of optimism and shared learning. His tireless commitment and invaluable contributions will be a lifelong inspiration to us all.

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The Institute for Healthcare Improvement (IHI) is a not-for-profit organization leading the improvement of health care throughout the world. IHI helps accelerate change by cultivating promising concepts for improving patient care and turning those ideas into action. Thousands of health care providers participate in IHI's groundbreaking work.

Campaign Donors

The 5 Million Lives Campaign is made possible through the generous leadership and support of America's Blue Cross and Blue Shield health plans. IHI also acknowledges the support of the Cardinal Health Foundation, and the support of the Blue Shield of California Foundation, Rx Foundation, the Aetna Foundation, Baxter International, Inc., The Colorado Trust, and Abbott Fund.

This initiative builds on work begun in the 100,000 Lives Campaign, supported by Blue Cross Blue Shield of Massachusetts, the Cardinal Health Foundation, the Rx Foundation, the Gordon and Betty Moore Foundation, The Colorado Trust, the Blue Shield of California Foundation, the Robert Wood Johnson Foundation, Baxter International, Inc., The Leeds Family, and the David Calkins Memorial Fund.

Don't miss…

- Tips and Tricks [p. 20]

Tips for successful testing and implementing of each intervention that we have gathered from our site visits to Campaign hospitals, our Campaign calls, and our Discussion Groups on IHI.org

- Frequently Asked Questions [pp. 21-23]

Questions about how to implement each intervention, with helpful, practical answers from IHI content experts

- Patients and Families Fact Sheet [pp. 24-25]

Information to help patients and their families in obtaining effective treatment and assisting medical professionals in the delivery of care

Goal

Prevent surgical site infections (SSI) by implementing four components of care:

1. Appropriate use of prophylactic antibiotics;
2. Appropriate hair removal;
3. Controlled 6 AM postoperative serum glucose in cardiac surgery patients; and
4. Immediate postoperative normothermia for colorectal surgery patients.

* These components of care are supported by clinical trials and experimental evidence in the specified populations; they may prove valuable for other surgical patients as well.

The Case for Preventing Surgical Site Infections

Surgical site infections are the second most common type of adverse events occurring in hospitalized patients (Brennan. *N Engl J Med*. 1991;324:370-376). Surgical site infections have been shown to increase mortality, readmission rate, length of stay, and cost for patients who incur them. (Kirkland. *Infect Control Hosp Epidemiol.* 1999;20:725). While nationally the rate of surgical site infection averages between two and three percent for clean cases (Class I/Clean as defined by CDC), an estimated 40 to 60 percent of these infections are preventable.

A review of the medical literature shows that the following care components reduce the incidence of surgical site infection: appropriate use of prophylactic antibiotics; appropriate hair removal; controlled postoperative serum glucose for cardiac surgery patients; and immediate postoperative normothermia for colorectal surgery patients. These components, if implemented reliably, can drastically reduce the incidence of surgical site infection, resulting in the nearly complete elimination of preventable surgical site infection in many cases.

Where Are We Now?

A medical record review of 34,133 charts performed under the auspices of the Centers for Medicare & Medicaid Services (CMS) demonstrated significant opportunity for improvement in surgical site prevention. (Bratzler. *Arch Surg*. 2005;140:174-182.) In the area of appropriate antibiotic use, the medical record review found the following:

- Appropriate antibiotic selection occurred in 92.6% of cases;
- Antibiotics were given within one hour of incision time to 55.7% of patients; and
- Prophylactic antibiotics were discontinued within 24 hours of surgery end time for only 40.7% of patients.

These performance levels existed even after these three measures had been generally accepted for several years and been the focus of many improvement collaboratives both nationally and at state levels. Recent data from SCIP indicates that while performance has improved considerably, significant gaps remain between national averages and benchmarks as recently as the 2nd quarter of 2007:

- Antibiotics within 1 hour 87.6% average (benchmark 98.6%)
- Correct antibiotics 93.7% (99.5%)
- Antibiotic discontinued within 24 hours 82.9% (97.4%)
- Glucose control (cardiac) 85% (98.8%)
- No razor 93.7% (100%)
- Normothermia 81.2% (99.3%)

Data Source: Oklahoma Foundation for Medical Quality.

A major national effort has been made to further improve compliance with SSI prevention measures through their inclusion in the Surgical Care Improvement

Project (SCIP). The 5 Million Lives Campaign intervention is aligned with this initiative.

A recent Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals published by SHEA-IDSA (in partnership with The Joint Commission, Association for Professionals in Infection Control and Epidemiology (APIC) and the American Hospital Association) emphasizes the importance of reducing these infections and includes a guideline of practice recommendations to address them.

http://www.shea-online.org/about/compendium.cfm

Yokoe DS, Mermel LA, Classen, D, et al. A compendium of strategies to prevent healthcare-associated infections in acute care hospitals. *Infect Control Hosp Epidemiol*. 2008; 29:S12-S21.

General Considerations for Improvement in SSI

Any improvement process should be driven by leadership, with a commitment to providing adequate resources and attention to the initiative. It is also imperative to involve a multidisciplinary team in the surgical site infection improvement process. Successful teams set clear aims for their work, establish baseline measurements of performance, regularly measure and study the results of their work, and test various process and systems changes over a variety of conditions in order to find the ones that lead to improvement in their particular setting.

Preventing Surgical Site Infection: Four Components of Care

1. Appropriate Use of Prophylactic Antibiotics

For the purposes of the 5 Million Lives Campaign, the antibiotic process measures are these:

1. Prophylactic antibiotic received within 1 hour prior to surgical incision*
2. Prophylactic antibiotic selection for surgical patients consistent with national guidelines (as defined in JCAHO/CMS Specification Manual and SCIP for Measure SCIP-Inf-2)
3. Prophylactic antibiotics discontinued within 24 hours after surgery end time (48 hours for cardiac patients)

It is worth noting that these measures apply to antibiotics administered for SSI prophylaxis only. The definition of the measures in SCIP excludes patients who are already receiving antibiotics for other reasons. It often is not necessary to administer an additional antibiotic or dose in such cases, as this only leads to unnecessary administrations which should be avoided.

*Due to the longer infusion time required for vancomycin, it is acceptable to start this antibiotic (e.g., when indicated because of beta-lactam allergy or high prevalence of MRSA) within 2 hours prior to incision.

» **What changes can we make that will result in improvement?**

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the antibiotic use measures. Some of these changes are:

- Use preprinted or computerized standing orders specifying antibiotic, timing, dose, and discontinuation.
- Develop pharmacist- and nurse-driven protocols that include preoperative antibiotic selection and dosing based on surgical type and patient-specific criteria (age, weight, allergies, renal clearance, etc.).

- Change operating room drug stocks to include only standard doses and standard drugs, reflecting national guidelines.
- Assign dosing responsibilities to anesthesia or designated nurse (e.g., pre-op holding or circulator) to improve timeliness.
- Involve pharmacy, infection control, and infectious disease staff to ensure appropriate timing, selection, and duration.
- Verify administration time during "time-out" or pre-procedural briefing so action can be taken if not administered.

2. Appropriate Hair Removal

For many years, it has been known that the use of razors prior to surgery increases the incidence of wound infection when compared to clipping, depilatory use, or no hair removal at all (Seropian. *Am J Surg*. 1971;121:251). Razors can cause small cuts and nicks to skin, many of which may be microscopic and not visible to the human eye. However, many teams working on this measure find that the use of razors in their own institutions can range from zero to nearly 100 percent.

Hair removal may not be necessary for many procedures, yet has been "carried over" from years ago when surgical patients commonly received extensive pre-op shaving. When hair must be removed to safely perform the procedure, it should never occur with a razor. The use of clippers has been found to be the best method in many hospitals, as depilatory creams can cause skin reactions. Staff must be trained in the proper use of clippers because an untrained user can damage the skin. If hair must be removed preoperatively, it is generally recommended that this not occur in the operating room itself, as loose hairs are difficult to control.

» **What changes can we make that will result in improvement?**

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the appropriate hair removal measure. Some of these changes are:

- Ensure adequate supply of clippers and train staff in proper use.
- Use reminders (signs, posters).
- Educate patients not to self-shave preoperatively.
- Remove all razors from the entire hospital.
- Work with the purchasing department so that razors are no longer purchased by the hospital.

3. Controlled Postoperative Serum Glucose in Cardiac Surgery * **

Review of medical literature shows that the degree of hyperglycemia in the postoperative period was correlated with the rate of SSI in patients undergoing major cardiac surgery (Latham*. Inf Contr Hosp Epidemiol*. 2001;22:607; Dellinger. *Inf Contr Hosp Epidemiol*. 2001;22:604). Glucose control post-operatively is focused on the cardiac surgical population in the Campaign, based on the literature and alignment with SCIP. Future studies of the effectiveness of glucose control in other surgical populations may be forthcoming; however, literature to date links this with SSI prevention only in the cardiac surgical population. Other articles have demonstrated that stringent glucose control in surgical intensive care unit patients reduces mortality (Van den Berghe. *NEJM*. 2001;345:1359).

*NOTE that, for this effort, “glucose control” is defined as serum glucose levels below 200 mg/dl, collected at or closest to 6:00 AM on each of the first two postoperative days.

**NOTE that tight glycemic control (e.g., using an insulin drip) is often performed in an intensive care setting or equivalent for safety.

» **What changes can we make that will result in improvement?**

Hospital teams across the United States are developing and testing process and systems changes to improve performance on the postoperative glucose control measure. Some of these changes are:

- Implement one standard glucose control protocol for cardiac surgery.
- Regularly check preoperative blood glucose levels on all patients to identify hyperglycemia; this is best done early enough that assessment of risk can be completed and treatment initiated if appropriate.
- Assign responsibility and accountability for blood glucose monitoring and control.

4. Immediate Postoperative Normothermia in Colorectal Surgery*

The medical literature indicates that patients undergoing colorectal surgery have a decreased risk of surgical site infection if they are not allowed to become hypothermic during the perioperative period (Melling. *Lancet*. 2001;358:876). Anesthesia, anxiety, wet skin preparations, and skin exposure in cold operating rooms can cause patients to become clinically hypothermic during surgery. In the Campaign and SCIP, current focus is directed at colorectal surgery patients based on literature linking this to SSI. However, there is evidence to show that preventing hypothermia is beneficial in reducing other complications, and it clearly is more comfortable for patients.

*NOTE that this component of care does not pertain to those patients for whom therapeutic hypothermia is being used (e.g., hypothermic cardioplegia).

Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Engl J Med*. 1996;334:1209-1215.

Mahoney CB, Odom J. Maintaining intraoperative normothermia: A meta-analysis of outcomes with costs. *AANA J*. 1999;67:155-163.

Doufas AG. Consequences of inadvertent perioperative hypothermia. *Best Pract Res Clin Anaesthesiol*. 2003;17:535-549.

Melling AC, et al. Effects of preoperative warming on the incidence of wound infection after clean surgery: A randomized controlled trial. *Lancet*. 2001;358:876-880.

Sessler DI, Akca O. Nonpharmacological prevention of surgical wound infections. *Clin Infect Dis*. 2002;35:1397-1404.

» What changes can we make that will result in improvement?

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the normothermia measure. Some of these changes are:

- Prevent hypothermia at all phases of the surgical process.
- Use warmed forced-air blankets preoperatively, during surgery and in PACU.
- Use warmed fluids for IVs and flushes in surgical sites and openings.
- Use warming blankets under patients on the operating table.
- Use hats and booties on patients perioperatively.
- Adjust engineering controls so that operating rooms and patient areas are not permitted to become excessively cold overnight, when many rooms are closed.
- Measure temperature with a standard type of thermometer.

Using the Model for Improvement

In order to move this work forward, IHI recommends using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of health care organizations to improve many different health care processes and outcomes.

The model has two parts:

- Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.

- The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings — by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

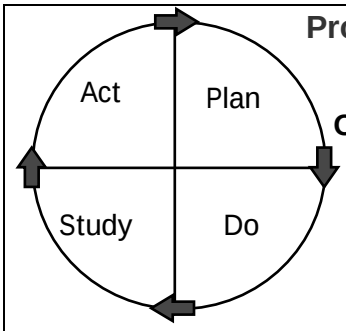
Implementation: After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale — for example, for an entire pilot population or on an entire unit.

Spread: After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement on www.IHI.org

PDSA WORKSHEET

CYCLE: 1 **DATE: 6/20/06**



Project: SSI - Prophylactic Antibiotic within One Hour before Incision

Objective for this PDSA Cycle: Test administration of antibiotic by anesthesiologists.

PLAN:
Questions: Will anesthesiologists agree to administer the antibiotic and document the time?
Predictions: The anesthesiologists will agree. Documentation location may need to be clarified for consistent practice.

Plan for change or test – who, what, when, where:
Get an anesthesiologist to volunteer to administer and document one antibiotic dose for first case on Tuesday.

Plan for collection of data – who, what, when, where:
- Nurse will record observations and any issues that arise.
- Anesthesiologist will document administration time on preoperative checklist.
- Debrief with anesthesiologist after the surgery is complete.

DO: Carry out the change or test. Collect data and begin analysis.
- Conducted the test on the first surgery on Tuesday morning.
- The anesthesiologist became frustrated because she did not have the pre-op checklist at administration time because the circulating nurse was using it.

STUDY: Complete analysis of data:

Debrief: Discuss whether the administration time can be documented on the anesthesia record instead of the checklist. The anesthesiologist is willing to try the test again tomorrow.

How did or didn't the results of this cycle agree with the predictions that we made earlier?
Documentation form currently in use is not ideal for use by anesthesiologists if they administer the dose.
Summarize the new knowledge we gained by this cycle:
May need to revise checklist and anesthesia record if tests are successful, so that documentation of administration time is always in the same place.

ACT: List actions we will take as a result of this cycle:
Repeat this test tomorrow after drafting a sample revision to anesthesia record.
Plan for the next cycle (adapt change, another test, implementation cycle?):
Run a second PDSA Cycle tomorrow for three scheduled surgeries.

Forming the Team

No single person can create system-level improvements alone. First, it is crucial to have the active support of leadership in this work. The leadership must make patient safety and quality of care strategic priorities in order for any surgical care improvement team to be successful.

Once leadership has publicly given recognition and support (dollars, person-time) to the program, the improvement team can be quite small. Successful teams include a physician (either surgeon, anesthesiologist, or both); an operating room nurse; and someone from the quality department. Each hospital will have its own methods for selecting a core team. The team should use the Model for Improvement to conduct small-scale, rapid tests of the ideas for improvement over various conditions in a pilot surgical population. The team should also track performance on a set of measures designed to help them see if the changes they are making are leading to improvement, and regularly report these measures back to leadership.

Measurement

See Appendix A for specific information regarding the recommended process and outcomes measures for surgical site infection prevention.

The recommended outcome measure is "Percent of Clean Surgery Patients with Surgical Infection" (i.e., surgical site infections within 30 days of surgery for patients with Class I / Clean wounds, as defined by CDC and NSQIP for wound classification). If you are just starting this work, this may be a good measure to begin tracking. We are not distinguishing as to whether this is superficial infections only, or also includes deep incision and organ space infections; this should be decided locally for your organization. As your work progresses and you are ready for advanced measures on this topic, consider measures that address the different types of SSIs as well as the other classes of wounds, similar to the data being collected in the National Surgical Quality Improvement Project at the American College of Surgeons (https://acsnsqip.org).

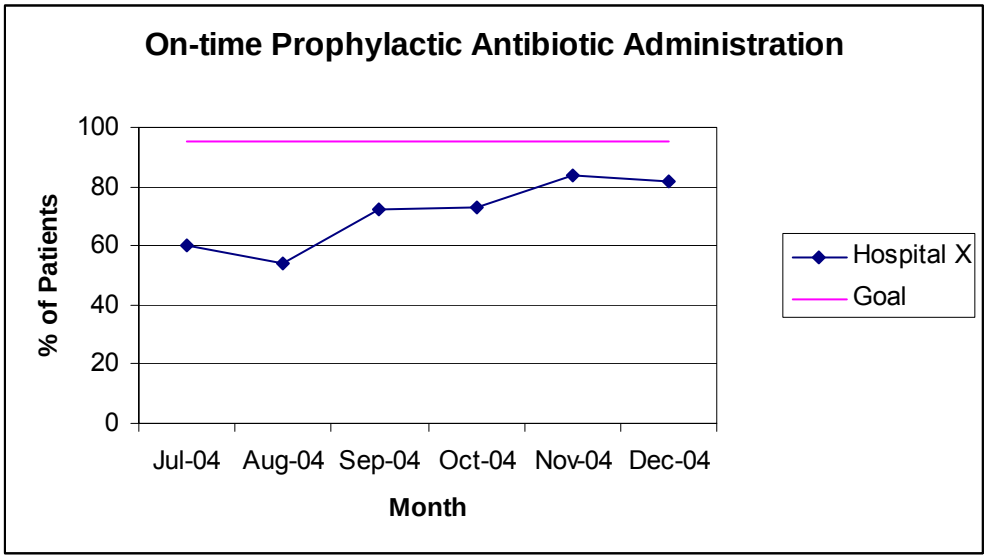
For each process measure, obtain the data via medical record review. (Follow the links in Appendix A for details about data collection.) The process measures recommended by the Campaign are identical to those being used in CMS's current Surgical Infection Prevention program, JCAHO's current core measure set, and the Surgical Care Improvement Project (SCIP). Using run charts helps make change over time visible to the team and to the leadership.

Run Charts

Improvement takes place over time. Determining if improvement has really happened and if it is lasting requires observing patterns over time. Run charts are graphs of data over time and are one of the single most important tools in performance improvement.

Using run charts has a variety of benefits:

- They help improvement teams formulate aims by depicting how well (or poorly) a process is performing.
- They help in determining when changes are truly improvements by displaying a pattern of data that you can observe as you make changes.
- As you work on improvement, they provide information about the value of particular changes.



First Test of Change

Teams may elect to work on any or all of the four care components: antibiotic use, hair removal, glucose control, and normothermia. A first test of change should involve a very small sample size (typically one patient) and should be described ahead of time in a Plan-Do-Study-Act format so that the team can easily predict what they think will happen, observe the results, learn from them, and continue to the next test.

Example: Administration of preoperative dose of antibiotic

> The team decides to test having the anesthesiologist administer the pre-operative dose of prophylactic antibiotic and document the administration time. They identify an anesthesiologist who supports the idea, and let the anesthesiologist know that they will test this with one case. On their PDSA form, they predict that the surgeon will agree to administer the dose but that documentation may need to be clarified. They then conduct the test. They note that the anesthesiologist becomes frustrated because s/he cannot access the preoperative checklist used for documentation of administration time because it is in use by the circulating nurse. The team's study of the data indicates that they should repeat this test, after first developing an alternative documentation location that will be accessible to the anesthesiologist at the time of administration.
>
> Ideally, teams will conduct multiple small tests of change simultaneously across all four components of care. This simultaneous testing usually begins after the first few tests are completed and the team feels comfortable and confident in the process.

Implementation and Spread

For surgical site infection, teams will usually choose to begin their improvement process by working with a "pilot" population. This pilot population may be the hip- and knee-replacement patients, for example, or cardiac operations, or gynecologic procedures, etc. It is possible to include the universe of surgical patients in the pilot population, if that number is small (fewer than 50 cases per month). We recommend including at least 50 cases per month in the pilot population in order to increase the ability to measure and detect improvement.

In order to maximize the reduction in overall hospital mortality related to surgical site infections, however, hospitals must spread improvements begun in a pilot population to the universe of surgical populations. Organizations that successfully spread improvements use an organized, structured method in planning and implementing spread across populations, units, or facilities. You can find information about planning, tracking, and optimizing spread at www.ihi.org. (See IHI's Innovation Series white paper, "A Framework for Spread: From Local Improvements to System-Wide Change," downloadable for free at www.ihi.org.)

Barriers

Teams working on preventing surgical site infection have learned a great deal about barriers to improvement and how to face them. Some common challenges and solutions are:

1. **Lack of support by leadership**

   Solution: Use opinion leaders (physicians) and data and if possible; a business case for the project may help to win leadership support.

2. **Uneven physician acceptance of new practices**

   Solution: Use physician opinion leaders, review the medical literature, and feed back data on a surgeon-specific level. Remember that physicians may fall anywhere on the "Adoption of Innovations" curve; work first with your early adopters and use their stories to convince the majority.

Tips and Tricks: Surgical Site Infections

More than 3,000 hospitals across the US have been working hard to implement the Campaign interventions. Here are some of the "tips and tricks" for successful testing and implementing of each intervention that we have gathered from our site visits to Campaign hospitals, our Campaign calls, and our Discussion Groups on IHI.org.

- Set a narrower range internally for timing of the preoperative antibiotic dose, e.g., 5-50 minutes prior to incision. This helps account for clocks not in synchrony and allows a small buffer.
- Use 36.5 degrees Celsius as the intervention point for temperature; waiting until 36 degrees is usually too late to prevent hypothermia below that level.
- Measure pre-op blood glucose early enough so that if it is unexpectedly high, a plan of action can be initiated.
- Schedule the times for post-op doses of prophylactic antibiotics in the OR, based on time incision is closed to ensure completion within 24 hours (don't use standard dosing times).
- Measure the SSI interventions as an all-or-nothing measure for each patient.
- Approach the SSI interventions like "mini-bundles" for each phase: pre-op, intra-op, and post-op. Hold each area accountable for their bundle.
- Maintain a reasonable temperature in the OR – not too cold for patients, but not too warm for staff. Ideal seems to be the high 60's Fahrenheit.
- Don't allow operating rooms to get excessively cold overnight when closed.

Frequently Asked Questions: Surgical Site Infections

Our surgeons are asking, "If there is no data that what I am doing—e.g., shaving just before surgery—is dangerous, why should I change?" I have no evidence-based medicine with which to answer them.

There is ample evidence that shaving prior to a surgical procedure is associated with more wound infections than removing hair with clippers or not removing hair at all.
The papers that support this conclusion are sound. You can challenge the studies as not specifically looking at shaving immediately prior to surgery because that study has not yet been done, as most patients are not prepared for surgery that way. There is nearly always a time gap between the shave prep and the incision; this likely varies greatly from institution to institution. It can be inferred from the literature that the time interval between the shaving and the incision is likely related to the wound infection rate. That interval in many cases is not absolutely controllable; cases get delayed or cancelled, putting those patients into a time range (from prep to incision) that we know scientifically is associated with more wound infections.

Further, there is no evidence that shaving immediately prior to surgery is a safe thing to do. There is no evidence that shaving with a razor at any time prior to surgery is ever associated with a lower rate of any type of complication. Why would you take a chance, in this unstudied area, with the patient's outcome?

Questions have come up in our organization regarding serum glucose. Can you help clarify?

In the glucose control measure for cardiac surgery patients, the goal is to include the "serum" glucose level as measured at 6 AM on post-op days 1 and 2 (or closest to it).

The word "serum" has caused some confusion; it has been interpreted as serum analyzed by the lab only (not finger sticks). We have clarified the definition with colleagues at the Surgical Care Improvement Project.

Glucose values for this measure may be obtained from the following:
• Blood sugar
• Fasting glucose
• Finger stick glucose

• Glucometer results
• Glucose
• Non-fasting glucose
• Random glucose
• Serum glucose

What is the time frame for defining post-op wound infections for this measure? Is it infections documented while in the hospital, or does it extend post discharge?

Most places are measuring SSI within 30 days and, in general, that has been our recommendation. Most inpatient stays are so short that we must consider the time after discharge, although surveillance is a real challenge.

The interventions we use in the 5 Million Lives Campaign contribute mostly to preventing infections within 30 days.

Is anyone looking at communication and handoffs relative to SSI prevention, specifically at incorporating Team Resource Management constructs such as briefings/debriefings and handoff tools in helping to ensure that all interventions have been completed?

A number of hospitals have built the SSI prevention items into their pre-procedural briefing. For example, during the briefing one of the items verified is whether the prophylactic antibiotic has been administered. If it has not, it provides an opportunity to mitigate.

Have a question for Fran Griffin, our Surgical Site Infection faculty expert? Post it to the Surgical Site Infection web discussion.

Looking for advice from other organizations like yours? Ask a Campaign Mentor Hospital! The organizations on the Campaign Mentor Hospitals list have volunteered to provide support, advice, clinical expertise, and tips to hospitals seeking help with their implementation efforts.

What You Need to Know about Infections after Surgery:
A Fact Sheet for Patients and Their Family Members

Most patients who have surgery do well. But sometimes patients get infections. This happens to about 3 out of 100 patients who have surgery. Infections after surgery can lead to other problems. Sometimes, patients have to stay longer in the hospital. Rarely, patients die from infections. Patients and their family members can help lower the risk of infection after surgery. Here are some ways:

Days or weeks before surgery:
Meet with your surgeon.

- Bring an up-to-date list of all the medications you take. Talk with your surgeon about why you take each medication and how it helps.
- Let the surgeon know if you are allergic to any medication and what happens when you take it.
- Tell the surgeon if you have diabetes or high blood sugar, or if family members do.
- Talk about ways to lower your risk of getting an infection. This may include taking antibiotic medicines.

The day or night before surgery:
Take extra good care of your body.

- Do not shave near where you will have surgery. Shaving can irritate your skin which may lead to infection. If you are a man who shaves your face every day, ask your surgeon if it is okay to do so.
- Keep warm. This means wearing warm clothes or wrapping up in blankets when you go to the hospital. In cold weather, it also means heating up the car before you get in. Keeping warm before surgery lowers your chance of getting an infection.

At the time of surgery:

- Tell the anesthesiologist (doctor or nurse who puts you to sleep for surgery) about all the medications you take. A good way to do this is to bring a written up-to-date medication list with you.

- Let the anesthesiologist know if you have diabetes or high blood sugar, or if family members do. People with high blood sugar have a greater chance of getting infections after surgery.
- Speak up if someone tries to shave you with a razor before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.
- Ask for blankets or other ways to stay warm while you wait for surgery. Find out how you will be kept warm during and after surgery. Ask for extra blankets if you feel cold.
- Ask if you will get antibiotic medicine. If so, find out how many doses you will get. Most people receive only one dose before surgery and are on antibiotics for just one day after surgery, as taking too much can lead to other problems.

You can learn more about Surgical Site Infection as it relates to the 5 Million Lives Campaign at www.ihi.org.

5 Million Lives Campaign

The 5 Million Lives Campaign is a national initiative to dramatically improve the quality of American health care. The Institute for Healthcare Improvement (IHI) and its partners seek to engage thousands of U.S. hospitals in an effort to reduce harm for five million American patients between December 2006 and December 2008. This ambitious work builds upon the great energy and commitment shown by hospitals during the 100,000 Lives Campaign, a national, IHI-led initiative focused on reducing unnecessary mortality and that ran from December 2004 to June 2006. Complete details, including materials, contact information for experts, and web discussions, are on the web at http://www.ihi.org/IHI/Programs/Campaign/.

Appendix A: Recommended Intervention-Level Measures

The following measures are relevant for this intervention. The Campaign recommends that you use some or all of them, as appropriate, to track the progress of your work in this area. In selecting your measures, we offer the following advice:

1. Whenever possible, use measures you are already collecting for other programs.
2. Evaluate your choice of measures in terms of the usefulness of the results they provide and the resources required to obtain those results; try to maximize the former while minimizing the latter.
3. Try to include both process and outcome measures in your measurement scheme.
4. You may use measures not listed here, and, similarly, you may modify the measures described below to make them more appropriate and/or useful to your particular setting; however, be aware that modifying measures may limit the comparability of your results to others'. (Note that hospitals using different or modified measures should not submit those measure data to IHI.)
5. Remember that posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful, and that they would be excited to see.

Process Measure(s):

Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision
Owner: **SCIP** Owner Measure ID: **SCIP-Inf-1a** Measure Information: **[NHQM Specifications Manual with Appendices]** Comments: • From the link above, scroll down to find the link for SCIP-Inf-1; SCIP-Inf-1a is defined within. • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Prophylactic Antibiotic Selection for Surgical Patients
Owner: **SCIP** Owner Measure ID: **SCIP-Inf-2a** Measure Information: **[NHQM Specifications Manual with Appendices]** Comments: • From the link above, scroll down to find the link for SCIP-Inf-2; SCIP-Inf-2a is defined within. • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Prophylactic Antibiotics Discontinued Within 24 Hours after Surgery End Time (48 Hours for Cardiac Patients)
Owner: **SCIP** Owner Measure ID: **SCIP-Inf-3a** Measure Information: **[NHQM Specifications Manual with Appendices]** Comments: • From the link above, scroll down to find the link for SCIP-Inf-3; SCIP-Inf-3a is defined within. • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Cardiac Surgery Patients with Controlled 6 AM Postoperative Serum Glucose
Owner: **SCIP** Owner Measure ID: **SCIP-Inf-4** Measure Information: **[NHQM Specifications Manual with Appendices]** Comments: • From the link above, scroll down to find the link for SCIP-Inf-4 • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Surgery Patients with Appropriate Hair Removal
Owner: **SCIP** Owner Measure ID: **SCIP-Inf-6** Measure Information: **[NHQM Specifications Manual with Appendices]** Comments: • From the link above, scroll down to find the link for SCIP-Inf-6 • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Colorectal Surgery Patients with Immediate Postoperative Normothermia
Owner: **SCIP** Owner Measure ID: **SCIP-Inf-7** Measure Information: **[NHQM Specifications Manual with Appendices]** Comments: • From the link above, scroll down to find the link for SCIP-Inf-7 • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Note: This measure is now optional in SCIP.

Outcome Measure(s):

Percent of Clean Surgery Patients with Surgical Infection
Owner: **IHI** Owner Measure ID: **N/A** Measure Information: **[Campaign MIF]** Comments:

Alignment with Other Measure Sets:

Measure Name	JCAHO	CMS	SCIP	NQF	CDC
Percent of Surgical Patients with Prophylactic Antibiotic Received within One Hour Prior to Surgical Incision – Overall Rate	√[1]	√[2]	√[3]	√[4]	
Percent of Surgical Patients with Appropriate Selection of Prophylactic Antibiotic – Overall Rate	√[1]	√[2]	√[3]	√[4]	
Percent of Surgical Patients with Appropriate Prophylactic Antibiotic Discontinuation – Overall Rate	√[1]	√[2]	√[3]	√[4]	
Percent of Major Cardiac Surgical Patients with Controlled Post Operative Serum Glucose	√[1]	√[2]	√[3]		
Percent of Surgical Patients with Appropriate Hair Removal	√[1]	√[2]	√[3]		
Percent of Colorectal Surgical Patients with Normothermia in PACU	√[1]	√[2]	√[3]		
Percent of Clean Surgery Patients with Surgical Infection					√[5]

[1] Matches a measure in the JCAHO National Hospital Quality Measures SCIP Core Measure Set
[2] Matches a measure in the CMS SCIP measure set
[3] Matches a measure in the SCIP measure set
[4] This measure is endorsed by the NQF
[5] The definitions of "clean surgery patient" and "surgical infection" used in this measure are the same as the CDC's NHSN Surgical Site Infection Event definitions, which can be found here.

Key Persons to Include in Your Team

- To form your team, first review the aim. Consider the system on which you will be working and what processes will be affected.
- It is important to include people who represent the different departments and parts of the care system involved in the improvement effort.

System or Process Leader

Someone with enough organizational authority to institute a change when one is suggested and to overcome barriers as they arise. Managers are one example.

Technical Experts

Subject matter experts. Usually a team has several technical experts who understand the process being improved. Examples of this would be IT staff and HUCS.

Day-to-Day Leaders

Individuals who work daily in the process and understand it. They are the most critical persons on the team. They are the front line leaders who will champion the change with other staff and ensure that changes are tested and implemented.

Physician Leaders

Physicians who are willing to test changes to practice and who are able to influence others.

Team Roles and Responsibilities

Once you have determined who needs to be on your team, choose which role they will play on the team.

Team Member

- Actively participate in the team meetings by sharing experience, knowledge, perspectives and ideas
- Adhere to meeting ground rules and help manage and improve the meeting process.
- Perform assignments on time and makes/keeps realistic commitments
- Works to develop an atmosphere of trust and respect on the team
- Pilot changes and provide feedback their effectiveness
- Collect measurement data
- Communicate clearly, listen
- Communicate activities/ideas of the team to peer group, obtain their feedback and represent them at the meetings

- Support implementation of recommendations
- Focus on the purpose of the team, thinking less about personal goals and more about the success of the team as a whole

Team Leader

- Provide direction and focus to team activities
- Guides teams to achieve successful outcomes
- Educate team members about the team purpose, limits, aims etc.
- Leads meetings
- Ensure productive use of team members' time by planning for meeting
- Track the team's aims, activities and achievements
- Represent the team to leadership about team's progress, needs and barriers
- Communicate with the rest of the organization about the team's actions and achievements
- Help resolve conflicts and remove barriers to progress.
- *Not* responsible for all decision making
- *Not* solely responsible for the success or failure of the team
- Helps resolve conflict

Facilitator

(Please note, in many groups, the leader and facilitator may be the same person)

- Acts as the process "expert"; keeping the team focused on their purpose to make it easy for a group to be successful
- Provides "just-in-time" training; coaches the team leader or team members on team skills; helps the group use basic problem-solving principles and tools
- Work with the team leader between meetings to plan meeting activities and break the work down into manageable tasks.
- Help the group decide what data are useful and how best to gather and analyze the data.
- Promote effective group dynamics, help deal with conflicts
- Ask questions to ensure full understanding of the topic,
- Encourage and support participation of all team members, seek opinions of all.
- Provide feedback and support to the team leader

Recorder

- May be a rotating position among team members
- Keeps minutes and other records to meet documentation requirements and facilitate team recall

Timekeeper

- May be a rotating position among team members
- Assists the team in managing time

Sponsor

- Champions the team's purpose
- Helps develop the team charter and aims
- Often the person or group that determined a team should be formed
- Assists the team in breaking through barriers
- Provides resources to the team
- Oversee and support the all activities of the team.
- Provides the team leader with direction and guidance by preparing the first draft of the team charter
- Provides direction on who to include on the on the team and provide other resources the team may need

SAFE CUTS

A – Access to Information

Road Map to a Comprehensive Surgical Site Infection Prevention Program Audit Tool

Surgical Site Infection (SSI) Definitions
Minnesota Department of Health

Surgical Site Infection (SSI) Event
Centers for Disease Control and Prevention

Patient Safety Quality Measures for the Surgical Care Improvement Project
Health Services Advisory Group

New 2010 National Patient Safety Goal 7: Gap Analysis
Joint Commission Resource

SSI Prevention Focus: HAI Event Review Process
HealthEast Care System

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

MINNESOTA MDH DEPARTMENT OF HEALTH

Minnesota Hospital Association

The ***Safe CUTS* road map** provides evidence-based recommendations/standards for Minnesota hospitals in the development of comprehensive surgical site infection (SSI) prevention programs. The road map and accompanying tool kit were developed as part of the Minnesota SSI Prevention Collaborative which was made possible with funding through the Centers for Disease Control and Prevention (CDC) Epidemiology and Laboratory Capacity Program (ELC) American Reinvestment and Recovery Act (ARRA).

The road map was written with elective, inpatient surgery in mind, and can be adapted for use in other settings such as ambulatory or emergency surgery. However, some of the recommendations clearly will not apply to those situations (e.g., providing smoking cessation services prior to emergency surgery). The road map reflects published literature and guidelines by relevant professional organizations and regulatory agencies (October 2011) as well as best practices identified by the SSI Prevention Collaborative. The road map and tool kit will be reviewed regularly and updated as indicated through published literature.

We would like to thank the following organizations and individuals for sharing their time, expertise and stories which made the road map and tool kit possible.

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Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
S	SSI Prevention Teams	1) Provide support and expectations for SSI prevention champions.	1a) A physician champion(s) has been identified (recommend surgeon and/or infectious disease specialist if possible) for SSI prevention.	☐	☐
			1b) An operational champion(s) has been identified for SSI prevention (e.g., OR director, infection preventionist).	☐	☐
			1c) The facility has a process in place to partner the physician and operational champions.	☐	☐
			1d) The facility has defined roles, set expectations and provides support for the champion(s).	☐	☐
		2) Adopt an inter-disciplinary team approach to SSI prevention with a designated coordinator to oversee implementation.	2a) The facility adopts a team approach with an interdisciplinary team to oversee and support SSI prevention work.	☐	☐
			2b) The facility has a designated coordinator to oversee SSI prevention implementation (e.g., schedule team meetings, plan staff education).	☐	☐
			2c) The designated SSI prevention coordinator has dedicated time to serve in this role.	☐	☐
			2d) Individual roles in the SSI prevention steps ('CUTS') are clearly defined and documented.	☐	☐
A	Access to Information	1) Verify the completion of the SSI prevention steps.	**Data Collection** The facility has in place: 1a) Documentation of the completion of each SSI prevention step for all interdisciplinary team members involved in the procedure (e.g., a pre-procedure, intra-procedure, and post-procedure checklist).	☐	☐
		2) Audit the completion of the SSI prevention steps.	<u>Pre-, Intra- & Post-Operative:</u> 2a) Chart audits of the completion of SSI prevention steps.	☐	☐
			2b) Observational audits of the completion of SSI prevention steps.	☐	☐
			2c) Standard criteria for auditors.	☐	☐
		3) Measure the outcomes of the SSI prevention efforts (surveillance).	3a) Standardized collection of SSI data using the National Healthcare Safety Network (NHSN) definitions.	☐	☐
			3b) SSI data includes information beyond rates to use in determining possible factors contributing to and/or causing the infection.	☐	☐
			3c) SSI data is submitted to NHSN.	☐	☐
		4) Evaluate the SSI prevention efforts for learning opportunities.	**Data Analysis** **The facility has a process in place to:** 4a) Routinely review and analyze SSI data.	☐	☐
			4b) Carry out additional analysis (e.g. case review) for learning and improvement opportunities when rates suggest trends or clusters.	☐	☐

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
			On at least a quarterly basis: 4c) Share data within and across teams.	☐	☐
			4d) Share data with senior leadership.	☐	☐
			4e) Share data with medical staff.	☐	☐
F	**Facility Expectations**	1) Set expectations for implementation of the SSI prevention steps for any OR procedure.	1a) The facility's policies address SSI prevention steps (i.e. "CUTS") and include expectations for following these steps.	☐	☐
		2) The facility has a clearly defined process for speaking up and "stopping the line" if a potential safety issue has been identified by staff.	**The process clearly outlines:** 2a) When to stop the line.	☐	☐
			2b) How to stop the line (e.g., "I need clarity").	☐	☐
			2c) The chain of command to follow if not supported in stopping the line.	☐	☐
			2d) Clear communication to staff from managers and leadership that staff will be supported if they speak up.	☐	☐
		3) Set expectations that the patient is optimally physically prepared pre-operatively.	**The facility has clearly communicated to providers that they are expected to address the following:** 3a) Pre-op planning includes assessment of modifiable risk factors and offering education and services for risk reduction (e.g., smoking cessation, weight loss, glucose management).	☐	☐
			3b) The facility pre-op physical is in the patient medical record and reviewed by pre-op team prior to surgery.	☐	☐
			3c) Pre-op physical includes evaluation for existing infections including, but not limited to, skin, urinary tract, sinus and periodontal.	☐	☐
			3d) If identified, infections are treated before elective surgery and surgery is postponed until resolution of infection (excluding emergency surgery).	☐	☐
E	**Educate Staff and Patients**	1) Provide SSI prevention education for all clinical staff involved in surgical procedures or caring for surgical patients.	**SSI prevention education and competencies have been incorporated into new employee orientation:** 1a) For all surgical staff.	☐	☐
			1b) For all health care personnel caring for surgical patients.	☐	☐
			1c) For surgeons and other providers.	☐	☐
			1d) Ongoing SSI prevention education is incorporated into training at least annually for all health care personnel involved in care of surgical patients.	☐	☐

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
		2) Educate patients, families, and caregivers on their role in SSI prevention.	2a) Pre-op SSI prevention education is provided to patients and families that includes identifying modifiable risk factors (e.g., smoking, obesity, diabetes management), not self-shaving, and instructions on hygiene (e.g., showering, hand hygiene, and pre-op surgical site preparation) prior to the procedure.	☐	☐
			2b) Post-op SSI prevention education is provided to patients and families prior to discharge including hygiene (e.g., when to resume showering/bathing, hand hygiene, laundry), wound care, and signs and symptoms of infection to report to provider.	☐	☐
Patient Care Bundle					
C	**Cleaning Surgical Equipment/ Environ-ment**	1) Appropriate use of immediate use sterilization.	**A standardized process is in place to:** 1a) Limit immediate use sterilization to instances when there are no other viable options (i.e., do not use for convenience, preference or when adequate inventory could eliminate the need for it).	☐	☐
			1b) Audit immediate use sterilization.	☐	☐
			1c) Review audit data on a quarterly basis.	☐	☐
			1d) Follow appropriate preparation methods for immediate use sterilization.	☐	☐
		2) Appropriate cleaning, disinfection and sterilization of surgical instruments and equipment.	2a) Follow manufacturer's instructions for cleaning, disinfection and sterilization.	☐	☐
			2b) Follow AAMI guidelines and use Spaulding scale definitions in determining appropriate cleaning, disinfection and sterilization.	☐	☐
		3) Appropriate cleaning and disinfection of the surgical environment.	3a) The hospital has and adheres to a policy for complete and thorough cleaning of the surgical environment that is based on a guideline or guidelines by nationally recognized organizations such as The Joint Commission, AORN and/or HICPAC and incorporates AAMI standards using Spaulding scale definitions.	☐	☐
			3b) Responsibility for cleaning and disinfecting each type of equipment and area is clearly defined.	☐	☐
			3c) The cleaning and disinfection process is routinely audited and evaluated.	☐	☐
U	**Undergoing Surgery** ***Pre-procedure***	1) Administer antimicrobial prophylaxis.	1a) An evidence-based standardized protocol is in place for the use of prophylactic antibiotics.	☐	☐
			1b) Surgeons, pharmacy, infection prevention, infectious disease and anesthesia staff are involved in the protocol development to ensure appropriate timing, selection and duration of antibiotics.	☐	☐

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
			1c) Pre-printed or computerized standard orders are in place specifying antibiotic, timing, dose and discontinuation. Instructions for re-dosing (e.g., related to duration of surgery and blood loss) or special weight considerations, especially for obese patients (body mass index >30) are included.	☐	☐
			1d) Roles are clearly assigned for ensuring that antibiotics are administered within one hour prior to surgical incision (2 hours for vancomycin and fluoroquinolones) and for re-dosing if needed.	☐	☐
			1e) Verify administration timing (including re-dosing) during "time-out" period or pre-procedural briefing.	☐	☐
		2) Prep Skin/Site.	**A standardized process is in place to prepare the patient's skin and operative site, which includes:** 2a) Leaving surgical site hair in place. If hair removal is necessary, razors or depilatory creams that may irritate skin are not used.	☐	☐
			2b) The skin around the surgical site is free of soil, debris, exudates, and transient organisms before application of the antiseptic skin preparation.	☐	☐
			2c) Selection of the pre-op skin antiseptic agent is based on FDA approval or clearance.	☐	☐
			2d) The pre-op antiseptic agent significantly reduces microorganisms and is broad spectrum, fast-acting and has a persistent effect. Consider use of 2% chlorhexidine gluconate (CHG) with isopropyl alcohol or iodine povacrylex with alcohol (70%) unless contraindicated.	☐	☐
			2e) Assess patient for allergies or sensitivities to skin preparation agents.	☐	☐
			2f) Any jewelry at or near the surgical site is removed before cleaning the skin.	☐	☐
			2g) Sterile gloves are worn unless the antiseptic prep applicator is of sufficient length to prevent hand contamination.	☐	☐
			2h) Any skin preparation containing alcohol must be allowed to dry before beginning surgery due to flammability of the product.	☐	☐
		3) Check pre-op blood glucose levels on all diabetic patients.	3a) A standardized glucose management protocol is in place for all known diabetic patients.	☐	☐
			3b) A baseline blood sugar is established for all patients with known diabetes on the day of surgery.	☐	☐
		4) Pre-warming of patients.	4a) A process is in place to pre-warm the patient's body temperature so that it can be maintained at >96.8° F/ 36° C during surgery.	☐	☐

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
	During the procedure	1) Keep OR door closed during surgery except as needed for passage of equipment, personnel and the patient.	**Expectations are in place to:** 1a) Keep the OR door closed during surgery except for essential passage of equipment, personnel and patient.	☐	☐
			1b) Discuss equipment/supply needs during pre-operative communication prior to the procedure to minimize the need to bring additional equipment/supplies in during the procedure.	☐	☐
			1c) Responsibility is assigned to monitor the room once sterile supplies are opened.	☐	☐
		2) Maintain patient normothermia.	2a) A standardized process is in place to maintain patient's body temperature at >96.8° F/ 36° C during surgery.	☐	☐
			2b) Patient's temperature will be measured just prior to or shortly after anesthesia has ended.	☐	☐
		3) Control blood glucose for at-risk patients.	3a) Clear expectations are in place for ongoing monitoring and management of blood glucose for diabetic patients during surgery.	☐	☐
		4) Antibiotic re-dosing occurs during surgery as indicated.	4a) If necessary, antibiotic dose is repeated during surgery at the appropriate time.	☐	☐
	Post-procedure	1) Apply sterile surgical wound dressings as appropriate.	**A standardized process is in place to:** 1a) Maintain sterility of surgical environment until sterile dressings have been applied and are secure.	☐	☐
			1b) Protect primary closure incisions with sterile dressings as appropriate for 24-48 hours.	☐	☐
		2) Maintain normothermia during the immediate post-operative period.	2a) Maintain normothermia in the post-anesthesia care unit (PACU).	☐	☐
		3) Control blood glucose during the post-operative period.	3a) Baseline and intra-op glucose levels are communicated during post-op hand-offs.	☐	☐
			3b) Have protocol in place to maintain post-operative glucose level at <200 mg/dl for 72 hours post-operatively while an inpatient.	☐	☐
		4) Discontinue antibiotics within 24 hours after end of surgery unless otherwise indicated.	4a) Discontinue antibiotics within 24 hours after end of surgery unless otherwise indicated. (Exceptions: CABG and other cardiac surgery.)	☐	☐
		5) Provide post-procedure education to patient/family.	5a) Post-op SSI prevention education is provided to patients and families prior to discharge. {Refer back to "Education"}	☐	☐

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
T	Team Account-ability/ Communi-cation	1) Communicate using standardized process.	1a) A pre-op team communication process, such as a pre-op briefing, is in place in the OR prior to incision that includes discussion on antibiotic, timing, need for re-dosing; and any special considerations.	☐	☐
			1b) A standardized process is in place to track completion of SSI prevention steps (i.e. incorporate into surgical checklist).	☐	☐
S	Staff	1) Set expectations for hand hygiene.	**Clear expectations are in place for hand hygiene, illness, and attire for all health care providers including:** 1a) Hand hygiene education is provided for all new employees.	☐	☐
			1b) Standardized procedures for hand hygiene are followed by all health care personnel.	☐	☐
			In the perioperative setting, hand hygiene practices for maintaining healthy skin and fingernail conditions as outlined by AORN guidelines are followed including: 1c) Fingernails are short, clean, and without chipped nail polish.	☐	☐
			1d) Artificial nails (any enhancement or resin bonding product including gel and shellac) are not worn.	☐	☐
			1e) Rings, watches, and bracelets are removed prior to hand hygiene.	☐	☐
			1f) Cuticles, hands and exposed skin are free of cuts, abrasions, open lesions, and new tattoos.	☐	☐
			1g) A surgical hand scrub is performed by health care personnel before donning sterile gloves for surgical or other invasive procedures.	☐	☐
			Hospital-wide: 1h) Hand hygiene and surgical hand scrub products are FDA-approved.	☐	☐
			1i) AORN, CDC, and/or WHO guidelines as well as manufacturer's directions are followed when using hand hygiene and surgical hand scrub products.	☐	☐
			1j) Hand hygiene audits are conducted for all health care personnel.	☐	☐
			1k) The "Just Culture" model will be applied when health care personnel are observed not following facility expectation for appropriate hand hygiene.	☐	☐
		2) Set expectations for staff illness.	2a) Staff who are acutely ill with a communicable infectious disease should be excluded from direct patient care.	☐	☐
		3) Set expectations for surgical attire.	**For staff in restricted and semi-restricted areas:** 3a) Fresh, hospital-laundered surgical attire donned upon arrival before entering the restricted and semi-restricted areas each day.	☐	☐
			3b) Surgical attire is changed if it becomes visibly soiled.	☐	☐

Road Map to a Comprehensive Surgical Site Infection (SSI) Prevention Program

	Safe from SSI Component	Specific Action(s)	Audit Questions	Yes	No
			3c) Scrubs are not to be worn outside the hospital. This applies to all health care personnel and vendors.	☐	☐
			3d) Personal attire is covered by hospital-provided attire.	☐	☐
			3e) Jewelry that is not covered by surgical attire is removed prior to entering restricted and semi-restricted area.	☐	☐
			3f) Scalp and hair is completely covered by disposable caps or caps that are hospital-laundered and changed daily.	☐	☐
			3g) Non-scrubbed health care personnel in the OR wear hospital-laundered long-sleeved cover jackets.	☐	☐
			3h) The "Just Culture" model will be applied when staff are observed not following facility expectation for appropriate surgical attire.	☐	☐

In addition to SSI, surgical patients are vulnerable to other health care-associated infections. Refer to guides for prevention of catheter-associated urinary tract infections, ventilator-associated pneumonia, central line-associated bloodstream infections, *Clostridium difficile* infection, pressure ulcers, and guidance on judicious antibiotic use for measures to prevent other infections.

December 2011

MINNESOTA MDH DEPARTMENT OF HEALTH

Minnesota Hospital Association

Surgical Site Infection (SSI) Definitions

(Adapted from the Centers for Disease Control & Prevention) 1/06

Superficial Incisional SSI*

- Occurs within 30 days after the operation;
- Involves only the skin or subcutaneous tissue; and
- At least 1 of the following:
  - Purulent drainage (culture documentation not required)
  - Organisms isolated from fluid/tissue of superficial incision
  - At least 1 sign of inflammation (eg, pain or tenderness, induration, erythema, local warmth of the wound)
  - Wound is deliberately opened by the surgeon
  - Surgeon or attending physician declares the wound infected.

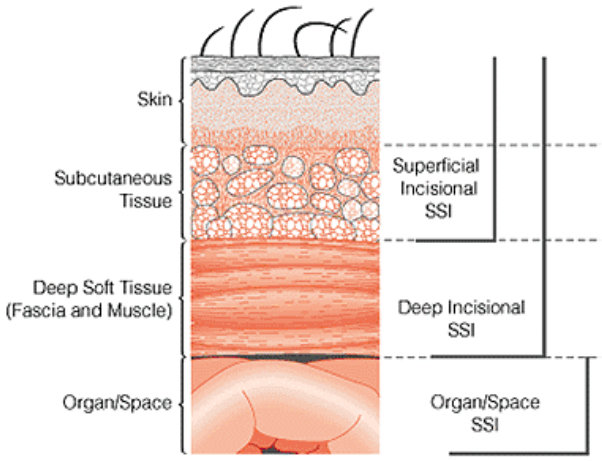
*A wound is not considered a superficial site infection if a stitch abscess is present, the infection is at an episiotomy or circumcision site or a burn wound, or the SSI extends into the fascia or muscle.

Deep Incisional SSI

- Occurs within 30 days of operation or within 1 year if an implant is present;
- Involves deep soft tissues (eg, fascia and/or muscle) of the incision; and
- At least 1 of the following:
  - Purulent drainage from the deep incision but without organ/space involvement
  - Fascial dehiscence or fascia is deliberately separated by the surgeon due to signs of inflammation
  - Deep abscess is identified by direct examination or during reoperation, by histopathology, or by radiologic examination
  - Surgeon or attending physician declares that deep incisional infection is present.

Organ/Space SSI

- Occurs within 30 days of operation or within 1 year if an implant is present;
- Involves anatomic structures not opened or manipulated during the operation; and
- At least 1 of the following:
  - Purulent drainage from a drain placed by a stab wound into the organ/space
  - Organisms isolated from organ/space by aseptic culturing technique
  - Identification of abscess in the organ/space by direct examination, during reoperation, or by histopathologic or radiologic examination
  - Diagnosis of organ/space SSI by surgeon or attending physician.



MINNESOTA MDH DEPARTMENT OF HEALTH
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651-201-5414 - TDD/TTY 651-201-5797 - www.health.state.mn.us

Surgical Site Infection (SSI) Event

Introduction: In 2002, in the United States, an estimated 14 million NHSN operative procedures were performed (CDC unpublished data). SSIs were the second most common healthcare-associated infection, accounting for 17% of all HAIs among hospitalized patients[1]. A similar rate was obtained from NHSN hospitals reporting data in 2006-2008 (15,862 SSI following 830,748 operative procedures) (CDC, unpublished data) with an overall rate of nearly 2%.

While advances have been made in infection control practices, including improved operating room ventilation, sterilization methods, barriers, surgical technique, and availability of antimicrobial prophylaxis, SSIs remain a substantial cause of morbidity and mortality among hospitalized patients. In one study, among nearly 100,000 HAIs reported in one year, deaths were associated with SSIs in more than 8,000 cases.[2]

Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk.[3,4,5,6,7] A successful surveillance program includes the use of epidemiologically-sound infection definitions and effective surveillance methods, stratification of SSI rates according to risk factors associated with SSI development, and data feedback.[4,5] Recommendations are outlined in the CDC's *Guideline for Prevention of Surgical Site Infection, 1999.*[7]

Settings: Surveillance will occur with surgical patients in any inpatient/outpatient setting where the selected NHSN operative procedure(s) are performed.

Requirements: Select at least one NHSN operative procedure category (Table 1) and indicate this on the *Patient Safety Monthly Reporting Plan* (CDC 57.106). Collect numerator and denominator data on all selected procedure categories for at least one month.

The *International Classification of Diseases, 9th Revision Clinical Modifications* (ICD-9-CM) codes, which are defined by the ICD-9 Coordination and Maintenance Committee of the National Center for Health Statistics and the Centers for Medicare and Medicaid Services (CMS), are developed as a tool for classification of morbidity data. The preciseness of the data, as well as their wide use, allows their use in grouping surgery types for the purpose of determining SSI rates. ICD-9-CM codes are updated annually in October and NHSN operative procedure categories are subsequently updated and changes shared with NHSN users. Table 1: NHSN Operative Procedure Category Mappings to ICD-9-CM Codes, below, outlines operative procedures and their grouping into NHSN operative procedure categories according to ICD-9-CM codes. A brief description of the types of operations contained in the NHSN operative procedure categories is also provided.

Table 1. NHSN Operative Procedure Category Mappings to ICD-9-CM Codes

Legacy Code	Operative Procedure	Description	ICD-9-CM Codes
AAA	Abdominal aortic aneurysm repair	Resection of abdominal aorta with anastomosis or replacement	38.34, 38.44, 38.64
AMP	Limb amputation	Total or partial amputation or disarticulation of the upper or lower limbs, including digits	84.00-84.19, 84.91
APPY	Appendix surgery	Operation of appendix (not incidental to another procedure)	47.01, 47.09, 47.2, 47.91, 47.92, 47.99
AVSD	Shunt for dialysis	Arteriovenostomy for renal dialysis	39.27, 39.42
BILI	Bile duct, liver or pancreatic surgery	Excision of bile ducts or operative procedures on the biliary tract, liver or pancreas (does not include operations only on gallbladder)	50.0, 50.12, 50.14, 50.21-50.23, 50.25, 50.26, 50.29, 50.3, 50.4, 50.61, 50.69, 51.31-51.37, 51.39, 51.41-51.43, 51.49, 51.51, 51.59, 51.61-51.63, 51.69, 51.71, 51.72, 51.79, 51.81-51.83, 51.89, 51.91-51.95, 51.99, 52.09, 52.12, 52.22, 52.3, 52.4, 52.51-52.53, 52.59-52.6, 52.7, 52.92, 52.95, 52.96, 52.99
BRST	Breast surgery	Excision of lesion or tissue of breast including radical, modified, or quadrant resection, lumpectomy, incisional biopsy, or mammoplasty.	85.12, 85.20-85.23, 85.31-85.36, 85.41-85.48, 85.50, 85.53-85.55, 85.6, 85.70-85.76, 85.79, 85.93-85.96
CARD	Cardiac surgery	Procedures on the valves or septum of heart; does not include coronary artery bypass graft, surgery on vessels, heart transplantation, or pacemaker implantation	35.00-35.04, 35.10-35.14, 35.20-35.28, 35.31-35.35, 35.39, 35.42, 35.50, 35.51, 35.53, 35.54, 35.60-35.63, 35.70-35.73, 35.81-35.84, 35.91-35.95, 35.98-35.99, 37.10-37.12, 37.31-37.33, 37.35-37.37, 37.41, 37.49, 37.60*
CEA	Carotid endarterectomy	Endarterectomy on vessels of head and neck (includes carotid artery and jugular vein)	38.12

Legacy Code	Operative Procedure	Description	ICD-9-CM Codes
CBGB	Coronary artery bypass graft with **both** chest and donor site incisions	Chest procedure to perform direct revascularization of the heart; includes obtaining suitable vein from donor site for grafting.	36.10-36.14, 36.19
CBGC	Coronary artery bypass graft with chest incision only	Chest procedure to perform direct vascularization of the heart using, for example the internal mammary (thoracic) artery	36.15-36.17, 36.2
CHOL	Gallbladder surgery	Cholecystectomy and cholecystotomy	51.03, 51.04, 51.13, 51.21-51.24
COLO	Colon surgery	Incision, resection, or anastomosis of the large intestine; includes large-to-small and small-to-large bowel anastomosis; does not include rectal operations	17.31-17.36, 17.39, 45.03, 45.26, 45.41, 45.49, 45.52, 45.71-45.76, 45.79, 45.81-45.83, 45.92-45.95, 46.03, 46.04, 46.10, 46.11, 46.13, 46.14, 46.43, 46.52, 46.75, 46.76, 46.94
CRAN	Craniotomy	Excision repair, or exploration of the brain or meninges; does not include taps or punctures	01.12, 01.14, 01.20-01.25, 01.28, 01.29, 01.31, 01.32, 01.39, 01.41, 01.42, 01.51-01.53, 01.59, 02.11-02.14, 02.91-02.93, 07.51-07.54, 07.59, 07.61-07.65, 07.68, 07.69, 07.71, 07.72, 07.79, 38.01, 38.11, 38.31, 38.41, 38.51, 38.61, 38.81, 39.28
CSEC	Cesarean section	Obstetrical delivery by Cesarean section	74.0, 74.1, 74.2, 74.4, 74.91, 74.99
FUSN	Spinal fusion	Immobilization of spinal column	81.00-81.08
FX	Open reduction of fracture	Open reduction of fracture or dislocation of long bones with or without internal or external fixation; does not include placement of joint prosthesis	79.21, 79.22, 79.25, 79.26, 79.31, 79.32, 79.35, 79.36, 79.51, 79.52, 79.55, 79.56
GAST	Gastric surgery	Incision or excision of stomach; includes subtotal or total gastrectomy; does not include vagotomy and fundoplication	43.0, 43.42, 43.49, 43.5, 43.6, 43.7, 43.81, 43.89, 43.91, 43.99, 44.15, 44.21, 44.29, 44.31, 44.38-44.42, 44.49, 44.5, 44.61-44.65, 44.68-44.69, 44.95-44.98

Legacy Code	Operative Procedure	Description	ICD-9-CM Codes
HER	Herniorrhaphy	Repair of inguinal, femoral, umbilical, or anterior abdominal wall hernia; does not include repair of diaphragmatic or hiatal hernia or hernias at other body sites.	17.11-17.13, 17.21-17.24, 53.00-53.05, 53.10-53.17, 53.21, 53.29, 53.31, 53.39, 53.41-53.43, 53.49, 53.51, 53.59, 53.61-53.63, 53.69
HPRO	Hip prosthesis	Arthroplasty of hip	00.70-00.73, 00.85-00.87, 81.51-81.53
HTP	Heart transplant	Transplantation of heart	37.51-37.55
HYST	Abdominal hysterectomy	Abdominal approach with uterine removal	68.31, 68.39, 68.41, 68.49, 68.61, 68.69
KPRO	Knee prosthesis	Arthroplasty of knee	00.80-00.84, 81.54, 81.55
KTP	Kidney transplant	Transplantation of kidney	55.61, 55.69
LAM	Laminectomy	Exploration or decompression of spinal cord through excision or incision into vertebral structures	03.01, 03.02, 03.09, 80.50, 80.51, 80.53, 80.54†, 80.59, 84.60-84.69, 84.80-84.85
LTP	Liver transplant	Transplantation of liver	50.51, 50.59
NECK	Neck surgery	Major excision or incision of the larynx and radical neck dissection; does not include thyroid and parathyroid operations.	30.1, 30.21, 30.22, 30.29, 30.3, 30.4, 31.45, 40.40-40.42
NEPH	Kidney surgery	Resection or manipulation of the kidney with or without removal of related structures	55.01, 55.02, 55.11, 55.12, 55.24, 55.31, 55.32, 55.34, 55.35, 55.39, 55.4, 55.51, 55.52, 55.54, 55.91
OVRY	Ovarian surgery	Operations on ovary and related structures	65.01, 65.09, 65.12, 65.13, 65.21-65.25, 65.29, 65.31, 65.39, 65.41, 65.49, 65.51-65.54, 65.61-65.64, 65.71-65.76, 65.79, 65.81, 65.89, 65.92-65.95, 65.99
PACE	Pacemaker surgery	Insertion, manipulation or replacement of pacemaker	00.50-00.54, 17.51, 17.52, 37.70-37.77, 37.79-37.83, 37.85-37.87, 37.89, 37.94-37.99
PRST	Prostate surgery	Suprapubic, retropubic, radical, or perineal excision of the prostate; does not include transurethral	60.12, 60.3, 60.4, 60.5, 60.61, 60.62, 60.69

Legacy Code	Operative Procedure	Description	ICD-9-CM Codes
		resection of the prostate.	
PVBY	Peripheral vascular bypass surgery	Bypass operations on peripheral arteries	39.29
REC	Rectal surgery	Operations on rectum	48.25, 48.35, 48.40, 48.42, 48.43, 48.49-48.52, 48.59, 48.61-48.65, 48.69, 48.74
RFUSN	Refusion of spine	Refusion of spine	81.30-81.39
SB	Small bowel surgery	Incision or resection of the small intestine; does not include small-to-large bowel anastomosis	45.01, 45.02, 45.15, 45.31-45.34, 45.51, 45.61-45.63, 45.91, 46.01, 46.02, 46.20-46.24, 46.31, 46.39, 46.41, 46.51, 46.71-46.74, 46.93
SPLE	Spleen surgery	Resection or manipulation of spleen	41.2, 41.33, 41.41-41.43, 41.5, 41.93, 41.95, 41.99
THOR	Thoracic surgery	Noncardiac, nonvascular thoracic surgery; includes pneumonectomy and hiatal hernia repair or diaphragmatic hernia repair (except through abdominal approach.)	32.09, 32.1, 32.20-32.23, 32.25, 32.26, 32.29, 32.30, 32.39, 32.41, 32.49, 32.50, 32.59, 32.6, 32.9, 33.0, 33.1, 33.20, 33.25, 33.28, 33.31-33.34, 33.39, 33.41-33.43, 33.48, 33.49, 33.98, 33.99, 34.01-34.03, 34.06, 34.1, 34.20, 34.26, 34.3, 34.4, 34.51, 34.52, 34.59, 34.6, 34.81-34.84, 34.89, 34.93, 34.99, 53.80-53.84
THYR	Thyroid and/or parathyroid surgery	Resection or manipulation of thyroid and/or parathyroid	06.02, 06.09, 06.12, 06.2, 06.31, 06.39, 06.4, 06.50-06.52, 06.6, 06.7, 06.81, 06.89, 06.91-06.95, 06.98, 06.99
VHYS	Vaginal hysterectomy	Vaginal approach with uterine removal	68.51, 68.59, 68.71, 68.79
VSHN	Ventricular shunt	Ventricular shunt operations, including revision and removal of shunt	02.2, 02.31-02.35, 02.39, 02.42, 02.43, 54.95^
XLAP	Abdominal surgery	Abdominal operations not involving the gastrointestinal tract or biliary system includes diaphragmatic hernia repair through abdominal approach.	53.71, 53.72, 53.75, 54.0, 54.11, 54.12, 54.19, 54.3, 54.4, 54.51, 54.59, 54.61, 54.63, 54.64, 54.71-54.75, 54.92, 54.93

*NOTE: The procedure represented by this ICD-9-CM code can be performed in a number of ways. However, as for all surgeries, if, at the end of the procedure, the skin incision edges do not meet because of wires, devices or other objects extruding through the incision, the incision is not considered primarily closed. Therefore the procedure is not considered an NHSN operative procedure and any subsequent infection is not considered a procedure-associated infection (i.e., not an SSI or PPP).

