Data Highlights
• From 1996–2001, 1,821 cases of blood lead levels (BLLs) of 25 micrograms per deciliter of blood (µg/dl) or greater among persons age 15 or older were reported to the Occupational Lead Poisoning Registry.

• Of 373 cases with very high BLLs (40 µg/dl or greater) with information about source of lead exposure, 80% were exposed at work.

• 77% of the occupationally exposed cases with BLLs of 40 µg/dl or greater worked in the construction industry, primarily as painters (41%) and deleaders (24%).

• House painters had some of the highest BLLs; 15 of the 69 house painters (22%) identified in the Registry had BLLs of 60 µg/dl or greater; three had BLLs of 100 µg/dl or greater.

• 10% of cases exposed at work who completed interviews were Hispanic, whereas Hispanic workers made up approximately 5% of the Massachusetts workforce during 1996–2001.

• The number of cases of BLLs 25 µg/dl or greater reported each year fell consistently from 383 cases in 1996 to 227 cases in 2001 – a 41% decline.

Lead - A Toxic Metal
Lead is a heavy metal that can cause health problems in children and adults. Adults who inhale or ingest lead can experience anemia, nervous system dysfunction, kidney problems, hypertension, infertility, and miscarriage. Children exposed to low levels of lead may suffer neurological damage including learning disabilities and short attention spans. Lead is also a probable carcinogen.1,2

The average blood lead level (BLL) in the general population is less than three micrograms per deciliter of blood (µg/dl). BLLs of 10 µg/dl or greater are considered abnormally high in both adults and children.2 BLLs in the 14-30 µg/dl range may cause small increases in blood pressure. BLLs as low as 30 µg/dl may cause nervous system dysfunction. Abdominal pain may occur in some adults at BLLs of about 40 µg/dl. Abnormal sperm and decreased sperm counts have been observed in men with BLLs of approximately 40 µg/dl.

The workplace is the primary source of lead exposures for adults. Workers in many industries, including bridge and house painting, deleading, battery manufacturing, and radiator repair are exposed to potentially dangerous levels of lead. Lead is also found in work processes such as welding, smelting, and soldering. Workers can bring lead home on their clothes, shoes, or tools and expose their families.
The Massachusetts Occupational Lead Poisoning Registry

The purpose of the Lead Registry, located in the Massachusetts Division of Occupational Safety, is to reduce lead poisoning among Massachusetts workers and their families by identifying workers and workplaces with overexposures to lead. Since 1991, clinical laboratories in Massachusetts have been required by state law to report blood lead levels of 15 µg/dl or greater in individuals age 15 or older to the Lead Registry. Lead Registry staff enter all reports into a computerized database and follow up reports of elevated BLLs with interviews and education of workers and physicians, workplace investigations, and employer education and technical assistance.

Lead Registry staff interview individuals with BLLs of 40 µg/dl or greater; as well as their health providers, to learn more about the sources of lead exposure and employer lead poisoning prevention practices. These individuals and their physicians receive educational materials. If a child under six lives in the home, the Lead Registry sends information on free blood lead testing programs. If deemed appropriate, inspectors conduct worksite investigations.

For every report of a BLL of 60 µg/dl or greater, the Lead Registry's medical consultant contacts the physician who ordered the blood test to provide them with information on treatment of lead poisoning and Occupational Safety and Health Administration (OSHA) requirements for medical monitoring of lead exposed workers.

The Massachusetts Occupational Lead Poisoning Registry participates in a nationwide adult lead surveillance program known as ABLES (Adult Blood Lead Epidemiology and Surveillance), maintained by the National Institute for Occupational Safety and Health. ABLES tracks BLLs of 25 µg/dl or greater in adults using data from clinical laboratory tests collected by states throughout the country. In 2002, ABLES identified 10,658 adults with BLLs 25 µg/dl or greater in 35 states.4

Terms and Methods Used in This Report

This report describes cases of elevated BLLs reported to the Lead Registry from 1996 through 2001. A “case” is an individual 15 years or older with a reported BLL greater or equal to 25 µg/dl for whom there were no reports of elevated BLLs in the previous calendar year. The same individual can be counted as a case more than once during the six-year surveillance period. For example, an individual who was in the Lead Registry in 1996, did not appear in the Lead Registry in 1997, but reappeared in 1998 is counted as two cases.

The “annual incidence rate” of elevated BLLs is the number of new cases of elevated BLLs per 100,000 employed workers per year. Information on the number of Massachusetts workers employed each year was obtained from the Current Population Survey conducted by the US Bureau of Labor Statistics. The frequencies and rates in this report are based on the highest BLL reported for each case during the surveillance period.

Limitations of the Surveillance Data

Given resource limitations, detailed information about cases with BLLs less than 40 µg/dl was not collected by the Registry until 2001. Therefore, there is no information on the sources of lead exposure or employer lead poisoning prevention practices for these cases.

