

1998

Annual Report on Blood Lead Levels Among Adults in Michigan



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Summary:

This is the first annual report on surveillance of blood lead levels among Michigan adults. It is based on regulations that went into effect on October 11, 1997 that require laboratories to report all blood lead levels analyzed.

In 1998, 6,934 reports were received for 6,373 individuals ≥ 16 years of age. Nine hundred and nineteen (14.4%) individuals had blood lead levels greater than or equal to $10 \mu\text{g/dL}$; 303 of those 919 had lead levels greater than or equal to $25 \mu\text{g/dL}$ and 31 of those 303 had blood lead levels greater than or equal to $50 \mu\text{g/dL}$.

Individuals with blood lead levels greater than or equal to $10 \mu\text{g/dL}$ were more likely to be men (92%), white (84%), and have an average age of 40. They were most likely to live in Wayne, Muskegon, Ingham, Montcalm, and Ionia counties.

Occupational exposure was the predominant source of lead exposure in Michigan adults. These exposures typically occurred where individuals were casting brass or bronze fixtures, repairing car radiators, or performing abrasive blasting on outdoor metal structures such as bridges, overpasses or water towers. More unusual sources of exposure included: shooting ranges, printing, and a non-occupational source -- the ingestion of a contaminated spice.

Work place follow-up at 28 companies where individuals worked, with blood lead levels greater than or equal to $30 \mu\text{g/dL}$ showed that 22 of 28 (79%) were in violation of the lead standard.

The first year of operation of adult blood lead surveillance in Michigan proved successful in identifying a large number of individuals with elevated blood lead levels and sources of workplace exposures that could be remediated to reduce exposure and protect other lead-exposed employees from developing lead poisoning.

Background:

This is the first annual report on surveillance of blood lead levels among Michigan adults. Blood lead levels of Michigan residents, including children, have been monitored by the state since 1992. From 1992 to 1997, laboratories performing analyses of blood lead levels, primarily of children, had been voluntarily submitting reports 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 Department of Consumer and Industry Services (MDCIS) 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. As of January 1997, 21 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. In addition to the 21 states funded for ABLES, there are 7 unfunded states conducting similar surveillance programs.

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 MDCIS, under Part 56 of Public Act 368 of 1978 (Appendix I). Since October 11, 1997, laboratories performing blood lead analyses of Michigan residents are required to report the results of all blood lead levels (BLLs) to the Michigan Department of Community Health. 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 II). 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 5 working days.

All blood lead results on individuals 16 years or older are forwarded to the Michigan Department of Consumer and Industry Services for potential follow-up.

Laboratories

Only laboratories that meet the Occupational Safety and Health Administration (OSHA) requirements for blood lead analysis and are approved by OSHA can conduct a BLL test performed

under the lead standard for employer medical-screening. Appendix III 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 30 $\mu\text{g}/\text{dL}$ or higher are contacted for an interview. 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) Enforcement Inspections

In work places identified through the surveillance system, enforcement inspections are conducted to assess current lead related work activities and exposures. The company is responsible for correcting any violations of Michigan OSHA regulations and must post issued MIOSHA citations, for employee review. 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 $\mu\text{g}/\text{dL}$ or an average of three blood lead levels greater than 50 $\mu\text{g}/\text{dL}$ 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 $\mu\text{g}/\text{dL}$. 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 $\mu\text{g}/\text{dL}$.

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). (See Appendix IV for most recent quarterly summary).

Results:

1998 is the first 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 1998 as well as more detailed information from interviews of those adults with BLLs $30 \mu\text{g/dL}$ and greater. It also describes the Michigan Occupational Safety and Health Act (MIOSHA) inspections at the work sites where these individuals were exposed to lead.

Blood Lead Levels Reported in 1998

Number of Reports and Individuals

Between January 1 and December 31, 1998, the State of Michigan received 6,934 blood lead level reports for individuals 16 years of age or older. Because an individual may be tested more than once each year, the 6,934 reports received were for 6,373 individuals (Table 1). Of the 6,373 individuals, 6,059 were first reported to the state in 1998; the remaining 314 individuals were initially reported in 1997 and then again in 1998. The following descriptive statistics are based on the 6,373 individuals reported in 1998, and are based on the highest BLL reported for each of these adults.

