

Lead *at* Work

Elevated Blood Lead Levels in Massachusetts Workers, 1996–2001

November 2005

Massachusetts Division of Occupational Safety
Occupational Health Surveillance Program • Massachusetts Department of Public Health

Data Highlights

- From 1996–2001, 1,821 cases of blood lead levels (BLLs) of 25 micrograms per deciliter of blood ($\mu\text{g}/\text{dl}$) or greater among persons age 15 or older were reported to the Occupational Lead Poisoning Registry.
- Of 373 cases with very high BLLs (40 $\mu\text{g}/\text{dl}$ or greater) with information about source of lead exposure, 80% were exposed at work.
- 77% of the occupationally exposed cases with BLLs of 40 $\mu\text{g}/\text{dl}$ 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 $\mu\text{g}/\text{dl}$ or greater; three had BLLs of 100 $\mu\text{g}/\text{dl}$ 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 $\mu\text{g}/\text{dl}$ 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 ($\mu\text{g}/\text{dl}$). BLLs of 10 $\mu\text{g}/\text{dl}$ or greater are considered abnormally high in both adults and children.³ BLLs in the 14-30 $\mu\text{g}/\text{dl}$ range may cause small increases in blood pressure. BLLs as low as 30 $\mu\text{g}/\text{dl}$ may cause

nervous system dysfunction. Abdominal pain may occur in some adults at BLLs of about 40 $\mu\text{g}/\text{dl}$. Abnormal sperm and decreased sperm counts have been observed in men with BLLs of approximately 40 $\mu\text{g}/\text{dl}$.

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 care 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.

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.

- 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.

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.⁴

Figure 1. Distribution of Cases Reported to the Massachusetts Occupational Lead registry by Blood Lead Level 1996–2001

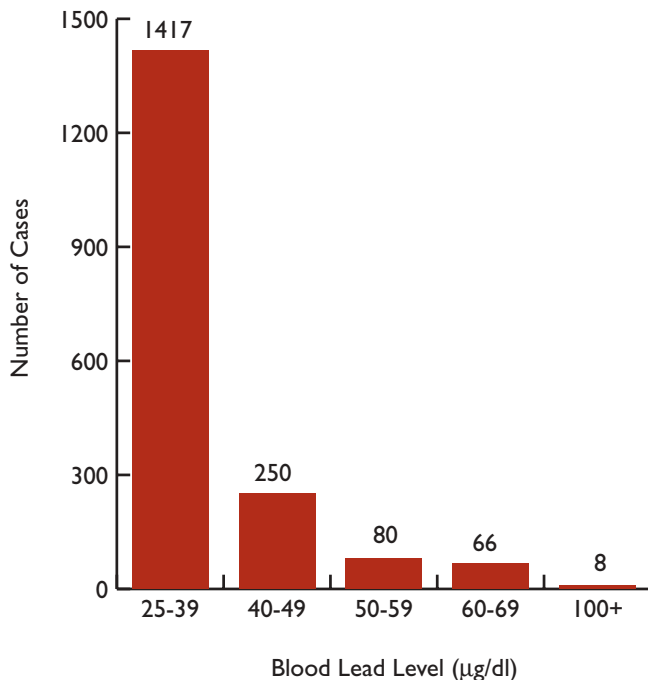
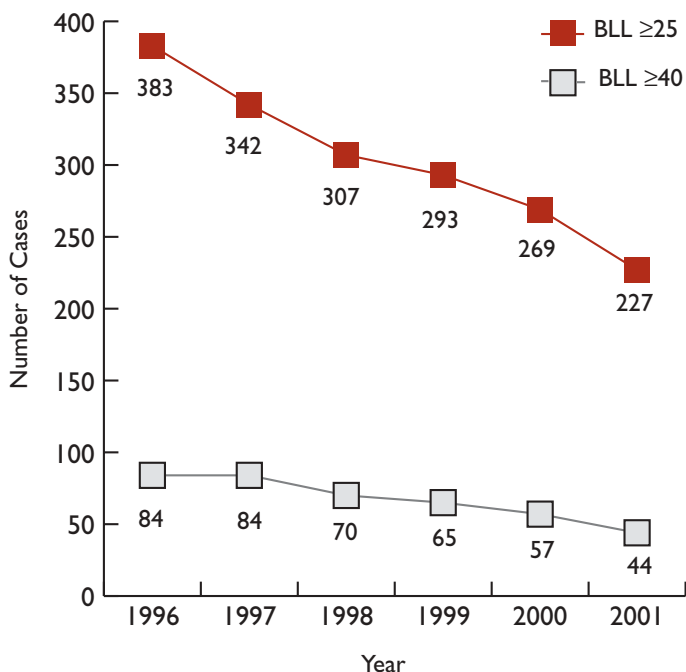