†NOTE: If this procedure is performed percutaneously, it is not considered an NHSN operative procedure and should not be included in LAM denominator data.

^NOTE: Include only if this procedure involves ventricular shunt.

For a complete mapping of all ICD-9-CM codes to their assignment as an NHSN operative procedure category, a surgical procedure other than an NHSN operative procedure (OTH), or a non-operative procedure (NO), see ICD-9-CM Procedure Code Mapping to NHSN Operative Procedure Categories at http://www.cdc.gov/nhsn/library.html.

Definitions:

An NHSN operative procedure is a procedure

1) that is performed on a patient who is an NHSN inpatient or an NHSN outpatient; 2) takes place during an operation (defined as a single trip to the operating room (OR) where a surgeon makes at least one incision through the skin or mucous membrane, including laparoscopic approach, and closes the incision before the patient leaves the OR; and 3) that is included in Table 1.

*NOTE: If the skin incision edges do not meet because of wires or devices or other objects extruding through the incision, the incision is not considered primarily closed and therefore the procedure is not considered an operation. Further, any subsequent infection is not considered a procedure-associated infection (i.e., not an SSI or PPP).

NHSN Inpatient: A patient whose date of admission to the healthcare facility and the date of discharge are different calendar days.

NHSN Outpatient: A patient whose date of admission to the healthcare facility and date of discharge are the same calendar day.

Operating Room (OR): A patient care area that met the Facilities Guidelines Institute's (FGI) or American Institute of Architects' (AIA) criteria for an operating room when it was constructed or renovated.[7] This may include an operating room, C-Section room, interventional radiology room, or a cardiac catheterization lab.

Implant: A nonhuman-derived object, material, or tissue that is permanently placed in a patient during an operative procedure and is not routinely manipulated for diagnostic or therapeutic purposes. Examples include: porcine or synthetic heart valves, mechanical heart, metal rods, mesh, sternal wires, screws, cements, internal staples, hemoclips, and other devices. Non-absorbable

sutures are excluded because Infection Preventionists may not easily identify and/or differentiate the soluble nature of suture material used.

Transplant: Human cells, tissues, organs, or cellular- or tissue-based products that are placed into a human recipient via grafting, infusion, or transfer. Examples include: heart valves, organs, ligaments, bone, blood vessels, skin, corneas, and bone marrow cells.
Autologous or "autograft" transplants are products that originate from the patient's own body.
Non-autologous or "allograft" transplants are tissues or other products derived from another human body, either a donor cadaver or a live donor.

REPORTING INSTRUCTIONS:

- Some products are a combination of human- and nonhuman-derived materials, such as demineralized human bone matrix with porcine gel carrier. When placed in a patient during an operative procedure, indicate "Yes" for both the Implant and Non-autologous Transplant fields.
- Some operative procedures involve placement of both autologous and non-autologous products. For these procedures, indicate "Yes" for Non-autologous Transplant field.

A **superficial incisional SSI** must meet one of the following criteria:

Infection occurs within 30 days after the operative procedure
and
involves only skin and subcutaneous tissue of the incision
and
patient has at least one of the following:

a. purulent drainage from the superficial incision.
b. organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
c. at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and superficial incision is deliberately opened by surgeon, and is culture-positive or not cultured. A culture-negative finding does not meet this criterion.
d. diagnosis of superficial incisional SSI by the surgeon or attending physician.

NOTE: There are two specific types of superficial incisional SSIs:

1. Superficial Incisional Primary (SIP) – a superficial incisional SSI that is identified in the primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CBGB)
2. Superficial Incisional Secondary (SIS) – a superficial incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site [leg] incision for CBGB)

REPORTING INSTRUCTIONS:

- Do not report a stitch abscess (minimal inflammation and discharge confined to the points of suture penetration) as an infection.

- Do not report a localized stab wound infection as SSI. While it would be considered either a skin (SKIN) or soft tissue (ST) infection, depending on its depth, it is not reportable under this module.
- "Cellulitis", by itself, does not meet the criteria for Superficial Incisional SSI.
- If the incisional site infection involves or extends into the fascial and muscle layers, report as a deep-incisional SSI.
- Classify infection that involves both superficial and deep incision sites as deep incisional SSI.
- An infected circumcision site in newborns is classified as CIRC. Circumcision is not an NHSN operative procedure. CIRC is not reportable under this module.
- An infected burn wound is classified as BURN and is not reportable under this module

A **deep incisional SSI** must meet one of the following criteria:
Infection occurs within 30 days after the operative procedure if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operative procedure
and
involves deep soft tissues (e.g., fascial and muscle layers) of the incision
and
patient has at least one of the following:

a. purulent drainage from the deep incision but not from the organ/space component of the surgical site
b. a deep incision spontaneously dehisces or is deliberately opened by a surgeon and is culture-positive or not cultured and the patient has at least one of the following signs or symptoms: fever (>38°C), or localized pain or tenderness. A culture-negative finding does not meet this criterion.
c. an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination
d. diagnosis of a deep incisional SSI by a surgeon or attending physician.

NOTE: There are two specific types of deep incisional SSIs:

1. Deep Incisional Primary (DIP) – a deep incisional SSI that is identified in a primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CBGB)
2. Deep Incisional Secondary (DIS) – a deep incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site [leg] incision for CBGB)

REPORTING INSTRUCTIONS:

- Classify infection that involves both superficial and deep incision sites as deep incisional SSI.

An **organ/space SSI** involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure. Specific sites are assigned to organ/space SSI to further identify the location of the infection. The table below lists the specific sites that must be used to differentiate organ/space SSI. An example is appendectomy with

subsequent subdiaphragmatic abscess, which would be reported as an organ/space SSI at the intraabdominal specific site (SSI-IAB). Specific sites of organ/space (Table 2) have specific criteria which must be met in order to qualify as an NHSN event. These criteria are in addition to the general criteria for organ/space SSI and can be found in Chapter 17.

An **organ/space SSI** must meet one of the following criteria:
Infection occurs within 30 days after the operative procedure if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operative procedure
and
infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure
and
patient has at least one of the following:

a. purulent drainage from a drain that is placed through a stab wound into the organ/space
b. organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space
c. an abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination
d. diagnosis of an organ/space SSI by a surgeon or attending physician.

REPORTING INSTRUCTIONS:

- Occasionally an organ/space infection drains through the incision. Such infection generally does not involve reoperation and is considered a complication of the incision. Therefore, classify it as a deep incisional SSI.
- Report mediastinitis following cardiac surgery that is accompanied by osteomyelitis as SSI-MED rather than SSI-BONE.
- If meningitis (MEN) and a brain abscess (IC) are present together after operation, report as SSI-IC.
- Report CSF shunt infection as SSI-MEN if it occurs ≤ 1 year of placement; if later or after manipulation/access, it is considered CNS-MEN and is not reportable under this manual.
- Report spinal abscess with meningitis as SSI-MEN following spinal surgery.
- Episiotomy is not considered an operative procedure in NHSN.

Table 2. Specific sites of an organ/space SSI. Criteria for these sites can be found in the NHSN Help System (must be logged in to NHSN) or Chapter 17.

Code	Site	Code	Site
BONE	Osteomyelitis	JNT	Joint or bursa
BRST	Breast abscess or mastitis	LUNG	Other infections of the respiratory tract
CARD	Myocarditis or pericarditis	MED	Mediastinitis
DISC	Disc space	MEN	Meningitis or ventriculitis
EAR	Ear, mastoid	ORAL	Oral cavity (mouth, tongue, or gums)
EMET	Endometritis	OREP	Other infections of the male or female reproductive tract

Code	Site	Code	Site
ENDO	Endocarditis	OUTI	Other infections of the urinary tract
EYE	Eye, other than conjunctivitis	SA	Spinal abscess without meningitis
GIT	GI tract	SINU	Sinusitis
HEP	Hepatitis	UR	Upper respiratory tract
IAB	Intraabdominal, not specified else-where	VASC	Arterial or venous infection
IC	Intracranial, brain abscess or dura	VCUF	Vaginal cuff

Numerator Data: All patients having the selected operative procedure are monitored for signs of SSI. The *Surgical Site Infection (SSI)* form (CDC 57.120) is completed for each such patient found to have an SSI.

NOTES:

1. If a patient has several NHSN operative procedures prior to an infection, report the operative procedure code of the operation that was performed most closely in time prior to the infection date, unless there is evidence that the infection is associated with a different operation.
2. If a procedure from more than one NHSN operative procedure category was done through a single incision, attempt to determine the procedure that is thought to be associated with the infection. If it is not clear (as is often the case when the infection is a superficial incisional SSI), or if the infection site being reported is not an SSI, use the NHSN Principal Operative Procedure Category Selection Lists (Table 3) to select which operative procedure to report.

Table 3. NHSN Principal Operative Procedure Category Selection Lists

The following lists are derived from Table 1, NHSN Operative Procedure Categories. The operative procedures with the highest risk of surgical site infection are listed before those with a lower risk.

Priority	Code	Abdominal Operations
1	SB	Small bowel surgery
2	KTP	Kidney transplant
3	LTP	Liver transplant
4	BILI	Bile duct, liver or pancreatic surgery
5	REC	Rectal surgery
6	COLO	Colon surgery
7	GAST	Gastric surgery
8	CSEC	Cesarean section
9	SPLE	Spleen surgery
10	APPY	Appendix surgery
11	HYST	Abdominal hysterectomy
12	VHYS	Vaginal Hysterectomy
13	OVRY	Ovarian surgery
14	HER	Herniorrhaphy

The following lists are derived from Table 1, NHSN Operative Procedure Categories. The operative procedures with the highest risk of surgical site infection are listed before those with a lower risk.		
15	CHOL	Gall bladder surgery
16	AAA	Abdominal aortic aneurysm repair
17	NEPH	Kidney surgery
18	XLAP	Laparotomy
Priority	**Code**	**Thoracic Operations**
1	HTP	Heart transplant
2	CBGB	Coronary artery bypass graft with donor incision(s)
3	CBGC	Coronary artery bypass graft, chest incision only
4	CARD	Cardiac surgery
5	THOR	Thoracic surgery
Priority	**Code**	**Neurosurgical (Spine) Operations**
1	RFUSN	Refusion of spine
2	FUSN	Spinal fusion
3	LAM	Laminectomy
Priority	**Code**	**Neurosurgical (Brain) Operations**
1	VSHN	Ventricular shunt
2	CRAN	Craniotomy
Priority	**Code**	**Neck Operations**
1	NECK	Neck surgery
2	THYR	Thyroid and or parathyroid surgery

The *Instructions for Completion of Surgical Site Infection* form (Tables of Instructions, Tables 12 and 2a) includes brief instructions for collection and entry of each data element on the form. The SSI form includes patient demographic information and information about the operative procedure, including the date and type of procedure. Information about the SSI includes the date of SSI, specific criteria met for identifying the SSI, when the SSI was detected, whether the patient developed a secondary bloodstream infection, whether the patient died, and the organisms isolated from cultures and the organisms' antimicrobial susceptibilities.

Denominator Data: For all patients having a procedure selected for surveillance during the month, complete the *Denominator for Procedure* form (CDC 57.121). The data are collected individually for each operative procedure performed during the month specified on the *Patient Safety Monthly Surveillance Plan* (CDC 57.106). The *Instructions for Completion of Denominator for Procedure* form (Tables of Instructions, Table 13) includes brief instructions for collection and entry of each data element on the form.

NOTES:

1. If procedures in more than one NHSN operative procedure category are performed during the same trip to the OR even if performed through the same incision, a Denominator for Procedure (CDC 57.121) record is reported for <u>each</u> operative procedure being monitored. For example, if a CARD and CBGC are done through the same incision, a *Denominator for Procedure* record is reported for each.
2. EXCEPTION: If a patient has both a CBGC and CBGB during the same trip to the OR, report only as a CBGB. Only report as a CBGC when there is a chest incision only. CBGB and CBGC are never reported for the same patient for the same trip to the OR. For bilateral operative procedures see #4 below.
3. If procedures of different ICD-9-CM codes from the same NHSN Operative Procedure Category are performed through the same incision, record only one procedure for that category. For example, if your facility is performing surveillance for both CBGB and CARD procedures, and a patient undergoes an aortocoronary bypass of one coronary vessel (36.11, CBGB) and the replacement of both the mitral and tricuspid valves (35.23 and 35.27, both CARD) during the same trip to the OR, you would complete a *Denominator for Procedure* record for the CBGB and another for the CARD.
4. If more than one NHSN operative procedure category is performed through the same incision, record the combined duration of all procedures, which is the time from skin incision to primary closure.
5. For bilateral operative procedures (e.g., KPRO), two separate Denominator for Procedure (CDC 57.121) records are completed. To document the duration of the procedure, indicate the incision time to closure time for each procedure separately or, alternatively, take the total time for both procedures and split it evenly between the two. See "5" below.
6. Laparoscopic hernia repairs are considered one procedure, regardless of the number of hernias that are repaired in that trip to the OR. In most cases there will be only one incision time documented for this procedure. If more than one time is documented, total the durations. In this situation, if more than one of the incisions should become infected, only report as a single SSI. Open [i.e., non-laparoscopic] hernia repairs are reported as one procedure for each hernia repaired via a separate incision, i.e., if two incisions are made to repair two defects, then two procedures will be reported. It is anticipated that separate incision times will be recorded for these procedures. If not, take the total time for both procedures and split it evenly between the two.
7. If a patient goes to the OR more than once during the same admission and another procedure is performed through the same incision within 24 hours of the original operative incision, report only one procedure on the *Denominator for Procedure* (CDC 57.121) form combining the durations for both procedures. For example, a patient has a CBGB lasting 4 hours. He returns to the OR six hours later to correct a bleeding vessel. The surgeon reopens the initial incision, makes the repairs, and recloses in 1.5 hours. Record the operative procedure as one CBGB and the duration of operation as 5 hour 30 minutes. If the wound class has changed, report the higher wound class. If the ASA class has changed, report the higher ASA class.

Data Analyses: The SIR is calculated by dividing the number of observed infections by the number of expected infections. The number of expected infections, in the context of statistical prediction, is calculated using SSI probabilities estimated from multivariate logistic regression models constructed from NHSN data during a baseline time period to represent a standard population.

NOTE: The SIR will be calculated only if the number of expected HAIs (numExp) is ≥ 1.

$$SIR = \frac{\text{Observed (O) HAIs}}{\text{Expected (E) HAIs}}$$

While the SSI SIR can be calculated for single procedure categories, and for specific surgeons, the measure also allows you to summarize your data across multiple procedure categories, while adjusting for differences in the estimated probability of infection among the patients included across the procedure categories. For example, you will be able to obtain one SSI SIR adjusting for all procedures reported. Alternatively, you can obtain one SSI SIR for all colon surgeries (COLO) only within your facility.

SSI rates per 100 operative procedures are calculated by dividing the number of SSIs by the number of specific operative procedures and multiplying the results by 100. SSI will be included in the numerator of a rate based on the date of procedure, not the date of event. Rate calculations can be performed separately for the different types of operative procedures and stratified by the basic risk index. SSI rate calculation options are available in the advanced analysis feature of the NHSN application.

- Basic SSI Risk Index. The index used in NHSN assigns surgical patients into categories based on the presence of three major risk factors:

  1. Operation lasting more than the duration cut point hours, where the duration cut point is the approximate 75th percentile of the duration of surgery in minutes for the operative procedure.
  2. Contaminated (Class 3) or Dirty/infected (Class 4) wound class.
  3. ASA classification of 3, 4, or 5.

  The patient's SSI risk category is simply the number of these factors present at the time of the operation.

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HSAG HEALTH SERVICES ADVISORY GROUP

Patient Safety Quality Measures *for the* Surgical Care Improvement Project

Measure		Rationale	Strategy
SCIP-Inf-1	Prophylactic antibiotics are administered one hour prior to incision.	Studies find that the lowest incidence of post-operative infection is associated with antibiotic administration during the one hour prior to surgery. The risk of infection increases progressively with greater time intervals between administration of the antibiotic and the skin incision.	• Include administration and documentation of the antibiotic in the surgical time out. • For one-hour antibiotics, the antibiotic is hung in pre-op, a surgical team member administers and documents the antibiotic infusion.
SCIP-Inf-2	Prophylactic antibiotics are consistent with current guidelines (specific to each type of surgical procedure).	Use an agent that is safe, cost-effective, and has a spectrum of action that covers most of the probable intraoperative contaminants for the operation. First- or second-generation cephalosporins satisfy these criteria for most operations, although anaerobic coverage is needed for colon surgery.	• The use of pre-printed orders that include the recommended antibiotic will assist surgeons with choosing appropriate antibiotics. • Vancomycin is appropriate if there is a risk of MRSA.
SCIP-Inf-3	Prophylactic antibiotics are to be discontinued within 24 hours after anesthesia end time. The discontinuation time extends to 48 hours for cardiac surgery patients.	Administration of antibiotics for more than a few hours after the incision is closed offers no additional benefit to the surgical patient. Prolonged administration increases the risk of *Clostridium difficile* infection and the development of antimicrobial resistant pathogens.	• Begin antibiotics in the PACU. • Administer cephalosporins every 6 hours rather than every 8 hours. • Antibiotics are not provided for more than 24 hours after surgery without appropriate documentation.
SCIP-Inf-4	Cardiac surgery patients with controlled 6 a.m. blood glucose (≤ 200 mg/dL) for the first two postoperative days.	Hyperglycemia in the immediate postoperative phase increases the risk of infection in both diabetic and non-diabetic patients; the higher the level of hyperglycemia, the higher the potential for infection in both patient populations.	• Blood glucose levels are monitored from pre-op through 48 hours post-operative. • The use of an insulin protocol for treating hyperglycemia with an insulin drip is strongly recommended.
SCIP-Inf-6	Surgery patients with appropriate surgical site hair removal. No hair removal, hair removal with clippers, or depilatory is appropriate.	There is no strong evidence to contraindicate preoperative hair removal; however, there is strong evidence against hair removal with a razor. Shaving is considered inappropriate.	• Take ALL razors out of the peri-operative area. • Instruct patients not to shave the surgical site.
SCIP-Inf-9	Surgical patients with urinary catheter removed on Postoperative Day 1 or Postoperative Day 2 with day of surgery being day zero. (This measure does not apply to certain urological, gynecological or perineal procedures.)	It is well-established that the risk of catheter-associated urinary tract infection (UTI) increases with increasing duration of indwelling urinary catheterization.	• Create a system of alerts or reminders to identify all patients with urinary catheters and assess the need for continued catheterization. • Develop guidelines and protocols for nurse-directed removal of unnecessary urinary catheters and management of postoperative urinary retention. • Consider the use of external catheters for cooperative males.

Measure	Rationale	Strategy
SCIP-Inf-10	Surgical patients should be actively warmed during surgery or have at least one recorded body temperature equal to or greater than 96.8° F within 30 minutes prior to the end of anesthesia to 15 minutes after anesthesia end time. (Patients with intentional hypothermia are excluded from this measure.)	Research has correlated impaired wound healing, adverse cardiac events, altered drug metabolism, and coagulopathies with unplanned perioperative hypothermia. A study by Kurtz, et al. (1996), found that incidence of culture-positive surgical site infections among those with mild perioperative hypothermia was three times higher than the normothermic perioperative patients.	• Use aggressive warming measures during surgery. • Ensure accurate documentation of post-operative temperature.
SCIP-Card-2	Surgery patients on beta-blockers prior to admission should continue beta-blocker therapy during the perioperative period.	The American College of Cardiology and the American Heart Association recommend continuation of beta-blocker therapy in the perioperative period as a class I indication, and accumulating evidence suggests that titration to maintain tight heart rate control should be the goal.	• Instruct patients to take their beta blockers the day of surgery. • Educate in-house clinicians about the importance of patients receiving their beta blockers the day of surgery, even while the patients are otherwise NPO. • Meet with physician office staff to ensure consistent instructions to the patients.
SCIP-VTE-1	Surgery patients with recommended venous thromboembolism (VTE) prophylaxis ordered anytime from hospital arrival to 48 hours after *Anesthesia End Time*.	Despite the evidence that VTE is one of the most common postoperative complications and prophylaxis is the most effective strategy to reduce morbidity and mortality, it is often under-used. The frequency of venous thromboembolism (VTE), which includes deep vein thrombosis and pulmonary embolism, is related to the type and duration of surgery, patient risk factors, duration and extent of postoperative immobilization, and use or non-use of prophylaxis.	• Use pre-printed orders that include nationally recommended guidelines for VTE prophylaxis. • A "hard stop" would be not to allow patients to leave the recovery area until VTE orders are completed by the surgeon. • Ensure that surgeon "preference" cards mirror national guidelines. • Pharmacists should assist surgeons with understanding the risk of bleeding with pharmacological interventions.
SCIP-VTE-2	Surgery patients who received appropriate venous thromboembolism (VTE) prophylaxis within 24 hours prior to *Anesthesia Start Time* to 24 hours after *Anesthesia End Time*.	Timing of prophylaxis is based on the type of procedure, prophylaxis selection, and clinical judgment regarding the impact of patient risk factors. The optimal start of pharmacologic prophylaxis in surgical patients varies and must be balanced with the efficacy-versus-bleeding potential. Due to the inherent variability related to the initiation of prophylaxis for surgical procedures, 24 hours prior to surgery to 24 hours post surgery was recommended by consensus of the SCIP Technical Expert Panel in order to establish a time frame that would encompass most procedures.	• (Please note that rates for SCIP-VTE- 2 may be lower than those for SCIP-VTE-1 as a result of more stringent criteria. SCIP-VTE-2 requires documentation that prophylaxis was ordered and actually started, whereas SCIP-VTE-1 requires only documentation of an order.) • Organizations with decreased VTE 2 rates should assess their processes to determine why physician orders are not being implemented.

This material was prepared by Health Services Advisory Group of California, Inc., the Medicare Quality Improvement Organization for California, under contract with the Centers for Medicare & Medicaid Services (CMS), an agency of the U.S. Department of Health and Human Services. The contents presented do not necessarily reflect CMS policy. Publication No. CA-9SOW-6.2.3-070210-01

New 2010 National Patient Safety Goal 7
Gap Analysis

NPSG.07.05.01 Implement evidence-based practices for preventing surgical site infections.			
Elements of Performance for NPSG.07.05.01	**Evidence of Compliance**	**Gaps Remaining**	**Plan for Full Implementation by January 1, 2010**
1. Educate staff and licensed independent practitioners involved in surgical procedures about surgical site infections and the importance of prevention. Education occurs upon hire, annually thereafter, and when involvement in surgical procedures is added to an individual's job responsibilities.			
2. Educate patients, and their families as needed, who are undergoing a surgical procedure about surgical site infection prevention.			
3. Implement policies and practices aimed at reducing the risk of surgical site infections. These policies and practices meet regulatory requirements and are aligned with evidence-based guidelines (for example, the Centers for Disease Control and Prevention (CDC) and/or professional organization guidelines).			
4. As part of the effort to reduce surgical site infections: - Conduct periodic risk assessments for surgical site infections in a time frame determined by the hospital. - Select surgical site infection measures using best practices or evidence-based guidelines. - Monitor compliance with best practices or			

evidence-based guidelines. - Evaluate the effectiveness of prevention efforts. Note: Surveillance may be targeted to certain procedures based on the hospital's risk assessment.				
5. Measure surgical site infection rates for the first 30 days following procedures that do not involve inserting implantable devices and for the first year following procedures involving implantable devices. The hospital's measurement strategies follow evidence-based guidelines. Note: Surveillance may be targeted to certain procedures based on the hospital's risk assessment.				
6. Provide process and outcome (for example, surgical site infection rate) measure results to key stakeholders.				
7. Administer antimicrobial agents for prophylaxis for a particular procedure or disease according to evidence-based best practices.				
8. When hair removal is necessary, use clippers or depilatories. Note: Shaving is an inappropriate hair removal method.				

HealthEast Care System

Confidential: Protected under MN Statute 145.61.

Surgical Site Infection (SSI) Prevention Focus
HAI Event Review Process

HE Facility: ❑ St. Joseph's ❑ St. John's ❑ Woodwinds ❑ Maplewood SC ❑ Midway SC

Patient Name:_____ **MRN#**_____ **DOB:** ____/____/____

Admission Date: ____/____/____ **Service:** _____ **Discharge Date:** ____/____/____

Procedure: _____ **Surgeon:** _____

Diagnosis: _____ **SSI Type:** ❑ Superficial ❑ Deep

Date of + Culture: ____/____/____ **Site:** _____**Organism(s):** _____

Symptoms: _____

Preop antibiotics: ❑ No ❑ Yes Name: _____ **Dose:** _____ **Weight:** _____

Antibiotic start location: ❑ SAU ❑ OR ❑ Floor **By:** ❑ Preop RN ❑ Anesthesia

Patient on Antibiotics for SSI: ❑ Yes ❑ No Name: _____

Duration of surgery: _____ min. (cut to close time) **Wound class:** ❑ I ❑ II ❑ III ❑ IV

ASA Score: ❑ 1 ❑ 2 ❑ 3 ❑ 4 **NNIS Risk Score:** ❑ 0 ❑ 1 ❑ 2 ❑ 3

Preop antibiotic administered within 60 min of incision? ❑ Yes ❑ No ❑ Unknown ❑ Not documented
(120 minutes for vancomycin and fluoroquinolones)

Antibiotic appropriate based on current recommendations? ❑ Yes ❑ No

Prophylactic antibiotic discontinued within 24 hours? ❑ Yes ❑ No

Hair removal per protocol? (clippers) ❑ Yes ❑ No ❑ N/A

Patient skin prep followed per protocol? ❑ Yes ❑ No

- Betadine/Povidone Iodine ❑
- Hibiclens ❑
- Duraprep ❑
- Chloraprep ❑
- Other: _____ ❑

Flash sterilization used for case? _____ ❑ Yes ❑ No

List other potential contributory factors: _____

_____

Recommendations on opportunity for improvement: _____

_____

Reported to: ❑ ICC ❑ Surgery ❑ Clinical Co-Management: _____ ❑ _____

Reviewed by: _____ Date: _____/_____/_____

Reviewed by: _____ Date: _____/_____/_____

Reviewed by: _____ Date: _____/_____/_____

For Performance Improvement Purposes only
Return to site Infection Control Specialist

9/06

SAFE CUTS

F – Facility Expectations

Best Practice: Prevention of Surgical Site Infections

HealthEast Care System

INFECTION PREVENTION & CONTROL

Best Practice

Evidence Based Practice Information Sheet for Prevention and Control of Health Care Associated Infections

Prevention of Surgical Site Infections

Surgical site infections (SSI) account for about 16% of health care acquired infections and among surgical patients, account for 40% of such infections, resulting in prolonged hospitalization (mean of 7 days), attributable mortality rate up to 30% and cost per infection on average of $3,152 up to $40,000+, depending on the type of surgery and wound type.

The Infection Control, Surgery Clinical Co-Management and Patient Safety Committees have endorsed the following practices as HealthEast policy, as a result of participation in the Safest in America and Institute for Healthcare Improvement (IHI) initiatives and the Surgical Care Improvement Project as well as review of evidence based literature and guidelines.

<u>All physicians and allied professionals who are involved in the care of the surgical patients are asked to utilize these practices in support of patient safety for the prevention of health care associated infections related to surgical procedures.</u>

- ✓ **Hand hygiene.** *Hand hygiene is a critical step in reducing numbers of potentially pathogenic organisms that could be present on the hands and transferred during the surgical procedure. A surgical scrub is to be performed by all personnel present in the sterile field during surgery.*

- ✓ **Eliminating use of razors for pre-operative hair removal.** *Use of razors to shave hair increases infection risk due to skin nicks. Remove hair only if necessary and then clippers are to be used as close to the time of the procedure as possible.*

- ✓ **Maintaining glucose control.** *Hyperglycemia increases risk for surgical site infections.*

- ✓ **Maintaining normothermia.** *Perioperative hypothermia can result in increased risk for myocardial events, coagulopathy and infection,, reduces drug metabolism, and also results in patient discomfort.*

- ✓ **Using prophylactic antibiotics appropriately.** *Antibiotics should be present in the tissue to be operated on at the time incision is made and throughout time the wound is open.*
  - o *Appropriate antibiotic selection*
  - o *Administer within 1 hour prior to surgical incision*
  - o *Discontinue prophylactic antibiotic within 24 hours of procedure end time*

- ✓ **Optimizing oxygen tension.** *Administration of supplemental perioperative oxygen has been demonstrated to decrease surgical site infection rates.*

- ✓ **Standardizing pre-operative skin antisepsis.** *Use of an appropriate antiseptic agent for patient skin preparation with correct technique reduces skin bioload and risk for infection.*

For questions, product information, copies of policies or supporting literature, please contact infection control

SAFE CUTS

E – Educate Staff and Patients

Postoperative Infections
JAMA-Patient Page, August 10, 2010

Preventing Surgical Site Infections: A Surgeon's Perspective
Emerging Infectious Diseases; April 2001

CATS Decrease Surgical Site Infections
HSAG; Heath Services Advisory Group

Beagles Save Lives
US Department of Health and Human Services

What You Can Do To Prepare for Surgery
Partnership for Healthcare Excellence

FAQS about Surgical Site Infections
SHEA, IDSA, AHA, APIC, CDC, and the Joint Commission

Protecting 5 Million Lives from Harm: What You Need to Know about Infections after Surgery: A Fact Sheet for Patients and Their Family Members

Speak Up: Five Things You Can Do To Prevent Infection
The Joint Commission

Partnering to Heal
U.S. Department of Health and Human Services

Hand Hygiene: A Healthy Habit
Mayo Clinic

Infection Prevention Checklist/Post-operative Infection Prevention
Olmsted Medical Center

Postoperative Infections

Infections after **surgical procedures** (operations) can cause pain, poor wound healing, need for further treatment including antibiotics, longer hospital stays, and increased health care costs. Postoperative infections may cause severe problems, including failure of the surgical procedure, other surgical complications, sepsis, organ failure, and even death. Some persons are at higher risk of developing postoperative infections than others. Ways to try to prevent these types of infections include giving antibiotics before a procedure, when appropriate; making sure the patient is in the best condition possible before elective surgery; using an antiseptic solution to "prep" the area around a surgical incision; maintaining **sterility** (no bacteria or other organisms, such as viruses or parasites) of the surgical area (also called the "surgical field") and operating tools; and having operating room staff wear clean scrub clothes, hats, and masks. The June 23/30, 2010, issue of *JAMA* contains an article evaluating measures designed to reduce the risk of infections that occur after surgical procedures.

RISK FACTORS FOR POSTOPERATIVE INFECTION

- Diabetes
- Obesity
- Older age
- Emergency operations
- Obvious contamination (with debris, pus, stool, or other substances) of the injury or the surgical area

TREATMENT

- Antibiotics are given, sometimes by mouth but often through an intravenous line (an IV) for serious infections. In many cases, cultures of the affected area are taken to see if **resistant bacteria** (which do not respond to the usual antibiotic treatment) are involved.
- Reexploration of a surgical incision may be necessary to drain pus, an **abscess** (a collection of infected fluid), or a **hematoma** (an area of blood and blood clot that can also become infected).
- If hardware is involved (such as plates, screws, or total joint replacements), and the infection is serious, the metal parts may need to be removed.
- Supportive care, including fluids, medications to lower a fever, and pain medication, is often needed. If the infection is severe, a person may require staying in the hospital or even in the intensive care unit (ICU) for treatment.

PREVENTING POSTOPERATIVE INFECTION

A national effort to reduce postoperative infections, sponsored by many organizations involved in surgical patient care and health care quality, the Surgical Care Improvement Program (SCIP) was launched in July 2006. Several steps were recommended, and some extra steps were added later, to help prevent surgically related infections. These include appropriate choice of preoperative antibiotics, proper timing and duration of antibiotic dosing, clipping of hair (instead of shaving) around a surgical incision site, keeping appropriate blood sugar levels for persons with diabetes (especially for individuals having heart surgery), and keeping patients having colon surgery at a normal body temperature.

FOR MORE INFORMATION

- Surgical Care Improvement Project (SCIP)
  www.qualitynet.org
  http://www.jointcommission.org/performancemeasurement/performancemeasurement/scip+core+measure+set.htm
- World Health Organization
  www.who.int
- Agency for Healthcare Research and Quality
  www.ahrq.gov
- American College of Surgeons
  www.facs.org

INFORM YOURSELF

To find this and previous JAMA Patient Pages, go to the Patient Page Index on *JAMA*'s Web site at www.jama.com. Many are available in English and Spanish. A Patient Page on quality of care was published in the October 22/29, 2008, issue; one on MRSA infections was published in the October 17, 2007, issue; one on inappropriate use of antibiotics was published in the August 19, 2009, issue; and one on intensive care units was published in the March 25, 2009, issue.

Sources: World Health Organization; Centers for Disease Control and Prevention; American College of Surgeons; American Society of Anesthesiologists; Surgical Care Improvement Project; The Joint Commission; Agency for Healthcare Research and Quality

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Preventing Surgical Site Infections: A Surgeon's Perspective

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Wound site infections are a major source of postoperative illness, accounting for approximately a quarter of all nosocomial infections. National studies have defined the patients at highest risk for infection in general and in many specific operative procedures. Advances in risk assessment comparison may involve use of the standardized infection ratio, procedure-specific risk factor collection, and logistic regression models. Adherence to recommendations in the 1999 Centers for Disease Control and Prevention guidelines should reduce the incidence of infection in surgical patients.

Postoperative surgical site infections remain a major source of illness and a less frequent cause of death in the surgical patient (1). These infections number approximately 500,000 per year, among an estimated 27 million surgical procedures (2), and account for approximately one quarter of the estimated 2 million nosocomial infections in the United States each year (3). Infections result in longer hospitalization and higher costs.

The incidence of infection varies from surgeon to surgeon, from hospital to hospital, from one surgical procedure to another, and—most importantly—from one patient to another. During the mid1970s, the average hospital stay doubled, and the cost of hospitalization was correspondingly increased when postoperative infection developed after six common operations (4). These costs and the length of hospital stay are undoubtedly lower today for most surgical procedures that are done on an outpatient basis, such as laparoscopic (minimally invasive) operations or those that require only a short postoperative stay. In these cases, most infections are diagnosed and treated in the outpatient clinic or the patient's home. However, major complications such as deep sternal infections continue to have a grave impact, increasing the duration of hospitalization as much as 20-fold and the cost of hospitalization fivefold (5). Any surgical site infection after open heart surgery results in a substantial net loss of reimbursement to the hospital compared with uninfected cases, a factor that should motivate hospitals to minimize the incidence of postoperative infections (6).

Description of Surgical Site Infections

The Centers for Disease Control and Prevention (CDC) term for infections associated with surgical procedures was changed from surgical wound infection to surgical site infection in 1992 (7). These infections are classified into incisional, organ, or other organs and spaces manipulated during an operation; incisional infections are further divided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue-muscle and fascia). Detailed criteria for these definitions have been described (7). These definitions should be followed universally for surveillance, prevention, and control of surgical site infections.

Microbiology of Surgical Site Infections

The pathogens isolated from infections differ, primarily depending on the type of surgical procedure. In clean surgical procedures, in which the gastrointestinal, gynecologic, and respiratory tracts have not been entered, *Staphylococcus aureus* from the exogenous environment or the patient's skin flora is the usual cause of infection. In other categories of surgical procedures, including clean-contaminated, contaminated, and dirty, the polymicrobial aerobic and anaerobic flora closely resembling the normal endogenous microflora of the surgically resected organ are the most frequently isolated pathogens (8).

According to data from the National Nosocomial Infections Surveillance System (NNIS), there has been little change in the incidence and distribution of the pathogens isolated from infections during the last decade (9). However, more of these pathogens show antimicrobial-drug resistance, especially methicillin-resistant *S. aureus* (10). Postoperative infections, including surgical site infections, were caused by multiple organisms in a multicenter outbreak due to contamination of an intravenous anesthetic, propofol (11). In this outbreak, CDC identified 62 patients at seven hospitals who had postoperative infections, primarily of the bloodstream or surgical site, after exposure to propofol. Only exposure to this anesthetic was substantially associated with these postoperative infections. In six of the seven hospitals, the same pathogen was isolated from several infected patients. The infections were due to extrinsic contamination of the propofol by the anesthesia personnel, who frequently carried the pathogens in lesions on their hands or scalp or in their nares. Lapses in aseptic technique and reuse of single-use vials for several patients were important factors in these outbreaks (11,12). This report stresses the importance of conducting a formal epidemiologic investigation when a cluster of infections involves an unusual organism such as *Moraxella osloensis* or *Serratia marcescens*.

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Prevention of Surgical Site Infections

The most critical factors in the prevention of postoperative infections, although difficult to quantify, are the sound judgment and proper technique of the surgeon and surgical team, as well as the general health and disease state of the patient (13-14). Other factors influence the development of postoperative wound infection, especially in clean surgical procedures, for which the infection rate (<3%) is generally low. Infections in these patients may be due solely to airborne exogenous microorganisms (15).

In 1999, CDC's Health Care Infection Control Practices Advisory Committee published revised guidelines for the prevention of infections (Table 1). This guideline delves extensively into the literature concerning perioperative factors associated with postoperative infections (16). The 1999 edition of the guideline has been extensively revised (Table 2).

Prophylactic Antibiotic Use in the Surgical Patient

The use of antibiotic prophylaxis before surgery has evolved greatly in the last 20 years (17). Improvements in the timing of initial administration, the appropriate choice of antibiotic agents, and shorter durations of administration have defined more clearly the value of this technique in reducing postoperative wound infections. Some historical milestones of the last 4 decades shed light on the current situation.

Historical Aspects

Confusing and heated debate concerning the efficacy of prophylactic antibiotics in surgery followed the publication of clinical trials during the 1950s. Errors in study design of these early efforts included nonrandomization, lack of blinding, faulty timing of initial antibiotic administration, prolonged antibiotic use, incorrect choices of antimicrobial agents, and inappropriate choices of control agents.

Experimental studies published during the early 1960s helped clarify many of these problems and resulted in a more scientifically accurate approach to antimicrobial prophylaxis. Most important was the report by Burke (18), which demonstrated the crucial relationship between timing of antibiotic administration and its prophylactic efficacy. His experimental studies showed that to greatly reduce experimental skin infection produced by penicillin-sensitive *S. aureus*, the penicillin had to be in the skin shortly before or at the time of bacterial exposure. This study and others fostered the attitude that to prevent subsequent infection the antibiotic must be in the tissues before or at the time of bacterial contamination. This important change in strategy helped correct the common error of first administering the prophylactic antibiotic in the recovery room.

As early as 1964, Bernard and Cole (19) reported on the successful use of prophylactic antibiotics in a randomized, prospective, placebo-controlled clinical study of abdominal operations on the gastrointestinal tract. The success of antibiotic prophylaxis noted in this early study was clearly due to the authors' appropriate patient selection and wise choice of available agents, as well as the timing of administration. Further advances in understanding of antibiotic prophylaxis in abdominal surgery occurred in the 1970s. During this decade, the qualitative and quantitative nature of the endogenous gastrointestinal flora in health and disease was appropriately defined (20). Many prospective, blinded clinical studies in the 1980s and 1990s prompted

Table 1. Hospital Infection Control Practices Advisory Committee partial recommendations for the prevention of surgical site infection,1999 (16)

Rankings	
Category 1A	Strongly recommended for implementation and supported by well-designed experimental, clinical, or epidemiologic studies
Category 1B	Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and strong theoretical rationale
Category II	Suggested for implementation and supported by suggestive clinical or epidemiologic studies or theoretical rationale
No recommendation; unresolved issue.	Practices for which insufficient evidence or no consensus regarding efficacy exists
Recommendations—Preoperative—partial and modified	
A. Preparation of the patient	
Category 1A	Treat remote infection before elective operation; postpone surgery until treated; Do not remove hair from operative site unless necessary to facilitate surgery; If hair is removed, do immediately before surgery, preferably with electric clippers
Category 1B	Control serum blood glucose perioperatively; Cessation of tobacco use 30 days before surgery; Do not withhold necessary blood products to prevent SSIs; Shower or bath on night before operative procedure; Wash incision site before performing antiseptic skin preparation with approved agent
Category II	Prepare skin in concentric circles from incision site; Keep preoperative stay in hospital as short as possible
Unresolved	Improve nutritional status; Use of mupirocin in nares; Improve oxygenation of wound space; Taper or discontinue systemic steroid use before elective surgery
B. Antimicrobial prophylaxis	
Category 1A	Select (if indicated) an antimicrobial agent with efficacy against expected pathogen; Intravenous route used to ascertain adequate serum levels during operation and for at most a few hours after incision closed; Before elective colorectal operations, in addition to parenteral agent, mechanically prepare the colon by use of enemas and cathartics. Administer nonabsorbable oral antimicrobial agents in divided doses on the day before the operation
Category 1B	Do not routinely use vancomycin for antimicrobial prophylaxis

SSI = surgical site infections

Table 2. Changes in CDC surgical site infections prevention guidelines, 1999 (16)

1985	1999
Category 1	Category 1A
Category II	Category 1B
Category III	Category II or no recommendation; unresolved
Preoperative hair removal	
Do not remove hair unless it will interfere with the operation Category II	Recommendation unchanged Category 1A
If removed, remove by clipping or use of a depilatory, not by shaving Category II	If removed, preferably remove immediately before the operation with electric clippers Category 1A
Preoperative shower or bath	
Patient should bathe with antimicrobial soap the night before an elective operation Category III	Require patients to shower or bathe with an antiseptic agent at least the night before surgery Category 1B
Preoperative hand and forearm antisepsis	
Perform surgical scrub for at least 5 minutes before first operation of day Category 1	Perform surgical scrub for at least 2-5 minutes with an appropriate antiseptic Category 1B
Between consecutive operations perform surgical scrub 2 to 5 minutes Category II	
After scrub, dry hands with sterile towel, don sterile gown and gloves Category 1	After scrub, keep hands up and away from body; dry hands with sterile towel; don sterile gown and gloves Category 1B
Preoperative patient preparation	
Treat and control all bacterial infections before operation Category 1	Identify and treat all remote infections before elective operation Category 1A
The hospital stay should be as short as possible Category II	Keep hospital stay as short as possible Category II
If patient is malnourished, enteral or parenteral nutrition should be given Category II	No recommendation to use nutritional support solely to prevent surgical site infection Unresolved
Preoperative antimicrobial prophylaxis	
Use for operations with high infection rate or for those with severe or life-threatening consequences if infection occurs Category 1	Administer antimicrobial agent only when indicated and select based on published recommendations for a specific operation and efficacy against most common pathogens Category 1A
Select antimicrobial agents that are safe and effective Category 1	
Start parenteral IV antimicrobial agents shortly before operation and discontinue shortly afterward Category 1	Administer antimicrobial agents by IV timed to ensure bactericidal serum and tissue levels when incision made Category 1A
	Maintain therapeutic levels during operation and, at most, a few hours after closure Category 1A
	Before colorectal elective operations, in addition to IV antimicrobial drugs, mechanically prepare the colon with enemas and cathartic agents; administer nonabsorbable oral antimicrobial agents in individual doses the day before surgery Category 1A
	For cesarean sections in patients at high risk administer IV antimicrobial agent immediately after cord is clamped Category 1A
	Do not routinely use vancomycin for prophylaxis Category 1B

definitive recommendations concerning the proper approaches to antibiotic prophylaxis in surgery (21).

Current Use of Parenteral Antibiotic Agents in Surgical Prophylaxis

The choice of parenteral prophylactic antibiotic agents and the timing and route of administration have become standardized on the basis of well-planned prospective clinical studies (21). It is generally recommended in elective clean surgical procedures using a foreign body and in clean-contaminated procedures that a single dose of cephalosporin, such as cefazolin, be administered intravenously by anesthesia personnel in the operative suite just before incision. Additional doses are generally recommended only when the operation lasts longer than 2 to 3 hours. Other controversial areas include the routine use of antibiotic prophylaxis in clean surgical procedures, such as hernia repair or breast surgery (21,22). This subject has been summarized in a published review (23), and some specific situations will be described.

Antibiotic Prophylaxis before Elective Colon Resection

The human colon and distal small intestine contain an enormous reservoir of facultative and anaerobic bacteria, separated from the rest of the body by the mucous membrane. A reliable method of sterilizing the colonic contents has been a goal of surgeons throughout this century (24). In the past 25 years, clinical trials have demonstrated that to substantially reduce septic complications after elective colon surgery, antibiotics must have activity against both colonic aerobes (e.g., *Escherichia coli*) and anaerobes (e.g., *Bacteroides fragilis*), a finding we reported over 25 years ago (25). Today, approaches to mechanical cleansing differ widely (26). Modern approaches include standard outpatient mechanical cleansing with dietary restriction, cathartics, and enemas for a 2-day period, or whole-gut lavage with an electrolyte solution of 10% mannitol, Fleet's phospho-soda, or polyethylene glycol, done the day before the operation.

Most surgeons use both antibiotics and mechanical cleansing for preoperative preparation before elective colon resection (26). Three regimens of oral agents combine neomycin with erythromycin base, metronidazole, or tetracycline. The most popular regimen in the United States has been the neomycin-erythromycin base preparation, which was introduced in 1972 (27).

In a survey published in 1997, 471 (58%) of 808 board-certified colorectal surgeons described their bowel preparation practices before elective procedures (26). All respondents used mechanical preparation: oral polyethylene glycol solution (70.9% of respondents), oral sodium phosphate solution with or without bisacodyl (28.4%), and accepted methods of dietary restriction, cathartics, and enemas (28.4%). Most (86.5%) surgeons added both oral and parenteral antibiotics to the regimen; 11.5% added only parenteral antibiotics, 1.1% added only oral antibiotics, and 0.9% did not add antibiotics. Oral neomycin and erythromycin or metronidazole were combined with a perioperative parenteral antibiotic by 77.8% of respondents. Most patients started the preparation as outpatients the day before surgery, and parenteral drugs were added to the regimen 1 to 2 hours before the procedure. The use of outpatient bowel preparation is increasing; however, patient selection is critical, and education is needed to reduce the rate of complications.

Antibiotic Prophylaxis for Appendectomy

The pathologic state of the appendix is the most important determinant of postoperative infection (28,29). Wound infection after appendectomy for perforative or gangrenous appendicitis is four to five times higher than for early disease. A prospective study of nonperforated appendicitis, using a logistic regression analysis of risk factors, showed that the risk for postoperative infection is related to lack of perioperative antibiotic prophylaxis and to the determination that the appendix was gangrenous (29). Because the pathologic state of the appendix often cannot be determined before or during operation, a parenteral antibiotic agent is recommended as prophylaxis in all patients.

Regimens with activity against both facultative gram-negative bacilli and anaerobes are more effective than those active only against aerobes (29). The use of antimicrobial agents in perforated appendicitis with evidence of local or general peritonitis or intraabdominal abscess, or both, should be considered therapeutic rather than prophylactic.

Preventive Antibiotics in Penetrating Abdominal Trauma

Hollow-lumen visceral damage with associated escape of endogenous microorganisms is the main risk factor for postoperative infections after exploratory laparotomy for penetrating abdominal trauma. A single dose of parenterally administered antibiotic, given just before abdominal exploration for penetrating abdominal trauma, is associated with low postoperative infection rate in patients with no observed gastrointestinal leakage (30). If gastrointestinal leakage is identified at the time of the operation, continuing the antibiotic agents for 1 to 3 days is usually recommended. It is important to use antibiotic agents with both facultative and anaerobic activity. Leaving the operative wound open, packed with saline-soaked gauze, decreases the incidence of postoperative wound infection in patients at high risk (31).

Preventive Antibiotic Use in Traumatic Chest Injuries

Recently published studies have shown the value of parenteral antibiotic prophylaxis in the prevention of pneumonia or empyema after the placement of a chest tube to correct the hemopneumothorax associated with chest trauma (32,33). In one study, 500 mg of cefazolin was given intravenously every 8 hours for 24 hours (32). In the other study, 1 g of cefonicid was administered every 24 hours until the chest tube was removed, usually before 5 days (33). In both studies patients receiving antibiotics had substantially lower infection rates than those receiving placebos.

Conclusions

Recent improvements in antibiotic prophylaxis, including the timing of initial administration, appropriate choice of antibiotic agents, and shortening the duration of administration, have established the value of this technique in many clinical surgical settings. Future study designs should strongly consider risk factors for individual patients when new antibiotic agents are tested or administration techniques are refined. A concentrated effort should be made in areas of clinical surgery where the value of antibiotic prophylaxis has not been proven. A single-dose systemic regimen of an appropriately chosen cephalosporin given during the immediate preoperative period is safe and the indicated practice.

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CATS Decrease Surgical Site Infections

Hair Removal:
If hair must be removed from the surgical site, clippers are the best option. ***Never use a razor.***

Prophylactic Antibiotics:
Antibiotics consistent with national guidelines should be administered within 1 hour of incision time and discontinued within 24 hours (48 hours for cardiac surgeries) of surgery end time.

Normothermia:
Colorectal surgery patients should be normothermic (≥ 96.8º F) within the first 15 minutes after leaving the operating room.

Glucose Control:
Cardiac surgery patients should have controlled 6 a.m. serum glucose (≤ 200 mg/dL) on postoperative Day 1 and Day 2.

Clippers Antibiotics Temperature Sugar

Additional information about reducing surgical site infections is available at www.medqic.org.

HSAG HEALTH SERVICES ADVISORY GROUP

This material was prepared by Health Services Advisory Group, Inc. (HSAG), the Medicare Quality Improvement Organization for Arizona, under contract with the Centers for Medicare & Medicaid Services (CMS), an agency of the U.S. Department of Health and Human Services. The contents presented do not necessarily reflect CMS policy.

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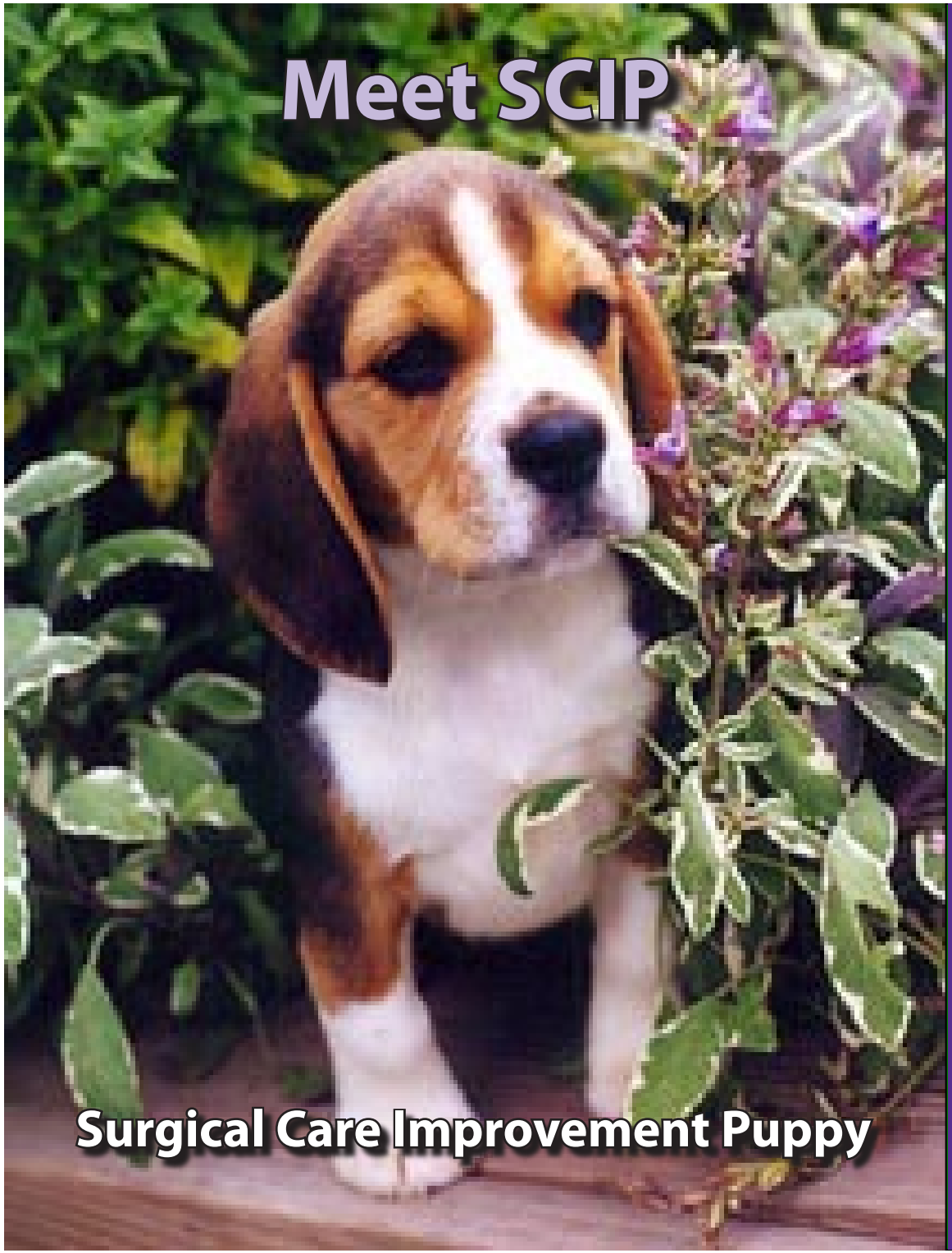

Beagles Save Lives

It is not just about CATS!

Beta Blockers
Environment control=temperature
Antibiotics
Glucose control
Lovenox
Embolism prevention
Skin preparation no razor

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What you can do to prepare for surgery.

Getting ready for surgery can be very stressful. Remember it's a team effort and you are part of that team. Talk with your doctor about why you need surgery, and how it may help you. And think about bringing a family member or a friend you trust, who can talk to your doctor and health care team about your progress while you are in the hospital.

Here are some things you can do to help make sure you get the best care:

1. Be Informed About the Procedure

Questions to ask your doctor before deciding to have surgery

- **What kind of surgery are you recommending?** Get as much information as you can about the surgery, how it will help you and whether there are other options.
- **Why do I need the surgery?** Is it to relieve or prevent pain, improve a body function, or diagnose a problem?
- **What are the possible risks and benefits of the surgery?** Weigh the benefits against possible risks and side effects.
- **What if I don't have the surgery?** Find out how your health will be affected if you decide not to have the surgery.
- **How much experience do you have doing this surgery?** Ask how many times the doctor has performed the surgery.
- **What kind of anesthesia will I need?** Ask about possible side effects, and make sure the anesthesiologist is aware of any allergies you may have and all medications you are taking.
- **How long will my recovery take?** Ask when you can go back to work and exercise again. Also, find out if you will need medical supplies or equipment at home. Be sure to get them in advance.
- **Are any approvals or paperwork needed for your health insurance plan?** Some insurance plans require pre-approvals or second opinions for certain kinds of surgeries. Ask member services at your health plan well in advance of your surgery.

2. Explore Your Options before Choosing a Hospital

Compare hospitals using quality ratings

- **Ask your doctor, and research hospital quality ratings to locate a hospital that will give you the best care.** Check out these resources:
  - **The Joint Commission** is the country's leading organization for setting standards in health care: www.jointcommission.org
  - **Hospital Compare** is a government-sponsored site. It provides information on how well hospitals care for adult patients with certain medical conditions: www.hospitalcompare.hhs.gov
  - **The Leapfrog Group** is an organization formed by large employers to improve safety, quality and affordability of health care: www.leapfroggroup.org

3. Before and During Your Hospital Stay

Take steps to have a safe hospital stay and reduce the risk of infections

- **Ask your doctor whether you should take antibiotics before the surgery.**
- **Follow all pre-surgery instructions carefully.** You will probably be asked to stop eating the night before surgery. You may be instructed to stop taking your regular medication or you may be given some special medication before you go the hospital.
- **Ask your doctor to mark the actual site he or she will operate on.**
- **Let the hospital staff know about all the medications you are taking.** You should bring a written list of your medications. Or you can bring all of your medications (in their original bottles or packages) to the hospital with you.
- **Tell your doctor about any allergies.**
- **Ask all hospital staff who have direct contact with you if they have washed their hands.** Hand washing helps prevent infections.

4. Recover Safely

Know what to do after you leave the hospital

- **Make sure you understand all instructions you are given when you leave the hospital.** Ask your doctor or nurse to give you a phone number to call if you have any questions.
- **Talk with your doctor or nurse about all new medications.** For each, ask how to take it and why you need it. Also, ask about any side effects you might get and what to do if they occur.
- **Call your doctor if you have any problems.** This includes fever, weight loss, pain and oozing or swelling at the surgery site.

5. Where to Learn More about Preparing for Surgery

Agency for Healthcare Research and Quality
U.S. Department of Health and Human Services
www.ahrq.gov/consumer/surgery/surgery.htm

The Joint Commission
www.jointcommission.org/patientsafety/speakup/

Association of Perioperative Registered Nurses
www.patientsafetyfirst.org/consumers/what-to-expect.html

THE PARTNERSHIP FOR
HEALTHCARE EXCELLENCE

www.partnershipforhealthcare.org

FAQs
(frequently asked questions)

about
"Surgical Site Infections"

What is a Surgical Site Infection (SSI)?

A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Most patients who have surgery do not develop an infection. However, infections develop in about 1 to 3 out of every 100 patients who have surgery.

Some of the common symptoms of a surgical site infection are:

- Redness and pain around the area where you had surgery
- Drainage of cloudy fluid from your surgical wound
- Fever

Can SSIs be treated?

Yes. Most surgical site infections can be treated with antibiotics. The antibiotic given to you depends on the bacteria (germs) causing the infection. Sometimes patients with SSIs also need another surgery to treat the infection.

What are some of the things that hospitals are doing to prevent SSIs?

