2003

Annual Report on Blood Lead Levels in Michigan

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A Joint Report

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Part I

Blood Lead Levels Among *Adults* in Michigan

Summary:

This is the sixth annual report on surveillance of blood lead levels in Michigan citizens. It is based on regulations that went into effect on October 11, 1997 that require laboratories to report all blood lead levels analyzed. Past reports have included an expanded section on elevated blood lead levels in children. We continue that inclusion for the 2003 report. See Part II about the results of blood lead tests in children under the age of six.

In 2003, 13,262 reports were received for 12,143 individuals ≥16 years of age. Nine hundred sixty-seven (8.0%) individuals had blood lead levels greater than or equal to 10 µg/dL; 175 of those 967 had lead levels greater than or equal to 25 µg/dL and 6 of the 175 had blood lead levels greater than or equal to 50 µg/dL.

There were 1,268 more reports (on 1,283 individuals) received in 2003 compared to 2002. Both the total number and percent of individuals with blood lead levels greater than or equal to 10 µg/dL decreased from 982 (9.0%) in 2002 to 967 (8.0%) in 2003. The number and percent of individuals with blood lead levels greater than or equal to 25 µg/dL decreased, from 197 (1.8%) in 2002 to 175 (1.4%) in 2003. The number of individuals with blood lead levels greater than or equal to 50 µg/dL decreased while the percent was unchanged, 7 (0.1%) in 2002 and 6 (0.1%) in 2003. This is the fifth year in a row that blood lead levels greater than or equal to 25 µg/dL decreased from the previous year.

Individuals with blood lead levels greater than or equal to 10 µg/dL were likely to be men (93.0%) and white (84.5%). Their mean age was 43. They were most likely to live in Wayne (23.7%), St. Clair (9.8%) and Clinton (7.0%) counties.

Occupational exposure remains the predominant source of lead exposure in Michigan adults (87% of all individuals with elevated blood lead, ≥ 10 µg/dL). These exposures typically occurred where individuals were casting brass or bronze fixtures, performing abrasive blasting on outdoor metal structures such as bridges, overpasses or water towers or exposed to lead fumes from guns at shooting ranges. Individuals with elevated blood lead from exposure at shooting ranges were exposed not only as part of work, but also from their involvement in the activity as recreation. This included individuals using commercial ranges and members of private clubs. This is the most common cause of non-occupational exposure (8.4% of all cases).

In 2003, inspection reports were finalized on fourteen companies where employees had blood lead levels greater than or equal to 25 µg/dL. These reports showed that 8 of 14 (57%) were in violation of the lead standard. Evaluation of these inspections has shown them to be effective relative to other types of workplace enforcement inspections and suggests that they play a role in helping to reduce blood lead levels (1).

This past year we compared blood lead values before and after a Michigan Occupational Safety and Health Administration (MIOSHA) inspection in 65 companies where we had received blood lead reports pre and post inspection. The average blood leads at the companies inspected were reduced 6 µg/dL from 22 to 16 µg/dL from before to after an inspection. Eighty-six percent of the companies had lower blood leads after the inspection.

The sixth year of operation of an adult blood lead surveillance system in Michigan proved successful in continuing to identify a large number of individuals with elevated blood lead levels and sources of workplace exposures that could be remediated to reduce lead exposure. Outreach activities that were continued this past year included: encouraging radiator repair facilities, which use lead, to conduct blood

lead testing; distributing resources on diagnosis and management of lead exposure to health care providers with patients with elevated blood lead levels; and distributing a new "how to" guide for home renovation.

Ongoing surveillance in future years will determine if the favorable trend in lower blood lead levels found from 1998-2003 will continue.

Background:

This is the sixth annual report on surveillance of blood lead levels in Michigan citizens. Blood lead levels of Michigan residents, including children, have been monitored by the state since 1992. From 1992 to 1995, laboratories performing analyses of blood lead levels, primarily of children, had been voluntarily submitting reports to the Michigan Department of Public Health and then beginning in 1996 to the Michigan Department of Community Health (MDCH). The Michigan Department of Community Health promulgated regulations effective October 11, 1997 that require laboratories to submit reports of both children and adults to the MDCH for any blood testing for lead. Coincident with this, the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Labor and Economic Growth (MDLEG) (formerly called the Occupational Health Division within the Michigan Department of Consumer and Industry Services (MDCIS); which formerly had been part of the Michigan Department of Public Health) received federal funding in 1997 from the Centers for Disease Control and Prevention (CDC) to monitor adult blood lead levels, as part of the Adult Blood Lead Epidemiology and Surveillance (ABLES) Program. Currently 35 states have established lead registries through the ABLES Program for surveillance of adult lead absorption, primarily based on reports of elevated blood lead levels (BLL) from clinical laboratories.

The Michigan Adult Blood Lead Registry:

Reporting Regulations and Mechanism

Since 1978, Michigan has required clinics, labs, hospitals and employers to report any patient with a known or suspected work-related disease including lead poisoning to the MDLEG, under Part 56 of Public Act 368 of 1978. Since October 11, 1997, laboratories performing blood lead analyses of Michigan residents are required to report the results of all blood lead level tests (BLLs) to the Michigan Department of Community Health (R325.9081-.9087). Prior to these new regulations, few reports of elevated lead levels among adults were received.

The laboratories are required to report blood sample analysis results, patient demographics, and employer information on a standard Michigan Department of Community Health Lead Reporting Form (Appendix I). The physician or health provider ordering the blood lead analysis is responsible for completing the patient information (section I), the physician/provider information (section II) and the specimen collection information (section IIa). Upon receipt of the blood sample for lead analysis, the clinical laboratory is responsible for completion of the laboratory information (section III). All clinical laboratories conducting business in Michigan that analyze blood samples for lead must report all adult and child blood lead results to the Michigan Department of Community Health, Childhood Lead Poisoning Prevention Program (MDCH/CLPPP) within five working days.

All blood lead results on individuals 16 years or older are forwarded to the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Labor and Economic Growth

(MDLEG) for potential follow-up. A summary of blood lead results from 2003 on children less than six years old is in Part II of this report.

Laboratories

Employers providing blood lead analysis on their employees as required by the Michigan Occupational Safety and Health Act (MIOSHA) are required to use a laboratory approved by OSHA to be in compliance with the lead standard. Appendix II lists the approved laboratories in Michigan.

Data Management

When BLL reports are received at the MDCH, they are reviewed for completeness. For those reports where information is missing, copies are returned to the physician/provider to complete. Lead Registry staff code the information on the lead reporting form using a standard coding scheme and enter this information into a computerized database. Each record entered into the database is visually checked for any data entry errors, duplicate entries, missing data, and illogical data. These quality control checks are performed monthly.

Case Follow Up

Adults whose BLL is 25 µg/dL or greater are contacted for an interview, unless their source of blood lead is known and if work-related, their workplace was inspected in the previous three years. We also interview individuals with blood lead levels ranging from 10 to 24 µg/dL if we cannot identify the source of their lead exposure from the reporting form. A letter is sent to the individual explaining Michigan's lead surveillance program and inviting them to answer a 15-20 minute telephone questionnaire about their exposures to lead and any symptoms they may be experiencing. The questionnaire collects patient demographic data, work exposure and history information, symptoms related to lead exposure, information on potential lead-using hobbies and non-work related activities, and the presence of young children in the household to assess possible take-home lead exposures among these children. Trained medical interviewers administer the questionnaire.

Michigan OSHA (MIOSHA) Requirements for Medical Monitoring and Medical Removal

MIOSHA requirements for medical surveillance (i.e. biological monitoring) and medical removal are identical to Federal OSHA's. The requirements for medical removal differ for general industry and construction. For general industry, an individual must have two consecutive blood lead levels above 60 µg/dL or an average of three blood lead levels greater than 50 µg/dL before being removed (i.e. taken pursuant to the standard or the average of all blood tests conducted over the previous six months, which ever is longer). For construction, an individual needs to have only two consecutive blood lead level measurements taken pursuant to the standard above 50 µg/dL. However, an employee shall not be required to be removed if the last blood-sampling test indicates a blood lead level at or below 40 µg/dL. See Appendix III for a more detailed description of the requirements.

In the absence of a specific exposure to lead, blood lead levels in the general population are typically below 10 µg/dL (2).

Dissemination of Surveillance Data

Quarterly data summaries, without personal identifiers, are forwarded to the Program's funding agency, the National Institute for Occupational Safety and Health (NIOSH). NIOSH compiles quarterly reports from all states that require reporting of BLLs and publishes them in the Morbidity and Mortality Weekly Report (MMWR) (3). See Appendix IV for most recent publication.

Results:

2003 is the sixth year with complete laboratory reporting in Michigan since the lead regulations became effective on October 11, 1997. Accordingly, this report provides a summary of all the reports of adult blood lead levels received in 2003 as well as more detailed information from interviews of those adults with BLLs 25 µg/dL and greater and the sample of individuals interviewed who had blood lead levels ranging 10-24 µg/dL. It also describes the Michigan Occupational Safety and Health Administration (MIOSHA) inspections at the work sites where these individuals were exposed to lead.

Blood Lead Levels Reported in 2003

Number of Reports and Individuals

Between January 1 and December 31, 2003, the State of Michigan received 13,262 blood lead level reports for individuals 16 years of age or older. Because an individual may be tested more than once each year, the 13,262 reports received were for 12,143 individuals (Table 1). The number of individuals tested for blood lead each year has gradually increased (Figure 1).

The following descriptive statistics are based on the 12,143 individuals reported in 2003, and are based on the highest BLL reported for each of these adults.

Distribution of Blood Lead Levels

In 2003, 967 (8.0%) of the 12,143 adults reported had blood lead levels greater than or equal to 10 µg/dL; 175 of those 967 had blood lead levels greater than or equal to 25 µg/dL and 6 of those 175 had blood lead levels greater than or equal to 50 µg/dL (Table 1). A total of 11,176 (92.0%) of the adults reported in 2003 had BLLs less than 10 µg/dL.

There has been a gradual decline in the number of individuals with elevated blood lead (Figure 2).

Gender and Age Distribution

All Blood Lead Levels

Sixty–one percent of the adults reported to the Registry were male, with females representing thirty-nine percent of the reports (Table 2). The age distribution is shown in Table 3. The mean age was 43.

Blood Lead Levels ≥ 10 µg/dL

For the 967 adults reported to the Registry with blood lead levels greater than or equal to 10 µg/dL, 899 (93.0%) were men and 68 (7.0%) were women (Table 2). The age distribution for these adults was similar to the reports of all BLLs (Table 3). The mean age was 43.

Race Distribution

All Blood Lead Levels

Although laboratories are required to report the patients' race, this information is frequently not completed. Race was missing for 6,200 (51.0%) of the 12,143 adults reported. Where race was known, 4,498 (75.7%) were reported as Caucasian, 1,273 (21.4%) were reported as African American, 69 (1.2%) were reported as Native American, 62 (1.0%) were reported as multiracial/other, and 41 (0.7%) were reported as Asian/Pacific Islander (Table 4).

Blood Lead Levels ≥ 10 µg/dL

For adults with blood lead levels greater than or equal to 10 µg/dL where race was indicated, 589 (84.5%) were reported as Caucasian, 87 (12.5%) were reported as African American, 10 (1.4%) were reported as Native American, 7 (1.0%) were reported as multiracial/other, and 4 (0.6%) were reported as Asian/Pacific Islander, (Table 4). Although the percentage of African-Americans with blood leads levels $\geq$ 10µg/dL decreased as compared to all blood lead levels, African Americans had a greater percentage of the extremely high blood leads $\geq$ 60µg/dL (Table 18).

Geographic Distribution

County of residence was determined for 8,875 of the 12,143 adults reported to the Registry. They lived in all of Michigan's 83 counties. The largest number of adults reported in 2003 lived in Wayne County (2,301, 26.0%), followed by Oakland (593, 6.7%) and Muskegon (540, 6.1%). County was unknown for 3,268 adults (Figure 3 and Table 5).

Figure 4 and Table 5 show the county of residence of the 830 adults with blood lead levels greater than or equal to 10 µg/dL where county of residence could be determined. The largest number of adults reported with a BLL of 10 µg/dL and greater were from Wayne County (197, 23.7%), followed by St. Clair (82, 9.9%) and Clinton (58, 7.0%). County was unknown for 137 adults.

Figure 5 and Table 5 show the county of residence for the 151 adults with blood lead levels greater than or equal to 25 µg/dL where county of residence could be determined. The largest number of adults reported with a BLL of 25 µg/dL and above were from Wayne County (29, 19.2%), followed by St. Clair (17, 11.3%) and Montcalm (10, 6.6%). County was unknown for 24 adults.

Figure 6 and Table 6 show the percentage of adults tested for blood lead within each county with BLLs of 10 µg/dL or greater. Ionia (36, 45.0%), St. Clair (82, 41.0%) and Clinton (58, 40.0%) counties had the highest percentages of adults with BLLs of 10 µg/dL or greater.

Figure 7 and Table 6 show the percentage of adults tested for blood lead within each county with BLLs of 25 µg/dL or greater. Antrim (3, 16.7%), Alpena (2, 10.5%) and Ionia (8, 10.0%) counties had the highest percentage of adults with BLLs of 25 µg/dL or greater.

Figure 8 and Table 7 show the incidence rates of BLLs of 10 µg/dL and above, by county, for women. There were 65 women reported in 2003 with a BLL of 10 µg/dL or greater where county of residence could be determined. Crawford (18/100,000), Alpena (16/100,000), and Clinton (16/100,000) had the three highest

incidence rates. Women with elevated blood lead had their exposure from work (22, 75.9%), mostly in fabricated metal products (17.2%), special trade construction (13.8%), transportation, electric, gas and sanitary services (13.8%), and transportation equipment (10.3%). Women with elevated blood leads also had non-work exposures mostly from remodeling performed in their homes (10.3%) and firearms (6.9%). Source of exposure was unknown for 39 of the 68.

Figure 9 and Table 8 show the incidence rates of BLLs of 10 μg/dL and above, by county, for men. There were 765 men reported in 2003 with a BLL of 10 μg/dL or greater where county of residence could be determined. Clinton (226/100,000), Montcalm (204/100,000) and Ionia (137/100,000) had the three highest incidence rates. The elevated rates in these counties were secondary to individuals exposed to lead while working in brass/bronze foundries. The overall incidence rate for men was 10 times higher than that for women (21/100,000 vs 2/100,000).

Source of Exposure

Table 9 shows the source of exposure of lead for individuals with blood lead levels greater than 10 μg/dL reported in 2003. For 670 (86.8%) individuals, work was the identified source, for the other 13.2% a hobby, mainly related to guns 65 (8.4%) was the source. Home remodeling was the source in 14 individuals (1.8%), and casting was the source in 6 (0.8%) of the individuals. For an additional 181 individuals, we are still investigating the source.

Table 10 shows the occupational sources of lead for individuals reported in 2003. The most frequent reports were on individuals in the manufacturing sector (46.8%), then construction (32.7%) and then transportation and public utilities (8.8%). Less common sources were services (5.3%), public administration (4.7%) and wholesale and retail trade (1.7%).

Figure 10 shows the distribution of the thirty non-construction companies that reported at least one adult with a BLL of 25 μg/dL or greater in Michigan during 2003. These companies included brass/bronze casting operations, performing radiator repair activities, indoor firing ranges and stained glass shops using lead solder. Of the 602 individuals with blood lead $\geq$ 10 μg/dL, 322 (53%) were from these thirty companies.

Summary of Industrial Hygiene Inspections

Since the 2002 report, the statewide surveillance system identified 30 companies where MIOSHA had not performed an inspection for lead in at least three years (Table 11). Fourteen of these companies have now been inspected. Inspections are planned for the other 13 companies. No inspections are planned at the remaining three companies because they had no employees (firing ranges). Inspections of these fourteen companies resulted in 9 of the 14 (64%) companies receiving citations for a violation of an occupational health standard (Table 12). Eight of the 14 (57%) companies were issued citations for violations of the lead standard. Violations of the lead standard by industry type is shown in Table 13.

Of the 30 companies identified, sixteen were identified by elevated blood lead reports collected because of a company's medical surveillance program and nine from an individual having the test performed by their personal health care provider. For five we are unable to determine at this time why the blood lead sample was collected. Two of the nine companies identified because an individual had the blood lead test performed by their personal health care provider were inspected and were cited for a lead violation.

Blood Lead Levels Before and After a MIOSHA Inspection

All companies from which a worker is reported with a blood lead of 25 µg/dL or greater undergo a Michigan OSHA enforcement inspection. MIOSHA inspections were conducted at 65 Michigan companies, since 1998, from which 2,836 blood lead reports were available on 517 individuals before and after the inspection. There have been another 30 inspections not included in this analysis because blood lead results were not available before and after the inspection.

The average blood lead decreased 6 µg/dL from 22 µg/dL to 16 µg/dL (Student T test, p = .000), comparing blood leads performed before to after an OSHA inspection. Fifty-six of the 65 (86.2%) companies had a reduction in their average blood lead after an inspection. The reduction in blood leads was of equal magnitude for inspections initiated because of blood lead reports ranging from 25 to 50 µg/dL (Table 14) as well as whether the initiating blood lead was ordered as part of the company's medical screening or by the individual's personal health care provider (Table 15). Neither an increase in the number of citations nor in the amount of penalties was associated with a greater reduction in blood lead values (Tables 16 and 17).

This analysis builds upon previous analyses that showed the numbers of citations and penalties issued for violations of the lead standard were similar for follow up of blood lead reports ranging from 30 to 50 µg/dL (1). Our data suggests that MIOSHA enforcement inspections of companies with blood lead levels of 25 µg/dL or greater are an effective intervention to reduce blood lead levels in the workplace.

Interviews of Adults with Blood Lead Levels of 10 µg/dL or Greater

Between October 15, 1997 and December 31, 2003, there were 857 reports received on adults with blood lead levels ≥10 µg/dL that completed an interview by telephone. The following summary of interview data is based on the 857 questionnaires completed by telephone. These 857 adults were reported to the Registry from October 15, 1997 to December 31, 2003.

Table 18 lists the demographic characteristics of the 857 adults with completed questionnaires by highest lead level reported. Most of the completed questionnaires were of males (92.5%), which parallels the gender distribution of the number of lead level reports ≥ 10 µg/dL submitted for adults in 2003. There was no difference in gender by highest blood lead level. The percentage of African-Americans was greater among adults with higher blood lead levels. The percentage of ever or current smokers was higher among adults with the higher blood lead levels. The group with the highest lead levels had the youngest mean age.

Table 19 presents the types of lead-related symptoms reported during the interviews, by lead level. Only individuals who had daily or weekly symptoms were included in this table. Loss of 10+ pounds without dieting, continued loss of appetite, frequent pain/soreness, muscle weakness, headache, feeling depressed, being tired, feeling nervous, waking up at night, and being irritable were associated with a statistically significant increasingly higher levels of blood lead. Having any gastro-intestinal, muscloskeletal, nervous, reproductive system symptom or any symptom was associated with a statistically significant increasingly higher levels of blood lead. Table 20 shows the reporting of anemia, kidney disease and high blood pressure by lead level category.

Table 21 presents the type of industry by lead level reported among those interviewed. Overall, 31.7% worked in special trade construction, followed by 26.5% working in the primary metals industry. Among individuals with the highest blood leads (≥ 40 µg/dL), the most common exposure was the same as for all

elevated blood lead levels with construction followed by the primary metals industry (foundries). Table 22 presents the number of years worked by highest lead level reported for the adults who completed a questionnaire. Higher blood lead level results were more likely to occur in shorter-term workers (i.e. worked in a lead exposed job for 5 or fewer years).

Table 23 lists the types of working conditions reported by the interviewed adults, again by highest lead level reported. Workers with lower lead levels were more likely to report having their work clothing laundered at work, having a showering facility and having a separate lunch room. They also were more likely to report eating in the lunch room. As expected, workers with higher blood lead levels were more likely to have been removed from the job.

The questionnaire also asks about children in the household, in order to document the potential for and extent of take-home lead. Twenty-nine percent of the adults interviewed reported children age 6 and younger living or spending time in the home (Table 24). Children from only 61 of the 248 (26.9%) households where an adult had an elevated lead level and young children lived or frequently visited were tested for blood lead. Among the 61 households where we know the childs' blood test results, 24 (41.4%) households had a child with an elevated blood lead level ($\geq$ 10 μg/dL). A letter was sent to all adults with young children encouraging them to test the children for lead.

Discussion:

An individual may have a blood lead test performed as part of an employer medical-screening program or as part of a diagnostic evaluation by their personal physician. Whatever the reason for testing, the results are then sent by the testing laboratories to the MDCH as required by law. If the individual reported is an adult, the report is then forwarded to the MDLEG and maintained in the ABLES Program Lead Registry. Individuals with a blood lead level of 25 μg/dL or greater, and a sample of individuals with blood lead levels of 10-24 μg/dL, are interviewed by a trained medical interviewer by telephone. The interview details demographic information, exposure history and the presence and nature of lead related symptoms. A MIOSHA enforcement inspection is conducted to assess the company's compliance with the lead standard when an individual from the company is identified with a blood lead value of 25 μg/dL or greater.

Michigan is one of 35 states conducting surveillance of elevated blood lead levels. Michigan requires the reporting of <u>all</u> blood lead level results. Major benefits for reporting all blood lead levels are: the ability to calculate the rates of elevated blood lead levels in specific groups of interest, the ability to monitor compliance with the testing requirements of the lead standard, and facilitating the tracking of reports from particular employers to monitor their progress in reducing workers' exposures to lead.

Data from the state surveillance systems shows that elevated lead levels from occupational exposures are an important public health problem in the United States (3). It is well-documented that exposure to lead may cause serious health effects in adults, including injury to the nervous system, kidneys, and blood-forming and reproductive systems in men and women. The level of lead in the blood is a direct index of a worker's recent exposure to lead as well as an indication of the potential for adverse effects from that exposure (4). A further problem is that workers can bring lead home on their clothes and expose children to lead. Forty-one percent of households with children under the age of six where the adult had an elevated blood lead level and the child was tested had an elevated blood level (Table 24). Children can experience serious adverse effects on neurological and intellectual development from lead exposure.

Average blood lead levels in the United States general population range from 2.1 to 3.4 μg/dL with 1.5 to 4.6% of adults tested for blood lead having blood lead levels greater than or equal to 10 μg/dL (2). On the average, blood lead levels are higher in the elderly, in men, and in African-Americans and Hispanics. Despite these differences, the mean blood lead levels and the percentage greater than 10 μg/dL for these sub populations are not clinically significantly different (2). A blood lead level greater than or equal to 10 μg/dL is an indication of exposure and increased absorption of lead regardless of age, race and gender. Values above 9 μg/dL indicate exposure to lead beyond that found in the background environment. An effort was made in previous years to have all laboratories to use the same normal ranges. All but one of the labs now uses 10 μg/dL as the upper limit for a "normal" blood lead level.

Symptoms involving the gastrointestinal, musculoskeletal and nervous systems occurred at levels within the allowable MIOSHA and OSHA standards (Table 19). The presence of these symptoms supports the need to lower the blood lead level that mandates medical removal. The current allowable level is up to 50 μ g/dL. Seventy percent of individuals with blood lead below this level had daily or weekly symptoms.

We have analyzed the symptom data and found that nervous system symptoms began to increase at 25-30 μg/dL, gastrointestinal symptoms at 30-35 μg/dL and musculoskeletal symptoms at 35-40 μg/dL (5). Other recent studies also support the inadequacy of the current occupational standard of 50 μg/dL to protect workers' health. Significant increases in all-cause, circulatory and cardiovascular mortality were reported in the United States among individuals followed up until 1992 who were identified with blood lead levels of 20-29 μg/dL during the years 1976 to 1980 (6). A further study from Taiwan among individuals with chronic renal disease without increased body burdens of lead and blood leads of only 5.3 μg/dL showed that treatment to increase lead excretion improved kidney function and decreased progression to end state renal disease (7). All these studies provide added weight to the inadequacy of the current occupational standard of 50 μg/dL. The American Conference of Governmental Industrial Hygienists has recommended a maximum blood lead of 30 μg/dL. In addition to suggesting the need for a new occupational standard, this data indicates the need to update health care providers of the latest information about the hazards of lead.

In 2003, there were 967 adults reported in Michigan with blood lead levels greater than or equal to 10 μg/dL. Ninety-three percent were men. The mean age was 43. They were predominately white (84.5%). They predominately resided in a band of counties stretching across the state from Muskegon and Oceana to Wayne and Macomb. The counties with the highest percentage of elevated blood leads were counties with brass/bronze foundries (Figure 10). The exposure was predominately occupational in origin, occurring during the casting of brass/bronze parts or among abrasive blasters removing paint from outdoor metal structures, among workers repairing car radiators or individuals who work in indoor firing ranges.

Individuals with the highest blood leads were more likely to be younger (Table 18). We attribute this finding to a higher percentage of younger workers in construction doing abrasive blasting on metal structures. Also younger, less experienced workers may be given the dirtier less desirable tasks.

Based on the experience in other states we presume that the number of reports of elevated blood lead levels we receive is an underestimate of the true number of Michigan citizens with elevated blood leads (8,9). For example, in a study in California while 95% of lead battery employees had blood leads performed by their employers, only 8% of employees from radiator repair facilities and 34% of employees from secondary smelters of non-ferrous metal had blood leads performed by their employer (9). Overall it was estimated that less than 3% of employees in California exposed to lead were provided blood lead testing by their employer (9). On a national basis it was estimated that less than 12% of companies using lead provided blood lead testing for their employees (8). We conducted a survey of 28 Michigan radiator repair facilities and found

that only 27% of the companies were providing blood lead testing to their employees, although this is better than the 8% reported from the survey conducted in the late 1980's in California. Fifteen percent indicated they were unaware of the requirement to provide blood lead testing and 42% indicated air lead levels in their facilities were below levels where such blood lead testing is required. Further follow-up is underway to determine the reliability of these self-reports.

