DEPARTMENT OF HEALTH

2022 Blood Lead Surveillance Report

LEAD AND HEALTHY HOMES PROGRAM

2022 Blood Lead Surveillance Report

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Upon request, this material will be made available in an alternative format such as large print, Braille or audio recording.

Contents

Acronyms and Abbreviations

ABLES	Adult Blood Lead Epidemiology and Surveillance Program
BLIS	Blood Lead Information System
BLL	Blood Lead Level (µg/dL)
CDC	Centers for Disease Control and Prevention
DHS	Minnesota Department of Human Services
DLI	Minnesota Department of Labor and Industry
EBLL	Elevated Blood Lead Level
EPA	Environmental Protection Agency
EPSDT	Medicaid's Early and Periodic Screening, Diagnosis, and Treatment Program
ESNDC	East Side Neighborhood Development Company
FDA	U.S. Food and Drug Administration
IDEPC	Division of Infectious Disease Epidemiology, Prevention, and Control
IQ	Intelligence Quotient
HUD	U.S. Department of Housing and Urban Development
LHHP	MDH Lead and Healthy Homes Program
MA	Minnesota Medical Assistance, Minnesota's Medicaid program
M-CLEAN	Minnesota Collaborative Lead Education and Assessment Network
MDE	Minnesota Department of Education
MDH	Minnesota Department of Health
MEDSS	Minnesota Electronic Disease Surveillance System
MN	Minnesota
MNCare	MinnesotaCare, a public health care program for Minnesotans with low incomes
NIOSH	National Institute for Occupational Safety and Health
PPB	Parts per Billion
SPRCPH	St. Paul-Ramsey County Public Health
U.S.	United States
µg/dL	Micrograms of lead per deciliter of whole blood

Executive Summary

This 2022 Blood Lead Surveillance Report describes the activities of the Minnesota Department of Health (MDH) Lead and Healthy Homes Program (LHHP) and the data analysis from the MDH Blood Lead Information System (BLIS) for the 2022 calendar year. The annual report contains a description of the trends in lead testing and elevated blood lead levels in Minnesota.

In 2022, about 84,000 Minnesota children received at least one blood lead test. Of these, 680 (under 1%) were found to have an elevated blood lead level. This number has been decreasing over the past decades, however, some populations and areas in Minnesota have much higher proportions of elevated blood lead levels than others.

Childhood blood lead screening in Minnesota has generally improved since 2000. Approximately 80% of children born in 2019 were tested at least once prior to their third birthday in 2022, compared to 42% of those born in 2000. However, further increases in the percent tested have not been seen since the 80% point was first reached by children born in 2008, and the proportion tested by age three years was lower for children born in 2019 than the two prior birth years, likely due to the COVID-19 pandemic's impact on testing rates. Just 35% of children born in 2019 received blood lead tests at both one and two years of age.

Once a child is detected as potentially having an elevated blood lead level (5+ µg/dL) through a screening test, a diagnostic follow-up test is recommended. In 2022, 75% of children with an elevated screening test received a follow-up test within the recommended time period. Local public health agencies provide case management services, ranging from educational mailings to home visits, to all children with elevated blood lead levels. If a child's blood lead level is confirmed to be elevated via a venous blood test, an environmental risk assessment of the child's residence by a licensed risk assessor is mandated. The blood lead level to initiate an environmental risk assessment was lowered from 15+ µg/dL to 5+ µg/dL in July 2021, however, staffing shortages limited investigations for many children below 15 µg/dL. In 2022, there were 565 children with confirmed blood lead levels over 5 µg/dL; 448 of these were newly identified. Risk assessments identified lead-based paint and lead contaminated dust hazards in the homes of most of these children.

In addition to childhood lead exposure, adults can also be exposed to lead. Most adult lead exposures are occupational. In 2022, 959 Minnesota adults were found to have elevated blood lead levels. Common industries where workers were exposed in 2022 included secondary smelting, sporting and athletic goods manufacturing (includes fishing sinker manufacturing), and small arms ammunition manufacturing.

Lead exposure surveillance through the Minnesota Blood Lead Information System enables the identification and response to lead exposures as well as monitoring of trends and patterns in the population. MDH also contributes to regional and national efforts to formulate strategies for identifying and preventing exposure to lead. MDH currently receives funding from state and federal sources, including funds from the Centers for Disease Control and Prevention (CDC) to support these activities. Ongoing investment is necessary to maintain data collection, entry, analysis, and quality assurance.

Lead Exposure

Although the toxicity of lead has been known for thousands of years, lead remains one of the most common environmental hazards for children. There are many sources of lead exposure, such as soil contaminated from years of leaded gasoline use, lead dust accidentally brought home from parents' workplaces and hobby areas, lead in plumbing, and some imported products and traditional remedies. However, deteriorated lead paint in homes remains the main source of lead exposure for U.S. children today. As lead paint deteriorates, it creates fine dust that is identical in appearance to ordinary house dust. Although lead paint was banned for residential use in 1978, many older homes still contain lead paint. It is estimated that nearly one million homes throughout Minnesota still have lead paint.

Elevated levels of blood lead occurring during the first years of life may not produce symptoms until the children enter school and display learning difficulties, reduction in IQ, or behavior problems.

Children less than six years old are most vulnerable to lead's toxicity due to their growing bodies, nutritional needs, mouthing behavior, and time spent on the floor. Pregnant women and the developing fetus are also at greater risk because lead easily passes through the placenta to the fetus. The changing nutritional needs of the mother also cause release of lead stored in bone. In addition, certain populations are at increased risk of lead exposure. For example, children enrolled in medical assistance programs are more likely to live in old, poorly maintained housing, which is more likely to contain lead paint hazards (CDC, Recommendations for Blood Lead Screening of Medicaid-Eligible Children Aged 1-5 Years: and Updated Approach to Targeting a Group at High Risk, 2009). Refugees arriving in Minnesota have also been found to be at increased risk for elevated blood lead levels, potentially due to lead exposure prior to their arrival (Zabel, Smith, & O'Fallon, 2008). Lead exposure is an important environmental justice concern, given these populations who are most at risk.

Lead in Drinking Water

While lead-based paint remains the most common source of lead exposure for children in Minnesota with elevated blood lead levels, lead in drinking water is more likely to create a lower-level exposure for a larger population (Zartarian, Xue, Tornero-Velez, & Brown, 2017). Efforts toward reducing lead in drinking water are therefore a means of primary prevention of lead exposure.

MDH regulates public water systems by:

- Enforcing the Safe Drinking Water Act Lead and Copper Rule and the 2021 Lead and Copper Rule Revisions, found at Revised Lead and Copper Rule (https://www.epa.gov/ground-water-and-drinking-water/revised-lead-and-copper-rule);
- Approving public water systems' corrosion control treatment plans;
- Testing public water supplies for lead: water systems must take action to reduce lead when testing shows the presence of lead above 15 parts per billion (PPB) in more than 10% of their compliance samples. Community water systems include their lead results in their annual Consumer Confidence Report (https:/mnccr.web.health.state.mn.us/index.faces).

- Providing grants and loans to water systems to assist with lead service line inventory and replacement.

Lead is not typically found in water coming from private wells, however, lead may enter drinking water as it passes through plumbing containing lead materials such as lead solder, lead service lines, brass, or other lead pipes. It is therefore recommended that private well owners and users test their water at least once for lead, as lead materials may have been used in well construction up until 1995. Additional information can be found at Lead in Well Water Systems (https://www.health.state.mn.us/communities/environment/water/wells/waterquality/lead.html).

Schools and childcare facilities in Minnesota are also required to test for lead and take action to reduce lead. Additional information is documented in Reducing Children's Exposure to Lead in Drinking Water (https://www.health.state.mn.us/communities/environment/water/docs/contaminants/lead.pdf) and Drinking Water in Schools, Child Care and Head Start Programs (https://www.health.state.mn.us/communities/environment/water/schools/index.html).

Elevated Blood Lead Levels

In May of 2021, the federal Lead Exposure and Prevention Advisory Committee voted in favor of lowering the reference level for an elevated blood lead level (EBLL) from 5 micrograms of lead per deciliter whole blood (µg/dL) to 3.5 µg/dL, and the updated value was adopted by the Centers for Disease Control and Prevention (CDC). The reference value is based on the 97.5th percentile of the blood lead distribution among U.S. children ages 1–5 years. CDC acknowledges that the reference value "is a screening tool to identify children with higher levels of lead in their blood compared with most children. The reference value is not health-based and is not a regulatory standard (CDC, Blood Lead Reference Value, 2021)." CDC also recognizes that there is no safe level of exposure to lead, and the effects of lead exposure appear to be irreversible. Therefore, primary prevention, or preventing lead exposure before it can start, is crucial.

Through 2022, Minnesota continued to define an EBLL as a diagnostic blood lead test of at least 5 µg/dL under Minnesota Statutes 144.9501, Subd. 9, which is consistent with Minnesota case management guidelines. Health care providers may use their discretion to confirm capillary blood lead levels between 3.5–5 µg/dL with a venous test if they feel it to be beneficial to their patients, however, this is not universally recommended at present.

Effective as of July 1, 2021, Minnesota Statutes 144.9504 mandates environmental interventions for venous blood lead levels of 5 µg/dL or greater in children less than 18 years old and in pregnant people. For levels of 5 µg/dL or greater, local public health nurses work with families to bring down elevated lead levels. For most children and adults exposed to lead, identification and elimination of the source of lead is the primary intervention.

Lead Poisoning Prevention Act Updates

REVISED JULY 2021

Minnesota Statutes 144.9501–144.9512 (the Minnesota Lead Poisoning Prevention Act) were enacted to protect children and pregnant people from the adverse health effects caused by

exposure to lead. Changes and language were added to the Lead Poisoning Prevention Act effective July 1, 2021. These changes:

- Lowered the EBLL required to trigger an environmental assessment for children and pregnant people from 15 µg/dL to 5 µg/dL, for a venous blood specimen
- Redefined children as anyone under the age of 18 rather than age 6
- Allow risk assessments to be completed at other locations where lead hazards are suspected in addition to homes, child care facilities, playgrounds, and schools
- Allow the assessing agency to order changes to stop take-home lead exposure, if another site is the original source of lead exposure
- Specify that data must be submitted to MDH by telephone, fax, or electronic transmission "as prescribed by the commissioner."

Additional information about lead laws and rules can be found at 2022 Minnesota Statutes (https://www.revisor.mn.gov/statutes/cite/144.9501).