Figure 2. Number of cases of elevated blood lead levels reported to the Massachusetts Occupational Lead Poisoning Registry per year, 1996–2001



Sources of Exposure

• Information on the source of lead exposure was available for 373 of the 404 cases of BLLs ≥ 40 $\mu\text{g}/\text{dl}$. 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 $\mu\text{g}/\text{dl}$ or Greater

Industries

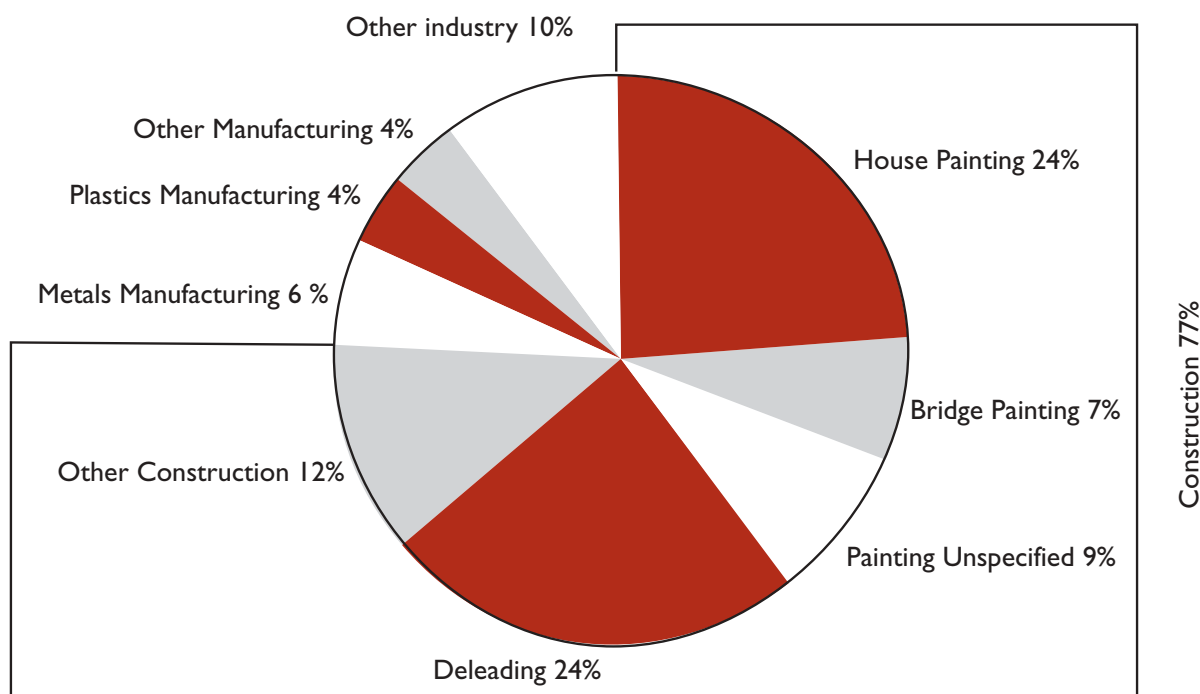
• Industry information was available for 282 (94%) of the 300 occupationally exposed cases of BLLs ≥ 40 $\mu\text{g}/\text{dl}$. Of these, 217 (77%) were employed in the construction industry, primarily as painters (115, 41%) and deleaders (68, 24%).

• Among the 68 deleaders reported, nine (13%) had BLLs ≥ 60 $\mu\text{g}/\text{dl}$.

• House painters had some of the highest BLLs: 15 of 69 house painters (22%) reported with BLLs ≥ 40 $\mu\text{g}/\text{dl}$ had BLLs of 60 $\mu\text{g}/\text{dl}$ or more, compared to 34 of 213 (16%) of occupationally exposed cases in other industries. Three house painters had BLLs ≥ 100 $\mu\text{g}/\text{dl}$.