Six adults had blood lead levels above 50 µg/dL, which is the maximum blood lead level allowed in the workplace. Two of the six adults were exposed to lead at work (one at a firing range and one from blasting/painting). Another two were exposed to lead through their hobby of shooting guns and one adult was eating paint chips. The source of lead in the sixth individual is still being investigated.

An inspection was conducted at fourteen companies where a worker was reported with a blood lead level $\geq$ 25 µg/dL. Eight of fourteen (57%) of these companies were cited for violations of the lead standard (Table 13). An analysis of blood lead levels before and after 65 inspections conducted since 1998 showed that average blood lead levels were reduced after the inspection in comparison to levels before the inspection (Table 14).

In its sixth year of operation, the surveillance system for lead proved successful in continuing to identify large numbers of adults with elevated lead levels and sources of exposure that could be remediated to reduce exposures. Outreach work is planned this coming year to disseminate information to firing ranges about controlling lead exposure. Similarly, continued outreach is planned to the medical community on the recognition and management of individuals with potential lead-related medical problems. Reevaluation of the current occupational lead standard should also be considered. Finally, we continue to be encouraged both by the increased compliance of the reporting law and by the reduction in blood lead levels greater than or equal to 25 and to 50 µg/dL (Figure 2). We will continue to monitor for this trend in the year 2004.

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Appendices

Appendix I	Blood Lead Analysis Reporting
Appendix II	OSHA Blood Lead Laboratories: Michigan
Appendix III	Summary of Michigan's Lead Standards
Appendix IV	Morbidity and Mortality Weekly Report (MMWR): Adult Blood Lead Epidemiology and Surveillance-United States, 1998-2001.

Table 1. Distribution of Highest Blood Lead Levels (BLLs) Among Adults in Michigan: 2003

BLLs (ug/dL)	Number	Percent
<10	11,176	92.0
10-24	792	6.5
25-29	74	0.6
30-39	72	0.6
40-49	23	0.2
50-59	2	0.0
≥ 60	4	0.0
TOTAL	**12,143 ***	**100.0**

*In 2003, 13,262 BLL reports were received for 12,143 individuals.

Table 2. Distribution of Gender Among Adults Tested for Blood Lead in Michigan: 2003

	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 ug/dL	
Gender	**Number**	**Percent**	**Number**	**Percent**
Male	7,369	60.7	899	93.0
Female	4,774	39.3	68	7.0
Total	**12,143**	**100.0**	**967**	**100.0**

Table 3. Distribution of Age Among Adults Tested for Blood Lead in Michigan: 2003

	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 ug/dL	
Age Range	**Number**	**Percent**	**Number**	**Percent**
16-19	703	5.8	8	0.8
20-29	2,036	16.8	135	14.0
30-39	2,425	20.0	199	20.6
40-49	2,982	24.6	314	32.5
50-59	2,079	17.1	213	22.0
60-69	978	8.1	77	8.0
70-79	599	4.9	16	1.7
80-89	285	2.3	5	0.5
90-99	23	0.2	0	0.0
100+	33	0.3	0	0.0
TOTAL	**12,143**	**100.0**	**967**	**100.0**

Table 4. Distribution of Race Among Adults Tested for Blood Lead in Michigan: 2003

	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 ug/dL	
Race	**Number**	**Percent**	**Number**	**Percent**
Caucasian	4,498	75.7	589	84.5
African American	1,273	21.4	87	12.5
Native American	69	1.2	10	1.4
Asian/Pacific Islander	41	0.7	4	0.6
Multiracial/Other	62	1.0	7	1.0
TOTAL	**5,943 ***	**100.0**	**697 ****	**100.0**

*Race was unknown for 6,200 additional individuals.
**Race was unknown for 270 additional individuals.

Table 5. Distribution of Adults with All Blood Lead Levels (BLLs), BLLs ≥10 ug/dL, and BLLs ≥25 ug/dL, Michigan by County of Residence: 2003

	All BLLs		BLLs ≥10 ug/dL		BLLs ≥25 ug/dL	
County	Number	Percent	Number	Percent	Number	Percent
Alcona	6	0.07	0	0.00	0	0.00
Alger	12	0.14	0	0.00	0	0.00
Allegan	50	0.56	2	0.24	0	0.00
Alpena	19	0.21	4	0.48	2	1.32
Antrim	18	0.20	3	0.36	3	1.99
Arenac	15	0.17	0	0.00	0	0.00
Baraga	15	0.17	1	0.12	0	0.00
Barry	39	0.44	0	0.00	0	0.00
Bay	70	0.79	8	0.96	3	1.99
Benzie	4	0.05	0	0.00	0	0.00
Berrien	105	1.18	15	1.81	2	1.32
Branch	14	0.16	1	0.12	0	0.00
Calhoun	149	1.68	11	1.33	6	3.97
Cass	12	0.14	2	0.24	1	0.66
Charlevoix	20	0.23	0	0.00	0	0.00
Cheboygan	16	0.18	1	0.12	1	0.66
Chippewa	67	0.75	7	0.84	2	1.32
Clare	135	1.52	0	0.00	0	0.00
Clinton	145	1.63	58	6.99	3	1.99
Crawford	46	0.52	2	0.24	2	1.32
Delta	21	0.24	2	0.24	2	1.32
Dickinson	12	0.14	3	0.36	1	0.66
Eaton	82	0.92	5	0.60	0	0.00
Emmet	13	0.15	2	0.24	1	0.66
Genesee	336	3.79	26	3.13	2	1.32
Gladwin	44	0.50	1	0.12	0	0.00
Gogebic	9	0.10	0	0.00	0	0.00
Grand Traverse	43	0.48	5	0.60	1	0.66
Gratiot	67	0.75	23	2.77	5	3.31
Hillsdale	39	0.44	0	0.00	0	0.00
Houghton	34	0.38	0	0.00	0	0.00
Huron	15	0.17	4	0.48	0	0.00
Ingham	249	2.81	18	2.17	4	2.65
Ionia	80	0.90	36	4.34	8	5.30
Iosco	14	0.16	0	0.00	0	0.00
Iron	13	0.15	1	0.12	0	0.00
Isabella	48	0.54	2	0.24	0	0.00
Jackson	100	1.13	3	0.36	1	0.66
Kalamazoo	271	3.05	5	0.60	1	0.66
Kalkaska	14	0.16	0	0.00	0	0.00
Kent	454	5.12	35	4.22	7	4.64
Keweenaw	2	0.02	0	0.00	0	0.00
Lake	2	0.02	0	0.00	0	0.00
Lapeer	61	0.69	3	0.36	0	0.00

Continued

Table 5. Distribution of Adults with All Blood Lead Levels (BLLs), BLLs ≥10 ug/dL, and BLLs ≥25 ug/dL, Michigan by County of Residence: 2003

	All BLLs		BLLs ≥10 ug/dL		BLLs ≥25 ug/dL	
County	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Leelanau	13	0.15	1	0.12	1	0.66
Lenawee	110	1.24	9	1.08	5	3.31
Livingston	127	1.43	5	0.60	2	1.32
Luce	8	0.09	0	0.00	0	0.00
Mackinac	40	0.45	0	0.00	0	0.00
Macomb	450	5.07	41	4.94	6	3.97
Manistee	32	0.36	1	0.12	1	0.66
Marquette	59	0.66	3	0.36	0	0.00
Mason	18	0.20	0	0.00	0	0.00
Mecosta	22	0.25	1	0.12	0	0.00
Menominee	13	0.15	0	0.00	0	0.00
Midland	72	0.81	4	0.48	1	0.66
Missaukee	7	0.08	0	0.00	0	0.00
Monroe	189	2.13	11	1.33	1	0.66
Montcalm	140	1.58	49	5.90	10	6.62
Montmorency	8	0.09	0	0.00	0	0.00
Muskegon	540	6.08	37	4.46	4	2.65
Newaygo	30	0.34	2	0.24	0	0.00
Oakland	593	6.68	42	5.06	7	4.64
Oceana	23	0.26	1	0.12	0	0.00
Ogemaw	10	0.11	0	0.00	0	0.00
Ontonagon	22	0.25	0	0.00	0	0.00
Osceola	17	0.19	0	0.00	0	0.00
Oscoda	5	0.06	0	0.00	0	0.00
Otsego	22	0.25	0	0.00	0	0.00
Ottawa	121	1.36	1	0.12	0	0.00
Presque Isle	7	0.08	1	0.12	0	0.00
Roscommon	27	0.30	3	0.36	1	0.66
Saginaw	118	1.33	11	1.33	1	0.66
Saint Clair	200	2.25	82	9.88	17	11.26
Saint Joseph	39	0.44	1	0.12	1	0.66
Sanilac	31	0.35	5	0.60	1	0.66
Schoolcraft	7	0.08	0	0.00	0	0.00
Shiawassee	78	0.88	13	1.57	1	0.66
Tuscola	32	0.36	1	0.12	0	0.00
Van Buren	72	0.81	6	0.72	1	0.66
Washtenaw	271	3.05	11	1.33	3	1.99
Wayne	2,301	25.93	197	23.73	29	19.21
Wexford	21	0.24	2	0.24	0	0.00
TOTAL	**8,875** *	100.00	**830** **	100.00	**151** ***	100.00

*County was unknown for 3,268 additional adults.

**County was unknown for 137 additional adults.

***County was unknown for 24 additional adults.

Table 6. Percentage of Adults Tested within County with Blood Lead Levels (BLLs) ≥10 ug/dL and ≥25 ug/dL, Michigan by County of Residence: 2003

	All BLLs		BLLs ≥10 ug/dL		BLLs ≥25 ug/dL	
County	Number	Percent	Number	Percent	Number	Percent
Alcona	6	0.07	0	0.00	0	0.00
Alger	12	0.14	0	0.00	0	0.00
Allegan	50	0.56	2	4.00	0	0.00
Alpena	19	0.21	4	21.05	2	10.53
Antrim	18	0.20	3	16.67	3	16.67
Arenac	15	0.17	0	0.00	0	0.00
Baraga	15	0.17	1	6.67	0	0.00
Barry	39	0.44	0	0.00	0	0.00
Bay	70	0.79	8	11.43	3	4.29
Benzie	4	0.05	0	0.00	0	0.00
Berrien	105	1.18	15	14.29	2	1.90
Branch	14	0.16	1	7.14	0	0.00
Calhoun	149	1.68	11	7.38	6	4.03
Cass	12	0.14	2	16.67	1	8.33
Charlevoix	20	0.23	0	0.00	0	0.00
Cheboygan	16	0.18	1	6.25	1	6.25
Chippewa	67	0.75	7	10.45	2	2.99
Clare	135	1.52	0	0.00	0	0.00
Clinton	145	1.63	58	40.00	3	2.07
Crawford	46	0.52	2	4.35	2	4.35
Delta	21	0.24	2	9.52	2	9.52
Dickinson	12	0.14	3	25.00	1	8.33
Eaton	82	0.92	5	6.10	0	0.00
Emmet	13	0.15	2	15.38	1	7.69
Genesee	336	3.79	26	7.74	2	0.60
Gladwin	44	0.50	1	2.27	0	0.00
Gogebic	9	0.10	0	0.00	0	0.00
Grand Traverse	43	0.48	5	11.63	1	2.33
Gratiot	67	0.75	23	34.33	5	7.46
Hillsdale	39	0.44	0	0.00	0	0.00
Houghton	34	0.38	0	0.00	0	0.00
Huron	15	0.17	4	26.67	0	0.00
Ingham	249	2.81	18	7.23	4	1.61
Ionia	80	0.90	36	45.00	8	10.00
Iosco	14	0.16	0	0.00	0	0.00
Iron	13	0.15	1	7.69	0	0.00
Isabella	48	0.54	2	4.17	0	0.00
Jackson	100	1.13	3	3.00	1	1.00
Kalamazoo	271	3.05	5	1.85	1	0.37
Kalkaska	14	0.16	0	0.00	0	0.00
Kent	454	5.12	35	7.71	7	1.54
Keweenaw	2	0.02	0	0.00	0	0.00
Lake	2	0.02	0	0.00	0	0.00
Lapeer	61	0.69	3	4.92	0	0.00

Continued

Table 6. Percentage of Adults Tested within County with Blood Lead Levels (BLLs) ≥10 ug/dL and ≥25 ug/dL, Michigan by County of Residence: 2003

	All BLLs		BLLs ≥10 ug/dL		BLLs ≥25 ug/dL	
County	Number	Percent	Number	Percent	Number	Percent
Leelanau	13	0.15	1	7.69	1	7.69
Lenawee	110	1.24	9	8.18	5	4.55
Livingston	127	1.43	5	3.94	2	1.57
Luce	8	0.09	0	0.00	0	0.00
Mackinac	40	0.45	0	0.00	0	0.00
Macomb	450	5.07	41	9.11	6	1.33
Manistee	32	0.36	1	3.13	1	3.13
Marquette	59	0.66	3	5.08	0	0.00
Mason	18	0.20	0	0.00	0	0.00
Mecosta	22	0.25	1	4.55	0	0.00
Menominee	13	0.15	0	0.00	0	0.00
Midland	72	0.81	4	5.56	1	1.39
Missaukee	7	0.08	0	0.00	0	0.00
Monroe	189	2.13	11	5.82	1	0.53
Montcalm	140	1.58	49	35.00	10	7.14
Montmorency	8	0.09	0	0.00	0	0.00
Muskegon	540	6.08	37	6.85	4	0.74
Newaygo	30	0.34	2	6.67	0	0.00
Oakland	593	6.68	42	7.08	7	1.18
Oceana	23	0.26	1	4.35	0	0.00
Ogemaw	10	0.11	0	0.00	0	0.00
Ontonagon	22	0.25	0	0.00	0	0.00
Osceola	17	0.19	0	0.00	0	0.00
Oscoda	5	0.06	0	0.00	0	0.00
Otsego	22	0.25	0	0.00	0	0.00
Ottawa	121	1.36	1	0.83	0	0.00
Presque Isle	7	0.08	1	14.29	0	0.00
Roscommon	27	0.30	3	11.11	1	3.70
Saginaw	118	1.33	11	9.32	1	0.85
Saint Clair	200	2.25	82	41.00	17	8.50
Saint Joseph	39	0.44	1	2.56	1	2.56
Sanilac	31	0.35	5	16.13	1	3.23
Schoolcraft	7	0.08	0	0.00	0	0.00
Shiawassee	78	0.88	13	16.67	1	1.28
Tuscola	32	0.36	1	3.13	0	0.00
Van Buren	72	0.81	6	8.33	1	1.39
Washtenaw	271	3.05	11	4.06	3	1.11
Wayne	2,301	25.93	197	8.56	29	1.26
Wexford	21	0.24	2	9.52	0	0.00
TOTAL	**8,875** *	100.00	**830** **	9.35	**151** ***	1.70

*County was unknown for 3,268 additional adults.

**County was unknown for 137 additional adults.

***County was unknown for 24 additional adults.

Table 7. Annual Incidence of Blood Lead Levels (BLLs) ≥10 ug/dL Among Women in Michigan by County of Residence: 2003

County	Number Reported	Michigan Population Women	Rate per 100,000 women
Alpena	2	12,900	16
Calhoun	1	55,391	2
Clinton	4	24,818	16
Crawford	1	5,597	18
Genesee	1	174,273	1
Ingham	1	116,096	1
Ionia	1	21,357	5
Kalamazoo	1	98,198	1
Kent	6	221,310	3
Macomb	2	320,054	1
Monroe	2	56,520	4
Muskegon	3	65,667	5
Oakland	4	479,049	1
Sanilac	1	17,407	6
Shiawassee	1	28,183	4
Wayne	34	816,907	4
TOTAL	**65 ***	**3,939,649 ****	2 ***

*County was unknown for 3 additional female adults.

**Total number of women in all 83 counties of Michigan age 16+ years; 2000 US. Census population data.

***Rate per 100,000 women, age 16+ years.

Table 8. Annual Incidence of Blood Lead Levels (BLLs) ≥10 ug/dL Among Men in Michigan by County of Residence: 2003

County	Number Reported	Michigan Population Men	Rate per 100,000 Men
Alcona	0	4,897	0
Alger	0	4,432	0
Allegan	2	38,907	5
Alpena	2	11,940	17
Antrim	3	8,967	33
Arenac	0	7,006	0
Baraga	1	3,728	27
Barry	0	21,439	0
Bay	8	41,323	19
Benzie	0	6,221	0
Berrien	15	59,386	25
Branch	1	17,848	6
Calhoun	10	50,858	20
Cass	2	19,607	10
Charlevoix	0	9,844	0
Cheboygan	1	10,312	10
Chippewa	7	17,815	39
Clare	0	12,012	0
Clinton	54	23,906	226
Crawford	1	5,651	18
Delta	2	14,862	13
Dickinson	3	10,324	29
Eaton	5	38,281	13
Emmet	2	11,857	17
Genesee	25	155,127	16
Gladwin	1	10,160	10
Gogebic	0	7,163	0
Grand Traverse	5	28,998	17
Gratiot	23	17,444	132
Hillsdale	0	17,632	0
Houghton	0	15,630	0
Huron	4	13,958	29
Ingham	17	105,117	16
Ionia	35	25,566	137
Iosco	0	10,658	0
Iron	1	5,317	19
Isabella	2	24,492	8
Jackson	3	62,265	5
Kalamazoo	4	89,177	4
Kalkaska	0	6,391	0
Kent	29	208,349	14
Keweenaw	0	1,015	0
Lake	0	4,840	0
Lapeer	3	33,294	9
Leelanau	1	8,199	12
Lenawee	9	37,872	24
Livingston	5	58,520	9
Luce	0	3,267	0
Mackinac	0	4,768	0
Macomb	39	298,569	13
Manistee	1	9,947	10
Marquette	3	26,345	11
Mason	0	10,866	0
Mecosta	1	16,425	6
Menominee	0	9,888	0
Midland	4	30,559	13
Missaukee	0	5,469	0
Monroe	9	54,135	17
Montcalm	49	24,010	204
Montmorency	0	4,149	0
Muskegon	34	62,948	54
Newaygo	2	17,519	11
Oakland	38	446,356	9
Oceana	1	10,111	10
Ogemaw	0	8,454	0
Ontonagon	0	3,260	0
Osceola	0	8,660	0
Oscoda	0	3,668	0
Otsego	0	8,778	0
Ottawa	1	86,189	1
Presque Isle	1	5,854	17
Roscommon	3	10,231	29
Saginaw	11	75,532	15
Saint Clair	82	61,051	134
Saint Joseph	1	23,088	4
Sanilac	4	16,668	24
Schoolcraft	0	3,540	0
Shiawassee	12	26,463	45
Tuscola	1	22,068	5
Van Buren	6	28,019	21
Washtenaw	11	127,697	9
Wayne	163	724,014	23
Wexford	2	11,349	18
TOTAL	**765** *	**3,688,521** **	21 ***

*County was unknown for 134 additional male adults.

**Total number of men in all 83 counties of Michigan age 16+ years; 2000 US. Census population data.

***Rate per 100,000 men, age 16+ years.

Table 9. Source of Exposure Among Adults with BLLs ≥10 ug/dL in Michigan: 2003

Exposure Source Description	Number	Percent
Work-Related	670	86.8
Hobby: Firearms	61	7.9
Remodeling	14	1.8
Hobby: Casting	6	0.8
Hobby: Reloader	4	0.5
Hobby: Unknown	4	0.5
Lead Paint Ingestion	4	0.5
Hobby: Other	2	0.3
Hobby: Stained Glass	2	0.3
Environment	2	0.3
Gun Shot Wound	2	0.3
Hobby: Sinkers	1	0.1
TOTAL	**772 ***	**100.0**

***** Patient interviews were attempted on 453 individuals; no patient interviews were attempted with 319 individuals, instead source was obtained from laboratory reporting form. For 118 additional adults source is pending an interview; for 63 additional adults source is pending medical records review; for 8 additional adults source was inconclusive based on interview; for 6 additional adults source was inconclusive and no patient interview was attempted.

Table 10. Industries Where Individuals with BLLs ≥10 ug/dL Were Exposed to Lead in Michigan: 2003

Industry (SIC Code)*	Work-Exposed Individuals (BLL ≥ 10 ug/dL) Number	Percent
Construction (15-17)	**197**	**32.7**
Painting (17)	190	
Manufacturing (20-39)	**282**	**46.8**
Fabricated and Primary Metals (33-34)	245	
Transportation and Public Utilities (40-49)	**53**	**8.8**
Wholesale and Retail Trade (50-59)	**10**	**1.7**
Services (70-89)	**32**	**5.3**
Automotive Repair Services (75)	14	
Public Administration (91-97)	**28**	**4.7**
Justice, Public Order, Safety (92)	16	
TOTAL	**602**	**100.0**

*Standard Industrial Classification.

Table 11. Inspection Status of Thirty New Companies that were Identified Since the 2002 Annual Analysis from a Blood Lead Report of ≥25 ug/dL in Michigan

Inspection Status	Number	Percent
Completed Inspections	14	46.7
Scheduled for Inspection	13 *	43.3
No Follow-Up Planned	3 **	10.0
TOTAL	**30**	**100.0**

*One inspection was referred to another OSHA state plan for follow up.
**Three facilities had no employees.

Table 12. Results of Fourteen New Companies that were Inspected Since the 2002 Annual Analysis from a Blood Lead Report of ≥25 ug/dL in Michigan

Inspection Results	Number	Percent
Cited for Lead Standard Violation(s) Only	2	14.3
Cited for Lead Standard and Other Violation(s)	6	42.9
Only Cited for Non-Lead Violation(s)	1	7.1
Not Cited for any Violation(s)	5	35.7
TOTAL	**14**	**100.0**

Table 13. Industry Distribution of Fourteen New Companies Inspected Since the 2002 Annual Analysis Resulting from Michigan Adults with Blood Lead Levels (BLLs) of ≥25 ug/dL

Industry (SIC)*	Companies Number	Cited for Violation of Lead Standard Number	Percent
Construction (15-17)			
Construction, Heavy (16)	1	0	--
Special Trade Construction (17)	7	4	57
Services (70-89)			
Automotive Repair Services (75)	3	2	67
Recreation (79)	2	1	50
Government (91-97)			
Police (92)	1	1	100
TOTAL	**14**	**8 ****	**57**

*Standard Industrial Classification

**Six facilities were not cited in violation of the Lead Standard.

Table 14. Average Blood Lead Levels Before and After a MIOSHA Enforcement Inspection in Sixty-Five Companies by Initiating Blood Lead Level, Michigan: 1998 to 2003

Blood Lead Level that Initiated Inspection (ug/dL)	Number of Companies Inspected	Pre-Inspection Blood Lead Average (ug/dL)	Post-Inspection Blood Lead Average (ug/dL)	Difference Post-Pre (ug/dL)
< 30	21	14.1	9.9	4.2*
30-39	19	21.6	13.7	7.9*
40-49	11	28.4	23.5	4.9
≥ 50	14	28.8	21.0	7.8*
All	**65**	**21.9**	**15.8**	**6.7***

*P=<0.05

Table 15. Average Blood Lead Levels Before and After a MIOSHA Enforcement Inspection in Sixty-Five Companies by Whether or not the Initiating Blood Lead Level was Ordered as Part of a Company Medical Screening or by a Personal Health Care Provider, Michigan: 1998 to 2003

	Number of Companies Inspected	Pre-Inspection Blood Lead Average (ug/dL)	Post-Inspection Blood Lead Average (ug/dL)	Difference Post-Pre (ug/dL)
Personal Health Care Provider	23	27.3	19.8	7.9*
Company Medical Screening	42	18.7	13.5	5.2*

*P=<0.05

Table 16. Average Blood Lead Levels Before and After a MIOSHA Enforcement Inspection by All Citations and Lead Citations Only, Michigan: 1998 to 2003

ALL CITATIONS Number of Citations	ALL CITATIONS Number of Companies Inspected	ALL CITATIONS Pre-Inspection Blood Lead Average (ug/dL)	ALL CITATIONS Post-Inspection Blood Lead Average (ug/dL)	ALL CITATIONS Difference Post-Pre (ug/dL)	LEAD CITATIONS Number of Citations	LEAD CITATIONS Number of Companies Inspected	LEAD CITATIONS Pre-Inspection Blood Lead Average (ug/dL)	LEAD CITATIONS Post-Inspection Blood Lead Average (ug/dL)	LEAD CITATIONS Difference Post-Pre (ug/dL)
0	15	15.0	10.3	4.7*	0	18	14.3	10.0	4.3*
≥ 1-7	25	10.0	8.8	1.3*	≥ 1-4	23	10.2	9.0	1.2*
≥ 8-11	12	19.0	16.7	2.2*	≥ 5-10	11	18.7	16.5	2.2*
≥ 12	13	25.6	19.8	5.8*	≥ 11	13	27.3	21.4	5.9*

*P=< 0.05

Table 17. Average Blood Lead Levels Before and After a MIOSHA Enforcement Inspection by All Penalties and Lead Penalties Only, Michigan: 1998 to 2003

ALL PENALTIES Amount of Penalties	ALL PENALTIES Number of Companies Inspected	ALL PENALTIES Pre-Inspection Blood Lead Average (ug/dL)	ALL PENALTIES Post-Inspection Blood Lead Average (ug/dL)	ALL PENALTIES Difference Post-Pre (ug/dL)	LEAD PENALTIES Amount of Penalties	LEAD PENALTIES Number of Companies Inspected	LEAD PENALTIES Pre-Inspection Blood Lead Average (ug/dL)	LEAD PENALTIES Post-Inspection Blood Lead Average (ug/dL)	LEAD PENALTIES Difference Post-Pre (ug/dL)
$0	26	14.5	10.7	3.8*	$0	32	14.0	11.9	2.1*
< $2,700	19	16.0	14.2	1.8*	< $2,700	16	17.7	13.7	3.9*
≥ $2,700-$5,625	10	7.6	6.1	1.5*	≥ $2,700-$5,500	8	7.0	5.5	1.5*
≥ $5,625	10	20.6	18.2	2.4*	≥ $5,500	9	20.6	18.3	2.3*

*P=< 0.05

Table 18. Demographic Characteristics of Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Demographic Characteristics	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Male	299	(89.8)	157	(92.9)	228	(95.0)	69	(93.2)	30	(96.8)	10	(100)	793	(92.5)
Female	34	(10.2)	12	(7.1)	12	(5.0)	5	(6.8)	1	(3.2)	0	--	64	(7.5)
Hispanic Origin	11	(3.6)	6	(3.8)	4	(1.7)	7	(9.9)	1	(3.3)	0	--	29	(3.6)
Caucasian	281	(85.2)	153	(91.1)	209	(87.4)	64	(86.5)	28	(90.3)	7	(70.0)	742	(87.1)
African American	33	(10.0)	7	(4.2)	18	(7.5)	6	(8.1)	3	(9.7)	3	(30.0)	70	(8.2)
Asian/Pacific Islander	1	(0.3)	1	(0.6)	2	(0.8)	0	--	0	--	0	--	4	(0.5)
Native American/Alaskan	2	(0.6)	2	(1.2)	7	(2.9)	0	--	0	--	0	--	11	(1.3)
Other	13	(3.9)	5	(3.0)	3	(1.3)	4	(5.4)	0	--	0	--	25	(2.9)
Average Age	46	n=333	46	n=169	45	n=240	49	n=74	49	n=31	40	n=10	46	n=857
Ever Smoked	205	(63.7)	118	(72.0)	160	(72.7)	51	(75.0)	22	(81.5)	7	(77.8)	563	(69.5)*
Now Smoke	103	(50.0)	66	(55.5)	113	(69.3)	39	(76.5)	18	(81.8)	5	(71.4)	344	(60.6)*

*P= < 0.05 for linear trend.