Take-Home Lead Exposure

Lead dust from workplaces can attach onto clothes, shoes, hair, and skin, where it can leave a trail and transfer to vehicles, carpets, floors, and furniture. Lead dust can also attach onto personal items such as watches, water bottles, phones, lunch boxes, and bags. Once inside vehicles or homes, other household members can become exposed to the lead dust. Lead carried home from a workplace or hobby is known as take-home lead.

In 2019, MDH worked closely with the Minnesota Department of Labor and Industry (DLI) and St Paul–Ramsey County Public Health to address take-home lead from Water Gremlin Company (Yendell, et al., 2022). MDH and DLI filed a complaint and motion for preliminary injunction in district court, stating that Water Gremlin had created a public health nuisance. A final settlement and consent decree were accepted by the court in October 2021. The response to Water Gremlin prompted the Minnesota Legislature to modify the Lead Poisoning Prevention Act in 2021 to allow assessing agencies to order facilities to remediate conditions to stop take-home lead exposure. MDH is now addressing take-home lead exposure after a single case from a facility is identified, rather than relying on a court to determine that a facility has created a public health nuisance.

State Blood Lead Guidelines

MDH has a set of four guidelines available for lead: Childhood Blood Lead Case Management, Blood Lead Screening for Pregnant Women, Childhood Blood Lead Screening, and Childhood Blood Lead Clinical Treatment, which may be found at MDH Blood Lead Level Guidelines (https://www.health.state.mn.us/communities/environment/lead/prof/guidelines.html). These guidelines are intended to establish standardized screening practices and minimum levels of care for providing services to children. However, local health departments that have greater resources available may wish to take a more rigorous approach to case management.

Childhood Blood Lead Screening Guidelines

REVISED DECEMBER 2022

The Childhood Blood Lead Screening Guidelines represent a set of best practices and recommendations for health care providers, local public health, and other individuals or organizations in identifying which children should receive a blood lead test. These guidelines were first released in 2000. They were revised for a second time in 2022 based on research and feedback from a multi-disciplinary workgroup consisting of health care and public health professionals, professional healthcare associations, and other relevant partners. These screening guidelines include both a three-page summary with testing recommendations and a lead risk questionnaire, as well as a longer reference manual with additional information on blood lead testing and follow-up. The Childhood Blood Lead Screening Guidelines now recommend:

- Universal blood lead testing for all children in Minnesota at both 12 and 24 months of age, and
- Targeted blood lead testing for children ages 25 months through 17 years.

Childhood Blood Lead Case Management Guidelines

REVISED DECEMBER 2017

The Case Management Guidelines work in concert with the MDH Blood Lead Screening Guidelines for Minnesota to identify and manage lead exposure in children. A qualified case manager should oversee the treatment and recovery of each child, and ensure that steps are taken to prevent further exposure of the child to potential sources of lead. Appropriate steps are presented for both capillary and venous test results, as well as information on the case manager's role, environmental risk assessments, home visits, sources of lead, referrals, and resources. The guidelines have an accompanying *Childhood Blood Lead Case Management Guidelines Summary*, a two-page summary document for a quick verification of intervention recommendations for each blood lead level.

Blood Lead Screening Guidelines for Pregnant Women

REVISED AUGUST 2015

The Blood Lead Screening Guidelines for Pregnant Women in Minnesota are designed to assist health care providers in screening pregnant women for elevated blood lead levels. Not every woman is at risk for lead exposure, so a risk screening questionnaire should be used to decide whether testing is recommended. Examples of risk factors for lead exposure include occupational exposure of the mother or another household contact, remodeling a home containing lead paint, using non-commercial home remedies that contain lead, and pica behavior. Identifying and preventing elevated blood lead levels in pregnant women also serves to protect the developing fetus.

Childhood Blood Lead Clinical Treatment Guidelines

REVISED OCTOBER 2019

The Childhood Blood Lead Clinical Treatment Guidelines are designed to assist health care providers in following up with patients with elevated blood lead levels. The clinical treatment guidelines recommend engaging families through education for all blood lead levels. Additional diagnostic tests and interventions, such as developmental assessments, iron studies, radiographs, additional bloodwork, and chelation therapy, are recommended at different levels of elevated blood lead levels. These treatment guidelines include both a two-page summary and a longer reference manual.

Data Collection

Lead Testing

During most of 2022, state guidelines recommended performing targeted blood lead testing based on established risk factors for most areas of the state. Children should have been evaluated using a screening questionnaire to determine whether they had risk factors for lead exposure; the goal was to test all children at risk for exposure to lead. Because lead testing was neither universal nor randomly sampled, the data in this report are not generalizable to the population of children living in Minnesota. However, a large proportion of Minnesota children are tested at least once prior to their third birthday. Of children born in 2019, 79% were tested at least once by their third birthday in 2022.

The blood specimens used in blood lead testing are drawn from either capillaries or veins. Tests on capillary blood are considered “screening” tests. They are drawn from a finger stick or heel stick, allowing them to be performed in a wide range of settings. While low (non-elevated) tests on capillary blood are considered accurate, Minnesota lead testing data suggest that about 60% of elevated capillary screening tests may be false positives (Wang, Rezania, Haugen, Baertlein, & Yendell, 2019). Therefore, a follow-up diagnostic test is needed to confirm an elevated capillary test. Venous specimens are drawn from a vein and are considered “diagnostic” because they are less prone to false positives than capillary tests, however, they can be more difficult to obtain. Venous tests are required to initiate an environmental investigation of an elevated lead result.

The MN Blood Lead Information System (BLIS)

MDH maintains a blood lead information system (BLIS) for tracking and monitoring trends in blood lead levels in adults and children in Minnesota. Laboratories submit results to the LHHP, as mandated by Minnesota Statutes 144.9502. These data are used to help identify populations at risk for EBLLs, to help ensure that screening services are provided to groups identified as having the highest risk of lead exposure, and to ensure that environmental and medical follow-up are provided to children with EBLLs. Data are also used to plan, develop, and implement primary prevention programs.

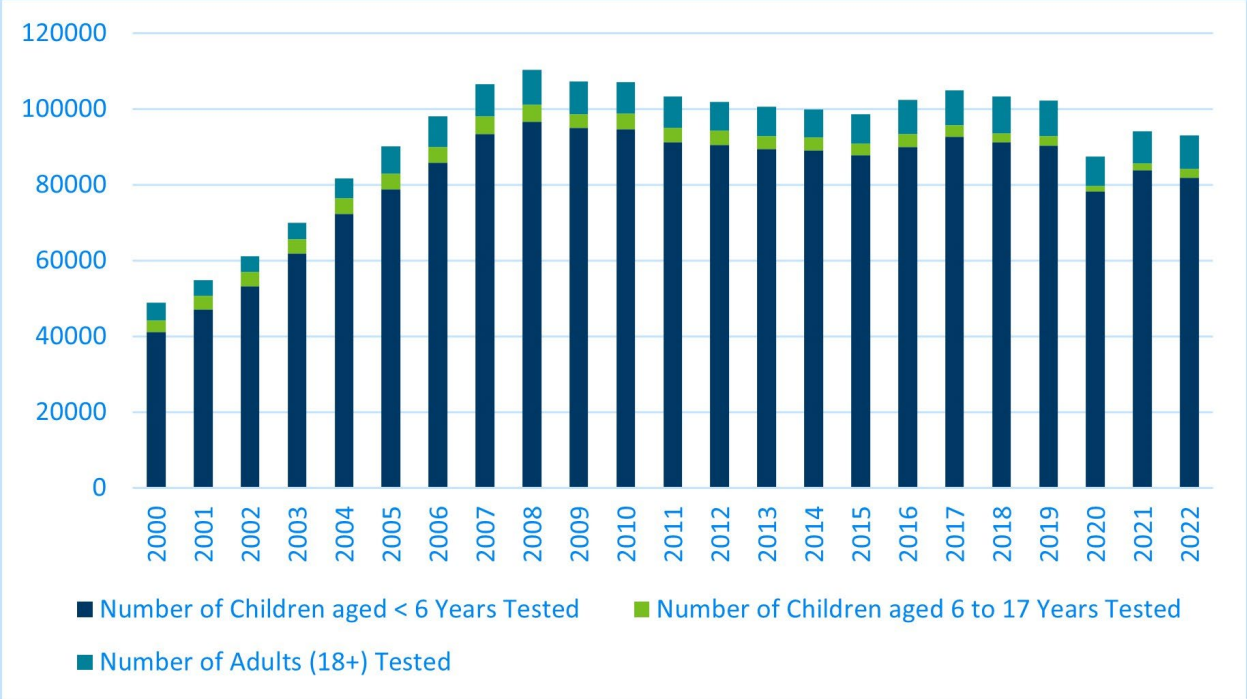
Statewide Surveillance Data

Statewide data are available starting from 1995. Data for years 2000–2021 are shown for historical context. The number of children tested for lead in Minnesota increased steadily from 2000 through 2008, decreased slightly over the next few years, and leveled off around 90,000 children tested annually. The COVID-19 pandemic had a significant impact on testing rates: from 2019 to 2020, there was a 16% drop in testing for children under 6 years. Testing recovered moderately in 2021 but declined again in 2022 (**Figure 1**).

Blood lead screening for older children (aged 6 to 17 years) and adults is much less common than for young children. Older children are not recommended to be routinely screened and tend to only receive blood lead tests if a provider has reason to suspect the child may be lead-exposed, such as recent immigration to the U.S., a lead-related hobby, or the child is symptomatic. In 2022, 2,298 children aged 6 to 17 years received a blood lead test.

Adults are tested for blood lead primarily if they are pregnant or at risk for occupational lead exposure. In many cases, this testing is part of routine medical monitoring programs implemented by their employers. In 2022, 8,878 adults (aged 18+) were blood lead tested.