To prevent SSIs, doctors, nurses, and other healthcare providers:

- Clean their hands and arms up to their elbows with an antiseptic agent just before the surgery.
- Clean their hands with soap and water or an alcohol-based hand rub before and after caring for each patient.
- May remove some of your hair immediately before your surgery using electric clippers if the hair is in the same area where the procedure will occur. They should not shave you with a razor.
- Wear special hair covers, masks, gowns, and gloves during surgery to keep the surgery area clean.
- Give you antibiotics before your surgery starts. In most cases, you should get antibiotics within 60 minutes before the surgery starts and the antibiotics should be stopped within 24 hours after surgery.
- Clean the skin at the site of your surgery with a special soap that kills germs.

What can I do to help prevent SSIs?

Before your surgery:

- Tell your doctor about other medical problems you may have. Health problems such as allergies, diabetes, and obesity could affect your surgery and your treatment.
- Quit smoking. Patients who smoke get more infections. Talk to your doctor about how you can quit before your surgery.
- Do not shave near where you will have surgery. Shaving with a razor can irritate your skin and make it easier to develop an infection.

At the time of your surgery:

- Speak up if someone tries to shave you with a razor before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.
- Ask if you will get antibiotics before surgery.

After your surgery:

- Make sure that your healthcare providers clean their hands before examining you, either with soap and water or an alcohol-based hand rub.

  If you do not see your providers clean their hands, please ask them to do so.

- Family and friends who visit you should not touch the surgical wound or dressings.
- Family and friends should clean their hands with soap and water or an alcohol-based hand rub before and after visiting you. If you do not see them clean their hands, ask them to clean their hands.

What do I need to do when I go home from the hospital?

- Before you go home, your doctor or nurse should explain everything you need to know about taking care of your wound. Make sure you understand how to care for your wound before you leave the hospital.
- Always clean your hands before and after caring for your wound.
- Before you go home, make sure you know who to contact if you have questions or problems after you get home.
- If you have any symptoms of an infection, such as redness and pain at the surgery site, drainage, or fever, call your doctor immediately.

If you have additional questions, please ask your doctor or nurse.

Co-sponsored by:

SHEA The Society for Healthcare Epidemiology of America
IDSA
American Hospital Association
APIC Spreading knowledge. Preventing infection.™
CDC Centers for Disease Control and Prevention
The Joint Commission

What You Need to Know about Infections after Surgery:
A Fact Sheet for Patients and Their Family Members

Most patients who have surgery do well. But sometimes patients get infections. This happens to about 3 out of 100 patients who have surgery. Infections after surgery can lead to other problems. Sometimes, patients have to stay longer in the hospital. Rarely, patients die from infections. Patients and their family members can help lower the risk of infection after surgery. Here are some ways:

Days or weeks before surgery:
Meet with your surgeon.

- Bring an up-to-date list of all the medications you take. Talk with your surgeon about why you take each medication and how it helps.
- Let the surgeon know if you are allergic to any medication and what happens when you take it.
- Tell the surgeon if you have diabetes or high blood sugar.
- Talk about ways to lower your risk of getting an infection. This may include taking antibiotic medicines.

The day or night before surgery:
Take extra good care of your body.

- Do not shave near where you will have surgery. Shaving can irritate your skin which may lead to infection. If you are a man who shaves your face every day, ask your surgeon if it is okay to do so.
- Keep warm. This means wearing warm clothes or wrapping up in blankets when you go to the hospital. In cold weather, it also means heating up the car before you get in. Keeping warm before surgery lowers your chance of getting an infection.

At the time of surgery:

- Tell the anesthesiologist (doctor or nurse who puts you to sleep for surgery) about all the medications you take. A good way to do this is with an up-to-date medication list.
- Let the anesthesiologist know if you have diabetes or high blood sugar. People with high blood sugar have a greater chance of getting infections after surgery.
- Speak up if someone tries to shave you before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.
- Ask for blankets or other ways to stay warm while you wait for surgery. Find out how you will be kept warm during and after surgery. Ask for extra blankets if you feel cold.
- Ask if you will get antibiotic medicine. If so, find out how much medicine you will get. Most people are on antibiotics for just one day as taking too much can lead to other problems.

You can learn more about Surgical Site Infection as it relates to the 5 Million Lives Campaign at www.ihi.org.

The 5 Million Lives Campaign is an initiative to protect patients from five million incidents of medical harm over the next two years (December 2006 – December 2008).

http://www.ihi.org/IHI/Programs/Campaign/Campaign.htm

Five Things You Can Do To Prevent Infection is supported by

American Hospital Association
www.hospitalconnect.com

Association for Professionals in Infection Control and Epidemiology, Inc.
www.apic.org

Centers for Disease Control and Prevention
www.cdc.gov

Infectious Diseases Society of America
www.idsociety.org

The Joint Commission
www.jointcommission.org

Society for Healthcare Epidemiology of America
www.shea-online.org

The Joint Commission is the largest health care accrediting body in the United States that promotes quality and safety.

Helping health care organizations help patients

The Joint Commission

SpeakUP™

5 Five Things You Can Do To Prevent Infection

Avoiding contagious diseases like the common cold, strep throat, and the flu is important to everyone. Here are five easy things you can do to fight the spread of infection.

1.

Clean your hands.

- Use soap and warm water. Rub your hands really well for at least 15 seconds. Rub your palms, fingernails, in between your fingers, and the backs of your hands.
- Or, if your hands do not look dirty, clean them with alcohol-based hand sanitizers. Rub the sanitizer all over your hands, especially under your nails and between your fingers, until your hands are dry.
- Clean your hands before touching or eating food. Clean them after you use the bathroom, take out the trash, change a diaper, visit someone who is ill, or play with a pet.

2.

Make sure health care providers clean their hands or wear gloves.

- Doctors, nurses, dentists and other health care providers come into contact with lots of bacteria and viruses. So before they treat you, ask them if they've cleaned their hands.
- Health care providers should wear clean gloves when they perform tasks such as taking throat cultures, pulling teeth, taking blood, touching wounds or body fluids, and examining your mouth or private parts. Don't be afraid to ask them if they should wear gloves.

3.

Cover your mouth and nose.

Many diseases are spread through sneezes and coughs. When you sneeze or cough, the germs can travel 3 feet or more! Cover your mouth and nose to prevent the spread of infection to others.

- Use a tissue! Keep tissues handy at home, at work and in your pocket. Be sure to throw away used tissues and clean your hands after coughing or sneezing.
- If you don't have a tissue, cover your mouth and nose with the bend of your elbow or hands. If you use your hands, clean them right away.

4.

If you are sick, avoid close contact with others.

- If you are sick, stay away from other people or stay home. Don't shake hands or touch others.
- When you go for medical treatment, call ahead and ask if there's anything you can do to avoid infecting people in the waiting room.

5.

Get shots to avoid disease and fight the spread of infection.

Make sure that your vaccinations are current—even for adults. Check with your doctor about shots you may need. Vaccinations are available to prevent these diseases:

- Chicken pox
- Measles
- Tetanus
- Shingles
- Mumps
- Diphtheria
- Hepatitis
- Meningitis
- Flu (also known as influenza)
- Whooping cough (also known as Pertussis)
- German measles (also known as Rubella)
- Pneumonia (*Streptococcus pneumoniae*)
- Human papillomavirus (HPV)

The goal of the Speak Up™ program is to help patients become more informed and involved in their health care.

FACT SHEET

Partnering to Heal: Teaming Up to Prevent Healthcare-Associated Infections

An interactive, computer-based training for health professionals and students on preventing HAIs
May 2011

Partnering to Heal: Teaming Up Against Healthcare-Associated Infections

Partnering to Heal is a computer-based, interactive learning tool for early-career clinicians, health professional students, and patients and visitors on preventing healthcare-associated infections.

The training highlights effective communication about infection control practices and ideas for creating a "culture of safety" in healthcare institutions to keep patients from getting sicker. *Partnering to Heal* follows five main characters who each make decisions, controlled by the user:

- **A Physician & Hospital Administrator**, Nathan Green, Director of a Hospital Post-op Unit, ready to start new prevention efforts in the unit
- **A Registered Nurse**, Dena Gray, working to learn effective communications skills for interacting with her patients
- **An Infection Preventionist**, Janice Upshaw, a new employee charged with using a team-based approach to reducing infections
- **A Patient Family Member**, Kelly McTavish, whose father was just admitted to the hospital
- A third-year **Medical Student**, Manuel Hernandez, who wants to gain confidence to make a difference for his patients.

The training is designed to engage a variety of individuals within the hospital -- including patients and visitors -- in a team-based approach to preventing healthcare-associated infections. The training seeks to address the underlying thinking and behaviors of clinicians which contribute to the occurrence of healthcare-associated infections, rather than on specific clinical interventions such as the proper way to insert a central line.

Background

The U.S. Department of Health and Human Services (HHS) created *Partnering to Heal* as part of a wider effort that works closely with public and private sector partners to improve the quality, safety, and affordability of health care for all Americans. Examples include the HHS Action Plan to Prevent Healthcare-Associated Infections which outlines a goal to train the next generation of healthcare providers in infection control practices and foster a "culture of safety" in healthcare institutions. The Action Plan's goals and activities are aligned with the newly launched Partnership for Patients: Better Care, Lower Costs, a public-private partnership to reduce hospital-associated illnesses and injuries by 1.8 million by 2013. The new national partnership with hospitals, medical groups, consumer groups and employers will help save lives by preventing millions of injuries and complications in patient care over the next three years.

Accessing the Training Materials

To access the training, a facilitator's guide, and additional resources:
http://www.hhs.gov/ash/initiatives/hai/training/.

FACT SHEET

Partnering to Heal: Teaming Up to Prevent Healthcare-Associated Infections

An interactive, computer-based training for health professionals and students on preventing HAIs

May 2011

Training Content

Partnering to Heal targets clinical audiences (students and early-career clinicians) as well as patients and visitors to assist in the prevention of:

- Surgical site infection
- Central line-associated bloodstream infection
- Ventilator-associated pneumonia
- Catheter-associated urinary tract infection
- *Clostridium difficile* infection
- Methicillin-resistant *Staphylococcus aureus* (MRSA) infection.

In addition, basic protocols for universal precautions and isolation precautions are covered to protect patients, visitors, and practitioners from even the most common disease transmissions. *Partnering to Heal* targets knowledge, attitudes, and behaviors of healthcare practitioners, patients, and visitors. Key behaviors targeted include:

- Teamwork
- Communication
- Hand washing
- Flu vaccination
- Appropriate use of antibiotics
- Proper insertion, maintenance, and removal of devices, such as catheters and ventilators.

About the Technology

In *Partnering to Heal*, users assume the identity of characters in a computer-based video simulation and make decisions as each of those characters. Based upon the decisions, the storyline branches to different pathways and outcomes. The training may be used by groups in facilitated training sessions and by individuals as a self-paced learning tool.

This type of interactive, computer-based training has been shown to enhance individual's critical thinking and decision making skills in a way that helps individuals perform better when they face similar situations and pressures in real life. Research[1] has shown this to be an effective tool in knowledge acquisition and behavior change.

Partnership for Patients

Partnering to Heal seeks safer and better care for all patients, which is consistent with the recently launched Partnership for Patients initiative. As part of the initiative, HHS has set a goal of decreasing preventable hospital-acquired conditions by 40 percent (compared with 2010 rates) by the end of 2013. Achieving this goal should result in approximately 1.8 million fewer injuries and illnesses to patients, with more than 60,000 lives saved over the next three years. The Partnership for Patients has the potential to save up to $35 billion in healthcare costs.

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[1] Five studies were conducted, the most notable from the Robert Wood Johnson Foundation and the Boston University School of Public Health. The study examined the effects of a training program to reduce adolescent substance abuse. It found that, relative to comparison students, students who engaged in the training met 90% of outcome measures, indicating training effectiveness.

MAYO CLINIC

To clean your hands with an alcohol-based hand rub:

1. Add a quarter-size amount of gel or foam into the center of one of your palms (Figure 2a).
2. Spread the gel or foam over all parts of your hands and rub for 15 seconds (Figure 2b). If you've used enough hand rub, it should take this long for the product to evaporate and your hand to dry completely.
3. Follow the instructions in Step 4 of the soap and water method for cleaning the area under your fingernails (Figure 2c).

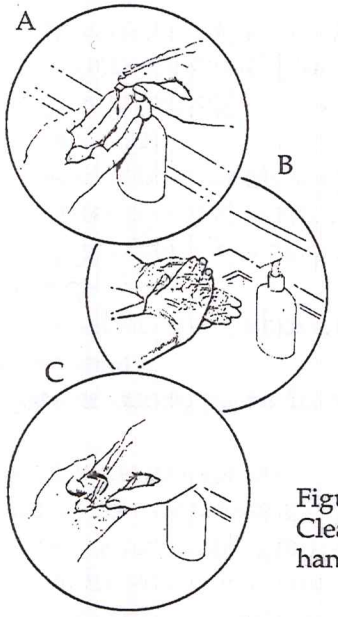

Figure 2(a, b, c). Cleaning hands with hand rub

Are alcohol-based hand rubs the same as antibacterial soaps?

No, **antibacterial soaps** contain agents that may cause organisms to become resistant and more difficult to kill. For this reason we do not recommend their use in the home. Handwashing with plain soap and running water is appropriate at all times. This method should always be used whenever your hands are visibly soiled and after using the bathroom.

Alcohol-based hand rubs kill bacteria without making them resistant. This makes hand rubs OK for use in all places whenever our hands are not visibly soiled.

If you have any questions about this, call Mayo Clinic and ask to speak to someone from Infection Prevention and Control.

Mayo Clinic:
Scottsdale and Phoenix, Ariz.
480-301-8000
Mayo Clinic: Jacksonville, Fla.
904-953-2000
Mayo Clinic: Rochester, Minn.
507-284-2511

MAYO CLINIC

200 First Street SW
Rochester, Minnesota 55905
www.mayoclinic.org

MC0467-03rev0608

PATIENT EDUCATION

Hand Hygiene: A Healthy Habit

EDUCATION
HEALTHY LIVING

BARBARA WOODWARD LIPS PATIENT EDUCATION CENTER

Why is hand hygiene a good habit?
Hand hygiene is the practice of cleaning and sanitizing your hands. It is a simple and effective method of preventing the spread of infection. It helps keep you from getting sick as well as reducing the risk of spreading bacteria or viruses that may cause infection in others.

When should you practice hand hygiene?
It is especially important to clean your hands:

- After using the bathroom
- After blowing your nose or having any contact with oral or respiratory secretions
- Before eating
- When handling food
- Before and after contact with a sick person
- When you are sick

What is the most effective way to cleanse your hands?
There are two ways to clean your hands. The first method involves using soap and water and is important for removing visible contamination.

To clean your hands with soap and water:

1. Turn on water and adjust it to a comfortable temperature (Figure 1a).
2. Wet your hands and wrists under running water.
3. Lather your hands, wrists, cuticle area and between your fingers and thumbs with soap.
4. The area under your nails provides an easy hiding place for germs and it often is neglected during routine hand cleansing. This may be especially true if you have long or artificial nails. To clean the area under your nails, bring your fingers and thumb together. Press your fingertips into the palm of your other hand and rotate your fingers in a circle (Figure 1b). Follow this process for each hand.
5. Continue to lather for at least 15 seconds. Rubbing (friction) will remove germs from your skin.
6. Rinse your hands and wrists under the running water. Angle your hands downward so soap and soil wash into the sink.
7. Completely dry your hands and wrists with a paper towel or clean hand towel.
8. Turn off the water faucet with a paper towel or hand towel (Figure 1c).

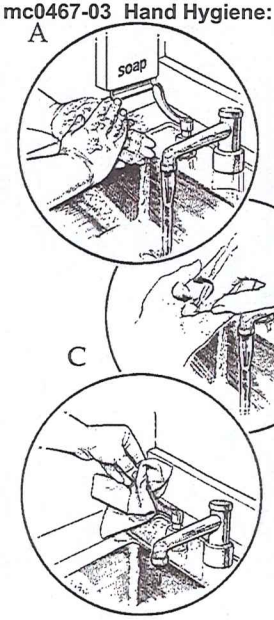

Figure 1(a, b, c). Cleaning the hands with soap

The second method of hand cleaning uses waterless alcohol-based hand rubs. These hand rubs come in the form of a gel or foam and usually can be purchased wherever hand soap is sold.

Hand cleaning with an alcohol-based hand rub is faster than using soap and water and may cause less skin irritation and dryness. In addition, it is as effective as soap and water **when hands are not visibly soiled.** If your hands are visibly soiled, use the soap and water method.

Infection Prevention Checklist

One of your surgical teams goals is to help prevent infections.
Listed below are things you should do to help prevent infections during your surgery.

As soon as surgery is scheduled:

- ☐ Immediately report ANY signs or symptoms of infection to your surgeon including rashes, fevers, urinary tract symptoms, sores, sore throat etc; your surgery will be delayed if you have an untreated infection.
- ☐ If you are smoker quit smoking 3-4 weeks before your surgery; remain smoke-free at least until healed.
- ☐ If you are diabetic, control your blood sugars; high blood sugars increase your infection risks.
- ☐ Do NOT shave near the site of your surgery for one week prior to surgery; your surgery may be delayed if you do.

Evening before your surgery:

- ☐ Put clean sheets on your bed.
- ☐ Prior to bed, shower using an antibacterial soap or use the soap and/or supplies provided by your surgeon.
- ☐ Use a clean towel and wash cloth (no reusable bath puffs/sponges).
- ☐ Do NOT use lotions, body sprays, or powders after showering.
- ☐ Wear clean pajamas to bed.
- ☐ Follow all the instructions your surgeon gave you.

Morning of Surgery:

- ☐ Shower using an antibacterial soap or use the soap or supplies provided by your surgeon.
- ☐ Use a clean towel and wash cloth (no reusable bath puffs/sponges).
- ☐ Do NOT use lotions, body sprays, or powders after showering.
- ☐ Do NOT apply or wear any make-up.
- ☐ Follow pre-operative instructions your surgeon gave you.

Post-Operative Infection Prevention

- ☐ After surgery you will get instructions for caring for your surgical wounds at home. Follow the instructions you are given.
- ☐ It is important that you leave your bandage on for the recommended amount of time. It is just as important to remove your bandage when you are told to.
- ☐ You must wash your hands thoroughly before and after touching your surgical wound or bandage. Anyone else who touches your wound or bandage needs to wash their hands too, this is for your protection, speak up if someone doesn't wash their hands.
- ☐ Clean your surgical wound as directed, often you are not to soak your wound as this can allow bacteria to enter your body and cause infection. Ask when you can start taking showers again and start showering when you are able, it is important to keep the rest of your body clean as well as your incision.
- ☐ Keep all of your post operative appointments (including the appointment to remove stitches if you have them).

Infection Recognition

If you have any of the following signs or symptoms let your surgeon know as soon as possible; your surgeon may need to look at your wound to decide if it is an infection that will require antibiotics.

- ☐ Redness
- ☐ Increased pain
- ☐ Increased warmth
- ☐ Increased swelling
- ☐ Drainage with pus from your incision
- ☐ Anything that doesn't seem normal to you
- ☐ Fever

SAFE CUTS

C – Cleaning Surgical Equipment/Environment

Options for Evaluating Environmental Cleaning
Centers for Disease Control and Prevention

CDC Environmental Checklist for Monitoring Terminal Cleaning
Centers for Disease Control and Prevention

Environmental Cleaning Evaluation Worksheet
Centers for Disease Control and Prevention

Immediate Use Steam Sterilization Statement

Options for Evaluating Environmental Cleaning

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December 2010

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National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

Introduction:

In view of the evidence that transmission of many healthcare acquired pathogens (HAPs) is related to contamination of near-patient surfaces and equipment, all hospitals are encouraged to develop programs to optimize the thoroughness of high touch surface cleaning as part of terminal room cleaning at the time of discharge or transfer of patients. Since dedicated resources to implement objective monitoring programs may need to be developed, hospitals can initially implement a basic or Level I program, the elements of which are outlined below. Some hospitals should consider implementing the advanced or Level II program from the start, particularly those with increased rates of infection caused by healthcare acquired pathogens (e.g., high *Clostridium difficile* infection rate). All hospitals that have successfully achieved a Level I program should advance to Level II.

At present, the objective monitoring of the cleaning process of certain high touch surfaces (e.g., the curtain that separates patient beds) beyond those outlined in the attached checklist is not well defined. Additionally, there is no standard method for measuring actual cleanliness of surfaces or the achievement of certain cleaning parameters (e.g., adequate contact time of disinfectant) or for defining the level of microbial contamination that correlates with good or poor environmental hygienic practices. As our understanding of these issues evolve and a standardization of assessment in these respective areas can be developed and practically implemented, hospitals that have obtained a high compliance rate with surface cleaning as outlined in the Level II program are encouraged to advance their efforts in optimizing environmental hygienic practices.

Level I Program

Elements of the program:

1. The program will be an infection preventionist/hospital epidemiologist infection prevention & control (IPC) based program internally coordinated and maintained through environmental services (ES) management level participation. The goal should be seen as a joint (IPC/ES), team effort during planning implementation and ongoing follow-up phases.

2. Each program will be hospital-specific and based on a joint (IC/ES) definition of institutional expectations consistent with the CDC standards[1,2] and the attached check list. The responsibilities of ES staff and other hospital personnel for cleaning high touch surfaces (e.g., equipment in ICU rooms) will be clearly defined.

3. Structured education of the ES staff to define programmatic and institutional expectations will be carried out and the proportion of ES staff who participate

will be monitored (see Elements of the Educational Intervention – Appendix A).

4. Development of measures for monitoring along with methods and identified staff for carrying out monitoring will be undertaken by the IPC/ES team. Monitoring measures may include competency evaluation of ES staff by ES management, IPC staff or, preferably, both. Teams are also encouraged to utilize patient satisfaction survey results in developing measures. Regular ongoing structured monitoring of the program will be performed and documented.

5 Interventions to optimize the thoroughness of terminal room cleaning and disinfection will be a standing agenda item for the Infection Control Committee (ICC) or Quality Committee as appropriate for the facility.

6. Consideration of the feasibility of moving to the Level II program will be discussed by the ICC and documented in the committee minutes.

Reporting:

Results should be reported to the ICC and facility leadership.

Level II Program

Elements of the Program

1. The program will be an infection preventionist/hospital epidemiologist infection prevention & control (IPC) based program internally coordinated and maintained through environmental services (ES) management level participation. The goal should be seen as a joint (IPC/ES), team effort during planning implementation and ongoing follow-up phases.

2. Each program will be hospital-specific and based on a joint (IC/ES) definition of institutional expectations consistent with the CDC standards[1,2] and the attached check list. The responsibilities of ES staff and other hospital personnel for cleaning high touch surfaces (e.g., equipment in ICU rooms) will be clearly defined.

3. Either covertly or in conjunction with ES staff, an objective assessment of the terminal room thoroughness of surface disinfection cleaning will be done using one or more of the methods discussed below (see Objective Methods for

Evaluating Environmental Hygiene - Appendix B) to document the pre-intervention thoroughness of disinfection cleaning (generally referred to as the "TDC Score" calculated as # of objects cleaned / total # of objects evaluated X 100). Such results will be maintained by the institution and used internally to optimize programmatic and educational interventions.

4. Structured education of the ES staff to define programmatic and institutional expectations will be carried out and the proportion of ES staff who participate will be monitored. It would be expected that the results of the pre-intervention objective evaluation of disinfection cleaning be incorporated into the ES educational activity in a non-punitive manner (see Elements of the Educational Intervention – Appendix A).

5. Scheduled ongoing monitoring of the TDC cleaning using one or more of the objective monitoring approaches discussed in Appendix B will be performed at least three times a year. The monitoring will use a projected sample size based on the previous level of TDC in order to detect a 10-20% change in performance (see Sample Size Determination – Appendix C). The results will be recorded in an excel spreadsheet to calculate aggregate TDC scores (see Appendix D).

6. The results of the objective monitoring program and the objectively developed TDC scores will be used in ongoing educational activity and feedback to the ES staff following each cycle of evaluation. It is recommended that such results be shared more widely within and beyond the institution as useful and appropriate.

7. Results of the objective monitoring program and interventions to optimize the thoroughness of terminal room cleaning and disinfection will be a standing agenda item for the Infection Control Committee (ICC).

Reporting:

Results should be reported to the ICC and facility leadership and could be reported to the state health department through the state prevention collaborative coordinator by various mechanisms (e.g., NHSN template), depending on infrastructure.

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[1] Guidelines for Environmental Infection Control in Healthcare Facilities, 2003 (http://www.cdc.gov/hicpac/pdf/guidelines/eic_in_HCF_03.pdf)

[2] Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008 (http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf)

Appendices to the Conceptual Program Model for Environmental Evaluation

APPENDIX A

Elements of the Educational Intervention

Environmental Services Line Personnel – A presentation should be developed for all line staff involved in terminal room cleaning and should:

A. Provide an overview of the importance of HAIs in a manner commensurate with their educational level using as many pictorial illustrations as is feasible.
B. Explain their role in improving patient safety through optimized hygienic practice.
C. Review specific terminal room cleaning practice expectations.
D. Discuss the manner in which their practice will be evaluated. For Level II programs, a participatory demonstration of the monitoring method is very useful.
E. Provide them with information from the baseline evaluation emphasizing or possibly exclusively showing them results for those objects which have been most thoroughly cleaned (Level II).
F. Stress the non-punitive nature of the program.
G. Inform them that their good performance will be broadly recognized (i.e., beyond their department) and highlighted within their department for others to emulate. (Level II)
H. Repeatedly reinforce the importance of their work, and how it directly relates to the hospital's goals and mission and how it is appreciated by patients and plays a major role in a patient's satisfaction with the hospital.

Many hospitals have provided a small (possibly ES staff-language specific) pictorial booklet to the environmental services personnel at the conclusion of the presentation which is often developed to be language skill appropriate.

ES managers – As senior managers will be actively involved in the design and implementation of either Level I or Level II programs, educational interventions for them will need to be customized. While many of these individuals have an excellent understanding of the basic policies and procedures involved in terminal room cleaning, most will benefit from focused educational interventions related to our evolving understanding of the role of the environment in healthcare-associated pathogen (HAP) transmission. Evaluation of mid-level managers also needs to be customized. Most importantly, the impact of the program on mid-level ES managers needs to be monitored since additional formal and informal education is frequently needed for those individuals who are somewhat unsure of the importance of developing programmatic approaches to optimize terminal room cleaning.

Other groups – Given the overall importance of optimizing the thoroughness of hygienic practice in healthcare settings, hospital specific educational interventions graphically illustrating the impact of the program should be considered for both Level I and Level II programs. Such communications should be developed for a range of audiences within the hospital including the senior hospital administration, the medical staff, nursing personnel on the units, executive nursing and medical staff committees and the hospital's board of managers or directors.

APPENDIX B

Objective Methods for Evaluating Environmental Hygiene

In considering implementation of a Level II program, the advantages and limitations of various monitoring approaches must be considered carefully. The factors which distinguish each approach to Level II monitoring are discussed below and summarized in Fig.1. With any method or methods used it is important that neither the system itself (fluorescent marker) nor its use (precleaning cultures or ATP measurements) induce a Hawthorne type effect.

Direct Practice Observation – Covert monitoring of disinfection cleaning can provide an objective assessment of individual ES staff performance and compliance with cleaning protocols. This approach has been used to objectively evaluate and improve ICU environmental hygiene in one hospital.[1] While conceptually feasible, logistical issues related to maintaining such a program outside a research setting may limit adaptation of this form of Level II monitoring. Furthermore, the complexity of monitoring cleaning practice in individual patient rooms without the evaluator being recognized as such might represent a difficult confounding issue.

Swab Cultures – While several outbreak intervention studies have associated decreased environmental contamination by target organisms as a result of modified cleaning practice leading to decreased acquisition of targeted pathogens, none of the reports specifically note if serial environmental culture results were actually used to provide practice feedback to the ES staff. Although swab cultures are easy to use, the cost of processing, including isolate identification, the delay in analyzing results, the need to determine pre-cleaning levels of contamination for each object evaluated in order to accurately assess cleaning practice, and the limited feasibility of monitoring multiple surfaces in multiple patient rooms as part of an ongoing Level II monitoring program represent issues which could limit the broad application of this system.

Agar Slide Cultures – Agar coated glass slides with finger holds were developed to simplify quantitative cultures of liquids. The slides have been adopted for use in environmental surface monitoring in healthcare settings.[2] These studies have used agar

coated slide systems to evaluate cleaning practice by quantifying aerobic colony counts (ACCs) per cm.[2,3] While studies have measured aggregate ACCs before and after cleaning, no studies to date have evaluated the actual thoroughness of cleaning of the same objects to determine if objects with relatively high ACCs were either poorly cleaned or actually overlooked by the ES staff. Although some difficulties have been encountered in utilizing the agar slide cultures on other than large, flat surfaces, they potentially provide an easy method for quantifying viable microbial surface contamination. There is a need, similar to that noted above for swab cultures, to determine pre-cleaning levels of contamination for each object evaluated in order to accurately assess cleaning practice.

Fluorescent Markers – Fluorescent gel, powder, and lotion have all been developed for the purpose of marking high touch objects prior to room cleaning. While the powder and lotion have been used as part of educational interventions, their overt visibility (lotions and powder), ease with which they can be disturbed (powder), and difficulty with easy removal (lotion if allowed to air dry) may limit their use in a monitoring system and there is little or no published experience in their use for this purpose. In contrast, the fluorescent gel dries transparent on surfaces, resists abrasion, and there are several studies demonstrating the accuracy of the system in objectively evaluating cleaning practice and quantifying the impact of educational interventions on such cleaning.[4,5] Because these fluorescent markers are all designed to indicate physical removal of an applied substance, surfaces that are effectively disinfected but less effectively cleaned may be more likely flagged as failing to meet a quality standard using one of these markers than one of the culture techniques.

ATP Bioluminesence – The measurement of organic ATP on surfaces using a luciferase assay and luminometer has been used to evaluate cleanliness of food preparation surfaces for more than thirty years. A specialized swab is used to sample a standardized surface area which is then analyzed using a portable handheld luminometer. The total amount of ATP, both microbial and non-microbial, is quantified and expressed as relative light units. Although readout scales vary more than 10 fold and sensitivity varies between commercially available systems, very low readings are typically associated with low aerobic colony counts (ACCs).[6] Very high readings may represent either a viable bioburden, organic debris including dead bacteria or a combination of both. An independent study in 2007 by the U.K. National Health Service evaluating the potential role of the ATP tool in assessing cleaning practice concluded that the tool could potentially be used effectively for ES education.[7] Although it is likely that part of the lack of correlation between ATP readings and ACCs noted in the preceding studies relates to the fact that ATP systems measure organic debris as well as viable bacterial counts, several studies have noted additional environmental factors which may increase or decrease ATP readings. Because a large proportion of surface contamination with ATP is non-microbial in origin, surfaces that are effectively disinfected but less effectively cleaned may be more likely flagged as failing to meet a quality standard

using the ATP tool than one of the culture techniques. Additionally, high concentrations of bleach may potentially quench the ATP bioluminescence reaction and result in a signal reduction, but further research is needed to better understand the impact of bleach-based disinfectants on the use of the ATP system. If a bleach-based disinfectant is used, it is important that the surface is dry before using the ATP tool. Similar to the culture methods described above, it is unclear whether "threshold values" for a clean hospital surface can be established using existing methods, suggesting use of the ATP tool is likely to require pre-cleaning levels of contamination for each object evaluated in order to accurately assess cleaning practice. Despite these limitations, the ATP system has been used to broadly document significant improvement in daily cleaning as well as provide quantitative measurement to indicate the level of cleanliness of high touch surfaces.[8,9]

Final Points

No matter which of the Level II monitoring approaches is chosen by the hospital, it is important that the monitoring be performed by hospital epidemiologists, infection preventionists or their designees who are not part of the actual ES cleaning program. Such an approach assures the validity of the information collected and provides an opportunity for the Infection Control and Prevention Department to independently champion the value of well performed disinfection cleaning.

A more detailed and fully referenced discussion of the above noted approaches to Level II monitoring of terminal room cleaning, may be found in the article **Evaluating Hygienic Cleaning in Healthcare Settings: What You Don't Know Can Harm Your Patients** by P.C. Carling and J.M. Bartley in the June, 2010 supplement to the American Journal of Infection Control
http://www.ajicjournal.org/issues/contents?issue_key=S0196-6553(10)X0005-0

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APPENDIX C

Sample Size Determination
Logistical issues must also be considered as part of planning for the implementation of an enhanced program. Before a decision has been made to use one of the Level II methods to objectively monitor cleaning practice, it is important to determine the number of surfaces to be evaluated for establishing baseline level of thoroughness of cleaning and the number of data points which must be monitored on a regular basis to accurately assess improvement or deterioration in practice. While it would be ideal to be able to identify small fluctuations in practice accurately (e.g., 10% relative change), such an approach would be highly labor intensive. Instead, a meaningful change in cleaning practice (e.g., 20% relative change) can be detected without having to evaluate a substantial number of surfaces. Previous experience suggests that conducting a baseline

evaluation of all available surfaces (listed in the checklist) in a 10-15% sample of representative patient rooms is reasonable in a hospital with ≥150 beds. When hospitals have achieved a thoroughness of cleaning rate of >80%, the number of surfaces to be monitored can be decreased to those available in a 5% sample of rooms per evaluation cycle unless there is a deterioration in practice. In hospitals with less than 150 beds, all available surfaces (listed in the checklist) in a minimum of 15 rooms may be monitored for baseline and ongoing evaluation.

APPENDIX D

Calculation of Aggregate Thoroughness of Disinfection Cleaning (TDC) Score

The results of the evaluation of each object listed on the check list can be recorded in the attached excel spreadsheet template. The percentage of individual surfaces cleaned across multiple patient rooms will be automatically calculated by the excel spreadsheet. Because it has been found that cleaning practice within an institution is more likely to vary between types of objects than by patient units, the high touch surfaces listed in the check list have been grouped into 5 categories for calculating aggregate TDC scores: High Touch I, High Touch II, High Touch III, Bathroom Surfaces, and Equipment Surfaces. The aggregate TDC scores for each category of objects can be reported to the HAI prevention collaborative coordinator by various mechanisms (e.g., NHSN), depending on infrastructure.

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Figure 1

Evaluating Patient Zone Environmental Hygiene

Method	Ease of Use	Identifies Pathogens	Useful for Individual Teaching	Directly Evaluates Cleaning	Published Use in Programmatic Improvement
Direct Practice Observation	Low	No	Yes	Yes	1 Hospital
Swab cultures	High	Yes	Not Studied	Potentially	1 Hospital
Agar slide cultures	Good	Limited	Not Studied	Potentially	1 Hospital
Fluorescent gel	High	No	Yes	Yes	49 Hospitals
ATP system	High	No	Yes	Potentially	2 Hospitals

INSTRUCTIONS FOR EVALUATING THE CLEANING OF OBJECTS IN THE PATIENT ZONE

The group of objects on the checklist was chosen on the basis of information regarding the contamination of these surfaces with healthcare-associated pathogens (HAPs) as well as a consideration of the likelihood they would be touched during routine care by healthcare personnel without changing gloves or performing hand hygiene prior to using these items.

The following descriptions and suggestions should be used to standardize, to the degree feasible, the manner in which the thoroughness of cleaning can be most consistently evaluated. If the evaluation system utilizes a fluorescent gel targeting system, the targets should generally be placed very near but not in/on the area of the object touched in routine use (as noted in the outline below) in order to avoid disturbing the target during actual use of the object. If one of the direct evaluation systems (one of the two culture methods or the ATP method as described in the Appendix) is being used, the primary hand touch area of each object should be evaluated as noted in the outline below, taking particular care to evaluate exactly the same area of the object before and after cleaning.

All available objects noted below should be marked in each room.

Patient Area

Bed rails – If the bed rail incorporates bed controls, evaluate the control area (on the patient side) slightly away from the control buttons. If the rails do not contain the new style control areas, the rails are best evaluated on the smooth inner surface in an area easily accessible to cleaning.

Tray table - The top of the tray table should be evaluated in one corner.

Call boxes – Evaluation is done on the back mid portion of the call box in an area easily accessible to cleaning. If tiny call buttons are used, mark the separate TV control box instead if feasible.

Telephones – Evaluation is best done on the back side of the hand-held portion of the telephone near the top of the phone, away from the end that is attached to the phone wire.

Bedside tables – The drawer pull is evaluated.

Patient chair – Evaluation is done in the center of the seat of the chair close to the rear of the cushion. If the cushion is covered in textured fabric, evaluate the arm of the chair.

IV pole – For hanging IV poles, the shaft of the pole just above the textured grab area should be evaluated. For standing IV poles, the chest-high portion where hand contact is most common should be evaluated.

Toilet Area

Sinks – If using a targeting system, the best place to mark the sink rim is towards the rear in order to avoid water splash interference with evaluation of the target. If direct evaluation is used, the faucet handle should be evaluated.

Bathroom and patient room light switches – When using a targeting method, a target is placed on the plate portion of the light switch. When using a direct evaluation system, the switch or plate should be evaluated because of its relatively large surface area.

Door knobs and door levers – The inside door knob or lever is marked for each bathroom door and each patient room door. If using a targeting system on a round door knob, the mark is best placed as close to the middle of the face of the door knob as possible. If the knob has a locking mechanism, place the target on the circular door plate that surrounds the handle. Lever-type handles are marked on any easily cleanable surface somewhat away from the end of the lever where direct hand contact would be most frequent. Similarly, when using a fluorescent system, door push plates are marked in the middle of the smooth part of the plate. When using direct evaluation systems, the most frequently contacted portion of the door knob, lever or push plate should be evaluated.

Toilet area hand holds (bathroom handrails) – Evaluate the most accessible surface of the hand hold just off the edge of the textured surface at the curve where the hand hold goes towards the wall. If there are two hand holds, mark the one most likely to be touched by a patient using the toilet.

Toilet seats – When using a targeting method, the target is placed on the back of the toilet seat just below the outside edge of the seat in an area readily accessible to cleaning activities. When using a direct evaluation method, the surface of the toilet seat should be evaluated, being sure to evaluate the same area before and after cleaning.

Toilet handles – When using a targeting method, the target is placed on top of the handle approximately two thirds away from the end of the handle.

Bed pan cleaning equipment – Two types of bed pan cleaning equipment designed as part of toilet units are in general use in hospitals.

Hinged pipe type cleaner - The most commonly used bed pan cleaner consists of a pipe with a small shower head type device that is lowered over the toilet bowl by the user. When the arm is lowered, the toilet flush water is sprayed in a stream through the cleaner head. This device is best targeted by marking the spray head (the most common area which would be touched by users).

Spray hoses – Some toilets have a spray hose with a lever-type trigger on the handle which is depressed to activate the spray head. Evaluate the handle itself.

Where Applicable

IV Pump control panel – Evaluate an area that is just adjacent to the portion of the panel that is most frequently touched by healthcare providers.

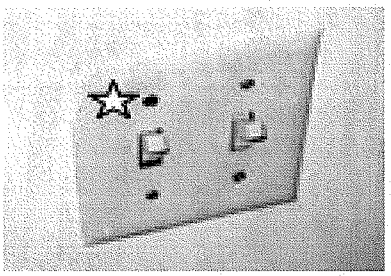
Monitor control panel – When using a targeting method, the control panel should be evaluated in an area immediately adjacent to a part of the panel which is directly contacted by caregivers' hands. When using a direct method, the control area itself is evaluated.

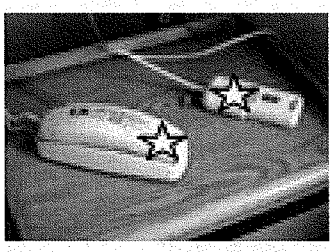
Monitor touch screen – The touch screen should be evaluated in the lower right hand corner in an area easily accessible to cleaning.

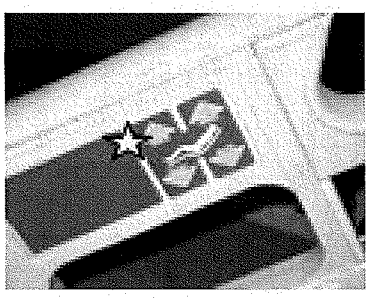
Monitor cables – Evaluate the junction box area.

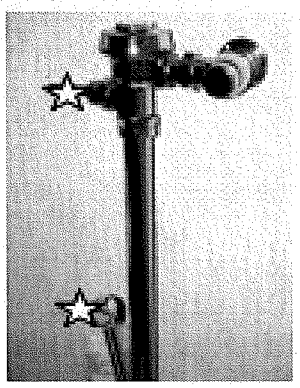
Ventilator control panel – Evaluate an area immediately adjacent to a part of the panel which is most frequently touched by healthcare provider.

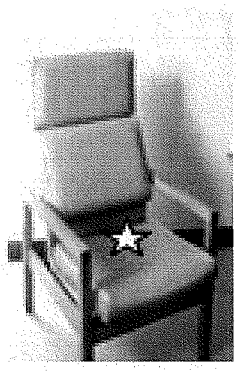
TARGET PLACMENT ON HIGH TOUCH OBJECTS

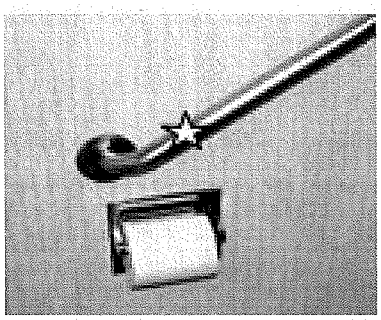


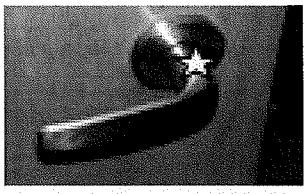












CDC Environmental Checklist for Monitoring Terminal Cleaning[1]

Date:	
Unit:	
Room Number:	
Initials of ES staff (optional):[2]	

Evaluate the following priority sites for each patient room:

High-touch Room Surfaces[3]	Cleaned	Not Cleaned	Not Present in Room
Bed rails / controls			
Tray table			
IV pole (grab area)			
Call box / button			
Telephone			
Bedside table handle			
Chair			
Room sink			
Room light switch			
Room inner door knob			
Bathroom inner door knob / plate			
Bathroom light switch			
Bathroom handrails by toilet			
Bathroom sink			
Toilet seat			
Toilet flush handle			
Toilet bedpan cleaner			

Evaluate the following additional sites if these equipment are present in the room:

High-touch Room Surfaces[3]	Cleaned	Not Cleaned	Not Present in Room
IV pump control			
Multi-module monitor controls			
Multi-module monitor touch screen			
Multi-module monitor cables			
Ventilator control panel			

Mark the monitoring method used:

☐ Direct observation ☐ Fluorescent gel
☐ Swab cultures ☐ ATP system ☐ Agar slide cultures

---

[1]Selection of detergents and disinfectants should be according to institutional policies and procedures
[2]Hospitals may choose to include identifiers of individual environmental services staff for feedback purposes.
[3]Sites most frequently contaminated and touched by patients and/or healthcare workers

TERMINAL CLEANING

Record results of evaluation for each surface on the check list for every room monitored. Use the following symbols for marking:

O = NOT CLEAN, X = CLEAN, LEAVE BLANK = NOT EVALUABLE **NOTE - USE CAP LETTERS "X" AND "O"**

The percentage of individual surfaces cleaned will be automatically calculated in Sheet 2 (Aggregate Score Sheet).

Please report aggregate scores calculated for each category highlighted in Sheet 2 (Aggregate Score Sheet).

				High Touch I			High Touch II			High Touch III				Bathroom Surfaces							Equipment Surfaces					Surfaces Cleaned for Each Room		
Unit	Rm No.	Date of Marking (if applicable)	Date of Evaluation	Bed rails	Tray table	IV pole	Call box / button	Telephone	Bedside table handle	Chair	Rm sink	Rm light switch	Rm inner doorknob	BR inner doorknob	BR light switch	BR handrails	BR sink	Toilet seat	Toilet flush handle	Toliet bedpan cleaner	IV pump control	Monitor controls	Monitor touch screen	Monitor cables	Ventilator panel	# Surfaces Cleaned	# Surfaces Evaluated	% of Surfaces Cleaned
																										0	0	#DIV/0!
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TERMINAL CLEANING

Automatic calculation of Aggregate Scores Across Surfaces and Rooms

	High Touch I			High Touch II			High Touch III				Bathroom Surfaces							Euipment Surfaces				
	Bed rails	Tray table	IV pole	Call box / button	Telephone	Bedside table handle	Chair	Rm sink	Rm light switch	Rm inner doorknob	BR inner doorknob	BR light switch	BR handrails	BR sink	Toilet seat	Toilet flush handle	Toliet bedpan cleaner	IV pump control	Monitor controls	Monitor touch screen	Monitor cables	Ventilator panel
# of Surfaces Cleaned	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Surfaces Evaluated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Surfaces Cleaned	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Category: Total # of Surfaces Cleaned	0			0			0				0							0				
Category: Total # of Surfaces Evaluated	0			0			0				0							0				
Category TDC Score: % of Surfaces Cleaned	#DIV/0!			#DIV/0!			#DIV/0!				#DIV/0!							#DIV/0!				

Aggregate TDC Score:
#DIV/0!

Immediate-Use Steam Sterilization

"Flash sterilization" has traditionally been used to describe steam sterilization cycles where unwrapped medical instruments are subjected to an abbreviated steam exposure time and then used promptly after cycle completion without being stored. This is in contrast to traditional "terminal sterilization" cycles, where instruments are sterilized within containers, wrappers, or primary packaging designed to maintain the instruments' sterility and allow the devices to be stored for later use. The term "flash" arose out of the abbreviated time of exposure of the unwrapped device.

Today, however, "flash sterilization" is an antiquated term that does not fully describe the various steam sterilization cycles now used to process items not intended to be stored for later use. Current guidelines may require longer exposure times and/or the use of single wrappers or containers designed to allow for aseptic transfer of an item to the point of use. The term "immediate-use steam sterilization" more accurately reflects the current use of these processes. The same critical reprocessing steps (such as cleaning, decontaminating, and transporting sterilized items) must be followed regardless of the specific sterilization cycle employed; a safe process does not include short-cuts or work-arounds.

"Immediate use" is broadly defined as the shortest possible time between a sterilized item's removal from the sterilizer and its aseptic transfer to the sterile field. Immediacy implies that a sterilized item is used during the procedure for which it was sterilized and in a manner that minimizes its exposure to air and other environmental contaminants. A sterilized item intended for immediate use is not stored for future use, nor held from one case to another. Immediacy, rather than being defined according to a specific time frame, is established through the critical analysis and expert collaboration of the health care team.

We agree that:

- Personnel involved in reprocessing should be knowledgeable and capable of exercising critical thinking and judgment, and should implement standardized practices. The supervising organization is responsible for ensuring appropriate training, education, and competency of staff and ensuring that the necessary related resources are provided.
    - Examples of education and certification resources include the Certification Board for Sterile Processing and Distribution (CBSPD) and the International Association of Healthcare Central Service Materiel Management (IAHCSMM).

- Examples of standards and practices can be found with the Association for the Advancement of Medical Instrumentation (AAMI), the Association of periOperative Registered Nurses (AORN), and the Centers for Disease Control and Prevention-Healthcare Infection Control Practices Advisory Committee (CDC-HICPAC).

- Sterilization personnel should be educated regarding the different types of steam sterilizers (i.e., gravity-displacement and dynamic air removal—prevacuum, high vacuum, and steam-flush-pressure-pulse sterilizers) and the different types of steam sterilization cycles (i.e., gravity-displacement and dynamic air removal cycles) used in health care facilities.
- Sterilization cycles with little or no dry time are efficacious when used in compliance with validated written instructions provided by the device manufacturers, sterilization equipment manufacturers, and (if applicable) container manufacturers and when done in accordance with professional guidelines.
- Cleaning, decontamination, and rinsing are critical and users must follow and complete all required processing steps regardless of the sterilization exposure parameters being used.
- Aseptic transfer from the sterilizer to the point of use is critical to protect items from contamination.
- Only items sterilized and packaged in materials cleared by the FDA for maintenance of sterility can be stored.
- The device manufacturer's written instructions for reprocessing any reusable device must be followed. The cycle parameters required to achieve sterilization are determined by the design of an instrument, the characteristics of the load, the sterilizer capabilities, and the packaging (if used).

  NOTE: The device manufacturer's instructions are not always compatible with the sterilizer instructions or the instructions for the container/ wrapper. Device manufacturers' instructions are sometimes unclear, incomplete, or require processes or cycles that are not available in the health care facility. Where instructions conflict or are insufficient, the device manufacturer should be contacted for more information/guidance. If differing instructions cannot be resolved and the instrument is urgently needed, the device manufacturer's instructions must be followed.

- Survey personnel involved in evaluating organizations that sterilize medical items should be knowledgeable and capable of exercising critical thinking and judgment. The regulatory or accrediting agency should evaluate whether the organization's leaders ensure that training, education, and resources are provided and the competency of staff is validated.
- Quality management is important to ensure compliance with processes and relating those processes to outcomes.
- Sterilization process monitoring is essential to ensure that sterilization practices are efficacious.

- Examples of process monitoring tools are physical indicators, biological indicators, and chemical indicators.

- Instrument inventories should be sufficient to meet anticipated surgical volume and permit the time to complete all critical elements of reprocessing.

Immediate-use sterilization should NOT be performed on the following devices:

- Implants[1], except in a documented emergency situation when no other option is available.
- Post-procedure decontamination of instruments used on patients who may have Creutzfeldt–Jakob disease (CJD) or similar disorders.
- Devices or loads that have not been validated with the specific cycle employed.
- Devices that are sold sterile and intended for single-use only.

[1] The FDA defines an implant as a "device that is placed into a surgically or naturally formed cavity of the human body if it is intended to remain there for a period of 30 days or more. FDA may, in order to protect public health, determine that devices placed in subjects for shorter periods are also 'implants.' " [21 CFR 812.3(d)]

Resources

Association for the Advancement of Medical Instrumentation. *ANSI/AAMI ST79: 2010 & A1:2010—Comprehensive Guide to Steam Sterilization and Sterility Assurance in Health Care Facilities*. Arlington, VA: Association for the Advancement of Medical Instrumentation, 2010.

Association for the Advancement of Medical Instrumentation. *ANSI/AAMI ST40—Table-top Dry Heat (Heated Air) Sterilization and Sterility Assurance in Health Care Facilities*. Arlington, VA: Association for the Advancement of Medical Instrumentation; 2004.

Recommended practices for sterilization in the perioperative setting. In: *Standards, Recommended Practices, and Guidelines*. Denver, CO: AORN, Inc; 2010.

Recommended practices for cleaning and care of surgical instruments and powered equipment. In: *Standards, Recommended Practices and Guidelines*. Denver, CO: AORN, Inc; 2010.

Centers for Disease Control, *Guideline for Disinfection and Sterilization in Healthcare Facilities*, 2008.

SAFE CUTS

U – Undergoing Surgery

Health Care Protocol: Perioperative Protocol
Institute for Clinical Systems Improvement, October 2011

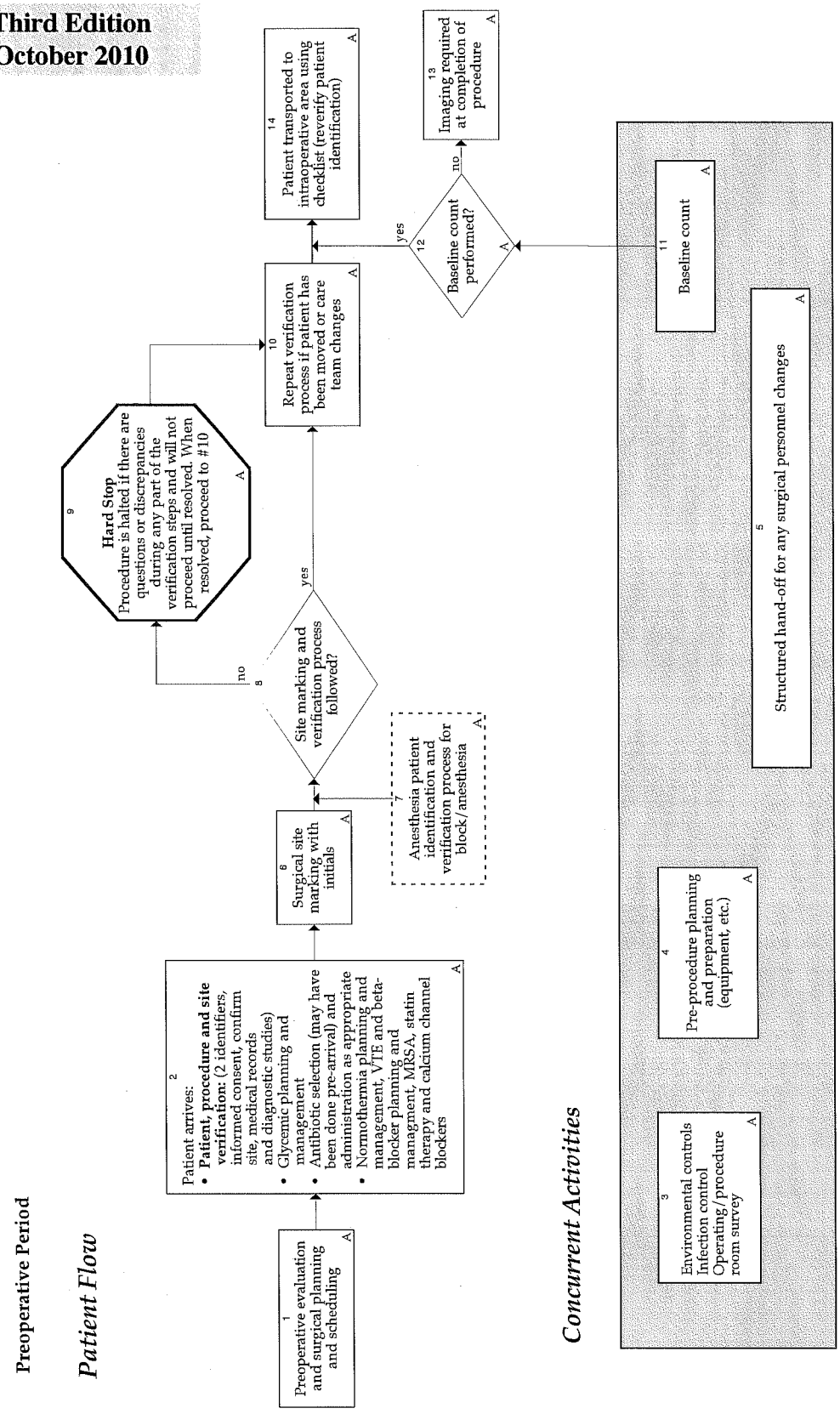
Intraoperative Antibiotic Dosing Guideline
Fairview

Let's Get Rolling poster
HealthEast

Preoperative Period Algorithm

All algorithm boxes with an "A" and those that refer to other algorithm boxes link to annotation content.

Text in blue throughout the document also provides links.



A = Annotation

Note: The *Patient Flow* (top) algorithm reflects the steps as the patient flows through each perioperative period. The *Concurrent Activities* (bottom gray-shaded area) reflects the indirect actions, or parallel processes, that occur simultaneously as the patient flows through the perioperative periods.

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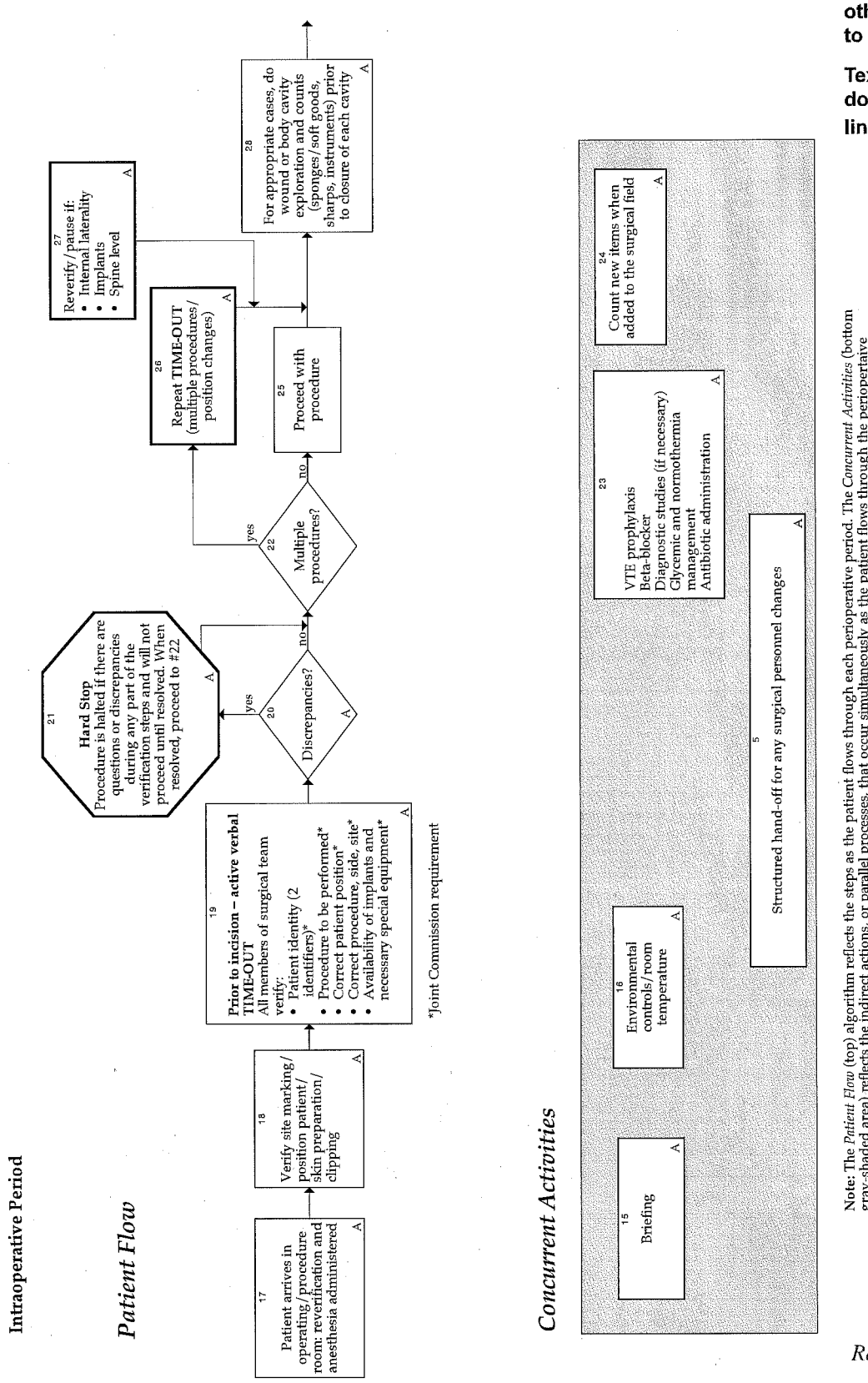
Intraoperative Period Algorithm

All algorithm boxes with an "A" and those that refer to other algorithm boxes link to annotation content.

Text in blue throughout the document also provides links.



Note: The *Patient Flow* (top) algorithm reflects the steps as the patient flows through each perioperative period. The *Concurrent Activities* (bottom gray-shaded area) reflects the indirect actions, or parallel processes, that occur simultaneously as the patient flows through the perioperative periods.

A = Annotation

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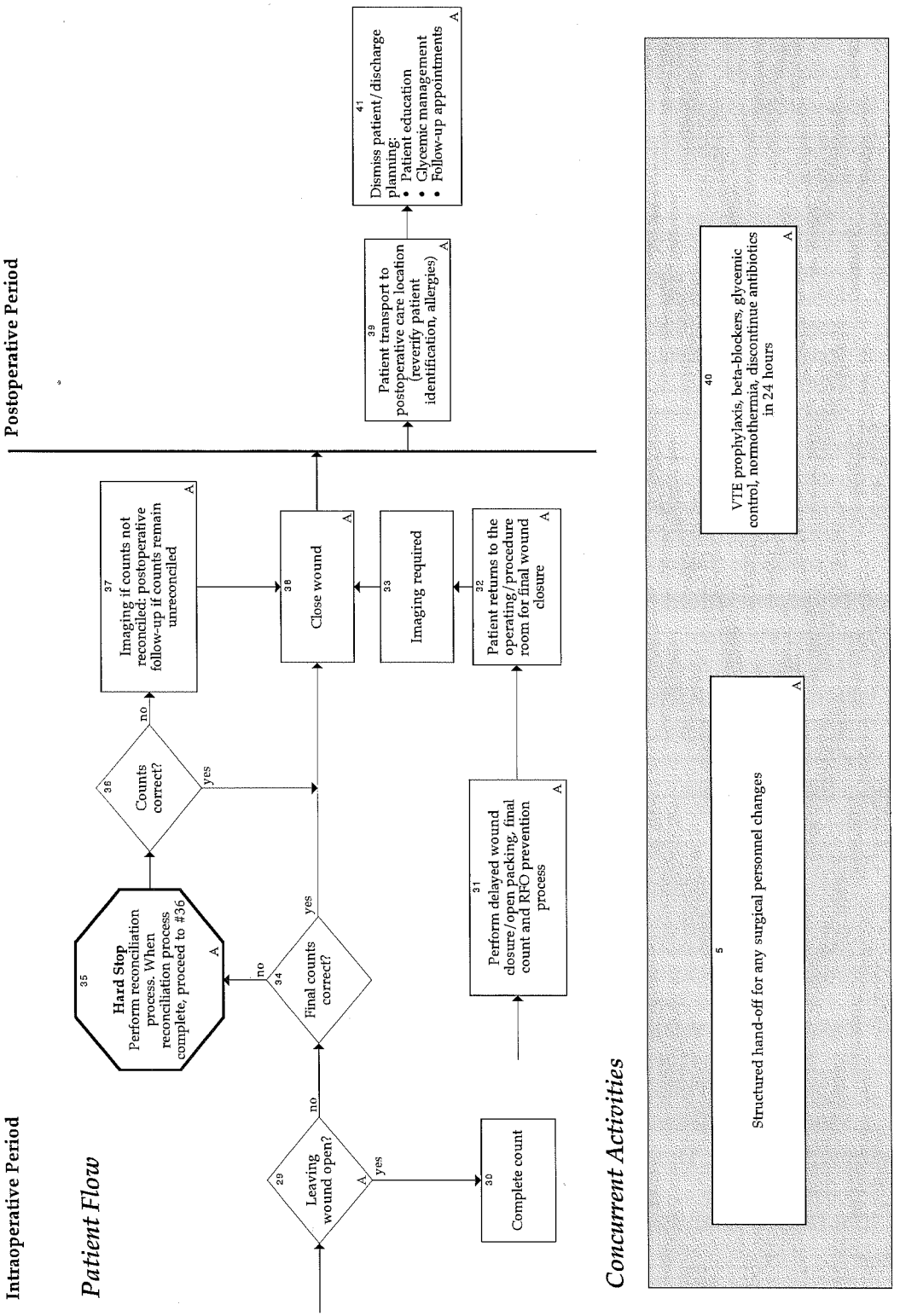
Intraoperative and Postoperative Period Algorithms

All algorithm boxes with an "A" and those that refer to other algorithm boxes link to annotation content.