Table 19. Symptoms of Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Symptoms	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
GASTRO-INTESTINAL														
Lost 10+ lbs without diet	34	(10.5)	12	(7.4)	32	(13.6)	18	(24.7)	6	(20.7)	1	(11.1)	103	(12.4)*
Continued loss of appetite	35	(10.7)	17	(10.2)	36	(15.1)	15	(20.5)	7	(23.3)	2	(20.0)	112	(13.3)*
Pains in belly	64	(19.5)	17	(10.2)	39	(16.6)	21	(28.4)	9	(30.0)	1	(10.0)	151	(17.9)
MUSCULOSKELETAL														
Frequent pain/soreness	122	(37.7)	52	(31.5)	87	(36.9)	40	(55.6)	14	(46.7)	5	(50.0)	320	(38.2)*
Muscle weakness	77	(23.9)	25	(15.2)	47	(20.2)	28	(38.4)	12	(40.0)	5	(50.0)	194	(23.3)*
NERVOUS														
Headaches	54	(16.5)	21	(12.5)	51	(21.4)	22	(29.7)	8	(25.8)	3	(30.0)	159	(18.7)*
Dizziness	30	(9.2)	13	(7.7)	16	(6.8)	12	(16.4)	4	(13.3)	3	(30.0)	78	(9.3)
Depressed	51	(15.7)	18	(11.0)	35	(15.1)	11	(15.3)	10	(32.3)	5	(50.0)	130	(15.6)*
Tired	130	(40.0)	54	(32.3)	116	(49.2)	44	(60.3)	19	(61.3)	6	(60.0)	369	(43.8)*
Nervous	46	(14.2)	17	(10.2)	37	(16.0)	16	(21.6)	10	(33.3)	4	(40.0)	130	(15.6)*
Waking up at night	91	(28.0)	35	(21.0)	81	(34.5)	28	(38.4)	14	(45.2)	4	(44.4)	253	(30.1)*
Nightmares	20	(6.1)	3	(1.8)	10	(4.3)	5	(6.9)	4	(13.3)	2	(20.0)	44	(5.3)
Irritable	70	(21.5)	41	(25.0)	68	(29.1)	27	(37.0)	13	(43.3)	5	(50.0)	224	(26.8)*
Unable to concentrate	54	(16.6)	21	(12.7)	46	(19.4)	13	(18.3)	9	(29.0)	3	(30.0)	146	(17.4)
REPRODUCTIVE														
Unable to have an erection	8	(18.2)	5	(8.2)	10	(8.1)	5	(12.8)	7	(36.8)	0	--	35	(11.9)
Trouble having a child	19	(5.9)	8	(4.9)	10	(4.4)	1	(1.4)	0	--	1	(12.5)	39	(4.8)
Gastro-Intestinal Symptoms	83	(25.2)	29	(17.3)	64	(26.8)	30	(40.5)	14	(45.2)	4	(40.0)	224	(26.3)*
Musculoskeletal Symptoms	134	(41.1)	55	(33.1)	95	(40.3)	44	(60.3)	16	(53.3)	6	(60.0)	350	(41.6)*
Nervous Symptoms	188	(57.3)	83	(49.4)	155	(65.1)	51	(68.9)	23	(74.2)	6	(60.0)	506	(59.6)*
Reproductive Symptoms	23	(37.7)	10	(15.4)	17	(13.3)	4	(10.0)	2	(10.5)	1	(14.3)	57	(17.8)*
Any Symptoms	224	(68.1)	101	(60.1)	163	(68.2)	60	(81.1)	26	(83.9)	7	(70.0)	581	(68.3)*
Average Number Symptoms	2.7	n=329	2.1	n=168	3.0	n=239	4.1	n=74	4.5	n=31	5.0	n=10	2.9	n=851

*P= < 0.05 for linear trend.

Table 20. Lead Related Health Conditions of Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Lead Related Disease	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Anemia	22	(6.9)	4	(2.5)	10	(4.3)	4	(5.7)	2	(6.7)	0	--	42	(5.1)
Kidney Disease	9	(2.8)	1	(0.6)	5	(2.1)	2	(2.7)	1	(3.3)	0	--	18	(2.1)
High Blood Pressure	22	(6.8)	9	(5.4)	27	(11.6)	12	(17.4)	4	(13.8)	1	(11.1)	75	(9.1)*

*P= < 0.05 for linear trend.

Table 21. Industry of Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Industry (SIC Code*)	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Construction, Building (15)	0	--	1	(0.7)	0	--	0	--	0	--	0	--	1	(0.2)
Construction, Heavy (16)	7	(3.3)	1	(0.7)	2	(1.0)	0	--	0	--	0	--	10	(1.5)
Special Trade Construction (17)	71	(33.3)	30	(21.3)	66	(32.7)	24	(40.7)	12	(44.4)	4	(40.0)	207	(31.7)
Lumber and Wood (24)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Furniture and Fixtures (25)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Printing and Publishing (27)	1	(0.5)	0	--	1	(0.5)	0	--	0	--	0	--	2	(0.3)
Stone/Clay/Glass (32)	3	(1.4)	3	(2.1)	4	(2.0)	2	(3.4)	0	--	0	--	12	(1.8)
Primary Metals Industry (33)	15	(7.0)	48	(34.0)	79	(39.1)	20	(33.9)	8	(29.6)	3	(30.0)	173	(26.5)
Fabricated Metal Products (34)	11	(5.2)	15	(10.6)	17	(8.4)	5	(8.5)	0	--	0	--	48	(7.4)
Industrial, Commercial Machinery (35)	5	(2.3)	3	(2.1)	5	(2.5)	1	(1.7)	2	(7.4)	1	(10.0)	17	(2.6)
Electronics (36)	10	(4.7)	1	(0.7)	0	--	0	--	0	--	0	--	11	(1.7)
Transportation Equipment (37)	9	(4.2)	3	(2.1)	3	(1.5)	2	(3.4)	1	(3.7)	0	--	18	(2.8)
Misc. Manufacturing Industries (39)	1	(0.5)	1	(0.7)	0	--	0	--	0	--	0	--	2	(0.3)
Railroad Transportation (40)	1	(0.5)	3	(2.1)	3	(1.5)	0	--	0	--	0	--	7	(1.1)
Motor Freight Trans, Warehousing(42)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Trans., Electric, Gas & San. Svcs. (49)	11	(5.2)	4	(2.8)	2	(1.0)	1	(1.7)	0	--	0	--	18	(2.8)
Wholesale-Durable Goods (50)	3	(1.4)	1	(0.7)	1	(0.5)	0	--	0	--	0	--	5	(0.8)
Building Materials, Hardware (52)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Automotive Dealers, Gas (55)	0	--	3	(2.1)	0	--	0	--	0	--	0	--	3	(0.5)
Other Retail Trade (59)	2	(0.9)	0	--	1	(0.5)	0	--	0	--	0	--	3	(0.5)
Finance, Insurance,Real Estate (65)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Business Services (73)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Automotive Repair Services (75)	10	(4.7)	7	(5.0)	4	(2.0)	4	(6.8)	2	(7.4)	0	--	27	(4.1)
Misc. Repair Services (76)	3	(1.4)	1	(0.7)	3	(1.5)	0	--	0	--	0	--	7	(1.1)
Amusement and Recreation (79)	7	(3.3)	3	(2.1)	2	(1.0)	0	--	2	(7.4)	2	(20.0)	16	(2.5)
Health Services (80)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Educational Services (82)	8	(3.8)	3	(2.1)	1	(0.5)	0	--	0	--	0	--	12	(1.8)
Museum, Art Galleries (84)	1	(0.5)	1	(0.7)	0	--	0	--	0	--	0	--	2	(0.3)
Engineering Services (87)	7	(3.3)	2	(1.4)	2	(1.0)	0	--	0	--	0	--	11	(1.7)
Services, NEC (89)	2	(0.9)	0	--	0	--	0	--	0	--	0	--	2	(0.3)
General Government (91)	1	(0.5)	0	--	0	--	0	--	0	--	0	--	1	(0.2)
Justice, Public Order, Safety (92)	11	(5.2)	6	(4.3)	5	(2.5)	0	--	0	--	0	--	22	(3.4)
Human Resources (94)	0	--	0	--	1	(0.5)	0	--	0	--	0	--	1	(0.2)
Admin Of Economic Programs(96)	4	(1.9)	1	(0.7)	0	--	0	--	0	--	0	--	5	(0.8)
National Security, Int'l Affairs (97)	2	(0.9)	0	--	0	--	0	--	0	--	0	--	2	(0.3)
TOTAL	**213**	**(100)**	**141**	**(100)**	**202**	**(100)**	**59**	**(100)**	**27**	**(100)**	**10**	**(100)**	**652**	**(100)**

*Standard Industrial Classification

Table 22. Number of Years Worked of Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Number of Years Worked	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
≤ 5	120	(53.3)	87	(62.6)	106	(51.5)	34	(56.7)	13	(50.0)	6	(60.0)	366	(55.0)
6 – 10	33	(14.7)	24	(17.3)	33	(16.0)	7	(11.7)	8	(30.8)	2	(20.0)	107	(16.1)
11 – 20	41	(18.2)	19	(13.7)	36	(17.5)	10	(16.7)	3	(11.5)	1	(10.0)	110	(16.5)
21 – 30	22	(9.8)	8	(5.8)	26	(12.6)	2	(3.3)	1	(3.8)	1	(10.0)	60	(9.0)
≥ 31	9	(4.0)	1	(0.7)	5	(2.4)	7	(11.7)	1	(3.8)	0	--	23	(3.5)

Table 23. Working Conditions Reported by Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Working Conditions	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Separate lockers: dirty and clean*	113	(52.6)	99	(71.2)	137	(68.8)	33	(55.9)	17	(60.7)	3	(33.3)	402	(61.9)
Work clothes laundered: work*	82	(38.5)	83	(60.6)	115	(57.2)	27	(45.8)	11	(39.3)	2	(22.2)	320	(49.5)
Shower facility*	114	(53.0)	91	(65.9)	144	(71.6)	29	(48.3)	12	(44.4)	4	(44.4)	394	(60.6)
Lunch room*	141	(64.7)	100	(73.0)	158	(78.6)	34	(56.7)	14	(51.9)	4	(44.4)	451	(69.2)
Clean off dust and wash hands before eating*	204	(93.2)	123	(89.1)	185	(91.1)	50	(86.2)	24	(85.7)	9	(100)	595	(90.8)
Eat in lunchroom*	96	(57.5)	82	(71.9)	106	(61.3)	27	(51.9)	8	(36.4)	3	(37.5)	322	(60.1)
Wear respirator*	133	(60.5)	97	(70.3)	154	(75.5)	47	(79.7)	18	(64.3)	8	(88.9)	457	(69.5)
Smoke in work area**	64	(60.4)	41	(63.1)	69	(62.7)	16	(42.1)	8	(44.4)	4	(80.0)	202	(59.1)
Keep cigarettes in pocket while working**	45	(43.7)	24	(36.4)	51	(46.8)	14	(36.8)	5	(27.8)	3	(60.0)	142	(41.9)
Exposed to Lead now*	120	(56.1)	83	(61.9)	132	(66.3)	31	(56.4)	17	(68.0)	2	(22.2)	385	(60.5)
Removal from job*	16	(7.3)	12	(8.6)	29	(14.3)	15	(25.9)	8	(28.6)	4	(44.4)	84	(12.8)*

*Based on positive questionnaire responses.
**Based on negative questionnaire responses.

Table 24. Number of Households with Children (6 or under) Potentially Exposed to Take-Home Lead from Michigan Adults with Blood Lead Levels (BLLs) of ≥10 μg/dL, Interviewed from 10-15-1997 to 12-31-2003, by Highest Reported Blood Lead Level (μg/dL)

Description of Households	10-24 μg/dL		25-29 μg/dL		30-39 μg/dL		40-49 μg/dL		50-59 μg/dL		≥60 μg/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Households with Children living or spending time in house	92	(28.0)*	48	(28.6)	75	(31.4)	20	(27.4)	11	(35.5)	2	(20.0)	248	(29.2)
Households with Children tested for Lead	26	(31.7)**	8	(17.8)	14	(20.0)	8	(47.1)	4	(36.4)	1	(50.0)	61	(26.9)
Households where Children had elevated Lead levels	12	(52.2)***	1	(14.3)	6	(35.3)	3	(42.9)	1	(33.3)	1	(100)	24	(41.4)

* Among individuals within blood lead category, percentage of their households with children living or spending time in house.

** Among individuals within blood lead category, percentage of households with children living or spending time in house where the children were tested for lead. Because of missing data the denominator may be less than the number with children living or spending time in house in the first row of the table.

*** Among individuals within blood lead category, percentage of households with children living or spending time in house where children, who had blood lead tests, had blood lead levels ≥ 10 μg/dL. Because of missing data, the denominator may be less then the number tested for lead in the second row of the table.

Figure 1. Number of Adults Tested for Blood Lead, Michigan: 1998-2003

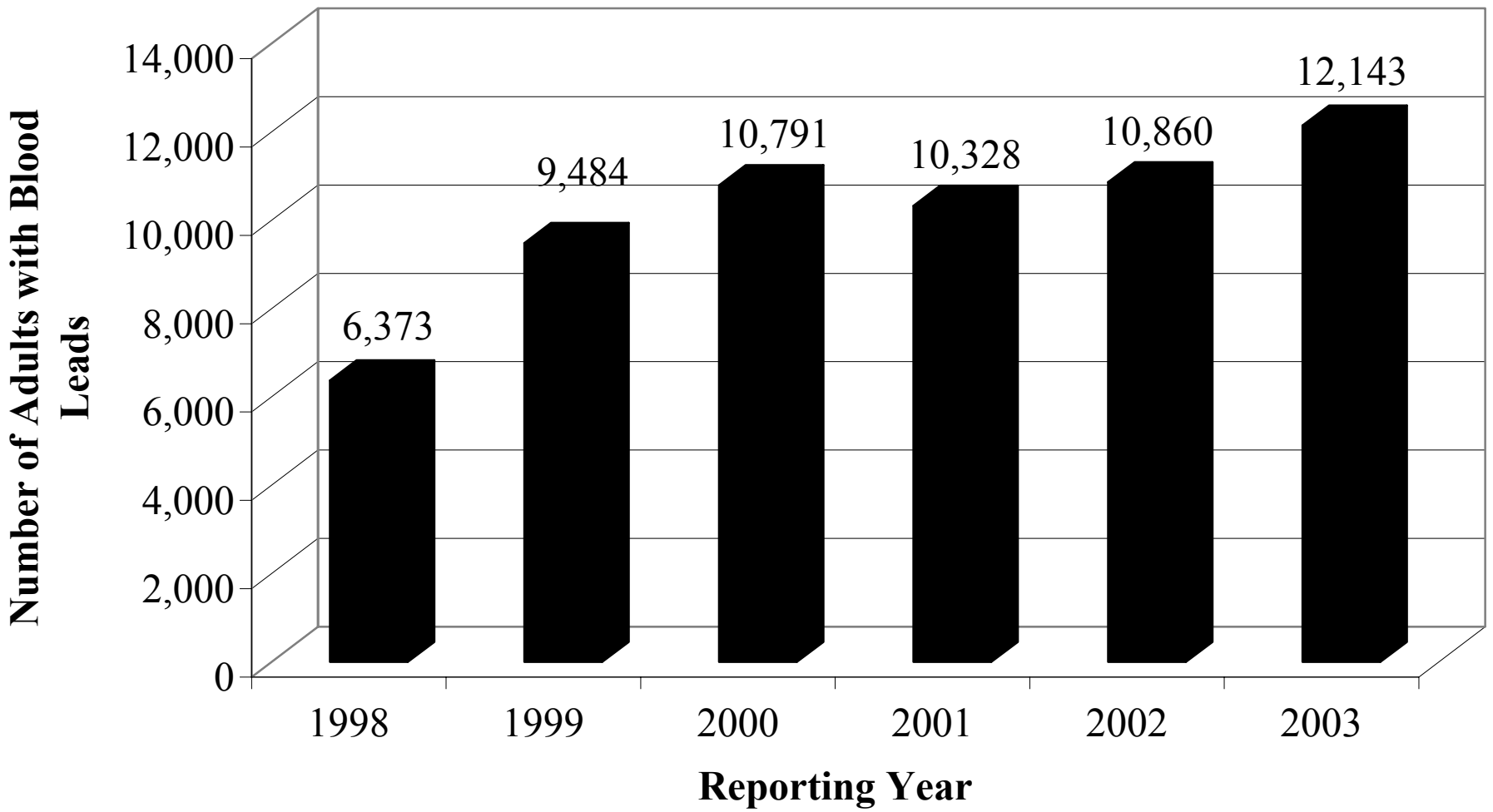


Figure 2. Number of Adults with Blood Lead Levels ≥ 10 ug/dL, ≥ 25 ug/dL and ≥ 50 ug/dL, Michigan: 1998-2003

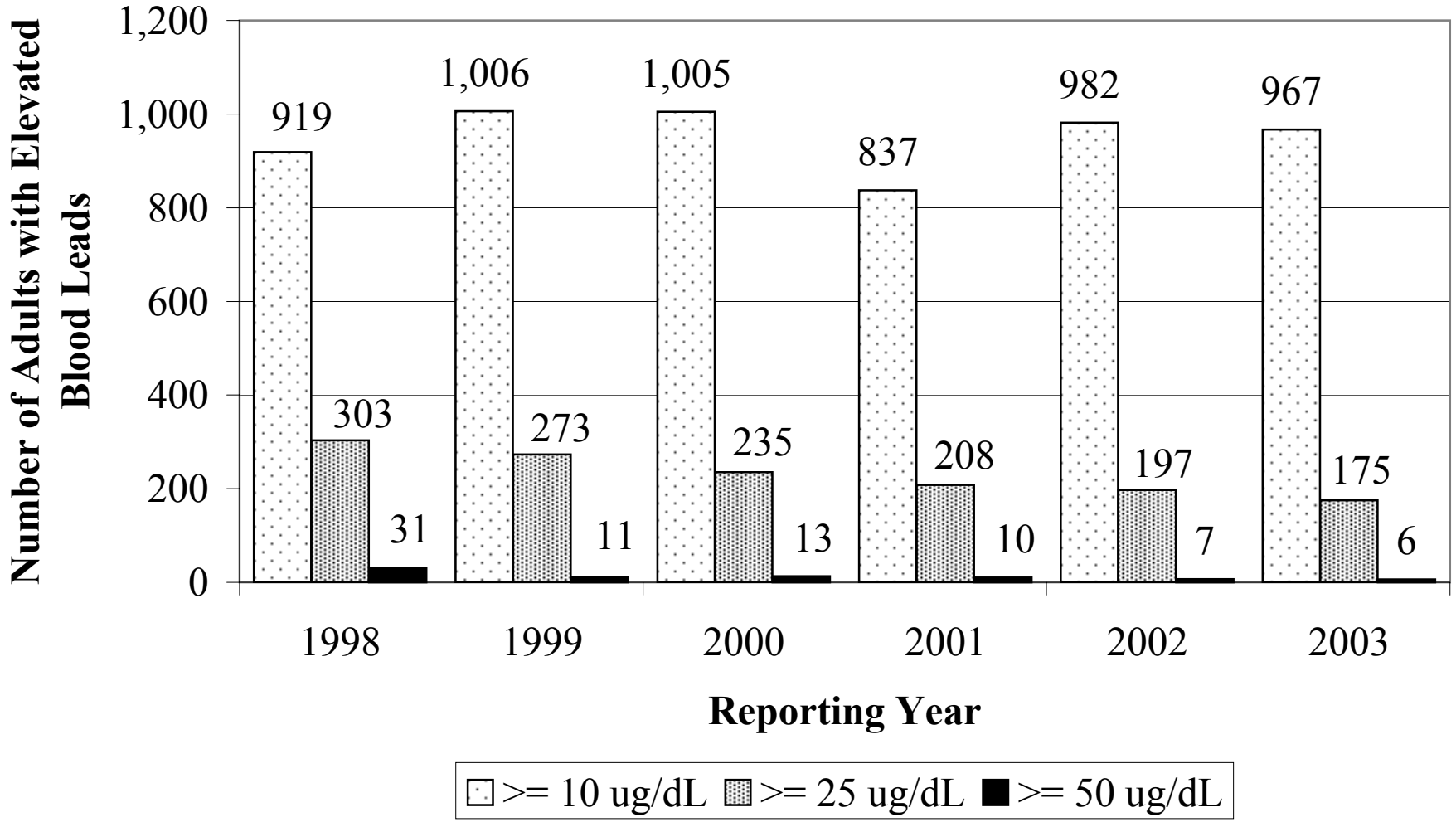
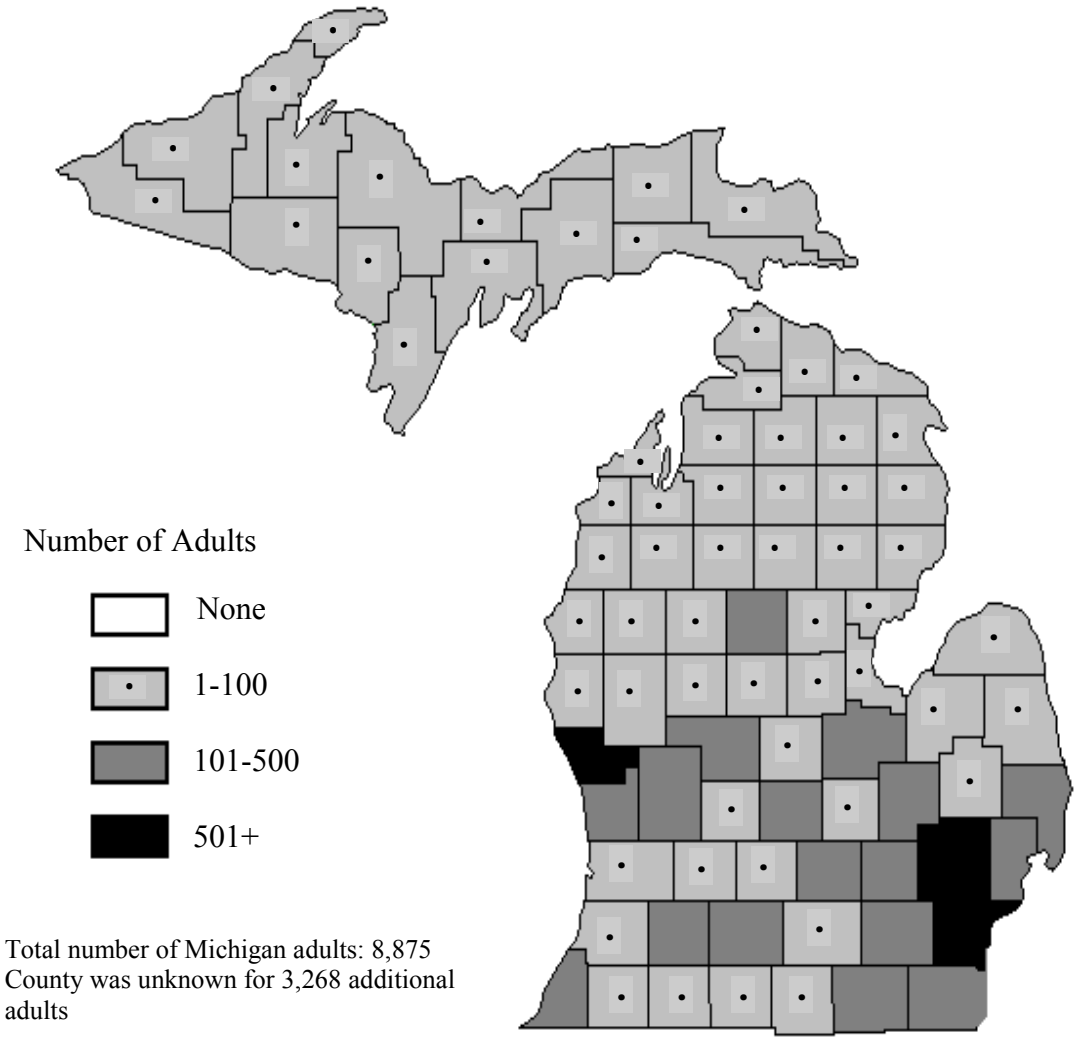