Figure 1. Number of Persons Blood Lead Tested by Year and Age Group, Minnesota, 2000–2022



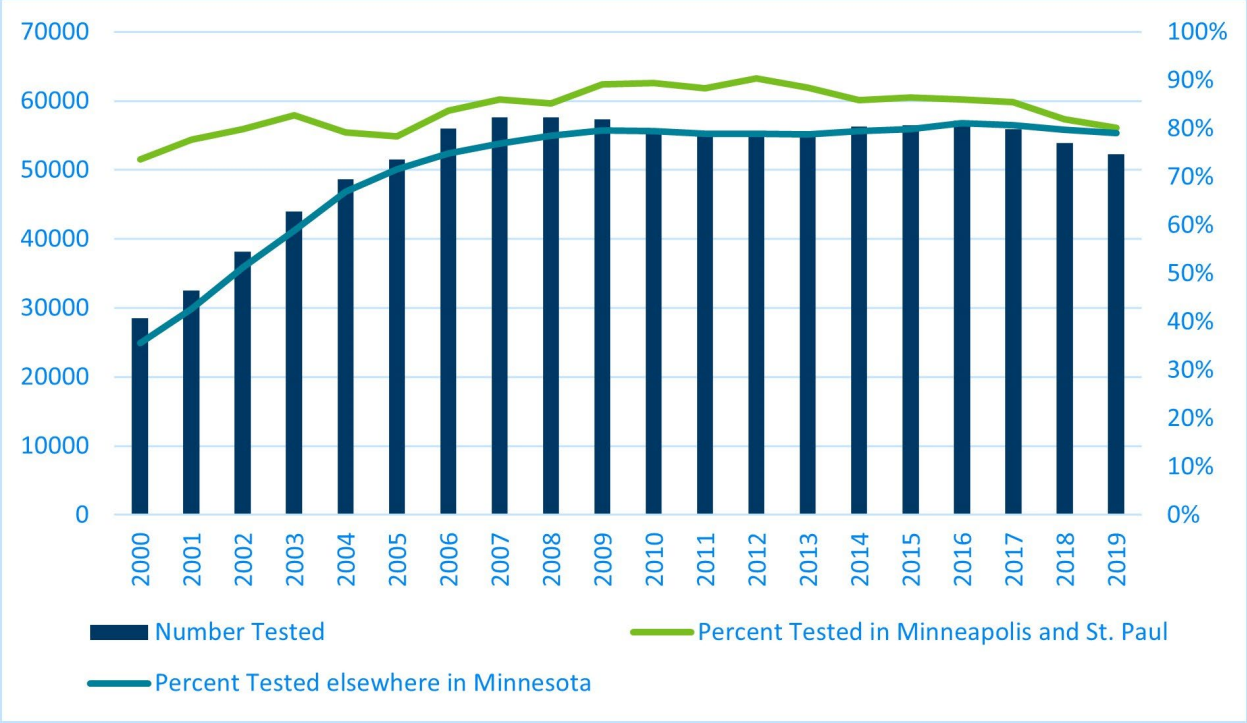
Childhood Blood Lead Screening

While Minnesota's blood lead screening guidelines prior to December 2022 recommended targeted rather than universal screening, the percentage of children tested has generally increased over time. To examine testing rates in children, a birth cohort approach can be useful. This approach looks at all children born in a given year and measures how many of these

children receive blood lead screening at specific benchmarks. These benchmarks include the percent of children who receive at least one test by three years of age, the percent who receive a blood lead test around one year of age, the percent tested around two years of age, and the percent tested at both one year and two years of age.

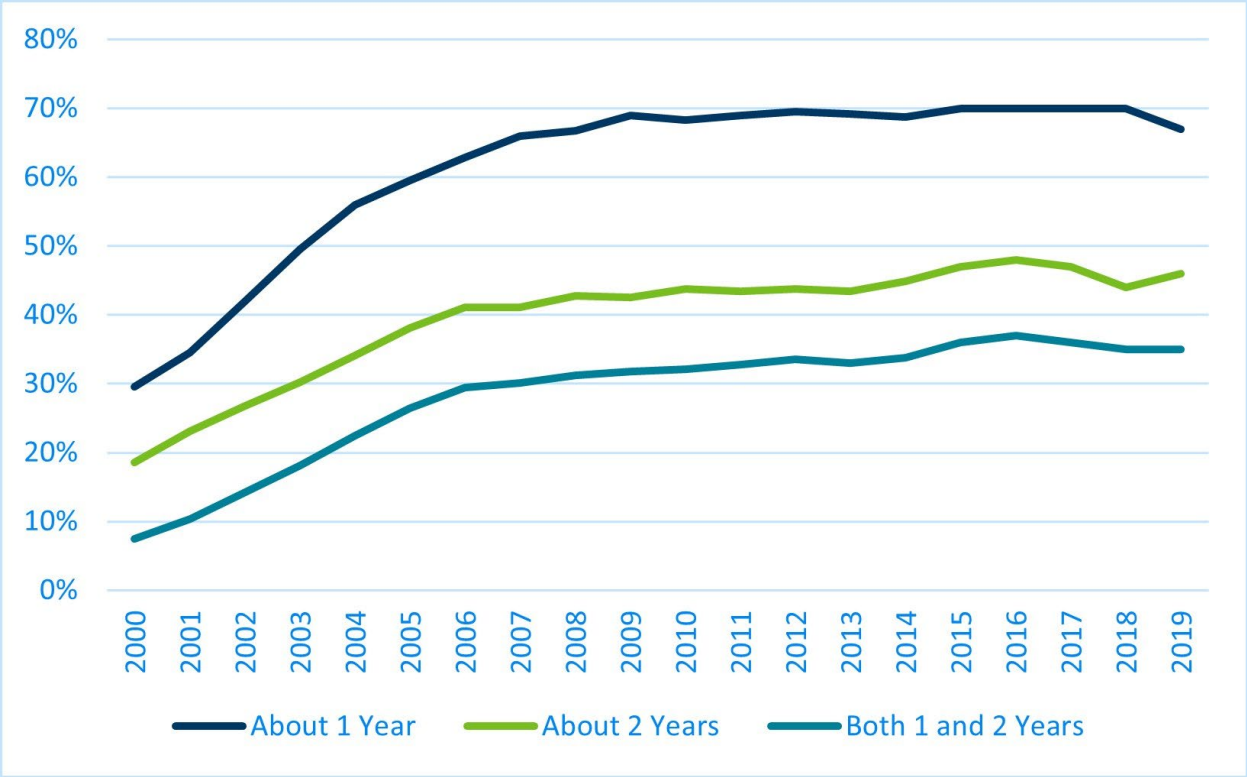
The most recent birth cohort to have been observed for a full three years is children born in 2019. Among the 66,022 children born in 2019, 52,329 children (79%) statewide were tested at least once by age three years. Among children in Minneapolis and St. Paul, where universal screening has historically been recommended, 80% were tested at least once. Elsewhere in the state, 79% were tested at least once. (**Figure 2**) There has been a slight decline in testing for children born in 2018 and 2019, likely due to effects of the COVID-19 pandemic.

Figure 2. Number and Percent of Children Blood Lead Tested at Least Once by Age 3 Years, by Birth Cohort



Within the 2019 birth cohort, while 79% of children were tested at least once by age three, 67% were tested around one year of age (9 to 18 months), 46% were tested around two years of age (18 to 36 months), and only 35% were tested at both one and two years of age (**Figure 3**). The COVID-19 pandemic likely contributed to the recent decline in testing at age one, as children born in 2019 would have had their first birthday in 2020. An increase in testing at ages one and two years is expected due to the updated screening guidelines as well as post-pandemic recovery.

Figure 3. Children Tested at 1 Year and 2 Years of Age, by Birth Year



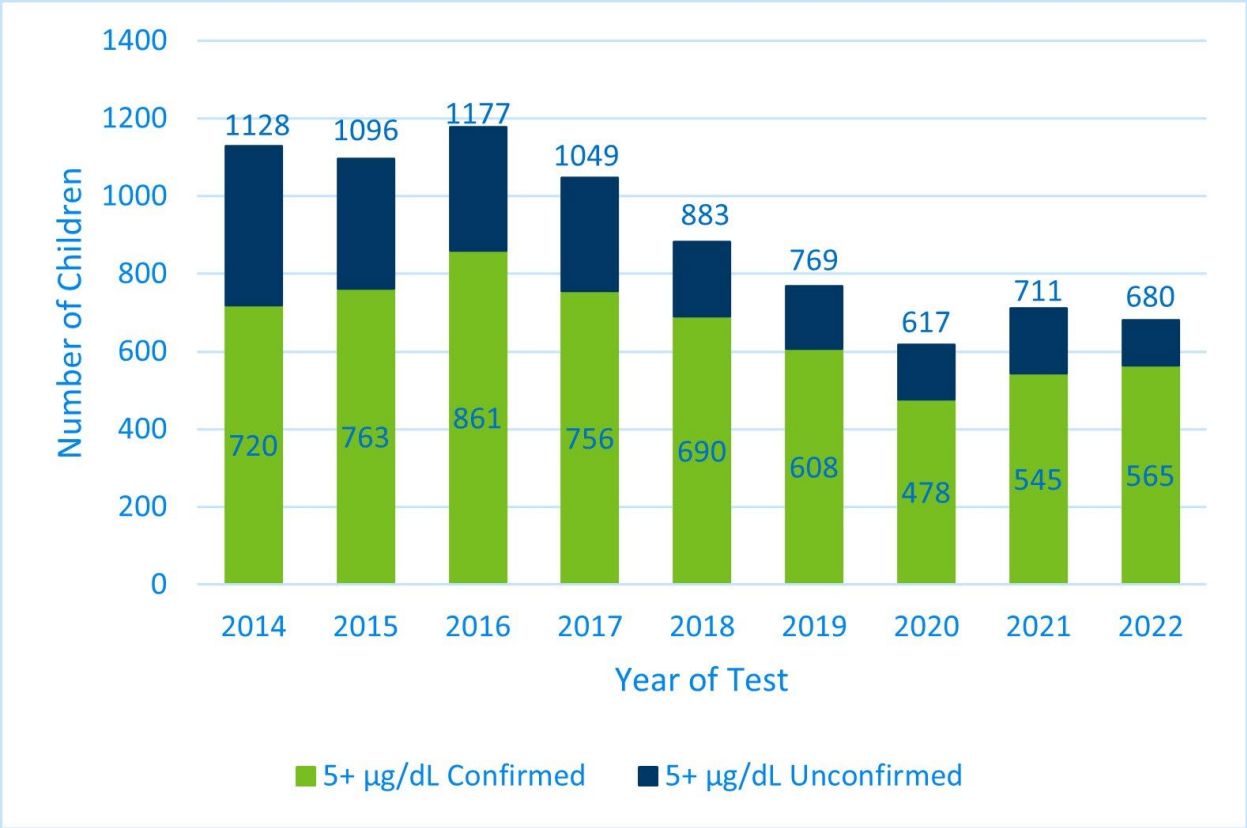
Two-year-old children are more mobile and interact with their environments differently than one-year-old children. This can change the risk for lead exposure between these ages, even if the child's house or other risk factors do not change. This is supported by MDH surveillance data: of children with an EBLL at age two years, 40% were tested and had a non-elevated test at one year of age. Therefore, the practice of not testing children at two years of age may lead to lead-exposed children going undetected.