Text in blue throughout the document also provides links.



Note: The *Patient Flow* (top) algorithm reflects the steps as the patient flows through each perioperative period. The *Concurrent Activities* (bottom gray-shaded area) reflects the indirect actions, or parallel processes, that occur simultaneously as the patient flows through the periopertaive periods.

A = Annotation

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Annotation Table by Topic

Numbers in table refer to specific annotations for ease in locating information by topic.
Also refer to alphabetized Index by Topic at the end of the document.

Focus Area	Preoperative	Intraoperative	Postoperative
Retained Foreign Objects	Baseline count[11, 12]	Counts throughout surgery[11]	
	Imaging[13]	Delayed wound closure[31]	
	Operating/procedure room survey[3]	Final wound closure[32]	
		Hard stop[35]	
		Imaging for unreconciled count[37]	
		Wound or body cavity exploration[28]	
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	Antibiotic selection[2]	Glycemic control[23]	Antibiotic re-dosing[40]
	Environmental controls[3]	Normothermia management[23]	Glycemic control[40, 41]
	Glycemic control[1, 2]	Skin prep[18]	Hand hygiene[40]
	Hand hygiene[3]		Incision managment[40]
	Identification and surveillance of SSI[3]		Normothermia management[40]
	MRSA[1]		
	Normothermia management[2]		
	Patient education[1]		
	Preoperative evaluation[1]		
Safe Site	Anesthesia patient identification/verification[7]	Hard stop[21, 35]	Reverification[39]
	Anesthesia site marking[7]	Repeat Time Out[26]	
	Anesthesia Time Out[7]	Reverification[17]	
	Hard stop[9]	Reverify/Pause[27]	
	Patient, procedure and site verification[2]	Time Out[19]	
	Surgical scheduling[1]	Time Out discrepancy[20]	
	Surgical site marking[6]	Verify site marking[18]	
Miscellaneous	Beta-blocker planning and management[2]	Beta-blocker management[23]	Beta-blocker management[40]
	Prep for colon surgery[1]	Briefing[15]	Follow-up appointments[41]
	Structured hand-off[5]	VTE prophylaxis[23]	Patient education[41]
	VTE prophylaxis[2]		VTE prophylaxis[40]

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Disclosure of Potential Conflict of Interest

In the interest of full disclosure, ICSI has adopted a policy of revealing relationships work group members have with companies that sell products or services that are relevant to this protocol topic. It is not assumed that these financial interests will have an adverse impact on content. They are simply noted here to fully inform users of the protocol.

Carol Hamlin, RN, MS has a family member employed by Arizant; company product includes Bair Hugger.

Dana Langness, RN, BSN, MA will be speaking for Optima Health; she will receive an honorarium.

Peter Argenta, MD has received a travel honorarium as a consultant for Ipsen, a French pharmaceutical company.

Greg Bielman, MD serves as an Advisory Board Committee Member for Hutchinson Technology, Inc. and has participated in the evaluation of The Inspectra product and has received associated reimbursement.

Greg Beilman, MD has received compensation from Lilly for participating as a speaker and an Advisory Board Committee Member, and he has been a participant in studies.

Marc Swiontkowski, MD was a priniciple investigator for a randomized control trial on hip fracture management associated with NIAMS/NIH. No associated compensation was disclosed.

No other work group members have potential conflicts of interest to disclose.

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Evidence Grading

A consistent and defined process is used for literature search and review for the development and revision of ICSI Protocols. Literature search terms for the current revision of this document include: surgery baseline counts, site marking, surgery antibiotics prophylaxis, retained foreign object technologies, surgery safety protocols, preoperative antibiotics, preoperative verification, pre-procedure briefings, normothermia, beta-blocker management in surgery and glycemic control.

Individual research reports are assigned a letter indicating the class of report based on design type: A, B, C, D, M, R, X.

Evidence citations are listed in the document utilizing this format: *(Author, YYYY [report class]; Author, YYYY [report class] – in chronological order, most recent date first)*. A full explanation of ICSI's Evidence Grading System can be found on the ICSI Web site at http://www.icsi.org.

Class	Description
Primary Reports of New Data Collections	
A	Randomized, controlled trial
B	Cohort-study
C	Non-randomized trial with concurrent or historical controls Case-control study Study of sensitivity and specificity of a diagnostic test Population-based descriptive study
D	Cross-sectional study Case series Case report
Reports that Synthesize or Reflect upon Collections of Primary Reports	
M	Meta-analysis Sytematic review Decision analysis Cost-effectiveness analysis
R	Consensus statement Consensus report Narrative review
X	Medical opinion

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Foreword

The work group acknowledges that this is a lengthy and complex document. The algorithm and corresponding annotations provide recommended steps to be taken during the preoperative, intraoperative and postoperative periods of a surgical procedure. There are two process flow diagrams. The *Patient Flow* (top) algorithm demonstrates the steps as the patient flows through each perioperative period. The *Concurrent Activities* (bottom) algorithm demonstrates the indirect actions, or parallel processes, that occur simultaneously as the patient flows through the process. These steps are indicated in the gray-shaded area of the algorithm. It is important to note that many of the process steps and corresponding documentation are repeated throughout this document as they relate to each surgical process (e.g., site marking and verification process). Although the algorithm demonstrates the linear progression of the patient flow with corresponding parallel processes, this repetition allows for specific areas or aspects of the protocol to be implemented in a non-sequential manner.

Introduction

An ongoing challenge faced by the work group is the limited number of peer-reviewed research studies to guide the development of the overall protocol recommendations.

Commercial aviation safety experts faced the same lack of evidence when they developed their, now generally accepted, standard operating procedures aimed at eliminating airplane accidents. Aviation has shown that broadly and systematically employing processes that include standardized procedures to minimize variation, implementing communication techniques such as crew resource management, and minimizing distractions during critical steps lead to improved safety and reliability *(Helmreich, 2000 [R])*.

Anesthesiology has led the health care industry in safety. One of the key safety strategies deployed by this group was the adoption of standardized processes for how anesthesiologists monitor and respond to intra-operative changes in the patient's condition. Incorporating these standards – developed by using human factors principles and communication strategies – into their workflow has helped anesthesia become the only health care discipline that has approached the Six Sigma level of performance *(Gaba, 2000 [R])*. See Appendix A, "Incorporating Human Factors Systems Design into Work Process Design," for an expanded discussion on human factors systems design principles.

The work group incorporated these principles, successfully employed by aviation and anesthesiology, into the development of this protocol. To aid in its future development it will be important to gather outcomes and costs associated with the implementation of the protocol.

Retained foreign objects

For as long as the medical community has been performing surgery or invasive procedures, there has been the risk and misfortune of unintentionally leaving items behind. Many measures have been instituted to mitigate the likelihood of an unintentionally retained item, but unfortunately they continue to occur. Exactly how often it happens is unknown; however, it has been estimated that on a national basis, approximately 1,500 patients per year will have a foreign body unintentionally retained following surgery *(Gawande, 2003 [C])*.

Professional organizations such as the American College of Surgeons *(American College of Surgeons, 2005 [R])*, Surgical Clinics of North America *(Gibbs, 2005 [R])*, the Association of PeriOperative Registered Nurses *(AORN, 2006 [R])*, Department of Veterans Affairs Veterans Health Administration *(Eldridge, 2006 [NA]); VHA Directive, 2006 [NA])*, the Council on Surgical and Perioperative Safety *(Council on Surgical and Perioperative Safety, 2005 [R])*, American College of Obstetricians and Gynecologists *(ACOG, 2006 [R])* and The Joint Commission *(Joint Commission International Center for Patient Safety, 2006 [R])* have all developed guidelines for the prevention of retained items. In an article published in February 2006, the Association of PeriOperative Registered Nurses *(AORN, 2006 [R])* established a set of six practices that if implemented, are expected to significantly reduce the risk of an unintentionally retained item.

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The Joint Commission categorizes the unintended retention of a foreign body after surgery or other procedure as a sentinel event. Health care organizations are required to conduct a root cause analysis and to develop a corrective action plan designed to reduce the probability of a repeat occurrence.

As part of the Minnesota Adverse Health Event law, these events are reported directly to the state and are publicly disclosed. In the Minnesota Department of Health's Fifth Annual Public Report, covering periods October 7, 2007-October 6, 2008, 312 total adverse events, were reported, with 37 reported as unintentionally retained objects *(Adverse Health Event in Minnesota, Fifth Annual Public Report, 2008 [NA])*.

Surgical infection

Surgical site infections are linked to a major cause of patient injury and death, and they consume substantial health care resources. A large percentage of the number of surgical site infections (40%-60%) is thought to be preventable and as such, characterized as a "never event" medical error. Surgical site infection rates have been cited in the literature as occurring in 2%-5% percent of patients after clean extra-abdominal surgeries and up to 20% of patients undergoing intra-abdominal procedures. It is difficult to identify nosocominal infections in patients who have been discharged. Some studies following patients in the post-discharge period have reported even higher rates.

The majority of surgical site infections have been linked to the failure to administer prophylactic antibiotics or the inappropriate timing of antibiotic prophylaxis. Baseline data from the National Surgical Infection Prevention Project indicate a surgical site infection rate of 2% of approximately 30 million surgeries per year.

While that rate may not seem large, patients who develop a surgical site infection are two to three times more likely to die compared to patients who do not develop a surgical infection. Data from the National Surgical Infection Prevention Project show that only 55.7% of patients received appropriate timing of antibiotic prophylaxis during the 60 minutes prior to incision of the selected procedures *(Bratzler, 2005b [R])*.

By focusing on adherence to recognized techniques and protocols, the National Surgical Infection Prevention Collaborative was able to reduce surgical site infections by 27% by focusing on timing of antibiotic prophylaxis, use of appropriate antibiotics, and the discontinuation of antibiotics within 24 hours in patients undergoing a variety of major procedures.

Safe site

This protocol is consistent with and based heavily on The Joint Commission's Board of Commissioners' approved Universal Protocol for Preventing Wrong Site, Wrong Procedure, and Wrong Person Surgery. The Universal Protocol was created to address the continuing occurrence of these medical errors. The Universal Protocol became effective July 1, 2004, for all accredited hospitals, ambulatory care and office-based surgery facilities and drew upon, expanded and integrated a series of requirements under The Joint Commission's National Patient Safety Goals. It is applicable to all operative and other invasive procedures.

The Universal Protocol is endorsed by nearly 50 professional health care associations and organizations including the American Medical Association, American Hospital Association, American College of Physicians, American College of Surgeons, American Dental Association, and the American Academy of Orthopedic Surgeons.

The work of implementing this protocol requires coordination between the physician/clinician, the patient/legal guardian, operating/procedure room staff, preoperative holding room staff, the patient's bedside nurse, procedural and clinic teams, radiology personnel, and anesthesia practitioners. All individuals involved in the process must take an active role in complying with this protocol, including patients as they are able.

Why is the focus for improvement important? Why is a zero error rate for wrong site events the goal? If we compare ourselves to the equally high-risk airline industry, which employs processes no different from procedural and surgical verification in its step-by-step approach, and if they set their goal at a 99.9%

error-free rate, nationally there would be two major airline crashes per week. A 99.9% error-free rate for the health care industry equates to 500 wrong surgical site surgeries nationally every week. In Minnesota, there are still patients affected by a wrong surgical or procedure event that directly applies to areas in this protocol. As part of the Minnesota Adverse Health Event law, these errors are also reported directly to the state and are publicly disclosed.

Each year as the protocol is reviewed, updated and redistributed to hospitals, many organizations make a concerted effort to review and educate all staff and physicians on the new changes to the existing protocol.

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Scope and Target Population

Patients of all ages having any type of surgical procedure performed in the operating/procedure room.

The protocol will describe the steps performed throughout the perioperative period (preoperative, intraoperative and postoperative) that are necessary to prevent wrong site, wrong patient or wrong procedure, as well as to prevent surgical site infection and prevent the unintentional retention of a foreign object.

Preventing wrong site, wrong patient or wrong procedure includes the processes involving patient consent and the verification and marking of the surgical site(s) including any procedure involving laterality, levels, multiple sites/digits or implants.

The prevention of surgical site infection covers adults and pediatric patients for abdominal; gynecologic; cardiac; orthopedic; ears, nose, throat; and neurologic surgical procedures, starting with the preoperative evaluation and surgical planning and proceeding through the perioperative period. The protocol includes antibiotic selection for prophylaxis, timing and discontinuation, surgical site preparation, glycemic control and normothermia.

The prevention of unintentionally retained foreign objects includes strict adherence to a counting process including obtaining radiographic imaging if the count process cannot be successfully reconciled.

Additionally, this protocol also includes management information specific to venous thromboembolism prophylaxis and beta-blocker therapy, recognizing the significance of these throughout the perioperative period.

Much of the evidence used to develop these recommendations is derived from populations of primarily adult patients. The work group has made the assumption that much of the benefit derived from these practices would be present in a similar population of pediatric patients.

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Aims

Outcome Aims and Measures

1. Eliminate the wrong surgical procedure, or surgery performed on the wrong body part, or on the wrong patient.
2. Eliminate unintentionally retained foreign objects during a surgical procedure.
3. Decrease the rate of infections in surgical patients undergoing clean surgery.

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Clinical Highlights

The following Clinical Highlights are summary statements only and are not intended to be the sole source of information for each point. It is important for you to read the annotation related to each item for a more detailed presentation of the material.

- Areas requiring focus throughout the perioperative period include venous thromboembolism prevention, beta-blocker therapy and methicillin-resistant staphylococcus aureus management. *(Annotations #2, 23, 40; Aim #3)*
- Preoperative verification process includes patient identification, procedure(s), site(s), laterality and level. This process is confirmed by source documents, consent form, medical record and discussion with the patient. Additional verification must occur at designated points in the perioperative period. *(Annotations #2, 7, 10, 14, 17, 18, 19, 26, 27, 39; Aim #1)*
- All procedure sites including level, position, laterality, multiple sites/digits in the same anatomic location, and bilateral procedures will be marked with the surgeons initials. The surgeon should follow the preoperative verification process prior to marking the sites. Surgeon initials must be visible at time of incision. Note: An anatomical diagram shall be used to identify surgical site(s) that are not visible through the surgical drape. *(Annotation #6; Aim #1)*
- Procedures involving level will have the preoperative imaging in the area where the procedure is being performed. High-quality intra-procedure imaging with opaque instruments marking specific bony landmarks will be taken and compared to the preoperative imaging to confirm the correct level/site prior to the procedure. *(Annotation #27; Aim #1)*
- A Time Out will be performed just prior to the start of the procedure (after the surgeon has gowned and scrubbed) with active verbal confirmation by all the professionals involved in the care of the patient. A repeat Time Out will be performed for multiple procedures or position changes. An intraoperative pause shall be performed for all procedures that involve level, implants and/or laterality after an orifice or midline entry. *(Annotations #19, 26, 27; Aim #1)*
- A pre-procedure briefing will be conducted. The purpose of the briefing is to present the plan for the procedure and confirm with the team members what will be needed during the procedure and when it will be needed. *(Annotation #15; Aims #1, 2, 3)*
- When a hand-off is required, a structured process should be followed. *(Annotation #5; Aims #1, 2, 3)*
- A Hard Stop will occur when either the verification process is incomplete and/or a discrepancy is identified. The procedure will not proceed until the discrepancy is resolved. *(Annotations #9, 21, 35; Aim #1)*
- Efforts should be made to focus on the processes of care represented by the quality measures associated with the Surgical Care Improvement Project (SCIP). *(Annotations #1, 2, 18, 23, 40; Aim #3)*
- Baseline counts should be effectively and reliably performed for soft goods and sharps. *(Annotation #11; Aim #2)*
- Imaging is required if the final count is unable to be reconciled. *(Annotation #37; Aim #2)*

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Implementation Recommendation Highlights

The following system changes were identified by the protocol work group as key strategies for health care systems to incorporate in support of the implementation of this protocol.

System implementation:

- The facility is encouraged to customize the protocol with a key that identifies the individuals responsible for completing the algorithm tasks (e.g., green shapes for those individuals responsible for counts).
- Leadership support and a surgeon champion are absolutely essential for the successful implementation of this protocol.
- Develop a procedural checklist to document completion of each step and ensure that all elements of the protocol are completed.
- Direct observations, along with coaching and immediate feedback, are effective strategies in gaining staff adherence to the protocol following implementation. Additionally, the use of crucial conversation tactics can be effective for staff.
- As it relates to this protocol, create and implement a process that allows for the detection and management of disruptive and inappropriate behavior. This process should include education of all physicians and non-physicians regarding appropriate professional behavior and the development of policies and procedures. Refer to The Joint Commission's leadership standards.
- Red rules* should be established, followed by staff and physicians and supported by leadership (see below for specific red rules suggested for this protocol)
  - *Red rules are the few, key rules created to prevent/address the specific actions that pose the highest level of consequence and risk to safety of patients or staff. The intention is to develop solid habits around these rules so that they are followed consistently and accurately each time. Individual responsibility to adhere to each red rule is imperative to ensure the safest environment and delivery of the care process.
  - Suggested red rules:
    - Never operate on a patient without verifying the correct patient identity, correct procedure and correct site.
    - Baseline counts are consistently performed before the patient arrives in the operating/ procedure room unless parallel processing is used.
    - Unreconciled counts require imaging verification, and wound closure stops until count reconciliation is achieved.

Retained foreign object implementation:

- The work group recommends that a preformatted white board be used as the primary record of the count. Documenting counts on a white board allows all surgical staff, and in particular the scrub tech, to independently view the count record. A public display of the count record in an area where the entire surgical team can view it is likely to reinforce the importance of the count process.
- The work group also recommends that a count worksheet be used as a memory aid when the white board is not easily accessible in a timely manner. The count worksheet should be used only as a memory aid for the baseline count and, if needed, for subsequent counts. A piece of scratch paper should not be used. In contrast, if the white board is located very close to the area when the count

occurs, and if the circulating nurse can easily write the counts on the white board without leaving the count area, there will be no need to use the count worksheet.

- Distractions and interruptions should be kept to a minimum during the count process. If a count is interrupted, then the category of items (e.g., laps) being counted will need to be recounted.

Surgical infection implementation:

- Using preprinted or computerized order sets can help in reminding and remembering specific antibiotics, timing, dose and discontinuation.
- Review patient education material to verify the message around no self-shaving before surgery. Distribute standardized patient education messages to surrounding outpatient clincs, as well.
- Remove all razors from the perioperative area.
- Use warming blankets, hats and booties routinely for patients.
- Establish an effective surveillance process that includes post-discharge or outpatient surveillance. Use inpatient case-finding for post-discharge or outpatient. It is important to include the following:
  - Use standardized definitions for surveillance of infections. These definitions also need to take into account the setting in which the surgical procedure was performed (acute care, ambulatory surgical center, etc.).
  - Establish a risk stratification for estimating surgical infection that adjusts for risk factors associated with infection for different care settings and procedures.
  - Work with surrounding outpatient clinics to develop communication strategy for tracking surgical infections and reporting back to the hospital.

Safe site implementation:

- To facilitate implementation of the Hard Stop concept, have your chief executive officer communicate to all staff and physicians their support for the institution of the Hard Stop.
- The Time Out is best followed when a particular person/role has responsibility to call the Time Out. The surgeon should then be the one to take the lead on initiating the Time Out and have the circulator begin the review of information.
- Establish pre-procedure and post-procedure communication standards in the form of structured hand-offs.
- Develop a verification process at the point of scheduling. The work group recommends that this process include:
  - Corroboration between the surgical consent, the order to schedule a procedure and an independent source document dictation (such as a radiology report or pathology report).
  - Review of documents by a licensed independent practitioner or an RN, with attention directed specifically to the organ to be operated upon and laterality as appropriate before proceeding to the scheduling process.
  - The independently verified documentation provided on paper, fax or electronic format, not by telephone or verbal communication. The only exception to this is during emergency situations.

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Related ICSI Scientific Documents

Guidelines

- Antithrombotic Therapy Supplement
- Preoperative Evaluation
- Venous Thromboembolism Prophylaxis

Order Sets

- Subcutaneous Insulin Management
- Surgical Site Infection Prevention for Adults
- Surgical Site Infection Prevention for Children

Protocols

- Non-OR Procedural Safety
- Prevention of Unintentionally Retained Foreign Objects During Vaginal Delivery
- Pressure Ulcer Prevention and Treatment

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Definitions

Body cavity: an anatomic cavity, orifice or a small cavity created as a result of the procedure being performed. This does not include the initial surgical incision.

Colonization versus infection: with colonization, a microorganism can inhabit a specific site on or in the body (e.g., the nares of the nasal passages) but not cause signs or symptoms of infection; however, the pathogen does have the capacity to cause an infection. Any colony can cause subsequent infection in the same patient or another person when it is transferred between sites or persons.

Colonization differs from infection in that an infection is caused by a pathogen that causes signs and/or symptoms of infection in a patient. Signs and symptoms may include redness, fever, pus, etc. *(Mangram, 1999b [R])*. In most cases, an infection is invasive, whereas with colonization, colonies of organisms may live on surface structures and not be actively fought by the body defense system.

Count stages:

Baseline count: conducted prior to the patient's arrival in the operating/procedure room (unless parallel process is used – see definition below) to establish the initial record of countable items that might be used during the procedure.

Closing a cavity within a cavity count: conducted before surgeon closes a cavity within a cavity. This count is performed to ensure that the count is reconciled prior to moving to the next level of wound closure.

Closing count: performed before wound closure begins.

Final count: performed at skin closure.

Count during hand-off that occurs with temporary relief of staff: a count that occurs during the hand-off each time there is temporary relief of staff.

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Count during hand-off that occurs with permanent relief of staff (e.g., at shift change): a count that occurs during the hand-off each time there is permanent relief of staff.

Countable items: any item that could be unintentionally left behind during a surgical procedure *(AORN, 2006 [R]; American College of Surgeons, 2005 [R]; Council on Surgical and Perioperative Safety, 2005 [R]; Joint Commission International Center for Patient Safety, 2006 [R]; VHA Directive, 2006 [NA])*. This includes:

- **Instruments:** tools or devices designed to perform a specific function, such as cutting, dissecting, grasping, holding, retracting or suturing.
- **Miscellaneous items:** includes vessel clips, vessel loops, suture reels, peripheral intravenous catheters and introducers, vascular inserts, cautery scratch pads, trocar sealing caps, catheter sheaths, non-radiopaque items such as hernia tapes and other small items.
- **Sharps:** items with edges or points capable of cutting or puncturing through other items. In the context of surgery, sharps include, but are not limited to, suture needles, scalpel blades, hypodermic needles, electrosurgical needles and blades and safety pins.
- **Sponges:** includes any soft goods such as gauze pads, cottonoids, peanuts, dissectors, tonsil sponges, laparotomy sponges, and towels used to absorb fluids, protect tissues or apply pressure or traction.
- **Tucked sponge:** refers to any soft good used to stop bleeding or absorb liquid, or used in conjunction with an instrument or the surgeon's hand to obtain traction, and that is left in location for the duration of the procedure.

Count documentation: a standardized format to document the number of sponges/soft goods, sharps and instruments.

This may be in paper and/or electronic format. Organizations may or may not choose to store specific count information for future retrieval.

- **White board:** A preformatted dry erase board or computer screen, directly viewable by the entire surgical team, should be used to document sponges/soft goods, sharps, miscellaneous item counts, and when possible, instrument counts. The ability of the entire team to view the count information and assist in the correct identification of tucked and unaccounted for items enhances safety and reduces the risk of errors *(France, 2005 [D])*.
  - The white board should have preformatted names of categories of countable items with standard columns and rows to record counts. In addition to the count, the white board should include the patient's name and other pertinent or patient unique information.
  - It is the recommendation of the work group that, whenever possible, only one source of count information be used during the procedure.
- **Paper:** a paper count sheet may be used in organizations where the use of a white board is not possible due to space limitations.
  - A standardized, formatted paper count sheet may be used instead of the white board or as a supplement for procedures where there is a large number and/or specificity of certain items (e.g., cardiac procedures). Refer to Resource Table Tool Kit for sample count sheet.
  - The paper form should be a standardized, preformatted form and when possible, specific to the procedure specialty/service.

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Hard Stop is performed when either the safe site surgical verification process has not been followed completely and a discrepancy is identified or when a count discrepency is identified. The procedure is halted and will not proceed until the appropriate verification/reconciliation steps have been performed and/or the discrepancy is resolved.

High-risk procedure is any procedure that is known to expose a patient to the risk of permanent loss of function or injury *(Joint Commission, 2004 [NA])*. Generally, this includes procedures requiring consent by the patient.

Hospital-acquired surgical infection: defined as an infection of the surgical site within 30 days after the operation. For procedures involving an implant, a hospital-acquired infection is defined as an infection occurring within six months for bone grafts and one year for other implants *(Mangram, 1999b [R])*.

- Excluded infections that are not reported as hospital-acquired surgical infections are stitch abscess infections; they are outside the scope of this protocol.
- Infection of an episiotomy or newborn circumcision site or infected burn wounds are reported using other specific criteria and are outside the scope of this protocol.

Criteria for defining surgical infection: in addition to the definition above, surgical site infections are classified as either incisional or organ/space infections. Incisional infections are subdivided for those involving only the skin and subcutaneous tissue and for those involving deeper soft tissue. Surveillance can include reviewing patients receiving antibiotic therapy for any reason within the defined period of time after a surgical procedure.

Superficial incisional infections: infection involving only the skin or subcutaneous tissue of the incision and one or more of the following:

- Purulent drainage from the superficial incision with or without laboratory confirmation
- Organisms confirmed by culture from either an aseptically obtained fluid or tissue from the superficial incision
- One or more signs of infection (pain/tenderness, localized swelling, redness or heat) AND the superficial incision is deliberately opened by the surgeon unless the incision is culture-negative
- A surgeon or attending physician diagnoses a superficial incision surgical site infection

Deep incisional infections: infection involving deep soft tissue of the incision such as facial and muscle layers and one or more of the following:

- Purulent drainage from the deep incision but not from the organ or space component of the surgical site
- The deep incision spontaneously separates or is deliberately opened by a surgeon when the patient has one or more of the signs of infection (fever over 38°C, localized pain or tenderness) unless the site is culture-negative
- A surgeon or attending physician diagnoses a deep incision surgical site infection

Organ/space infections: infection involving any part of the body, for example, organs or spaces, other than the incision, that was opened or manipulated during the procedure and one or more of the following:

- Purulent drainage from a drain that is placed through a stab wound into the organ/space
- Organisms confirmed by culture from either an aseptically obtained fluid or tissue from the organ/space

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- Presence of an abscess or other evidence of infection involving the organ/space that is found on direct examination, during re-operation, or by histopathologic or radiologic examination
- A surgeon or attending physician diagnoses an organ/space surgical site infection

Hypothermia: defined as body temperature below 36°C (96°F) *(Mangram, 1999b [R])*.

Intraoperative image: a radiographic image obtained within the operating/procedure room, usually with portable radiographic equipment.

Intra-procedure pause: a pause during the procedure(s) when the clinician will indicate verbally:

- Level(s)
- Internal laterality after a midline or orifice entry
- Implant information

An intra-procedure pause should not to be confused with the Time Out.

Invasive procedure: any procedure that exposes the patient to more than minimal risk. This includes, but is not limited to, any entry, puncture or insertion of an instrument or foreign material into tissues, cavities or organs. This applies to any procedure performed in settings such as special procedure units, rooms or clinics, or at the patient's bedside. These procedures may involve moderate or deep sedation. Generally, this includes procedures requiring consent by the patient. This excludes venipuncture, intravenous therapy, nasogastric tube insertion, Foley catheters, flexible sigmoidoscopy, and vaginal exams (Pap smears) *(Joint Commission, 2004 [NA])*. See Appendix B, "List of Invasive, High-Risk or Surgical Procedures," for examples.

Laterality: refers to any anatomical structure that occurs on both sides of the body, both internally and externally (i.e., right, left or bilateral). Reference to laterality is always with respect to the patient (i.e., the patient's right or left, not the clinician's) *(Joint Commission, 2004 [NA])*.

Level: refers to any anatomical structures that include multiples occurring linearly (e.g., spinal vertebrae, ribs).

Major surgical procedure: a procedure performed in an operating/procedure room and involving general or regional anesthesia, monitored anesthesia care or conscious sedation.

Micro needle: a surgical needle that, for adults, is less than 13 mm in size. When using portable radiographic equipment, needles smaller than 13 mm in length are very difficult to detect in the adult torso *(Macilquham, 2003 [D])*; however, they may be visible in adult extremities or in children. Each organization will need to establish a policy for the use of intraoperative imaging when attempting to locate an unaccounted for micro needle. Unintentionally retained micro needles are not reportable as retained foreign objects.

Normothermia: defined as the core temperature 36°-38°C (96.8°-100.4°F) *(Mangram, 1999b [R])*.

Notification: if an unintentionally retained foreign object is found during a patient examination in a clinic or emergency department, or during a subsequent hospitalization, the facility that performed the original procedure should be notified.

Parallel process: two separate activities performed simultaneously in the same area with two entirely separate groups of staff. Using a parallel processing is not multitasking. When parallel process is used in relation to this protocol, two circulators will be needed: one dedicated to patient care and one dedicated to the baseline count process, for example.

Perioperative period: the perioperative period is considered to be from the night before the surgical procedure until 48 hours postoperatively.

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Physician/clinician designee/dentist: a member of the team performing the procedure who is a credentialed and privileged provider as defined by the institution's medical staff bylaws or who is a physician in residency training.

Position: refers to the placement or angle of the patient for the procedure (e.g., supine, prone). Reference to position is important when determining laterality *(Joint Commission, 2004 [NA])*.

Possibles: refers to possible sites and/or procedures listed on the patient consent; the decision whether to perform the additional procedure is based on the findings of the initial procedure. These should follow the same process for site marking and verification listed for multiple sites.

Radiology room image: a radiographic image obtained in a radiographic room with a fixed tube and moving grid.

Safety stop: refers to taking a break from the procedure anytime a team member perceives a threat to patient safety. Examples include a perceived threat to patient safety stemming from how the Time Out or a count was conducted.

Selected surgical patient: any adult or pediatric patient having had a surgical procedure, with an incision, performed in an operating/procedure room. Specific procedures include cardiac; orthopedic; abdominal; gynecologic; ear, nose, throat; and neurological surgeries, but the term applies to any surgical patient.

Site: the specific anatomic location of the procedure site (incision, insertion or injection) as indicated by a description of the body part(s), levels (e.g., spine level or ribs) and digits (for hands, use thumb, index, long, ring, small; for toes, use great toe, 2nd, 3rd, etc.) to be subjected to intervention. Midline not associated with laterality or level need not be marked; however, if the internal target site involves laterality, site marking is required to indicate the intended side and/or level. This mark is at or near the incision/instrumentation site to indicate correct side or level of proposed procedure. For spinal procedures, the incisional site, anterior or posterior, and general level (cervical, thoracic or lumbar) are marked *(Joint Commission, 2004 [NA])*.

Source document: refers to an original radiology or pathology report that identifies laterality and/or specifies anticipated procedural location.

Structured hand-off: standardized method of communication to improve exchange of information during patient care transition.

Surgeon: a physician who treats disease, injury or deformity by operative methods. For the purposes of this document, surgeon refers to the individual(s) who are primarily responsible for the actual procedure; this may include individuals currently in a fellowship or residency program. Those individuals authorized to complete surgeon responsibilities should be determined by individual organizational policy.

Surgical retained foreign object: an object that is unintentionally retained after final closure of the wound, excluding micro needles.

Surgical procedure: a procedure performed in an operating/procedure room that involves an incision and general, regional, local or monitored anesthesia, or conscious sedation.

Surgical wound classification: the following are the four definitions for types of surgical wounds.

Class I/clean – an uninfected surgical wound in which no inflammation is observed and the respiratory, alimentary, genital or uninfected urinary tract is not entered.

Class II/clean-contaminated – a surgical wound in which the respiratory, alimentary, genital or urinary tracts are entered as part of the planned surgical procedure and without unusual contamination.

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Class III/contaminated – open, fresh accidental wounds or procedures with major breaks in sterile technique or gross gastrointestinal spillage. Also includes surgical wounds when acute, non-purulent inflammation is observed.

Class IV/dirty-infected – old wounds from trauma with retained devitalized tissue or surgical wounds with existing infection or perforated viscera.

Time Out: the full verification that is performed just prior to the start of the procedure, when the entire care team will actively and verbally confirm *(Joint Commission, 2004 [NA])*:

- patient's identity (two identifiers);
- procedure to be performed;
- correct patient position;
- correct procedure side/site and/or level including visualization of surgeon's initials if applicable; and
- as appropriate, imaging, equipment, implants or special requirements (e.g., pre-procedure antibiotic administration.

Vendor: A non-hospital individual who provides support to the surgeon and surgical services personnel.

Verification: refers to checking for consistency between the:

- informed consent documentation,
- physician's order,
- diagnostic studies, and
- response of the patient/legal guardian.

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Special Circumstances

Anatomical variation: when a patient is known to have anatomical variation involving the procedure site, this information should be shared with the care team and additional steps taken to confirm the correct procedure site. This may include additional imaging or a second physician confirming the procedure site.

Communication of unresolved counts in operating/procedure room: in the event that a countable item is lost and cannot be accounted for, surgical teams that may be performing subsequent procedures in the same room prior to its terminal cleaning should be alerted. The circulator should record the date, time, type and number of the missing item on the room's white board, if present, or other salient documentation devices so that the next surgical team is aware of the unresolved discrepancy. Word of mouth is an insufficient means for communicating this information.

Equipment: it is important that operating/procedure room staff be familiar with all equipment used during a specific procedure. To reduce the risk of any retained items, specific attention should be directed toward equipment that has removable parts and/or parts that have the potential to break off during a procedure.

Outside events: events within a department, between departments or outside of an organization where the procedure is taking place that can contribute to the occurrence of an error. Strict labeling of specimens with a verification process is encouraged to reduce the potential of an error in a report, medical record documentation or diagnostic study that could lead to a wrong site, wrong patient or wrong procedure.

Patient management considerations

- **Heart valve condition** – in addition to the recommendations established in this protocol, patients with a heart valve condition should be managed according to guidelines regarding the selection of antibiotic, use of oral antibiotics before the day of surgery and length of course of antibiotic prophylaxis.
- **Existing infection** – recommendations for patients with an existing infection either elsewhere on the body or at the surgical site are outside the scope of protocol.
- **Management of comorbidities** – management of patient comorbidities beyond what is outlined for glycemic control for the prevention of surgical site infection, venous thromboembolism prophylaxis beta-blocker therapy and statin therapy are outside the scope of this protocol.

Pediatric populations

Much of the evidence used to derive these recommendations is derived from populations of primarily adult patients. The work group has made the assumption that much of the benefit derived from these practices would be present in a similar population of pediatric patients.

Surgical considerations and implants

- Donor and tissue testing for transmittable diseases or infection – the testing and/or confirming that donor tissue and other implants are free of infectious agents is outside the scope of this protocol.
- Dropped organs or other items – recommendations for reducing the possibility of infection due to dropped organs or other implants is outside the scope of this protocol.

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Algorithm Annotations

Preoperative Period Algorithm Annotations

1. Preoperative Evaluation and Surgical Planning and Scheduling

The verification process will be carried throughout the organization's entire pre-procedure processes from scheduling through the verification of the patient/procedure/side/site at the time of presentation of the patient for surgery. Documentation of the verification process will be performed in the appropriate medical record.

Scheduling

A verification process must exist at the point of scheduling. To eliminate mistakes, such as left/right translation errors, made in the documentation of a surgical visit for evaluation and planning of a procedure, the work group recommends that the surgical scheduling process require corroboration between the surgical consent, the order to schedule a procedure and an independent source document dictation (such as a radiology report or pathology report). Attention by a clinical professional must be directed specifically to the organ to be operated upon and laterality as appropriate before proceeding to the scheduling process. Independently verified documentation should be provided on paper, facsimile or electronic format, not by telephone or verbal communication. The only exception to this is during emergency situations. Ideally, the patient should also be provided the same information in hard copy form.

Verification of consistency between the planned procedure, the consent and the "source document" should occur when the patient arrives at the surgical facility, along with the rest of the preoperative verification process (refer to Annotation #2, "Patient Arrives [Patient, Procedure and Site Verification]"). A Hard Stop will occur during the verification process if a discrepancy is noted. The patient will not proceed through the perioperative process until the discrepancy has been resolved. The clinical professional will contact the attending surgeon for resolution of any discrepancies between the scheduled procedure, consent, radiographic/pathology report (other "source document") or the final imaging review. The discrepancy must be reconciled at any point when such discrepancies are discovered.

Preoperative Waiting Area

Verification of the correct person, surgical procedure, side and site will occur in the preoperative waiting area. The clinical professional verbally and visually verifies the patient's name and date of birth, surgical procedure/site/side, and the attending surgeon with the patient, family member, legal representative or hospital care provider/interpreter. In addition, they will verify that the patient information is consistent with identification wristband, scheduled procedure, consent, radiographic/pathology report (other "source document") or the final imaging review. The clinical professional will contact the attending surgeon for resolution of any discrepancies. There will be a Hard Stop. The patient will not proceed through the perioperative process until the verification process is complete and any discrepancies have been resolved.

Operating/Procedure Room

The verification process will occur upon patient entry into the operating/procedure room. The registered nurse verbally reverifies the patient's name and date of birth, surgical procedure/site/side, and the primary surgeon with the patient, family member, legal representative or hospital care provider/interpreter. The registered nurse will verify that the patient's information is consistent with identification wristband, scheduled procedure, consent, radiographic/pathology report (other "source document") or the final imaging review. If there are any clarifications necessary, the appropriate care provider will be contacted. When all the members of the surgical/procedural team are not in agreement, the discrepancy needs to be resolved before proceeding with incision/procedural start.

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In addition to the initial review of imaging at the surgical planning visit, the relevant imaging should also be reviewed by the attending surgeon immediately prior to the procedure, and viewed specifically in conjunction with the radiologist's/pathologist's report for congruency. If for some reason the independently documented imaging/pathology report is not available at the time of surgery, the surgeon must indicate which report in the medical record is relevant in order for it to be retrieved prior to the preparation of the patient for surgery.

Preoperative Evaluation

Prevention of surgical site infection begins with the preoperative evaluation.

Preoperative evaluation includes:

- Medical history, including past surgical infections
- Physical examination
- Preoperative diagnostic testing based on patient and surgical risk indications
- Patient education
  - Procedure-specific
  - General orientation
  - Preoperative surgical site infection prevention

Refer to the ICSI Preoperative Evaluation guideline for more information.

Medical history and physical examination

In addition to obtaining a thorough medical history and performing a routine physical examination, a nutritional assessment of the patient is important in the evaluation of the risk for a surgical site infection.

Risk Factors for Development of Surgical Site Infection *(Mangram, 1999a [R])*

Patient Factors	Local Factors	Microbial Factors
• Age • Unintentional weight loss of 30 pounds or more in the last three months • Immunosuppression • Obesity • Diabetes mellitus • Chronic inflammatory process • Malnutrition • Peripheral vascular disease • Anemia • Radiation • Chronic skin disease • Carrier state (e.g., chronic staphylococcus carriage) • Recent operation • Smoking status (especially for head and neck surgeries) *(Kuri, 2005[B])*	• Poor skin preparation • Contamination of instruments • Inadequate antibiotic prophylaxis • Prolonged procedure • Local tissue necrosis • Hypoxia, hypothermia	• Prolonged hospitalization (leading to nosocomial organisms) • Toxin secretion • Resistance to clearance (e.g., capsule formation)

Many of the same factors that increase a patient's risk of surgical site infection also put the patient at increased risk for development of a pressure ulcer. As part of the physical examination, a risk assessment for the patient's risk of pressure ulcer and prevention planning are also important.

See the ICSI Pressure Ulcer Prevention and Treatment protocol for more information.

Penicillin allergy management

Given that many of the recommendations for surgical prophylaxis are cephalosporins, there is often a concern about giving cephalosporins to patients with known penicillin allergy. When penicillin allergy is identified, often these patients receive agents that should be reserved for treatment of resistant organisms, which contributes to antibiotic resistance.

Current evidence-based practice guidelines for pediatrics endorse the use of certain cephalosporins in patients with reported allergies to penicillins, provided that the reactions are not severe or life threatening. This practice provoked a meta-analysis of data assessing the safe use of cephalosporins in penicillin-allergic patients *(Pichichero, 2007 [M])*.

Previously, the cited rate of cross-reactivity was approximately 10%. This data has now been found to be an overestimate for a number of reasons. The data was collected in the 1960s and 1970s and was based on results from in-vitro testing not supported by clinical skin testing in penicillin-allergic patients. At that time, researchers were not taking into account the threefold increased risk of adverse reaction to any unrelated drugs in patients with a penicillin allergy. The term allergy was also loosely defined and included unspecified rash. In addition, before 1980, first-generation cephalosporins were produced by a mold later found to contain trace amounts of penicillin *(Pichichero, 2007 [M])*.

IgE-mediated reactions (type I hypersensitivity reactions) such as angioedema, laryngeal edema, urticaria and anaphylaxis are the only true allergic reactions and are the only reactions that should be considered when making choices regarding cephalosporin alternatives.

Idopathic drug reactions such as maculopapular or morbilliform rashes can occur in 1%-4% of patients receiving penicillins and cephalosporins *(Pichichero, 2006 [M]; Pichichero, 2005 [R]; Romano, 2004 [D])*. This incidence is reported at a higher rate in children (3%-7%) *(Pichichero, 2005 [R])*. These rashes are most likely not IgE-mediated, although they may be if they occur late in the antibiotic course and are pruritic *(Pichichero, 2006 [M]; Pichichero, 2005 [R])*.

Some viral infections can alter the immune response to antibiotics. A prime example of this is the rash that develops when amoxicillin is given in patients with acute Epstein-Barr virus infection. These rashes are typically maculopapular and pruritic but are unlikely to reoccur with later penicillin class challenge *(Pichichero, 2006 [M]; Pichichero, 2005 [R])*.

While penicillins and cephalosporins do share similarities in their chemical structures, they contain important differences in ring structures, substitution sites and degradation patterns. Based on these differences, there should be minimal immunologic cross-reactivity between these compounds *(Pichichero, 2007 [M])*.

The incidence of cross-reactivity with cephalosporins in penicillin-allergic patients does vary, and depends on similarity in side-chain structure. First-generation cephalosporins do have a potential for cross-reactivity, but at a risk closer to 0.5% (versus the previously quoted 10%). It is now commonly accepted that most second- or third-generation cephalosporins are actually unlikely to be associated with any cross-reactivity based on differences in their chemical structures *(Pichichero, 2007 [M])*.

Current data suggests that patients with a true, documented IgE-mediated allergic reaction to penicillins should not be given cephalosporins with similar side chains, but those with different side chains can be administered safely *(Pichichero, 2007 [M])*.

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Skin testing

The ability of penicillin skin testing to predict cephalosporin allergy is controversial. In order for penicillin skin testing to reliably predict corresponding cephalosporin allergy, the side chains must be similar. Skin testing does not necessarily predict a clinical reaction, as approximately 90% of patients who possess IgE antibodies to penicillin or amoxicillin do tolerate cephalosporins that contain similar or even identical side chains *(Pichichero, 2007 [M])*.

Vancomycin allergy management

Vancomycin allergy is rare. Red-man syndrome, a pruritic, truncal redness, is caused by histamine release with rapid infusion rate. This reaction may be mislabeled as an allergy. Infusion times of 90-120 minutes at usual doses should prevent this reaction.

Perioperative management of multidrug-resistant organisms (methicillin-resistant Staphylococcus aureus)

In order to control or eradicate multidrug-resistant organisms, a number of interventions need to be utilized. Administration must be able to ensure prompt and effective communication of patients known to be colonized or infected with multidrug-resistant organisms, maintain appropriate staffing levels, and enforce adherence to infection control practices (hand hygiene, standard and contact precautions). Patients with known colonization or infection should be assigned priority for a single room (isolation). If this is not possible, cohorting patients with shared multidrug-resistant organisms is an option. Dedication of non-critical medical equipment should be implemented to avoid contamination. While decolonization regimens have not been routinely used to eradicate multidrug-resistant organisms, this option is being studied and reported in the literature. Antimicrobial agents should be used judiciously by increasing use of narrow spectrum agents, treating infections versus contaminants, restricting use of broad-spectrum agents, and avoiding excessive duration of therapy. The use of active surveillance cultures to identify patients colonized with multidrug-resistant organisms (cultures of the nares for methicillin-resistant staphylococcus aureus screening) has been reported as beneficial by some studies, but more research is needed in this area *(Siegel, 2007 [R])*.

Glycemic control

Determination of a patient's glycemic control status is an important factor in preventing surgical site infection. In diabetics, outcomes are improved in patients with preoperative Hgb A1c less than 7; however, there is no data on interventions that establish tight control *(Dronge, 2006 [B])*.

The evidence that strict glycemic control is necessary in patients without diabetes is controversial *(Dellinger, 2001 [X]; Latham, 2001 [C]; Van den Berge, 2001 [A])*.

Recommendations:

- A standardized protocol for preoperative, intraoperative and postoperative glucose monitoring should be implemented.
  - All patients with known diabetes should have baseline blood sugar tested prior to surgery.
  - Selection of patients to monitor intraoperatively (typically hourly) should be made by clinical judgment regarding patient illness, type and length of surgery.
  - An insulin nomogram should be available for treatment of insulin-dependent diabetics and patients undergoing inpatient surgery. A hospitalwide policy for care of these patients should be instituted, including monitoring for resulting hypoglycemia.
  - Tight glycemic control (blood sugar < 110 except parturients, blood sugar < 100), while possibly ideal, adds risks of hypoglycemia to selected patients (increased severity of illness, renal failure, sepsis). In addition, the stress response to surgery and nutritional needs should be considered.

Clinical judgment on a case-by-case basis is best. Some clinicians consider blood sugars in the range of 140-180 to be adequate.

- Outpatients who are found to be severely hyperglycemic (> 200) and are insulin-naïve should be referred to their primary care physician. If insulin is required to be started intraoperatively, overnight stay, observation for hypoglycemia, and plans made for optimizing blood sugar control may be indicated *(Krinsley, 2007 [C]; Nunally, 2005 [X]; American College of Endocrinology, 2004 [R]; Classen, 2004 [NA])*.

Oral hypoglycemic therapy

According to the American College of Endocrinology, oral hypoglycemic medications such as sulfonylureas and thiazolidinediones do not contribute to tight glycemic control and should be avoided in hospitalized patients unless they are eating a regular diet. Many of these medications do not directly affect serum glucose; instead, they increase insulin sensitivity. Metformin, specifically, is used with caution perioperatively due to the potential risk for development of postoperative lactic acidosis *(Martinez, 2007 [X])*.

Preoperative preparation for colon surgery

As a result of pivotal trials performed in the 1970s by Condon, Gorbach and Nichols, surgeons of the last generation have incorporated routine mechanical and oral antibiotic bowel preparations into the practice of surgery on the colon. However, a number of recent trials in the modern era suggest that these two mainstays of preparation may not be necessary.

Mechanical bowel prep: At least 10 randomized control trials have demonstrated no difference in surgical site infection rates for patients receiving mechanical bowel preparation *(Fa-Si-Oen, 2005 [A]; Wille-Jorgensen, 2005 [M])*. Mechanical bowel preparation for patients undergoing colorectal surgery is controversial and at the discretion of the surgeon. The classic dogma requiring a mechanical bowel preparation has been challenged recently, with a number of studies failing to identify a decrease in contamination of the wound after mechanical bowel preparation.

Antibiotic bowel prep: in the era of availability of modern single- and double-agent prophylactic therapy at the time of surgery, an oral antibiotic for bowel preparation the day prior to surgery is controversial and at the discretion of the surgeon *(Nichols, 2005 [R]; Jimenez, 2003 [R]; Zmora, 2001 [M])*.

All patients should receive a dose of intravenous antibiotics at the time of surgery with efficacy against colonic and skin flora.

Patient education

Patient education on the specifics of the procedure, as well as a general orientation, is part of the preoperative evaluation. This includes where possible, written instruction on which medications they should continue to take, how their medications and conditions will be managed during their surgical procedures (anticoagulation bridging, insulin management, etc.), and how long before the surgery to have nothing by mouth.

Patients should be given specific instructions on how to decrease their risk of surgical site infection. These include:

- instructions not to shave or remove any hair at or near the surgical site area;
- cleansing the skin the night before or morning of surgery; and
- for patients with diabetes, instructions on the additional benefit of good glucose control for the prevention of surgical site infections.

There is no evidence stating a specific time frame to tell patients when they should refrain from hair removal at or near the surgical site. Shaving at or near the surgical site more than 24 hours prior to the procedure is documented to increase infection risk *(Mangram, 1999b [R])*.

Patients should cleanse the skin the night before or the morning of surgery to reduce the bacteria load at the surgical site. There is insufficient evidence to support that having patients use an antiseptic agent reduces the risk of infection; their doing so is at the discretion of the surgeon *(Edwards, 2006 [M])*.

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2. Patient Arrives (Patient, Procedure and Site Verification)

The American Society of PeriAnesthesia Nurses is responsible for defining and establishing the scope and Standards of Practice for perianesthesia nursing. This includes care of patients prior to admission and care the day of surgery.

Patient, Procedure and Site Verification

With the patient awake and aware if possible, the clinicians involved in the care of the patient will confirm the patient's identity, procedure and site by comparing the following:

- Patient's identity, using two approved identifiers
- Procedure name and site as documented on the informed consent
- Information in the medical record
- Diagnostic studies
- Discussion with the patient/legal guardian

Each time a new member of the clinical team is introduced to the patient, the patient's identity, procedure and site should be verified. Ideally, a checklist is used to document each clinician's verification.

Ultimate responsibility for procedure and site verification lies with the surgeon/clinician performing the procedure.

Glycemic Planning and Management

Refer to recommendations in Annotation #1, "Preoperative Evaluation and Surgical Planning and Scheduling."

Antibiotic Selection (may have been done pre-arrival) and Administration as Appropriate

Antibiotic choice is based on the activity against the normal flora associated with the surgical site and addressing specific patient factors such as methicillin-resistant staphylococcus aureus status *(Medical Letter, Treatment Guidelines, 2006 [R]; Bratzler, 2005a [R]; Prokuski, 2005 [R])*.

Per the Treatment Guideline from the Medical Letter for Antimicrobial Prophylaxis for Surgery, "the need for prophylaxis in breast surgery, herniorrhaphy and other 'clean' surgical procedures has been controversial. Medical Letter consultants generally do not recommend surgical prophylaxis for these procedures because of the low rate of infection and the potential adverse effects of prophylaxis in such a large number of patients; some recommend prophylaxis for procedures involving placement of prosthetic material (e.g., synthetic mesh, saline implants, tissue expanders)" *(Medical Letter, Treatment Guidelines, 2009 [R])*.

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Endocarditis

Prophylaxis to prevent infective endocarditis is limited to those patients with cardiac conditions at highest risk for adverse outcomes from infective endocarditis. The 2007 AHA guidelines recommend prophylactic antibiotics for high-risk patients before procedures likely to result in bacteremia with a microorganism that has the potential to cause endocarditis, such as dental procedures, those involving the respiratory tract, procedures involving ongoing gastrointestinal or genitorurinary tract infections and/or if the procedure involves manipulation of infected skin or musculoskeletal tissue. Patients with the following cardiac conditions meet this criterion and are considered high-risk:

- Prosthetic material used for valve repair
- A history of infective endocarditis
- Valvulopathy in cardiac transplant patients
- Unrepaired cyanotic congenital heart disease
- Repaired congenital heart disease if prosthetic material was used (first six months after procedure only)
- Repaired congenital heart disease with prosthetic material or device if an adjacent residual defect remains that prevents endothelialization

Recommended antibiotics are amoxicillin or cephalexin prior to procedure for B-hemolytic streptococci and staphylococci. Clindamycin is advised if patient has allergy to amoxicillin or cephalexin *(Wilson, 2007 [R])*.

Other procedures in patients with previous total joint replacement

There is no evidence to suggest that patients with existing prosthetic joints undergoing procedures should receive antibiotic prophylaxis in the absence of other indications. There are various expert opinions on use of antibiotics in certain cutaneous or urologic procedures and in patients with high risk for infection, but no clinical trials to support their use. The decision to use prophylactic antibiotics in the absence of other indications must be based on clinical judgment and may be considered for patients who are at increased risk for infection *(Kuong, 2009 [R])*.

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Procedure Type/Surgical Site	Common Pathogens	Antibiotic Choice[1]	Alternative to First Choice When IgE Allergy Present
Cardiovascular	S.epidermidis S.aureus	cefazolin or cefuroxime (intranasal mupirocin the night before, day of surgery and BID x 5 days if nares positive for MRSA)	vancomycin or clindamycin
Gastroduodenal High risk only[2]	Enteric gram-negative bacilli, gram positive cocci	cefazolin or cefotetan or cefoxitin or ceftizoxime or cefuroxime	clindamycin + (ciprofloxacin, levofloxacin, gentamicin or aztreonam)
Biliary tract High risk only[3]	Enteric gram-negative bacilli, enterococci, clostridia	cefazolin or ceftizoxime	clindamycin + (ciprofloxacin, levofloxacin, gentamicin or aztreonam)
Endoscopic retrograde chlangiopancreatography (ERCP) (no antibiotic needed without obstruction)	Enteric gram-negative bacilli, enterococci, clostridia	If obstruction or possible incomplete drainage: ciprofloxacin or ceftizoxime or piperacillin/tazobactam	clindamycin + (ciprofloxacin, levofloxacin, gentamicin or aztreonam)
Colorectal, includes appendectomy[4]	Enteric gram-negative bacilli, anaerobes, enterococci	cefazolin + metronidazole cefoxitin or cefotetan or ampicillin-sulbactam or ertapenem[5]	clindamycin + (ciprofloxacin, levofloxacin, gentamicin or aztreonam) or metronidazole + aztreonam + (ciprofloxacin, levofloxacin or gentamicin)
Head and neck (Antibiotics appear efficacious only for procedures involving oral/pharyngeal mucosa. Uncontaminated head and neck surgery does not require prophylaxis.)	Anaerobes, enteric gram-negative bacilli, S.aureus	clindamycin or cefazolin + metronidazole	gentamicin + clindamycin
Neurosurgical	S.aureus, S.epidermidis	cefazolin	vancomycin or clindamycin
Orthopedic[6]	S.aureus, S.epidermidis	cefazolin or cefuroxime or ceftriaxone	clindamycin or vancomycin
Urologic (anibiotics needed only if preoperative bacteriuria [positive culture or unavailable] or preop catheter)	Enteric gram-negative bacilli, enterococci	Preoperative bacteriuria: cefazolin every 8 hours for 1 to 3 doses perioperatively followed by oral antibiotic (nitrofurantoin or TMP-SMX until catheter removed or for 10 days Trans-rectal prostate biopsy: ciprofloxacin 500 mg by mouth 2 hours before biopsy and repeated 12 hours after	
Obstetric/gynecologic	Enteric gram-negative bacilli, anaerobes, Gp B strep, enterococci	laproscopic, vaginal or abdominal hysterectomy: cefazolin or cefoxitin or cefotetan or cefotetan or cefuroxime or ampicillin-sulbactam Caesarean: cefazolin	Clindamycin + (ciprofloxacin, levofloxacin, gentamicin, or aztreonam)
Ophthalmic	S.epidermidis, S.aureus, streptococci, enteric gram-negative bacilli, Pseudomonas spp.	Multiple drops topically over 2-24 hrs: gentamicin, tobramycin, ciprofloxacin, gatifloxacin, levofloxacin, moxifloxacin, ofloxacin, or neomomycin-gramicidin-polymyxin B, cefazolin, providone-iodine	
Thoracic (non-cardiac)	S.aureus, S.epidermidis, streptococci, enteric gram-negative bacilli	Cefazolin or cefuroxime	Vancomycin
Vascular	S.aureus, S.epidermidis, enteric gram-negative bacilli, clostridia	Cefazolin	Vancomycin

The information in this table was compiled from The Sanford Guide to Antimicrobial Therapy 2009, and Treatment Guidelines from the Medical Letter, Antimicrobial Prophylaxis for Surgery 2009 and is current as of August 31, 2010. For the most up-to-date medication and prescribing information, consult with your pharmacist or consider the following sources: www.micromedex.com, www.uptodate.com and The Sanford Guide to Antimicrobial Therapy.

1. New guidelines are recommending only a **single dose** of antibiotics for procedures lasting **less than four hours**. In procedures lasting more than four hours or those with major blood loss, intra-operative re-dosing should occur every one to two half-lives of the antibiotic in patients with normal renal function *(Med Letter Treatment Guidelines 2009 [R]; Fonseca, 2006 [B]).*
2. High-risk patients for infection include esophageal obstruction, morbid obesity, reductions in gastric acidity or gastric motility (due to obstruction, hemorrhage, gastric ulcer, malignancy, or proton pump inhibitor therapy). Not indicated for routine gastroesophageal endoscopy.
3. High-risk patients include greater than 70 years, acute cholecystitis, a non-functioning gallbladder, obstructive jaundice, common bile duct stones with cholangitis, treat as infection, not prophylaxis.
4. In the era of availability of modern single- and double-agent prophylactic therapy at the time of surgery, an oral antibiotic for bowel preparation the day prior to surgery is at the discretion of the surgeon *(Nichols, 2005 [R]; Jimenez, 2003 [R]; Zmora, 2001 [M]).*
5. The 2009 Medical Letter guidelines advise against the routine administration of carbapenems for surgical prophylaxis because widespread use of these drugs may result in increased rates of resistance.
6. If a tourniquet is used in procedure, the entire dose of antibiotic must be infused prior to its inflation.
7. Single-dose antibiotic prophylaxis with amoxicillin/clavulonic acid reduced wound related infections and problems after groin incision varicose vein surgery, thus should be considered for this procedure *(Mekako, 2010 [])*.

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Antibiotic Administration Infused within 60 Minutes Prior to Incision

Antibiotics should be administered so that the bactericidal concentration is present in the tissues at the time of incision. For most antibiotics, that concentration is reached 30 minutes after infusion. Vancomycin and fluoroquinolone infusion should be initiated within 120 minutes prior to incision due to a longer infusion time.

Normothermia Planning and Management

The American Society of Anesthesiologists' Practice Management Guidelines for perioperative normothermia document consequences of "even mild hypothermia (one to two degrees C below normal)" as:

- prolonged drug action and delayed recovery and hospital discharge *(Lenhardt, 1997 [A]; Leslie, 1995 [D]; Heier, 1991 [C])*,
- post-anesthetic shivering and thermal discomfort *(Kurz, 1995 [A]; Sessler, 1991 [D])*,
- increased susceptibility to infection *(Melling, 2001 [A]; Kurz, 1996 [A]; Bremmelgaard, 1989 [C])*,
- impaired coagulation and increased transfusion requirements *(Winkler, 2000 [A]; Schmied, 1996 [A])*, and
- cardiovascular stress and cardiac complications *(Persson, 2001 [A]; Frank, 1997 [A]; Frank, 1995a [D]; Frank, 1995b [A])*.

The causes of perioperative hypothermia include:

- anesthetic-induced impairment of thermoregulatory control,
- body cavities and organs exposed to cool operating/procedure room environment *(Roe, 1971 [D])*, and
- core-to-peripheral redistribution of body heat *(Matsukawa, 1995 [D])*.