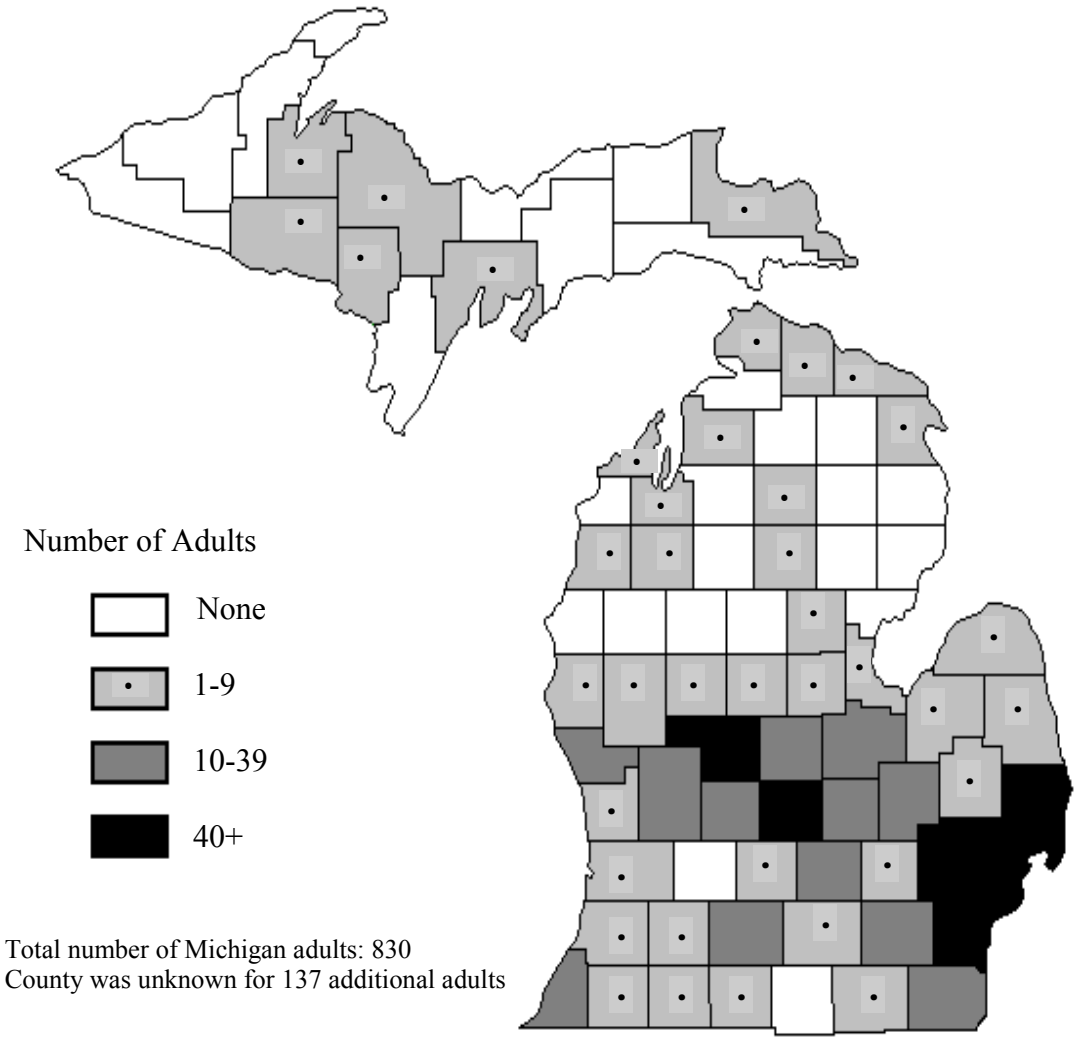
Figure 3. Distribution of Adults Tested for Blood Lead in Michigan by County of Residence: 2003



Total number of Michigan adults: 8,875
County was unknown for 3,268 additional adults

Oakland and **Wayne** counties had the highest number of adults reported, with 593 and 2,301, respectively.

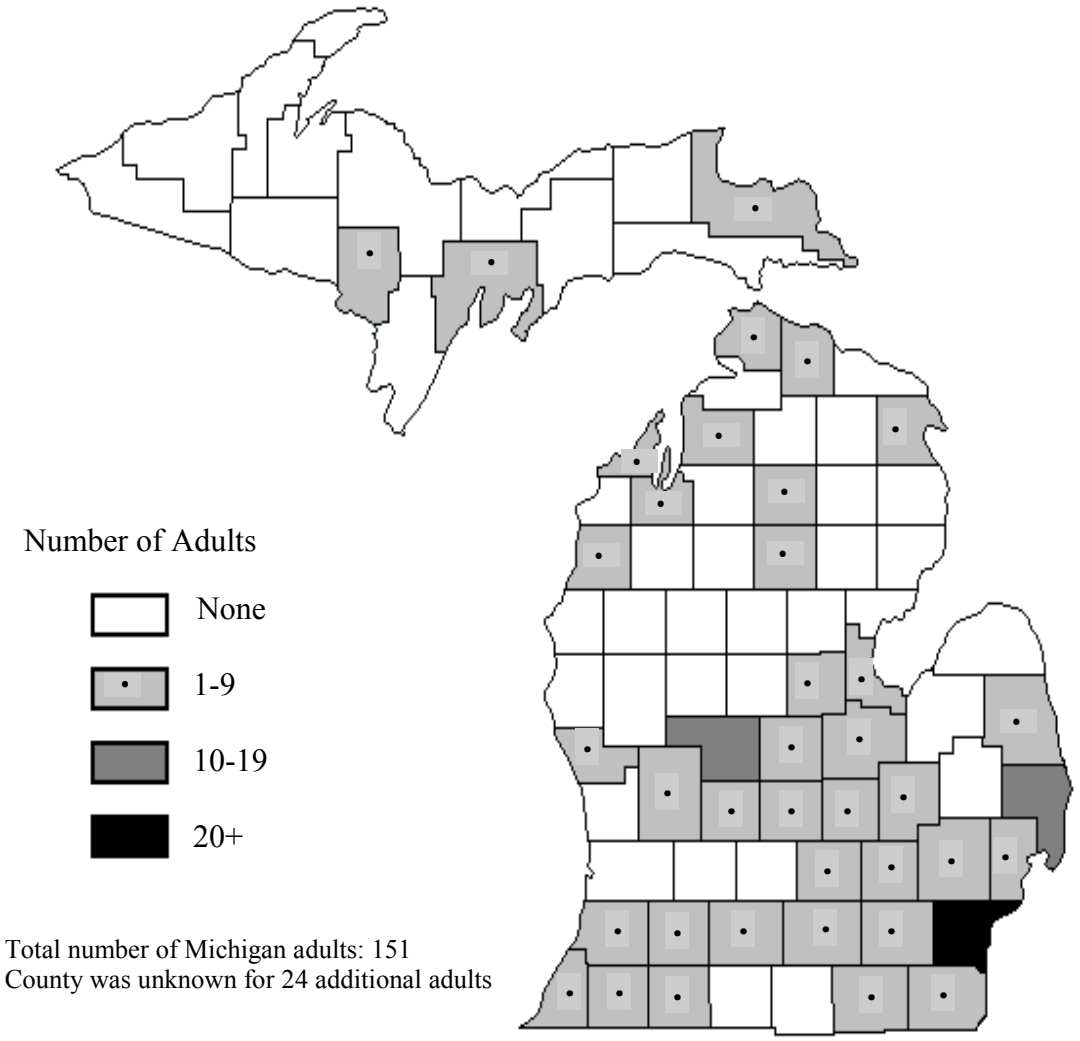
Figure 4. Distribution of Adults with Blood Lead Levels (BLLs) ≥10 ug/dL in Michigan by County of Residence: 2003



Total number of Michigan adults: 830
County was unknown for 137 additional adults

St. Clair and **Wayne** counties had the highest number of adults with blood lead levels of 10 ug/dL or greater reported, with 82 and 197, respectively.

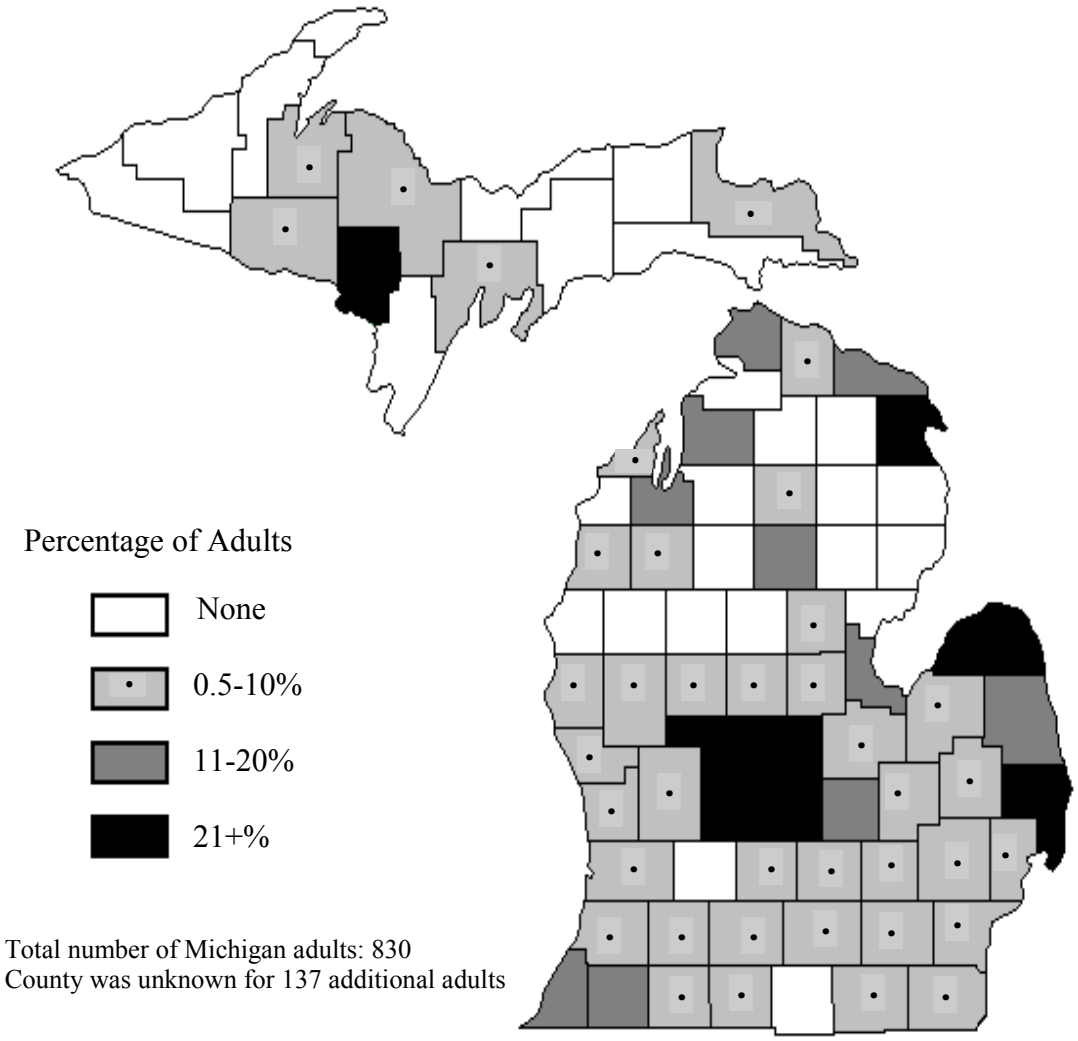
Figure 5. Distribution of Adults with Blood Lead Levels (BLLs) ≥25 ug/dL in Michigan by County of Residence: 2003



Total number of Michigan adults: 151
County was unknown for 24 additional adults

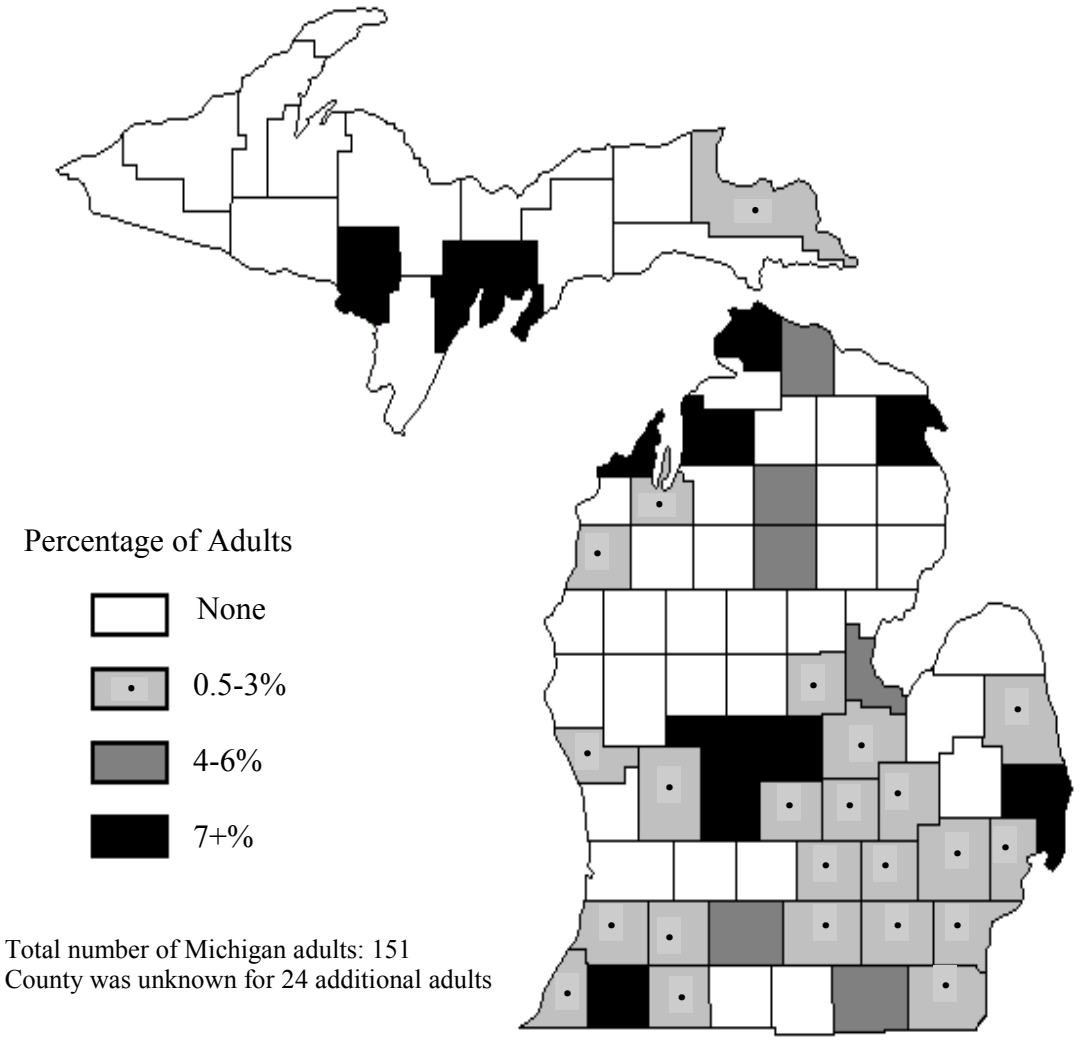
St. Clair and **Wayne** counties had the highest number of adults with blood lead levels of 25 ug/dL or greater reported, with 17 and 29 adults, respectively.

Figure 6. Percentage of Adults with Blood Lead Levels (BLLs) ≥10 ug/dL in Michigan by County of Residence: 2003*



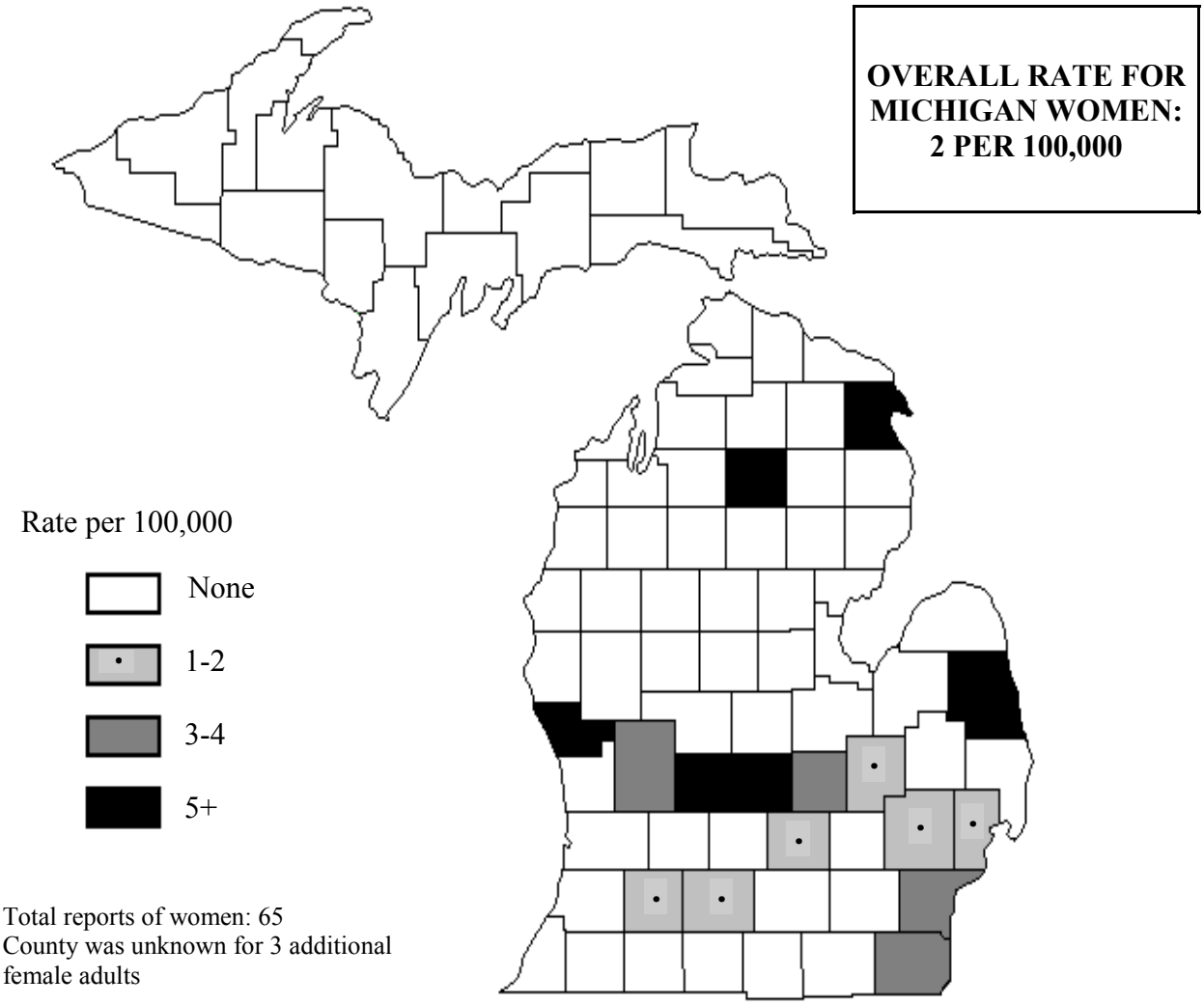
*Denominator used was the total number of adults tested for blood lead within each county.

Figure 7. Percentage of Adults with Blood Lead Levels (BLLs) ≥25 ug/dL in Michigan by County of Residence: 2003*



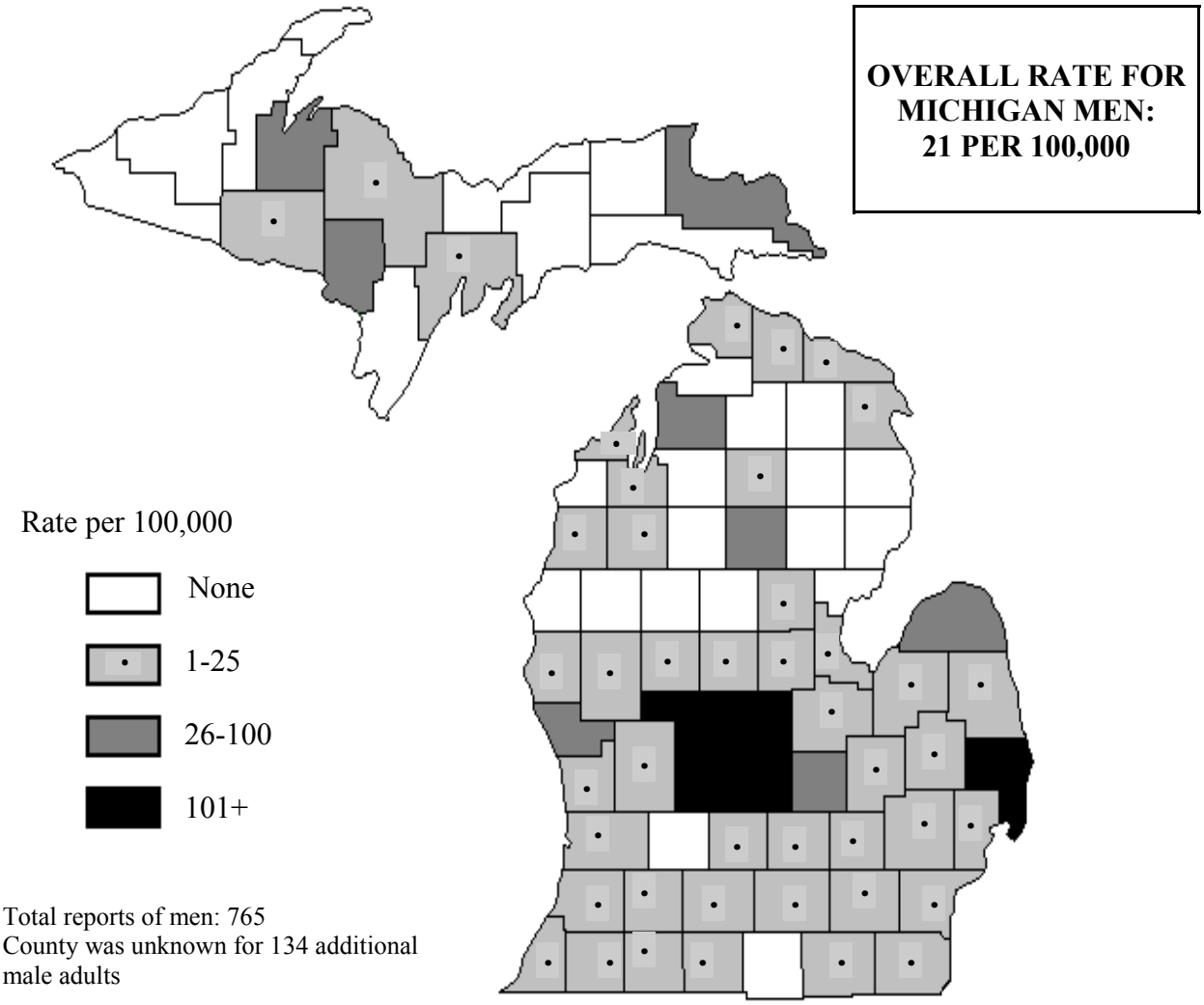
*Denominator used was the total number of adults tested for blood lead within each county.

Figure 8. Annual Incidence of Blood Lead Levels (BLLs) ≥10 ug/dL Among Women in Michigan by County of Residence: 2003*



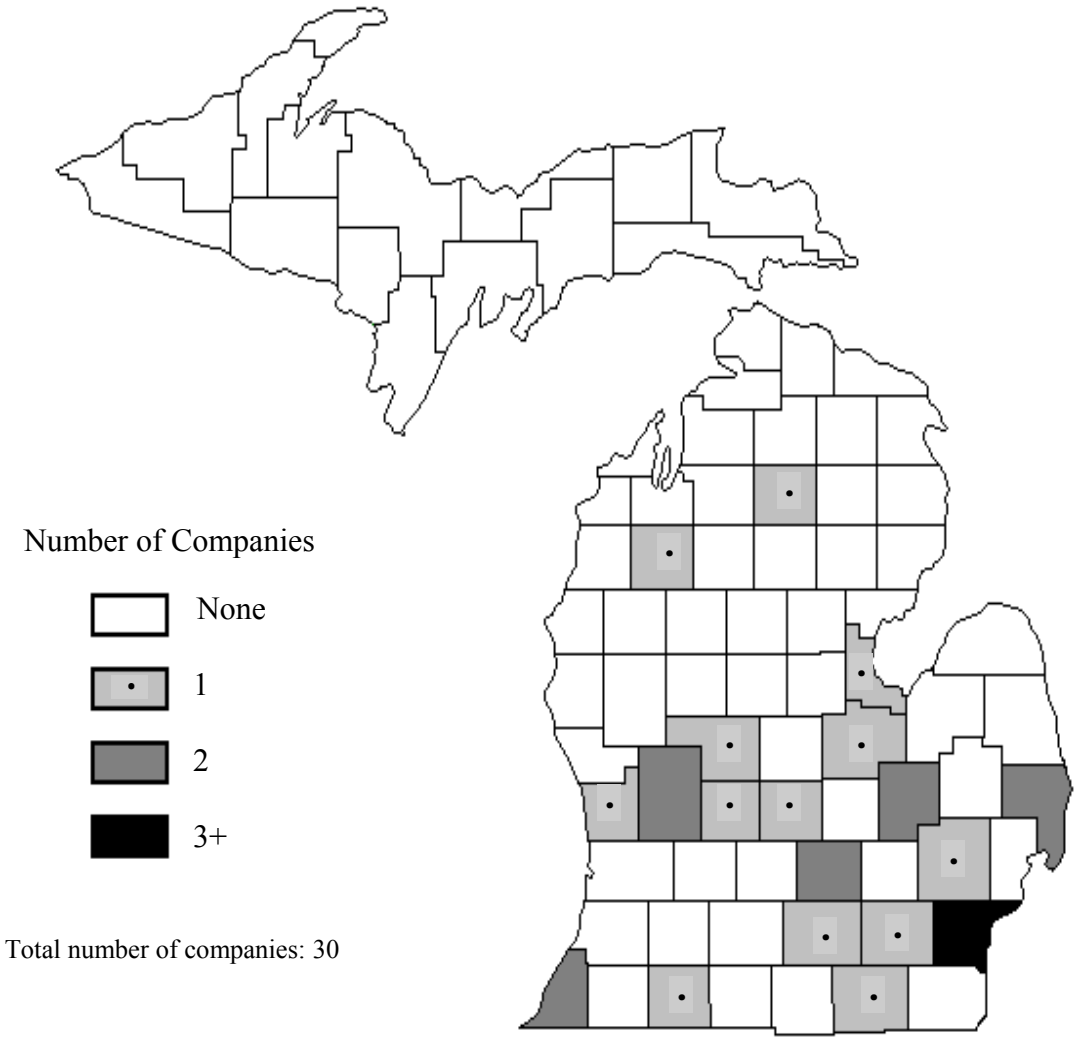
*Rate per 100,000 women age 16+; denominator is the 2000 US. Census population data.