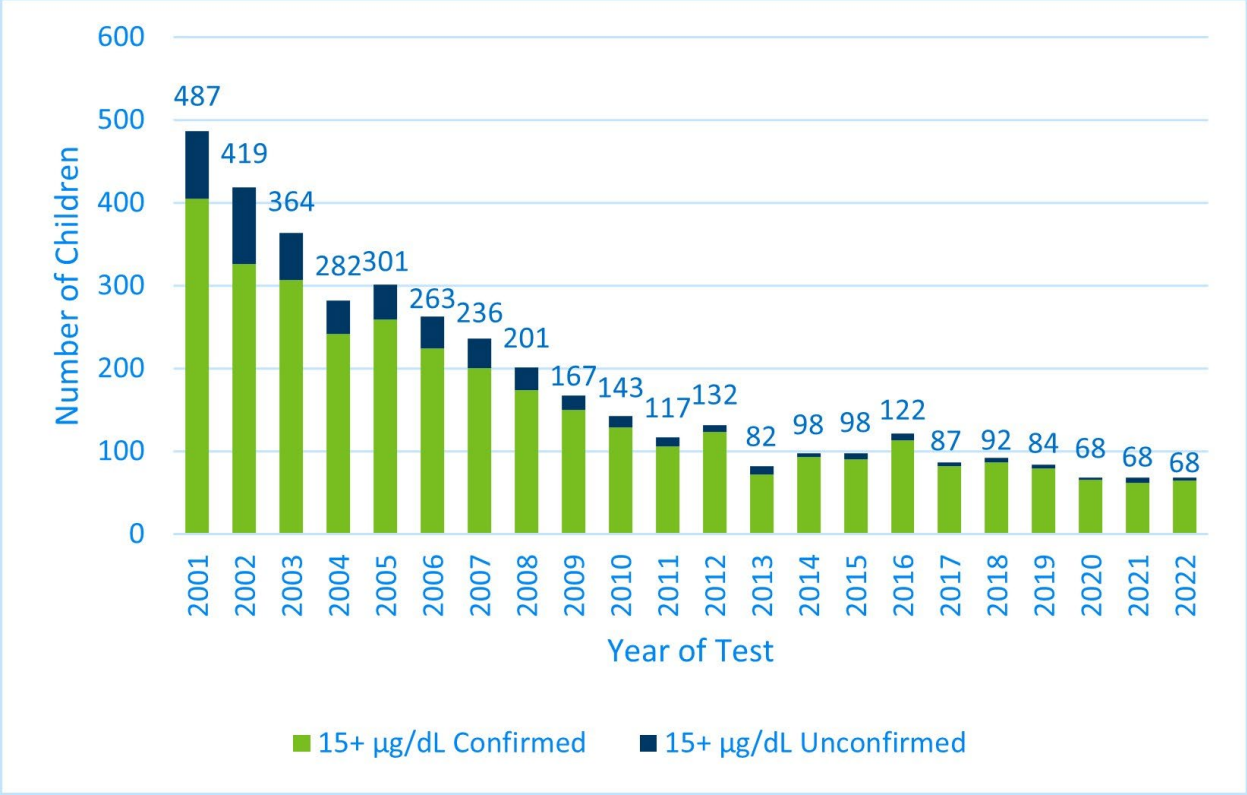
Blood lead screening statistics are available at the county scale through the MDH Data Access Portal's Childhood Lead Exposure (https://data.web.health.state.mn.us/web/mndata/lead) page.

Elevated Blood Lead Levels in Children

Trends in the prevalence of lead exposure in Minnesota children can be understood by examining trends in the number of children with detected EBLLs per year (**Figure 4**). The number of EBLL cases has continued to decrease in recent years. However, in 2022, there were still 565 Minnesota children who had confirmed blood lead levels of at least 5 µg/dL, 65 of whom had confirmed blood lead levels of at least 15 µg/dL. The highest confirmed blood lead level identified in a child from Minnesota in 2022 was 73.8 µg/dL.

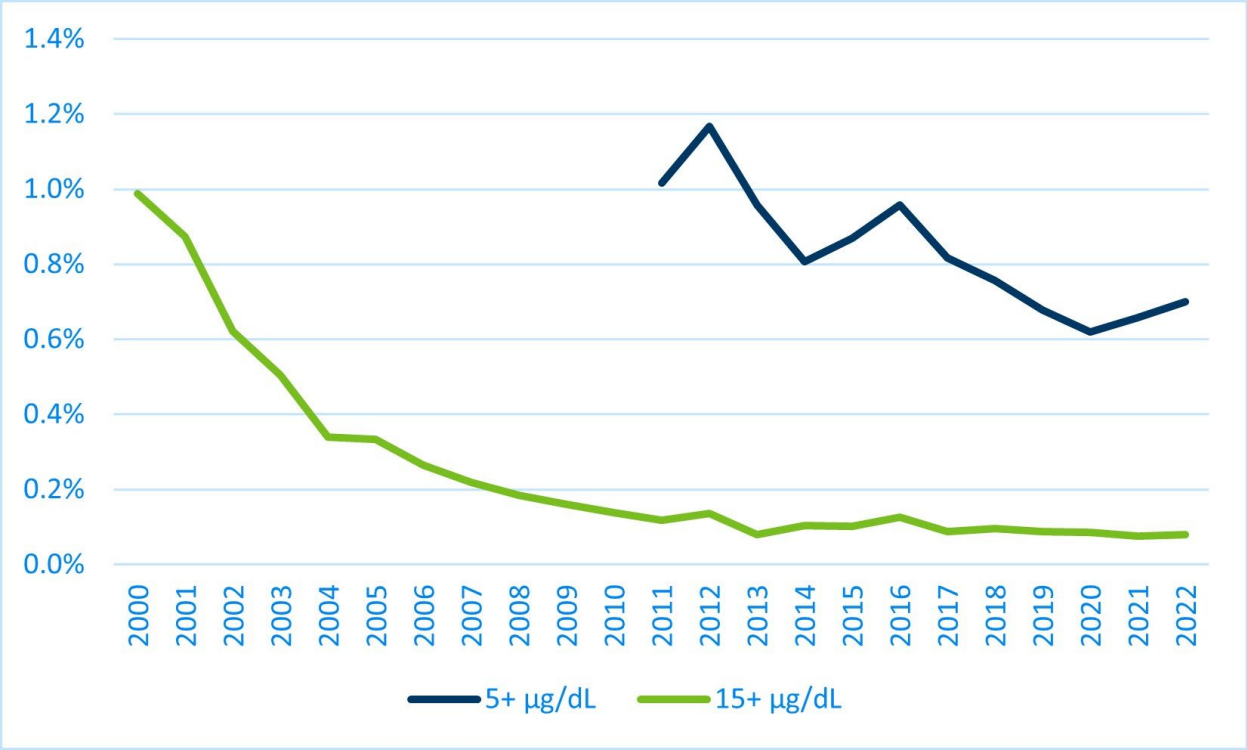
Figure 4. Number of Children with Confirmed and Unconfirmed Elevated Blood Lead Levels (5+ µg/dL and 15+ µg/dL) by Year of Test, 2001–2022





The surveillance definition of a confirmed elevated blood lead level is any elevated venous blood lead test result or any elevated capillary blood lead test result followed-up by a second elevated capillary test within 12 weeks (CDC, Standard Surveillance Definitions and Classifications, 2021). An unconfirmed elevated blood lead level is an elevated capillary blood lead test without a follow-up test. Elevated capillary tests that receive a non-elevated venous follow-up test within 12 weeks are excluded since these are likely to be false positive tests. The true number of children with elevated blood lead levels is likely somewhere between the total (confirmed and unconfirmed) count and the confirmed count. In 2022, for levels 5 µg/dL or greater, this would be somewhere between 565 and 680. In 2022, 80,700 children were blood lead tested and 565 (0.7%) had a confirmed EBLL of 5 µg/dL or greater while 65 (0.1%) had a confirmed EBLL of 15 µg/dL or greater (**Figure 5**).

Figure 5. Percent of Children with Confirmed Elevated Blood Lead Levels by Year, Among Tested Children, 2000–2022

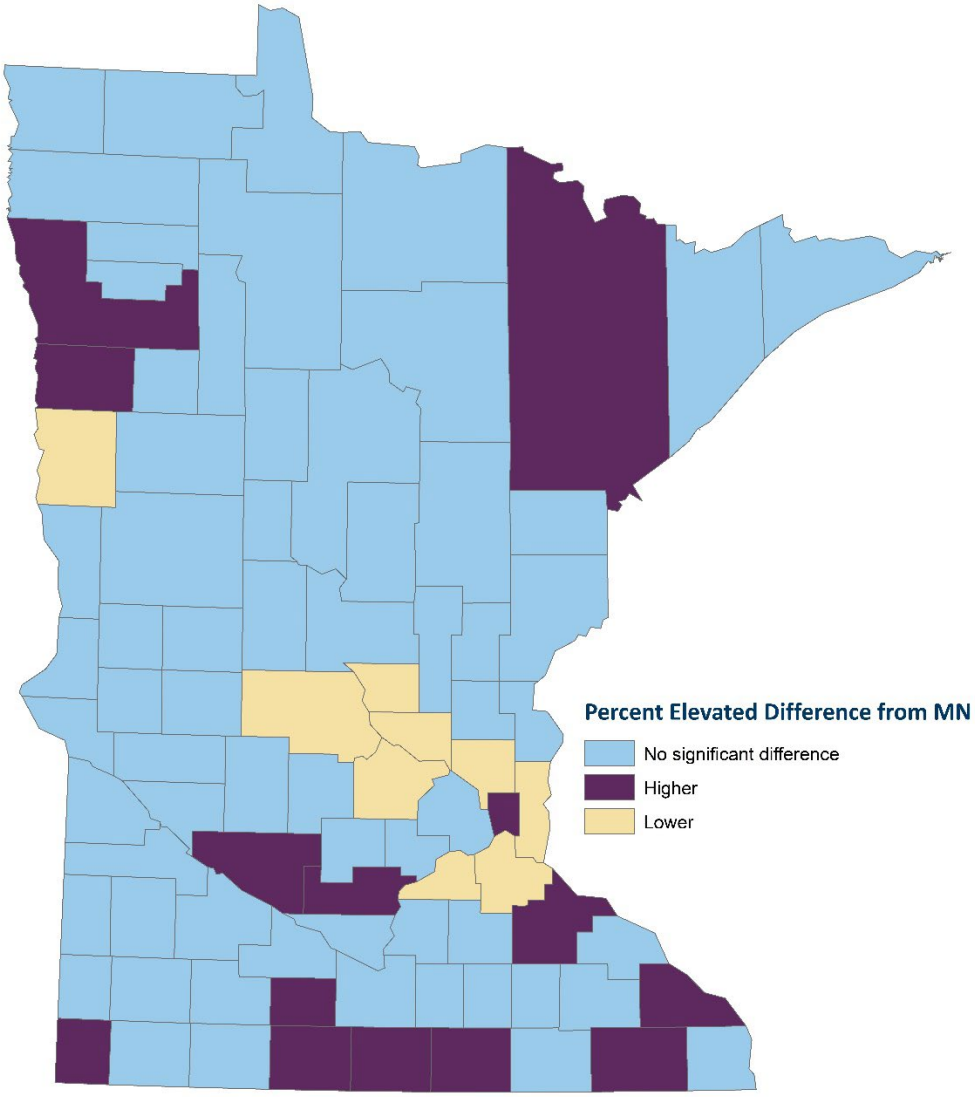


Geographic Variability in Elevated Blood Lead Levels

While the percent of children with elevated blood lead levels among tested children has declined statewide, there remain geographic areas where higher percentages of children are found to have EBLLs. To estimate the percent EBLL at county and sub-county geographic scales, blood lead testing data for three birth cohort years (2017–2019) were compiled to increase estimate precision. Statewide, the percentage of children tested with a confirmed EBLL was 0.7%. At the county level, the percentage of children tested with confirmed EBLLs ranged from 0% to 4.5%. Counties with EBLL rates that were statistically significantly higher than the statewide percent EBLL were mostly found in the southern half of the state and included Ramsey County but not Hennepin County. Counties surrounding Ramsey and Hennepin