Recommendations:

Temperature should be monitored in all patients receiving anesthesia when significant changes in body temperature are intended, anticipated or suspected *(ASA Standards, Guidelines, and Statements, 2007 [R])*. Many means to monitor temperature exist with varying levels of accuracy and ease of use. These include oral, tympanic membrane, esophageal, axillary, skin, bladder, rectal, trachea, nasopharynx, and pulmonary artery catheters. The choice of the site depends on access, type of surgery and accuracy.

Considerations:

- There is evidence that suggests alternative active warning measures to maintain body temperature, including control of ambient temperature, administration of warmed intravenous fluids, and surface warming with forced hot air, warmed gel pads, radiant heat, warmed blankets or circulating water mattresses. The choice of modalities is a medical judgment made by the anesthesiologist considering the patient and procedural issues in an individual case.
- An effective means of maintaining perioperative normothermia is prevention through prewarming.
- Achievement of an immediate postoperative temperature greater than 36°C is an important, beneficial, and realistic goal for patients undergoing general anesthesia lasting more than 60 minutes.
- Core temp is best measurement tool. Oral temperature measurement is recommended as best practice method when core thermometry is not possible.
- Intraop all patient's should receive limited skin exposure, passive warming measures, ambient room temp maintained from 20°-25°C.

- If the procedure is anticipated to be less than 30 min. and/or patient is at risk for hypothermia or its complications, active forced air warming should be implemented.

(Hooper, 2009 [R])

Methicillin-Resistant Staphylococcus Aureus Planning and Management

Refer to Annotation #1, "Preoperative Evaluation and Surgical Planning and Scheduling."

Venous Thromboembolism Prophylaxis Planning and Management

The American College of Chest Physicians recommends that hospitals develop a formal, active strategy to prevent the occurrence of venous thromboembolism *(Geerts, 2008 [R])* in the surgical patient. All patients undergoing surgery should be assessed for their risk of thromboembolism utilizing a standard risk assessment tool. Determination of the best mechanism for prevention of venous thromboembolism (mechanical and/or pharmacologic) should be made based on individual patient risk level *(AORN Journal, 2007 [R])*.

General recommendations from the American College of Chest Physicians Guidelines include the following *(Geerts, 2008 [R])*:

- The use of mechanical methods of thromboprophylaxis primarily in patients who are at high risk of bleeding or as a potential adjunct to anticoagulant-based thromboprophylaxis.
- The use of aspirin alone as thromboprophylaxis for venous thromboembolisn (VTE) in any patient group.
- For elderly patients with diabetes mellitus and those at high risk for bleeding, renal function should be evaluated when making decisions about the use and/or the dose of low-molecular-weight heparin (LMWH), fondaparinux and other antithrombotic drugs.
- Appropriate patient selection and caution should be used when choosing anticoagulant thromboprophylaxis for patients undergoing neuraxial anesthesia or analgesia due to the risk of spinal hematoma.
- All major trauma patients should receive thromboprophylaxis including LMWH, unless there is a major contraindication.

For more specific recommended prophylaxis based on surgery type, refer to the ICSI Venous Thromboembolism Prophylaxis guideline.

In all high-risk or complex cases, and in particular with patients who are on pharmacologic anticoagulation therapy in the outpatient setting, we recommend that the surgeon, anesthesiologist and cardiologist/internist, if appropriate, discuss VTE prophylaxis strategies to be utilized in the perioperative and postoperative periods. One such example is the decision whether or not to stop antiplatelet therapy in patients with drug-eluting stents and the relatively high risk of the patient experiencing perioperative stent thrombosis (29%) with accompanying mortality (20%-45%) *(Grines, 2007 [R])*.

It is recommended that hospitals establish a protocol for emergency access to interventional cardiology for coronary revascularization if needed for stent thrombosis.

Interruption of Vitamin K Antagonist Therapy:

Refer to the American College of Chest Physicians guidelines for perioperative management of antithrombotic therapy during temporary interruption of vitamin K antagonist therapy *(Douketis, 2008 [R])*.

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Patients with mechanical heart valve/atrial fibrillation/venous thromboembolism:

- High risk for thromboembolism: recommend bridging with therapeutic-dose of LMWH or UFH over no bridging.
- Moderate risk for thromboembolism: recommend bridging with therapeutic dose of LMWH, UFH or low-dose LMWH over no bridging.
- Low risk for thromboembolism: recommend low-dose LMWH or no bridging over bridging with therapeutic-dose LMWH or UFH.

Refer to ICSI Antithrombotic Therapy Supplement guideline for specific recommendations regarding bridging regimens.

Refer to ICSI Preoperative Evaluation guideline for further information on management of specific comorbidities.

Refer to Centers for Medicare and Medicaid Services (CMS) and The Joint Commission (JC) Surgical Care Improvement Project (SCIP) Care Measure VTE Prophylaxis guidelines at http://www.jointcommission.org.

Beta-Blocker Planning and Management

Beta adrenoreceptor antagonists (beta-blockers) have been studied for their role in prevention of cardiac complications surrounding surgical procedures. These medications reduce heart rate and contractility, therefore increasing perfusion and decreasing oxygen demand. These effects may play a role in stabilizing vulnerable coronary plaques and reducing inflammation via decreased sympathetic tone *(Mason, 2006 [R])*.

Current literature suggests that perioperative ischemia, risk of myocardial infarction, and death may be reduced by beta-blocker use in high-risk patients. There is evidence to strongly suggest starting beta-blockers days to weeks before elective surgery, although this has not been proven true. Goal heart rate should be titrated to a resting heart rate of 60-80 beats per minute in the absence of hypotension *(Fleisher, 2009 [R])*. The Poise Trial has indicated that benefits may not outweigh risks of beta-blocker regimes in non-selected patient populations *(POISE Study Group, 2008 [A])*.

A recent meta-analysis was performed in order to explore the negative outcomes concluded by the POISE trial. Use of long-acting beta-blockers, titration to low goal heart rates and initiation of beta-blocker therapy immediately before surgery are being discussed as possible explanations for the higher risks found in POISE *(van Lier, 2010 [M])*.

The most recent ACC/AHA Guidelines on Perioperative Cardiovascular Evaluation and Care for Non-Cardiac Surgery (released 2007) have been updated in 2009. ACCF/AHA provided a focused update on perioperative beta-blockade, and incorporated this update into the exisiting 2007 guidelines. The following recommendations are provided by the updated guidelines:

Class I: Beta-blockers should be continued in patients undergoing surgery who are receiving beta-blockers for treatment of conditions with ACCF/AHA Class I guideline indications for the drugs

Class IIa:

Beta-blockers titrated to heart rate and blood pressure are:

- probably recommended for patients undergoing vascular surgery who are at high cardiac risk owing to coronary artery disease or the finding of cardiac ischemia on preoperative testing;
- reasonable for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than one clinical risk factor; and

- reasonable for patients in whom preoperative assessment identifies coronary artery disease or high cardiac risk, as defined by the presence of more than one clinical risk factor, who are undergoing intermediate-risk surgery.

Class IIb:

The usefulness of beta-blockers is uncertain in patients undergoing:

- either intermediate-risk procedures or vascular surgery in whom preoperative assessment identifies a single clinical risk factor in the absence of coronary artery disease, and
- vascular surgery with no clinical risk factors who are not currently taking beta-blockers.

Class III:

- Beta-blockers should not be given to patients undergoing surgery who have absolute contraindications to beta-blockade.
- Routine administration of high-dose beta-blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta-blockers who are undergoing non-cardiac surgery.

(All recommendations taken directly from Fleisher 2009 – ACCF/AHA update to 2007 ACC/AHA perioperative guidelines.)

For further reference, see Appendix F, "Beta-Blocker Table."

Recommendations:

1) Each patient should be evaluated for his/her Revised Cardiac Risk Index *(Lee, 1999 [B])*.
   a) High-risk surgery (orthopedic, intraperitoneal, vascular, intrathoracic)? Yes____No____
   b) Ischemic heart disease? Yes____No____
   c) Cerebral vascular disease? Yes____No____
   d) Renal insufficiency (Creatinine > 2.0)? Yes____No____
   e) Diabetes (insulin dependent diabetes mellitus or non-insulin dependent diabetes mellitus? Yes____No____
   f) Congestive heart failure? Yes____No____
2) If patient scores more than two "yes" answers, start one of following protocols:
   a) Atenolol 25-50 mg oral daily x three weeks; start one week preoperative. Clinician's judgment regarding size and age of patient.
   b) Metoprolol 25 mg oral twice daily x three weeks, start one week preoperative (note slight reduction in risk with atenolol versus metoprolol *(Redelmeier, 2005 [B])*
   c) Patient already on beta-blockers; continue.
   d) Unable to use beta-blockers, consider clonidine (0.2 mg oral night before surgery and morning of surgery, or clonidine TTS #2 Patch (0.2 mg/24 hrs) applied night before surgery).
   e) Metoprolol 5 mg intravenous as needed perioperatively. Continue on metoprolol 25 mg twice daily for 10-14 days postoperatively.

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f) Risks/benefits information to patient as well as contact person for problems (primary care physician).

3) Goal is heart rate control around 60-80 beats per minute.

(Beattie, 2008 [M]; Wallace, 2008 [X]; Fleisher, 2007 [R]; Redelmeier, 2005 [B])

The work group acknowledges that studies have proven beta-blocker use beneficial in high-risk patients. Studies are needed, however, in the areas of target population, duration of preoperative titration, and route of administration. Research also needs to be done to explore the negative outcomes associated with perioperative beta-blocker use in low-risk patients *(Fleisher, 2007 [R])*.

Perioperative Statin Therapy

Current ACC/AHA guidelines provide recommendations regarding perioperative statin use. Observational studies have shown statins to be potentially cardio-protective surrounding non-cardiac surgery. A study released in the *New England Journal of Medicine* in September 2009 concluded perioperative fluvastatin therapy was associated with an improvement in cardiac outcome in patients undergoing vascular surgery *(Schouten, 2009 [A])*. The work group acknowledges that perioperative statin use may benefit select patients, but research needs to be continued in order to identify target patients, optimal statin doses, and optimal target lipoprotein levels. The perioperative period is an opportunity for health care providers to impact long-term health, and assessing the need for statin therapy may be one avenue by which to do so. Specific ACC/AHA recommendations:

Class I:

For patients currently taking statins and scheduled for non-cardiac surgery, statins should be continued.

Class IIa:

For patients undergoing vascular surgery with or without clinical risk factors, statin use is reasonable.

Class IIb:

For patients with at least one clinical risk factor who are undergoing intermediate-risk procedures, statins may be considered *(Fleisher, 2007 [R])*.

Perioperative calcium channel blockers

Current ACC/AHA guidelines refer to 2003 meta-analysis that showed calcium channel blockers to be associated with trends toward reduced death and myocardial infarction, and reductions in ischemia and supraventricular tachycardia. This meta-analysis concluded that larger scale trials are necessary in order to define the value of calcium channel blockers perioperatively *(Fleisher, 2007 [R])*.

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3. Environmental Controls/Infection Control/Operating/Procedure Room Survey

The following recommendations for surgical staff are based on experimental, clinical or epidemiological studies, or theoretical rationale and are supported by consensus statements of several professional organizations *(Association of Operating Room Nurses, 2006 [R]; Boyce, 2002 [R]; Mangram, 1999a [R])* or federally regulated *(Wallace, 2008 [X]; U.S. Department of Labor, 2006 [R]; Centers for Disease Control, 2001 [R])*.

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Recommendations for Surgical Staff

Hand hygiene

- Skin is a major potential source of microbial contamination.
- Hand hygiene is a critical step in prevention and spread of infection. It is the single most important step in the prevention of infection. General hand hygiene should be performed before and after each patient contact, after glove removal, following any contact with blood or other infectious materials, before and after eating, and after using the restroom. Wash with soap and water with mechanical friction for 15 seconds. If hands are not soiled, a waterless alcohol preparation may be used. Waterless alcohol preparations reduce more organisms on the hands than soap and water alone *(Boyce, 2002 [R])*.
- Fingernails should be short, clean and healthy. Nail polish should not be chipped. Association of Peri-Operative Registered Nurses recommends that artificial nails not be worn. Artificial nails can make it more difficult to eliminate bacteria from under the nails. Strict adherence to appropriate hand washing and the use of alcohol-based cleansers is critical to reducing the risk of surgical site infection from organisms transferred by health care worker hands, either with or without artificial nails *(McNeil, 2001 [C])*.
- Cuticles, hands and forearms should be free of open lesions and breaks. This presents a risk for exposure to blood-borne pathogens for both patients and personnel.
- All jewelry must be removed.
- Surgical hand antisepsis (surgical scrub) is performed to significantly reduce the number of microorganisms on the hands and forearms of scrubbed members of the surgical team.
- Antiseptic agents should be limited to those that are Federal Drug Administration compliant, have a documented ability to kill organisms upon application, provide persistence to reduce regrowth and have a cumulative effect over time. (Alcoholic chlorhexidine has been shown to have the greatest residual effect.) Studies have measured bacterial colony counts; no trials have evaluated the impact of scrub agent choice on surgical site infection. Alcohol is the European gold standard; 7.5% povidone-iodine and 4% CHG are the United States agents of choice.

Management of surgical personnel

- Educate and encourage staff to report promptly to their supervisor if they have signs and symptoms of a transmissible infectious illness.
- Develop policies on reporting illness, work restrictions and work clearance following an illness.
- Culture and exclude from direct patient care surgical personnel who have exudative skin lesions or weeping dermatitis until infection has been ruled out or therapy resolves it.
- All personnel who might be exposed to blood-borne pathogens should receive the hepatitis B vaccine unless medically contraindicated *(U.S. Department of Labor, 2006 [R]; Centers for Disease Control, 2001 [R]; Centers for Disease Control, 1991 [R])*.
- Personnel participating in exposure-prone procedures or postoperative cleaning and processing of exposure-prone equipment (as identified by the institution) should know their human immunodeviciency virus status. Those who do not have serologic evidence of immunity to HBV should know their HbsAg status, and if positive, should know their HbeAg status *(Centers for Disease Control, 1991 [R])*.
- Personnel who are infected with human immunodeficiency virus or HBV (and HbeAg positive) should not perform exposure prone procedures or postoperative cleaning and processing of exposure-prone

equipment (as identified by the institution) unless they have been advised they may continue to perform these procedures as determined by an expert review panel *(Centers for Disease Control, 1991 [R])*.

- Mandatory testing of personnel for human immunodeficiency virus or HBV is not recommended *(Centers for Disease Control, 1991 [R])*.
- It is not necessary to exclude personnel who are colonized with organisms such as staphylococcus aureus or group A Streptococcus unless they are linked to an outbreak.

Recommendations for operating/procedure room environmental controls

Operating/procedure room environmental controls are mandated and regulated by each state's department of health. For specific recommendations from the Minnesota Department of Health, see:

http://www.health.state.mn.us/

Management of operating/procedure room surfaces

- Operating/procedure room surfaces (tables, floors, walls, etc.) have rarely been shown to be the source of surgical infection for patients.
- Routine cleaning practices are important to return the operating/procedure room to a clean state after each procedure.
- Operating/procedure room surfaces that are visibly soiled or contaminated with potentially infectious material should be cleaned with an EPA-approved hospital disinfectant before the next procedure.
- Cleaning of all operating/procedure room surfaces with an EPA-approved hospital disinfectant is routinely performed after the last procedure.
- Routine microbial sampling of operating/procedure room surfaces is not recommended. Microbial sampling should be reserved for epidemiologic investigations.

Sterilization of operating/procedure room devices

- Inadequate sterilization of surgical instruments has resulted in surgical infections, and routine monitoring of the quality of the sterilization process is recommended.
- Surgical devices may be sterilized by:
  - **Steam under pressure**

    Microbial monitoring of steam autoclave performance is necessary and organizations should follow the manufacturer's recommendations and regulations established by their state's department of health.
  - **Peractic acid**
  - **Plasma hydrogen perioxide**
  - **Cold sterilants**
  - **Dry heat**
  - **Ethylene oxide**
  - **Flash sterilization**

Use of flash sterilization should be kept to a minimum. Flash sterilization should be used only in selected clinical situations and in a controlled manner.

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Flash sterilization may be associated with increased risk of infection to patients because of pressure on personnel to eliminate one or more steps in the cleaning and sterilization process. Proper decontamination is essential in removing bioburden and preparing an item for sterilization by any method. Failures in instrument cleaning have resulted in transmission of infectious agents.

Flash sterilization should be used only when there is insufficient time to process by the preferred wrapped or container method. Flash sterilization should not be used as a substitute for sufficient instrument inventory.

System Approaches to the Identification and Surveillance of Surgical Site Infections

Surveillance of surgical site infection with appropriate data to surgeons is an important step to decreasing surgical site infections. Between 12% and 84% of surgical site infections are detected after patients are discharged *(Mangram, 1999a [R])*. The difficulty is not only the identification of surgical site infections in patients who have been discharged or received care outside of the care system, but having the staff and resources for effective surveillance processes.

Surveillance systems need to be simple, with reliable data. The following areas are crucial for an effective surveillance system:

- Use standardized definitions for surveillance of infections. These definitions also need to take into account the setting in which the surgical procedure was performed (acute care, ambulatory surgical center, etc.).
- Establish an effective surveillance process that includes post-discharge or outpatient surveillance. A strong post-discharge surveillance process is becoming more important as hospital stays shorten and more surgical procedures are performed in other care settings.
    - Use inpatient case-finding for post-discharge or outpatient.
    - Surveillance will result in underestimations of many surgical infections rates.

Important surveillance can consist of direct and indirect observation. Direct methods include observation of the surgical site by the surgeon, trained nurse surveyor, or infection control practitioner for the identification of surgical site infection. Indirect methods consist of review of lab reports, patient records and interactions with caregivers.

Post-discharge surveillance can include direct examination of the patient's wound during follow-up physician visits, review of medical records of surgery clinic patients, patient surveys by mail or telephone, or surgeon surveys. At present, there is no standard method for performing surgical site infection surveillance outside the hospital *(Janelle, 2004 [R])*. Some studies show that utilizing automated claims data and pharmacy data improves the possible detection of surgical site infections and is less resource intensive over more traditional surveillance systems *(Yokoe, 2004 [B]; Platt, 2002 [B])*. The use of pharmacy data for antibiotic exposure in the absence of standard definitions and criteria for determining possible surgical site infections is insufficient for surveillance systems.

Operating/Procedure Room Survey Performed by Circulator Prior to Baseline Count

The operating/procedure room survey is a safety check done to ensure that all items associated with a previous patient and procedure are removed from the operating suite or room. This is done after the patient has left the operating/procedure room.

The circulating nurse will be the designated person in charge of the survey. Other surgical team members including scrub personnel, anesthesia personnel, surgical assistants and housekeeping will be expected to assist in this process. The circulating nurse will be the final designee expected to do the final survey of the room prior to preparation for the next patient and procedure including the first procedure of the day.

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The room survey includes, but is not limited to, the following considerations:

- Remove all items related to the previous patient.
- Remove any paper or electronic medical records, labels or imaging films.
- Verify that the white board and other record-keeping documents are clean and do not contain information from the previous procedure. The exception is the documentation required from a previous case when there was a missing item that was never recovered.
- Observe for any personal items of the patient. Examples include hearing aids, eyeglasses, dentures, clothes or any medical devices such as braces or assistive devices. These items may have been left with family members or may have been brought to the operating/procedure room with the patient.
- Check all receptacles, particularly those used for sponges. Ensure they are empty and that depending on the method of disposal, all items or bags from the previous procedure are removed from the room.
- Remove any equipment or supplies from the previous procedure that will not be needed for the next procedure.

Does Circulator Perform Room Survey Prior to Baseline Count?

If the circulator does not perform the room survey prior to the baseline count, then there is the potential for the baseline count to be compromised. In the event that the circulator does not perform the room survey prior to the baseline count, then all counts may be considered compromised and an image may be obtained at the close of the case.

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4. Pre-Procedure Planning and Preparation (Equipment, etc.)

Pre-procedure planning and preparation include those activities done at various times prior to the procedure to ensure preparedness for the patient and procedure. This includes:

- The circulating and scrub review the surgeon orders, equipment requests, preference cards and any other information that will contribute to the specific preparation required for the patient and procedure.
- Preparation is carried out for special patient needs including positioning requirements, allergies, height, weight, etc.
- Prepare the room, ensuring all is in working order including such items as operating/procedure room table, lights, tourniquet and microscope.
- Limit the number of receptacles for discarded items, particularly for sponges.
- Confirm that all needed instruments and implants are available and ready.
- Confirm that all staff needed for the procedure are available and ready. This may include residents, hemodynamic staff or company representatives.

Refer to Annotation #15, "Briefing," for related discussion.

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5. Structured Hand-Off for Any Surgical Personnel Changes

During the perioperative period, care is serially assumed by various individuals. It remains extremely important to fully communicate patient-relevant information and pertinent problems each step of the way. A transfer of care occurs when one health care provider transfers responsibility for the patient's care to another health care provider. This occurs from pre-anesthesia to hospital discharge. Each care team is obligated to remain in close physical proximity to the patient as long as medically necessary until the receiving health care provider has all the information needed to assume care. Dialogue between the health care providers must be verbal and face to face.

To increase efficiency and consistency in the exchange of information, it is recommended that a standard format be developed for giving "report" from one health care provider to another. This includes, but is not limited to, patient name, procedure, medications given and to be given, pertinent problems, allergies, fluid status, cardiorespiratory status and laboratory values received or pending. The receiving health care provider must be given the opportunity to ask questions and receive answers. It is STRONGLY recommended that this information be given verbally person to person, e.g., for transfer of the patient from the operating/procedure room or post-anesthesia care unit to the intensive care unit, physician-to-physician personal communication is optimal rather than information given through one or more intermediaries *(Guidelines for Patient Care in Anesthesia, 2007 [R])*.

Structured Hand-off Process

A structured hand-off is a standardized method of communication to ensure a complete exchange of information occurs when the patient is transitioned from health care provider to health care provider; whether or not that transition includes a geographic change.

The kind of information that should be provided during the transition includes the following:

- Patient name
- Type of procedure to be performed, being performed, or performed
- Critical test results
- Patient status
- Recent/anticipated changes in patient condition
- Plan of care/goals
- What to watch for in next interval of care

Preoperative Care Areas: utilize the hand-off process when transferring the care of a patient to the preoperative holding area and for shift changes or break relief.

Examples: Inpatient registered nurse to preoperative holding registered nurse
Preoperative registered nurse to preoperative registered nurse

Intraoperative Care Area: utilize the hand-off process with intraoperative personnel during shift changes, break relief, or when there is an addition or change to the surgical team.

Examples: Anesthesia provider to anesthesia provider
Circulator to circulator
Scrub to scrub
Resident surgeon to attending surgeon and vice versa
Attending surgeon to attending surgeon
Resident surgeon to resident surgeon

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Postoperative Care Area: utilize the hand-off process when transferring the care of a patient and for shift changes or break relief.

Examples: Anesthesia provider to same day surgery/post-anesthesia care unit personnel
Anesthesia provider to in-patient unit nurse
Post-anesthesia care unit registered nurse to post-anesthesia care unit registered nurse
Post-anesthesia care unit registered nurse to in-patient unit nurse
Physician to physician

See Resources Table for Surgical Care Tool Kit for Hand-Off Tools.

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6. Surgical Site Marking with Initials

All personnel (e.g., preoperative nurse, circulating nurse, surgeon, and/or clinician designees, and anesthesia practitioner) involved in the surgical procedure must take an active role in this process. If at any time a particular section of the protocol is not required (e.g., site marking), the other verifications and consent steps still apply.

Documentation of each step of the verification process is required. A single, consistent form/checklist or process within the electronic medical record system is recommended. Refer to Resources Table for Surgical Care Tool Kit for example.

Site Marking by Surgeon

The surgeon will verify the patient's identity and the correct site of the surgical procedure: the surgeon and will mark the surgical site with his/her ***initials***. Prior to marking, the surgical site location will be confirmed through a review of:

- procedure and site identification information in the informed consent documentation,
- information in the medical record,
- diagnostic studies, and
- discussion with the patient/legal guardian.

If there is a discrepancy regarding procedure and/or site in any of these information sources, the team will work together to resolve the discrepancy with relevant diagnostic sources before marking the site and proceeding with the case.

The initials indicating the surgical site will be written using an indelible surgical marker and will be **visible when the patient is positioned and draped.**

The work group recommends the use of an anatomical diagram when the surgeon's initials are not visible because of drapes or if it is not possible to mark the physical site.

Sensitive site marking – when there is a site sensitive area, mark the site on the correct operative side, directly above the site. Ensure that this marking is visible through drapes or use an anatomical diagram if it will not be visible.

For multiple sites/digits on the same anatomical site – the procedures should be numbered on the informed consent documentation and the sites marked with the appropriate corresponding number, along with the surgeon's initials.

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For procedures involving laterality – the informed consent documentation will indicate the laterality and the site will be marked accordingly.

Laterality also applies to procedures that have a midline or orifice entry but the internal target location involves laterality. The laterality for procedures entered via midline or orifice entry will be indicated on the informed consent documentation and will be marked on an anatomical diagram. See the definition for Site for more information.

Both sites will be marked for bilateral procedures.

For procedures involving level (spine or ribs) – the informed consent documentation will indicate the laterality and level, and the site will be marked in a way to indicate anterior or posterior, and general level (cervical, thoracic, lumbar, or rib number). An intraop radiographic image will be taken to confirm the exact surgical site.

Teeth – mark the operative tooth (teeth) on the dental radiographs or dental diagram.

Premature infants for whom the mark may cause a permanent tattoo. All infants under the corrected gestational age of 38 weeks should not be marked. It is recommended that the surgical site be marked on an anatomical diagram.

Situations where marking the site would cause the patient harm (e.g., emergency procedures and unstable back fractures) – the site should not be marked and the rationale documented in the patient record.

Patient refusals – the surgical/procedural site should be marked on an anatomical diagram in the event a patient refuses a site marking.

Exceptions to skin site marking

Midline structures

- Single organ cases without laterality
- Endoscopies without intended laterality
- Procedures where the insertion site is not predetermined.
- Caesarean sections

The procedure must have the exception to site marking documented in the patient record and "Not Applicable" or "NA" should be written in the patient record for a surgical/procedural site not requiring a mark. The other verifications and consent steps still apply.

Site marking in multiple procedure cases involving multiple surgeons who cannot all mark their respective site(s) before patient is transported to operating/procedure room

For some cases, multiple surgeons are scheduled to perform independent procedures on the same patient. Sometimes they are not all able to visit the patient to mark their respective site(s) before the patient is transported to the operating/procedure room. In lieu of marking the physical site, these surgeons will mark the surgical site on an anatomical diagram. (They will follow the site marking protocol before marking the diagram: The patient's chart and affirmation of informed consent will be checked, the relevant image[s] will be consulted where appropriate, and the patient and/or patient's representative[s] will be consulted, if available, before marking the anatomical diagram. A discrepancy between these information sources will be resolved before marking the site on the anatomical diagram.) Each diagram featuring the relevant site marking will be included in the patient's chart and will be referenced in the operating/procedure room during the Time Out for that particular procedure. A Time Out must be performed just prior to the onset of each procedure.

Individual facilities are encouraged to consider and interpret the 2009 National Patient Safety Goal recommendations (effective January 2009) that state:

Elements of Performance for UP.01.02.01

1. *For all procedures involving incision or percutaneous puncture or insertion, the intended procedure site is marked. The marking takes into consideration laterality, the surface (flexor, extensor), the level (spine), or specific digit or lesion to be treated.*

   Note: For procedures that involve laterality of organs, but the incision(s) or approaches may be from the midline or from a natural orifice, the site is still marked and the laterality noted.

2. *The procedure site is initially marked before the patient is moved to the location where the procedure will be performed and takes place with the patient involved, awake and aware, if possible.*

3. *The procedure site is marked by a licensed independent practitioner or other provider who is privileged or permitted by the hospital to perform the intended surgical or non-surgical invasive procedure. This individual will be involved directly in the procedure and will be present at the time the procedure is performed.*

   Note: Final confirmation and verification of the site mark takes place during the Time Out.

4. *The method of marking the site and the type of mark is unambiguous and is used consistently throughout the hospital.*

5. *The site marking has the following characteristics:*

   - *It is made at or near the procedure site or the incision site. Other non-procedure site(s) are not marked unless necessary for some other aspect of care.*
   - *It includes, preferably, the surgeon's or proceduralist's initials, with or without a line representing the proposed incision.*
   - *It is made using a marker that is sufficiently permanent to remain visible after completion of the skin prep and sterile draping. Adhesive site markers are not to be used as the sole means of marking the site.*
   - *It is positioned to be visible after the patient has his or her skin prepped, is in his or her final position, and sterile draping is completed.*

6. *For spinal procedures, in addition to preoperative skin marking of the general spinal region, special intraoperative radiographic techniques are used for marking the exact vertebral level.*

7. *A defined, alternative process is in place for patients who refuse site marking or who cannot easily be marked under the following conditions:*

   - *For cases in which it is technically or anatomically impossible or impractical to mark the site (mucosal surfaces, perineum, premature infants), an alternative method for visually identifying the correct side and site is used. For example, the hospital may place a temporary, unique wrist band on the side of the procedure containing the patient's name, and use a second identifier for the intended procedure and site.*
   - *For minimal access procedures that intend to treat a lateralized internal organ, whether percutaneous or through a natural orifice, the intended side is indicated by a mark at or near the insertion site, and remains visible after completion of the skin prep and sterile draping.*
   - *For interventional procedure cases for which the catheter/instrument insertion site is not predetermined (for example, cardiac catheterization, pacemaker insertion).*
   - *For teeth, the operative tooth name(s) and number are indicated on documentation or the operative tooth (teeth) is marked on the dental radiographs or dental diagram. The documentation, images, and/or diagrams are available in the procedure room before the start of the procedure.*
   - *For premature infants, for whom the mark may cause a permanent tattoo (Joint Commission, 2008 [NA]).*

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7. Anesthesia Patient Identification and Verification Process for Block/Anesthesia

The anesthesia care provider will mark the anesthesia block site prior to the administering sedation.

Inherent in the risks of surgery are the separate risks of anesthesia. The importance of patient verification, informed anesthesia consent, laterality, marking and Anesthesia Time Out prior to the onset of anesthesia or regional block for postoperative pain has been recognized in the rare but not-unheard-of incidents of wrong patient, wrong type of anesthetic, wrong side regional block, and the need for disclosure of risks inherent to the anesthesia alone. While not currently mandated by current regulatory agencies *(Center for Medicaid and State Operations/Survey and Certification Group, Hospital Interpretive Guidelines for Informed Decision Making and Informed Consent, 2007 [NA])*, most hospitals and surgical centers have implemented procedures for preventing problems specifically related to correct patient, site and type of anesthetic.

During the pre-anesthetic visit, anesthesiologists disclose common risks of general and regional anesthesia (sore throat, nausea, vomiting, drowsiness, urinary retention, pain management problems, headache, bleeding, infection, failure to provide anesthesia/analgesia, and backup methodologies). More severe and potentially devastating risks, such as postoperative vision loss, aspiration, malignant hyperthermia, permanent nerve damage, seizures, coma and death, need to be mentioned, but it is suboptimal for patients to be first hearing about these in the preoperative holding area. A dialogue about an uncommon but higher-incidence complication in relation to a specific procedure should be commenced in the surgeon's office ahead of time (e.g., risk of postoperative vision loss associated with major reconstructive spine surgery) *(O'Leary, 2008 [X])*.

General Recommendations

Overall, each institution should define in writing its own practice parameters with regards to patient identification, verification of procedure, cross-referencing surgical consent, anesthesia consent, anesthesia marking and Anesthesia Time Out.

Specific Recommendations

- **Patient identification/verification.** Ask each patient to verbalize his/her name, date of birth and understanding of the proposed procedure; this will help to prevent mistakes with patients who may simply nod in response to query. In addition, checking the patient's name band and verifying the surgical consent are common practices.
- **Anesthesia informed consent.** Informed consent for anesthesia separate from surgery is done for anesthesia procedures *without* surgery, such as pain procedures, sedation for magnetic resonance imaging, placement of central catheters, etc., per MHA recommendation. Whether a department of anesthesiology chooses to formulate its own separate anesthesia consent or not for surgical anesthesia, discussion of complications from anesthesia should be documented in the patient's medical record *(American Society of Anesthesiologists Newsletter, 2007 [X]; American Society of Anesthesiologists Newsletter, 2006 [X]; American Society of Anesthesiologists Newsletter, 2000 [X])*.

Each organization should consider utilization of a standardized, institutional anesthesia consent that details common risks of all techniques, and patient-specific risks can be added.

The elements of informed consent are *(American Medical Association Professional Resources [legal issues] informed consent, 2008 [X])*:

- The patient understands the diagnosis (if known), nature of the procedure and the indications for the proposed procedure.
- The patient understands potential short- and long-term risks and benefits of the proposed procedure.

- Reasonable alternatives have been discussed (regardless of their cost or the extent to which the treatment options are covered by health insurance).
- The risks and benefits of alternative treatment, including the option of no treatment, and consequences of refusing treatment are understood.

- **Anesthesia site-marking**

  Before marking the site the anesthesia care provider should review:

  - procedure and site identification information in the informed consent documentation,
  - information in the medical record,
  - diagnostic studies, and
  - discuss with the patient/legal guardian.

  The anesthesia care provider will mark an "A" with a circle around it on the intended site. It is specifically noted that the anesthesiologist *will not use his/her initials*, as this is reserved for the surgeon. Heightened awareness and rigid adherence to established procedures for identification and marking will decrease the likelihood of wrong site anesthesia *(American Society of Anesthesiologists Newsletter, 1996 [X])*.

- **Anesthesia Time Out**

  The Anesthesia Time Out is a safety check that is performed just prior to administering an anesthesia block. The anesthesia care provider who will administer the block will initiate the Anesthesia Time Out and the anesthesia block assistant will perform the Anesthesia Time Out together. The purpose is to ensure that the correct anesthesia block is administered to the correct patient at the correct site.

  Please note: the patient information on the consent form should have been verified against the patient's ID when the patient entered the operating room (for blocks performed in the OR or preop area).

  The Anesthesia Time Out should be performed as follows:

  1. Anesthesia care provider initiates the Anesthesia Time Out just prior to administering the block.
  2. The anesthesia care provider and the anesthesia block assistant will cease their activity.
  3. The anesthesia block assistant audibly reads the following from the patient's informed consent:
     - Patient name
     - Procedure
     - Laterality/level of anesthesia procedure as appropriate
  4. Anesthesia block assistant notes position of patient.
  5. Both provider and assistant actively looks at anesthesia site marking, verifies that he/she sees the anesthesia site mark, and indicates where it is located.
  6. Anesthesia care provider states entire procedure verbally – from memory – including side/level for which anesthesia block will be administered.

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9. Hard Stop

If any part of the verification process was not followed and/or a discrepancy is discovered, the procedure is halted and will not continue until the missing steps of the verification process are completed and the discrepancies resolved.

Resolution of discrepancies will include:

- reverification of patient identification,
- review of the information in informed consent documentation,
- review of the medical record,
- review of diagnostic studies, and
- discussion with the patient/legal guardian (if appropriate).

Conversations related to resolution of discrepancies should be held in a quiet location, away from activity/distractions.

To consider a discrepancy resolved, confirmation of the correct procedure or surgical site and side must include all forms of documentation, as well as a discussion with the patient/legal guardian. After the discrepancy has been resolved, the procedure and site verification will be repeated.

If the steps of the verification process cannot be completed or are not completed and/or any discrepancies cannot be resolved, the procedure is canceled and rescheduled.

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10. Repeat Verification Process If Patient Has Been Moved or Care Team Changes

Refer to Annotation #5, "Structured Hand-Off for Any Surgical Personnel Changes."

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11. Baseline Count

Perform Baseline Count Before Patient Arrives in the Operating/Procedure Room Suite

The counting recommendations outlined in this protocol are based on consensus statements and guidelines of American College of Obstetricians and Gynecologists and the American Academy of Pediatrics *(ACOG Committee on Quality Improvement and Patient Safety, 2006 [R]; AORN, 2006 [R]; CRICO/RMF, 2006 [R]; Eldridge, 2006 [NA]; Harder, 2006 [D]; Joint Commission International Center for Patient Safety, 2006 [R]; American College of Surgeons, 2005 [R]; Council on Surgical and Perioperative Safety, 2005 [R]; Gibbs, 2005 [R]; Brennan, 2004 [C]; Vincent, 2004 [R]; Thomas, 2000 [C]; Leape, 1991 [C]).*

In addition, articles on communication, teamwork, multitasking and interruptions and their relationship to unanticipated events were consulted *(Haig, 2006 [D]; ECRI, 2005 [R]; Leonard, 2004 [D]; Lingard, 2004 [D]).*

Accurately accounting for all items that could potentially become unintentionally retained is a priority of the entire surgical team, though the primary responsibility for performing the count process belongs to the circulator and scrub. There must be no distractions (e.g., extraneous conversation, music, unnecessary

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interruptions). The circulator must be a registered nurse *(AORN, 2006 [R]; American College of Surgeons, 2005 [R]).*

Radiographic imaging is not a substitute for performing accurate count procedures. Count procedures may be omitted or modified in an extreme patient emergency. This exception will be documented in the patient's medical record and when the patient's condition allows, radiographic imaging should be obtained to rule out the possibility of an unintentionally retained foreign object.

What Items Will Be Included in the Count Process

Best practice is the use of only radiopaque items in the surgical wound *(AORN, 2006 [R]; VHA Directive, 2006 [NA]; American College of Surgeons, 2005 [R]; Council on Surgical and Perioperative Safety, 2005 [R]).* The work group recognizes that not every item that may be used during a surgical procedure is radiopaque.

It is the recommendation of the work group that radiopaque items should be used if that product is manufactured in a radiopaque form and all non-radiopaque items should be counted, regardless of whether that item is a required, countable item.

Sponges/soft goods – sponges/soft goods will be counted for all procedures when they are used. Only radiopaque sponges/soft goods will be present within the surgical field *(AORN, 2006 [R]; VHA Directive, 2006 [NA]; American College of Surgeons, 2005 [R]; Council on Surgical and Perioperative Safety, 2005 [R]).*

Laparotomy sponges or 4x8 sponges will not be cut into pieces or otherwise used for dressing *(AORN, 2006 [R]; VHA Directive, 2006 [NA]; Council on Surgical and Peroperative Safety, 2005 [R]).*

Non-radiopaque gauze used for dressing will be held in a separate area until the wound is closed *(AORN, 2006 [R]; American College of Surgeons, 2005 [R]).*

Sharps – Sharps will be counted for all procedures when they are used *(AORN, 2006 [R]; American College of Surgeons, 2005 [R]).*

An unintentionally retained micro needle is not reportable as a retained foreign object. Organizations will need to define a micro needle depending on their patient population (e.g., infants).

Miscellaneous items – miscellaneous items will be counted for all procedures *(AORN, 2006 [R]; American College of Surgeons, 2005 [R]; Council on Surgical and Perioperative Safety, 2005 [R]).*

Examples of a miscellaneous item include vessel clips, vessel loops, vascular inserts, cautery scratch pads, trocar sealing caps, catheter sheaths, non-radiopaque items such as hernia tapes and other small items.

Instruments – instruments will be counted for all procedures when the possibility exists that an instrument could be unintentionally left behind *(AORN, 2006 [R]).*

Organizations will need to define instruments that are at risk for being unintentionally retained. The work group has listed the following guiding principles to assist organizations in defining instruments to be counted:

- Size of the wound relative to the instruments being used
- Instruments that leave the hand of the operator after being placed in the operative field
- Instruments that are obscured within the wound and not clearly visible throughout the procedure (clips, guide wires, small clamps, etc.)

Instruments that are to be counted should be identified by specialty/service and specific to the procedure and surgical technique employed.

Examples of surgical procedures where instruments may be identified as a required countable item include chest, open abdominal, and pelvic procedures. Refer to Resources Table for Surgical Care Tool Kit for examples of a standardized instrument count sheet.

When the Count Process Will Be Performed *(AORN, 2006 [R]; VHA Directive, 2006 [NA])*

- The baseline count will be performed before the patient is brought to the operating/procedure room unless parallel processing is used. When parallel a process is used, two different circulators will be needed: one dedicated to a focused count process and one dedicated to focused patient care.
- At the time of closure of a cavity within a cavity
- Before wound closure (e.g., fascia)
- At the end of the procedure/final closure (e.g., skin) – sponges/soft goods used for wound debridement procedures for burn patients are exempt from the final count process. A final count, as outlined in the protocol, must be performed for all other items (sharps, miscellaneous items, instruments) used in wound debridement procedures for burn patients.
- Any time a member of the surgical team has concerns about the accuracy of the counts, even when the counts appear correct
- Whenever there is a permanent staff change of the circulator and/or scrub:
  - All visible items will be counted and all items in use in the surgical field will be accounted for.
  - When the circulator and/or scrub is changed for a short duration (e.g., lunch break), a structured hand-off is required but a count is not. The structured hand-off is performed for two purposes:
    (1) to maintain the scrub's safety with sharps on the field
    (2) to account for items in use in the field
- At final closure of a wound that was intentionally delayed (damage control), temporary implants are used, or a wound is temporarily closed with a non-radiopaque item (e.g., wound vacuum sponge)

How the Count Process Will Be Performed

- The circulator and scrub (the circulator must be a registered nurse) will directly view the items being counted and will count out loud and concurrently *(AORN, 2006 [R]; Council on Surgical and Perioperative Safety, 2005 [R])*.
- There is evidence that distractions, multitasking and conflicting priorities, especially during critical cognitive steps, will, with high predictability, lead to an error. It is recommended by the work group that the surgeon declare critical times, if known, during the briefing so the team can appropriately plan for breaks/reliefs. The surgical team is otherwise advised to use critical thinking skills to determine safe case interruption times *(ACOG Committee on Quality Improvement and Patient Safety, 2006 [R])*. Therefore, distractions and interruptions should be minimized during the count process *(ACOG Committee on Quality Improvement and Patient Safety, 2006 [R]; American College of Surgeons, 2005 [R])*. If the count process is interrupted, the circulator and scrub will restart the count of the count category that was interrupted.
- The circulator will document the number and type of sponges/soft goods, sharps, miscellaneous items, and instruments on a preformatted white board or other standardized, preformatted documentation record. The scrub verbally confirms the number.

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- It is best practice for the circulator to document the number of each item immediately after counting them. This diminishes the likelihood that the number will be recalled incorrectly or the circulator will forget to document the number on the white board.
- Best practice is to use a preformatted white board, directly viewable by the entire surgical team *(France, 2005 [R])*.
- For procedures where there is a large number and/or specificity of certain items (e.g., cardiac procedures), a standardized, preformatted paper record may be used. See Resources Table for Surgical Care Tool Kit for sample document.
- It is the recommendation of the work group that, whenever possible, only one source of count information be used during the procedure.

- All sponges/soft goods, sharps, miscellaneous items, and instruments will be counted in the same order each time *(AORN, 2006 [R])*.
  - It is the recommendation of the work group that items be counted in the order they are listed on the preformatted white board.
- Sponges/soft goods will be separated and counted individually *(AORN, 2006 [R])*.
  - Some organizations allow 4x8 sponges to be held by the bottom third and counted by individually separating the top two-thirds of each sponge. It is the work group's recommendation that best practice is to separate all sponges and count them individually.
- Every sponge/soft good will be visually inspected to ensure that the radiographic-detectible indicator is present *(AORN, 2006 [R]; American College of Surgeons, 2005 [R]; Council of Surgical and Perioperative Safety, 2005 [R])*.
  - If the indicator is not present, the entire package of sponges/soft goods will be removed from the suite and given to the designated person for follow-up with the manufacturer *(AORN, 2006 [R])*.
- Instruments should be counted in sets.
  - It is the work group's recommendation that best practice is for all instruments, regardless of whether they are required countable items or not, be added to the surgical field in pairs and retrieved in pairs.
- Packages where the labeling on the package does not match the number of items in the package will be removed from the suite and given to the designated person for follow-up with the manufacturer *(AORN, 2006 [R])*.
- Counts will begin at the surgical field and move away from the patient.
- Gauze and other soft goods used by anesthesia will not enter the surgical field or be mixed in with sponges/soft goods used and counted for the surgical procedure.
- Sponges/soft goods, sharps, miscellaneous items, and instruments added during a procedure will be counted prior to entering the surgical field *(AORN, 2006 [R]; Council on Surgical and Perioperative Safety, 2005 [R])* and documented as soon as possible.
- Used sponges/soft goods will be unballed, separated and pulled apart for counting.
- All sharps, miscellaneous items, and instruments will be inspected for broken or missing pieces when counted *(AORN, 2006 [R]; Council on Surgical and Perioperative Safety, 2005 [R])*.
- Any sponge/soft good, sharp, miscellaneous item, or instrument dropped during the procedure will be retrieved, shown to the person responsible for counting, and isolated from the surgical field to be included in the final count.

- Gauze and other soft goods used for wound dressing will not be present in the surgical field until the wound is closed.
- Any item intentionally left behind in a patient because it would do more harm to retrieve will be documented in the patient's medical record.

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12. Baseline Count Performed?

If the baseline count cannot be performed prior to the patient being brought to the operating/procedure room (unless a parallel process is used – see below), the counts should be considered compromised and inaccurate. Continue to follow the Perioperative Protocol and obtain portable, intraoperative radiographic imaging for a potentially retained foreign object.

Some organizations are utilizing a parallel process to improve operating/procedure room turnover times. A parallel process is when two separate activities with two entirely separate groups of staff are performed simultaneously. A parallel process is **not** multitasking. For the count process, two different circulators will be needed: one dedicated to the count process and one dedicated to patient care.

If separate staff is not available, the baseline count **must** occur **before** the patient arrives in the operating/procedure room.

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13. Imaging Required at Completion of Procedure

Refer to Annotation #37, "Imaging If Counts Not Reconciled: Postoperative Follow-Up If Counts Remain Unreconciled."

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14. Patient Transported to Intraoperative Area Using Checklist (Reverify Patient Identification)

The transition of the patient from one location to another, whether or not the care providers change, creates the opportunity for errors to occur. Prior to moving the patient from the preoperative area to the operating/procedure room, the anesthesia care provider or circulating nurse is responsible for final verification, including:

- Verifying consent is complete;
- Verifying preoperative checklist has been completed by all required staff. Refer to Resource Table Tool Kit for additional information on pre-procedure verification checklist;
- Verifying operative site is correctly marked (if applicable) by verifying the site marking against the patient's informed consent; and
- Notifying preoperative staff, verbally and/or electronically, that the patient is being moved to the operating/procedure room.

Whenever possible, the patient should be an active participant in the verification process.

Immediately upon entry to the operating/procedure room, the anesthesia care provider and circulating nurse will verify the patient's identification, surgeon and procedure to be performed. To ensure that the correct patient documents arrived in the operating room with the patient, the patient's ID band should be checked against the patient information documented on the patient's informed consent and anesthesia care record.

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If an electronic medical record is used, the patient information on the informed consent will be checked against the EMR to ensure the correct EMR is open. This should be done before moving the patient to the operating/procedure room table. Persons doing final verification should be at least two members of the operating team. Ideally, this would be the circulating nurse and the anesthesia care provider. If possible, the patient should participate in the verification process.

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Intraoperative Period Algorithm Annotations

15. Briefing

It is expected that the initial plan for the surgical procedure will have been disseminated prior to the day of surgery, preferably at the time of scheduling. The briefing is intended as a time to confirm the plan for a particular procedure. Ideally, the briefing should be conducted prior to case setup in the operating/procedure room, but is acceptable to conduct the briefing anytime between case setup and patient positioning. It is recommended that members of the operating/procedure room team (surgeon, circulating nurse, anesthesia care provider, scrub) who will be present during the procedure will participate in the briefing together. The purpose of the briefing is to confirm the plan for the surgical procedure and to confirm with team members what will be needed during the procedure and when it will be needed. During the briefing, the team members should be informed about particular patient needs and about the equipment and supplies that will be needed – particularly if there are any requirements for a particular case that are not typically needed for that type of procedure. With advance planning the circulating nurse and/or other team members will be able to ensure that the equipment and supplies needed for the procedure will be available at the time they are needed – this will minimize the delays caused by the circulating nurse leaving the operating/procedure room to retrieve an item. Further, an effective briefing to confirm particular patient needs will help to ensure that all team members are prepared for potential problems or issues that might arise. The briefing is *not* rigid, and it is *not* a checklist. Briefing content is driven by procedure need. At a minimum it is important for team members to greet each other or, if they do not know each other, introductions should be made.

Appropriate elements for the briefing include:

- Team greeting or introduction of individual team members
- Any special patient needs or potential issues including safety precautions based on patient history or medication use
- Anticipated problems
- Patient positioning
- Status of the patient consent
- Patient allergies
- Medications (e.g., antibiotics)
- Anticipated blood components
- Specimens, if applicable, and how they should be handled
- Discussion about radiological images, if applicable, including whether they are properly labeled and appropriately displayed
- Discussion of implants, if applicable

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- Details regarding special equipment
- Discussion of any special intraoperative requests (e.g., surgeon informs circulating nurse and scrub about times during the procedure when he or she would prefer that they avoid taking a break)
- Team members are asked whether or not they have any other concerns or issues related to the patient or the procedure

If these elements are covered thoroughly in the briefing, then team members will know what is expected of them, delays while waiting for required equipment and supplies should be minimized, and the procedure should run more smoothly and efficiently.

For organizations that have not implemented the briefing, these elements would be required during the Time Out.

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16. Environmental Controls/Room Temperature

Surgical staff and operating/procedure room environmental controls

The following recommendations for surgical staff are based on experimental, clinical or epidemiological studies, or theoretical rationale and are supported by consensus statements of several professional organizations *(Association of Operating Room Nurses, 2006 [R]; Boyce, 2002 [R]; Mangram, 1999a [R])* or federally regulated *(U.S. Department of Labor, 2006 [R]; Centers for Disease Control, 2001 [R]; Centers for Disease Control, 1991 [R])*.

Preoperative scrub

- Wash hands and forearms with plain or antimicrobial soap.
- Clean the subungual areas of both hands; use nail cleaner (first scrub of day).
- Rinse hands under running water.
- Dispense scrub agent; apply to wet hands and forearms with sterile soft sponge. Brushes are not recommended.
- Hold hands higher than elbows and away from the body.
- In the operating/procedure room, dry hands and arms with a sterile towel.
- It may be preferable to perform steps one through three, then dry hands and forearms thoroughly with a paper towel. Apply a Federal Drug Administration-approved alcohol-based solution, preferably containing CHG, to hands and forearms, rubbing until dry. Depending on manufacturer, it may be necessary to repeat application process.
- Put on sterile gown and gloves.
- Double gloving has been shown to decrease hand contamination with blood-borne pathogens through perforations in the gloves *(Lin, 2005 [R]; Berridge, 1998 [A])*. Surgical staff, particularly those who are involved with exposure-prone procedures or who handle exposure-prone instruments, should consider double gloving as a precaution against the exposure to blood-borne pathogens.
- Alcohol-based hand rubs may be used for routine decontamination of hands. Using an alcohol-based hand rub for hands that are visibly dirty or contaminated is not recommended. Soap and water should be used and may then be followed by an alcohol-based solution.

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Surgical asepsis

The following are guidelines by which contamination with microorganisms may be prevented. There are not studies to support whether these methods are effective; however, having similar recommendations among organizations does help staff that work across multiple organizations.

- Individuals who enter the semirestricted and restricted areas of the operating/procedure room should wear freshly laundered surgical attire donned at the facility.
- Surgical attire should be changed daily or whenever it becomes visibly soiled, contaminated or wet.
- Surgical attire should not be home laundered. Laundered attire should be protected from contamination during transfer and storage.
- Personnel should wear long-sleeved jackets that are closed during use when there is the possibility of contact with blood-borne pathogens.
- Personnel should cover head and facial hair, including side burns, when in restricted or semirestricted areas.
- Masks should be worn in the restricted area when open sterile supplies and equipment are present.
- Protective barriers (gloves, eyewear) must be available to reduce the risk of exposure. Gowns and shoe covers should be worn when exposure to blood or infectious materials is anticipated.
- Scrubbed persons should function within a sterile field. Following hand antisepsis, they should don sterile gown and gloves. The gown is sterile from the chest to the level of the sterile field. The sleeves from two inches above the elbow to the cuff, the cuff should remain covered by the sterile glove and should remain at or below the natural wrist.
- Sterile drapes should be used to establish a sterile field and provide an aseptic barrier to minimize microorganisms between non-sterile and sterile areas. These should be placed on the patient, furniture and equipment to be included in the sterile field.
- Drapes should be handled as little as possible, held in a compact manner, and gloved hands should be protected by cuffing the drape. Drapes must not be moved after they are positioned.
- Items used within the sterile field must be sterile. Sterility should be event related. All items should be opened, dispensed and transferred by methods that maintain sterility and integrity.
- It is standard practice when performing surgical procedures that involve two surgical sites, one clean and one clean-contaminated, to always move from the clean to the clean-contaminated site. When this is not possible, use separate instruments and other materials for the two surgical sites.
- Sharps, heavy objects and peel-packed items should be presented to scrubbed staff, to prevent tearing of the drapes. Rigid containers should be opened on a separate surface.
- Unscrubbed personnel should never reach over the sterile field to introduce sterile items. Liquids should not be allowed to splash. Medications should be delivered aseptically, stoppers should not be removed; rather, sterile transfer devices should be used.
- Sterile field should be monitored at all times and prepared as close as possible to the time of use (there is no designated amount of time supplies can be opened, event related); supplies should be opened for only one case at a time.

- Sterile fields should not be covered.
- Equipment should be secured to the sterile field with non-perforating devices.
- Unscrubbed staff should face sterile fields on approach, not pass between two sterile fields, and should keep their distance.
- Traffic in and out of the room should be kept to a minimum.

Recommendations for Operating/Procedure Room Environmental Controls

There must be no distractions (e.g., extraneous conversation, music, unnecessary interruptions) and when the circulator and/or scrub is changed for a short duration (e.g., lunch break), a structured hand-off is required but a count is not.

Operating/procedure room environmental controls are mandated and regulated by each state's department of health. For specific recommendations from the Minnesota Department of Health, see:

http://www.health.state.mn.us/

Temperature Control

Development of hypothermia in the patient has been shown to be associated with increased risk of infection. Prevention of hypothermia begins prior to patient arrival in the room. The room temperature should be such that a minimally clothed patient is comfortable. It is appropriate to adjust room temperature to a level comfortable for the operating/procedure room personnel once the patient has received active or passive measures to prevent heat loss. (See Annotation #2, "Patient Arrives [Patient, Procedure and Site Verification]," for information on normothermia planning and management.)

Noise Control to Minimize Distraction and Patient Stimuli

There must be no distractions (e.g., extraneous conversation, music, unnecessary interruptions). Adjust music volume to level that is appropriate to work being performed. The music should not interfere with communication among members of the operating/procedure room team.

Recommendations for Operating/Procedure Room Vendor Access

The surgical environment can be enhanced by establishing guidelines for effective control of operating/procedure room access to external constituencies. Vendors can be granted access to the operating/procedure room when services are pertinent to patient care. It is recommended that a specific policy be established for the purposes of defining vendor access. Examples of vendor procedure statements may include the following:

- All vendors must initially contact hospital administration through the proper institutionally designated process.
- **Vendors will be admitted to the operating/procedure room only after the patient has been draped for the purpose of providing a resource to the surgeon or staff in the use of instrumentation, equipment or patient care items.**
- One vendor per operating/procedure room per surgeon unless there are clinical reasons.
- Appointments will be pre-arranged and scheduled by one of the following: surgeon, nurse manager/supervisor or charge nurse.
- The nurse manager/supervisor and/or surgeon's secretary will contact the surgical administration office to confirm prior vendor approval.

- Vendors who have received access to the operating/procedure room will register at the surgical administration office and be provided an identification tag to be worn during their operating/procedure room visit.
- Vendors will not set up displays in or around the operating/procedure room unless a surgical services educator or designee has requested an educational display be provided for staff.
- The vendor is accountable to the surgeon and surgical personnel while in the operating/procedure room.
- Surgery administration reserves the right to govern and restrict vendor access visits to the operating/procedure room.
- **Vendors do not provide patient care. Vendors must not open any surgical supplies, implantables or surgical instrumentation. The purpose of a site visit to the operating/procedure room is to answer questions about the operation of their equipment or to troubleshoot any problems occurring with the use of the equipment.**
- Demonstration of new equipment to be used for new procedures will be done in an appropriate setting outside of the operating/procedure room.
- Vendors will restrict their visit to the designated area. Expanded visits require pre-arrangement with the nurse manager/supervisor or designee of other specialty areas.
- No cell phones or personal digital assistants are allowed in the operating/procedure room.
- Must have closed-toe, non-fabric shoes that are clean and professional in appearance.
- Pagers will be set on silent.

Example of Vendors Check-In Process

- Fill out visitor card yearly (kept for one calendar year), filed by vendor name.
- Provide business card (dated by office staff and filed in card file).
- Visitor name badge is required.
- Receive locker assignment.
- Change into surgical scrubs.
- Return to the surgical administration office.
- Lock all cell phones, cameras, personal digital assistants and other personal items in the locker.
- Escort to appropriate operating/procedure room.

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17. Patient Arrives in Operating/Procedure Room: Reverification and Anesthesia Administered

Complete reverification. Refer to Annotation # 2, "Patient Arrives (Patient, Procedure and Site Verification)," Annotation #7, "Anesthesia Patient Identification and Verification Process for Block/Anesthesia," and Annotation #14, "Patient Transported to Intraoperative Area Using Checklist (Reverify Patient Identification)," for specifics.

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18. Verify Site Marking/Position Patient/Skin Preparation/Clipping

Verify Site Marking

Refer to Annotation #6, "Surgical Site Marking with Initials," for site-marking specifics.

Skin Preparation and Hair Removal

Most surgical site infections are from skin normal flora (coagulase-negative staphylococcus non-aureus).

- The surgical site should be assessed before skin preparation. Skin should be assessed for the presence of moles, warts, rashes or other skin conditions. Inadvertent removal of lesions may provide an opportunity for wound colonization.
- The surgical site and surrounding areas should be clean.
- Antiseptics are shown to reduce bacteria on the skin, but a corresponding decrease in surgical site infection rates has not been demonstrated. The Centers for Disease Control's 1999 guidelines do recommend the use of antiseptics *(Ellenhorn, 2005 [A]; Jacobson, 2005 [A]; Ostrander, 2005 [A]; Sowapat, 2005 [C]; Hibbard, 2002 [A])*. There is insufficient evidence from randomized trials to support the use of antiseptic preparation of the skin, or of one antiseptic over another *(Edwards, 2006 [M])*. Several antiseptic agents are available for preoperative preparation of skin at the incision site. Careful consideration should be given to the patient's condition. Some antiseptic agents may burn mucous membranes, and others are highly flammable. The prepared area must be large enough to extend the incisions or create drain sites. Some guidelines recommend applying the antiseptic with sterile supplies, but again there is no literature to support this.
- Personnel should be knowledgeable in skin preparation techniques, including maintaining skin integrity and preventing injury to the skin *(Association of Operating Room Nurses Recommended Practices Committee, 2002 [R]; Mangram,1999a [R])*. Special considerations should include:
  - preparing areas with high microbial counts last;
  - isolating colostomy sites, covering with an antiseptic-soaked sponge, and preparing them last;
  - using normal saline to prepare burned, denuded or traumatized skin;
  - avoiding the use of chorhexidine gluconate and/or alcohol based products on mucous membranes;
  - allowing sufficient contact time for antiseptics before applying sterile drapes;
  - allowing sufficient time for complete evaporation of flammable agents; and
  - preventing antiseptics from pooling beneath patients or equipment.
- Patient skin preparation should be documented in the patient record.
- Policies and procedures on skin prep should be reviewed regularly to assess new evidence.

See Appendix C, "Overview of Topical Antiseptics Used for Preoperative Skin Preparation."

Hair removal

- The operating/procedure room should be assessed for amount and degree of hair removal.
- Refrain from hair removal unless the hair at or around the incision may interfere with the procedure *(Winston, 1992 [D])*. Hair removal should be the exception, not the rule.

- Hair removal, when necessary, should occur as close as possible to the time of a surgical procedure and should be performed with clippers *(Mangram, 1999a [R])*. There is no evidence stating a specific time when to refrain from hair removal at or near the surgical site. Shaving more than 24 hours prior to the procedure is documented to increase infection risk *(Mangram, 1999b [R])*.

Definitions for hair removal should be clarified

- The shaving method uses a sharp blade over the patient's skin to cut hair close to its surface. The razor is typically disposable. Shaving with a razor may result in cuts and abrasions to the skin and therefore should not be used.
- The clipping method uses clippers with fine teeth to cut hair close to the patient's skin. It leaves a short stubble of hair typically one millimeter in length. A clipper typically has a disposable head or is disinfected between patients. Staff should follow manufacturer's instructions provided with the hair clippers. Clippers do not come in contact with the patient's skin, thus decreasing cuts and abrasions.
- The use of depilatory creams is a method in which chemicals dissolve the hair. This is a slower process lasting anywhere from 5 to 20 minutes. Chemical depilatories may irritate the skin or result in an allergic reaction. A patch test is recommended 24 hours prior to cream applications.
- Consideration should be given to where hair removal occurs. Hair removal at the sterile field could potentially contaminate the surgical site and/or sterile fields due to loose hairs.
- For some surgical procedures, hair removal may not be necessary. Patients requiring emergent procedures may not have time for hair removal.
- Staff performing patient hair removal should be instructed to use the proper technique.
- Policies and procedures should indicate when and how to remove hair at the incision site. Hair removal should occur under physician orders and/or following protocol for particular surgical procedures.
- If hair removal occurs, it should be documented. Documentation should include condition of the skin at the surgical site, who has done the removal, the method of hair removal, area of hair removal and when it was done.