Figure 9. Annual Incidence of Blood Lead Levels (BLLs) ≥10 ug/dL Among Men in Michigan by County of Residence: 2003*



*Rate per 100,000 men age 16+; denominator is the 2000 US. Census population data.

Figure 10. Geographic Distribution of Non-Construction Companies Reporting Adults with Blood Lead Levels (BLLs) ≥25 ug/dL in Michigan: 2003



Part II

Blood Lead Levels Among *Children* in Michigan

Childhood Lead Poisoning Prevention Program
Michigan Department of Community Health
2003 Annual Report

Overview:

The Childhood Lead Poisoning Prevention Program (CLPPP), located in the Michigan Department of Community Health, focuses its activities on children younger than six years of age, their families, their health care providers, and child health advocates in their communities.

The Centers for Disease Control and Prevention (CDC) has provided funding for lead poisoning related activities in Michigan since 1992. The State of Michigan provides a modest amount of funding (from General Funds), and the federal Maternal Child Health Block Grant (Title V) also provides some funding for the program. Michigan continues to be one of the top ten states in the country for numbers of children who are lead poisoned. The primary source of lead exposure for Michigan children is lead-based paint in pre-1978 housing. Deteriorating lead-based paint---flaking, chipping, peeling, or simply dust from multiple coats of paint on impact surfaces---creates an often invisible hazard on windowsills, floors, porches, and in the drip lines around the outside of a home. Soil in driveways and yards adjacent to streets and highways may also be a source of invisible lead exposure.

Young children ingest lead dust through developmentally appropriate hand-to-mouth behaviors. As the central nervous system is undergoing a period of rapid and critical growth in early childhood, and because children (as compared with adults) absorb a greater proportion of the lead that they consume, the effects on a child's nervous system, hearing, vision, cognitive development and behavior can be devastating. For the most part it is also irreversible. Long-term effects of lead poisoning reduce a child's potential in school, work, health and human relationships. Thus long-term effects of lead poisoning impact the whole community.

A statewide surveillance system is the basis for the Statewide Testing/Screening Plan, which is updated by the CLPPP staff and approved by the Lead Advisory Committee annually. Since 1997, the CLPPP has maintained a registry of all children with a Michigan address who have had a blood lead test. Participation in reporting of test results to the registry is mandatory, as required by Michigan Administrative Rules (333.5111 and 325.78 and 330.3101 of the Michigan Compiled Laws). The CLPPP assures that the health care provider for each child tested and the local public health agency for the child's area of residency are notified of test results. Providing professional education and training, current health education materials as well as education for the general public are other CLPPP activities. CLPPP staff continues monitoring policy development (both internal and external to the Department) that potentially affects the lead program, and collaboration with housing authorities, rental property owners and other community groups to provide safe housing for children.

Partners in these efforts include the MDCH Trace Metals Laboratory, local public health departments, and other agencies throughout the state with shared interests: Department of

Education, Department of Labor and Economic Growth, Michigan State Housing Development Authority, Department of Environmental Quality, Family Independence Agency, WIC (Women, Infants and Children food supplement program), Early On, Head Start and Early Head Start.

CLPPP also provides funding to nine regions, or clusters of local health departments, with a Regional Coordinator identified in each. This represents a new strategy to accomplish three program goals: 1) to increase blood lead testing, with particular emphasis on eleven targeted communities; 2) to assure that case management occurs for all children with venous blood lead levels $\geq$ 20µg/dL; and 3) to encourage and promote primary prevention (of childhood lead poisoning), with emphasis, once again, on reaching families in pre-1978 housing where young children or pregnant women reside in eleven targeted communities. The Regional Coordinator will develop local relationships and offer professional information and technical support to the lead contact person in each health department in her/his region. In collaboration with that individual and the health department leadership, planning for increasing testing, case management and primary prevention activities in that county will take place. The Regional Coordinator will provide oversight for case management and care coordination; responsibility for service, however, will still belong to the local health department. If the community has the political will to develop a community coalition around the issue of lead poisoning/child health, the Coordinator may provide assistance in beginning that project. Approximately half of the nine Regional Coordinators are also certified Lead Inspector/Risk Assessors; in counties where no certified inspector exists, the Coordinator may also complete a lead inspection when a child with lead poisoning is identified.

The federal Centers for Medicare and Medicaid Services (CMS) requires blood lead testing of **all** Medicaid-eligible children at the ages of one and two years. That federal requirement cannot be waived. If a Medicaid-eligible child is between the ages of three and six years and has never had a blood lead test, he/she is required to have at least one test during those years. The CDC, utilizing data collected in the national Childhood Blood Lead Surveillance System, has reported that more than 80% of children with blood lead levels equal to or greater than 20µg/dL are Medicaid-eligible children. Of all children who are Medicaid eligible, more than half of them are lead-poisoned.

2003:

During the year ending December 31, 2003, over 100,000 children in Michigan received blood lead tests. This represents an increase in testing of more than 8,000 children (as compared with 2002); nonetheless that testing number accounts for only 12% of Michigan children younger than age six years. To put this number in perspective: approximately half of Michigan children are Medicaid-eligible/enrolled, and the federal Centers for Medicare and Medicaid requires that all of their insured be tested at the ages of one and two years. The undertesting performance of health care providers is very apparent. Increasing testing numbers, especially in "target" communities, remains one of CLPPP's primary goals.

Reviewing the testing of children younger than age six years, the number of children tested was 100,181, or 12% of the 814,505 children (2000 census). Among these children, there were 3,141 with elevated blood lead levels; this is an EBLL rate (≥ 10µg/dL), for the state of Michigan, of 3.2%. (National EBLL rate is now 2.2%.)

While children younger than six years of age are CLPPP's focus, special emphasis is placed on testing appropriate children at the ages of one and two years, when creeping and hand-to-mouth behaviors begin, and then peak. Slightly more than (51,450) half of children tested in 2003 were in that age group. This number represents 19% of one and two year olds. Among this cohort, 1,687 children had elevated blood lead levels (≥10µg/dL). This yields an elevated blood lead level (EBLL) rate of 3.3%.

The number of children with dangerously high blood lead levels (≥ 40µg/dL) in 2003 was 51; of those children, 33 had BLLs ≥ 45µg/dL. Children with blood lead levels in this range require hospital treatment, often numerous times, to even begin to lower their BLLs. Except in the situation of a single, near-catastrophic, exposure to lead (e.g., child drinks pottery glaze), children with BLLs in this range have had chronic, low level exposure to a lead source over a lengthy period of time. Reducing the child's BLL is a process that takes place over a year or more. The damage is irreversible.

MDCH CLPPP, along with their colleagues in Medical Services Administration (Medicaid), closely monitor provider compliance with testing requirements. Each of the Medicaid managed care plans receives a quarterly report from MSA identifying children in their respective plan who have been tested and those children who are in the age-appropriate group requiring blood lead testing.

The 2003 change in Medicaid policy requiring local public health agencies in which children were blood lead tested to bill the qualified health plans ("Medicaid Managed-Care Organizations") directly was a disincentive to test in the health departments. They typically do not have sophisticated billing systems; in some local public health agencies, there are prohibitions against "contracting" with other "businesses."

Fortunately, Medicaid recognized the hindrance and, realizing that our shared goal is "no missed opportunities" (for testing), and that they could actually facilitate testing by local public health agencies, developed a new policy allowing the health departments to bill Medicaid directly when tests are provided (as opposed to billing the health plans). The new policy became effective on January 1, 2004.

During 2003, MDCH CLPPP:

- Provided staff support for the Governor's Task Force on Elimination of Childhood Lead Poisoning.

In January 2003, the Detroit Free Press published a five day investigative report on childhood lead poisoning in Michigan as part of their "Children First" campaign. Throughout the year they have kept the issue in the public awareness by reporting updates and various perspectives on the issue. Governor Granholm's first State of the State address to the Legislature and the citizens of Michigan referenced the scope of the problem in this state, and her goal of eliminating childhood lead poisoning by 2010. Intensive background work for the Task Force was completed by the CLPPP staff, including materials development, stakeholder identification, subcommittee structure, membership and anticipated outcomes, meeting preparation and note taking, and all the other components of a major state governmental project. There were more than seventy participants in the Task Force, and over eighty individuals working on six subcommittees. (Subcommittees: Compliance, Education and Outreach, Funding, Health, Housing, Legislation and Policy)

- The results of the Task Force's effort: a set of priority recommendations for the Governor ("Advising the Budget Process") to be used in budget development for 2005-2006 budget year; and a full report, with over one hundred strategies and recommendations identified, to be released by the Governor in February, 2004.

- Implemented the Regional Coordinator concept, with responsible persons identified in each of nine regions to assist groups of local health departments to develop strategies and plans to increase blood lead testing for children in their catchment areas, to provide primary prevention activities in target areas, and to assure that children with blood lead levels $\geq$ 20µg/dL receive all of the services needed to manage their lead poisoning.

- Reviewed the collaborative work product of Michigan State University and the Department of Community Health designed to identify data which provides the best predictor that any given child could be lead poisoned. This project was funded by the Centers for Disease Control and Prevention (CDC). The findings of this project will be reviewed with the Lead Advisory Committee for a planned modification of the Statewide Testing/Screening Plan in March, 2004.

- Wrote and submitted a grant proposal, and received funding through the CDC, for continued childhood lead poisoning related activities in the state. This first year of the new grant cycle has been devoted to the development of an Elimination Plan, supporting the federal and state goal of eliminating childhood lead poisoning in Michigan and in the U.S. by 2010. The work of the Governor's Task Force will provide the basis for our strategic plan. The final report will be available online at www.michigan.gov shortly after the Governor releases it to the public. A background document, "Childhood Lead Poisoning Prevention: A Call to Action" is currently available for review at the same web address.

- Observed a modest increase in number of children lead-tested, as reported to our registry. In some areas of the state, providers have implemented the use of alternate collection and/or testing strategies to make testing accessible to the children/families in their

practices. Use of a microanalyzer (LeadCare machine), as well as utilizing filter paper for collection with atomic furnace for analysis are alternatives that are in practice. Regardless, all blood lead tests completed on an individual with a Michigan address are reported to the lead registry.

There are 16,000 children in Michigan whose blood lead level (5-9µg/dL) indicates that an exposure to lead has taken place, but the blood lead level is not yet at the CDC's "level of concern." This number identifies that we have an appropriate opportunity for early intervention/primary prevention of childhood lead poisoning on a very large scale. When both environmental and health information are given to the affected family, exposure can be controlled and/or eliminated before the child's blood lead level reaches the level of concern.

There is new and ongoing research, published or released in 2003, indicating that blood lead levels less than 10 µg/dL have a measurable impact on the IQ of a child. These findings (and the research is ongoing) reinforce the assertion that there is NO "safe" blood lead level for children.

In Summary, the main focus areas for the Childhood Lead Poisoning Prevention Program at the State of Michigan in the 2004-2005 grant year will be:

- Increase numbers of children tested, at the appropriate ages, and particularly in the "target communities;"
- Provide primary prevention outreach for children younger than six years of age, and for pregnant women; and
- Assure that comprehensive case management for children with BLLs $\geq$ 20µg/dL takes place throughout the state.

Table 1. CHILDHOOD LEAD POISONING DATA FACTS -- ALL MICHIGAN COUNTIES

Children Ages One & Two - Calendar Year 2003

County	%Pre-1950 Housing*	Children Ages 1 & 2*	Children Ages 1 & 2, Tested for Lead: Number of Children Tested	Children Ages 1 & 2, Tested for Lead: % Tested	Children w/confirmed elevated blood lead levels (EBLL): Number of Children w/EBLL	Children w/confirmed elevated blood lead levels (EBLL): % EBLL**	Children w/confirmed elevated blood lead levels (EBLL): 10-14 ug/dL	Children w/confirmed elevated blood lead levels (EBLL): 15-19 ug/dL	Children w/confirmed elevated blood lead levels (EBLL): 20+ ug/dL	Children w/elevated capillary tests, not confirmed by venous
Alcona	21%	224	29	13%	0	0.0%	0	0	0	0
Alger	33%	166	66	40%	0	0.0%	0	0	0	1
Allegan	27%	2,978	336	11%	5	1.5%	3	0	2	2
Alpena	29%	687	149	22%	3	2.0%	2	1	0	1
Antrim	23%	533	31	6%	1	3.2%	1	0	0	0
Arenac	21%	348	70	20%	0	0.0%	0	0	0	0
Baraga	35%	210	50	24%	0	0.0%	0	0	0	0
Barry	29%	1,475	363	25%	2	0.6%	1	0	1	2
Bay	37%	2,690	519	19%	9	1.7%	4	2	3	2
Benzie	27%	408	19	5%	0	0.0%	0	0	0	0
Berrien	33%	4,169	882	21%	41	4.7%	24	13	4	3
Branch	37%	1,158	130	11%	1	0.8%	0	0	1	0
Calhoun	36%	3,534	774	22%	21	2.7%	15	5	1	2
Cass	30%	1,212	164	14%	0	0.0%	0	0	0	0
Charlevoix	26%	676	24	4%	0	0.0%	0	0	0	0
Cheboygan	22%	638	11	2%	0	0.0%	0	0	0	0
Chippewa	28%	819	176	21%	0	0.0%	0	0	0	2
Clare	13%	742	76	10%	0	0.0%	0	0	0	0
Clinton	29%	1,755	112	6%	2	1.8%	2	0	0	0
Crawford	20%	295	26	9%	0	0.0%	0	0	0	0
Delta	38%	841	328	39%	2	0.6%	1	1	0	3
Dickinson	42%	598	86	14%	0	0.0%	0	0	0	0
Eaton	23%	2,558	625	24%	0	0.0%	0	0	0	3
Emmet	28%	756	11	1%	0	0.0%	0	0	0	0
Genesee	23%	12,624	2,155	17%	28	1.3%	16	9	3	0
Gladwin	14%	555	41	7%	1	2.4%	1	0	0	0
Gogebic	54%	294	35	12%	0	0.0%	0	0	0	0
Grand Trav	18%	1,908	44	2%	1	2.3%	1	0	0	0
Gratiot	40%	1,000	92	9%	0	0.0%	0	0	0	0
Hillsdale	39%	1,209	187	15%	2	1.1%	1	0	1	0
Houghton	55%	776	149	19%	2	1.4%	0	2	0	1
Huron	33%	793	102	13%	1	1.0%	0	1	0	1
Ingham	26%	7,137	1,074	15%	14	1.3%	7	4	3	11
Ionia	38%	1,704	246	14%	1	0.4%	1	0	0	2
Iosco	20%	535	59	11%	0	0.0%	0	0	0	0
Iron	44%	225	27	12%	0	0.0%	0	0	0	0
Isabella	19%	1,321	114	9%	0	0.0%	0	0	0	0
Jackson	36%	4,112	364	9%	10	2.8%	8	0	2	1
Kalamazoo	25%	6,175	927	15%	23	2.5%	13	5	5	2
Kalkaska	15%	408	37	9%	1	2.7%	1	0	0	0
Kent	27%	17,768	6,517	37%	211	3.3%	129	40	42	137
Keweenaw	55%	39	10	26%	0	0.0%	0	0	0	0
Lake	15%	250	40	16%	0	0.0%	0	0	0	0
Lapeer	22%	2,356	152	6%	1	0.7%	0	0	1	0
Leelanau	22%	430	9	2%	0	0.0%	0	0	0	0
Lenawee	39%	2,420	321	13%	14	4.4%	8	3	3	0
Livingston	14%	4,482	89	2%	0	0.0%	0	0	0	0
Luce	30%	135	46	34%	0	0.0%	0	0	0	0
Mackinac	28%	205	84	41%	0	0.0%	0	0	0	0
Macomb	11%	20,271	2,795	14%	14	0.5%	13	0	1	0
Manistee	36%	532	67	13%	0	0.0%	0	0	0	0
Marquette	33%	1,307	161	12%	3	1.9%	3	0	0	0
Mason	31%	619	76	12%	0	0.0%	0	0	0	0
Mecosta	22%	981	219	22%	0	0.0%	0	0	0	0
Menominee	38%	603	172	29%	0	0.0%	0	0	0	1
Midland	17%	2,167	134	6%	0	0.0%	0	0	0	0
Missaukee	21%	380	22	6%	0	0.0%	0	0	0	0
Monroe	28%	3,898	751	19%	4	0.5%	4	0	0	0
Montcalm	28%	1,601	235	15%	0	0.0%	0	0	0	0
Montmorency	18%	192	21	11%	0	0.0%	0	0	0	0
Muskegon	30%	4,670	1,273	27%	41	3.2%	26	9	6	1
Newaygo	23%	1,336	275	21%	0	0.0%	0	0	0	0
Oakland	16%	31,861	3,795	12%	32	0.8%	23	5	4	1
Oceana	27%	697	191	27%	1	0.5%	0	0	1	2
Ogemaw	18%	432	35	8%	0	0.0%	0	0	0	0
Ontonagon	43%	125	13	10%	0	0.0%	0	0	0	0
Osceola	24%	604	98	16%	0	0.0%	0	0	0	0
Oscoda	18%	190	20	11%	0	0.0%	0	0	0	0
Otsego	13%	586	6	1%	0	0.0%	0	0	0	0
Ottawa	18%	7,321	756	10%	12	1.6%	8	4	0	5
Presque Isle	28%	277	27	10%	1	3.8%	1	0	0	1
Roscommon	16%	447	22	5%	0	0.0%	0	0	0	0
Saginaw	29%	5,709	1,052	18%	30	2.9%	16	8	6	4
St Clair	30%	4,355	516	12%	5	1.0%	4	1	0	2
St Joseph	35%	1,727	269	16%	6	2.2%	5	0	1	0
Sanilac	35%	1,165	121	10%	0	0.0%	0	0	0	0
Schoolcraft	33%	215	85	40%	0	0.0%	0	0	0	2
Shiawassee	36%	1,939	238	12%	1	0.4%	0	0	1	0
Tuscola	33%	1,410	138	10%	1	0.7%	1	0	0	0
Van Buren	29%	2,047	366	18%	6	1.6%	2	2	2	1
Washtenaw	19%	8,086	503	6%	2	0.4%	1	0	1	0
Wayne ex Det	24%	30,284	4,374	14%	78	1.8%	42	16	20	20
Wexford	26%	740	42	6%	0	0.0%	0	0	0	1
Detroit, City of	56%	30,307	14,604	48%	1,053	7.3%	612	238	203	213
MICHIGAN	27%	267,412	51,450	19%	1,687	3.3%	1,000	369	318	430

* U.S. Census Bureau, Census 2000

** %EBLL is calculated as follows: Number of Children w/EBLL divided by (Number of Children Tested minus Children w/elevated capillary tests, not confirmed by venous)

Note: Counts of children tested and blood lead levels are reported from Michigan Department of Community Health, Childhood Lead Poisoning Prevention Project statewide database.

Note: Column for "Children Tested" reflects capillary and venous blood tests. Columns for "Children w/confirmed elevated blood lead levels" reflect venous tests only.

February 23, 2004 (corrected)

Table 2. CHILDHOOD LEAD POISONING DATA FACTS -- ALL MICHIGAN COUNTIES

Children Age < Six Years - Calendar Year 2003

			Children < Age 6, Tested for Lead		Children w/confirmed elevated blood lead levels (EBLL)					Children w/elevated capillary tests, not confirmed by venous
County	%Pre-1950 Housing*	Children Under Age 6*	Number of Children Tested	% Tested	Number of Children w/EBLL	% EBLL**	10-14 ug/dL	15-19 ug/dL	20+ ug/dL	
Alcona	21%	630	53	8%	1	1.9%	1	0	0	0
Alger	33%	562	88	16%	0	0.0%	0	0	0	1
Allegan	27%	9,272	714	8%	9	1.3%	5	2	2	4
Alpena	29%	2,118	216	10%	2	0.9%	2	0	0	2
Antrim	23%	1,625	78	5%	0	0.0%	0	0	0	1
Arenac	21%	1,124	139	12%	0	0.0%	0	0	0	0
Baraga	35%	590	140	24%	1	0.7%	0	0	1	0
Barry	29%	4,606	561	12%	3	0.5%	2	0	1	2
Bay	37%	8,126	767	9%	13	1.7%	7	2	4	3
Benzie	27%	1,135	40	4%	1	2.5%	1	0	0	0
Berrien	33%	12,820	1,870	15%	75	4.0%	44	24	7	4
Branch	37%	3,484	241	7%	2	0.8%	1	0	1	0
Calhoun	36%	10,945	1,472	13%	44	3.0%	31	8	5	3
Cass	30%	3,818	325	9%	6	1.9%	3	1	2	2
Charlevoix	26%	2,052	47	2%	0	0.0%	0	0	0	0
Cheboygan	22%	1,893	48	3%	0	0.0%	0	0	0	0
Chippewa	28%	2,500	335	13%	1	0.3%	1	0	0	2
Clare	13%	2,236	177	8%	0	0.0%	0	0	0	0
Clinton	29%	5,436	216	4%	2	0.9%	2	0	0	0
Crawford	20%	949	36	4%	0	0.0%	0	0	0	0
Delta	38%	2,530	412	16%	4	1.0%	1	1	2	3
Dickinson	42%	1,871	138	7%	0	0.0%	0	0	0	0
Eaton	23%	7,980	887	11%	0	0.0%	0	0	0	3
Emmet	28%	2,366	52	2%	1	1.9%	1	0	0	0
Genesee	23%	38,236	4,115	11%	56	1.4%	30	13	13	3
Gladwin	14%	1,733	107	6%	2	1.9%	2	0	0	0
Gogebic	54%	973	91	9%	0	0.0%	0	0	0	0
Grand Trav	18%	5,733	190	3%	2	1.1%	2	0	0	0
Gratiot	40%	3,012	166	6%	0	0.0%	0	0	0	0
Hillsdale	39%	3,628	337	9%	3	0.9%	2	0	1	0
Houghton	55%	2,348	314	13%	2	0.6%	0	2	0	3
Huron	33%	2,447	223	9%	1	0.5%	0	1	0	1
Ingham	26%	21,259	2,053	10%	29	1.4%	17	9	3	16
Ionia	38%	5,111	453	9%	1	0.2%	1	0	0	4
Iosco	20%	1,577	147	9%	0	0.0%	0	0	0	1
Iron	44%	677	39	6%	0	0.0%	0	0	0	0
Isabella	19%	3,945	226	6%	0	0.0%	0	0	0	0
Jackson	36%	12,586	600	5%	21	3.5%	15	2	4	1
Kalamazoo	25%	18,597	1,541	8%	37	2.4%	23	7	7	3
Kalkaska	15%	1,306	83	6%	2	2.4%	2	0	0	0
Kent	27%	53,436	10,174	19%	304	3.0%	179	61	64	206
Keweenaw	55%	127	19	15%	0	0.0%	0	0	0	0
Lake	15%	718	113	16%	0	0.0%	0	0	0	0
Lapeer	22%	7,217	305	4%	1	0.3%	0	0	1	0
Leelanau	22%	1,328	33	2%	0	0.0%	0	0	0	0
Lenawee	39%	7,564	495	7%	18	3.6%	12	3	3	0
Livingston	14%	13,800	285	2%	0	0.0%	0	0	0	0
Luce	30%	438	76	17%	0	0.0%	0	0	0	0
Mackinac	28%	708	120	17%	0	0.0%	0	0	0	0
Macomb	11%	61,805	4,602	7%	24	0.5%	21	1	2	1
Manistee	36%	1,616	151	9%	1	0.7%	1	0	0	0
Marquette	33%	3,985	256	6%	3	1.2%	3	0	0	1
Mason	31%	1,902	125	7%	0	0.0%	0	0	0	0
Mecosta	22%	2,892	338	12%	2	0.6%	1	0	1	0
Menominee	38%	1,783	241	14%	0	0.0%	0	0	0	2
Midland	17%	6,572	251	4%	0	0.0%	0	0	0	0
Missaukee	21%	1,143	65	6%	0	0.0%	0	0	0	0
Monroe	28%	11,757	1,208	10%	5	0.4%	5	0	0	0
Montcalm	28%	4,888	336	7%	0	0.0%	0	0	0	0
Montmorency	18%	544	37	7%	0	0.0%	0	0	0	0
Muskegon	30%	14,215	2,560	18%	76	3.0%	51	14	11	2
Newaygo	23%	4,014	478	12%	2	0.4%	2	0	0	0
Oakland	16%	97,281	7,128	7%	57	0.8%	41	11	5	2
Oceana	27%	2,092	430	21%	1	0.2%	0	0	1	5
Ogemaw	18%	1,384	79	6%	0	0.0%	0	0	0	0
Ontonagon	43%	419	42	10%	0	0.0%	0	0	0	0
Osceola	24%	1,754	164	9%	0	0.0%	0	0	0	0
Oscoda	18%	608	37	6%	0	0.0%	0	0	0	0
Otsego	13%	1,759	26	1%	0	0.0%	0	0	0	0
Ottawa	18%	21,940	1,199	5%	14	1.2%	10	4	0	10
Presque Isle	28%	832	51	6%	1	2.0%	1	0	0	1
Roscommon	16%	1,368	57	4%	0	0.0%	0	0	0	0
Saginaw	29%	17,275	2,153	12%	59	2.8%	37	14	8	12
St Clair	30%	13,360	969	7%	10	1.0%	5	2	3	2
St Joseph	35%	5,389	613	11%	11	1.8%	10	0	1	1
Sanilac	35%	3,506	294	8%	1	0.3%	0	1	0	0
Schoolcraft	33%	615	105	17%	0	0.0%	0	0	0	2
Shiawassee	36%	5,914	541	9%	3	0.6%	2	0	1	0
Tuscola	33%	4,310	309	7%	1	0.3%	1	0	0	0
Van Buren	29%	6,243	708	11%	8	1.1%	4	2	2	5
Washtenaw	19%	24,173	977	4%	6	0.6%	5	0	1	0
Wayne ex Det	24%	92,253	9,479	10%	158	1.7%	99	31	28	29
Wexford	26%	2,377	117	5%	0	0.0%	0	0	0	1
Detroit, City of	56%	93,365	32,698	35%	2,054	6.4%	1,266	440	348	403
MICHIGAN	27%	814,505	100,181	12%	3,141	3.2%	1,952	656	533	747

* U.S. Census Bureau, Census 2000

** %EBLL is calculated as follows: Number of Children w/EBLL divided by (Number of Children Tested minus Children w/elevated capillary tests, not confirmed by venous)

Note: Counts of children tested and blood lead levels are reported from Michigan Department of Community Health, Childhood Lead Poisoning Prevention Project statewide database.