It is important to note that many individuals are never tested for lead exposure, even if they work in industries in which workers are known to be exposed to lead. This is especially true of workers in small establishments.


Magnitude

• The number of cases of BLLs ≥25 µg/dl reported each year fell consistently from 632 in 1991 to 227 in 2001.

• An average of 507 cases per year of BLLs ≥25 µg/dl was reported during 1991–1995. An average of 304 cases per year was reported during 1996–2001—a 40% decline.

• There was also a shift in the distribution of cases by BLLs over time, with proportionally fewer cases with BLLs ≥40 µg/dl in 1996–2001 (22%) than in 1991–1995 (31%).

Industries

• Among occupationally exposed cases of BLLs ≥40 µg/dl, the percentage employed in the painting industry increased from 26% in 1991–1995 to 41% in 1996–2001. This shift was accounted for largely by an increase in the proportion of cases employed as house painters, from 11% to 24%. The proportion of cases employed as bridge painters declined over time from 18% to 7%.

• The proportion of occupationally exposed cases of BLLs ≥40 µg/dl employed in the manufacturing sector was lower in 1996–2001 (13%) than in 1991–1995 (21%).

• Hispanic workers were over represented in the Lead Registry in both time periods. Of the Hispanic cases interviewed, the proportion employed in construction increased from 11 of 19 (58%) in 1991–1995 to 15 of 18 (83%) in 1996–2001.

• An average of 100+60-6950-5940-4925-3920-10+0 µg/dl was reported during 1996–2001. An average of 100+60-6950-5940-4925-3920-10+0 µg/dl was reported during 1991–1995.
Training on Lead Hazards at the Workplace
• Overall, only 55% (n=95) of occupationally exposed cases interviewed reported being trained on lead hazards, as required by OSHA standards.
• Whereas most bridge painters and deleadlers reported being trained, only 14 of 48 (29%) interviewed cases exposed to lead in house painting, one in deleading, and one whose specific job was unknown.

Notification of Blood Lead Test Results
• Overall, 25 (13%) interviewed cases reported that they had not been informed about their BLLs. Six (23%) said they had not been informed about their elevated BLLs.
• Even among the 33 workers with the highest BLLs (60 µg/dl or greater), four (12%) reported that they had not been informed about their BLLs.
• Among the 32 (34%) in “other industry” and 18 (39%) in “other construction,” reported receiving training on lead hazards.

Medical Removal of Cases with Very High Blood Lead Levels
• Among 26 interviewed cases with the highest high BLLs (60 µg/dl or greater), six (23%) said they had not been removed from working in the conditions that had exposed them to lead, as required by OSHA.

Cases of Blood Lead Levels 25 µg/dl or Greater
• Magnitude of the Problem
  • From 1996–2001, 1,821 cases of BLLs ≥25 µg/dl, involving 1,704 individuals, were reported to the Lead Registry.
  • 404 (22%) were cases of BLLs ≥40 µg/dl, levels which the Occupational Safety and Health Administration (OSHA) considers elevated for regulatory purposes.
  • 154 (8%) were cases of BLLs ≥50 µg/dl, a level which may require medical treatment and should trigger removal of the individual from further exposure under the OSHA lead standard for construction and state deleading regulations.
  • Eight (0.4%) were cases of BLLs ≥100 µg/dl. Five of these were exposed to lead at work, all in the construction industry.

Age and Sex
• Nearly all cases (96%) were males.

Trends
• Numbers of cases of BLLs ≥25 µg/dl reported each year decreased steadily, falling by 41% from 383 cases in 1996 to 227 in 2001.
• The annual incidence rate of cases per 100,000 employed workers decreased by 43%, from 12.6 in 1996 to 7.2 in 2001.
• The number of cases of BLLs ≥40 µg/dl was 84 in 1996 and in 1997, then fell each year to 44 in 2001, a decline of 48%.

These downward trends in Massachusetts are consistent with those reported nationally by the ABLES program.

OSHA has legal standards for protecting employees from lead exposure in both general industry and the construction industry (Code of Federal Regulations 1910.1025 and 1926.62). These standards require blood lead testing for employees who perform jobs that may expose them to certain levels of lead.

The general industry standard requires medical removal from work with payment of wages (Medical Removal Protection) for employees with a single and confirmatory BLL of ≥60 µg/dl, or average BLLs ≥50 µg/dl based on the last three BLLs or all BLLs over the previous six months (whichever covers a longer time period). The construction industry standard requires Medical Removal Protection for employees with BLLs ≥50 µg/dl. These standards require employers to train all employees who may be occupationally exposed to lead about lead hazards, preventing lead exposure, and using respirators.
Information from Worker Interviews

Follow-up interviews were completed with 193 (64%) of the cases with BLLs of 40 µg/dl or greater who had occupational exposures. The main reason for failure to interview was inability to contact the individual by phone. Bridge painters, many of whom come from out of state, were much less likely to complete interviews (7, 33%) than cases employed in other industries.