Counties tended to have EBLL rates that were statistically lower than the statewide percent EBLL. (**Figure 6)**

Figure 6. Elevated Blood Lead Levels (5+ µg/dL) by County, Among Children Born 2017–2019



The majority of high percent-EBLL census tracts are found in the cities of Minneapolis and St. Paul, but can also be found in rural areas of the state. Tracts with higher percent-EBLL tend to have more houses built prior to 1950, a larger proportion of the population living in poverty, and a larger proportion of the population being persons of color than lower percent-EBLL tracts.

Additional county-level and tract-level data regarding blood lead testing and the distribution of EBLLs among Minnesota children are available on the MDH Data Access Portal's Childhood Lead Exposure (https://data.web.health.state.mn.us/web/mndata/lead) page.

Demographics

The demographic indicators sex, race and ethnicity are collected by MDH with blood lead test results. While the reporting of sex and race with the results of a blood lead test is required under Minnesota Statutes 144.9502, MDH accepts records where these are reported as "Unknown." Data on sex tend to be mostly complete; race and ethnicity are often reported as "Unknown." This limits assessment of racial disparities in lead testing and lead exposure.

In 2022, blood lead test results for children aged less than six years were reported for 41,345 males, 39,337 females, and 18 persons for whom sex was not reported. The percentage of confirmed EBLLs was not significantly different between males and females **(Table 1)**.

Table 1. Summary of the Reported Demographic Characteristics of Children Aged < 6 Years Blood Lead Tested in 2022 and EBLL Cases (Confirmed ≥ 5 µg/dL)

Demographic: Sex	Tested, n (%)	EBLL Cases, n	Percent EBLL
Female	39,337 (49%)	244	0.5%
Male	41,345 (51%)	321	0.6%
Unknown	18 (0%)	0	0%

Racial and ethnic disparities in the prevalence of lead poisoning have been shown in national data. A summary of 1999–2016 data from the National Health and Nutrition Examination Survey for U.S. children aged 1–5 years compared geometric mean BLLs among non-Hispanic Black children and non-Hispanic White children. While lead levels have been declining for all racial/ethnic groups over time, non-Hispanic Black children continue to show higher BLLs than non-Hispanic White children (Teye, et al., 2021). The gap has been declining over time, but continues to be statistically significant.

Individual race and ethnicity data reported with blood lead tests is too incomplete to provide reliable estimates of racial and ethnic disparities in Minnesota, however, the LHHP is working to improve data completeness (see *Evaluation of BLIS* section of this report).

Special Populations: Medicaid Enrolled Children

Nationally, children enrolled in Medicaid tend to be more than twice as likely to have elevated blood lead levels as non-enrolled children (CDC, Blood Lead Levels in Children Aged 1-5 Years - United States, 1999-2010, 2013). However, this disparity may vary by state and the CDC has recommended that states develop screening plans consistent with their local risk patterns. A study of Minnesota blood lead surveillance data indicates that the disparity in EBLL prevalence between children enrolled in Medical Assistance (MA) or MinnesotaCare (MNCare), Minnesota's Medicaid programs, and those not enrolled parallels the national disparity: of Minnesota children tested in 2022, 1.4% of children who had been enrolled in Medicaid had an EBLL, compared to 0.6% of non-enrolled children**.**

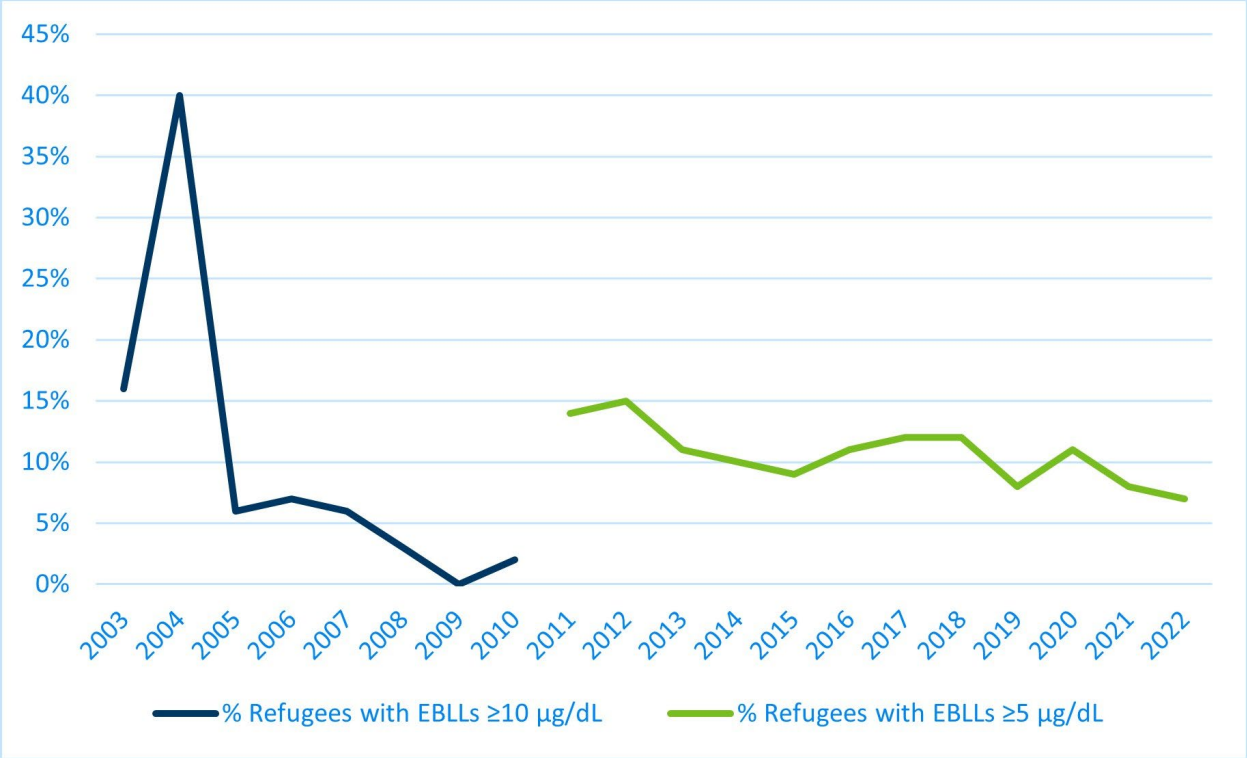
MA and MNCare's Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) program requires that well-child visits include blood lead testing at both 12 and 24 months, however, compliance rates are unclear. The MDH LHHP and the Minnesota Department of Human Services (DHS) currently have a data sharing agreement in place to improve surveillance of

blood lead screening and blood lead levels in the Medicaid-enrolled child population. In 2022, the LHHP began matching claims for blood lead tests completed for Medicaid-enrolled children to tests in BLIS. Two rounds of data matching were completed, spanning service dates from April 2019–December 2021. Of roughly 100,000 claims for blood lead tests, all but 2% were matched to tests in BLIS. LHHP staff contacted health care facilities with claims that could not be matched to BLIS records and recovered 1,188 blood lead tests results for Medicaid-enrolled children, as well as an additional 191 results for non-enrolled children. Future efforts will focus on identifying missed opportunities for blood lead testing in Medicaid-enrolled children: instances in which enrolled children visited a primary care provider around ages 12 or 24 months but did not receive a blood lead test.

Special Populations: Refugee Children

Refugees are persons who are forced to leave their home country because of disasters, war, or persecution. Refugees come to Minnesota with a special immigration status and may be at high risk for lead exposure in their country of origin as well as further exposure once they arrive in the United States. The percentage of EBLLs for refugees who receive a blood lead test is ten times higher than the percentage of elevated blood lead levels among Minnesota children in general (**Figure 7**). The Division of Infectious Disease Epidemiology, Prevention, and Control (IDEPC) at MDH collects demographic data on refugee children aged under 17 years entering the state who receive an initial health screening. The LHHP and IDEPC work together to match blood lead tests to refugee information, and provide resources and prompt follow-up for refugees with elevated results.