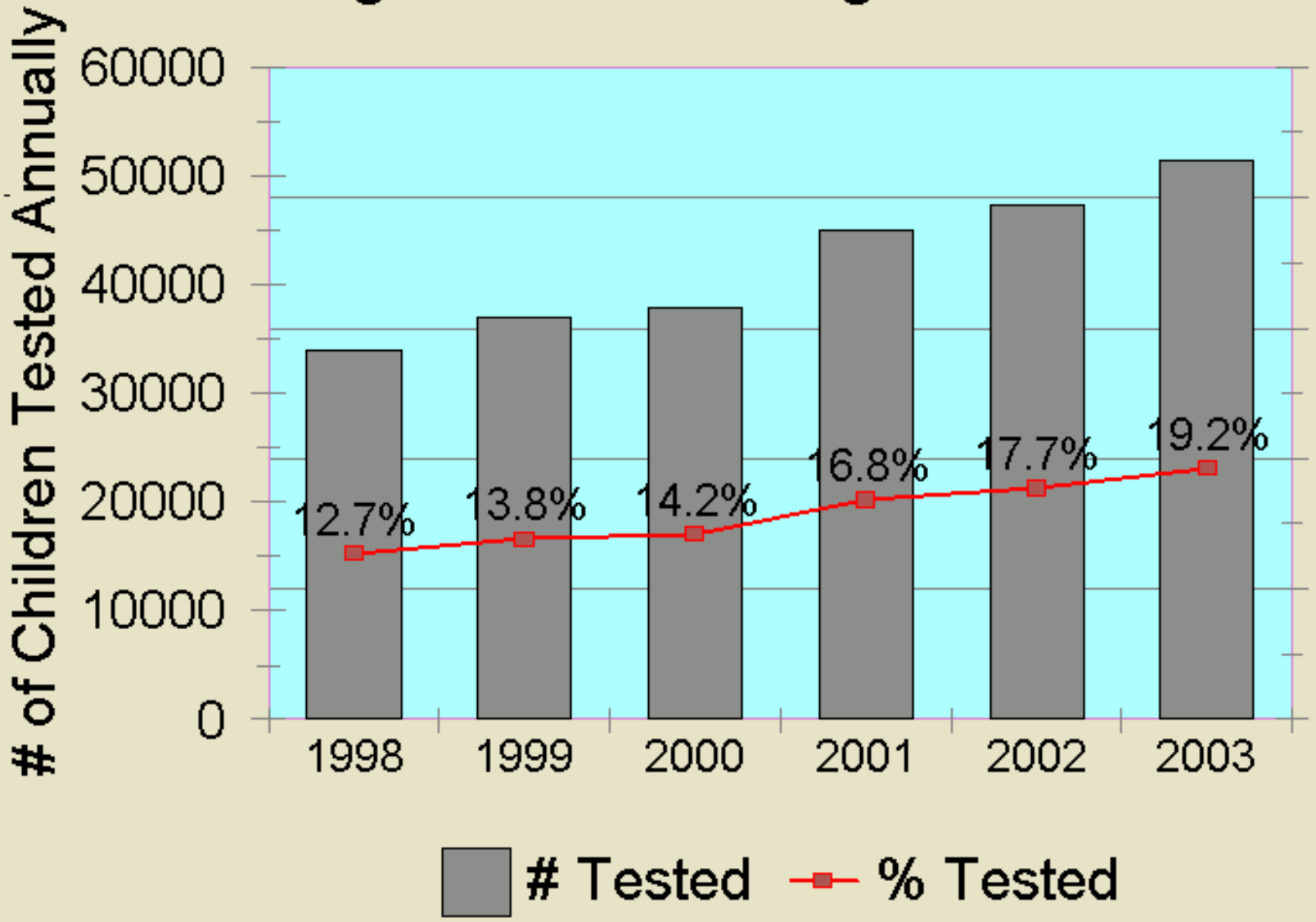
Note: Column for "Children Tested" reflects capillary and venous blood tests. Columns for "Children w/confirmed elevated blood lead levels" reflect venous tests only.

February 2004

DCH-0706

Figure 1. Testing for Blood Lead

Michigan Children Ages 1 & 2



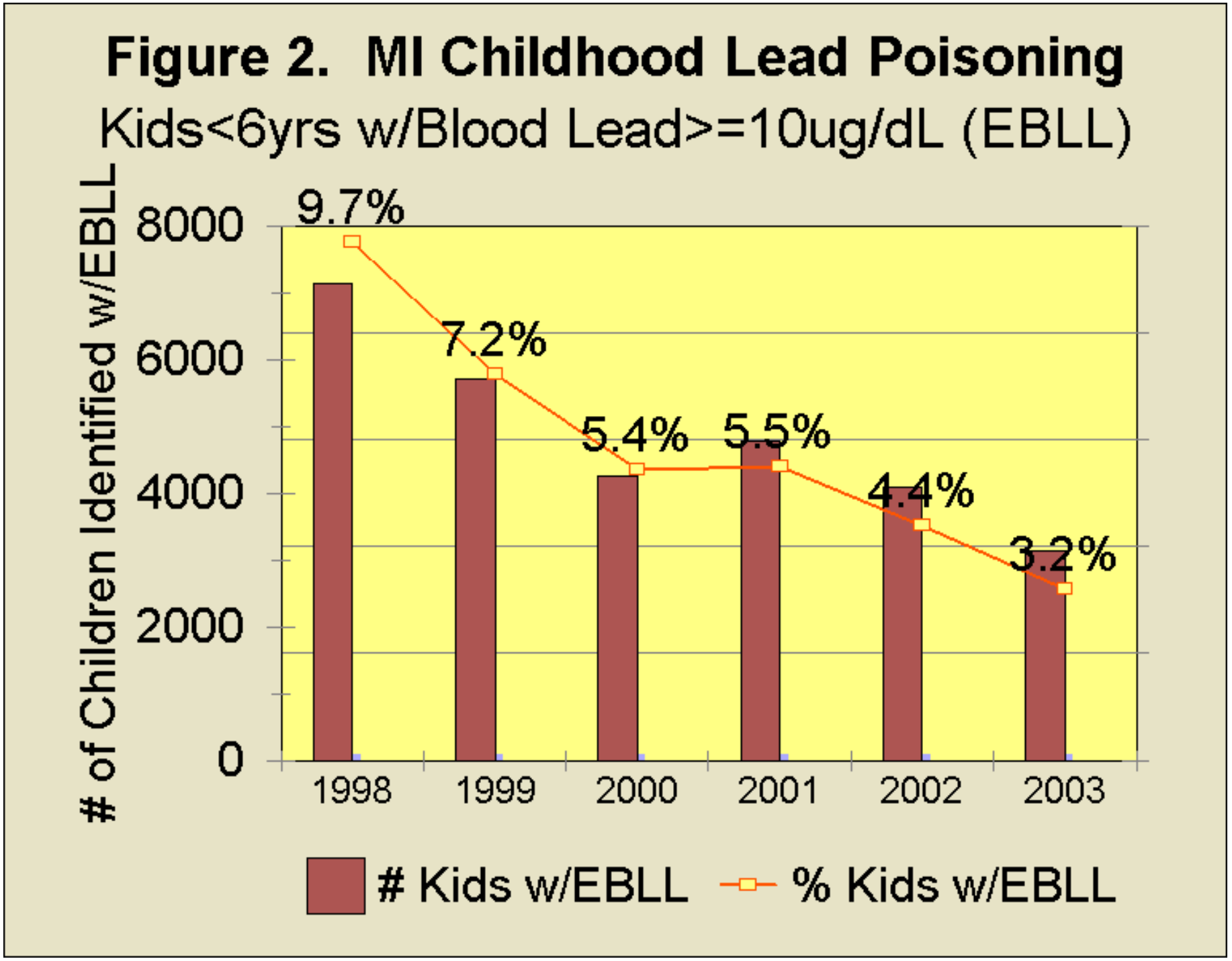
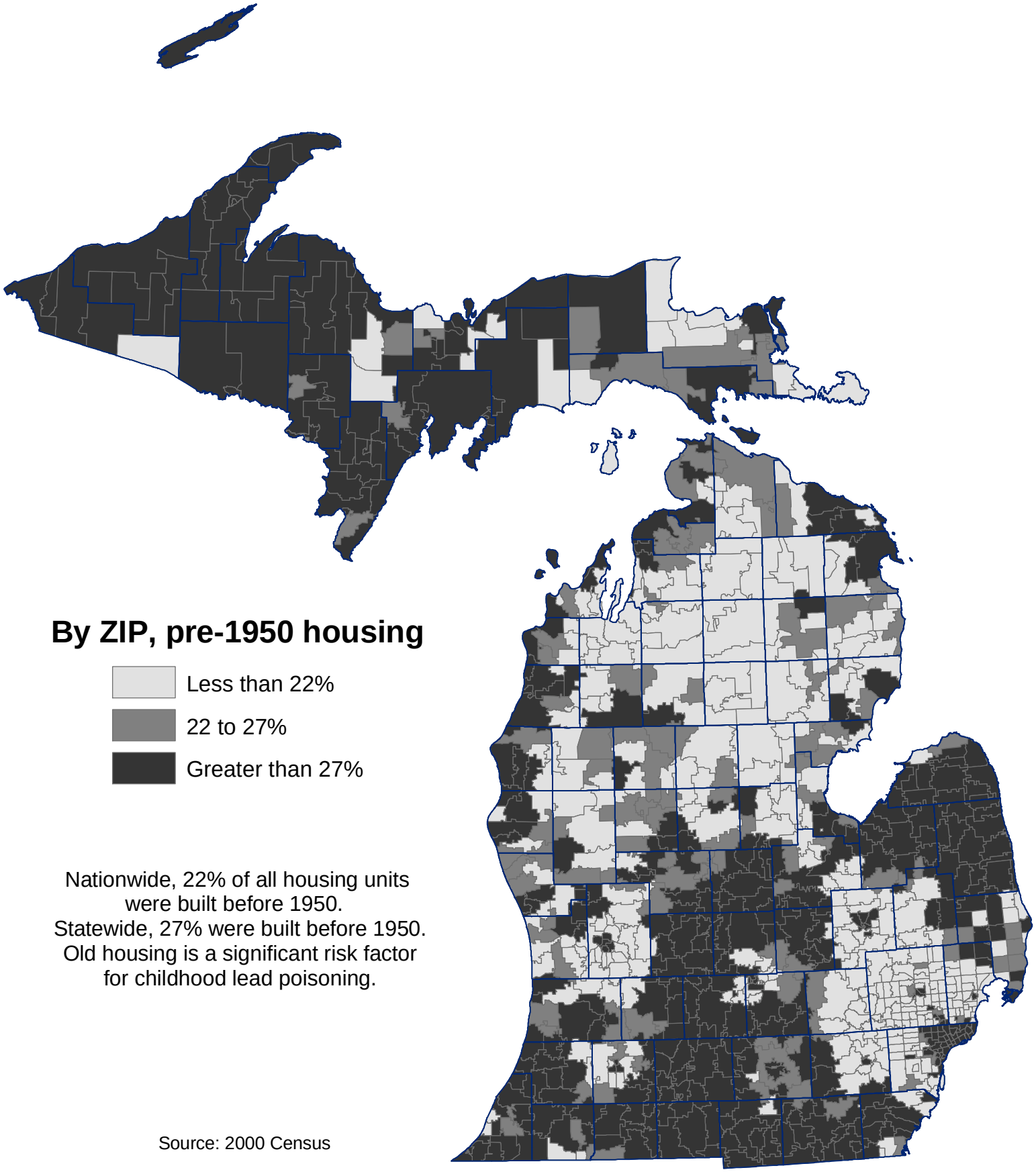


Figure 2. MI Childhood Lead Poisoning
Kids<6yrs w/Blood Lead>=10ug/dL (EBLL)
# of Children Identified w/EBLL
8000
6000
4000
2000
0
9.7%
7.2%
5.4%
5.5%
4.4%
3.2%
1998
1999
2000
2001
2002
2003
Kids w/EBLL
% Kids w/EBLL

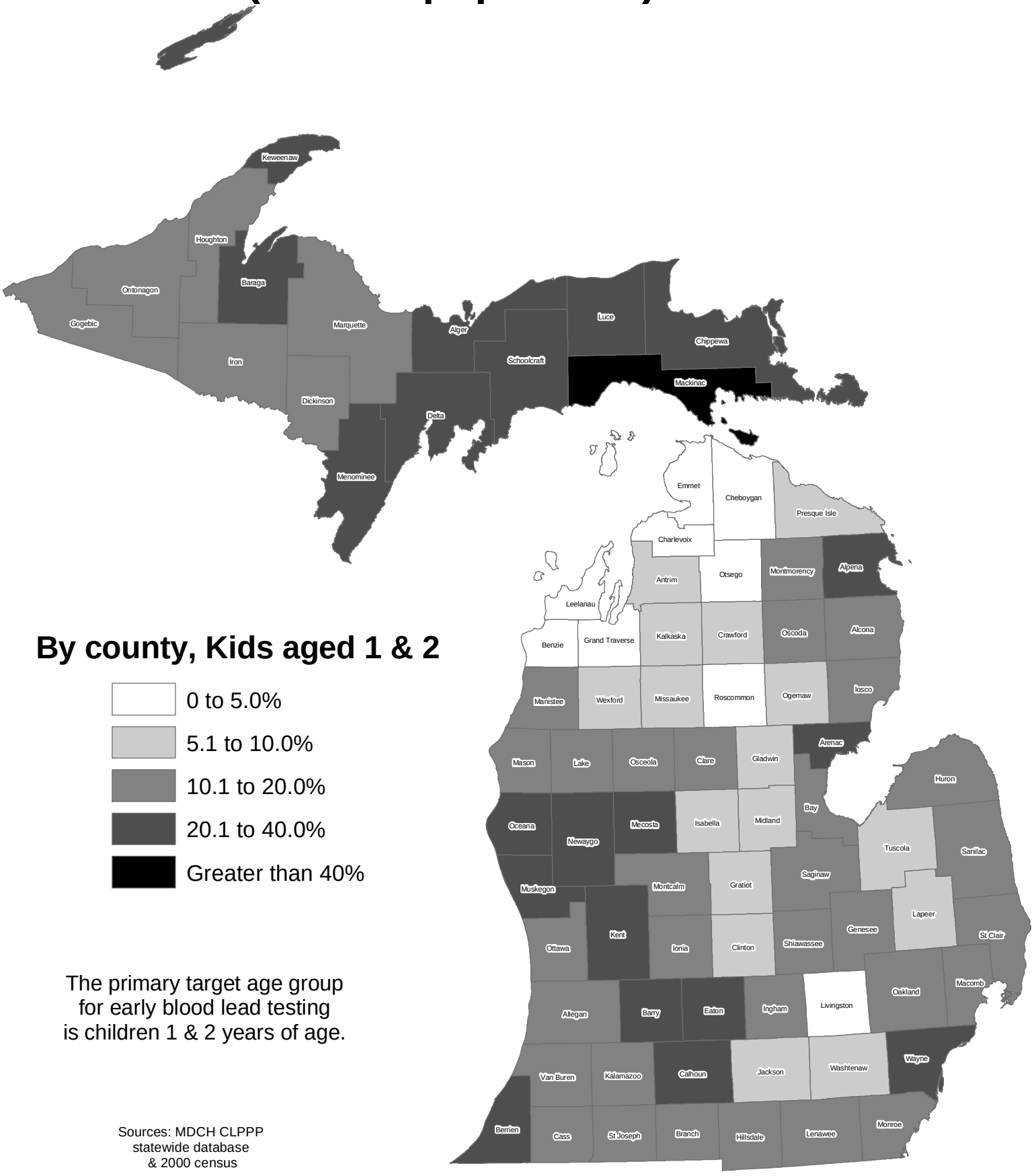
Figure 3. Pre-1950 Housing in Michigan



Nationwide, 22% of all housing units were built before 1950.
Statewide, 27% were built before 1950.
Old housing is a significant risk factor for childhood lead poisoning.

Source: 2000 Census

Figure 4. Children Tested for Blood Lead (as % of population) - 2003



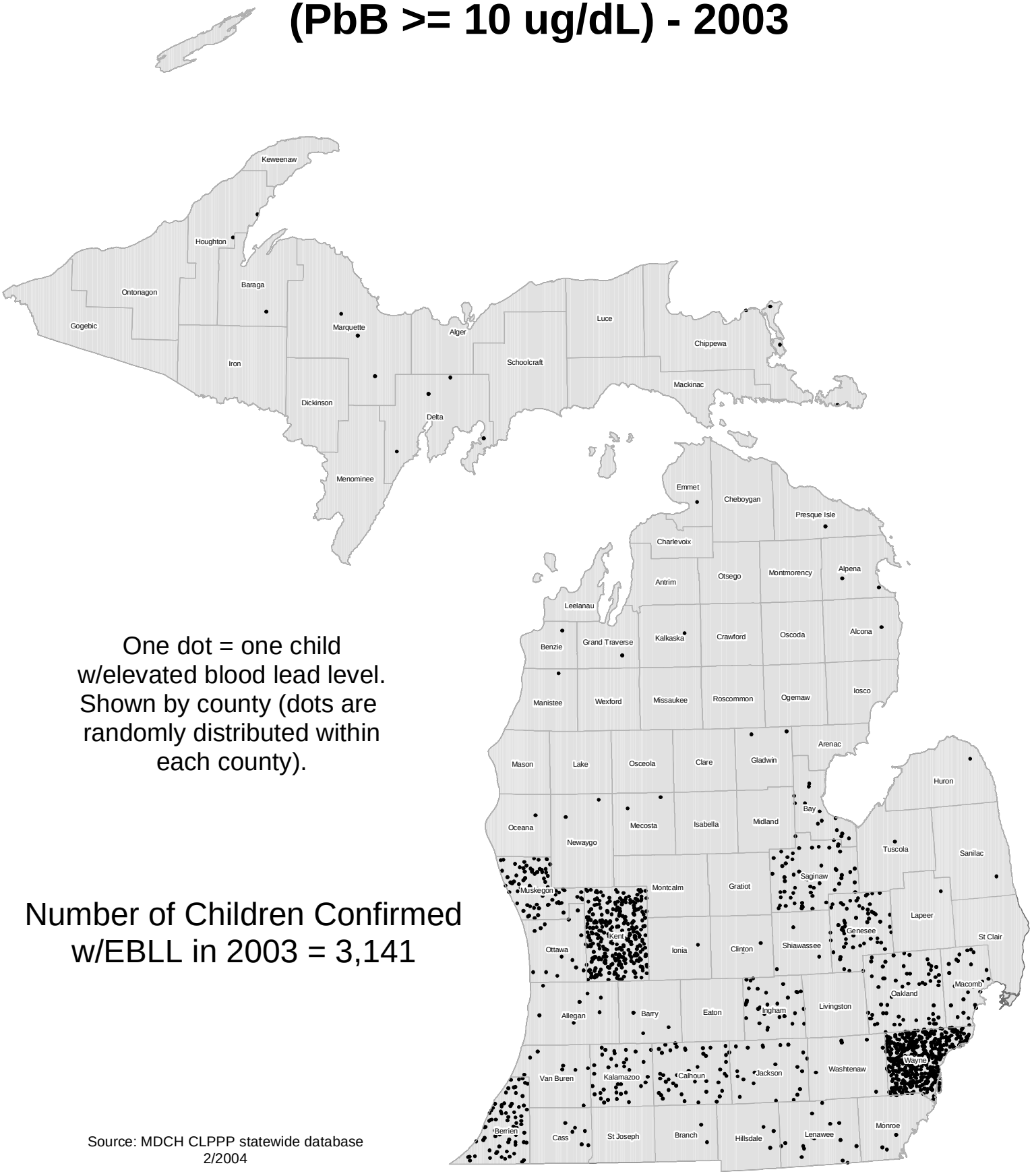
By county, Kids aged 1 & 2

- 0 to 5.0%
- 5.1 to 10.0%
- 10.1 to 20.0%
- 20.1 to 40.0%
- Greater than 40%

The primary target age group for early blood lead testing is children 1 & 2 years of age.

Sources: MDCH CLPPP statewide database & 2000 census

Figure 5. Children aged < six years with Elevated Blood Lead Levels (PbB >= 10 ug/dL) - 2003



One dot = one child w/elevated blood lead level. Shown by county (dots are randomly distributed within each county).

Number of Children Confirmed w/EBLL in 2003 = 3,141

Source: MDCH CLPPP statewide database 2/2004

APPENDIX I

DEPARTMENT OF COMMUNITY HEALTH

HEALTH LEGISLATION AND POLICY DEVELOPMENT

BLOOD LEAD ANALYSIS REPORTING

Filed with the Secretary of State on September 25, 1997. These rules take effect 15 days after filing with the Secretary of State.

(By authority conferred on the community public health agency by section 5111 of Act No. 368 of the Public Acts of 1978, as amended, section 8 of Act No. 312 of the Public Acts of 1978, and Executive Reorganization Order No. 1996-1, being §§333.5111 and 325.78, and 330.3101 of the Michigan Compiled Laws)

R 325.9081 Definitions.

Rule 1. (1) As used in these rules:

(a) "Blood lead analysis report form" means the form used to report the required reportable information for blood that has been analyzed for lead.

(b) "Agency" means the community public health agency.

(c) "Physician/provider" means a licensed professional who provides health care services and who is authorized to request the analysis of blood specimens. For this purpose, provider may also mean the local health department.

(2) The term "local health department," as defined in Act No. 368 of the Public Acts of 1978, as amended, being §333.1101 et seq. of the Michigan Compiled Laws, has the same meaning when used in these rules.

R 325.9082 Reportable information.

Rule 2. (1) Reportable information is specifically related to blood samples submitted to clinical laboratories for lead analysis.

(2) Upon initiating a request for blood lead analysis, the physician/provider ordering the blood lead analysis shall complete the client information (section I) and the physician/provider information (section II) of a blood lead analysis report form designated by the agency or shall complete another similar form that ensures the inclusion of the same required data and shall provide all of the following information:

(a) All of the following information with respect to the individual tested:

(i) Name.

(ii) Sex.

(iii) Racial/ethnic group.

(iv) Birthdate.

(v) Address, including county.

(vi) Telephone number.

(vii) Social security number and medicaid number, if applicable.

(viii) If the individual is a minor, the name of a parent or guardian and social security number of the parent or guardian.

(ix) If the individual is an adult, the name of his or her employer.

(b) The date of the sample collection.

(c) The type of sample (capillary or venous).

(3) The blood lead analysis report form or a document with the same data shall be submitted with the sample for analysis to a clinical laboratory that performs blood lead analysis.

(4) Upon receipt of the blood sample for lead analysis, the clinical laboratory shall complete the laboratory information (section III) and provide all of the information required and/or submitted by the physician/provider and the following:

(a) The name, address, and phone number of the laboratory.

(b) The date of analysis.

(c) The results of the blood lead analysis in micrograms of lead per deciliter of whole blood rounded to the nearest whole number.

R 325.9083 Reporting responsibilities.

Rule 3. (1) All clinical laboratories doing business in this state that analyze blood samples for lead shall report all blood lead results, rounded to the nearest whole number, for adults and children to the Community Public Health Agency, Childhood Lead Poisoning Prevention Program (CPHA/CLPPP), 3423 N.M.L. King Jr. Blvd., Lansing , MI 48909. Reports shall be made within 5 working days after test completion.

(2) Nothing in this rule shall be construed to relieve a laboratory from reporting results of a blood lead analysis to the physician or other health care provider who ordered the test or to any other entity as required by state, federal, or local statutes or regulations or in accordance with accepted standard of practice, except that reporting in compliance with this rule satisfies the blood lead reporting requirements of

Act No. 368 of the Public Acts of 1978, as amended, being §333.1101 et seq. of the Michigan Compiled Laws.

R 325.9084 Electronic communications.