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19. Prior to Incision – Active Verbal Time Out

The Time Out is to be performed after the surgeon has scrubbed and gowned and just prior to beginning the procedure. It is the final safety stop before the surgical procedure begins. The purpose of the Time Out is to ensure that the correct patient, procedure to be performed, site of the procedure and patient positioning are all correctly verified.

All the elements to be included in The Joint Commission (2009 National Patient Safety Goals) required Time Out are consistent with the elements included in the briefing **and** Time Out within this protocol.

The recommendation from this work group is to cover all those required elements, but to cover them in two distinct temporal steps. Also see Annotation #15, "Briefing," for the specific elements covered in the briefing.

During the Time Out, each person in the operating/procedure room must cease his/her activity and actively participate in the process. The team includes the surgeon, resident(s), student(s), anesthesia care provider, scrub and circulator. No individual (e.g., student[s], vendor[s]) is exempt from stopping his/her activity during

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the Time Out. If a member of the team refuses to actively participate in the Time Out, the scalpel or cutting/incising device is not handed to the surgeon until that individual is replaced and the Time Out completed.

The Time Out is to be initiated by the surgeon after he/she scrubs for the procedure. It should occur just prior to incision/procedure start. The scalpel or other cutting/incising device is not to be handed to the surgeon until the Time Out has been completed.

It is recommended that a visual memory aid be used to remind the surgeon to initiate the Time Out. For example, a Time Out sign or towel can be used to cover the scalpel or cutting/incising device. When one of these aids is used, it is important to hand it off the surgical field at the conclusion of the Time Out so it is not retained in the patient.

Each Time Out must include the following standard elements:

- Patient identity, using a minimum of two identifiers (e.g., patient name and medical record number)
- Procedure to be performed
- Site of procedure (and level, if applicable) including **visualization of the surgeon's initials** (either on the patient's body or on an anatomical diagram), if applicable
- Patient position

The initiation of the Time Out is the responsibility of the surgeon (e.g., "Let's do the Time Out"). The team ceases activity. The circulator reads the patient's affirmation of informed consent for the Time Out elements. However, prior to its use the consent must have been validated against other documents, such as history and physical, radiology or pathology reports, progress notes, etc., in the preoperative area. After the circulator reads the patient, procedure, site and patient position information from the patient's affirmation of informed consent, the following team verification is recommended:

(a) Anesthesia provider:

(i) Reads patient's name, medical record number, and procedure – circulating nurse verifies that information on affirmation of informed consent matches what anesthesia care provider reads.

(ii) States antibiotic name, dose and administration status (optional).

(b) Scrub:

(i) States procedure he/she has set up for.

(ii) Announces that he/she sees the site marking (as applicable). Note: in the event the site is marked on an anatomical diagram, the circulating nurse will use the anatomical diagram to confirm the site with the team.

(c) Surgeon – says patient's name, complete procedure, and site from memory.

Environmental distractions are to be eliminated as much as possible during the Time Out. For example, music is turned off, pagers are set on vibrate, talking other than participation in Time Out ceases and no staff are permitted to enter or exit the room. If during the Time Out an interruption or distraction occurs (pager goes off or an individual enters the room), the Time Out must be restarted.

The attending surgeon may designate a surgical resident or fellow to initiate the Time Out in the attending surgeon's absence. When the attending surgeon joins the case in the operating/procedure room, the surgical resident or fellow will communicate the patient's name and procedure to the attending surgeon.

A Time Out is to be performed prior to the onset of each procedure when multiple procedures are performed on the same patient during the same surgical period whether or not the procedures involve a new surgical

team. The process and elements of the Time Out as described above must occur prior to the start of each procedure.

If the patient is repositioned during the procedure and this repositioning affects the patient's presentation (i.e., the patient is turned from supine to prone), an abbreviated Time Out including the site (including level, if applicable) and visualization of the surgeon's initials will be conducted. The Time Out process will be conducted in the same manner as described above.

Individual facilities are encouraged to consider and interpret the 2009 National Patient Safety Goal recommendations (effective January, 2009) that state:

Rationale for UP.01.03.01

The purpose of the Time Out immediately before starting the procedure is to conduct a final assessment that the correct (patient), site, positioning, and procedure are identified and that, as applicable, all relevant documents, related information, and necessary equipment are available.

The Time Out is consistently initiated by a designated member of the team and includes active communication among all relevant members of the procedure team. It is conducted in a standardized fail-safe mode (that is, the procedure is not started until all questions or concerns are resolved).

Elements of Performance for UP.01.03.01

1. *The Time Out is conducted prior to starting the procedure and, ideally, prior to the introduction of the anesthesia process (including general/regional anesthesia, local anesthesia, and spinal anesthesia), unless contraindicated.*
2. *The Time Out has the following characteristics:*
   - *It is standardized (as defined by the hospital).*
   - *It is initiated by a designated member of the team.*
   - *It involves the immediate members of the procedure team including the proceduralist(s), the anesthesia providers, the circulating nurse, the operating room technician, and other active participants as appropriate for the procedure, who will be participating in the procedure at its inception.*
   - *It involves interactive verbal communication between all team members, and any team member is able to express concerns about the procedure verification.*
   - *It includes a defined process for reconciling differences in responses.*
3. *During the Time Out, other activities are suspended, to the extent possible without compromising patient safety, so that all relevant members of the team are focused on the active confirmation of the correct patient, procedure, site, and other critical elements.*
4. *When two or more procedures are being performed on the same patient, a Time Out is performed to confirm each subsequent procedure before it is initiated.*
5. *The Time Out addresses the following:*
   - *Correct patient identity*
   - *Confirmation that the correct side and site are marked*
   - *An accurate procedure consent form*
   - *Agreement on the procedure to be done*
   - *Correct patient position*
   - *Relevant images and results are properly labeled and appropriately displayed*
   - *The need to administer antibiotics or fluids for irrigation purposes (See also NPSG.07.05.01, EP 7)*
   - *Safety precautions based on patient history or medication use*
6. *The completed components of the Universal Protocol and Time Out are clearly documented (Joint Commission, 2008 [NA]).*

20. Discrepancies?

If during the Time Out, discrepancies among the consent, team members, imaging and/or equipment are discovered, the scalpel or cutting/incising device will not be handed to the surgeon until the discrepancy is resolved.

Institutions must develop a culture of safety. It is important that the organization and surgical services leadership team set the expectation that staff may, at any time, raise concerns or objections related to elements of the Time Out if they believe discrepancies do or may exist. Demeaning, derogatory or retaliatory statements and/or actions taken against one or more individuals as a result of a concern raised during the Time Out or any other part of the procedure are not to be tolerated. Each organization must have a process for immediate management when such behavior exists (The Joint Commission 2009 requirement).

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21. Hard Stop

If any part of the verification process was not followed and/or a discrepancy is discovered, the procedure is halted and will not continue until the missing steps of the verification process are completed and the discrepancies resolved.

Resolution of discrepancies will include:

- reverification of patient identification,
- review of the information in informed consent documentation,
- review of the medical record,
- review of diagnostic studies, and
- discussion with the patient/legal guardian (if appropriate).

Conversations related to resolution of discrepancies will be held in a quiet location, away from activity/distractions. To consider a discrepancy resolved, confirmation of the correct procedure or surgical site and side must include all forms of documentation, as well as a discussion with the patient/legal guardian. After the discrepancy has been resolved, the procedure and site verification will be repeated.

If the steps of the verification process cannot be completed or are not completed and/or any discrepancies cannot be resolved, the procedure is canceled and rescheduled.

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23. Venous Thromboembolism Prophylaxis, Beta-Blocker, Diagnostic Studies (If Necessary), Glycemic and Normothermia Management, Antibiotic Administration

Readministration of antibiotics for surgical site infection prophylaxis is based on the antibiotic selected and the length of the surgical procedure. Newer guidelines are recommending only a single dose of intravenous antibiotics for procedures lasting less than four hours. In procedures lasting more than four hours or when major blood loss occurs, re-dosing should occur every one to two half-lives of the antibiotic (in patients with normal renal function) so that the bactericidal concentrations are maintained in the tissues while the incision remains open *(Bratzler, 2005a [R]; Zanetti, 2001 [B])*.

Institutions may consider adding a reminder system or note on anesthesiology flow sheets close to the four-hour point of a surgery to prompt the question of whether to re-dose the antibiotic. This system may help

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ensure that patients in longer surgeries receive sufficient concentration of antibiotic, while still decreasing the risk of antimicrobial resistance.

(Medical Letter, Treatment Guidelines, 2009 [R])

For most antibiotics, the concentration is reached 30 minutes after infusion.

Modifying the Safe Site Protocol to include antibiotic prophylaxis has been shown to increase timely antibiotic administration *(Peterson, 2006 [D])*.

(Fonseca, 2006 [B]; Medical Letter, Treatment Guidelines, 2006 [R])

Glycemic Control

Glycemic control planning and management

In patients undergoing heart surgery, increased intraoperative blood sugars were associated with increased complications *(Gandhi, 2005 [D])*. Intraoperative infusions of glucose, insulin and potassium in heart surgery have not demonstrated convincing benefits in multiple randomized trials *(Pittas, 2004 [M])*.

Lead Author	Timing	Population	Study Design	n	Results
Pittas	SICU	Diabetics, glucose control	Meta-analysis of 35 RCTs	na	Mortality decreased in all subgroups (O.R. less than 1.0)

Tight blood glucose control (80-110 mg/dL) using insulin infusion results in decreased mortality in surgical patients admitted to the intensive care unit.

- Insulin infusion is associated with decreased mortality and sternal wound infection in diabetic patients undergoing coronary artery bypass grafting.
- Obtain tight glucose control using insulin infusion in all surgical patients with diabetes until baseline oral intake and insulin dosing are restored.
- Consider closer monitoring and treatment of non-diabetic patients with hyperglycemia.

Lead Author	Timing	Population	Study Design	n	Results
Furnary	Postop	Diabetics with cardiac surgery	Prospective observational (two time periods subQ vs. drip insulin)	3,554	Mortality (subQ insulin vs. drip) 5.3% vs. 2.5%
Furnary	Postop	Diabetics with cardiac surgery	Prospective, observational (as above)	2,467	Sternal wound infection (subQ insulin vs. drip) 2.0% vs. 0.8%
Van den Berghe	Postop	Surgical ICU patients	Prospective, randomized: tight (80-110) vs. standard Rx	1,548	Mortality ("tight" vs. "standard") 7.2% vs. 10.9%

(Furnary, 2003 [C]; Van Den Berghe, 2001 [A]; Furnary, 1999 [C])

The work group acknowledges that while benefits of tight glucose control have been proven in critically ill patients, some diabetic patients, and postoperative cardiac surgery patients, there is controversy over which other patient populations may benefit from this type of glycemic control. Studies are ongoing, and further study regarding target glucose concentration, glucose variability, and consequences of hypoglycemia is warranted before tight glycemic control is implemented for every surgical patient *(Blondet, 2007 [R])*.

See the ICSI Subcutaneous Insulin Management order set for more information.

Normothermia Management

Refer to Annotation #2, "Patient Arrives (Patient, Procedure and Site Verification)."

Beta-Blocker

Refer to Annotation #2, "Patient Arrives (Patient, Procedure and Site Verification)."

During surgery, the patient's blood pressure should be maintained within 20% of the baseline value *(Feneck, 2007 [M])*.

Venous Thromboembolism Prophylaxis

- When performing preoperative assessment, confirm that mechanical antiembolism devices are placed properly and thromboprophylactic medications are given as ordered.
- Intermittent pneumatic compression devices should be turned on before the beginning of induction of general anesthesia or before regional anesthesia has been administered.
- Avoid extreme degrees of flexion/internal rotation of hip/knee in order to prevent endothelial damage due to abnormal leg positioning.
- Unnecessarily high tourniquet pressures and prolonged periods of inflation of tourniquets should be avoided if possible.
- Avoid reverse Trendelenburg position whenever possible.
- Ensure that intermittent pneumatic compression devices are working properly throughout the procedure.

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24. Count New Items When Added to the Surgical Field

Refer to Annotation #11, "Baseline Count."

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26. Repeat Time Out (Multiple Procedures/Position Changes)

Refer to Annotation #19, "Prior to Incision – Active Verbal Time Out."

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27. Reverify/Pause If Internal Laterality/Implants/Spine Level)

If the procedure performed involves internal laterality, spine levels or the insertion of one or more implants, an intraoperative pause will be conducted. The pause will include the following elements (as appropriate):

- Side or site involved (e.g., left ovary, right kidney)

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- Level to be entered (e.g., T4 left side) using images to validate location. Procedures involving level (spine) will have preoperative and intraoperative imaging present in the operating/procedure room. During the intraoperative period, the level will be identified using high-quality imaging and marked with opaque markers with specific bony landmarks. The surgeon will stop after the initial incision and confirm the target level of the procedure by comparing the preoperative and intraoperative imaging.
- Implant to be inserted, specifically the:
  - Implant specification/type/expiration date
  - Size
  - Side or laterality

The pause will include verbal confirmation by the surgeon, circulating nurse and scrub.

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28. For Appropriate Cases, Do Wound or Body Cavity Exploration and Counts (Sponges/Soft Goods, Sharps, Instruments) Prior to Closure of Each Cavity

Body Cavity Entered/Created

Entering an existing body cavity or creating an artificial cavity during a surgical procedure, whether it is an open surgical wound or through a laparoscopic or hand-assisted procedure, increases the risk for an unintentionally retained foreign object. For the purposes of this protocol, an existing or artificially created body cavity are treated the same.

A methodical wound exploration will be performed prior to the closure of the wound and/or any body cavity. It is possible that the surgeon may perform multiple wound/body cavity explorations during the procedure (e.g., the stomach and abdominal cavities *(AORN, 2006 [R]; Eldridge, 2006 [NA]; VHA Directive, 2006 [NA]; American College of Surgeons, 2005 [R])*.

Whenever possible, the surgeon will use both visualization and touch during the cavity exploration. Generally, the type of surgical procedure performed guides the wound exploration technique employed. It is recommended that the wound exploration be methodical and performed by each physician the same way each time (e.g., top to bottom, quadrant to quadrant). For an example of a detailed methodical wound exploration process for open abdominal, pelvic or thoracic surgery, refer to Appendix D, "Veterans Administration Methodical Wound Exploration Process" *(Edlridge, 2006 [NA]; American College of Surgeons, 2005 [R]; Council of Surgical and Perioperative Safety, 2005 [R]; Gibbs, 2005 [R])*.

A methodical wound exploration may be omitted or abbreviated in an extreme patient emergency or if the patient becomes clinically unstable. Ideally, the method used to perform the wound exploration will be documented by the surgeon as part of the operative note.

The cavity exploration may be performed simultaneously with the counting by the scrub and circulator. The cavity will not be closed until counts have been reconciled. If the counts cannot be reconciled even after a thorough exploration of the cavity and the cavity is expected to be closed at the end of the procedure, an intraoperative film must be obtained prior to the cavity closure.

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Intraoperative and Postoperative Period Algorithm Annotations

29. Leaving Wound Open?

Certain circumstances require that a wound be left open following a surgical procedure with the intent that the patient will return to the operating/procedure room at a later time for final wound closure. Examples of these cases include grossly contaminated wounds (Class III and IV wounds) or when the patient is unstable or has the potential to develop instability (e.g., damage control procedure).

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31. Perform Delayed Wound Closure/Open Packing, Final Count and Retained Foreign Object Prevention Process

When the closure of a wound is intentionally delayed (damage control) or when implants are used as part of the treatment (e.g., antibiotic beads, wound-vacuum sponges), the following will be performed:

- Radiopaque items will be used if that product is manufactured in a radiopaque form *(AORN, 2006 [R]; Council on Surgical and Perioperative Safety, 2005 [R]).*
- Count the items and document the item categories and numbers in the procedure record.
- Any sponges/soft goods packed in the operating/procedure room and removed must be counted and documented in the patient's medical record.
- Any sponge/soft goods packed into or left on the wound must be counted and documented in the patient's medical record.

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32. Patient Returns to the Operating/Procedure Room for Final Wound Closure

- Establish a baseline count of sponges/soft goods, sharps and instruments that will be used in the final wound closure and document them on a preformatted white board (or on a preformatted count worksheet if a preformatted white board is not available).
- When the patient returns to the operating/procedure room for final wound closure, sponges/soft goods removed from the open wound should be isolated from sponges/soft goods used during the final wound closure.
- Count packed items as they are removed from the wound and reconcile the items and number of items with what was previously documented in the patient's medical record.
- When there is a discrepancy between what was removed and what was documented as left in the wound, an attempt to reconcile the discrepancy will be performed as described in Annotation #35, "Hard Stop – Perform Reconciliation Process."
- A thorough wound exploration will be performed prior to closing the wound and documented in the patient's record.
- Count the sponges/soft goods, sharps and instruments that were used in the final wound closure procedure and reconcile the count with what is documented on the preformatted white board (or on a preformatted count worksheet if a preformatted white board is not available).

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- When there is a discrepancy between the baseline count and the final count record, an attempt to reconcile the discrepancy is performed as described in Annotation #35, "Hard Stop – Perform Reconciliation Process."
- An intraoperative radiographic image should be obtained prior to final wound closure to ensure all items have been removed.

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35. Hard Stop – Perform Reconciliation Process

Process for Managing Count Discrepancies

When a discrepancy in countable items is identified, the missing item and number are reported to the surgical team by the circulator. A discussion (involving the surgeon, circulator nurse and scrub) will occur during which the circulator will communicate to the surgeon the type(s) and number(s) of missing foreign objects. If the patient's condition permits, wound closure should be suspended during the discussion regarding the missing foreign object. If wound closure has begun it will not continue until the discussion occurs. This is a Hard Stop.

The work group recommends that the circulating nurse organize used countable items in such a way that counts (e.g., closing a cavity within a cavity, initial closing count, final count) performed after the baseline count can be performed effectively and efficiently. Sponge count bags and numbered needle boards are tools that will help to organize items for counting.

If a closing count is incorrect, the following steps will be taken to reconcile the count if the patient's condition permits *(AORN, 2006 [R]; VHA Directive, 2006 [NA])*:

(1) The surgeon *must* be notified immediately. A discussion will occur, during which the circulator will communicate to the surgeon the type(s) and number(s) of missing items. This is a Hard Stop.

(2) The circulating nurse will summon additional personnel to the operating/procedure room to assist with resolving the count.

(3) The surgeon will re-explore the wound paying special attention to the location where that particular item may be retained (e.g., sponges tucked behind organs).

(4) The count is repeated and verified. A discrepancy with the count will never be resolved by using the number listed on opened packages.

(5) Surgical closure may continue at the surgeon's discretion, but final skin closure cannot occur until all x-ray results are reviewed and communicated back to the surgeon by the radiologist.

(6) If the item is still missing after the recount and wound exploration, the scrub team must search the drapes, field, Mayo stand, and back table. At the same time, the circulating nurse must search the sponge count bag, trash, linen, floor, kick bucket(s) and all items that have been counted off the field. Sponges/soft goods will be unballed and separated for counting.

(7) If the item is located in this search, a complete recount *must* be conducted and the correct count documented.

(8) If counts cannot be reconciled by team members, and the missing item is radiopaque, notify the attending surgeon and obtain an x-ray order to "rule out retained foreign object."

(i) These images will be marked "STAT" and will be prioritized before other radiology requests.

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(ii) Portable intraoperative imaging should be obtained and reviewed by the surgeon and radiologist before wound closure. See Annotation #37, "Imaging If Counts Not Reconciled: Postoperative Follow-Up If Counts Remain Unreconciled."

(iii) The intraoperative film order will indicate a phone number for the appropriate operating/procedure room for proper follow-up to occur.

(iv) In response to a film ordered to "rule out retained foreign object," the interpreting radiologist will discuss the findings with the surgeon. The two individuals will view the images simultaneously to identify all findings. The name of the surgeon and time the call was made will be recorded in the radiology report. Additional films with various angles may also be requested in order to view the possible retained foreign object.

If the counts cannot be reconciled, all the measures taken and the outcomes of those steps should be documented per the organization's policy. A radiographic image obtained in a radiology room with fixed equipment and moving grid should be obtained.

Note: The Minnesota Adverse Event Reporting law requires the reporting of a retained foreign object. The above reconciliation steps give consideration to the current definition of a reportable event and are intended to avoid such an adverse event. The work group will continue to review for evidence supporting best practice.

Policy exception:

An exception may occur when the attending surgeon decides that any delay required for an intraoperative x-ray or removal of the foreign object(s) will cause harm to the patient due to their emergent medical condition.

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37. Imaging If Counts Not Reconciled: Postoperative Follow-Up If Counts Remain Unreconciled

Radiographic imaging, whether a portable radiographic image obtained in the operating/procedure room or a postoperative image obtained in a radiographic room, is not a substitute for performing an accurate count process and methodical wound exploration.

An intraoperative radiographic image can be used to exclude the possibility of a retained foreign object. Portable radiographic imaging has limitations that should be considered, especially for visualizing micro needles. In addition, the type of imaging equipment (e.g., C-arm) used and cassette orientation relative to the surgical site should be considered.

The highest quality radiographic imaging is obtained in a radiographic room with fixed radiographic equipment and moving grid. If there are still unreconciled counts, it is recommended that the surgeon have a discussion with the patient and make a follow-up plan. The plan could include additional imaging (x-ray, computed tomography, magnetic resonance imaging).

Portable imaging considerations and limitations:

- patient condition
- size and type of retained item (non-radiopaque items, micro needles)
- limited placement options of the radiographic film cassettes under operating/procedure room tables limiting anatomy included on the images
- lower tube power

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- instruments obscuring the image area
- availability of portable radiographic equipment and staff

Portable intraoperative imaging should be obtained when:

- counts are off and cannot be reconciled,
- the patient's condition did not allow for the count process to be followed (rushed counts, incomplete counts),
- any individual has a concern about the accuracy of the counts, or
- before final closure when the wound was previously intentionally left open/packed.

Imaging requests to rule out a possible retained foreign object need to include the following information:

- Callback number and surgeon's name
- Location and status of patient (e.g., in operating/procedure room with wound closure suspended, in post-anesthesia care unit)
- Type of surgery
- Type of item missing
- Details of the surgery as appropriate

The radiology technologist will review the radiographic images for quality and repeat the imaging as necessary.

Prior to the radiographic images being interpreted by radiology, the surgeon will review the radiographic images for adequate anatomic coverage related to the procedure and operative site. If the surgeon is unable to verify adequate anatomic coverage on the portable intraoperative images, postoperative radiographic imaging with fixed radiographic equipment should be obtained.

The work group recommends that the radiologist and surgeon simultaneously review the radiographic images both verbally and visually to correlate the anatomical coverage of the images with the surgical procedure, as well as a description of the potentially retained foreign object.

If a radiologist is not immediately available, the preliminary interpretation of the radiographic images to exclude a potentially retained foreign object is the responsibility of the surgeon.

Postoperative radiographic imaging in a radiographic room with fixed radiographic equipment and moving grid should be obtained as soon as possible when there is a discrepancy in the counts and:

- the patient's condition did not allow for intraoperative imaging to be obtained,
- the entire anatomic area was not included in the portable intraoperative imaging, or
- the intraoperative imaging failed to locate the retained foreign object and the counts could not be reconciled.

Prior to the radiographic images being interpreted by radiology, the surgeon will review the radiographic images for adequate anatomic coverage related to the procedure and operative site. The radiology technologist will review the radiographic images for quality and repeat the imaging as necessary *(AORN, 2006 [R]; VHA Directive, 2006 [NA]; Council on Surgical and Perioperative Safety, 2005 [R]).*

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38. Close Wound

Close Wound and Finish Procedure

A radiographic image prior to closure of the wound does not need to be obtained when count processes are rigorously followed and all counts can be reconciled.

Post-procedure tasks

- Any countable item that accompanies the patient out of the operating/procedure room will be communicated to the circulator and documented *(AORN, 2006 [R]; Council on Surgical and Perioperative Safety, 2005 [R])*.
- After the counts have been reconciled, all items will be removed from the operating/procedure room. No items will be removed from the operating/procedure room until all counts have been reconciled and inspections completed.
- The white board will be cleaned at the end of the procedure and before setup begins for the next procedure.
  - Note: The date, time, type and number of any unaccounted for item will be recorded on the white board and communicated to each subsequent surgical team until the operating/procedure room is terminally cleaned.

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Postoperative Period Algorithm Annotations

39. Patient Transport to Postoperative Care Location (Reverify Patient Identification, Allergies)

Receiving staff completes verification process and reviews for other pertinent patient-care related elements such as allergies, procedure completed, clinical information, etc., while establishing postoperative plan of care.

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40. Venous Thromboembolism Prophylaxis, Beta-Blockers, Glycemic Control, Normothermia, Discontinue Antibiotics in 24 hours

It is recommended that each organization assign who is responsible for oversight and management of the following.

Post-Anesthesia Care (typically under the direction of the anesthesiologist) in Post-Anesthesia Care Unit: nursing care provided in the immediate post-anesthesia period following a surgical procedure.

Infection Prevention

- **Inspired FIO2**

  The effects of the level of inhaled oxygen on surgical site infection rates have been studied. Although an initial study provided evidence that patients who received high levels of inhaled oxygen during colorectal surgery developed fewer surgical site infections *(Greif, 2000 [A])*, data to the contrary recently have been reported *(Pryor, 2004 [A])*. Unfortunately, several of the aforementioned studies report surgical site infection rates among study patients that are higher than those reported and expected among similar groups of patients, making comparison difficult. Of note, stratification

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using the NNIS classification methodology was not employed. Further evaluation via multicenter studies is needed prior to implementation of these modalities as standard therapies.

Normothermia Management

Upon arrival to post-anesthesia care units, initial patient assessment should include signs of hypothermia. Postoperative shivering, while an effective thermoregulatory mechanism, results in increased cardiac stress and should therefore be treated using active warming devices *(Nesher, 2005 [A]; Brauer, 2004 [A]; Melling, 2001 [A]; Kurz, 1996 [A])*. Isolated shivering in a normothermic patient can be treated with meperidine.

Patients undergoing procedures employing cardiopulmonary bypass should be rewarmed using an active warming device. The use of any device is more important than the specific type of device.

Postoperative Management (typically under the direction of the surgeon, intensivist and anesthesiologist)

Infection Prevention

- **Antibiotic discontinuation**

  There is evidence that extending antibiotic prophylaxis past 24 hours does not decrease the risk of surgical site infection and does increase the potential for patient intolerance and complications *(Prokuski, 2006 [R]; Bratzler, 2005b [B]; Mui, 2005 [A]; Mangram, 1999a [R])*.

- **Hand hygiene**

  - Skin is a major potential source of microbial contamination.
  - Hand hygiene is a critical step in prevention and spread of infection. It is the single most important step in the prevention of infection.
  - Hand washing by nursing staff and physicians managing wound dressings should take place before and after every contact. Hand gels appear to be as effective as washing with soap.

  (Mangram, 1999a [R])

Normothermia Management

Body temperature should be maintained as close to normal as possible, using any of a variety of safe, non-invasive means.

Glucose Control

Refer to Annotation #1, Preoperative Evaluation and Surgical Planning and Scheduling."

Beta-Blockers

Studies have shown that beta-blockers should be continued through hospitalization, if not longer. Beta-blockers should be tapered, instead of abruptly discontinued, to avoid hyperadrenergic withdrawal responses. One study observed an increased risk for postoperative myocardial infarction in patients who had beta-blockers discontinued immediately after surgery. Other studies indicated that therapy could be discontinued after the first postoperative week in low- to moderate-risk patients, and should be continued at least 14 to 30 days postoperatively in patients undergoing vascular procedures. Patients who had been receiving long-term therapy may be maintained on a regimen for continuity of therapy *(Mason, 2006 [R])*.

Venous Thromboembolism Prophylaxis

- Continue established protocol orders for venous thromboembolism prevention (mechanical and/or pharmacologic prophylaxis). Refer to ICSI Venous Thromboembolism Prophylaxis guideline.
- Ensure intermittent pneumatic compression devices, if used, do not hinder ambulation and are not removed for long periods of time.
- Ensure that intermittent pneumatic compression devices, if used, are turned on and are working properly.
- Instruct the patient on the importance of ambulating per the surgeon's postoperative orders.

(AORN Guideline for Prevention of Venous Stasis, 2007 [R])

Incision Management and Wound Care

- Protect the incision with sterile dressing for 24-48 hours.
- Minor surgical wounds can be allowed to get wet in the first 48 hours without increasing risk of infection *(Heal, 2006 [A])*.
- Extremity wounds may be covered with a clear film dressing, which reduces the rate of blistering and exudates *(Cosker, 2005 [A])*.
- Surgical wounds in children may be left without dressings without additional risk of infection *(Merei, 2004 [A])*.
- Limb amputation wounds are best treated with rigid postoperative dressings to reduce the rate of infection.
- There are no unique advantages to any type of dressing/packing following septoplasty.

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41. Dismiss Patient/Discharge Planning: Patient Education/Glycemic Management/Follow-Up Appointments

Patient Education

- Patients and families should be educated on how to manage their postoperative pain when to resume activities of daily living and how to manage other risk factors such as diabetes, incontinence and impaired immune status/response.
- Patients will be educated on medications that are prescribed at discharge. Medication reconciliation will be completed and a current medication list sent home with the patient.
- All patients should be educated on the signs and symptoms of surgical site infection *(Mangram, 1999a [R])*.
- Patients and families should be provided emergency contact numbers and instructions on whom to call.
- Nurse must confirm that discharge instructions have been explained and patients and family should verbalize understanding. Because patients may forget verbal instructions, written instructions should be provided *(Schlossberg, 1992 [X])*.
- When necessary, the nurse should verify that the patient will have care assistance for at least 24 hours.
- Patient and families should be educated on the importance of good hand hygiene in the prevention of infection. Patients and families managing wound dressings should wash their hands (either soap and

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water or waterless hand gels) before and after every contact. Hand gels appear to be as effective as washing with soap *(Mangram, 1999a [R])*.

- Patients and families should be instructed on proper incision and wound care recommendations:
  - Protect the incision with a sterile dressing for 24-48 hours.
  - Minor surgical wounds can be allowed to get wet in the first 48 hours without increasing risk of infection *(Heal, 2006 [A])*.
  - Extremity wounds may be covered with a clear film dressing which reduces the rate of blistering and exudates *(Cosker, 2005 [A])*.
  - Surgical wounds in children may be left without dressings without risk of infection *(Merei, 2004 [A])*.

Glycemic Control

Patients with diabetes should receive instructions on the role of good glucose control in the prevention of surgical site infections. Outcomes are improved for those with preoperative Hgb A1c less than 7 *(Dronge, 2006 [B])*.

Beta-Blockers

Refer to Annotation #40, "Venous Thromboembolism Prophylaxis, Beta-Blockers, Glycemic Control, Normothermia, Discontinue Antibiotics in 24 Hours."

Follow-Up Appointments

Patients should be encouraged to schedule and keep all follow-up appointments with their surgeon and primary provider. Follow-up appointments provide the opportunity for the surgeon and primary provider to assess the patient for signs and symptoms of infection related to the surgical procedure and intervene or modify the care plan as appropriate *(Mangram, 1999a [R])*.

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This section provides resources, strategies and measurement for use in closing the gap between current clinical practice and the recommendations set forth in the protocol.

The subdivisions of this section are:

- Aims and Measures
  - Measurement Specifications
- Implementation Recommendations
- Resources
- Resources Table

Aims and Measures

Outcome Aims and Measures

1. Eliminate the wrong surgical procedure or surgery performed on the wrong body part, or on the wrong patient. *(Annotations #15, 19)*

   Measures for accomplishing this aim:

   Outcome Measures:

   a. Wrong surgery events per month.

   b. Rate of wrong surgery events per month.

   c. Near misses reported per month.

2. Eliminate unintentionally retained foreign objects during a surgical procedure. *(Annotations #11, 24, 37)*

   Measures for accomplishing this aim:

   Outcome Measure:

   a. Number of unintentionally retained foreign objects in surgery.

   b. Rate of unintentionally retained foreign objects in surgery.

3. Decrease the rate of infections in surgical patients undergoing clean surgery. *(Annotations #2, 3)*

   Measure for accomplishing this aim:

   Outcome Measures:

   a. Rate or percentage of postoperative wound infection in patients undergoing clean surgery. (IHI, 5M Lives Campaign)

Process Aim and Measures

4. Improve the adherence of the key components of the Perioperative Protocol. *(Annotations #1, 2, 3, 5, 9, 11, 14, 15, 19)*

   Measures for accomplishing this aim:

   Process Measures:

   a. Percentage of surgical patients with documentation of preoperative verification of correct patient, procedure, and site/side/level.

   b. Percentage of appropriate surgical patients who had their site marked by the surgeon in preoperative with his/her initials.

   c. Percentage of surgical cases in which a verbal, active Time Out has been conducted by all appropriate members of the surgical team prior to incision.

   d. Percentage of surgical cases where the baseline count was conducted prior to the patient arriving in the operating/procedure room.

   e. Percentage of surgical cases where counts were not reconciled and imaging was performed.

   f. Percentage of surgical patients with prophylactic antibiotic received within 60 minutes prior to surgical incision. (SCIP-Inf-1*)

g. Percentage of surgical patients receiving prophylactic antibiotic selection consistent with guidelines for specific surgical type. (SCIP-Inf-2*)

h. Percentage of surgical patients whose prophylactic antibiotic is discontinued within 24 hours after surgery end time. (SCIP-Inf-3*)

i. Percentage of cardiac surgery patients with controlled 6 a.m. blood glucose (greater than or equal to 200 mg/dL) on postoperative day one and postoperative day two. (SCIP-Inf-4*)

j. Percentage of selected surgical patients with appropriate surgical site hair removal. (SCIP-Inf-6*)

k. Percentage of patients with urinary catheter removed on postoperative day one or postoperative day two with day of surgery being zero. (SCIP-Inf-9*)

l. Percentage of selected surgical patients with immediate postoperative normothermia (greater than or equal to 96.8°F) within 15 minutes after leaving the operating/procedure room. (SCIP-Inf-10*)

m. Percentage of surgical patients on beta-blocker therapy prior to admission who received beta-blocker during the perioperative period. (SCIP-Card-2*)

n. Percentage of surgery patients with recommended venous thromboembolism prophylaxis orders within 24 hours prior to surgical incision time to 24 hours after surgery end time. (SCIP-VTE-1*)

o. Percentage of surgery patients who received appropriate venous thromboembolism prophylaxis within 24 hours prior to surgical incision time to 24 hours after surgery end time. (SCIP-VTE-2*)

p. Percentage of surgical patients who have had all required components of the perioperative protocol applied.

* For current and comprehensive information on SCIP measures, refer to the Specifications Manual for National Hospital Inpatient Quality Measures.

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Measurement Specifications

Measurement #1a

1a. Number of wrong surgery events per month

or

1b. Rate of wrong surgery events per N surgical procedures.

Population Definition

Patient of all ages who have a surgical procedure performed.

Data of Interest

1a. # of wrong surgery events per month, see definition below

1b. Rate of wrong surgery events per N surgical procedures

$$\frac{\text{\# of wrong surgery events}}{\text{Total \# of surgical cases per month}} \times N$$

N is determined based on the size of the denominator

If denominator is less than 100, use a rate of per 100

If denominator is greater than 100 – less than 1,000, use rate of per 1,000

If denominator is greater than 1,000 – less than 10,000, use a rate of per 100,000

If denominator is greater than 10,000 – less than 100,000, use a rate of per million

Numerator and Denominator Definitions

Numerator: Wrong surgery event is defined as a wrong surgical procedure, a surgical procedure performed on the wrong patient, or a surgical procedure performed on the wrong side, site or level.

Denominator: Surgery is defined as an invasive procedure that takes place in an operating/procedure room by surgeon.

Method/Source of Data Collection

Event data should be reported through an incident or sentinel event report or follow the hospital's policy for reporting.

Total surgical cases can be collected through the surgical schedule, log, or hospital billing.

Data Collection Time Frame

The suggested time period is a calendar month, but three months could be consolidated into quarterly data points, as well, if case load and/or event numbers are small.

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Measurement #2

2a. Number of unintentionally retained foreign objects in surgery

or

2b. Rate of unintentionally retained foreign objects in surgery

Population Definition

Patients of all ages who have a surgical procedure performed.

Data of Interest

2a. # of unintentionally retained foreign objects (reported as a raw number)

2b. Rate of unintentionally retained foreign objects

$$\frac{\text{\# of unintentionally retained foreign objects}}{\text{Total \# of surgical cases per month}} \times N$$

N is determined based on the size of the denominator

If denominator is less that 100, use a rate of per 100

If denominator is greater than 100 but less than 1,000, use rate of per 1,000

If denominator is greater than 1,000 but less than 10,000, use a rate of per 10,000

If denominator is greater than 10,000 but less than 100,000, use a rate of per 100,000

Numerator/Denominator Definitions

Numerator: Unintentionally retained foreign object is any object unintentionally retained after a surgical procedure.

Denominator: Surgery is defined as an invasive procedure that takes place in an operating/procedure room by a surgeon.

Method/Source of Data Collection

Event data should be reported through an incident report or sentinel event report.

Total surgical cases can be collected through the surgical schedule, log, or hospital billing.

Time Frame Pertaining to Data Collection

The suggested time period is a calendar month but three months could be consolidated into quarterly data points, as well, if caseload and/or event numbers are small.

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Measurement #3

Rate or percentage of infection in patients undergoing clean surgery.

Numerator/Denominator Definitions

Numerator: Number of clean surgery patients having a postoperative wound infection

Denominator: Number of clean surgery patients

- If reporting as a rate, you would take the numerator divided by the denominator and multiple by 1,000)

Denominator exclusions:

- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases
- Patients with documentation by physician of infection prior to surgical procedure

Method/Source of Data Collection

Sample size: Suggestion to begin by looking for total surgical site infections. If less than or equal to 25 cases occur per month, analyze total number. If greater than 25, you may choose to review all or take a random sample of 25.

Time Frame Pertaining to Data Collection

Monthly

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Measurement #4

Improve the adherence of the key components of the safe site protocol in surgical cases.

Measurement Specification

4a. Percentage of surgical patients with documentation of verification of correct patient, site/side and procedure.

4b. Percentage of appropriate surgical patients who have their site marked by the surgeon in preop with his/her initials.

4c. Percentage of surgical cases in which a verbal, active Time Out is conducted by all appropriate members of the surgical team prior to incision.

4d. Percentage of surgical cases where the baseline counts was conducted prior to the patient arriving in the operating/procedure room.

4e. Percentage of surgical patients with prophylactic antibiotic received within 60 minutes prior to surgical incision.

Population Definition

Patients of all ages who have a surgical procedure performed.

Data of Interest

4a. $\frac{\text{\# of charts/flowsheets/electronic medical record with documentation of verification of correct patient, correct site/side and correct procedure}}{\text{Total \# of surgical patients reviewed}}$

4b. $\frac{\text{\# of surgical patients with sites marked with surgeon's initials}}{\text{Total \# of patients appropriate for site marking}}$

4c. $\frac{\text{\# of surgical cases observed to have active, verbal participation in the Time Out prior to incision/insertion by all appropriate surgical team members}}{\text{Total \# of surgical cases observed}}$

4d. $\frac{\text{\# of patients having a baseline count conducted and documented on the white board prior to surgical Time Out}}{\text{Total \# of surgical cases}}$

4f. $\frac{\text{\# of selected surgical patients whose prophylactic antibiotics were initiated within 60 minutes prior to surgical incision}}{\text{Selected surgical patients (exclusions listed below)}}$

Denominator exclusions:

- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases
- Patients who were receiving antibiotics within 24 hours prior to arrival
- Patients who were receiving antibiotics more than 24 hours prior to surgery

- Patients with documentation by physician of infection prior to surgical procedure
- Patients who had other procedures that required general or spinal anesthesia that occurred within 24 hours prior to this procedure during this hospital stay

Method/Source of Data Collection

Retrospective collection of any measures associated with documentation can be done by randomly sampling charts of patient cases.

Concurrently, collection will need to be done through direct observation either by a quality/safety advocate or "secret shopper," someone who has a dual function on the team but whose observation and measurement function is not known.

Data Collection Time Frame

Suggested sample size and time frame for any of these measures would be minimum of 10 per month. A larger hospital with a large caseload for surgery and adequate resources could have a larger sample size.

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Implementation Recommendations

Prior to implementation, it is important to consider current organizational infrastructure that address the following:

- System and process design
- Training and education
- Culture and the need to shift values, beliefs and behaviors of the organization

The following system changes were identified by the protocol work group as key strategies for health care systems to incorporate in support of the implementation of this protocol.

System implementation:

- The facility is encouraged to customize the protocol with a key that identifies the individuals responsible for completing the algorithm tasks (e.g., green shapes for those individuals responsible for counts).
- Leadership support and a surgeon champion is absolutely essential for the successful implementation of this protocol.
- Develop a procedural checklist to document completion of each step and ensure that all elements of the protocol are completed.
- Direct observations, along with coaching and immediate feedback, are effective strategies in gaining staff adherence to the protocol following implementation. Additionally, the use of crucial conversation tactics can be effective for staff.
- As it relates to this protocol, create and implement a process that allows for the detection and management of disruptive and inappropriate behavior. This process should include education to all physicians and non-physicians regarding appropriate professional behavior; the development of policies and procedures. Refer to The Joint Commission's leadership standards.
- Red rules* should be established, followed by staff and physicians and supported by leadership (see below for specific red rules suggested for this protocol).
  - *Red rules are the few, key rules created to prevent/address the specific actions that pose the highest level of consequence and risk to safety of patients or staff. The intention is to develop solid habits around these rules so that they are followed consistently and accurately each time. Individual responsibility to adhere to each red rule is imperative to ensure the safest environment and delivery of the care process.
  - Suggested red rules:
    - Never operate on a patient without verifying the correct patient identity, correct procedure and correct site.
    - Baseline counts are consistently performed before the patient arrives in the operating/ procedure room unless parallel processing is used.
    - Unreconciled counts require imaging verification, and wound closure stops until count reconciliation is achieved.

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Retained foreign object implementation:

- The work group recommends that a preformatted white board be used as the primary record of the count. Documenting counts on a white board allows all surgical staff, and in particular the scrub tech, to independently view the count record. A public display of the count record in an area where the entire surgical team can view it is likely to reinforce the importance of the count process.
- The work group also recommends that a count worksheet be used as a memory aid when the white board is not easily accessible in a timely manner. The count worksheet should be used only as a memory aid for the baseline count and, if needed, for subsequent counts. It should be used rather than a piece of scratch paper. In contrast, if the white board is located very close to the area when the count occurs, and if the circulating nurse can easily write the counts on the white board without leaving the count area, there will be no need to use the count worksheet.
- Distractions and interruptions should be kept to a minimum during the count process. If a count is interrupted, then the category of items (e.g., laps) being counted will need to be recounted.

Surgical infection implementation:

- Using preprinted or computerized order sets can help in reminding and remembering specific antibiotics, timing, dose and discontinuation.
- Review patient education material to verify the message around no self-shaving before surgery. Distribute standardized patient education messages to surrounding outpatient clincs, as well.
- Remove all razors from the perioperative area.
- Use warming blankets, hats and booties routinely for patients.
- Establish an effective surveillance process that includes post-discharge or outpatient surveillance. Use inpatient case-finding for post-discharge or outpatient. It is important to include the following:
  - Use standardized definitions for surveillance of infections. These definitions also need to take into account the setting in which the surgical procedure was performed (acute care, ambulatory surgical center, etc.).
  - Establish a risk stratification for estimating surgical infection that adjusts for risk factors associated with infection for different care settings and procedures.
  - Work with surrounding outpatient clinics to develop communication strategy for tracking surgical infections and reporting back to the hospital.

Safe site implementation:

- To facilitate implementation of the Hard Stop concept, have your chief executive officer communicate to all staff and physicians their support for the institution of the Hard Stop.
- The Time Out is best followed when a particular person/role has responsibility to call the Time Out. The surgeon should then be the one to take the lead on initiating the Time Out and have the circulator begin the review of information.
- Establish pre-procedure and post-procedure communication standards in the form of structured hand-offs.
- Develop a verification process at the point of scheduling. The work group recommends that this process include:
  - Corroboration between the surgical consent, the order to schedule a procedure and an independent source document dictation (such as a radiology report or pathology report).

- Review of documents by a licensed independent practitioner or an RN, with attention directed specifically to the organ to be operated upon and laterality as appropriate before proceeding to the scheduling process.
- The independently verified documentation provided on paper, fax or electronic format, not by telephone or verbal communication. The only exception to this is during emergency situations.

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Resources

Criteria for Selecting Resources

The following resources were selected by the protocol work group as additional resources for providers and/or patients. The following criteria were considered in selecting these resources.

- The site contains information specific to the topic of the protocol.
- The content is supported by evidence-based research.
- The content includes the source/author and contact information.
- The content clearly states revision dates or the date the information was published.
- The content is clear about potential biases, noting conflict of interest and/or disclaimers as appropriate.

Resources Available to ICSI Members Only

ICSI has a wide variety of knowledge resources that are ***only*** available to ICSI members (these are indicated with an asterisk in far left-hand column of the Resources table). In addition to the resources listed in the table, ICSI members have access to a broad range of materials including tool kits on CQI processes and Rapid Cycling that can be helpful. To obtain copies of these or other Resources, go to http://www.icsi.org/improvement_resources. To access these materials on the Web site, you must be logged in as an ICSI member.

The resources in the table on the next page that are not reserved for ICSI members are available to the public free-of-charge.

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Resources Table

*	Author/Organization	Title/Description	Audience	Web Sites/Order Information
	American College of Surgeons	The American College of Surgeons is a scientific and educational association of surgeons that work to improve the quality of care for the surgical patient. The Web site provides information for patients, the public, and surgeons.	Health Care Professionals; Patients and Families	http://www.facs.org
	American Hospital Association	Tips for Safer Surgery A tip sheet for patients and their families with questions to ask before surgery.	Patients and Families	http://www.aha.org
	American Society of Anesthesiology	The American Society of Anesthesiology is an educational, research and scientific association of physicians organized to raise and maintain the standards of the medical practice of anesthesiology and improve the care of the patient.	Health Care Professionals	http://www.asahq.org
	American Society of PeriAnesthesia Nurses (ASPAN)	The American Society of PeriAnesthesia Nurses is the professional specialty nursing organization representing the interests of nurses practicing in all phases of preanesthesia and postanesthesia care, ambulatory surgery, and pain management.	Health Care Professionals	http://www.aspan.org
	Association of Peri-Operative Registered Nurses (AORN)	The Association of periOperative Registered Nurses (AORN) is a professional association that "empowers the operating/procedure room nurse with education, standards of practice, and peer networking."	Health Care Professionals	http://www.aorn.org
	Department of Veterans Affairs Veterans Health Administration, Washington, DC 20420	VA National Center for Patient Safety (NCPS) The Web site's provides information for health care professionals and health care administrators. However, veterans and the general public are encouraged to explore the site. The Patient Safety for patients sections provides information, tips and tools, and resources for patients and families.	Health Care Professionals; Patients and Families	http://www.va.gov/ncps/

* Available to ICSI members only.

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*	Author/Organization	Title/Description	Audience	Web Sites/Order Information
*	Institute for Clinical Systems Improvement, the ICSI Perioperative work group, and ICSI member groups	Surgical Care Tool Kit – • Surgical Procedural Checklist • Sample Count Sheet • Sample Cardiovascular Blade and Needle Count Sheet • Hand-off Communication Scrub to Scrub • Hand-off Communication Surgical Services • WHO surgical safety checklist • Briefings Handout • Briefings "How To" • Pre-procedure Verification Checklist	Health Care Professionals	http://www.icsi.org/tools
	Institute for Healthcare Improvement	Independent not-for-profit organization helping to lead the improvement of health care throughout the world. Web site provides various tools supporting patient safety.	Health Care Professionals	http://www.ihi.org
	The Joint Commission	Joint Commission Web site for regulatory standards and patient safety goals.	Health Care Professionals	http://www.jointcommission.org
	Minnesota Department of Health	Minnesota Department of Health The site provides patient safety information that includes adverse event reporting and information for consumers and patients.	Health Care Professionals; Patients and Families	http://www.health.state.mn.us/patientsafety/index.html
	Minnesota Hospital Association	The Minnesota Hospital Association Safe Site Call to Action Web site includes tools that address procedures outside the operating room.	Health Care Professionals	http://www.mnhospitals.org
	National Initiative for Children's Healthcare Quality Pediatric Affinity Group	Reducing Surgical Complications/ Surgical Site Infections: Pediatric Supplement A how-to guide for surgical site infection in the pediatric population.	Health Care Professionals	http://www.nichq.org/areas_of_focus/patient_safety_infections.html

* Available to ICSI members only.

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The subdivisions of this section are:

- References
- Appendices

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Appendix A – Incorporating Human Factors Systems Design into Work Process Design

Two large population-based studies of medical injury published in 1991 and 2000 led to the initiation of many efforts to reduce medical error. The first of the studies, the Harvard Medical Practice Study (HMPS), examined the outcomes of 30,121 randomly chosen patient cases from 51 hospitals in New York State in 1984 *(Brennan, 1991 [C]; Leape, 1991 [C])*. In the second, the Utah and Colorado Medical Practice Study (UCMPS), the records of 14,052 randomly selected hospitalizations from 28 hospitals in Utah and Colorado in 1992 were reviewed *(Thomas, 2000 [C])*. Similar results were found in both studies, and extrapolation from the results of the most recent of the studies, the UCMPS, indicates that approximately 44,000 deaths recorded in 1997 in the United States of America could have occurred as a result of preventable adverse events. Many efforts to reduce medical error that were initiated as a result of these studies have included Human Factors methodology to investigate and improve health care systems.

Human Factors emphasizes designing systems and producing work processes that enhance human performance. Human Factors Systems Design considers weaknesses and strengths in the entire medical delivery process from diagnosis through the prescription and delivery of treatment, and includes examining the work processes of, for example, surgeons, anesthesiologists, nurses, scrub technicians, phlebotomists, pharmacists, and health unit coordinators.

Human Factors Systems Design focuses on how the work process and performance of health care providers are affected by issues such as work space design; the functionality and ease of using electronic medical records systems; distractions and interruptions; workload; the complexity, length and urgency of procedures, fatigue and personal stress; intra- and interdepartmental communication issues; staffing requirements; the use of float staff; shift changes; staff competencies; and training.

Human Factors Systems Design seeks to identify the probable and potential causes of errors and to identify factors contributing to safety gaps in medical processes. Then design improvements, based on Human Factors principles, are developed so that the errors and safety gaps are addressed without introducing problems elsewhere in the system. The goal is to foster better work environments, minimize potential errors, improve patient care, and enhance patient safety.

Communication Factors and Events

In root cause analysis findings submitted to The Joint Commission in the 10 years from 1995 to 2005, the number one reason identified as causal in all sentinel events was communication *(Joint Commission of Accreditation Organization, 2006 [NA])*. In 2006, in an attempt to address these findings, The Joint Commission required accredited organizations to implement a national patient safety goal (NPSG) related to communication. While organizations have been given flexibility in determining how to meet the expectations of this goal, many have adopted SBAR (situation, background, assessment and recommendation) as one way of improving communication. While SBAR has its origins in the nuclear power and commercial aviation industries, it has been successfully adapted to the medical community *(Haig, 2006 [D])*.

One of the benefits of this communication model is that it addresses the different ways in which physicians are trained to communicate versus other health care professionals, especially nurses *(Leonard, 2004 [D])*.

One mechanism to decrease events, including retained items, is the use of preprocedural briefings. The purpose of a briefing is to ensure that all the members of the team are working toward a common goal and are aware of any concerns the physician/nurse midwife may have related to the procedure. The briefing also provides a platform for any member of the team to raise a misgiving *(ECRI, 2005 [R])*. At the conclusion of the procedure, team members can debrief the process to identify what went well, what could have been done differently, and what can be done the next time *(ECRI, 2005 [R])*.

Both communication methodologies promote the use of "stop the line." Again, developed outside the health care industry, this concept allows any member of the team to speak up about a patient safety concern at any time during the procedure. Implementing a "stop the line" process requires a culture that promotes and rewards behaviors consistent with patient safety efforts. No matter the outcome, the willingness of the individual to raise a concern is directly related to the organization's administrative support of the action.

(Harder, 2006 [D]; Lingard, 2004 [D])

Distractions, Environmental Factors and Events

When an event occurs, one of the contributing factors that are explored is the environment. Noise in the procedure room, including music, can interfere with the team's ability to communicate, increase stress levels and adversely affect motor skills *(Vincent, 2004 [R])*. Distractions (e.g., pagers in the labor and delivery room) and interruptions by individuals not directly involved should be kept to a minimum, especially during critical stages of a procedure *(ACOG, 2006 [R])*. Other factors that should be taken into consideration when evaluating the environment are adequate lighting in the room for team members to see clearly and read labels, unpleasant odors that may be a direct result of the procedure being performed, or the room temperature. While the latter two factors may be outside the direct control of the team members, nonetheless they should be taken into consideration and recognized as risk factors for an event.

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Appendix B – List of Invasive, High-Risk or Surgical Procedures

- Any procedures involving skin incision
- Any procedures involving general or regional anesthesia, monitored anesthesia care, or conscious sedation
- Injections of any substance into a joint space or body cavity
- Percutaneous aspiration of body fluids or air through the skin (e.g., arthrocentesis, bone marrow aspiration, lumbar puncture, paracentesis, thoracentesis, suprapubic catheterization, chest tube)
- Biopsy (e.g., bone marrow, breast, liver, muscle, kidney, genitourinary, prostate, bladder, skin)
- Cardiac procedures (e.g., cardiac catheterization, cardiac pacemaker implantation, angioplasty, stent implantation, intra-aortic balloon catheter insertion, elective cardioversion)
- Endoscopy (e.g., colonoscopy, bronchoscopy, esophagogastric endoscopy, cystoscopy, percutaneous endoscopic gastrostomy, J-tube placements, nephrostomy tube placements)
- Laparoscopic procedures (e.g., laparoscopic cholecystectomy, laparoscopic nephrectomy)
- Invasive radiological procedures (e.g., angiography, angioplasty, percutaneous biopsy)
- Dermatology procedures (biopsy, excision and deep cryotherapy for malignant lesions – excluding cryotherapy for benign lesions)
- Invasive ophthalmic procedures, including miscellaneous procedures involving implants
- Oral procedures including tooth extraction and gingival biopsy
- Podiatric invasive procedures (removal of ingrown toenail, etc.)
- Skin or wound debridement performed in an operating/procedure room
- Electroconvulsive treatment
- Radiation oncology procedures
- Central line placement
- Kidney stone lithotripsy; and
- Colposcopy, and/or endometrial biopsy

Procedures **NOT** considered surgical, high-risk or invasive include:

- Electrocautery of lesion
- Venipuncture
- Manipulation and reductions
- Chemotherapy/oncology procedure
- Intravenous therapy
- Nasogastric tube insertion
- Foley catheter insertion
- Flexible sigmoidoscopy
- Vaginal exams (Pap smear)

This list is not meant to be comprehensive and was drawn from United States Department of Veterans Affairs. The PDF version of VHA Directive 2004-028 was last accessed on November 23, 2010, at http://www1.va.gov/vhapublications/ViewPublication.asp?pub ID=1106.

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Appendix C – Overview of Topical Antiseptics Used for Preoperative Skin Preparation

The properties listed in the left-hand column are those that are desirable in a skin preparation product. No one product has all desirable traits and is also without potential risk. No studies have adequately assessed the comparative effects of these preoperative skin antiseptics on surgical site infection risk in well-controlled, operation-specific studies.

Properties	Chlorhexadine (CHG)	Povodine-iodine (PVP-I)	Alcohol	CHG + Alcohol	PVP-I + Alcohol	PCMX
Examples of trade names	Hibiclens	Betadine	Alcohol	Chloraprep	Duraprep	Technicare*
Killing gram pos. bacteria	Excellent	Excellent	Excellent	Excellent	Excellent	Good
Killing gram neg. bacteria	Good	Good	Excellent	Excellent	Excellent	Fair (*Good against Pseudomonas*)
Rapidity of action	Intermediate	Intermediate	Most Rapid	Rapid	Rapid	Intermediate
Persistence	Excellent	Minimal but will maintain as long as present on skin	None	Excellent	Minimal but will maintain as long as present on skin	Good
Maintains activity in presence of organic material	Yes	No	No	Yes	No	Yes
Minimal systemic absorption	Yes	No	Yes	Yes	No	Yes
Toxicity	Ototoxicity Corneal injury Avoid contact with meninges Keep away from eyes, ears and mouth	Absorption from skin with possible thyroid toxicity – especially in low-birth-weight infants	Drying to skin Should not be used near eyes	Ototoxicity Corneal injury Avoid contact with meninges Keep away from eyes, ears and mouth	Drying to the skin Absorption from skin with possible thyroid toxicity – especially in very-low-birth-weight infants	Non-toxic in the Technicare formulation
Comments	Incidence of skin irritation minimal. When used for cleansing superficial wounds, will not cause additional tissue injury or delay healing. May be more effective and safer than iodophors	Significant transcutaneous absorption may occur after the topical application in infants and can cause alterations in thyroid function – especially in very-low-birth-weight infants.	Flammable – care must be taken to remove excess liquid and allow to completely dry prior to using cautery	See comments on CHG and alcohol	See comments on PVP-I and alcohol. Duraprep adds benefit of "shellac" type activity that adheres to the skin and *may* inhibit organisms from releasing into the wound.	Can be used for treatment of chronic wounds. Is not harmful to eyes or ears

References:
MicroMedex Online
CDC Guidelines for Prevention of Surgical Site Infection – 1999
CareTech Laboratories information on Technicare online: http://www.caretechlabs.com/DesktopDefault.aspx?tabid=18
*** Reflects published data – however, formulation enhances the performance of PCMX. See Caretechlab.com.**
Prepared by Sue Gustafson, Infection Control Department, Fairview Health Services, 2/16/2005

Appendix D – Veterans Administration Methodical Wound Exploration Process

A methodical wound exploration will be performed prior to the closure of that cavity. Surgeons will use both touch and sight during the exploration whenever possible and should not rely on just one sensory perception.

A methodical wound exploration may be omitted or abbreviated in an extreme patient emergency or if the patient becomes critically unstable. This exception will be documented in the surgical record and if appropriate, a radiograph should be performed as soon as is reasonable, based on the patient's condition.

Abdominal and Pelvic Process

Unless contraindicated for a specific patient, these steps should be performed prior to the removal of stationary or table-mounted retractors. The methodical wound exploration process includes the exploration of all four quadrants of the abdomen.

- Lift and examine around the transverse colon.
- Examine above and around the liver.
- Examine around the spleen.
- Examine within and between the loops of bowel.
- For the pelvis:
  - Examine behind the bladder.
  - Examine behind the uterus (if present).
  - Examine around the upper rectum.
- Examine the area inside of the vagina if it was entered as part of the procedure.
- Examine in and around any place a retractor or retractor blades were placed.

Mediastinum or Thorax Process

Unless contraindicated for a specific patient, these steps should be performed for all procedures involving the mediastinum or thorax.

- For cardiac procedures:
  - Examine the heart by elevating the apex of the heart and examine the retrocardiac space.
  - Examine the transverse sinus to the right and left of the aorta and pulmonary vein.
  - For procedures involving the mediastinum, if the mediastinal pleura was opened, examine the ipsilateral pleural cavity.
  - For thoracic procedures:
    - Examine the thoracic cavity, paying particular attention to the thoracic apex and base of the lungs, paravertebral sulcus and inferior recesses. Examination includes placing a hand or finger behind the lung and palpating from apex to base.

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Appendix E – Protocol

The Perioperative Protocol is for patients of all ages having any type of surgical procedure procedure performed in the operating/procedure room.

Preoperative Evaluation and Surgical Planning and Scheduling

- Scheduling
  - Corroboration among scheduled procedure, surgical consent, source document and physician order
- Evaluation
  - Preoperative evaluation, testing, surgical planning
  - Nutritional assessment
    - Risk factors for surgical site infection
  - Penicillin allergy management
    - Use of certain cephalosporins for penicillin-allergic patients
  - Methicillin-resistant staphylococcus auerus identification
  - Glycemic control for diabetic patients
  - Patient education
    - Skin preparation night before and morning of surgery

Patient Arrives

- Patient, procedure and site verification
- Items included in the pre-procedure verification include the following:
  - Patient's identity, using two identifiers
  - Procedure name and site in the informed consent documentation
  - Information in the medical record
  - Diagnostic studies
  - Discussion with the patient/legal guardian
- Glycemic planning and management
- Antibiotic selection and administration
- Normothermia management
- Venous thromboembolism management
- Beta-blocker planning and management
- Methicillin-resistant staphylococcus auerus planning and management
- Perioperative statin therapy

Environmental Controls/Infection Control/Operating/Procedure Room Survey

- Hand hygiene
- Operating/procedure room surfaces
- Sterilization of devices
- Surveillance of surgical site infections
- Operating/procedure room survey
  - Remove all items related to previous patient, including records, label, films
  - Limit and check receptacles in room
  - Verify white board and record keep documents are cleaned from previous procedure

Pre-Procedure Planning and Preparation

- Review of surgeons orders, equipment, preference cards
- Special needs considered: patient height, weight, positioning, allergies
- Operating/procedure room equipment in working order
- Ensure all needed instruments and implants if applicable are available.
- Ensure that all staff are available: residents, hemodynamic staff, company representatives, etc.