Figure 7. Elevated Blood Lead Levels (EBLLs) among Refugee Children who Received a Blood Lead Test



Case Management

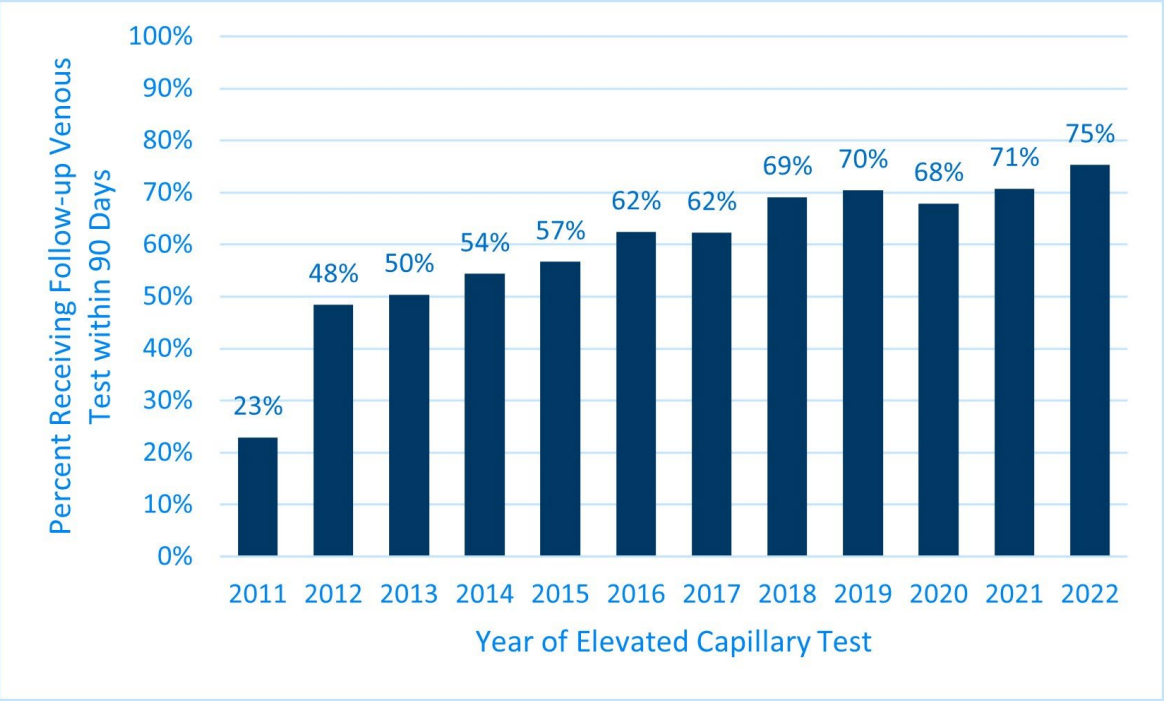
The LHHP provides technical assistance and coordinates with local public health agencies in the state of Minnesota to ensure case management services are available for children with blood lead levels greater than or equal to 5 µg/dL. These activities include:

- Assuring case management activities and follow-up testing for children and pregnant women are performed in accordance with MDH guidelines;
- Providing educational materials, in appropriate languages, to assist in communicating lead exposure prevention measures;
- Coordinating communication and case management activities between health care providers and local lead case managers; and
- Communicating regularly with lead risk assessors to assess progress on open lead cases and facilitate communication between the lead risk assessors and local lead case managers.

Follow-up Testing

MDH recommends follow-up tests for children with elevated blood lead screening tests. The period of time recommended for re-testing varies according to the initial blood level and the test type. Diagnostic venous testing is recommended for all capillary results of 5 µg/dL or greater. Of the 692 Minnesota children whose first elevated blood lead level was a capillary test in 2022, 521 (75%) received a follow-up venous test within 90 days (**Figure 8**). This is an improvement over 2011, the first year in which follow-up venous testing for capillary results in the 5–9.9 µg/dL range was recommended, when just 23% received follow-up tests within 90 days.

Figure 8. Percent of Children with Initial Capillary Tests ≥ 5 µg/dL Receiving a Follow-up Venous Test within 90 Days



Timely follow-up testing is important both for identifying cases so that public health responses can be initiated as well as detecting false-positive screening tests. Capillary tests, typically used for blood lead screening, are prone to false positive results. This can be due to contamination on a child's finger or other contamination during the testing and analysis process. A false positive test is defined as an elevated capillary test with a follow-up venous test that is below 5 µg/dL within 90 days. In 2022, 300 (58%) of the 521 initial elevated capillary tests that received a venous follow-up test within 90 days were false positives. This proportion is dependent on the prevalence of elevated blood lead levels in the population and is expected to increase as the prevalence decreases.

Healthcare providers can help prevent false positive capillary tests by thoroughly cleaning a child's finger prior to conducting a capillary test to remove any surface lead contamination. This should include thoroughly washing the child's hand with soap and water before drawing blood, wearing gloves, and blotting/discarding the initial drop of blood (CDC, Steps for Collecting Fingerstick Blood Samples in Micro-Vials for Lead Testing, 2021).

Environmental Risk Assessments

For children found to have an elevated blood lead level, identifying and removing the source of lead exposure is a priority. Not only does this prevent further exposure to the child who has already been exposed, it also prevents other children from being exposed to that lead hazard. Until July 2021, Minnesota Statutes 144.9504 required assessing agencies to ensure that children with venous blood lead levels 15 µg/dL or greater were provided risk assessment services to limit exposure to lead hazards. Risk assessments are performed by licensed lead risk assessors using documented methodologies.

As of July 1, 2021, changes and language were added to trigger in-home assessments for children up to age 18 with venous BLLs of 5 µg/dL or greater. The changes additionally broadened the type of properties where lead risk assessments can be conducted and expanded the assessing agency's authority to order the responsible part to perform lead hazard reductions. Agencies currently performing assessments in Minnesota are MDH, the City of Minneapolis Health Department and St. Paul-Ramsey County Public Health. MDH conducts risk assessments for other assessing agencies outside of Minneapolis and Ramsey County through contractual agreements.

In 2022, there were 448 children newly identified with venous confirmed EBLLs ≥ 5 µg/dL. Ninety-three of these children lived in Minneapolis, 110 lived in Ramsey County, and 245 lived elsewhere in Minnesota. However, due to staffing shortages, MDH was only able to coordinate risk assessments for children with EBLLs greater than or equal to 15 µg/dL, as well as a handful of children with EBLLs under 15 µg/dL (31 children). Additionally, there were three instances in which a child had a prior venous EBLL below 15 µg/dL, and now qualified for an environmental risk assessment. Twenty residences included multiple children with newly identified venous EBLLs; in total there were 204 residences contacted for 237 qualifying children. For clarity, the following summary is presented in terms of children rather than residences.

Seventy-six of the 237 (32%) children received a lead risk assessment within 10 working days of the blood lead test being reported to MDH and 189 (80%) received an assessment within 60 working days; the median number of working days between the EBLL being reported to MDH

and the risk assessment was 13 days. Fourteen of the outstanding 48 children received environmental risks assessments; for the remaining 34, properties could not be accessed or contact could not be established. Several of the families that could not be contacted were refugees with insufficient contact information – eight of the 34 were believed to have exposure to lead outside of the US.

Lead hazards were identified for 177 of the 203 (87%) children who received environmental risk assessments, and many assessments identified multiple hazards. Lead-based paint and/or lead contaminated indoor dust was identified as a possible source of lead exposure for 167 children. Indoor dust is commonly contaminated by deteriorating lead-based paint in the house, and is the main source of lead exposure for children in Minnesota. Lead soil hazards, measured by laboratory analysis of soil samples, were identified for 72 children; all but two also had paint/dust hazards identified during their assessments. Other sources of lead were identified in 30 assessments, including cultural items, keys, pottery/cookware, and incense. Take-home lead was suspected to be the source of exposure for two children (see page 5 of this report for additional information on take-home lead).

Not all types of potential hazards are tested during every risk assessment. For example, soil was not tested if there was no bare soil the child could have been exposed to. The figures presented in **Table 2**, interpreted as 'ballpark' estimates, show that lead based paint and/or dust hazards are tested for most children (97% in this sample), and these hazards are present for most children who receive an environmental risk assessment (167 of 203, 82%). Soil hazards are tested less frequently, with results reported for 91 of 203 (45%) children, but are commonly identified when soil is tested (identified for 72 children among 91 assessed, 79%). Other hazards are tested less frequently, but increasingly compared to prior years. In 2022, other sources of lead were tested for 48 (24%) of children who received a risk assessment.

Table 2. Lead Hazards Assessed and Identified during Lead Risk Assessments for Children, 2022 (n=203)

Lead Hazard Type	Tested	Hazard Identified, n (%)
Lead-based paint and/or lead-contaminated indoor dust	196	167 (85%)
Outdoor contaminated soil	91	72 (79%)
Contaminated drinking water	43	3 (7%)*
Other lead source	48	30 (63%)
Any hazard type	203	177 (87%)
Multiple hazard types†	133	86 (65%)

*Hazards in drinking water are shown in the table according to the EPA action level of 15 ppb. A detectable level of lead was found for 19 children; the concentration of lead exceeded 15 ppb for three children.
†Includes paint/indoor dust (as a single type), soil, water, and other.

Drinking water is tested during all risk assessments, however, testing of drinking water is becoming more common. In 2022, drinking water was tested during risk assessments for 43 children, and three tests were found to be slightly above the EPA action level of 15 ppb for

public water systems. A public water system must take actions to reduce the amount of lead in the water if more than 10 percent of the water samples have lead levels over 15 ppb. This is an action level; there is no safe level of lead in water. Obtaining a water sample that truly captures its potential lead level can be difficult, as ideally the faucet would not be used for 6 hours prior to sampling. For more information on lead in drinking water, see pages 3–4 of this report.

Multiple types of lead hazards were often identified for children. Multiple hazard types (paint/dust, soil, water and/or other) were tested for 133 children, and more than one hazard type was identified in 86 cases (65%). This suggests that it may be common for children with elevated blood lead levels to be exposed to multiple sources of lead contamination. Testing all possible sources as part of a comprehensive risk assessment, even after one hazard or type of hazard is identified, may help in creating a lead-safe environment for the lead-exposed child and other children in that environment.

For 26 children (13%), no current lead sources were identified. These children may have been exposed to lead prior to arriving in Minnesota or may have had transient lead exposure to an unidentified source.

Adults

In adults, lead exposure can lead to increased risk for chronic diseases such as hypertension and kidney disease. The Adult Blood Lead Epidemiology and Surveillance (ABLES) program is an active surveillance program that follows up on EBLLs reported to BLIS among adults in Minnesota and ascertains the source of lead exposure. This includes calling healthcare providers to determine the source of an adult's lead exposure, their employer information, job title, known non-occupational lead exposures, and pregnancy status. The National Institute for Occupational Safety and Health (NIOSH), CDC, and the State of Minnesota use a reference value of 5 µg/dL in adults. MDH reports work-related blood lead levels of 25 µg/dL or greater to DLI so DLI can investigate the conditions that led to the EBLL. Adult lead testing is most common among people working in high-risk industries and pregnant women with either occupational or non-occupational risk factors for lead exposure.

The total number of BLL tests reported for adults in 2022 in Minnesota is presented in **Table 3**. There were 10,865 BLL tests performed in 2022 on 9,110 adults (aged ≥ 16 years). Of those 9,110 adults, 4,286 (47%) were men and 4,774 (52%) were women; 50 adults (0.5%) were of unknown gender. Pregnancy status was unreported too often for reliable estimates. Of adults tested, 11% had an EBLL of 5 µg/dL or greater, and of those people, 95% were under 25 µg/dL.