• 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 $\geq 40\mu\text{g}/\text{dl}$ by industry Massachusetts Occupational Lead Poisoning Registry, 1996–2001 (n=282)



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.

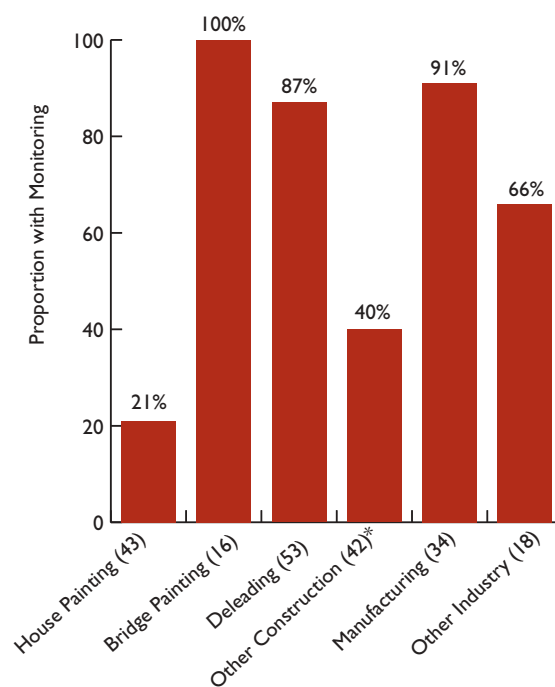
- Less than half of interviewed cases exposed to lead in house painting (10 of 48) and "other construction" (17 of 42) reported being tested through their employers' monitoring programs.

- 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.

*Not all interviewed cases answer all questions. Percentages in this section are based on numbers responding to the specific questions.

**Information about medical monitoring was available for some cases who did not complete interviews.

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



*Includes painting, unspecified

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 mcg/dl, respectively. One worked for the employer for all three years, with BLLs over 50 mcg/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 mcg/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.

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 deleaders reported being trained, only 14 of 48 (29%) interviewed cases exposed to lead in house painting, 11 of 32 (34%) in “other construction,” and seven of 18 (39%) in “other industry” reported receiving training on lead hazards.

Notification of Blood Lead Test Results

- Overall, 25 (13%) interviewed cases reported that they had not been informed about their elevated BLLs by either their health care providers or their employers.

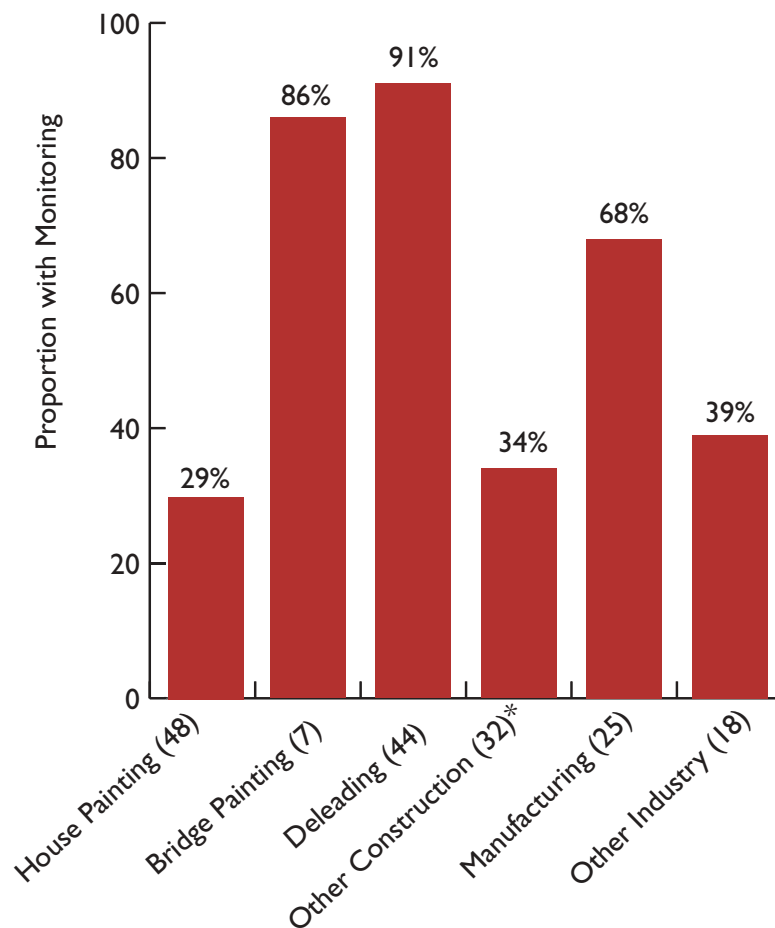
- Even among the 33 workers with the highest BLLs (60 µg/dl or greater), four (12%) reported that they had not been not informed about their BLLs.