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Site Marked with Surgeon Initials

- Prior to marking the site, the provider will complete a procedure verification.
- The site will be marked using a surgical marker that will be visible when the patient is positioned.
- For multiple sites/digits on the same anatomic site, they will be marked appropriately following the informed consent documentation.
- For procedures involving midline or orifice entry, the laterality will be indicated on the informed consent documentation.
- For procedures involving level (spine or ribs), the informed consent will indicate the laterality and level and the site will be marked to indicate anterior or posterior, and general level (cervical, thoracic, lumbar, or rib number).
- Site sensitive areas may be marked above or lateral to the procedure site.

Site Marking Not Required

- Site marking is not required when the provider performing the procedure is in continuous physical presence with the patient from arrival for the procedure to its conclusion.
- Patient refusals
- Site marking where the marking would cause harm

Anesthesia Patient Identification and Verification Process for Block/Anesthesia

- Patient identification and procedure verification
- Anesthesia marking (should NOT be initials)

Hard Stop

- The procedure will be halted if any questions or discrepancies during any part of the verification steps and will not resume until the discrepancy is resolved.

Repeat Verification Process If Patient Has Been Moved or Care Team Changes

- Repeat patient identification and procedure verification

Baseline Count

- Items included in the count process include:
  - Sponges/soft goods – only radiopaque sponges will be present in the surgical field
  - Sharps
  - Miscellaneous items
  - Instruments, for procedures where the possibility exists that a particular instrument could be unintentionally left behind
  - In addition to the items listed above, all non-radiopaque items will be counted.
- The count process will be performed at the following times:
  - A baseline count will occur before the patient is brought to the surgical suite unless parallel processing is used. For the count process using parallel processing, two separate circulators will be needed: one dedicated to the count process and one dedicated to the patient care and setup.
  - Closure of a cavity within a cavity
  - Before wound closure
  - At the end of the procedure
  - Any time a member of the surgical team has concerns about the accuracy of the count process
  - Whenever there is a permanent staff change of the circulator
  - When closure of the wound in intentionally delayed (damage control), temporary implants are used, or a wound is temporarily closed with a non-radiopaque item (e.g., wound vacuum sponge)

- The count process will be performed in the following manner:
  - The circulator and scrub person (one of whom must be a registered nurse) will directly view the items being counted and will count out loud concurrently.
  - The circulator will document the number and type of sponges/soft goods, sharps, miscellaneous items, and instruments on a preformatted white board or other standardized, preformatted documentation record. The scrub person verbally confirms the number.
  - All items will be counted in the same order for each count, usually in the order listed on the white board.
  - Soft goods will be separated and counted individually
  - Sponges/soft goods will have visual verification that the radiographic-detectible indicator is present.
  - Instruments will be counted in sets.
  - Counts will begin at the surgical field and move away from the patient.
  - Items added during the procedure will be counted prior to entering the surgical field and documented on the white board as soon as possible.
  - Used sponges/soft goods will be unballed and pulled apart for the count process.
  - Instruments and sharps will be inspected for broken or missing pieces for the count process.

Briefing

- Ideally the briefing should be conducted in the operating/procedure room after anesthesia induction and before patient positioning and should at a minimum include the following:
  - Introduction of individual team members
  - Any special patient needs or potential issues
  - Anticipated problems
  - Patient positioning
  - Status of the patient consent
  - Patient allergies
  - Medications (e.g., antibiotics) given or to be given
  - Anticipated blood components
  - Specimens, if applicable, and how they should be handled
  - Pathology
  - Discussion about radiological images, if applicable
  - Discussion of implants, if applicable
  - Details regarding special equipment
  - Discussion of any special intraoperative requests (e.g., surgeon informs circulating nurse and scrub about times during the procedure when he or she would prefer that they avoid taking a break)
  - Team members are asked whether or not they have any other concerns or issues related to the patient or the procedure.

Patient Transported to Operating/Procedure Room

- Anesthesia care provider completes final verification of the following:
  - Consent is complete
  - Verification of patient's identification
  - Universal protocol checklist completed by all required staff
  - Operative site marked as appropriate
  - Notification to preoperative staff that patient is being moved to the operating/procedure room Upon arrival to the operating/procedure room, anesthesia care provider and circulating nurse verify patient identification, surgeon and procedure before moving patient to the operating/procedure table.

Environmental Controls

- Preoperative scrub
- Surgical asepsis
- Temperature controls
- Vendor access
- Noise

Anesthesia Administration

- Prior to regional block, a "procedural Time Out" is performed between the anesthesia professional, the patient and staff
- Prior to anesthesia of any type and for all cases, a verification Time Out is completed

Position Patient/Verify Site Marking/Hair Removal

- Prior to incision:
  - Hair removal (if hair removal is necessary, use clippers)
  - Skin preparation
  - Complete antibiotic administration (within 60 minutes of incision)

Time Out

- Performed immediately prior to start of the procedure and initiated by surgeon
- Elements included:
  - Patient identity, using minimum of two identifiers
  - Procedure(s) to be performed
  - Patient positioning if not already verified
  - Procedure side, site and/or level including visualization of surgeon's initials
  - As appropriate imaging, equipment, implants or special requirements (e.g., pre-procedure antibiotics)
- Recommended order of verification:
  1. Circulator
  2. Anesthesia care provider
  3. Scrub
  4. Surgeon
- Additional Time Outs are performed when two or more different procedures are performed during the same procedure time.
- If repositioning is required, an abbreviated Time Out is conducted.
- If the procedure involves a single provider, an abbreviated Time Out is still required.

Hard Stop

- The procedure will be halted if any questions or discrepancies during any part of the verification steps and will not resume until the discrepancy is resolved.

Count New Items Added to Surgical Field

- Follow count process outlined for baseline count.

Intra-Procedure Management

- Antibiotic re-dosing as required based upon length of surgery
- Glycemic control
- Normothermia management (monitor continuously or every 30 minutes and warm patient as indicated)
- Beta-blocker therapy
- Venous thromboembolism
  - Intermittent pneumatic compression devices turned on before anesthesia administration
  - Avoid Trendelenburg position when possible
  - Check for correct positioning of anti-embolism stockings

Intra-Procedure Pause

- The provider will conduct an Intra-Procedure Pause to confirm internal laterality/level/implant prior to proceeding in the following situations:
  - Procedures that have midline or orifice entry
  - Procedures involving level (spine or ribs)
  - Implants (specifications/type/expiration date, size, laterality)

Wound or Body Cavity Exploration and Count Prior to Closure of Each Cavity

- A methodical wound exploration will be performed prior to the closure of the wound and/or any cavity.
- The type of surgical procedure will guide the wound exploration technique employed.

Close Wound and Finish Procedure

- Radiographic imaging prior to wound closure does not need to be obtained when count processes are rigorously followed and all counts can be reconciled.

Wound Closure Delayed/Open Wound Packing

- The number and type of items used in the wound packing will be documented in the procedure record.
- Any items removed or added to the wound must be counted and documented in the patient's medical record.
- When the patient returns to the operating/procedure room for final wound closure, items used in the original packing will be isolated and counted separately from the items used in the final wound closure procedure. Both counts should be reconciled prior to wound closure.
- If a discrepancy is noted, an attempt should be made to reconcile the discrepancy.
- A thorough wound exploration will be performed.
- If radiopaque items were used, portable intraoperative imaging should be taken prior to final wound closure.

Hard Stop – Perform Reconciliation Process for Count Discrepancies

- When a discrepancy is identified, the number and type of item missing are reported to the surgical team by the circulator.
- A decision is held within between surgical team, if patient's condition permits, wound closure should be suspended during discussion.
- A manual inspection of the operating/procedure room is conducted, including a visual inspection of the area surrounding the surgical field, the floor, kick buckets, linens, and trash receptacle.
- The count is repeated and verified.
- The wound is reexplored.
- Portable intraoperative imaging is obtained if the counts cannot be reconciled.

Patient Transported to Postoperative Care Location

- Receiving staff completed verification process and reviews for pertinent patient-care-related elements such as allergies, procedure completed, clinical information, etc.

Postoperative Management

- The following items should be addressed in the immediate postoperative period:
  - Antibiotic discontinuation
  - Normothermia management (monitoring for hypothermia and warm patient as indicated)
  - Glucose control
  - Incision management (sterile dressing over incision for 24-48 hours)
  - Beta-blocker continuation
  - Venous thromboembolism prophylaxis

Dismiss Patient/Discharge Planning

- Patient education to include
  - Signs and symptoms of surgical site infection
  - Incision and wound care recommendations
  - Hand hygiene
  - Postoperative pain control
  - Follow-up appointments

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Appendix F – Beta-Blocker Table

Study	Procedure	n	Drug	Myocardial Ischemia	MI	Death	Stroke	Cardiac Death/MI
Pasternack 1987	abdominal aortic aneurysmorrhaphy	83	metoprolol		Control 17.6% Drug 3.1% (p<0.05)			
Pasternack 1989	vascular	200	metoprolol	Control 1.8 +/- 3.2 episodes Drug 0.8 +/- 1.6 episodes (p<0.05)				
Stone 1988	non-cardiac	112	labetalol atenolol	Control 28.2% Drug 2.2% (p<0.05)	Control 0% Drug 0%			
Poldermans 1999	vascular	112	bisoprolol		Control 17% Drug 0% (p<0.05)	Control 17% Drug 3.4% (p<0.05)		
Mangano 1996 Wallace 1998	Non-cardiac	200	atenolol	Control 38.6% Drug 24.2% (p<0.05)		(At 6 months) Control 9.9% Drug 1.0 % (p<0.05)		
Brady 2005 (POBBLE)	vascular	103	metoprolol	Control 9% Drug 9.4%	Control 11.3% Drug 5.6%	Control 2.2% Drug 5.6%		
Juul 2006 (DiPoM)	non-cardiac	921	metoprolol ER			Control 16% Drug 16%		
Murphy 2007 (MAVS)	vascular	496	metoprolol		Control 8.4% Drug 7.7%			
Devereaux 2008 (POISE)	non-cardiac	8351	metoprolol ER		Control 5.7% Drug 4.2 % (p=0.0017)	Control 2.3% Drug 3.1% (p=0.0317)	Control 0.5% Drug 1.0% (p=0.0053)	
Dunkelgrun 2009 (DECREASE-IV)	non-cardiac	1066	bisoprolol		Control 6.7% Drug 1.9% (p=0.01)	(at 30 days) Control 3.4% Drug 1.1%		Control 7.8% Drug 1.9% (p=0.001)

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ICSI

INSTITUTE FOR CLINICAL SYSTEMS IMPROVEMENT

Document History, Development and Acknowledgements: Perioperative Protocol

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The next scheduled revision will occur within 24 months.

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Document History

In 2005-2007, ICSI hospital members championed patient safety activities aimed at advancing efficient surgical process flow and creating safe and reliable practices that reduced the number of adverse events in surgery. In collaboration with its members, ICSI developed standardized surgical protocols for safe site marking, the reduction of surgical site infection and retained foreign objects. This work resulted in the creation of three specific safety protocols:

Safe Site Protocol for All Invasive, High-Risk or Surgical Procedures; Prevention of Unintentionally Retained Foreign Objects in Surgery; and *Prevention of Surgical Site Infection.*

In 2007-2008, ICSI facilitated a Reliability Centered Surgical Care Redesign Collaborative, which provided a collaborative learning environment for participants to become knowledgeable in reliability theory and principles. This collaborative provided an opportunity for participants to share their learnings as they worked to implement these and other surgical related protocols.

Recognizing that these surgical processes are part of the comprehensive perioperative experience, these three distinct protocols were merged in 2008 to create one comprehensive Perioperative Protocol consistent with the requirements established by The Joint Commission National Patient Safety Goals.

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ICSI Document Development and Revision Process

Overview

Since 1993, the Institute for Clinical Systems Improvement (ICSI) has developed more than 60 evidence-based health care documents that support best practices for the prevention, diagnosis, treatment or management of a given symptom, disease or condition for patients.

Document Development and Revision Process

The development process is based on a number of long-proven approaches. ICSI staff first conducts a literature search to identify pertinent clinical trials, meta-analysis, systematic reviews, regulatory statements and other professional protocols. The literature is reviewed and graded based on the ICSI Evidence Grading System.

ICSI facilitators identify gaps between current and optimal practices. The work group uses this information to develop or revise the clinical flow and algorithm, drafting of annotations and identification of the literature citations. ICSI staff reviews existing regulatory and standard measures and drafts outcome and process measures for work group consideration. The work group gives consideration to the importance of changing systems and physician behavior so that outcomes such as health status, patient and provider satisfaction, and cost/utilization are maximized.

Medical groups, who are members of ICSI, review each protocol as part of the revision process. The medical groups provide feedback on new literature, identify areas needing clarification, offer recommended changes, outline successful implementation strategies and list barriers to implementation. A summary of the feedback from all medical groups is provided to the protocol work group for use in the revision of the protocol.

Implementation Recommendations and Measures

Each protocol includes implementation strategies related to key clinical recommendations. In addition, ICSI offers protocol-derived measures. Assisted by measurement consultants on the protocol development work group, ICSI's measures flow from each protocol's clinical recommendations and implementation strategies. Most regulatory and publicly reported measures are included but, more importantly, measures are recommended to assist medical groups with implementation; thus, both process and outcomes measures are offered.

Document Revision Cycle

Scientific documents are revised every 12-24 months as indicated by changes in clinical practice and literature. Each ICSI staff monitors major peer-reviewed journals every month for the protocols for which they are responsible. Work group members are also asked to provide any pertinent literature through check-ins with the work group mid-cycle and annually to determine if there have been changes in the evidence significant enough to warrant document revision earlier than scheduled. This process complements the exhaustive literature search that is done on the subject prior to development of the first version of a protocol.

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Fairview OR Intra-Op Antibiotic Dosing Guidelines**

(Adult Patients)

Interval	2 Hrs*	6 Hrs	8 Hrs
Antibiotic	ampicillin/sulbactam, or Unasyn™ 1.5 gm cefazolin 1 gm cefoxitin 1 gm cefuroxime 1.5 gm piperacillin/tazobactam, or Zosyn™ 2.25 gm	cefotetan ciprofloxacin clindamycin metronidazole	ertapenem gentamicin 1.7mg/kg vancomycin 1gm for < 80 kg vancomycin 1.5gm for ≥ 80kg

* For 2 hour antibiotics use dose listed in table for re-dosing. (This dose may differ from pre-op dose.)

**<u>Re-Dosing in Renal Impairment</u>: CrCl < 50 mL/min, DOUBLE the time interval.
CrCl < 10 mL/min (on dialysis), do NOT re-dose.

CrCl = (140 – age) x LBW / (72) x SCr (x 0.85 if female).

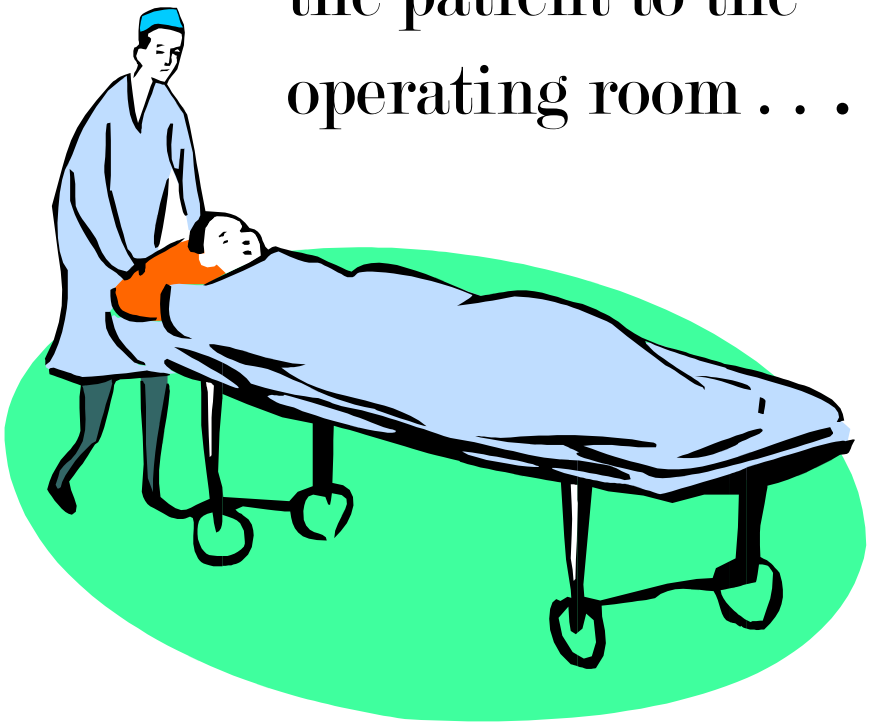
NOTE: Intervals could be longer (e.g., renal failure) or shorter (e.g., extensive blood loss and fluid replacement) depending on conditions.

NOTE: Cardiac surgery with assistance of extracorporeal circulation (bypass) may require additional consideration.

Source: FV System Pharmacy
Approved by: System Formulary, FSH Peri-op Committee
Rev. July 2010

LET'S GET ROLLING!!

When you **ROLL** the patient to the operating room . . .



ROLL the clamp to start the antibiotic!

SAFE CUTS

T – Team Accountability

Resources for Implementation: WHO Surgical Safety Checklist
World Health Organization, 2009

Comprehensive Surgical Checklist
AORN, 2010

Surgical Safety Checklist

World Health Organization | Patient Safety
A World Alliance for Safer Health Care

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?

- ☐ Yes

Is the site marked?

- ☐ Yes
- ☐ Not applicable

Is the anaesthesia machine and medication check complete?

- ☐ Yes

Is the pulse oximeter on the patient and functioning?

- ☐ Yes

Does the patient have a:

Known allergy?

- ☐ No
- ☐ Yes

Difficult airway or aspiration risk?

- ☐ No
- ☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?

- ☐ No
- ☐ Yes, and two IVs/central access and fluids planned

Before skin incision

(with nurse, anaesthetist and surgeon)

- ☐ **Confirm all team members have introduced themselves by name and role.**
- ☐ **Confirm the patient's name, procedure, and where the incision will be made.**

Has antibiotic prophylaxis been given within the last 60 minutes?

- ☐ Yes
- ☐ Not applicable

Anticipated Critical Events

To Surgeon:

- ☐ What are the critical or non-routine steps?
- ☐ How long will the case take?
- ☐ What is the anticipated blood loss?

To Anaesthetist:

- ☐ Are there any patient-specific concerns?

To Nursing Team:

- ☐ Has sterility (including indicator results) been confirmed?
- ☐ Are there equipment issues or any concerns?

Is essential imaging displayed?

- ☐ Yes
- ☐ Not applicable

Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:

- ☐ The name of the procedure
- ☐ Completion of instrument, sponge and needle counts
- ☐ Specimen labelling (read specimen labels aloud, including patient name)
- ☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:

- ☐ What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

Revised 1 / 2009

COMPREHENSIVE SURGICAL CHECKLIST

Blue = World Health Organization (WHO) Green = The Joint Commission - Universal Protocol (JC) 2010 National Patient Safety Goals Orange = JC and WHO

PREPROCEDURE CHECK-IN	SIGN-IN	TIME-OUT	SIGN-OUT
In Holding Area	**Before Induction of Anesthesia**	**Before Skin Incision**	**Before the Patient Leaves the Operating Room**
Patient/patient representative actively confirms with Registered Nurse (RN):	**RN and anesthesia care provider confirm:**	**Initiated by designated team member** All other activities to be suspended (unless a life-threatening emergency)	**RN confirms:**
Identity □ Yes Procedure and procedure site □ Yes Consent(s) □ Yes Site marked □ Yes □ N/A by person performing the procedure **RN confirms presence of:** History and physical □ Yes Preanesthesia assessment □ Yes Diagnostic and radiologic test results □ Yes □ N/A Blood products □ Yes □ N/A Any special equipment, devices, implants □ Yes □ N/A **Include in Preprocedure check-in as per institutional custom:** **Beta blocker medication given (SCIP)** □ Yes □ N/A **Venous thromboembolism prophylaxis ordered (SCIP)** □Yes □ N/A **Normothermia measures (SCIP)** □ Yes □ N/A	Confirmation of: identity, procedure, procedure site and consent(s) □ Yes Site marked □ Yes □ N/A by person performing the procedure Patient allergies □ Yes □ N/A Difficult airway or aspiration risk? □ No □ Yes (preparation confirmed) Risk of blood loss (> 500 ml) □ Yes □ N/A # of units available _____ Anesthesia safety check completed □ Yes **Briefing:** All members of the team have discussed care plan and addressed concerns □ Yes	Introduction of team members □ Yes **All:** Confirmation of the following: identity, procedure, incision site, consent(s) □ Yes Site is marked and visible □ Yes □ N/A Relevant images properly labeled and displayed □ Yes □ N/A Any equipment concerns? **Anticipated Critical Events** **Surgeon:** States the following: □ critical or nonroutine steps □ case duration □ anticipated blood loss **Anesthesia Provider:** □ Antibiotic prophylaxis within one hour before incision □ Yes □ N/A □ Additional concerns? **Scrub and circulating nurse:** □ Sterilization indicators have been confirmed □ Additional concerns?	Name of operative procedure Completion of sponge, sharp, and instrument counts □ Yes □ N/A Specimens identified and labeled □ Yes □ N/A Any equipment problems to be addressed? □ Yes □ N/A **To all team members:** What are the key concerns for recovery and management of this patient? _____ _____ _____ _____ _____ _____ _____ _____ April 2010 

The JC does not stipulate which team member initiates any section of the checklist except for site marking.
The Joint Commission also does not stipulate where these activities occur. See the Universal Protocol for details on the Joint Commission requirements.

SAFE CUTS

S –Staff

Hand Hygiene

How-to Guide: Improving Hand Hygiene
Institute for Healthcare Improvement.

Recommended Standards of Practice for Hand Hygiene and Fingernails
Association of Surgical Technologists, 2007.

Inpatient Hand Hygiene Monitoring Form
Mayo Clinic

Surgical/Procedural Hand Hygiene Monitoring Form
Mayo Clinic

Contact Isolation Audit: Perianesthesia and Surgery
Gillette Children's Specialty Healthcare

Avera Marshall Hand Hygiene Observation Tool
Avera Marshall Regional Medical Center

Hand Hygiene Observation Tool
Park Nicollet Methodist

Hand Hygiene Monitoring Form
St. Luke's Hospital

Laboratory Hand Hygiene Monitoring Form
St. Luke's Hospital

Radiology Hand Hygiene Monitoring Form
St. Luke's Hospital

Alcohol Hand Rub (AHR) Accessibility
Park Nicollet Methodist

Outpatient Hand Cleaning: How Are We Doing?
Mayo Clinic

Surgical Attire

Nursing Policy: Non Sterile Dress Attire for Peri-anesthesia, Surgical Services and Reprocessing *Gillette Children's Specialty Healthcare*

Policy: Dress Code in the Operating Room
Avera Marshall Regional Medical Center

Policy: Physician Guideline for Dress
Avera Marshall Regional Medical Center

INSTITUTE FOR HEALTHCARE IMPROVEMENT

How-to Guide:

Improving Hand Hygiene

A Guide for Improving Practices among Health Care Workers

This guide was prepared in collaboration with the Centers for Disease Control and Prevention (CDC), the Association for Professionals in Infection Control and Epidemiology (APIC), and the Society of Healthcare Epidemiology of America (SHEA), and has been endorsed by APIC and SHEA. Valuable input also was provided by the World Health Organization's World Alliance for Patient Safety through the Global Patient Safety Challenge.

Acknowledgments

The Institute for Healthcare Improvement (IHI) acknowledges the valuable contributions of the following individuals:

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The purpose of this guide is to help organizations reduce health-care-associated infections, including infections due to antibiotic-resistant organisms, by improving hand hygiene practices and use of gloves among health care workers.

The Case for Improving Hand Hygiene and Use of Gloves among Health Care Workers

Health-care-associated infections are an important cause of morbidity and mortality among hospitalized patients worldwide. Such infections affect nearly 2 million individuals annually in the United States and are responsible for approximately 80,000 deaths each year. Transmission of health-care-associated pathogens most often occurs via the contaminated hands of health care workers. Accordingly, hand hygiene (i.e., handwashing with soap and water or use of a waterless, alcohol-based hand rub) has long been considered one of the most important infection control measures for preventing health-care-associated infections. However, compliance by health care workers with recommended hand hygiene procedures has remained unacceptable, with compliance rates generally below 50% of hand hygiene opportunities.

- Jarvis WR. Selected aspects of the socioeconomic impact of nosocomial infections: Morbidity, mortality, cost, and prevention. *Infect Control Hosp Epidemiol*. 1996 Aug;17(8):552-557.
- Pittet D, Mourouga P, Perneger TV. Compliance with handwashing in a teaching hospital. *Ann Intern Med*. 1999;130:126-130.
- Lankford MG, Zemblower TR, Trick WE, Hacek DM, Noskin GA, Peterson LR. Influence of role models and hospital design on hand hygiene of healthcare workers. *Emerg Infect Dis*. 2003;9:217-23.

Many factors have contributed to poor handwashing compliance among health care workers, including a lack of knowledge among personnel about the importance of hand hygiene in reducing the spread of infection and how hands become contaminated, lack of understanding of correct hand hygiene technique, understaffing and overcrowding, poor access to handwashing facilities, irritant contact dermatitis associated with frequent exposure to soap and water, and lack of institutional commitment to good hand hygiene.

- Pittet D, Boyce JM. Hand hygiene and patient care: Pursuing the Semmelweis legacy. *Lancet Infect Dis*. 2001;1:9-20.

To overcome these barriers, the Centers for Disease Control and Prevention's (CDC's) Healthcare Infection Control Practices Advisory Committee (HICPAC) published a comprehensive *Guideline for Hand Hygiene in Health-Care Settings* in 2002. One of the principal recommendations of this guideline was that waterless, alcohol-based hand rubs (liquids, gels or foams) are the preferred method for hand hygiene in most situations due to the superior efficacy of these agents in rapidly reducing bacterial counts on hands and their ease of use. Alcohol preparations also rapidly kill many fungi and viruses that cause health-care-associated infections. The guideline recommended that health care facilities develop multidimensional programs to improve hand hygiene practices.

- Boyce JM, Pittet D, et al. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Morbid Mortal Wkly Rep*. 2002;51(RR16):1-45.

Recognizing a worldwide need to improve hand hygiene in health care facilities, the World Health Organization (WHO) launched its *Guidelines on Hand Hygiene in Health Care (Advanced Draft)* in October 2005. These global consensus guidelines reinforce the need for multidimensional strategies as the most effective approach to promote hand hygiene. Key elements include staff education and motivation, adoption of an alcohol-based hand rub as the primary method for hand hygiene, use of performance indicators, and strong commitment by all stakeholders, such as front-line staff, managers and health care leaders, to improve hand hygiene.

- *WHO Guidelines on Hand Hygiene in Health Care (Advanced Draft): A Summary*. World Health Organization; 2005. [Available online at http://www.who.int/patientsafety/events/05/HH_en.pdf]

Wearing gloves during patient care is an additional intervention to help reduce transmission of infectious agents in high-risk situations. Gloves protect patients by reducing contamination of the health care worker's hands and subsequent transmission of pathogens to other patients. In addition, when gloves are worn in compliance with CDC's Standard Precautions, gloves protect health care workers from exposure to bloodborne infections such as HIV and hepatitis B and C.

However, gloves must be used properly. Gloves can become contaminated during care and must be removed or changed when moving from a contaminated site to a clean site on the same patient. Gloved hands can also become contaminated due to tiny punctures in the glove material or during glove removal; therefore, hand hygiene must be performed immediately after glove removal. Consequently, use of gloves is an important adjunct to, but not a replacement for, proper hand hygiene practice.

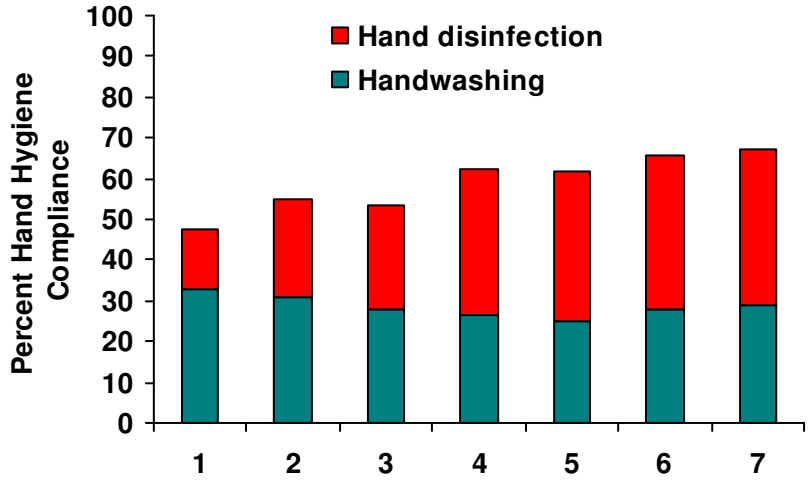
- Pittet D, et al. Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med*. 1999;159:821-826.
- Pessoa-Silva CL, Richtmann R, Calil et al. Dynamics of bacterial hand contamination during routine neonatal care. *Infect Control and Hosp Epidemiol*. 2004;25:192-197.
- Tenorio AR, Badri SM, Sahgal NB, et al. Effectiveness of gloves in the prevention of hand carriage of vancomycin-resistant Enterococcus species by health care workers after patient care. *Clin Infect Dis*. 2001;32:826-829.
- Johnson S, Gerding DN, et al. Prospective, controlled study of vinyl glove use to interrupt Clostridium difficile nosocomial transmission. *Am J Med*. 1990;88:137-140.
- Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol*. 1996;17:53-80. [Available online at http://www.cdc.gov/ncidod/dhqp/gl_isolation.html]

The Potential Impact of Improving Hand Hygiene

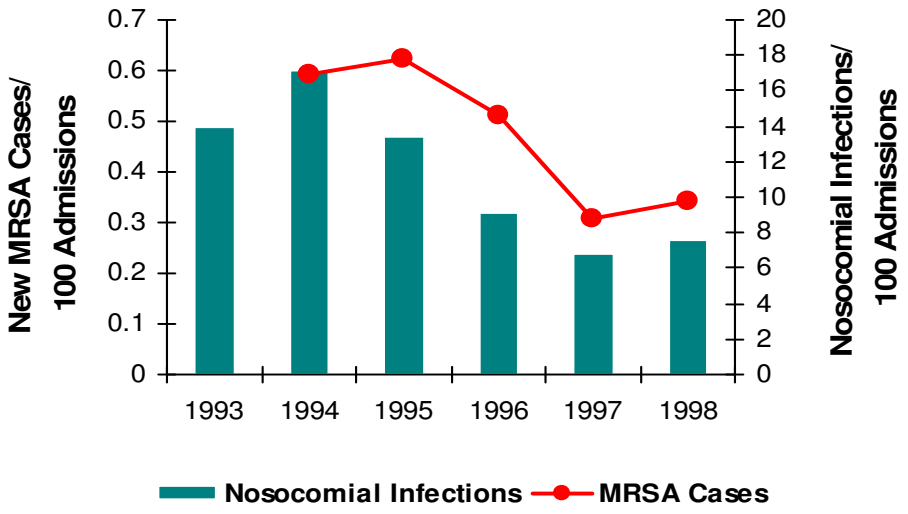
Numerous studies have suggested that hand hygiene compliance can be improved, at least modestly, by a variety of interventions, introduction of alcohol-based hand rub and educational and behavioral initiatives. Most authorities believe that multidimensional interventions are more effective. For example, Pittet et al. implemented a multidisciplinary, multimodal hand hygiene improvement program featuring promotion of alcohol-based hand rub and achieved substantial improvement in hand hygiene compliance. Much of the improvement in compliance was attributed to increased use of the alcohol-based hand rub. As hand hygiene compliance improved, both the incidence of nosocomial infections and new methicillin-resistant *Staphylococcus aureus* (MRSA) cases decreased, although the authors did not assert that they had rigorously demonstrated a causal link (see figures below).

- Pittet D, Hugonnet S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet*. 2000;356:1307-1312.

Impact of Interventions on Handwashing and Hand Disinfection with an Alcohol-Based Hand Rub



Impact of Hand Hygiene on Incidence of Methicillin-Resistant *Staphylcoccus aureus* (MRSA) and Nosocomial Infections



The Hand Hygiene Intervention Package

The hand hygiene intervention package is a group of best practices that individually improve care, but when applied together should result in substantially greater improvement. The science supporting each intervention is sufficiently established to be considered a standard of care.

The following four components of the hand hygiene intervention package are critical aspects of a multidimensional hand hygiene program. Glove use is included in this package because proper glove use is inextricably linked to effective hand hygiene.

1. Clinical staff, including new hires and trainees, understand key elements of hand hygiene practice (demonstrate knowledge)
2. Clinical staff, including new hires and trainees, use appropriate technique when cleansing their hands (demonstrate competence)
3. Alcohol-based hand rub and gloves are available at the point of care (enable staff)

4. Hand hygiene is performed at the right time and in the right way and gloves are used appropriately as recommended by CDC's Standard Precautions (verify competency, monitor compliance, and provide feedback)

1. Clinical staff, including new hires and trainees, understand key elements of hand hygiene practice (demonstrate knowledge)

Health care workers' hands can become contaminated by touching the body secretions, excretions, nonintact skin, and wounds of patients; however, they can also become contaminated by touching intact skin of patients and environmental surfaces in the immediate vicinity of the patients. Health care workers should demonstrate accurate knowledge that their hands can become contaminated during all of these activities.

- Pittet D, Dharan S, Touveneau S, Savan V, Perneger TVl. Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med*. 1999;159:821-826.
- Duckro AN, Blom DW, Lyle EA, Weinstein RA, Hayden MKl. Transfer of vancomycin-resistant enterococci via health care worker hands. *Arch Intern Med*. 2005;165:302-307.

Compared to handwashing, alcohol-based hand rubs have been shown to be more effective in reducing the number of viable bacteria and viruses on hands, require less time to use, can be made more accessible at the point of care, and cause less hand irritation and dryness with repeated use. Handwashing is required when hands are visibly contaminated and is also appropriate after caring for patients with diarrhea, including patients with *Clostridium difficile* associated diarrhea, before eating, and after use of the restroom. Health care workers should demonstrate accurate knowledge of the advantages of the use of hand rubs in most situations as well as the specific indications for handwashing.

- Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Morbid Mortal Wkly Rep*. 2002;51:1-45.

- *WHO Guidelines on Hand Hygiene in Health Care (Advanced Draft): A Summary*. World Health Organization; 2005. [Available online at http://www.who.int/patientsafety/events/05/HH_en.pdf]

»What changes can we make that will result in improvement?

Hospital teams across the United States and in other countries around the world have developed and tested change strategies that allowed them to improve knowledge of key elements of hand hygiene practice. Successful strategies include:

- Discussing the types of patient care activities that result in hand contamination as a supplement to educational material provided to health care workers
- Discussing with clinical staff the relative advantages and disadvantages of handwashing and use of alcohol-based hand rubs at the point of care
- Emphasizing the important role that contaminated hands play in transmission of health-care-associated pathogens, including multidrug-resistant pathogens and viruses
- Informing clinical staff of the morbidity and mortality caused by health-care-associated infections

2. Clinical staff, including new hires and trainees, use appropriate technique when cleansing their hands (demonstrate competency)

To be optimally effective, an appropriate volume of alcohol-based hand rub or soap must be applied to all surfaces of the hands and fingers for a sufficient length of time. Failure to do so will reduce the efficacy of the hand hygiene regimen. Accordingly, clinical staff should demonstrate competency in performing hand hygiene correctly. Competent hand rubbing requires that a sufficient volume of an alcohol-based rub is applied to cover all surfaces of the hands and fingers and that at least 15 seconds of rubbing is necessary before the hands are dry. Competent handwashing requires that a sufficient volume of soap is applied to cover all surfaces of the hands and fingers, and that at least 15 seconds of scrubbing with friction is performed before rinsing. Care should be taken to avoid contamination of hands after handwashing (paper towels or

single use cloth towels should be used; if the faucet is hand-operated, the towel should be used to turn of the spigot).

- Larson EL, Eke PI, Wilder MP, Laughon BE. Quantity of soap as a variable in handwashing. *Infect Control*. 1987;8:371-375.
- Widmer AE, Dangel M. Alcohol-based hand rub: Evaluation of technique and microbiological efficacy with international infection control professionals. *Infect Control Hosp Epidemiol*. 2004;25:207-209.

»What changes can we make that will result in improvement?

Hospital teams have developed and tested change strategies that allow them to improve competence with hand hygiene practices. Some of these changes include:

- Conducting live demonstrations of correct techniques for using an alcohol-based hand rub and handwashing during educational sessions for health care workers
- Providing videotape presentations of correct handwashing and hand rubbing technique in educational material for health care workers
- Emphasizing that an appropriate volume of hand rub or soap must be used if hand hygiene is to be effective
- Using fluorescent dye-based training methods to demonstrate correct hand hygiene techniques to clinical staff
- Periodically monitoring the adequacy of hand hygiene technique among clinical staff, and giving them feedback regarding their performance

3. Alcohol-based hand rub and gloves are available at the point of care (enable staff)

Placing alcohol-based hand rub dispensers near the point of care has been associated with increased compliance by health care workers with recommended hand hygiene procedures.

For example, Bischoff et al. found that compliance by health care workers was significantly greater when dispensers for alcohol-based hand rub were adjacent to each patient's bed than when there was only one dispenser for every four beds. In critical care, availability of alcohol-based hand rub at the point of care proved to minimize the time constraint associated with hand hygiene during patient care and to predict better compliance. In a study of hand hygiene among physicians, Pittet et al. found that easy access to an alcohol-based hand rub was an independent predictor of improved hand hygiene compliance.

- Bischoff WE, Reynolds TM, Sessler CN, Edmond MB, Wenzel RP. Handwashing compliance by health care workers: The impact of introducing an accessible, alcohol-based hand antiseptic. *Arch Intern Med*. 2000;160:1017-1021.
- Pittet D, Hugonnet S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet*. 2000;356:1307-1312.
- Hugonnet S, Perneger TV, Pittet D. Alcohol-based hand rub improves compliance with hand hygiene in intensive care units. *Arch Int Med*. 2002;162:1037-1043.
- Pittet D, Simon A, Hugonnet S, et al. Hand hygiene among physicians: Performance, beliefs, and perceptions. *Ann Intern Med*. 2004;148:1-8.

Availability of alcohol-based products at the point of care should be supplemented by availability of gloves in appropriate sizes for use in the high-risk situations described previously for which barrier technique is indicated. Sterile gloves are not required for this purpose; studies have shown that clean single-use gloves have negligible numbers of non-pathogenic microorganisms when cultured.

»What changes can we make that will result in improvement?

Hospital teams that have developed and tested change strategies to make alcohol-based hand rub and clean gloves readily available to health care workers saw improved hand hygiene compliance. Some of these changes include:

- Placing dispensers for alcohol-based hand rub and boxes of clean gloves of various sizes near the point of care, such as:
  - Next to each patient's bed
  - Attached to the frame of patient beds

  - Near the door to each patient's room (either adjacent to the door in the corridor or just inside the door)
  - At nursing stations or on medication carts
  - Supplied as portable (pocket or belt) individual dispensers for personal use
- Installing alcohol-based hand rub dispensers in locations that are compliant with local and federal fire safety regulations
- Assigning responsibility for checking alcohol-based hand rub dispensers and glove boxes on a regular basis to assure that:
  - Dispensers and glove boxes are not empty
  - Dispensers are operational
  - Dispensers provide the correct amount of the product
- Evaluating the design and function of dispensers before selecting a product for use since poorly functioning dispensers may adversely affect hand hygiene compliance rates

4. Hand hygiene is performed and gloves are used appropriately as recommended by CDC's Standard Precautions (verify competency, monitor compliance, and provide feedback)

Clinical staff should clean their hands according to recommendations listed in the CDC *Guideline for Hand Hygiene in Health-Care Settings*. These recommendations include:

- Washing hands with plain soap or with antimicrobial soap and water, as follows:
  - When hands are visibly dirty or contaminated with proteinaceous material or with blood or other body fluids
  - Before eating
  - After using the restroom
  - After caring for patients colonized with *Clostridium difficile*
- If hands are not visibly soiled, use an alcohol-based hand rub for routinely decontaminating hands in the following situations:

  - Before direct contact with patients
  - Before donning sterile gloves when inserting a central intravascular catheter
  - Before inserting indwelling urinary catheters, peripheral vascular catheters, or other invasive devices
  - After direct contact with a patient's skin
  - After contact with body fluids, mucous membranes, nonintact skin, and wound dressings if hands are not visibly soiled
  - When moving from a contaminated body site to a clean body site during patient care
  - After contact with inanimate objects in the immediate vicinity of the patient
  - After removing gloves
- If there has been any contact with the patient or the patient's environment, hands should be decontaminated when leaving the patient's bedside or room

- Boyce JM, Pittet D, et al. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Morbid Mortal Wkly Rep*. 2002;51(RR16):1-45.
- *WHO Guidelines on Hand Hygiene in Health Care (Advanced Draft): A Summary*. World Health Organization; 2005. [Available online at http://www.who.int/patientsafety/events/05/HH_en.pdf]

Clinical staff should wear gloves according to recommendations listed in CDC's Standard Precautions. These recommendations include:

- Wearing gloves when contact with blood or other potentially infectious body fluids, excretions, secretions (except sweat), mucous membranes, and nonintact skin could occur
- Removing gloves after caring for a patient — personnel should not wear the same pair of gloves for the care of more than one patient
- Changing gloves during patient care when moving from a contaminated body site to a clean body site
- Performing hand hygiene immediately after removal of gloves

- Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol*. 1996;17:53-80. [Available online at http://www.cdc.gov/ncidod/dhqp/gl_isolation.html]
- *WHO Guidelines on Hand Hygiene in Health Care (Advanced Draft): A Summary*. World Health Organization; 2005. [Available online at http://www.who.int/patientsafety/events/05/HH_en.pdf]

»What changes can we make that will result in improvement?

Hospital teams have developed and tested change strategies that allow them to improve hand hygiene practice and use of gloves by health care workers. Some of these changes include:

- Incorporating the indications for hand hygiene and use of gloves in educational material presented to health care workers. Examples of educational materials include:
  - Periodic lectures given by knowledgeable personnel, including interactive, audience-response software, if possible
  - Videotapes and PowerPoint presentations that demonstrate the importance of proper hand hygiene techniques in health care settings
  - Interactive, computer-assisted learning available to clinical staff via the hospital's Intranet
- Conducting educational programs for personnel that include instructions for proper technique when washing hands with soap and water, or when using an alcohol-based hand rub
- Ensuring that providers understand the rationale for hand hygiene and gloves and can comply with best practices and improve patient outcomes (self-efficacy)
- Initiating a multi-component publicity campaign (e.g., posters with photos of celebrated hospital doctors/staff members recommending hand hygiene and use of gloves; drawings by children in pediatric hospitals; screen savers with targeted messaging)
- Using opinion leaders as role models and educators ("academic detailing")
- Creating a culture where reminding each other about hand hygiene and use of gloves is encouraged and makes compliance the social norm

- Enabling health care workers to comply with best hand hygiene and glove practices by creating reliable systems that ensure alcohol-based hand hygiene products and gloves in appropriate sizes are always readily available at the point of care
- Engage patients and families in hand hygiene efforts by providing patient safety "tip sheets" outlining appropriate hand hygiene and glove practices, and encouraging them to remind health care providers to comply with these standards
- Monitoring compliance by health care workers with recommended indications for hand hygiene and use of gloves, including real-time feedback to personnel and trending compliance over time

How to Begin Improvement in Your Organization

Forming the Team

The Institute for Healthcare Improvement (IHI) recommends a multidisciplinary team approach to improving hand hygiene among health care workers. Improvement teams should be heterogeneous in make-up, but unified in mindset. The value of bringing diverse personnel together is that all members of the care team are given a stake in the outcome and work together to achieve the same goal.

Including all stakeholders in the process to implement proper hand hygiene techniques will help gain buy-in and cooperation of all parties. For example, teams without nurses are bound to fail. Teams led by nurses and therapists may be successful, but often lack leverage; physicians must also be part of the team. The team should include, at a minimum, an administrator or senior leader who can help remove barriers to implementation, as well as a member of the department that supplies hand hygiene agents to clinical areas. Involve the team in designing or selecting hand hygiene posters or other motivational and educational materials.

Some suggestions for attracting and retaining excellent team members include: using data to define and solve the problem; finding champions and opinion leaders within the hospital to lend the effort immediate credibility; and engaging individuals who want to work on the project rather than trying to convince those who do not.

Commitment of institutional leadership is a key determinant of success. There must be alignment of leadership, including the board, executives, heads of clinical departments, and the infection control team. Leadership should give encouragement, set expectations, remove barriers, and celebrate success. Concrete, “raise-the-bar” goals (i.e., those that strive to achieve unprecedented levels of performance) set the stage for achieving rates of compliance well beyond historical levels. An “all-or-none” mentality for compliance (i.e., performing all elements of good practice) is necessary to achieve the highest possible levels of reliable performance. From the patient’s perspective, compliance with all elements of appropriate hand hygiene and glove practice is a reasonable expectation.

Once high levels of compliance are achieved, a “process owner” must be identified — the person who will ensure that high levels of performance are maintained and help to troubleshoot key aspects of the hand hygiene program if the compliance rate falls.

Setting Aims

Dramatic improvement requires setting clear aims and quantitative time-specific improvement targets. An organization will not improve without a firm commitment and measurable goals. Teams are more successful when they have unambiguous, focused aims. Setting numerical goals clarifies the aims, creates tension for change, directs measurement, and focuses initial changes. Once aims have been established, the team needs to be careful not to back away from the aims deliberately or "drift" away unconsciously. Appropriate resources and personnel time must be allocated to achieve raise-the-bar targets.

An example of an appropriate aim for improving hand hygiene compliance can be as modest as, "Increase hand hygiene compliance by 25% within one year." However, more aggressive targets are desirable. Consistent with the JCAHO's National Patient Safety Goal #7, a raise-the-bar aim would be to improve hand hygiene compliance to greater than 90%. This latter goal helps change the focus from hand hygiene as a laudable practice to hand hygiene as a mandatory procedure. Regardless of the exact numeric target, the aim should be endorsed completely and enthusiastically by institutional leadership and opinion leaders.

Using the Model for Improvement

In order to move this work forward in your organization, IHI recommends using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of health care organizations to improve many different health care processes and outcomes.

The model has two parts:

- Three fundamental questions that guide improvement teams to: 1) set clear aims; 2) establish measures that will tell if changes are leading to improvement; and 3) identify changes that are likely to lead to improvement.
- Plan-Do-Study-Act (PDSA) cycles — small-scale tests of change in real work settings. Teams plan a test, try it, observe the results, and act on what is learned. It is critical for tests to be small and rapid (e.g., a test with two intensive care unit patients tomorrow). This is the scientific method applied to action-oriented learning.

Implementation:

After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale — for example, try to determine the best location for alcohol-based hand hygiene

products and gloves at the point of care in just one or two rooms in the ICU; try including checks on the availability of alcohol-based hand hygiene products and compliance with hand hygiene and glove policies in multidisciplinary rounds.

Spread:
After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement and how to spread improvements on IHI's website [http://www.IHI.org/IHI/Topics/Improvement].

Getting Started

Do not expect that the hand hygiene and glove intervention package can be implemented successfully overnight. A successful program involves careful planning, testing to determine if the processes are working, making modifications as needed, re-testing, and carefully implementing best practices.

- Select the team and the ward(s) for initial testing of change ideas.
- Assess current practice and compliance. Even if there is a hand hygiene and glove program currently in place, work with staff to begin preparing for changes to achieve raise-the-bar performance targets. Perform a survey to determine baseline hand hygiene and glove compliance rates. Determine how these compliance rates compare to those published in the literature.
- Organize an educational program. Teach the core principles of hand hygiene and glove practices to clinical staff throughout the hospital. Providing feedback to staff using baseline compliance data will open people's minds to opportunities for improvement.
- Assess satisfaction with current hand hygiene products. If an alcohol-based hand hygiene product is already available in the institution, interview caregivers about

their satisfaction with the product in terms of degree of skin irritation, consistency ("stickiness"), drying time, scent, and ease of use and reliability of dispensers.

- If an alcohol-based hand hygiene product is not currently available in the institution, have nurses and some physicians trial two or three products to determine which one(s) are most acceptable to clinical staff before selecting the product to be used. It is also important to evaluate the design and function of dispensers before selecting a product for use since poorly functioning dispensers may adversely affect hand hygiene compliance rates.
- Solicit input from clinical staff (including nurses, physicians, respiratory therapists, and others on the care team) about the best locations for installing alcohol-based hand hygiene product dispensers.
- Introduce the hand hygiene intervention package to all staff.

First Test of Change

Once a team has prepared the way for change by studying the current process and educating health care providers, the next step is to begin testing the hand hygiene intervention package.

- Select a few nursing units on which to begin using the intervention package.
- Make sure that alcohol-based hand hygiene product dispensers have been installed at the point of care and are functioning properly.
- Ensure that there is an adequate supply of clean gloves of various sizes available at the point of care.
- Conduct educational sessions on individual nursing units, or sessions that can be attended by personnel from multiple nursing units. Include patient care managers in early educational sessions.
- Give demonstrations on the appropriate techniques for using an alcohol-based hand rub and handwashing with soap and water.
- Have a member of the team (e.g., an infection control professional) visit the nursing unit(s) to answer any questions about using an alcohol-based hand hygiene product routinely for cleansing hands and appropriate use of gloves.

- Place hand hygiene promotion posters in highly visible locations throughout the hospital and begin a multi-modal campaign to improve performance.
- Engage patients and families by providing a patient safety "tip sheet," including information about hand hygiene best practices. Encourage patients and families to remind clinical staff to comply with hand hygiene and glove policies.

Measurement

Measurement tools have been included as appendices in this guide:

- Appendix 1. Hand Hygiene Knowledge Assessment Questionnaire
- Appendix 2. Checklist for the Availability of Alcohol-Based Hand Rub and Clean Gloves
- Appendix 3. Hand Hygiene and Glove Use Monitoring Form

For Appendices 2 and 3, please refer to the forms for specific information regarding the recommended process and outcome measures for improving hand hygiene.

Compliance with all aspects of each of the four interventions in the hand hygiene package should be measured as "all-or-none." In other words, if staff demonstrate correct knowledge of some, but not all, of the aspects of hand hygiene and glove use, they are not in compliance with the intervention package. If staff demonstrate only partial competency, they are not yet competent. If alcohol is present at the point of care but the dispenser is empty or gloves are not available, this is not compliant with the package. Similarly, all aspects of hand hygiene and glove use must be performed correctly during a patient encounter. This measurement strategy recognizes that raise-the-bar performance requires highly reliable care processes, and that from the patient's point of view, partial compliance is unacceptable.

Measurement is the only way to know whether a change represents an improvement. There are a number of measures that can be used to determine if hand hygiene and glove use are improving.

1. The percentage of caregivers who answer *all five questions* correctly on a standardized hand hygiene knowledge assessment survey

This measure assesses the proportion of clinical staff who demonstrate adequate knowledge of the key elements of hand hygiene and glove use. A simple, rapid, and low technology strategy is to assess the knowledge of caregivers in real time on the ward. Consider selecting a random sample of 10 clinical providers from diverse disciplines each month (or at other intervals specified by the hospital) to answer a five-question survey (see Appendix 1) in tandem with a competency check (see measure 2 below). Specific questions can be designated by the hospital and/or selected from examples in the survey in Appendix 1.

An alternative strategy is to assess knowledge using an Intranet-based learning or knowledge management system. Such electronic systems are being adopted rapidly by health care institutions in the United States. The clear advantage of this approach is that the entire clinical staff can be tested annually, or a sample may be tested at more frequent intervals. Completion of the assessment can be documented electronically and used for recredentialing purposes. Some systems can document which questions are being answered incorrectly, allowing direct measurement of the percent of caregivers who answer all of the questions correctly and facilitating design of targeted educational programs. However, some systems do not capture incorrect answers, and others allow personnel to retake the test as often as necessary to achieve a perfect score, making it impossible to calculate the required measure.

2. The percentage of caregivers who perform *all three* key hand hygiene procedures correctly

This is a simple, rapid, low technology strategy that can be used in tandem with the method described in measure 1. Randomly select a sample of 10 clinical providers from diverse disciplines each month (or at other intervals specified by the hospital) and

observe them to determine if they perform the three key hand hygiene procedures correctly: handwashing, alcohol-based hand rub, and gloves. This method has the strength of direct evaluation and feedback, but is time consuming. It also provides an opportunity to ensure that providers are not wearing artificial nails or nail extenders and have their nails trimmed to less than ¼ inch.

- Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Morbid Mortal Wkly Rep*. 2002;51:1-45.

Alternatively, competence can be assessed by monitoring hand hygiene practices during actual work (see measure 4 below). This has the advantage of being unobtrusive and integrated with other monitoring activities, but precludes direct feedback and adds complexity to the monitoring process.

- Handwashing: Wash hands with soap and water, including contact with soap for at least 15 seconds, covering all surfaces (palm, back of hand, fingers, fingertips, and fingernails); rub with friction
    - Turn off water without recontaminating hands: If the faucet is hand-operated, use paper towel to turn off the faucet; if the faucet is automatic, credit for compliance is given for correct performance
    - Dry hands with fresh paper towel
- Alcohol-based hand hygiene product (rub, gel, or foam): Use enough to cover all surfaces (palm, back of hand, fingers, fingertips, and fingernails); rub until dry (at least 15 seconds), which ensures sufficient volume has been applied
- Remove gloves using correct technique (so as not to contaminate the hands with a contaminated glove surface)

3. The percentage of bed spaces at which there are clean gloves in appropriate sizes *and* dispensers (wall-mounted or free-standing bottles) for alcohol-based hand rub/gel/foam that contain product, are functional, and dispense an appropriate volume of product

Make direct observations monthly (or at other intervals specified by the hospital) using a standardized procedure and form (see Appendix 2) on the same nursing units where measures 1 and 2 are monitored. Alternatively, availability can be assessed periodically as part of routine multidisciplinary rounds.

- Dispenser of alcohol-based product must be present, readily accessible at the point of care, not empty, functional, and capable of delivering the appropriate volume of product. If hand/pocket bottles are used, an adequate supply must be readily available and accessible on the ward.
- At least two sizes of gloves should be available and readily accessible at the point of care.

4. The percentage of patient encounters in which there is compliance by health care workers with all components of appropriate hand hygiene and glove practices

Compliance is monitored with direct observation by a trained observer using a standardized procedure and form (see Appendix 3). Independent observers are strongly recommended, preferably individuals who routinely are on the ward for other purposes and are not part of the care team. (This independent monitoring can be reinforced with monitoring by the care team during routine multidisciplinary rounds, which permits immediate assessment and feedback.) Observation periods should be 20-30 minutes (repeated if necessary) so that approximately 25-30 patient encounters are observed. The emphasis should be on observing complete encounters so that the proper measure of *complete* compliance with all components of the hand hygiene and glove intervention package can be calculated. Divide the number of encounters in which all components were performed correctly by the number of encounters observed and multiply by 100 to calculate the percentage compliance rate.

"Complete compliance" is defined by the adherence with the hand hygiene techniques and use of gloves as outlined in the table below. Gloves should be worn for all types of contact if the patient is on isolation precautions that require the use of gloves for contact with the patient and the environment, or if there is a unit-based procedure for universal gloving (wearing gloves for contact with all patients and their immediate environment).

Type of contact	Hand hygiene before	Hand hygiene after	Use of gloves
Patient contact that involves an invasive procedure (i.e., insertion of an intravascular catheter, urinary catheter, or other invasive device)	Yes	Yes	Yes
Patient contact that involves direct contact or potential contact with blood, body fluids, secretions (except sweat), excretions, mucous membranes, and nonintact skin (i.e., wounds, ulcers)	Yes	Yes	Yes
Patient contact not involving those noted above (i.e., taking vital signs, examination, repositioning, etc.)	Yes	Yes	*
Contact with the patient environment	--	Yes	*

** Gloves should be worn for all types of contact if the patient is on isolation precautions that require the use of gloves for contact with the patient and the environment, or if there is a unit-based procedure for universal gloving (wearing gloves for contact with all patients and their immediate environment).*

The following additional measure can also be used, but it does not replace direct observation of health care worker compliance during patient encounters:

- Volume of alcohol-based hand hygiene product consumed per week (or per month) divided by the number of patient days in the corresponding time period

Self-reporting by personnel or patients is not a reliable measure of compliance.

Barriers That May Be Encountered

- **Reluctance to change, tolerance of the status quo:** All change is difficult. The antidote is knowledge about the deficiencies of the present process and optimism about the potential benefits of a new process. The rate of compliance in most institutions is woeful, and dramatic improvement is possible.
- **Lack of leadership commitment and follow-through:** Hard work and good intentions cannot produce dramatic, long-term change without leadership buy-in and support.
- **Failure to educate and communicate:** Staff must understand the rationale for hand hygiene and glove practices, the danger of non-compliance to themselves and their patients, and the effectiveness and tolerability of hand hygiene products.
- **Failure to tailor product selection to staff preferences:** Staff should test products before they are introduced.
- **Lack of staff self-efficacy and empowerment:** Staff must believe that they have the ability and power to make major improvements.
- **Failure to make compliance a social norm and establish a culture of safety:** Staff must be empowered to remind other caregivers, regardless of rank or position, to practice hand hygiene. This should be reinforced by patients.
- **Failure to provide real time feedback of performance data:** Performance data should be communicated regularly and properly. Post trended data prominently.
- **Lack of a cohesive approach to behavior change:** A multi-factorial, creative approach to behavior change is essential.
- **Lack of physician buy-in:** Opinion leaders, role models, and physician champions, armed with educational materials and evidence, are essential.