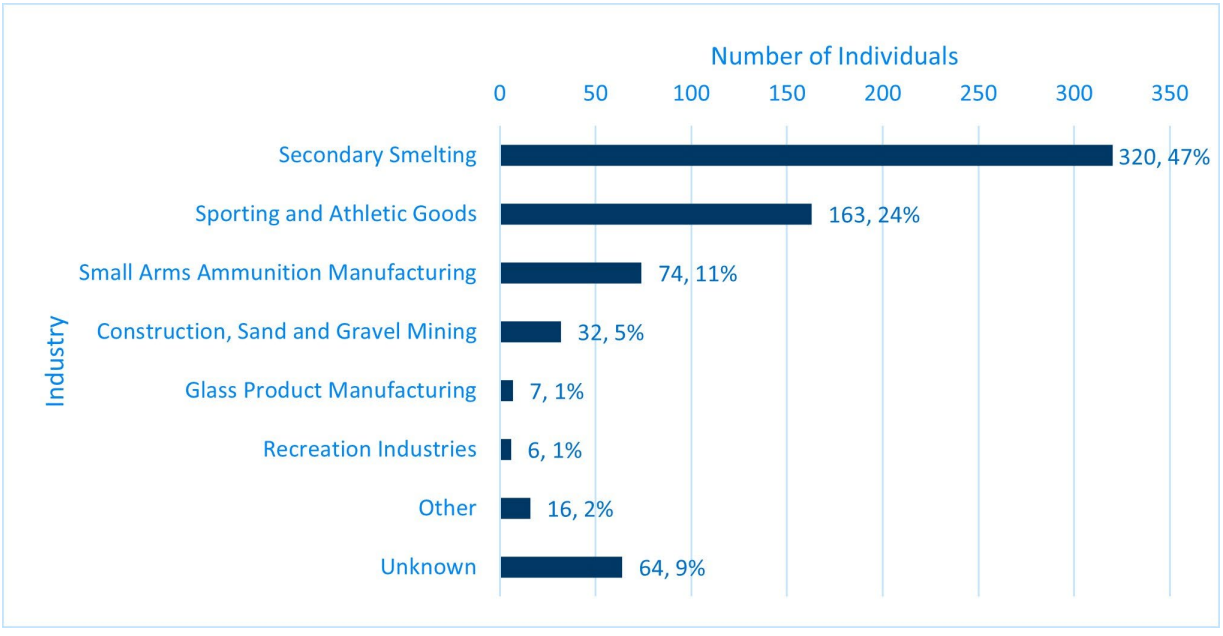
Although more women than men were tested during 2022, 90% of adults with an EBLL of at least 5 µg/dL were men. This was likely due to more men than women working in industries and occupations with high risk for lead exposure. Of the 959 adults with BLLs 5 µg/dL or greater, 682 (71%) were fully or partially due to occupational exposures, 24 (3%) were due to non-occupational exposures, and 253 (26%) were due to unknown exposures.

Table 3. Blood Lead Levels among Tested Adult (Aged 16+) Minnesota Residents

2022 Adult Blood Lead Data	BLL < 5 µg/dL	BLL 5–9 µg/dL	BLL 10–24 µg/dL	BLL ≥ 25 µg/dL	Total
Number of blood lead tests	8,721	773	1,273	98	10,865
Number of individuals tested	8,151	463	445	51	9,110
Occupational Exposure	1,003	281	362	39	1,685
Number of men tested	805	257	343	38	1,443
Number of women tested	163	19	18	0	200
Non-occupational exposure	0	0	16	8	24
Number of men tested	0	0	10	7	17
Number of women tested	0	0	6	1	7
Unknown exposure source	7,148	182	67	4	7,401
Number of men tested	2,617	148	57	4	2,826
Number of women tested	4,523	34	10	0	4,567

EBLLs caused by occupational exposures were analyzed and are reported in **Figure 9**. Together, the secondary smelting, sporting and athletic goods manufacturing, and small arms ammunition manufacturing industries accounted for over 80% of occupational exposures. Construction and sand/gravel mining, glass product manufacturing, and work in recreation industries together comprised another 7% of occupational exposures. Other occupational exposures included painting, various types of contracting work, and police protection/national security. Among people with EBLLs from non-occupational sources, shooting firearms as a hobby was the most common source, with retained bullets as the second most common source. The highest EBLL due to a non-occupational exposure was 36.4 µg/dL in an individual with a retained bullet.

Figure 9. Work Related EBLLs (≥ 5 µg/dL) by Industry, 2022



Evaluation of BLIS and LHHP

MDH has been consistently improving the Blood Lead Information System (BLIS) through recent years. Improvements have been made in the completeness and timing of the data in the system. In addition, reevaluation of processes within the LHHP is ongoing to assess the use of resources and its value to stakeholders.

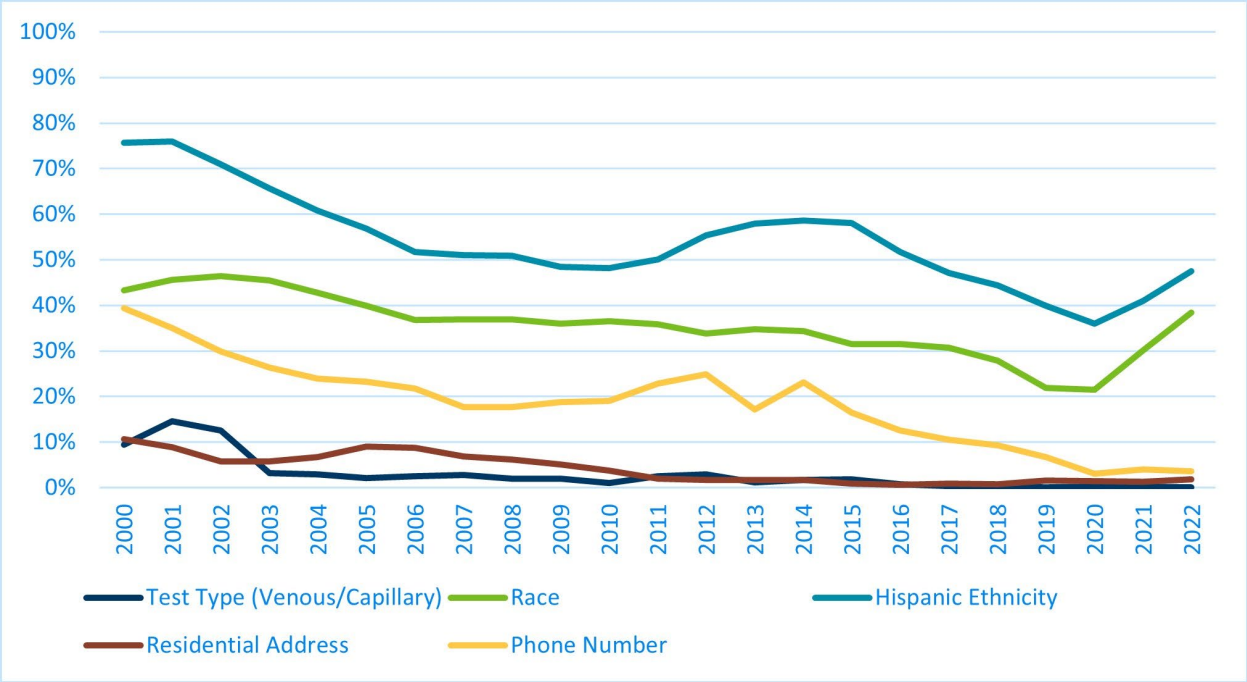
Transition to MEDSS

The LHHP will be retiring BLIS as a standalone database. Data will be migrated into the Minnesota Electronic Disease Surveillance System (MEDSS). MEDSS offers a number of advantages compared to BLIS, including the ability to store and track variables such as pregnancy status, preferred language, and occupational data. MEDSS will also allow users from local public health to access data for their jurisdiction directly, which will eliminate several process lag times that currently slow the transfer of information from laboratories to MDH, then from MDH to local public health. The transition is expected to be completed in late 2023.

Completeness of Data

Extensive efforts are made by MDH staff to ensure the completeness of data in BLIS. This often involves contacting clinics and laboratories to obtain additional information when incomplete records are submitted to MDH, as well as monitoring submissions from laboratories to detect and remediate any missed submissions. These efforts have resulted in an improvement in the completeness of several variables that are necessary for both surveillance and case response functions of BLIS. The test type (venous or capillary) has improved from being undocumented on nearly 10% of records in 2000 to 0.1% in 2022. Test type is used for case confirmation and initiation of environmental risk assessment services. The completeness of address and phone number fields have also improved substantially. These variables help local public health agencies contact families of lead exposed children to provide public health services. Race and ethnicity would be useful for surveillance, to monitor disparities and identify high-risk populations, if the completeness were further improved. Unfortunately, increased use of reference laboratories has led to an uptick of missing information in recent years. (**Figure 10**).

Figure 10. Missing Data Elements in Blood Lead Records Sent to MDH by Year



Timing of Data

The timing of the data in BLIS is measured by the time between a blood lead test, its submission to MDH, and its entry into BLIS. The use of electronic reporting formats allows for greater efficiency in handling large numbers of records.

In 2022, there were 98,843 total blood lead tests reported to BLIS, 97% of which were received electronically via secure data connection, encrypted email, or secure web downloads. Although the majority of test results were received electronically, there were still 2,966 results received by paper reporting through mail or fax. Electronic reporting significantly improves timeliness and requires less staff time for entry of records into BLIS compared to paper reporting. The average total time from specimen collection to entry into BLIS was 7 days for electronic records during 2022, while the average total time to entry into BLIS for paper records was 16 days. This total time applies to blood lead test results below 5 µg/dL; results at or above 5 µg/dL that must be manually entered are separated and entered immediately upon receipt. (**Figure 11**) The LHHP continues to work with laboratories to increase their capacity to submit results electronically. In recent years there has been a general upwards trend in the percentage of results received electronically by the LHHP (**Figure 12**).