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.

- The six cases who were still working in the conditions that had exposed them to lead were all employed in construction; four in house painting, one in deleading, and one whose specific job was unknown.

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



*Includes painting, unspecified

The OSHA Lead Standards

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.

Changes over Time: 1991–1995 vs. 1996–2001

The Occupational Lead Registry began collecting data in April 1991⁵. Findings from 1996–2001 were compared to findings from the 1991–1995 surveillance period.

Magnitude

- The number of cases of BLLs ≥ 25 $\mu\text{g}/\text{dl}$ reported each year fell consistently from 632 in 1991 to 227 in 2001.
- An average of 507 cases per year of BLLs ≥ 25 $\mu\text{g}/\text{dl}$ 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 $\mu\text{g}/\text{dl}$ in 1996–2001 (22%) than in 1991–1995 (31%).

Industries

- Among occupationally exposed cases of BLLs ≥ 40 $\mu\text{g}/\text{dl}$, 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 $\mu\text{g}/\text{dl}$ 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 (38%) in 1991–1995 to 15 of 18 (83%) in 1996–2001.

Figure 6. Distribution of cases reported to the Occupational Lead Registry Poisoning by blood lead levels, MA, 1991–1995 and 1996–2001

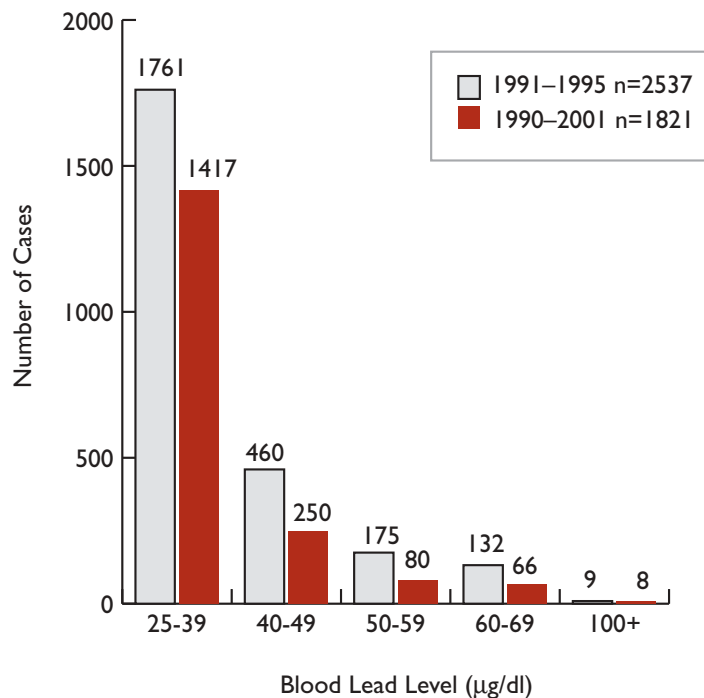
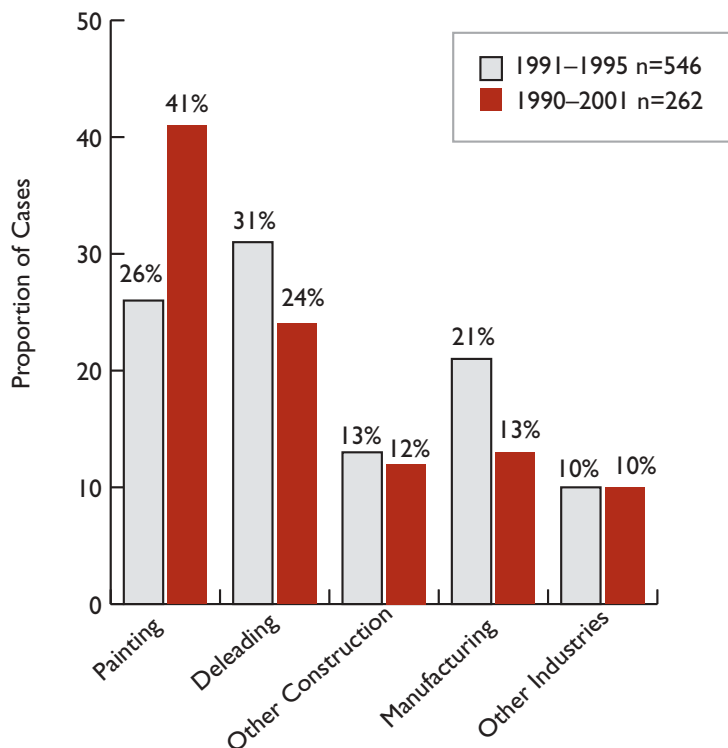