Rule 4. (1) A clinical laboratory may submit the data required in R 325.9083 electronically to the agency.

(2) For electronic reporting, upon mutual agreement between the reporting laboratory and the agency, the reporting shall utilize the data format specifications provided by the agency.

R 325.9085 Quality assurance.

Rule 5. For purposes of assuring the quality of submitted data, each reporting entity shall allow the agency to inspect copies of the medical records that will be submitted by the reporting entity to verify the accuracy of the submitted data. Only the portion of the medical record that pertains to the blood lead testing shall be submitted. The copies of the medical records shall not be recopied by the agency and shall be kept in a locked file cabinet when not being used. After verification of submitted data, the agency shall promptly destroy the copies of the medical records.

R 325.9086 Confidentiality of reports.

Rule 6. (1) The agency shall maintain the confidentiality of all reports of blood lead tests submitted to the agency and shall not release reports or any information that may be used to directly link the information to a particular individual, unless the agency has received written consent from the individual, or from the individual's parent or legal guardian, requesting the release of information.

(2) Medical and epidemiological information that is released to a legislative body shall not contain information that identifies a specific individual. Aggregate epidemiological information concerning the public health that is released to the public for informational purposes only shall not contain information that identifies a specific individual.

R 325.9087 Blood lead analysis report form.

Rule 7. The blood lead analysis report form reads as follows:

MICHIGAN DEPARTMENT OF COMMUNITY HEALTH
BLOOD LEAD ANALYSIS REPORT
DATA/INFORMATION REQUIRED BY ADMINISTRATIVE RULE # R 325.9082 and R 325.9083

I. PATIENT INFORMATION

Last Name _____ First Name _____ Initial _____

Address _____ City _____ State _____ ZIP Code _____ County _____

( ) - _____
Area Code and Phone Number

Date of Birth _____ Patient's Social Security Number _____

Does this child have Medicaid? ☐ yes ☐ no

Sex
☐ Male
☐ Female

Race
☐ Native American (1)
☐ Asian/Pacific Islander (2)
☐ Black (3)
☐ White (5)
☐ Multiracial (7)

Ethnic Group
☐ Hispanic (1)

Parent/Guardian Name (please print) _____

Parent/Guardian Social Security Number _____

If Patient is an adult, list Employer _____

II. PHYSICIAN/PROVIDER INFORMATION

Physician or Clinic Name _____

Mailing Address _____ City _____ State _____ Zip Code _____

Area Code and Phone Number _____

IIa. SPECIMEN COLLECTION INFORMATION
To be Completed by Person who draws Specimen

Specimen Collection Date _____

Type of Specimen: ☐ Capillary ☐ Venous

III. LABORATORY INFORMATION
Completion required by testing laboratory

Specimen Number _____

BLOOD LEAD LEVEL_____MICROGRAMS PER DECILITER

Date of Analysis _____

Laboratory Name _____

Area Code and Phone Number _____

APPENDIX II

OSHA BLOOD LEAD LABORATORIES*: MICHIGAN

Laboratory Name	City	County
Blodgett Toxicology Lab	Grand Rapids	Kent
Comprehensive Health Services Inc	Detroit	Wayne
Detroit Health Department	Detroit	Wayne
DMC University Laboratories	Detroit	Wayne
Hackley Hospital Laboratory	Muskegon	Muskegon
Marquette General Health Systems	Marquette	Marquette
Michigan Department of Community Health	Lansing	Ingham
Mount Clemens General Hospital	Mount Clemens	Macomb
Quest Diagnostics	Auburn Hills	Oakland
Regional Medical Laboratories	Battle Creek	Calhoun
Sparrow Regional Laboratories	Lansing	Ingham
Warde Medical Laboratory	Ann Arbor	Washtenaw

*OSHA approved blood lead laboratories as of January 23, 2004. For a complete listing of OSHA approved blood lead laboratories, visit the OSHA web site at www.osha.gov/SLTC/bloodlead/index.html

APPENDIX III

SUMMARY OF MICHIGAN'S LEAD STANDARDS

In 1981, under the authority of the Michigan Occupational Safety and Health Act (MIOSHA), Michigan promulgated a comprehensive standard to protect workers exposed to lead in general industry (i.e., R325.51971 - 325.51958). That standard was most recently amended in February, 1998. In October 1993, MIOSHA adopted by reference the federal Occupational Safety and Health Administration's (OSHA) Lead Standard for Construction (i.e., 29 CFR 1926.62). That standard was most recently amended October 18, 1999. Both the MIOSHA Lead Exposure in Construction Standard (Part 603) and the Lead Exposure in General Industry Standard (Part 310) establish an "action level" (30 micrograms of lead per cubic meter of air [ug/m^3] averaged over an eight-hour period) and a permissible exposure limit (50 ug/m^3 averaged over an eight hour period) for employees. Both standards require employers to conduct initial exposure monitoring and to provide employees written notification of these monitoring results. If employee exposure levels exceed the permissible exposure limit (PEL), employees are required to develop a written compliance program that addresses the implementation of feasible engineering and/or work practice controls to reduce and maintain employee exposures below the PEL. The Lead Exposure in Construction Standard (Part 603) also allows the use of administrative controls to achieve this objective. An employer's obligations concerning hygiene facilities, protective work clothing and equipment, respiratory protection, medical surveillance and training under the Lead Exposure in Construction Standard (Part 603) are triggered initially by job tasks and secondarily by actual employee exposure level to lead. Under the Lead Exposure in General Industry Standard (Part 310), these potential obligations are triggered by actual employee exposure levels to lead. Medical surveillance and training are triggered by exposures above the action level (AL), whereas protective clothing and equipment, respiratory protection and hygiene facilities are triggered by exposures above the PEL.

The medical surveillance program requirements for Michigan's Lead Exposure in General Industry Standard (Part 310) versus those required in Lead Exposure in Construction Standard (Part 603) do vary. Under the Lead Exposure in General Industry Standard (Part 310), a medical surveillance program must be implemented which includes periodic biological monitoring (blood tests for lead and zinc protoporphyrin [ZPP] levels), and medical exams/consultation for all workers exposed more than 30 days per year to lead levels exceeding the AL. Under the Lead Exposure in Construction Standard (Part 603), a distinction is made between "initial medical surveillance" (consisting of biological monitoring in the form of blood sampling and analysis for lead and ZPP levels) and secondary medical surveillance (consisting of follow-up biological monitoring and a medical examination/consultation). The initial medical exam is triggered by employee exposure to lead on any day at or above the AL. The secondary medical exam is triggered by employee exposures to lead at or above the AL for more than 30 days in any 12 consecutive months period.

Michigan's Lead Exposure in General Industry Standard (Part 310) mandates that employees exposed at or above the AL must be removed from the lead exposure when:

- A periodic blood test and follow-up blood test indicate that the blood lead level (BLL) is at or above 60 micrograms per deciliter (ug/dL) of whole blood.

- Medical removal is also triggered if the average of the last 3 BLL or the average of all blood sampling tests conducted over the previous six months, whichever is longer, indicates the employees blood lead level is at or above 50 ug/dL. Medical removal is not required however, if the last blood sampling test indicates a blood lead level at or below 40 ug/dL of whole blood.

- When a final medical determination reveals that an employee has a detected medical condition which places that employee at an increased risk of material impairment to health from the lead exposure.

The Lead Exposure in Construction Standard (Part 603) mandates removal of an employee from a lead exposure at or above the AL when:

- A periodic and follow-up blood test indicates that an employee's BLL is at or above 50 ug/dL; or

- There is a final medical determination that an employee has a detected medical condition which places that employee at an increased risk of material impairment to health from the lead exposure.

When an employee can return to work at their former job also differs by standard. The Lead Exposure in General Industry Standard (Part 310) allows an employee to return to his or her former job status under any of the following circumstances:

- If the employee's BLL was at or above 70 ug/dL, then two consecutive blood tests must have the BLL at or below 50 ug/dL.

- If the employee's BLL was at or above 60 ug/dL or due to an average BLL at or above 50 ug/dL, then two consecutive BLL must be at or below 40 ug/dL.

- For an employee removed due to a final medical determination, when a subsequent medical determination no longer detects a medical condition which places the employee at an increased risk of material impairment to health from exposure to lead.

The Lead Exposure in Construction Standard (Part 603) allows the employer to return an employee to their former job status under these circumstances:

- If the employee's BLL was at or above 50 ug/dL, then two consecutive blood tests must have the employee's BLL at or below 40 ug/dL.

- For an employee removed due to a final medical determination, when a subsequent medical determination no longer has a detected medical condition which places the employee at an increased risk of material impairment to health from exposure to lead.

Both the Lead Exposure in General Industry (Part 310) and Lead Exposure in Construction (Part 603) Standards have a medical removal protection benefits provision. This provision requires employers maintain full earnings, seniority and other employment rights and benefits of temporarily removed employees up to 18 months on each occasion that an employee is removed from exposure to lead. This includes the right to their former job status as though the employee had not been medically removed from the job or otherwise medically limited.

Provisions of Lead Exposure in General Industry (Part 310) and Lead Exposure in Construction (Part 603) Standards

Workers exposed to lead have a right to: an exposure assessment, respiratory protection, protective clothing and equipment, hygiene facilities, medical surveillance, medical removal and training. The triggering mechanisms that activate these rights are primarily based upon employee lead exposure levels. However, under the Lead Exposure in Construction Standard (Part 603), many of these rights are initially triggered by the specific work activity being performed.

Exposure Assessment

Air monitoring must be conducted to determine employee airborne lead exposure levels when a potential lead exposure exists. Under the Lead Exposure in Construction Standard (Part 603), however, specific work activities are identified/categorized that require "interim protection" (i.e., respiratory protection, personal protective clothing and equipment, work clothes change areas, hand washing facilities, biological monitoring and training) until air monitoring has been performed that establishes that these lead exposure levels are within the acceptable limits (AL or PEL).

Respiratory Protection

Respiratory protection is required whenever employee exposure levels exceed the PEL and as an interim control measure under the Lead Exposure in Construction Standard (Part 603). The level of respiratory protection required is dependent upon the actual employee exposure level or by the job activities identified in the Lead Exposure in Construction Standard (Part 603).

Protective Clothing/Equipment

Protective clothing/equipment (i.e., coveralls or similar full body clothing; gloves, hats, shoes or disposable shoe coverlets; and face shield, vented goggles, or other applicable equipment) is required whenever employee exposure levels exceed the PEL and as an interim protection measure under the Lead Exposure in Construction Standard (Part 603).

Hygiene Facilities

Hygiene facilities (i.e., clothing change areas, showers, eating facilities) are required whenever employee exposures to lead exceed the PEL. Except for shower facilities, these same hygiene facilities must be provided as interim protection under the Lead Exposure in Construction Standard (Part 603). The construction employer must, however, provide hand washing facilities in lieu of the shower facility as an interim protection.

Medical Surveillance

Medical surveillance (i.e., medical exam and consultation) is required when workers are exposed to lead at or exceeding the AL for more than 30 days a year. Biological blood sampling and analysis to determine lead and ZPP levels is required initially under the Lead Exposure in Construction Standard (Part 603) when employee lead exposure is at or exceeds the AL on any single day. Under the Lead Exposure in General Industry Standard (Part 310), it is required when employees are exposed to concentrations of airborne lead greater than the A.L. for more than 30 days per year.

Medical Removal

Workers covered by the Lead Exposure in General Industry (Part 310) Standard have the right to be removed from airborne lead exposures at or above the AL when their periodic and follow-up blood lead level is at or above 60 ug/dL or when an average of the last three blood lead levels or the average of all blood sampling tests conducted over the previous six months, whichever is longer, indicates the employee blood lead level is at or above 50 ug/dL. However, under this later removal criteria, they are not required to be removed if the last blood sampling test indicates a blood lead level at or below 40 ug/dL.

Workers covered by the Lead Exposure in Construction Standard (Part 603) have the right to be removed from airborne lead exposures at or above the AL on each occasion that a periodic and follow-up blood sample test indicate that the employee's blood lead level is at or above 50 ug/dL.

Under both the Lead Exposure in General Industry (Part 310) and Lead Exposure in Construction (Part 603) Standards, workers also have the right to be removed from airborne lead exposures at or above the AL whenever there is a final medical determination that has detected that they have a medical condition that places them at an increased risk of material impairment to health from exposure to lead.

Training

Under the Lead Exposure in General Industry Standard (Part 310), employees exposed to any level of airborne lead must be informed of the contents of appendices A and B from that standard.

Under both the Lead Exposure in General Industry (Part 310) and Lead Exposure in Construction (Part 603) Standards, employees who are exposed at or above the AL on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation must be provided comprehensive training covering all topics specified in those standards.

Also, under the Lead Exposure in Construction Standard (Part 603), employees involved in any of the specified work activities requiring interim controls, must receive training prior to initiating those activities that addresses the recognition and avoidance of unsafe conditions involving lead and the specific regulations applicable to the worksite that have been established to control or eliminate the hazards associated with exposure to lead.

APPENDIX IV

Adult Blood Lead Epidemiology and Surveillance — United States, 1998–2001

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Abstract

Problem/Condition: Elevated blood lead levels (BLLs) in adults can damage the cardiovascular, central nervous, reproductive, hematologic, and renal systems. The majority of cases are workplace-related. U.S. Department of Health and Human Services recommends that BLLs among all adults be reduced to <25 µg/dL. The highest BLL acceptable by standards of the U.S. Occupational Safety and Health Administration is 40 µg/dL. The mean BLL of adults in the United States is <3 µg/dL.

Reporting Period: This report covers cases of adults (aged ≥16 years) with BLLs ≥25 µg/dL, as reported by 25 states during 1998–2001.

Description of System: Since 1987, CDC has sponsored the state-based Adult Blood Lead Epidemiology and Surveillance (ABLES) program to track cases of elevated BLLs and provide intervention consultation and other assistance. Overall ABLES program data were last published in 1999 for the years 1994–1997. This report provides an update with data from 25 states reporting for ≥2 years during 1998–2001. During that period, the ABLES program funded surveillance in 21 states — Alabama, Arizona, Connecticut, Iowa, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Washington, Wisconsin, and Wyoming. Four additional states — California, Nebraska, New Hampshire, and Utah — contributed data without CDC funding.

Results: During 1998–2001, the overall program's annual mean state prevalence rate for adults with BLLs ≥25 µg/dL was 13.4/100,000 employed adults. This compares with 15.2/100,000 for 1994–1997. Yearly rates were 13.8 (1998), 12.9 (1999), 14.3 (2000), and 12.5 (2001).

For adults with BLLs ≥40 µg/dL, the overall program's annual mean state prevalence rate during 1998–2001 was 2.9/100,000 employed adults. This compares with 3.9/100,000 for 1994–1997. Yearly rates were 3.3 (1998), 2.5 (1999), 2.9 (2000), and 2.8 (2001).

Interpretation: Although certain limitations exist, the overall ABLES data indicate a declining trend in elevated BLLs among employed adults.

Public Health Actions: ABLES-funded states increased from 21 to 35 in 2002, and more detailed reporting requirements were put into effect. These, and other improvements, will enable the ABLES program to work more effectively toward its 2010 target of eliminating all cases of BLLs ≥25 µg/dL in adults caused by workplace exposures.

Introduction

Inorganic Lead

Inorganic lead is a bluish gray metal valued since ancient times because of its useful properties (e.g., low melting point, pliability, and resistance to corrosion). The ancient Romans and Greeks first discovered its toxic effects. Lead is ubiquitous in U.S. urban environments because of the widespread use of lead compounds in industry, gasoline, and paints during the 1900s (*1–3*).

Adult Lead Exposure

Adult exposure to inorganic lead occurs when dust and fumes are inhaled and when lead from lead-contaminated hands, food, water, cigarettes, and clothing is ingested. Lead absorbed through the respiratory and digestive systems is released into the blood, which distributes the lead throughout the body. Approximately 90% of total body lead content is accumulated in the bones, where it is stored for decades. Lead in bones continues to be released gradually back into the body after the external environmental exposure occurs (*1–3*).

Health Effects of Adult Lead Exposure

The adverse health effects of elevated exposure to lead among adults include damage to the cardiovascular, central nervous, reproductive, hematologic, and renal systems (*1–3*). Studies have reported that adults with blood lead levels (BLLs) of 25–60 µg/dL can exhibit nonspecific symptoms, including irritability, fatigue, headache, sleep disturbance, decreased libido, and depressed mood (*4*). Studies have also reported adverse health effects, including hypertension, subtle or subclinical central nervous system deficits, and adverse reproductive outcomes among adults exposed to lead at concentrations below the existing regulatory exposure limits of 40 µg/dL (*5–9*). Although the significance of these subclinical effects on long-term health continues to be studied, the U.S. Department of Health and Human Services (DHHS) recommends that BLLs be reduced to <25 µg/dL among all adults as a preventive health measure (*10,11*).

Lead readily crosses the placenta. The source of lead exposure for a fetus might be the mother's recent exposure to lead or mobilization of lead into the blood during pregnancy from bone stores because of past exposure. The American Conference of Governmental Industrial Hygienists (ACGIH) advises women of child-bearing age, if their BLL is >10 µg/dL, they are at risk for delivering a child with a BLL >10 µg/dL (*12*) — the level of concern in CDC's pediatric guidelines.

Sources of Adult Lead Exposures

Data reported to the Adult Blood Lead Epidemiology and Surveillance Program (ABLES), suggest >90% of elevated BLL cases among adults result from workplace exposure (*13,14*). National Health and Nutrition Examination Survey data indicate that by 1991–1994, the geometric mean BLL of U.S. adults had dropped to 2.1, 3.1, and 3.4 µg/dL for persons aged 20–49, 50–69, and ≥70 years, respectively (*15*). This compares with a geometric mean of 13.1 µg/dL for persons aged 20–74 years for the period 1976–1980 (*16*). Although the mean BLL of the entire U.S. population is relatively low, adult workers continue to be exposed to high concentrations of lead in >100 industries, including battery manufacturing, painting, nonferrous smelting, radiator repair, brass and bronze foundries, pottery production, scrap metal recycling, firing ranges, and wrecking and demolition (*11*).

Elevated BLLs among adults can also be caused by exposure to nonoccupational (i.e., ambient or environmental) sources of lead (e.g., recreational target shooting, home remodeling, casting bullets and fishing weights, making stained glass and ceramics, cookware, pica behavior [ingestion of nonfood items], traditional remedies, drinking homemade alcoholic brews, and retaining bullets in or near a synovial joint). When occupational exposure is not proven or seems unlikely, clinicians should investigate these factors as potential cases of elevated BLLs (*11*).

Adult Blood Lead Epidemiology and Surveillance Program

Since 1987, CDC's National Institute for Occupational Safety and Health (NIOSH) has sponsored ABLES, a state-based program that tracks laboratory-reported BLLs among adults, and teams with other agencies to intervene and help prevent further high-level lead exposures. For states that report to ABLES, the primary sources of BLL reports are public and private laboratories; secondary sources are physicians. ABLES requires that laboratory reporting to the state health department (or other designee) of BLL results, both occupational and nonoccupational, be mandatory under state law. Laboratory reports include basic demographic information with unique identifiers to differentiate between new and ongoing cases and to account for multiple reports regarding the same person. Those reporting are also urged to include information regarding occupations and industries, lead-related avocations, and whether the laboratory is approved for occupational lead testing by the Occupational Safety and Health Administration (OSHA). The minimum BLL reporting requirement varies from state to state. Moreover, reporting of all BLLs is encouraged, because these data are useful for

analyzing exposure trends and for providing the basis for future ABLES consultation and education on intervention strategies.

The public health objective of the ABLES program, as stated in *Healthy People 2010*, is to reduce the number of persons with BLLs ≥25 µg/dL from work exposures; the target is to reduce that number to zero by 2010 (*10*). In collaboration with the ABLES program, the Council of State and Territorial Epidemiologists (CSTE) has adopted a surveillance case definition: an adult (aged ≥16 years) with a venous (or comparable) BLL ≥25 µg/dL of whole blood (*17*).

The ABLES program seeks to accomplish its objective by continuing to improve its surveillance programs and helping state health and other agencies to effectively intervene to prevent further lead exposures. Intervention strategies implemented by ABLES-reporting states include conducting follow-up interviews with physicians, employers, and workers; investigating work sites; delivering technical assistance regarding exposure reduction or prevention; providing referrals for consultation and enforcement; and developing and disseminating educational materials and outreach programs. The educational materials developed by ABLES-reporting states are listed on, or linked to, the ABLES website.*

The ABLES program is a complete surveillance program that entails not only enumerating adults with elevated BLLs, but also analyzing and reporting data, helping appropriate agencies intervene to prevent further exposures, and testing the effectiveness of those interventions. State and federal ABLES participants and partners have published analyses of their intervention activities (*18–22*), surveillance data, and investigations (*13,14,23–27*).

To coordinate their reporting and intervention activities for maximum efficiency, state ABLES programs are strongly encouraged to develop effective working relationships with the childhood lead prevention programs in their states. An estimated 2%–3% of children with BLL ≥10 µg/dL reach those levels from exposure to lead brought home from the workplace on the clothes or in the vehicles of their adult caregivers (*23*). State ABLES programs are also encouraged to develop effective working relationships with other federal and state agencies involved in preventing adult lead poisoning (e.g., OSHA, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency, U.S. Department of Transportation, and U.S. Department of Defense).

Overall ABLES program data were last published in the *MMWR* in 1999 for 1994–1997 (*28*). This report provides data for 1998–2001. This will be the last report for ABLES data collected under the old aggregate format. Increased data requirements that took effect in 2002 will track adult BLLs by age, sex, and industry.

* Available at http://www.cdc.gov/niosh/ables.html.

Methods

Biological Indices

The best method for monitoring exposure to lead is measuring BLLs in whole blood, although other biological indices exist. As the BLL increases, the frequency and severity of symptoms associated with lead exposure also increase (albeit with considerable variability). With other indices of lead exposure, no such specific relationship with symptoms has been established (*1–3*). Furthermore, BLL is responsive to recent exposures — the cases most amenable to preventive intervention. Among other indices, measurement of protoporphyrin (free or zinc protoporphyrin) concentration in red blood cells can be an accurate indicator of inhibition of heme synthesis by lead. However, other causes of elevated protoporphyrin levels exist (e.g., iron-deficiency anemia and inflammatory conditions) (*29*). Lead concentrations can be measured in urine, teeth, and hair, but these measurements are not as reliable as BLLs. An experimental technique, radiographic fluorescence, provides a more accurate method for determining long-term, cumulative lead exposure and the total body burden of lead (*7*), but only a limited number of research facilities in the United States and Canada provide bone lead measurements.

Testing Requirements

Permissible exposure limits for lead in the workplace and worker monitoring are regulated by OSHA standards, which differ slightly for general industry† (*30*) and the construction industry§ (*31*). A detailed comparison of the standards has been published elsewhere (*32*). When airborne lead concentrations exceed the action level of 30 µg/m^3, OSHA requires medical surveillance, which includes biologic monitoring of BLLs by an OSHA-approved laboratory. Under the OSHA general industry standard, workers must be removed from substantial lead exposure when their BLLs are ≥60 µg/dL or when they averaged ≥50 µg/dL during the previous six months, or when workers have detected medical conditions that place them at increased risk for material impairment to health from lead exposure. After workers have been medically removed, they may return to work when their BLLs fall to 40 µg/dL. Thus, 40 µg/dL can be construed as the highest BLL deemed acceptable under OSHA lead standards.

† 29 CFR 1910.1025.
§ 29 CFR 1926.62.

Surveillance Reporting

In this report, ABLES prevalence is reported according to two benchmarks: BLLs ≥25 µg/dL, the limit set by *Healthy People 2010* in its public health objective (*10*); and ≥40 µg/dL, the limit at which OSHA will permit a worker to return to work after being medically removed. To enable year-to-year and state-to-state comparisons of ABLES data, adjustments were made to account for the changing number and roster of states, and to control for their different populations. Prevalence rates were established by expressing cases of BLLs ≥25 and ≥40 µg/dL for each reporting state as annual rates per 100,000 persons employed (aged ≥16 years). State employment data were obtained from the Bureau of Labor Statistics, Current Population Survey [¶] (*33*).

Results

The data reported here are for the 25 state ABLES programs reporting for ≥2 years during 1998–2001 (Figure 1). These data can differ slightly from previous ABLES reports that included states no longer reporting (states that stopped reporting and the years they did report: Maine 1994–1998, Illinois 1994–1996, New Mexico 1997, and Vermont 1994 and 1997).

For 1998–2001, a total of 25 ABLES states reported 41,984 adults with BLLs ≥25 µg/dL and 8,265 adults with BLLs ≥40 µg/dL. The yearly totals for BLLs ≥25 µg/dL were 10,459 (1998) with 24 of 25 states reporting; 10,310 (1999) with 25 states reporting; 11,272 (2000) with 25 states reporting; and 9,943 (2001) with 23 of 25 states reporting (Table 1). The yearly totals for BLLS ≥40 µg/dL were 2,071 (1998); 1,933 (1999); 2,252 (2000); and 2,009 (2001) (Table 2).

More populous ABLES states reported more cases (Tables 1 and 2). To illustrate the degree of variance among states, mean annual percentages by state are presented for adults with BLLs ≥25 µg/dL for 1998–2001 (Figure 2). These percentages were derived by 1) calculating the mean number of annual cases for each state during 1998–2001; 2) adding those means; and 3) calculating the percentage of this sum of means for each state. On average, Pennsylvania, Ohio, California, and New York — when combined — reported 50% of the adult cases with BLLs ≥25 µg/dL, whereas Arizona, Oklahoma, South Carolina, Utah, and Wyoming reported <1% each (Figure 2). Using the same method for cases with BLLs ≥40 µg/dL, on average, the same four populous states, plus North Carolina, combined to report 55% of the cases, whereas Arizona, Nebraska, Oklahoma, Utah, and Wyoming reported, on average, <1% each (Figure 3).