Figure 11. Average Timeframes for Electronic and Paper Blood Lead Test Results Reported to BLIS, 2022

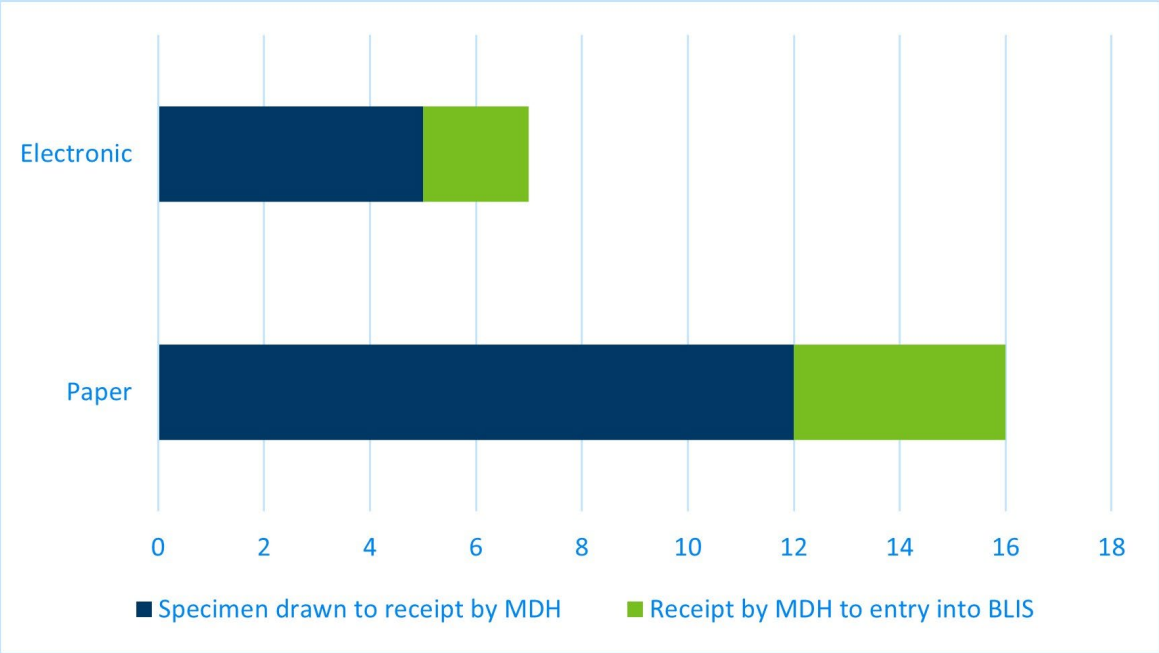
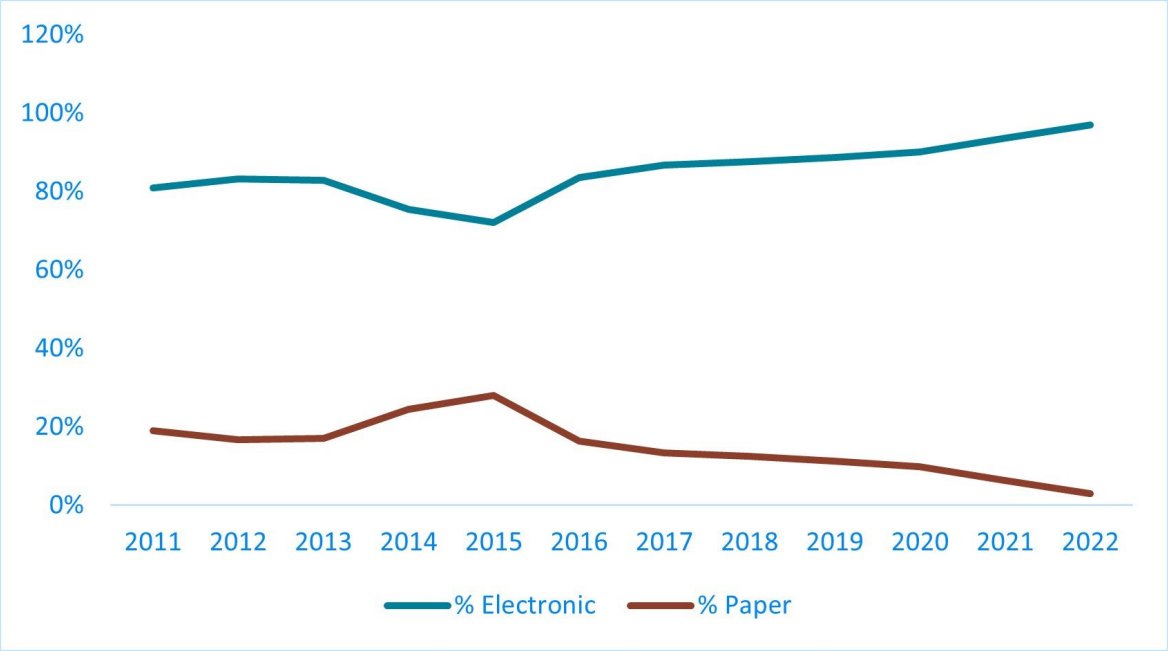


Figure 12. Percentage of Electronic and Paper Blood Lead Test Results by Year



Other Resources Available from LHHP

The Lead Program maintains a Lead (www.health.state.mn.us/lead) web page through the MDH web site that provides a number of lead education materials for providers, regulated parties, and the general public. This site contains numerous fact sheets in 15 languages, a list of "frequently asked questions," all publications and reports (including guidelines for screening

children and pregnant women, case management, and clinical treatment in children), and links to many external lead resources.

M-CLEAN

The Minnesota Collaborative Lead Education and Assessment Network (M-CLEAN) is a workgroup that meets semiannually to discuss various sources of lead exposure, prevention initiatives, and legislative developments. Membership is open to all interested stakeholders. Organizations that typically participate in M-CLEAN include MDH, local public health agencies, other governmental agencies, community action agencies, non-profit organizations, and industry groups. More information on M-CLEAN meetings can be found at Lead Poisoning Prevention: M-CLEAN (Minnesota Collaborative Lead Education and Assessment Network) (https://www.health.state.mn.us/communities/environment/lead/prof/mclean.html). The M-CLEAN webpage also contains a link to subscribe to the Lead Hot Topics newsletter.

Lead Hazard Reduction Grant

The Minnesota Department of Health (MDH) has been awarded a $3.3 million grant from the U.S. Department of Housing and Urban Development (HUD) to fund work protecting families from lead and other household hazards in southeastern Minnesota. MDH will deliver these services in partnership with the City of Rochester and local community organizations in Dodge, Fillmore, Freeborn, Goodhue, Houston, Mower, Olmsted, Rice, Steele, Wabasha and Winona counties. The grant period runs until June 2024.

According to MDH data, southeastern Minnesota has higher rates of elevated blood lead levels in children compared with the state average. Factors contributing to these higher rates include the region's high percentage of older homes painted with lead-based paint, its relatively high proportion of low-income families, and the region's shortage of newer housing for its growing population. Many families living in older homes are unable to afford to maintain or rehabilitate them, exposing children to lead dust and other hazards.

Organizations interested in becoming sub-grantees for this grant can apply at Lead Grants (https://www.health.state.mn.us/communities/environment/lead/prof/leadgrants.html).

The grant prioritizes connecting families whose children already have elevated blood lead levels to lead hazard reduction resources, but also provides primary prevention to families whose children have not yet had elevated blood lead levels. This work aligns with MDH's goal and its ongoing Centers for Disease Control-supported initiatives to advance health equity by eliminating exposure to lead hazards in the homes of low-income Minnesota families.

Swab Team Services Grants

MDH has collaborated with community partners through Swab Team Services Grants since 2006. The grants are authorized under Minnesota Statutes 144.9512.

MDH's Swab Team Services Grant provides nonprofit organizations with funding to:

- Increase the screening of children under six years and pregnant women to identify elevated blood lead levels (EBLL) in populations at high risk for lead exposure

- Plan, implement, and execute successful lead screening events in communities with high lead exposure
- Provide education and outreach services when an EBLL is identified
- Provide swab team services to protect populations from identified lead hazards in their residences

Organizations funded by the Swab Team Services Grants during 2022 were Sustainable Resources Center in Minneapolis and East Side Neighborhood Development Company (ESNDC) in St. Paul.

Healthy Homes Information

In addition to lead exposure prevention responsibilities, the LHHP at MDH administers the Healthy Homes Program. This program distributes $240,000 per year in grants to local agencies and organizations as authorized by Minnesota Statutes 144.9513, which defined healthy housing and established healthy housing grants. These grants address lead, asthma, radon, injuries, smoking, excessive moisture/mold, pests, carbon monoxide, fire hazards, and other home-related health hazards. Additional information on the Healthy Homes program and grants can be found at Healthy Homes Minnesota (https://www.health.state.mn.us/communities/environment/healthyhomes/hhgrant.html).

Further Lead Information

More information about lead exposure prevention in Minnesota is available at the MDH Lead (https://www.health.state.mn.us/lead) program web site or by calling 651-201-4620.

References

CDC. (2009). Recommendations for Blood Lead Screening of Medicaid-Eligible Children Aged 1-5 Years: and Updated Approach to Targeting a Group at High Risk. *Morbidity and Mortaility Weekly Report*, 58. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5809a1.htm

CDC. (2013). Blood Lead Levels in Children Aged 1-5 Years - United States, 1999-2010. *Morbidity and Mortality Weekly Report*, 245-248. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6213a3.htm

CDC. (2021, October 27). *Blood Lead Reference Value*. Retrieved from Childhood Lead Poisoning Prevention: https://www.cdc.gov/nceh/lead/data/blood-lead-reference-value.htm

CDC. (2021, October 27). *Standard Surveillance Definitions and Classifications.* Retrieved from Childhood Lead Poisoning Prevention: https://www.cdc.gov/nceh/lead/data/definitions.htm

CDC. (2021, June). *Steps for Collecting Fingerstick Blood Samples in Micro-Vials for Lead Testing.* Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/biomonitoring/pdf/Lead_Fingerstick_Poster-508.pdf

Teye, S. O., Yanosky, J. D., Cuffee, Y., Weng, X., Luquis, R., Farace, E., & Wang, L. (2021). Exploring Persistent Racial/Ethnic Disparities in Lead Exposure amoung American Children aged 1-5 Years: Results from NHANES 1999-2016. *International Archives of Occupational and Environmental Health*, 723-730.

Wang, A., Rezania, Z., Haugen, K. M., Baertlein, L., & Yendell, S. J. (2019). Screening for Elevated Blood Lead Levels: False-Positive Rates of Tests on Capillary Samples, Minnesota, 2011-2017. *Journal of Public Health Management and Practice*, S44-S50.

Yendell, S. J., Janowiak, D., Yannarelly, J., Rezania, Z., Haugen, K. M., Yang, D., . . . Surdo, P. (2022). Tackling the Lead Gremlins: A Response to Take-Home Lead Exposure in a Minnesota Industrial Facility, 2019. *American Journal of Public Health*, S655-S657.

Zabel, E. W., Smith, M. E., & O'Fallon, A. (2008). Implementation of CDC Refugee Blood Lead Testing Guidelines in Minnesota. *Public Health Reports*, 111-116. Retrieved from https://pubmed.ncbi.nlm.nih.gov/18457063/

Zartarian, V., Xue, J., Tornero-Velez, R., & Brown, J. (2017). Children's Lead Exposure: A Multimedia Modeling Analysis to Guide Public Health Decision-Making. *Environmental Health Perspectives*, 111-123. Retrieved from https://ehp.niehs.nih.gov/doi/10.1289/EHP1605