Race and Ethnicity

- The majority (83%) of interviewed cases with occupational exposures were non-Hispanic whites.
- Hispanic workers were over-represented in the Lead Registry compared to their participation in the workforce. Whereas close to 10% (n=18) of the occupationally exposed cases with BLLs \( \geq 40 \) µg/dl interviewed were Hispanic, Hispanics made up approximately 5% of the Massachusetts workforce during 1996–2001.
- 15 of the 18 Hispanic cases interviewed worked in the construction industry. Of these, 10 were employed as house painters.

Employer Medical Monitoring

- Most interviewed cases exposed to lead in the bridge painting (16 of 16), deleading (46 of 53), and manufacturing (31 of 34) industries reported being tested through their employers' medical monitoring programs, as required by law.
- Less than half of interviewed cases exposed to lead in house painting (10 of 48) and "other construction" (17 of 42) reported being tested through their employers' monitoring programs.
- Of cases not enrolled in employer medical monitoring programs, 8 of 38 (21%) house painters and 11 of 25 (44%) in "other construction" were tested because they showed symptoms of lead poisoning.

Case Study

Immigrant Brazilian House Painters

Over a three-year period the Lead Registry recorded elevated blood lead levels (BLL) for three immigrant Brazilian house painters who worked for the same painting company. The highest BLL for each worker was 64, 63, and 48 µg/dl, respectively. One worked for the employer for all three years, with BLLs over 50 µg/dl each year. All three painters had very limited English-speaking ability.

According to the workers and/or their physicians, important OSHA lead standard requirements were not followed. The employer did not have a medical monitoring program, and one of the two who could be interviewed indicated that he had received no training or information on lead hazards. At the time of the interviews, both of the workers who had BLLs over 50 µg/dl continued to work at lead-exposed jobs.

The Massachusetts Division of Occupational Safety provided consultation to this company and continues to monitor its progress in protecting its employees from lead exposure.

Sources of Exposure

- Information on the source of lead exposure was available for 373 of the 404 cases of BLLs \( \geq 40 \) µg/dl. Of these, 300 (80%) were occupationally exposed to lead.
- House painting and repair (n=13), and sports shooting (n=12) were the two most common known sources of non-occupational exposure.

Work-Related Cases of BLLs 40 µg/dl or Greater

Industries

- Industry information was available for 282 (94%) of the 300 occupationally exposed cases of BLLs \( \geq 40 \) µg/dl. Of these, 217 (77%) were employed in the construction industry, primarily as painters (115, 41%) and deleaders (68, 24%).
- Among the 68 deleaders reported, nine (13%) had BLLs \( \geq 60 \) µg/dl.
- House painters had some of the highest BLLs: 15 of 69 house painters (22%) reported with BLLs \( \geq 40 \) µg/dl had BLLs of 60 µg/dl or more, compared to 34 of 213 (16%) of occupationally exposed cases in other industries. Three house painters had BLLs \( \geq 100 \) µg/dl.
- 38 (13%) of the 282 occupationally exposed cases worked in manufacturing, primarily of metal products (17, 6%), plastics (11, 4%), and glass (6, 2%).

Figure 3. Distribution of cases of blood lead level \( \geq 40 \) µg/dl by industry, Massachusetts Occupational Lead Poisoning Registry, 1996–2001 (n=282)

Figure 4. Proportion of interviewed cases in workplace medical monitoring programs by industry, MA 1996–2001 (n=211)**

**Information about medical monitoring was available for some cases who did not complete interviews.
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- The majority (83%) of interviewed cases with occupational exposures were non-Hispanic whites.
- Hispanic workers were over represented in the Lead Registry compared to their participation in the workforce. Whereas close to 10% (n=18) of the occupationally exposed cases with BLLs ≥40 µg/dl interviewed were Hispanic, Hispanics made up approximately 5% of the Massachusetts workforce during 1996–2001.
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T he OSHA Lead Standards

Figure 5. Proportion of interviewed cases who received lead safety training, by industry, MA, 1996–2001 (n=174)

Figure 1. Distribution of cases reported to the Massachusetts Occupational Lead Poisoning Registry by blood lead level, 1996–2001

Figure 2. Number of cases of elevated blood lead levels reported to the Massachusetts Occupational Lead Poisoning Registry per year, 1996–2001

The proportion of interviewed cases who received lead safety training, by industry, was as follows:

- House Painting (25%), 35 cases
- Bridge Painting (41%), 19 cases
- Deleading (25%), 18 cases
- Other Construction (47%), 14 cases
- Manufacturing (65%), 2 cases
- Other Industry (18%), 1 case

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• Nearly all cases (96%) were males.

• The age distribution of cases of BLLs ≥25 µg/dl was similar to that of the working population in Massachusetts. Cases ranged in age from 16 to 91 years.

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