Year-to-year comparisons were enabled by expressing cases of BLLs ≥25 and ≥40 µg/dL for each reporting state as annual rates per 100,000 persons employed (aged ≥16 years). Mean annual state rates for the overall ABLES program were then calculated for each year during 1998–2001 (Figure 4). State-to-state comparisons of 1998-2001 data were made in a similar fashion. The 25 ABLES states are displayed in order of their 4-year mean annual rates for adults with BLLs ≥25 µg/dL (Figure 5). The overall mean for the 25 states for 1998-2001 was 13.4/100,000 employed. ABLES states are also displayed in order of their 4-year mean annual rates for adults with BLLs ≥40 µg/dL (Figure 6). The overall mean for the 25 states for 1998-2001 was 2.9/100,000.

To make state-to-state comparisons of 1998–2001 data with 1994–1997 data, only 20 of the 25 ABLES states — those that reported for ≥2 years during both 4-year periods — were used (Figures 7 and 8). The mean annual rates for each state were then calculated, as well as the mean annual rates for the program overall, during each 4-year period. For adults with BLLs ≥25 µg/dL, 17 of 20 states reported lower rates for 1998–2001, compared with 1994–1997 (only Alabama, North Carolina and Maryland reported higher rates). For the ABLES program overall, the mean annual rates were 15.2/100,000 for 1994–1997 compared with 13.4/100,000 for 1998–2001 (Figure 7). Using the same method for adults with BLLs ≥40 µg/dL, 16 of 20 states reported lower rates for 1998–2001, compared with 1994-1997 (only Alabama, North Carolina, and Pennsylvania reported higher rates; Maryland's rate did not change). For the program overall, the mean annual rates for adults with BLLs ≥40 µg/dL were 3.9/100,000 for 1994–1997 and 2.9/100,000 for 1998–2001 (Figure 8).

[¶] Available at http://www.bls.gov/lau/staa_7000.pdf.

FIGURE 1. States reporting to the Adult Blood Lead Epidemiology and Surveillance (ABLES) program for ≥2 years — United States, 1998–2001

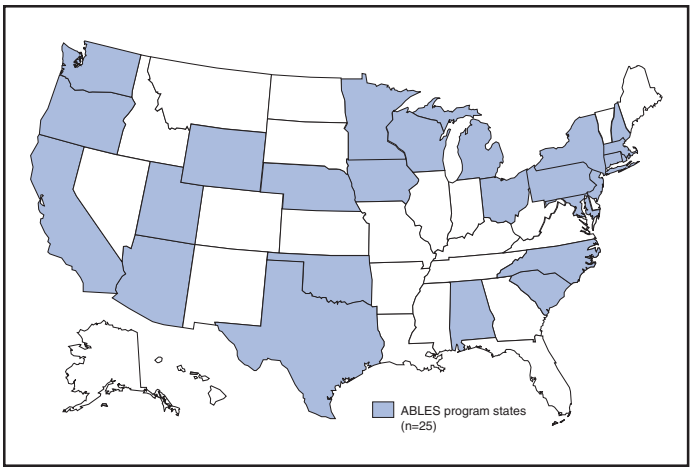


TABLE 1. Adults with blood lead levels ≥25 µg/dL reported to the Adult Blood Lead Epidemiology and Surveillance (ABLES) program during 1994–2001 by 25 states

State	1994	1995	1996	1997	1998	1999	2000	2001
Alabama	502	NA*	511	567	549	490	634	578
Arizona	40	148	56	79	91	48	58	35
California	1,347	997	1,010	1,044	900	911	1,001	872
Connecticut	354	262	229	207	118	124	99	77
Iowa	NA	533	522	421	309	401	268	432
Maryland	196	178	153	189	162	292	229	205
Massachusetts	755	641	582	507	470	429	368	297
Michigan	NA	NA	NA	136	303	273	235	208
Minnesota	NA	467	255	258	264	272	190	244
Nebraska	NA	NA	NA	NA	NA	143	94	NA
New Hampshire	NA	NA	NA	187	213	174	212	142
New Jersey	744	611	592	567	511	534	572	543
New York	955	850	1,115	1,045	903	948	955	834
North Carolina	224	342	269	362	379	426	475	558
Ohio	NA	NA	1,367	1,440	1,146	1,090	1,039	1,572
Oklahoma	52	76	94	88	67	46	66	49
Oregon	269	199	204	187	129	170	180	89
Pennsylvania	2,005	2,897	2,862	3,348	2,394	2,031	2,826	2,113
Rhode Island	NA	NA	NA	104	78	67	178	95
South Carolina	367	595	188	189	195	32	60	NA
Texas	387	189	738	687	556	510	554	307
Utah	83	102	57	98	75	41	34	45
Washington	232	241	203	277	152	148	160	120
Wisconsin	713	932	600	528	428	671	738	507
Wyoming	NA	NA	NA	99	67	39	47	21
Total	**9,225**	**10,260**	**11,607**	**12,614**	**10,459**	**10,310**	**11,272**	**9,943**

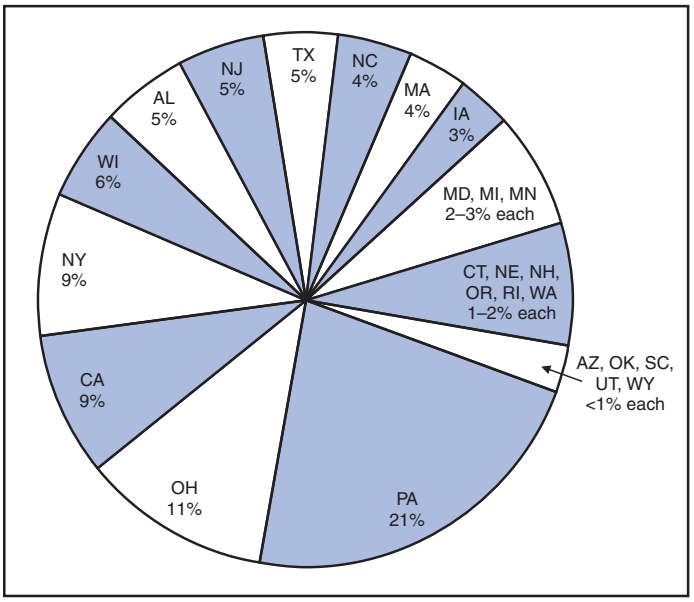
* NA = Not available.

TABLE 2. Adults with blood lead levels ≥40 µg/dL reported to the Adult Blood Lead Epidemiology and Surveillance (ABLES) program during 1994–2001 by 25 states

State	1994	1995	1996	1997	1998	1999	2000	2001
Alabama	180	NA*	165	165	142	144	221	217
Arizona	9	39	19	23	16	2	9	8
California	232	196	167	142	150	126	149	134
Connecticut	85	38	29	46	26	21	20	18
Iowa	NA	99	100	68	24	37	19	41
Maryland	61	41	39	47	33	77	54	32
Massachusetts	189	158	122	115	99	80	71	49
Michigan	NA	NA	NA	25	72	48	48	36
Minnesota	NA	120	92	64	54	48	39	56
Nebraska	NA	NA	NA	NA	NA	21	12	NA
New Hampshire	NA	NA	NA	48	66	45	53	32
New Jersey	183	121	127	120	116	104	119	113
New York	164	136	230	208	199	205	178	141
North Carolina	137	181	139	207	188	191	289	386
Ohio	NA	NA	414	384	222	257	304	318
Oklahoma	15	26	35	35	23	18	17	17
Oregon	49	26	38	28	13	27	38	8
Pennsylvania	NA	NA	506	482	294	242	325	222
Rhode Island	NA	NA	NA	26	24	17	44	25
South Carolina	290	485	94	101	85	4	16	NA
Texas	306	127	163	147	109	111	111	64
Utah	19	18	11	19	16	4	5	14
Washington	75	57	58	65	22	29	38	18
Wisconsin	125	156	95	67	49	68	71	55
Wyoming	NA	NA	NA	36	29	7	2	5
Total	**2,119**	**2,024**	**2,643**	**2,668**	**2,071**	**1,933**	**2,252**	**2,009**

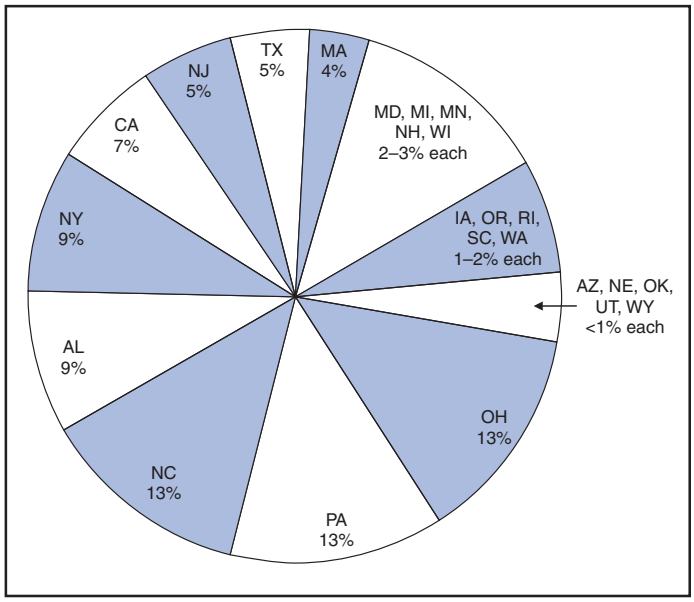
* NA = Not available.

FIGURE 2. Mean annual percentages by state of total adults with blood lead levels ≥25 µg/dL as reported by 25 ABLES program states, 1998–2001*



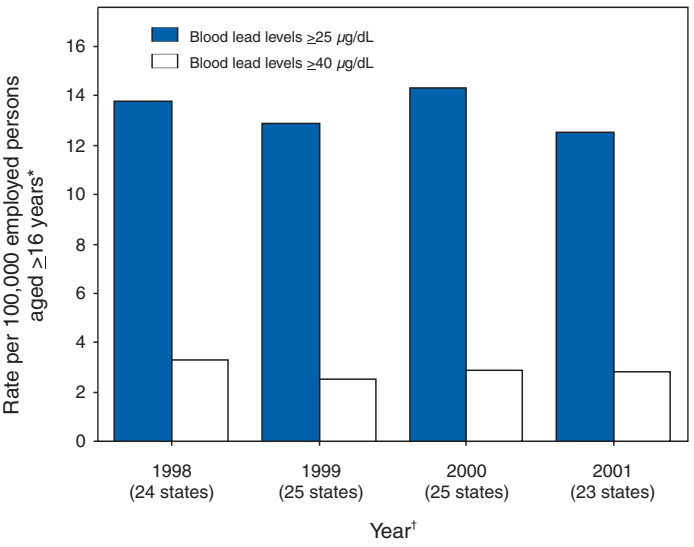
* Nebraska, 2 years of data; South Carolina, 3 years of data.

FIGURE 3. Mean annual percentages by state of total adults with blood lead levels ≥40 µg/dL as reported by 25 ABLES program states, 1998–2001*



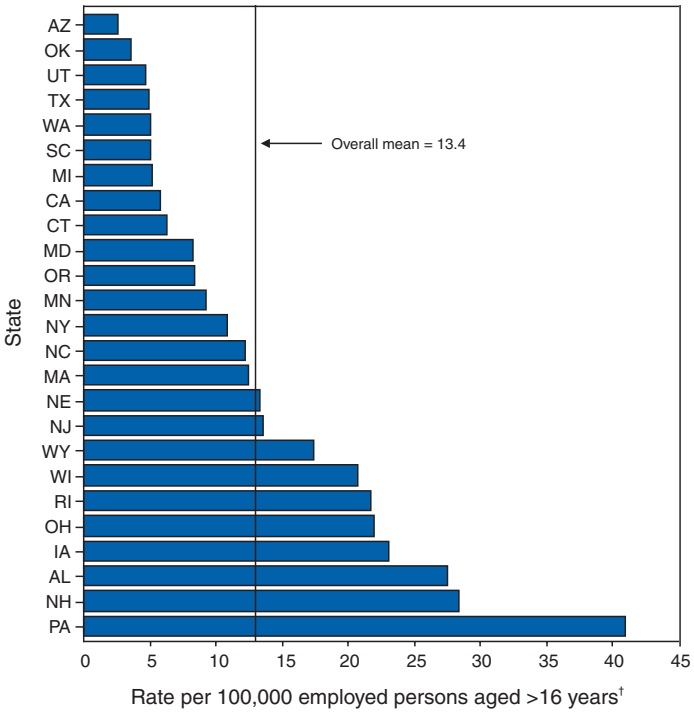
* Nebraska 2 years of data, South Carolina 3 years of data.

FIGURE 4. Mean annual state rates of adults with elevated blood lead levels, as reported by 25 ABLES program states, 1998–2001



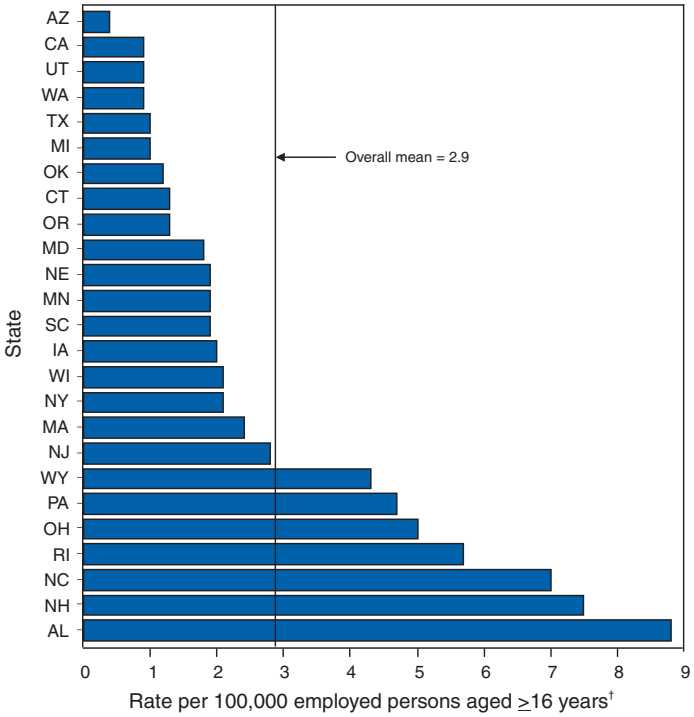
* **Source:** Bureau of Labor Statistics, Current Population Survey, 2001.
† Nebraska, 1999–2000 only; South Carolina, 2000 only.

FIGURE 5. Mean annual rate by state of adults with blood lead levels ≥25 µg/dL reported by 25 ABLES program states, 1998–2001



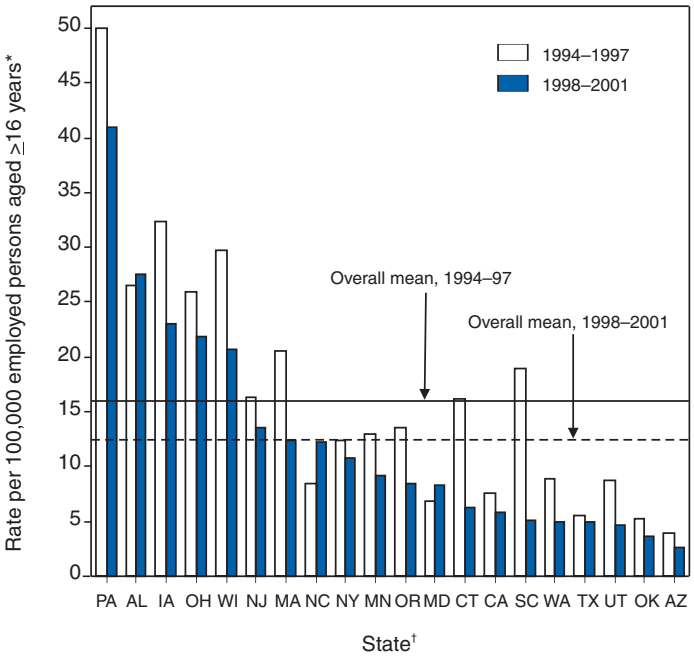
* Nebraska 2 years of data; South Carolina 3 years of data.
† **Source:** Bureau of Labor Statistics, Current Population Survey, 2001.

FIGURE 6. Mean annual rate by state of adults with blood lead levels ≥40 µg/dL reported by 25 ABLES program states, 1998–2001



*Nebraska, 2 years of data; South Carolina, 3 years of data.
†**Source:** Bureau of Labor Statistics, Current Population Survey, 2001.

FIGURE 7. Mean annual rates by state, 1998–2001 compared with 1994–1997, for adults with blood lead levels ≥25 µg/dL — 20 ABLES program states reporting data for ≥2 years in each period



*†**Source:** Bureau of Labor Statistics, Current Population Survey, 2001.
†South Carolina, 3 years of data (1998–2001); Ohio, 2 years of data; Alabama, Iowa, and Minnesota, 3 years of data (1994–1997).

To better illustrate the decline in BLL rates, the mean annual rates for the overall program are presented for the years 1994–1997 (Figure 9). From 1998 onward, with the exception of 2000, the rates for adults with BLLs ≥25 µg/dL decreased to <14/100,000. Likewise, the rates for adults with BLLs ≥40 µg/dL decreased to <3/100,000.

CDC/NIOSH funding has enabled surveillance and intervention activities among ABLES states that have contributed to the decline in adult BLLs. NIOSH increased its funding commitment, allowing the ABLES program to expand from 21 to 35 funded states for 2002 (Figure 10). Four of these additional 14 states were already providing data to ABLES (California, Nebraska, New Hampshire, and Utah); three resumed reporting (Illinois, Maine, and New Mexico); and seven were completely new (Florida, Georgia, Hawaii, Kansas, Kentucky, Missouri, and Montana).

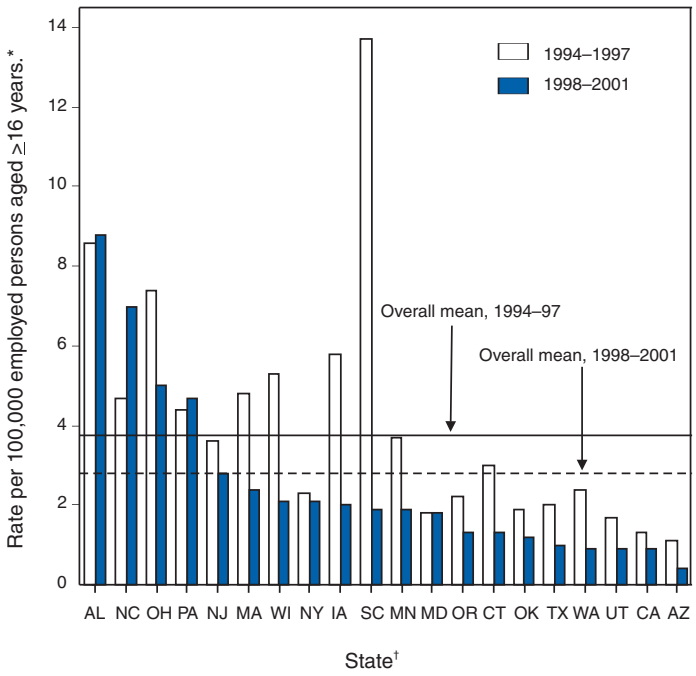
Discussion

This data analysis has certain limitations, including the numerators and denominators used in calculating the prevalence rates. The numerators are the numbers of adults with BLLs ≥25 or ≥40 µg/dL, as reported by the ABLES states. These numbers are likely underreported because 1) not all employers provide BLL testing to lead-exposed workers; and 2) to a lesser extent, certain laboratories might not be in compliance with reporting requirements. Additionally, certain states with workers at risk do not participate.

The denominators are the numbers of persons, aged ≥16 years, who were employed in the state during the year in question. An advantage of using the employed population as the denominator is that it excludes unemployed adults who have limited risk for lead exposure. A disadvantage of using the employed population is that the numbers include those whose jobs do not involve lead exposures.

State-to-state comparisons have been made in this report by using the data reported from the states to the ABLES program. Questions regarding the specifics of any state's reporting should be addressed to the ABLES contact from that state (state contacts are available at the ABLES website). Certain states publish in-depth analyses of their surveillance data, and these analyses provide the most complete descriptions (*13–14,25–26*).

FIGURE 8. Mean annual rates by state, 1998–2001 compared with 1994–1997, for adults with blood lead levels ≥40 µg/dL — 20 ABLES program states reporting data for ≥2 years in each period



* **Source:** Bureau of Labor Statistics, Current Population Survey, 2001.
† (1998–2001) South Carolina 3 years of data; (1994–1997) Ohio and Pennsylvania 2 years of data; Alabama, Iowa, and Minnesota, 3 years of data.

FIGURE 10. States funded for ABLES program by CDC/ National Institute for Occupational Safety and Health — United States, 2002

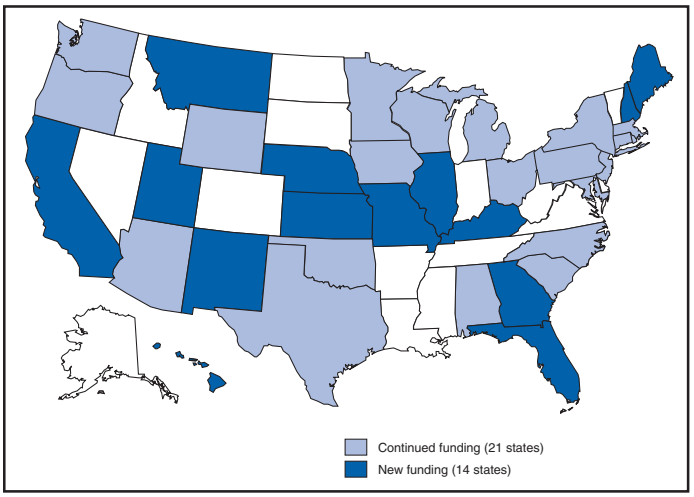
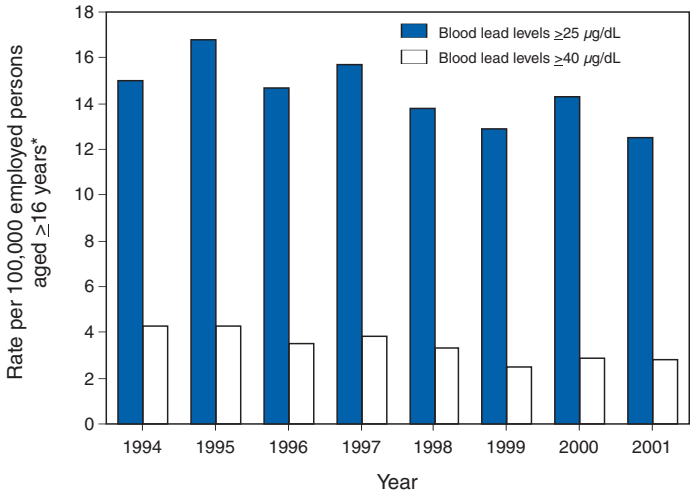


FIGURE 9. Mean annual state rates of adults with elevated blood lead levels, as reported by ABLES program states, 1994–2001



* **Source:** Bureau of Labor Statistics, Current Population Survey, 2001.

The decline in BLL rates observed in this analysis depends on continued, effective intervention and prevention efforts by ABLES program participants and their partners. For example,

- In California, high efficiency particulate air-exhausted power-sanding reduced paint dust exposure by approximately 80%–90% (*18*). Also, contractors and their employees can now make moderate improvements in lead safety practices if provided extensive training and technical assistance (*19*).
- In Michigan, follow up of companies identified with at least one worker with a BLL of 30–39 µg/dL was determined to be an effective method for targeting inspections, leading Michigan OSHA to follow up on all BLLs >25 µg/dL (*20*).
- In Washington, potentially exposed workers were identified through hazard surveillance and characterization of workplace knowledge and practices (through survey and registry), allowing targeting of resources toward industries most in need (*27*).

CDC/NIOSH continues to take steps to improve the ABLES program. In addition to expanding the program from 21 to 35 states, NIOSH stipulated that future ABLES data would be collected on an individual rather than aggregate basis. These individual data, providing information specific to occupation, industry, sex, and age, will be more useful to the efforts to reduce BLLs. With NIOSH assistance, persons from certain ABLES states are also developing clinical/laboratory guidelines that will help improve identification of lead

exposure and treatment by medical personnel of this often unrecognized and misunderstood public health problem (*11*). At the same time, CDC is working to implement greater standardization and efficiency for all its surveillance programs, including ABLES, under the National Electronic Disease Surveillance System.**

Other partners in the effort to reduce BLLs include the following:

- OSHA's National Emphasis Program to reduce occupational lead exposures;††
- voluntary lead-reducing initiatives by trade associations (e.g., Lead Industries Association Incorporated and Battery Council International);
- lead research and training programs for the construction industry offered by the Center to Protect Workers' Rights;§§ and
- lead initiatives taken by CSTE. In addition to collaborating with ABLES in developing the case definition for elevated BLLs among adults (*17*), CSTE also adopted the position that ABLES be designated the initial core component of state-based occupational health and safety surveillance (*34*), and coordinated development with ABLES of the CSTE occupational health surveillance indicator for lead (*35*). CSTE advocates that these occupational health surveillance indicators be collected in all 50 states and U.S. territories. CSTE has also called for a tightening of OSHA's lead standards (*36*).

Despite limitations and variations within the ABLES program, data indicate a declining trend in the number of adults with elevated BLLs. Because the program has increased in size and with the addition of more detailed reporting requirements, ABLES has increased its capability to offer data, intervention insights, and other assistance as it works toward its *Healthy People 2010* target of eliminating work-related BLLs ≥25 µg/dL among all adults by 2010 (*10*).

Acknowledgments

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** Available at http://www.cdc.gov/programs/research12.htm.
†† Available at http://www.osha-slc.gov/SLTC/lead/index.html.
§§ Available at http://www.cpwr.com.

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