Appendix 1. Hand Hygiene Knowledge Assessment Questionnaire

Use this questionnaire to periodically survey clinical staff about their knowledge of key elements of hand hygiene. Select 5 questions from this survey, or use other questions derived from your hospital's existing educational program. ***[NOTE: The correct answer for each question has been indicated below.]***

1. In which of the following situations should hand hygiene be performed? ***[Correct answer: #4]***

   A. Before having direct contact with a patient
   B. Before inserting an invasive device (e.g., intravascular catheter, foley catheter)
   C. When moving from a contaminated body site to a clean body site during an episode of patient care
   D. After having direct contact with a patient or with items in the immediate vicinity of the patient
   E. After removing gloves

Circle the number for the best answer:

1. B and E
2. A, B and D
3. B, D and E
4. All of the above

2. If hands are not visibly soiled or visibly contaminated with blood or other proteinaceous material, which of the following regimens is the most effective for reducing the number of pathogenic bacteria on the hands of personnel? ***[Correct answer: C]***

Circle the letter corresponding to the single best answer:

A. Washing hands with plain soap and water
B. Washing hands with an antimicrobial soap and water
C. Applying 1.5 ml to 3 ml of alcohol-based hand rub to the hands and rubbing hands together until they feel dry

3. How are antibiotic-resistant pathogens most frequently spread from one patient to another in health care settings? ***[Correct answer: C]***

Circle the letter corresponding to the single best answer:

A. Airborne spread resulting from patients coughing or sneezing
B. Patients coming in contact with contaminated equipment
C. From one patient to another via the contaminated hands of clinical staff
D. Poor environmental maintenance

4. Which of the following infections can be potentially transmitted from patients to clinical staff if appropriate glove use and hand hygiene are not performed? ***[Correct answer: E]***

Circle the letter corresponding to the single best answer:

A. Herpes simplex virus infection
B. Colonization or infection with methicillin-resistant *Staphylococcus aureus*
C. Respiratory syncytial virus infection
D. Hepatitis B virus infection
E. All of the above

5. *Clostridium difficile* (the cause of antibiotic-associated diarrhea) is readily killed by alcohol-based hand hygiene products ***[Correct answer: False]***

__ True
__ False

6. Which of the following pathogens readily survive in the environment of the patient for days to weeks? ***[Correct answer: #3]***

A. *E. coli*
B. *Klebsiella spp.*
C. *Clostridium difficile* (the cause of antibiotic-associated diarrhea)
D. Methicillin-resistant *Staphyloccus aureus* (MRSA)
E. Vancomycin-resistant enterococcus (VRE)

Circle the number for the best answer:

1. A and D
2. A and B
3. C, D, E
4. All of the above

7. Which of the following statements about alcohol-based hand hygiene products is accurate? ***[Correct answer: C]***

Circle the letter corresponding to the single best answer:

A. They dry the skin more than repeated handwashing with soap and water
B. They cause more allergy and skin intolerance than chlorhexidine gluconate products
C. They cause stinging of the hands in some providers due to pre-existing skin irritation
D. They are effective even when the hands are visibly soiled
E. They kill bacteria less rapidly than chlorhexidine gluconate and other antiseptic containing soaps

Appendix 2. Checklist for the Availability of Alcohol-Based Hand Rub and Clean Gloves

Unit/Dept.: _____ Day of Week: _____ Date: _____/_____/_____ Time: ____:____AM/PM to ____:____AM/PM Initials _____

	Room #	Bedspace #	Hand rub bottle or dispenser				Clean gloves near patient	Adherence to all elements	Comments
			Near patient	Not empty	Functional	Dispenses correct volume			
1			Y N	Y N	Y N	Y N	Y N	Y N	
2			Y N	Y N	Y N	Y N	Y N	Y N	
3			Y N	Y N	Y N	Y N	Y N	Y N	
4			Y N	Y N	Y N	Y N	Y N	Y N	
5			Y N	Y N	Y N	Y N	Y N	Y N	
6			Y N	Y N	Y N	Y N	Y N	Y N	
7			Y N	Y N	Y N	Y N	Y N	Y N	
8			Y N	Y N	Y N	Y N	Y N	Y N	
9			Y N	Y N	Y N	Y N	Y N	Y N	
10			Y N	Y N	Y N	Y N	Y N	Y N	
11			Y N	Y N	Y N	Y N	Y N	Y N	
12			Y N	Y N	Y N	Y N	Y N	Y N	
13			Y N	Y N	Y N	Y N	Y N	Y N	
14			Y N	Y N	Y N	Y N	Y N	Y N	
15			Y N	Y N	Y N	Y N	Y N	Y N	
16			Y N	Y N	Y N	Y N	Y N	Y N	
17			Y N	Y N	Y N	Y N	Y N	Y N	
18			Y N	Y N	Y N	Y N	Y N	Y N	
19			Y N	Y N	Y N	Y N	Y N	Y N	
20			Y N	Y N	Y N	Y N	Y N	Y N	
21			Y N	Y N	Y N	Y N	Y N	Y N	
22			Y N	Y N	Y N	Y N	Y N	Y N	
23			Y N	Y N	Y N	Y N	Y N	Y N	
24			Y N	Y N	Y N	Y N	Y N	Y N	
25			Y N	Y N	Y N	Y N	Y N	Y N	
26			Y N	Y N	Y N	Y N	Y N	Y N	
27			Y N	Y N	Y N	Y N	Y N	Y N	
28			Y N	Y N	Y N	Y N	Y N	Y N	
29			Y N	Y N	Y N	Y N	Y N	Y N	
30			Y N	Y N	Y N	Y N	Y N	Y N	
		Total # Y							
		% Present	%	%	%	%	%	%	

Appendix 2. Checklist for the Availability of Alcohol-Based Hand Rub and Clean Gloves (continued)

Instructions:

1. Each row should be used to record data regarding the availability of an alcohol-based hand rub (liquid, gel, or foam) and clean gloves at the point of care for an individual patient. A point of care is a bedspace, exam room, or treatment/procedure area. If multiple hand rub bottles or dispensers are available at a specific point of care, only one need be assessed. If pocket/belt bottles or dispensers are the primary way hand rub is dispensed in the unit or department, each row should be used to assess the bottle or dispenser for an individual health care worker providing care to patients in this unit or department during the assessment period.
2. The room number and bedspace fields are used to facilitate a complete assessment of all points of care in a unit or department and for reference if problems are noted with the availability of hand-rub bottles or dispensers or clean gloves, or if additional comments are recorded.
3. To qualify as being near the patient, a hand-rub bottle or dispenser and clean gloves should be accessible to a health care worker who is standing or sitting at the point of care (i.e., close to the patient's bed or attached to the frame of the bed) or to a health care worker who approaches the point of care (i.e., inside the patient's room just inside the door or in the corridor adjacent to door).
4. For the purposes of this measurement exercise, each bottle or dispenser should be assessed with regard to its capacity to dispense the correct volume into the hand of the user when activated once (i.e., that the bottle is not empty, is functional and does not spray aberrantly, and dispenses correct volume of product). Additional comments regarding bottles that are poorly placed, nearly empty, or functioning incorrectly can be noted in the comments section of the form to facilitate remedial action.
5. Codes are: Y = Yes, N = No.
6. In the Adherence field, use the following rule: Y = if **all** elements are Y (that is, Near patient, Not empty, Functional, Dispenses correct volume, and Clean gloves near patient are **all** Y); N = if not.
7. Count the total number of Y for each column and record the total in box at the bottom of each column.
8. Calculate the percent adherence using the formula below and record the percent in the box at the bottom of each column.

   Total # of Y ÷ Total # of Points of Care (number of rows with data recorded) x 100

Appendix 3. Hand Hygiene and Glove Use Monitoring Form

Unit/Dept.: _____ **Day of Week:** _____ **Date:** _____/_____/_____ **Time:** ____:____**AM/PM to** ____:____**AM/PM Initials** _____

	Type of Healthcare Worker (circle only one)	Type of contact		Hand hygiene before	Gloves		Hand hygiene after	Adherence		
		Patient	Environment		Required	Used		Hand hygiene	Glove use	Overall
1	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
2	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
3	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
4	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
5	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
6	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
7	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
8	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
9	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
10	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
11	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
12	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
13	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
14	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
15	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
16	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
17	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
18	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
19	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
20	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
21	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
22	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
23	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
24	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
25	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
26	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
27	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
28	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
29	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
30	D N TH PH XR ES TR OT	Y N	Y N	Alc HW N	Y N	Y N	Alc HW N	Y N	Y N NA	Y N
							Total # of Y			
							% Adherence	%	%	%

Type of Healthcare Worker: **D** = attending, fellow, resident, PA, med stud; **N** = nurse, aide, **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/IV team; **XR** = radiology technician; **ES** = environmental services; **TR** = transporter; **OT** = other

Hand hygiene before/after: Alc = alcohol-based hand rub; HW = handwashing with soap and water; N = none

Gloves Required: Y if isolation requiring gloves or contact involves an invasive procedure or contact with blood, body fluids, secretions/excretions, mucous membranes, or non-intact skin; N if not

Adherence: Hand hygiene -- Y if patient contact and hand hygiene before and after are both Y or if environmental contact only and hand hygiene after is Y; N = if not / **Glove use --** Y if Gloves Required and Used are both Y; N if Gloves Required is Y and Used is N; NA if Gloves Required is N / **Overall adherence --** Y if Hand hygiene is Y and glove use is Y or NA; N if not

Appendix 3. Hand Hygiene and Glove Use Monitoring Form (continued)

Instructions:

1. Each row should be used to record an encounter between one healthcare worker (HCW) and one patient that involves touching by the HCW of the patient or the patient's immediate environment. In situations involving and extended or complicated encounter, it is appropriate to use more than one row (see #4 below). Encounters that do not involve touching (i.e., only verbal communication between the HCW and the patient) should not be recorded.
2. An encounter may involve patient contact, environmental contact or both.
3. Patient contact involves touching the patient's body, gown, or clothes. Environmental contact involves touching the patient's bed or bed linen, bedside equipment, or other equipment, supplies, articles, or surfaces in the patient's bedspace or room.
4. For the purposes of this measurement exercise, an encounter begins when a healthcare worker enters the patient's room or approaches the patient's bedside (for multibed rooms) and ends when the healthcare worker leaves the room or bedside. In a situation where a patient requires extended or complicated care (such as in an ICU), an encounter may involve multiple contacts and it may be appropriate to record these individually if they are distinct activities. For example, a nurse may perform multiple patient care tasks at the bedside, complete this care, and then begin a series of contacts with the patient's environment. Or a nurse may complete a task that involves contact with mucous membranes and secretions, such as suctioning a patient, and then take on a separate task at a separate body site, such as changing a dressing. To the extent that these contacts can be observed and distinguished clearly, they may be recorded separately on separate rows.
5. The observer must be aware of whether a patient is on any type of isolation precautions that require the use of gloves. This information is necessary to determine whether gloves are required (see below).
6. For patient contact, the observer should be aware of the nature of the contact. This information is necessary to determine whether gloves are required (see below). It is important to distinguish three general subtypes of patient contact:
    a. contact that involves performing an invasive procedure (i.e., inserting an intravascular catheter or indwelling urinary catheter);
    b. contact that involves actual or potential contact with blood, body fluids, secretions (except sweat), excretions, mucous membranes or non-intact skin (i.e., suctioning an intubated patient, emptying a urinal or bedpan, changing an dressing on an open wound);
    c. other patient contact that does not qualify for a or b (i.e., measuring vital signs, examining a patient, repositioning a patient, etc.).
7. Use the following codes to record data (Note: Y = Yes, N = No, unless otherwise noted):

    Type of Healthcare Worker: D = attending physician, fellow, resident, physician's assistant, medical student; N = nurse, aide, TH = therapist (respiratory therapist, physical therapist, occupational therapist); PH = phlebotomy/IV team; XR = radiology technician; ES = environmental services; TR = transporter; OT = other;

    Hand hygiene before/after: Alc = alcohol-based hand rub (liquid, gel, or foam); HW = handwashing with soap and water; N = none;

    Gloves Required: Y if the patient is on any type of isolation precautions requiring gloves or the Type of Contact involved an invasive procedure or actual/potential contact with blood, body fluids, secretions/excretions, mucous membranes, or non-intact skin; N if not.
8. In the Adherence section, use the following rules to record Y or N for Hand Hygiene, Glove Use, and Overall Adherence:

    Hand hygiene: Y if the Type of Contact was patient contact and Hand hygiene before and after are both Y or if the Type of Contact was Environmental Contact only and Hand hygiene after is Y; N = if not;

    Glove use: Y if Gloves Required and Used are both Y; N if Gloves Required is Y and Used is N; NA if Gloves Required is N;

    Overall: Y if Hand hygiene is Y and Glove Use is Y or NA; N if not.
9. In the Adherence section, count the number of Y for Hand hygiene, Glove use, and Overall and record the total in box at the bottom of each column.
10. In the Adherence section, calculate the percent adherence using the formulas below and record the percent in the box at the bottom of each column

    Hand hygiene: Total # of Y ÷ Total # of Encounters (number of rows with data recorded) x 100

    Glove use: Total # of Y ÷ [Total # of Encounters (number of rows with data recorded) – Total # of NA] x 100

    Overall: Total # of Y ÷ Total # of Encounters (number of rows with data recorded) x 100

Recommended Standards of Practice for Hand Hygiene and Fingernails

Introduction

The following Recommended Standards of Practice were researched and written by the AST Education and Professional Standards Committee and have been approved by the AST Board of Directors. They are effective April 13, 2007.

AST developed the following Recommended Standards of practice to support health care facilities in the reinforcement of best practices related to hand and fingernail hygiene in the perioperative setting. The purpose of the recommended standards is to provide an outline that health care workers (HCWs) in the perioperative setting can use the Recommended Standards are presented with the understanding that it is the responsibility of the health care facility to develop, approve, and establish policies and procedures for performing counts according to established hospital protocols.

Rationale

Handwashing with soap and water has long been considered a standard of personal hygiene and its efficacy dates back to the 19th century. In 1846, Ignaz Semmelweis observed that women whose babies were delivered by medical students and physicians at the Vienna General Hospital had a much higher mortality rate compared to women whose babies were delivered by midwives. He observed that physicians were going directly from the autopsy room to the obstetrics ward to deliver babies without washing their hands, and he made the connection. Beginning in mid 1847, he became a proponent of students and physicians washing their hands with a chlorine solution between patients; and the mortality rate significantly decreased. This represents the first evidence indicating that handwashing between patients will contribute to the prevention of the transmission of disease between health care workers (HCW) and patients. In 1843, Oliver Wendell Holmes associated the spread of puerperal fever by the hands of HCWs. He was an advocate of handwashing between patients, but initially ignored. However, over time due to the observations and advocacy of Semmelweis and Holmes, handwashing has now become recognized as an important measure to be practiced by HCWs in preventing the transmission of pathogens.

However, it is interesting to note that studies have indicated adherence by HCWs to proper hand hygiene is still poor.[2] Refer to Table 1 for the factors that influence adherence to hand hygiene practices.

Table 1: Factors for Poor Adherence to Hand-Hygiene Practices

Observed risk factors for poor adherence to recommended hand hygiene practices [2]

- Physician status (rather than a nurse)
- Nursing assistant status (rather than a nurse)

- Male sex
- Working in an ICU
- Working during the week (versus the weekend)
- Wearing gowns/gloves
- Automated sink
- Activities with high risk of cross-transmission
- High number of opportunities for hand hygiene per hour of patient care

Self-reported factors for poor adherence with hand hygiene

- Handwashing agents cause irritation and dryness
- Sinks are inconveniently located/shortage of sinks
- Lack of soap and paper towels
- Often too busy/insufficient time
- Understaffing/overcrowding
- Patient needs to take priority
- Hand hygiene interferes with health care worker relationship with patients
- Low risk of acquiring infection from patients
- Wearing of gloves/beliefs that glove use obviates the need for hand hygiene
- Lack of knowledge of guidelines/protocols
- Not thinking about it/forgetfulness
- No role model from colleagues or superiors
- Skepticism regarding the value of hand hygiene
- Disagreement with the recommendations
- Lack of scientific information of definitive impact of improved hand hygiene on health care associated infection rates

Additional perceived barriers to appropriate hand hygiene

- Lack of active participation in hand hygiene promotion at individual or institutional level
- Lack of role model for hand hygiene
- Lack of institutional priority for hand hygiene
- Lack of administrative sanction of noncompliers/rewarding compliers
- Lack of institutional safety climate

Based upon the above information, it is recognized that the transfer of microorganisms from the fingernails, hands and arms of HCWs to patients has been a longtime infection-control concern. Proper care and hygiene of the fingernails, hands and arms by the surgical team members is essential to promoting surgical conscience, providing quality surgical care to the patient, and ensuring a positive outcome for the patient.

Standard of Practice I

The surgical team members should practice on a daily basis effective hand and fingernail hygiene.

1. Effective hand hygiene should be practiced on a daily basis to remove dirt, skin oil, debris and transient microorganisms to prevent transmission to the patient.
    A. Indications for handwashing include the following:

(1) Hands are visibly dirty or contaminated, or visibly contaminated with blood or body fluids.
(2) Anytime the possibility existed of contact with blood or body fluids
(3) When entering the surgical suite at the beginning of a day or shift
(4) Prior to having direct contact with a patient and between patients
(5) Immediately after the removal of gloves
(6) Before and after eating
(7) Immediately after using the restroom

2. Hand hygiene includes daily skin care by using hand lotions or creams to minimize the occurrence of irritant contact dermatitis, dry and cracked skin associated with repeated handwashing.[1,2]
    A. Manufacturers of hand lotions and creams should be consulted regarding any effects their product(s) may have on the persistent effects of antimicrobial soaps being used in the health care facility in order to choose the proper lotion or cream.[2]
    B. Lotions and creams should be selected based on compatibility with gloves.
3. The skin of surgical team members should be healthy and intact. Cuts, abrasions, open sores and hangnails provide a portal of exit and entry of microorganisms, thereby providing risk of exposure to surgical personnel and patients.

Standard of Practice II

Fingernails should be natural and polish-free. Fingernails should be short, debris-free, and not extend past the tips of the fingers.

1. The subungual area of the fingernail harbors high concentrations of bacteria, particularly coagulase-negative *staphylococci*, gram-negative rods, Corynebacteria, and yeasts. The subungual area should be cleansed with particular attention, using a disposable fingernail cleaner and/or fingernail brush under running water.[7]
2. Artificial fingernails should not be worn by surgical team members.[14]
    A. Artificial fingernails are more likely to harbor greater numbers of microorganisms, as compared to the natural fingernail, even after handwashing.[5,13] Personnel wearing artificial nails have been epidemiologically connected in outbreaks of infection.[2,7,10,11,12]
    B. Fungal growth can occur between the natural fingernail, and the artificial fingernail due to moisture, and products used to apply the artificial fingernail.[9]
3. Studies have established that there is no increase in microbial growth related to wearing freshly applied nail polish. However, it is recommended that fingernail polish should not be worn by surgical personnel.
    A. Chipped fingernail polish may support microbial growth on the fingernails.[6,15]
    B. Data does indicate that chipped nail polish or polish that has been worn for more than four days does harbor greater numbers of bacteria.[6,15]
4. The relationship between long fingernails and surgical site infections has not been established. However, it is known fingernails that extend beyond the fingertips are

more difficult to clean and keep clean, and therefore could contribute to an increase in the potential for harboring greater numbers of microorganisms.[1]

A. Fingernails that extend beyond the fingertips add to the potential for scratching patients during patient care, transfer and transport to and from the surgical suite and O.R., and while positioning the patient.
B. Fingernails that extend beyond the fingertips increase the risk of tearing or puncturing gloves .[1]
C. It is recommended that the natural nail tips be kept less than ¼ inch long and not significantly extend past the fingertips.[2]

Standard of Practice III

The reinforcement of hand and fingernail hygiene should be constantly emphasized with surgical technology students and peers.

1. Hand and fingernail hygiene begins in the classroom, lab and clinical rotation, and should be constantly emphasized to the student.
2. Education and promotion of hand and fingernail hygiene have been targeted as the primary factors in gaining compliance by HCWs.

Competency Statements

Competency Statements	Measurable Criteria
1. Certified Surgical Technologists (CSTs) and Certified First Assistants (CFAs) have the knowledge and proper skills, concerning patient care practices in the perioperative environment. 2. CSTs and CFAs are highly knowledgeable about surgical asepsis, modes of microbial transmission, and proper hand and fingernail hygiene practices related to providing safe patient care practices in the perioperative environment.	1. Educational standards as established by the *Core Curriculum for Surgical Technology* and *Core Curriculum for Surgical Assisting*.[3,4] 2. The subject area of proper hygiene as related to safe patient care practices is included in the didactic studies as a surgical technology and surgical assistant student. 3. Students demonstrate knowledge of recommended practices of hand and fingernail hygiene and preventing microbial transmission in the surgical environment in the lab/mock O.R. setting and during clinical rotation under the supervision of instructors and preceptors. 4. As practitioners, CSTs and CFAs apply the principles of hand and fingernail hygiene in providing safe patient care practices in the perioperative environment.

	5. CSTs and CFAs complete continuing education to remain current in their knowledge of microbial transmission and safe patient care practices.

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INPATIENT HAND HYGIENE MONITORING FORM

Unit/Dept.: _____ **Day of Week:** _____ **Date:** _____/_____/_____ **Initials** _____

	Type of Worker	Contact Type		Requires Gloves	Gloves Worn	Hand Hygiene Before	Hand Hygiene After
	(circle only one)	(circle only one)		Y=Yes N=No	Y=Yes N=No	Alc=Alcohol Rub HW=Hand Washing N=None	Alc=Alcohol Rub HW=Hand Washing N=None
1	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
2	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
3	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
4	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
5	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
6	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
7	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
8	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
9	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
10	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
11	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
12	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
13	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
14	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
15	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
16	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
17	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
18	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N
19	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N

INPATIENT HAND HYGIENE MONITORING FORM

20	D ES IV N OT PH2 PT/OT XR RT UT TR	Patient	Environment	Y N	Y N	Alc HW N	Alc HW N

Instructions:

- Each row should be used to record an encounter between one healthcare worker (HCW) and one patient that involves touching by the HCW of the patient or the patient's immediate environment. Encounters that do not involve touching (i.e., only verbal communication between the HCW and the patient) should not be recorded.
- An encounter may involve patient contact, environmental contact or both.
- For the purposes of this measurement exercise, an encounter begins when a healthcare worker enters the patient's room or approaches the patient's bedside (for multi-bed rooms) and ends when the healthcare worker leaves the room or bedside. In a situation where a patient requires extended or complicated care (such as in an ICU), an encounter may involve multiple contacts and it may be appropriate to record these individually if they are distinct activities. For example, a nurse may perform multiple patient care tasks at the bedside, complete this care, and then begin a series of contacts with the patient's environment. To the extent that the patient care and environmental contacts can be observed and distinguished clearly, they may be recorded separately.
- The observer should be aware of whether a patient is on Contact, Droplet, or Strict Isolation. Gloves are required for all of these types of isolation precautions.
- For patient contact, the observer should be aware of the nature of the contact. This information is necessary to determine whether gloves are required. It is important to understand the general types of patient contact listed below:
    - Requires Gloves:
        - contact that involves performing an invasive procedure (i.e., inserting an intravascular catheter or indwelling urinary catheter)
        - contact that involves actual or potential contact with blood, body fluids, secretions (except sweat), excretions, mucous membranes or non-intact skin (i.e., suctioning an intubated patient, emptying a urinal or bedpan, changing an dressing on an open wound)
        - patients on isolation precautions (see above)
    - Doesn't Require Gloves:
        - other patient contact that does not involve risk to blood/body fluid exposure (i.e., measuring vital signs, examining a patient, repositioning a patient, etc.) and patient is not on isolation precautions
- Use the following codes to record data on the monitoring form:
    - <u>Type of Worker</u>:
        - D = Attending Physician, Fellow, Resident, Physician's Assistant, Medical Student
        - ES = Environmental Services
        - IV = IV/Transfusion Service
        - N = Nurse, Aide
        - OT = Other
        - PH2 = Phlebotomy
        - PT/OT=Physical Therapist/Occupational Therapist
        - XR=Radiology Technician
        - RT=Respiratory Therapist
        - TR = Transporter

INPATIENT HAND HYGIENE MONITORING FORM

- Contact Type:
  - PATIENT= touching the patient's body, gown, or clothes
  - ENVIRONMENT= touching the patient's bed or bed linen, bedside equipment, or other equipment, supplies, articles, or surfaces in the patient's bed-space or room
- Requires Gloves (see above):
  - Y = Yes (contact requires gloves)
  - N = No (contact does not require gloves)
- Gloves Worn:
  - Y= Yes (gloves were worn)
  - N= No (gloves were not worn)
- Hand Hygiene Before:
  - Alc = Alcohol Rub (hands cleansed with alcohol rub prior to contact)
  - HW = Hand Washing (hands washed with soap & water prior to contact)
  - N = None (hands were not cleansed with soap & water or alcohol rub prior to contact)
- Hand Hygiene After:
  - Alc = Alcohol Rub (hands cleansed with alcohol rub after contact)
  - HW = Hand Washing (hands washed with soap & water after contact)
  - N = None (hands were not cleansed with soap & water or alcohol rub after contact)

Surgical/Procedural Hand Hygiene Monitoring Form

Department _____ **Division** _____ **Location** _____ **Date:** _____/_____/_____ **Initials** _____

	Type of Worker	Contact Type		Contact Time	Hand Hygiene Before	Hand Hygiene After	Clean Items not touched with contaminated gloves	Gloves removed before exiting room	Hand hygiene after glove removal
	(circle one)	(circle one)		(circle one)	(circle one) Complete if "E"	(circle one) Complete if "EX" Complete if "RM"	(circle one) Complete if "EX" Complete if "RM"	(circle one) Complete if "EX"	(circle one) Complete if "EX"
1	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
2	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
3	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
4	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
5	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
6	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
7	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
8	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
9	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA
10	D CORE CRNA CSA CST ES IV N Other PCA PH2 PT/OT XR RT SCT TR	Patient	Environment	E EX RM	HH, Gloves, None	ALC HW N	Y N NA	Y N NA	Y N NA

Surgical/Procedural Hand Hygiene Monitoring Form

Instructions:

- Each row should be used to record an encounter between one healthcare worker (HCW) and one patient that involves touching by the HCW of the patient or the patient's immediate environment. Encounters that do not involve touching (i.e., only verbal communication between the HCW and the patient) should not be recorded.
- An encounter may involve patient contact, environmental contact or both.
- For the purposes of this measurement exercise, an encounter begins when a healthcare worker enters the procedure room or approaches the patient's bedside and ends when the healthcare worker leaves the procedure room or bedside. In a situation where a patient requires extended or complicated care, an encounter may involve multiple contacts and it may be appropriate to record these individually if they are distinct activities. To the extent that the patient and environmental contacts can be observed and distinguished clearly, they may be recorded separately.
- The observer should be aware of whether a patient is on Contact, Droplet, or Strict Isolation. Gloves are required for all of these types of isolation precautions.
- For patient contact, the observer should be aware of the nature of the contact. This information is necessary to determine whether gloves are required. It is important to understand the general types of patient contact listed below:
    - Requires Gloves:
        - contact that involves performing an invasive procedure (i.e., inserting an intravascular catheter or indwelling urinary catheter)
        - contact that involves actual or potential contact with blood, body fluids, secretions (except sweat), excretions, mucous membranes or non-intact skin (i.e., suctioning an intubated patient, emptying a urinal or bedpan, changing an dressing on an open wound)
        - patients on isolation precautions (see above)
    - Doesn't Require Gloves:
        - other patient contact that does not involve risk to blood/body fluid exposure (i.e., measuring vital signs, examining a patient, repositioning a patient, etc.) and patient is not on isolation precautions
- Use the following codes to record data on the monitoring form:
    - <u>Type of Worker:</u>
        - D = Attending Physician, Fellow, Resident, Physician's Assistant, Medical Student
        - CORE = Surgical Core
        - CRNA = Certified RN Anesthetist
        - CSA= Certified Surgical Assistant
        - CST = Certified Surgical Technician
        - ES = Environmental Services
        - IV = IV/Transfusion Service
        - N = Nurse; Aide
        - OTHER=Other
        - PCA=Patient Care Assistant (OR)
        - PH2= Phlebotomy
        - PT/OT=Physical Therapist/Occupational Therapist
        - XR= Radiology Technician
        - RT=Respiratory Therapist
        - SCT=SCT

- TR = Transporter

- Contact Type:
  - PATIENT= touching the patient's body, gown, or clothes
  - ENVIRONMENT= touching the patient's bed or bed linen, bedside equipment, or other equipment, supplies, articles, or surfaces
- Contact Time:
  - E (Entry)= entry into procedure room or before contact
  - EX (Exit)= exit from the procedure room or after contact
  - RM (In Room) = in the room, neither entering or exiting for the contact
- Hand hygiene before: answered when Contact time=E
  - HH (Hand Hygiene)=washing of hands with soap & water or cleansing of hands with alcohol rub prior to contact
  - GLOVES=gloves put on prior to contact
  - NONE=hand hygiene not performed and/or gloves not worn prior to contact
- Hand hygiene after: answered when Contact time=EX or RM
  - ALC (Alcohol Rub) = hands cleansed with alcohol rub after contact and before next contact
  - HW (Hand Washing) = hands washed with soap & water after contact and before next contact
  - N (None) = no hand hygiene performed (hands were not cleansed with soap & water or alcohol rub) after contact and before next contact
- Clean items not touched with contaminated gloves: answered Yes or No when Contact Time=RM and gloves were worn during contact
  - Y= Yes (healthcare worker did not touch patient and/or clean environment with contaminated gloves or contaminated hands)
  - N= No (healthcare worker touched patient and/or clean environment with contaminated gloves or contaminated hands)
  - N/A =Not Applicable (unable to observe)
- Gloves removed before exiting room: answered Yes or No when Contact Time=EX and gloves were worn during contact
  - Y= Yes (healthcare worker removed gloves before exiting room)
  - N= No (healthcare worker did not remove gloves before exiting room)
  - N/A =Not Applicable (gloves not worn during contact; Contact Time=E; Contact Time=RM)
- Hand hygiene after glove removal: answered Yes or No when Contact Time=EX and gloves were worn during contact
  - Y= Yes (healthcare worker washed hands with soap & water or cleansed hands with alcohol rub after gloves were removed and prior to next contact)
  - N= No (healthcare worker did not wash hands with soap & water or cleanse hands with alcohol rub after gloves were removed and prior to next contact)
  - N/A =Not Applicable (gloves not worn during contact; Contact Time=E; Contact Time=RM)

2010 Contact Isolation Audit
Perianesthesia and Surgery

Month/Yr Data Collection _____ Dept/Unit _____

Person submitting data Name _____ Ext _____

- Self-audit ***5*** patient encounters and **5** independent observations with surgical patients requiring contact precautions each month
- Send to **QIR – 183 Bldg** by the 1st Tuesday of each month, **FAX** 651-229-1778, **email** to "QI Data Inbox"

☐ Check this box if you are completing this form as an *Independent Observer* - Name: _____

		Point of Care: Pre-Op/OR Suite/PACU				At End of Patient Encounter		
Audit	Your Department	Was a **Contact sign** visible at point of care?	Did you complete **hand hygiene** *before* touching patient?	If there is direct contact with patient are **gloves** worn?	If there is direct contact with patient is **gown** worn?	Did you **clean equipment** after patient use?	Did you **remove your gown and gloves** *when leaving* the OR ***or*** *when completing a patient* transport to PACU or inpatient unit?	Did you complete **hand hygiene** *after* the patient encounter?
1		Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No N/A Not observed	Yes No Not observed	Yes No Not observed
2		Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No N/A Not observed	Yes No Not observed	Yes No Not observed
3		Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No N/A Not observed	Yes No Not observed	Yes No Not observed
4		Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No N/A Not observed	Yes No Not observed	Yes No Not observed
5		Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No Not observed	Yes No N/A Not observed	Yes No Not observed	Yes No Not observed

Edited: 12/3/10

Contact Isolation Audit – Perianesthesia/Surgery Instructions

Complete **5** self-audits and **5** independent observations with surgical patients (inpatient and/or same-day surgery) requiring contact precautions

Forward the completed form to the QIR department by the end of the 1st Tuesday each month.

Form header:
Month/Yr Data Collection – note the month and year during which observations are done
Dept/Unit – note the unit/department/area within which audits are being done
Person Submitting Data – enter name of person submitting data to QIR
Ext – note your phone extension in case of questions

For self-audit:
Your department – name of the department in which you are employed (Imaging, Casting, Perianesthesia, and Surgery)

Note: "Not observed" is not a choice for self-auditors.

Point of Care: Pre-Op/OR Suite/PACU
Isolation sign visible? – circle "Yes" or "No" if sign visible at point of care of audit. (Note: staff from support departments – Imaging, Casting, etc – will not be docked for lack of a contact sign at point of care
Hand hygiene before touching patient? – circle "Yes" or "No"
Gloves worn with patient contact? – circle "Yes" or "No"
Gown worn with patient contact? – circle "Yes" or "No"

At End of Patient Encounter
Did you clean equipment before the next patient use or when equipment removed from OR suite? – circle "Yes" or "No" or "N/A" ("N/A" only applicable if no equipment was used with the isolation patient)
Gown and gloves removed before leaving OR or when patient transport is completed? – circle "Yes" or "No" or "N/A" (not applicable) ("N/A" would apply only to staff that have not had contact with the patient, i.e. Circulating Nurse)
Hand hygiene completed after the patient encounter? – circle "Yes" or "No"

For Independent Observation auditors:
Check the "independent observer" box near the top of the form and record your name.
Otherwise, same as above *except* record the department of the person you are observing in the "Your department" column

Note: be sure to use the "Not observed" option instead of "No" if you didn't observe a particular step.

Avera Marshall Regional Medical Center

Avera Marshall
Hand Hygiene Observation Tool

August 2011 Shift: Department/Unit: Observer:

Instructions:

1. Make **3** observations. Record one observation per column. Observation can be done at one time or different times.
2. Fill in the Worker Code in the top box for each observation. Try to get the multi-discipline mix representative of your unit.
3. Put a checkmark ✓ in the white box by the type of hand hygiene opportunity you observed. Please observe only one area listed.
4. Record the hygiene activity by code number that you observed in the shaded box.

   Hygiene Activity Codes:

   0 = No hand hygiene took place

   1 = Hands were washed with soap and water

   2 = Alcohol based hand rub was used

   Mark Activity Code 0 if 1 or 2 are not correct. Examples: washed with water only no soap definitely washed short time 10<seconds, alcohol foam not used on all surfaces of hand back & front

	1		2		3	
Worker Code						
Opportunity Observed						
• When beginning direct patient care						
• After completion of patient care						
• After removing gloves						
• After contact with contaminated item						

*Call lights, bed rails, telephones, doorknobs, faucet handles, toilet handles, bedside tables, beds, trash, laundry, specimen, etc…

Worker Codes:

P = Physician	N = Nurse	L = Laboratory	X = Radiology
RT = Respiratory Therapy	A = PCA/CNA/ER/HH Aide	TH = PT / OT / Speech Therapy	D = Dietary
E = Environmental Services (Housekeeping, Laundry, Maintenance)	SW = Social Worker / Discharge Planner	S = Student	O = Other (write in comment field)

5. Complete and return to Infection Prevention by the end of August. If you have any questions, contact Jo Coover 79354.

Comments if any

Hand Hygiene Observation Tool

(Use one tool per observation period. Obs. period = 1.5 hours or 8 HH opportunities)

Date_____ Your name_____

Obs. start time_____Obs. end time_____ Total obs. time for this period (check one)

- ☐ 0-30 min
- ☐ 31-60 min.
- ☐ 61-120 min.

HCW codes

N= nurse	RT= resp therapy
P = physician	PT =phys therapy
NA = nurse assist	OT= occ. therapy
X = xray	L = lab
U = unknown/other	T = tech
IV = IV therapy	TR= transporter

HH OPPORTUNITY DEFINITIONS:

After patient care:
After pt. contact, immediately between 2 pts., after removing gloves, after contact with patient's environment

Before patient care:
Before pt. contact, when moving from desk activities to patient care activities

1. UNIT/DEPT	2. HCW CODE (from above)	3. TYPE OF OPPORTUNITY (**Circle** after or before)	4. DID HH OCCUR? (**Circle** yes or no)	5. WHAT PRODUCT WAS USED FOR HH? (Circle one)	6. **CHECK BELOW** if HH opportunity occurred during care of a **PATIENT IN ISOLATION**
1.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
2.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
3.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
4.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
5.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
6.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
7.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
8.		After / Before	Yes / No	a. Alcohol hand rub / b. Soap & water	
		TOTALS			

Hand hygiene Observation Tool Instructions

Observe and record 16 opportunities for hand hygiene (2 sheets)

OPPORTUNITIES FOR HAND HYGIENE

We will be collecting data on two types of opportunities for hand hygiene. These are:

A. After Patient Care. This includes:

- After touching patient or things in patient space
- When moving from one patient, immediately to the next, with no other activities between patients
- After removal of gloves

B. Before Patient Care. This includes:

- Before patient contact
- When moving from desk activities (computer, charting, phone, etc.) to patient care activities

USING THE HAND HYGIENE OBSERVATION TOOL

Do your observations at a time when you can devote 100% of your attention to data collection—don't try to squeeze it in while you're doing patient care. Record your observations and other pertinent information on the hand hygiene observation tool. Use 1 copy of the tool for each 1.5 hour / 8 opportunity observation period. If you run out of space while observing, just attach another copy of the tool to the one you started with. Record each HH opportunity in a separate row. Very important: Do not record any HCW names when doing observation!

INSTRUCTIONS FOR FILLING OUT THE HAND HYGIENE OBSERVATION TOOL

Date: Date you are doing observations (separate sheet for each date)
Your name: Please put your name here in case I need to contact you with questions
Obs. start time: Time you begin observation period (military)
Obs. end time: Time you end observation period (military)
Total obs. time: Check the box with the range that contains your total observation time
Column 1. Unit: Unit where you are observing
Column 2. HCW Code: Use letters in "HCW Codes" box to record the professional category of each HCW you observe. If you are not sure of a worker's profession, ask the worker if possible. If not possible, mark "U" for unknown.
Column 3. Type of opportunity for hand hygiene: This is when hand hygiene should have occurred. Remember that we are only looking at 2 opportunities—before and after patient care. Indicate they type of opportunity you observed by circling either *after* or *before*, never both. See definitions on the tool
Column 4. Did hand hygiene occur? Circle "yes" of you saw that hand hygiene occurred when there was an opportunity for hand hygiene, circle "no" if you observed an opportunity but did not observe hand hygiene being done
Column 5. What product was used for hand hygiene? If hand hygiene did occur, circle "alcohol handrub" or "soap & water."
Column 6. Check column 6 if opportunity for hand hygiene occurred during care of a patient in isolation.

THINGS TO KEEP IN MIND:

- **Record only what you see:** If you identify an opportunity but can't see if hh occurred, **don't record anything!**
- When distinguishing between which type of hand hygiene opportunity to mark: Mark the opportunity that is closest to the activity. For example, if hand hygiene occurs immediately between two patients, count this as "after" because hand hygiene occurred closest to finishing with the first patient.
- How many opportunities should be observed for one HCW? You may record observations of all hand hygiene opportunities and occurrences for a single HCW during a single cycle of activity. When that cycle of activity seems complete, go on to observe another HCW. Don't observe an individual HCW for more than one of your observation periods; try to collect data on a variety of shifts.
- Other infection control practices: You will observe many interesting infection control practices. Feel free to note your other observations on the back/margins of the tool.

FINISHING UP: When you are finished with an observation period, record the totals for each column in the "totals" row of the HH tool. Make a copy of your observation sheets in case they get lost in the mail! **SEND COMPLETED OBSERVATION TOOLS TO INFECTION CONTROL AND PREVENTION SERVICE.** Thank you for your participation!

Observer Name/Initials

_____

Hand Hygiene Monitoring Form*

Unit/Dept.: _____ **Date:** _____/_____/_____

	Type of Healthcare Worker (circle only one)							Hand Hygiene Before Patient Contact			Hand Hygiene After Patient Contact		
1	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
2	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
3	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
4	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
5	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
6	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
7	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
8	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
9	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
10	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
11	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
12	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
13	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
14	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
15	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
16	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
17	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
18	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
19	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
20	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
21	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
22	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
23	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
24	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
25	D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N

Type of Healthcare Worker: **D** = doctor, resident, physician assistant, med student; **N** = nurse, aide; **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/lab; **XR** = radiology technician; **TR** = transporter; **OT** = other

Hand hygiene before/after: **Alc** = alcohol-based hand rub; **HW** = handwashing with soap and water; **N** = none

*Form adapted from Institute for Healthcare Improvement (IHI) How-to Guide: Improving Hand Hygiene, Appendix 3
Endorsed by the Centers for Disease Control and Prevention (CDC), the Association for Professionals in Infection Control and Epidemiology, Inc. (APIC), and the Society for Healthcare Epidemiology of America (SHEA).

When complete please return to: Infection Control
Quality Management
1st Floor St. Luke's Clinic Building

Instructions:

1. Each row should be used to record an encounter between one healthcare (HCW) and one patient that involves touching by the HCW of the patient. In situations involving and extended or complicated encounter, it is appropriate to use more than one row (see #4 below). Encounters that do not involve touching (i.e., only verbal communication between the HCW and the patient) should not be recorded.
2. Each encounter **MUST** involve patient contact.
3. Patient contact involves touching the patient's body, gown, or clothes. Environmental contact involves touching the patient's bed or bed linen, bedside equipment, or other equipment, supplies, articles, or surfaces in the patient's bedspace or room and should **NOT** be recorded.
4. For the purposes of this measurement exercise, an encounter begins when a healthcare worker enters the patient's room or approaches the patient's bedside (for multibed rooms) and ends when the healthcare worker leaves the room or bedside. In a situation where a patient requires extended or complicated care (such as in an ICU), an encounter may involve multiple contacts and it may be appropriate to record these individually if they are distinct activities. For example, a nurse may perform multiple patient care tasks at the bedside, complete this care, and then begin a series of contacts with the patient's environment. Or a nurse may complete a task that involves contact with mucous membranes and secretions, such as suctioning a patient, and then take on a separate task at a separate body site, such as changing a dressing. To the extent that these contacts can be observed and distinguished clearly, they may be recorded separately on separate rows.
5. Use the following codes to record data (Note: Y = Yes, N = No):

   Type of Healthcare Worker:
   D = doctor, resident, physician assistant, medical student; **N** = nurse, aide; **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/lab; **XR** = radiology technician; **TR** = transporter; **OT** = other

   Hand hygiene before/after:
   Alc = alcohol-based hand rub (liquid, gel, or foam); **HW** = handwashing with soap and water; **N** = none

Observer Name/Initials

_____

Laboratory Hand Hygiene Monitoring Form*

Unit/Dept if all Observations are done at the same location_____Date: _____/_____/_____

	Location of observation (Nursing Unit or ED)	Type of Healthcare Worker (circle only one)							Hand Hygiene Before Patient Contact			Hand Hygiene After Patient Contact		
1		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
2		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
3		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
4		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
5		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
6		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
7		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
8		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
9		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
10		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
11		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
12		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
13		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
14		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
15		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
16		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
17		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
18		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
19		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
20		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
21		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
22		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
23		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
24		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
25		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N

Type of Healthcare Worker: **D** = doctor, resident, physician assistant, med student; **N** = nurse, aide; **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/lab; **XR** = radiology technician; **TR** = transporter; **OT** = other

Hand hygiene before/after: **Alc** = alcohol-based hand rub; **HW** = handwashing with soap and water; **N** = none

*Form adapted from Institute for Healthcare Improvement (IHI) How-to Guide: Improving Hand Hygiene, Appendix 3
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Quality Management
1st Floor St. Luke's Clinic Building

Instructions:

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2. Each encounter **MUST** involve patient contact.
3. Patient contact involves touching the patient's body, gown, or clothes. Environmental contact involves touching the patient's bed or bed linen, bedside equipment, or other equipment, supplies, articles, or surfaces in the patient's bedspace or room and should **NOT** be recorded.
4. For the purposes of this measurement exercise, an encounter begins when a healthcare worker enters the patient's room or approaches the patient's bedside (for multibed rooms) and ends when the healthcare worker leaves the room or bedside. In a situation where a patient requires extended or complicated care (such as in an ICU), an encounter may involve multiple contacts and it may be appropriate to record these individually if they are distinct activities. For example, a nurse may perform multiple patient care tasks at the bedside, complete this care, and then begin a series of contacts with the patient's environment. Or a nurse may complete a task that involves contact with mucous membranes and secretions, such as suctioning a patient, and then take on a separate task at a separate body site, such as changing a dressing. To the extent that these contacts can be observed and distinguished clearly, they may be recorded separately on separate rows.
5. Use the following codes to record data (Note: Y = Yes, N = No):

   Type of Healthcare Worker:
   D = doctor, resident, physician assistant, medical student; **N** = nurse, aide; **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/lab; **XR** = radiology technician; **TR** = transporter; **OT** = other

   Hand hygiene before/after:
   Alc = alcohol-based hand rub (liquid, gel, or foam); **HW** = handwashing with soap and water; **N** = none

Observer Name/Initials

_____

RADIOLOGY Hand Hygiene Monitoring Form*

Unit/Dept if all Observations are done at the same location_____Date: _____/_____/_____

	Location of observation if done in different locations.	Type of Healthcare Worker (circle only one)							Hand Hygiene Before Patient Contact			Hand Hygiene After Patient Contact		
1		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
2		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
3		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
4		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
5		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
6		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
7		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
8		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
9		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
10		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
11		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
12		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
13		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
14		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
15		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
16		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
17		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
18		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
19		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
20		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
21		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
22		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
23		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
24		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N
25		D	N	TH	PH	XR	TR	OT	Alc	HW	N	Alc	HW	N

Type of Healthcare Worker: **D** = doctor, resident, physician assistant, med student; **N** = nurse, aide; **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/lab; **XR** = radiology technician; **TR** = transporter; **OT** = other

Hand hygiene before/after: **Alc** = alcohol-based hand rub; **HW** = handwashing with soap and water; **N** = none

*Form adapted from Institute for Healthcare Improvement (IHI) How-to Guide: Improving Hand Hygiene, Appendix 3
Endorsed by the Centers for Disease Control and Prevention (CDC), the Association for Professionals in Infection Control and Epidemiology, Inc. (APIC), and the Society for Healthcare Epidemiology of America (SHEA).

When complete please return to: Infection Control
Quality Management
1st Floor St. Luke's Clinic Building

Instructions:

1. Each row should be used to record an encounter between one healthcare (HCW) and one patient that involves touching by the HCW of the patient. In situations involving and extended or complicated encounter, it is appropriate to use more than one row (see #4 below). Encounters that do not involve touching (i.e., only verbal communication between the HCW and the patient) should not be recorded.
2. Each encounter **MUST** involve patient contact.
3. Patient contact involves touching the patient's body, gown, or clothes. Environmental contact involves touching the patient's bed or bed linen, bedside equipment, or other equipment, supplies, articles, or surfaces in the patient's bedspace or room and should **NOT** be recorded.
4. For the purposes of this measurement exercise, an encounter begins when a healthcare worker enters the patient's room or approaches the patient's bedside (for multibed rooms) and ends when the healthcare worker leaves the room or bedside. In a situation where a patient requires extended or complicated care (such as in an ICU), an encounter may involve multiple contacts and it may be appropriate to record these individually if they are distinct activities. For example, a nurse may perform multiple patient care tasks at the bedside, complete this care, and then begin a series of contacts with the patient's environment. Or a nurse may complete a task that involves contact with mucous membranes and secretions, such as suctioning a patient, and then take on a separate task at a separate body site, such as changing a dressing. To the extent that these contacts can be observed and distinguished clearly, they may be recorded separately on separate rows.
5. Use the following codes to record data (Note: Y = Yes, N = No):

   Type of Healthcare Worker:
   D = doctor, resident, physician assistant, medical student; **N** = nurse, aide; **TH** = therapist (RT, PT, OT); **PH** = phlebotomy/lab; **XR** = radiology technician; **TR** = transporter; **OT** = other

   Hand hygiene before/after:
   Alc = alcohol-based hand rub (liquid, gel, or foam); **HW** = handwashing with soap and water; **N** = none

Alcohol Hand Rub (AHR) Accessibility

Instructions:

1. Check 10 patient rooms (fewer if you have less than 10 rooms) and indicate the following in the space provided below:
   - If an empty can of AHR was in the wall-mounted dispenser (check for emptiness by shaking can or trying to dispense)
   - If extra can in designated storage area (drawer, cabinet) in the patient room
   - If AHR sticker on storage drawer/cabinet
2. Return this completed form to Infection Control

Date_____ Unit_____ Your name_____

	Room number	**Is AHR dispenser empty? (check if YES)**	**Is extra AHR can in designated storage space? (check if YES)**	**Is AHR sticker on storage drawer/cabinet? (check if YES)**
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

MAYO CLINIC | *Hand Cleaning: How Are We Doing?*

Department/Division/Location_____ Date Today__ __/__ __/__ __ __ __
Month Day Year

Providing Quality Care To You Is A Priority At Mayo Clinic

We adopt rigorous practices and measure our performance to advance the quality of your care. You can partner with us to reach this goal. Please take a moment to complete this short survey to help us continue to provide the excellent care at Mayo Clinic you have come to expect. Thank you!

Instructions: Please complete this questionnaire at the end of your appointment. It can be completed by the patient or an accompanying family member for the patient. Observe one person – a doctor or nurse or other professional who provided your care and answer the questions below:

1. **Which health professional providing care did you choose to observe?**

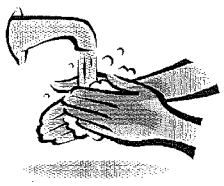
   ☐ Doctor ☐ Nurse ☐ Other health care professional

2. **Did this person touch you during this appointment to do an examination, procedure, treatment or test?**

   ☐ **YES** ☐ **NO → If you answered NO, please STOP here.**

3. ***Before*** **touching you (patient), did the care provider do any of the following?**

   ☐ **YES**
   ☐ **NO**

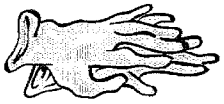


Wash his/her hands with soap and water?

OR

Rub his/her hands with hand sanitizer?

OR

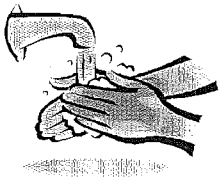


Put on clean gloves?

Omit question # 4 below if the only care provided to you was in a lab setting. (Example: doing blood draws or urine tests)

4. ***After*** **touching you (patient), did the care provider do either of the following?**

   ☐ **YES**
   ☐ **NO**



Wash his/her hands with soap and water?

OR

Rub his/her hands with hand sanitizer?

Please leave the completed questionnaire in the exam room or return it to the front desk.

Gillette Children's Specialty Healthcare	**Policy Number:** S0097	**Title:** Non Sterile Dress Attire for Peri-Anesthesia, Surgical Services and Reprocessing	
	Policy Coordination: Infection Prevention		
	Effective Date: 8/10 **Origination Date: 12/89**	**Page 1 or 3**	**Surgery**

I. PURPOSE

To provide guidelines for attire worn within the semi-restricted and restricted areas of Surgical Service environments. The human body is a source of microbial contamination. Clean scrub clothing is worn to promote cleanliness and hygiene within the surgery and minimize the bacterial shedding from clothing and skin.

II. POLICY

All staffs will follow the guidelines for proper attire identified in these policy/procedures. Laundering of surgical attire will be done through the Gillette contracted laundry service. Surgical attire and personal protective equipment supplies will be available in the designated changing rooms and at the point of entry to the semi-restricted and restricted zones of the department. Visitors and families will be assisted to wear the identified personal protective equipment and clothing when they are in the semi-restricted and restricted zones of the department.

Peri-Anesthesia & Surgical Services Traffic Zones and Expected Behaviors

Zone	Location	Dress Attire
Unrestricted	• Pre-Op • Same Day • PACU • Corridor to Central OR Desk	Street clothes are allowed Employees must have visible name badges displayed Gillette Staffs doing direct patient care wear clean surgical scrubs
Semi-restricted **Semi-restricted continued**	Reprocessing (all areas) Support spaces to actual surgical suite Scrub sink areas • All entrances and corridors leading to surgical suites • Storage spaces for clean and sterile supply	Gillette Staffs doing direct patient care wear clean surgical scrubs Support department staff coming to the OR may cover their own uniform with a coverall (bunny suit) Families cover clothing with coverall Hair/facial beard coverings required Shoe covers for street shoes

Restricted	Clean core room servicing operating rooms Operating Rooms	Gillette Staffs doing direct patient care wear clean surgical scrubs Support department staff coming to the OR may cover their own uniform with a coverall (bunny suit) Hair/facial beard coverings required. Mask tied/eye protection when sterile supplies open in the OR room. Shoe covers for street shoes and OR shoe protection

III. PROCEDURE

A. Upon entry/arrival to the department each day, staff working in the semi-restricted, restricted areas of surgery are expected to don Gillette provided, freshly laundered surgical attire.

1. **Hair cover**: Wearing a clean hair covering reduces the risk of hair or dandruff being shed onto a surgical field. A single-use hair covering is donned first so that hair does not fall on clean scrub clothing. Hair covering(s) should cover and contain all hair. Two coverings may be necessary for long hair.
2. **Hoods** are used to cover facial hair. Facial hair includes sideburns, necklines and beards.
3. **Skull caps** that fail to cover the side hair above the ears and hair at the nape of the neck should not be worn in the surgical suite.
4. **Scrubs** worn from another hospital should be changed before entering the semi-restricted and restricted zones of Gillette surgery. There is a potential for environmental contamination from animal hair in a car, blowing dust/dirt outside.
5. **Scrubs** worn outside the Gillette building should be changed on return to Surgical Services, including hair cover.
6. **Scrubs** should be changed when visibly soiled, contaminated with blood or body fluids or become wet.
7. **Fleece** is not an acceptable garment material in the operating room. Fleece produces lint which contributes to increased particle counts in the operative environment.
8. **Personal long-sleeved shirt** garments from home should not be worn.
9. **Warm-up jackets**: Freshly laundered hospital provided warm up jackets are allowed in the semi-restricted, restricted zones.
10. **Lab coats** should be removed before entering these areas.
11. **Masks/Protective eye wear:** Intended to contain and filter droplets of microorganisms expelled from the mouth and nasopharynx. Should be worn when open sterile items and equipment and scrubbed persons are present.
    - Are a single use item; a new mask is needed for each additional surgical case.
    - Must be fluid resistant
    - Should cover mouth and nose and be secured to prevent venting.
    - Protect staffs from blood and fluid exposures during surgery.
    - Should not hang around neck or be tucked into a pocket for future use.
12. **Protective eye wear:** Worn when entering the surgical room when a case is in progress to prevent splashing or spraying to facial skin and eyes. Generally integrated into a single use droplet mask. A facial shield may also be added for staff protection.
    - Remove when contaminated as promptly as possible.

- Reusable eye wear protective equipment must be cleaned and low level disinfected between cases per manufacture's written instructions.

13. **Shoes:** Foot attire has no proven significance in reducing surgical site wound infections. Shoes worn within the surgical environment and outside the department must be clean with no visible soiling and should provide staff with protection from sharp instrument strikes. (No open toed shoes).
14. **Shoe covers:** Fluid resistant shoe covers are considered PPE and must be worn when anticipating splashes or spills to the feet during surgery.
    - Street shoes should be covered to assist with not tracking dirt into the semi-restricted, restricted areas.
    - Shoe covers should be removed when leaving Surgical Services (going to cafeteria, clinic and other departments.)
15. **Gloves:** Are selected and worn depending on the task performed: sterile gloves when performing sterile procedures, unsterile gloves for other tasks. Gloves are changed or removed with performing separate dirty/clean procedures within the same patient and when removed. Hand hygiene is performed after glove removal.
16. **Jewelry:** All personnel entering the semirestricted and restricted areas of the surgical suite should confine or remove all jewelry and watches. (AORN Recommendation IV for Surgical Attire. (AORN 2010 Standards and Recommendations. P. 69) Rings should not be worn by healthcare personnel in the perioperative setting (AORN Perioperative Standards and Recommended Practices, 2010 Edition, p. 75-76). Watches and bracelets should be removed prior to washing hands.
17. Rings, watches and bracelets are removed.
18. Other jewelry is removed or confined within the scrub attire.

B. **Fingernails** must be kept short, clean and healthy.
   1. Artificial nails or nail extenders are not permitted.
   2. Nail polish must be chip free.

C. **Removal of surgical attire** and personal protective equipment: follow Gillette Safety policy SF:17.

D. **Non-Gillette staff** entering the semi-restricted or restricted areas of the surgical department (law enforcement officers, parents, biomedical vendors) will be instructed on hand hygiene and use of required dress attire for semi-restricted and restricted areas in the department. Non-Gillette staff are expected to wear hair cover, mask and disposable coveralls (bunny suit) to cover street clothes or change into clean hospital provided scrubs.
   - A coverall (bunny suit) is a single use item.

IV. REFERENCES

APIC State of the Art Report: Use of scrubs and related apparel in health care facilities. Nathan L.Belkin, PhD. AJIC Am J Infect Control 1197; 25:401-4.

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AVERA MARSHALL REGIONAL MEDICAL CENTER
POLICY TITLE: Dress Code in the Operating Room

CATEGORY: OR
PRIMARY AUTHOR: Manager, OR Services
COLLABORATOR(S):

APPROVED BY:

EFFECTIVE: 4/11
REVIEWED: __/__
REVISED: _7_/__11

DEPARTMENTS AFFECTED: OR

DISTRIBUTION: [X] OR

I. POLICY: Surgical attire is worn to promote cleanliness, surgical consciousness and professionalism within the surgical environment.

Definitions:

A. Surgical attire includes scrub clothes, hair coverings, mask, protective eyewear and other protective garments, provide a barrier to contamination that may pass from personnel to patient as well as from patient to personnel.

B. The following are area definitions for Avera Marshall surgical areas:

1. Restricted: Operating rooms
2. Semi-restricted: hallways within the surgical suite (which are not located where open sterile supplies or scrubbed persons may be located)
3. Unrestricted: Same Day Surgery, holding rooms, staff lounge

II. PURPOSE: To achieve optimal health and safety for patients and staff.

III. PROCEDURE:

A. Identification: An Avera Marshall identification badge, with the employee's photograph and appropriate title will be worn by each employee while on hospital premises. This ID badge should in no way interfere with patient care nor jeopardize aseptic technique. Identification badges are worn in clear sight above the waist with name, title and picture clearly visible.

B. Hygiene:

1. Good personal hygiene shall be observed. The body shall be clean/free of body odor and/or strong fragrances.
2. Hand washing or hospital approved disinfectant is required between patients and when they become soiled or when gloves have been removed.
3. Fingernails are kept clean, well cared for, and no longer than ¼ inch from fingertip in length. Artificial and long natural fingernails are not permitted for those providing direct patient care. The definition of artificial fingernails includes, but is not limited to, acrylic nails, all overlays, tips, bondings, extensions, tapes, inlays, and wraps. Nail jewelry is not permitted. Nail polish, if worn, is well maintained. Chipped nail polish is not allowed.

C. Personal Protection Equipment:

1. Hats/head covers: All head and facial hair must be completely covered.
2. Masks: Disposable masks must be worn in restricted areas and applied to prevent "venting". The mouth and nose should be completely covered. Masks should be changed when they become moist or soiled or if leaving the OR suite and restricted areas.
3. Shoe covers: Fluid-resistant shoe covers should be worn when it is anticipated that splashes or spills may occur. If shoe covers are worn, they should be changed whenever they become torn, wet, or soiled, and they should be removed and discarded in a designated container before leaving the surgical area.
4. Eyewear and gloves: Gloves and protective eyewear or face shields shall be worn by all operating room personnel when performing duties that require direct patient contact or contact with contaminated items. Gloves and protective eyewear should be changed after such contacts and before exiting the room.

D. Clothing and Personal Articles:
    1. Personal clothing worn to and from work should be consistent with hospital policy. Hospital provided scrub attire must not be worn arriving or departing from the hospital grounds.
    2. Jewelry: All scrub personnel entering the semi-restricted and restricted areas of the surgical suite are required to have all jewelry removed or confined within staff and physician's scrub clothes.
    3. Cloth hats: Cloth hats must be laundered daily.
    4. Scrubs: All persons entering semi-restricted and restricted areas of the operating room must be dressed in clean Avera Marshall surgical attire. (Attire from institutions other than Avera Marshall is prohibited). Scrub clothes must be clean at all times. They are to be changed when soiled by blood, body fluids, excessive betadine, food or following documented isolation cases.
    5. Tops: A short sleeve t-shirt may be worn by all personnel under scrub tops. Long sleeve tops may not be worn when scrubbed, but may be worn by non-scrubbed personnel if covered by a clean scrub jacket.
    6. Jackets:
        a. Only warm up jackets provided by hospital linen services are allowed in the restricted/semi-restricted areas and must be laundered daily. This jacket cannot be worn outside the restricted/semi-restricted area.
    7. Shoes: Shoes worn within the surgical environment should be clean with no visible soiling and should provide protection. Open-toe shoes should not be worn. Vented shoes should be covered by fluid-resistant shoe covers when it is anticipated that splashes or spills may occur.

E. Home laundering of scrub attire is not allowed. All scrubs worn in the OR must be the property of Avera Marshall and laundered by the hospital laundry. Staff not participating in direct patient care follows the Avera Marshall dress code policy. Those with possible sensitivity allergies should report to Employee Health. Employee Health must document in writing hypersensitivity to Avera Marshall laundered scrubs. It is the responsibility of the employee to present this documentation to his/her supervisor and receive written permission to home launder their scrubs. Laundering must be according to the stringent AORN protocol and scrubs must be transported to and from Avera Marshall in a plastic bag.

REFERENCE(S):
RELATED P&P(S):
ATTACHMENTS:
KEY WORDS:
TYPIST:

POLICY TITLE: Physician Guideline for Dress

CATEGORY: HR
PRIMARY AUTHOR: AMG Regional Administrator
COLLABORATOR(S):
ID#:
Page 1 of 2

APPROVED BY:
EFFECTIVE:
REVIEWED:
REVISED:

DEPARTMENTS AFFECTED: Avera Medical Group

I. POLICY: Providers should dress in a manner which reflects positively on the department, hospital and their profession. Clothing worn to work should reflect professional status, be clean, provide for mechanical safety of the provider and the patient, allow for full performance of all duties and provide easy identification of the medical provider and his /her department.

II. PURPOSE: To establish a suitable standard dress and appearance code for all medical providers that will promote a professional work environment within the Avera Medical Group-Marshall.

- Name badges (provided by the Avera Medical Group) will be worn at all times in a easily seen location above the waist.
  The goal is identification, and the name badge should be easily visible to persons lying in bed.

- Blue jeans are not permitted during a provider's regular working hours.
  A physician on call may report to the facility in jeans. However, the physician's overall appearance/attire must be professional in nature.

- White lab coats will be provided by the Avera Medical Group and will be worn by physicians providing direct patient care (hospital setting), except in areas where other protective clothing is required, such as surgery. Lab coats must be neat, clean and in good repair.

  Lab coats are not required:
  - In out-patient areas;
  - Providers within each specialty will define clinic dress, based upon expectations/needs of patients served.

- Appropriate footwear must be worn. Open-toed shoes will be allowed. Shoes should not have high heels or built up soles such that could endanger the provider or the patient.

- Polo shirts or styled cotton tops with pockets are acceptable (no t-shirts or tank tops).

- Sweatshirts are not suitable in direct patient care areas or in the clinic during regular business hours.

- Clothing bearing logos or company names other than Avera Marshall will not be allowed.

- Fragrances should be avoided.

- Long hair should be tied back during patient treatment or when operating machinery.

- Jewelry must be discrete and provide no risk to the wearer or the patient.
- **No wearing Scrubs outside of the hospital.**

REFERENCE(S):
RELATED P&P(S):
ATTACHMENTS:
KEY WORDS:
TYPIST: all

SAFE CUTS

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SAFE CUTS

A – Access to Information

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E – Educate Staff and Patients

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http://www.hhs.gov/ash/initiatives/hai/training. Link to U.S. Department of Health and Human Services on-line training program for HAI prevention, Partnering to Heal.