Figure 7. Distribution of cases of blood lead levels ≥ 40 $\mu\text{g}/\text{dl}$ by industry, MA 1991–1995 and 1996–2001*



*Percentages may exceed 100% due to rounding.

Conclusions & Recommendations

The US Public Health Service has called for eliminating cases of BLLs of ≥ 25 $\mu\text{g}/\text{dl}$ due to occupational exposures by the year 2010.⁶ While occupational lead poisoning in Massachusetts declined steadily from 1991 to 2001, a trend similar to declines seen in other states, several hundred cases of elevated BLLs continued to be reported each year. Lead exposures can result in short-term and long-term health problems for the exposed workers and potentially other members of their households. Continued efforts are needed to prevent occupational lead exposures in Massachusetts.

The findings in this report highlight the problem of lead exposure in the Massachusetts construction industry, especially in painting and deleading. Workers in these two industries accounted for 65% of the cases with BLLs of 40 $\mu\text{g}/\text{dl}$ or greater. The continued presence of deleaders and bridge painters in the Lead Registry, even though they reported being trained about lead, underscores the hazardous nature of these industries and the need to be vigilant in implementing exposure control measures. House painters accounted for an increasing proportion of the cases reported over time and had some of the highest blood lead levels. They also appeared much less likely than either bridge painters or deleaders to have participated in employer medical monitoring programs or to have been trained about lead hazards. Innovative strategies are needed to reach the house painting industry to promote compliance with lead standards, including required blood lead testing and training as well as measures to prevent exposures.

The finding that Hispanic workers appear to be disproportionately exposed to lead is consistent with Lead Registry findings reported by other states and with evidence that minority workers are more likely than other workers to be employed in high-risk job categories. It highlights the need for culturally and linguistically appropriate interventions targeting Hispanic workers, particularly in construction.

Resources

Massachusetts Division of Occupational Safety

Occupational Lead Poisoning Registry 617-969-7177
Asbestos and Lead Program (deleading certification)
617-727-7047

US Occupational Safety and Health Administration (OSHA)
Region I, 617-565-9860

Massachusetts Coalition for Occupational Safety and Health
617-825-7233

Massachusetts Department of Public Health

Childhood Lead Poisoning Prevention Program 617-624-5757
Occupational Health Surveillance Program 617-624-5632

References

- ¹ International Agency for Research on Carcinogens. Inorganic and Organic Compounds. *IARC* 2004; 87 (February 10-17).
- ² National Toxicology Program, US Department of Health and Human Services. *Report on Carcinogens, 11th Edition*, 2004.
- ³ Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report, Blood Lead Levels—United States, 1999-2002. Vol. 54, No 20, May 27, 2005.
- ⁴ Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report, Vol. 53, No 26, July 9, 2004.
- ⁵ Massachusetts Departments of Labor and Workforce Development and Public Health, *Lead at Work: Elevated Blood Lead Levels in Massachusetts Workers, April 1991–December 1995*, 1998.
- ⁶ US Department of Health and Human Services. *Healthy People 2010*, Washington DC: January 2000.

Acknowledgements

The Lead Registry would like to thank Rokho Kim, MD, DrPH, and Olivier Humblet, MS, who assisted in the development of this report.

The Massachusetts Occupational Lead Poisoning Registry is supported in part by funds from the National Institute for Occupational Safety and Health.