In addition, 48 reports of individuals for whom age was unknown were received in 1998. Forty (40) of those individuals had blood lead levels less than $10 \mu\text{g/dL}$. The remaining eight (8) had blood lead levels between $12 \mu\text{g/dL}$ and $20 \mu\text{g/dL}$. These 48 individuals are not included in the statistics reported below.

Distribution of Blood Lead Levels

In 1998, 919 (14.4%) of the 6,373 adults reported had blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$; 303 of those 919 had blood lead levels greater than or equal to 25 $\mu\text{g}/\text{dL}$ and 31 of those 303 had blood lead levels greater than or equal to 50 $\mu\text{g}/\text{dL}$ (Table 1). A total of 5,454 (85.6%) of the adults reported in 1998 had BLLs less than 10 $\mu\text{g}/\text{dL}$.

Gender and Age Distribution

All Blood Lead Levels

Approximately two-thirds of the adults reported to the Registry were male (68.0%), with females representing one-third of the reports (32.0%). Gender was unknown for 15 adults reported (Table 2). The age distribution is shown in Table 3. The average age was 41.

Blood Lead Levels $\geq 10 \mu\text{g}/\text{dL}$

For the 919 adults reported to the Registry with blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$, 839 (91.7%) were men and 76 (8.3%) were women. Gender was unknown for 4 individuals (Table 2). The age distribution for these adults was similar to the reports of all BLLs. The average age was 40 (Table 3).

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 2,722 (42.7%) of the 6,373 adults reported. Where race was known, 3,026 (82.9%) were reported as white, 499 (13.7%) were reported as African American, 76 (2.1%) were reported as Native American, 27 (0.7%) were reported as Asian/Pacific Islander, and 22 (0.6%) were reported as multiracial (Table 4).

Blood Lead Levels $\geq 10 \mu\text{g}/\text{dL}$

For adults with blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$ where race was indicated, 508 (84%) were reported as white, 75 (12%) were reported as African American, 12 (2%) were reported as Native American, 4 (1%) were reported as Asian/Pacific Islander, and 3 (0.5%) were reported as multiracial (Table 4).

Geographic Distribution

The 6,373 adults were reported to the Registry from 82 of Michigan's 83 counties. The largest number of adults reported in 1998 lived in Wayne county (1344, 21.4%), followed by Oakland (675, 10.8%), Genesee (383, 6.1%), and Kent (382, 6.1%). County was unknown for 100 adults (Figure 1 and Table 5).

Figure 2 and Table 6 show the county of residence of the 919 adults with blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$. The largest number of adults reported with a BLL of 10 $\mu\text{g}/\text{dL}$ and greater were from Wayne county (140, 15.4%), followed by Muskegon (112, 12.3%), Ingham (79, 8.7%), Montcalm (65, 7.2%), and Ionia (49, 5.4%). Figure 3 and Table 7 show the county of residence for the 303 adults with blood lead levels greater than or equal to 25 $\mu\text{g}/\text{dL}$. The largest number of adults reported with a BLL of 25 $\mu\text{g}/\text{dL}$ and above were from Muskegon county (62, 21.0%), followed by Wayne (40, 13.6%), Montcalm (22, 7.5%), Ionia (19, 6.4%), and Oakland, Ottawa, and St. Clair (14, 47%) counties.

Figure 4 and Table 8 show the percentage of adults tested for blood lead within each county with BLLs of 10 $\mu\text{g}/\text{dL}$ or greater. Huron (10, 83.3%), Montcalm (65, 66.3%), Presque Isle (5, 62.5%), Ionia (49, 61.3%) and Muskegon (112, 51.0%) counties had the highest percentages of adults with BLLs of 10 $\mu\text{g}/\text{dL}$ or greater.

Figure 5 and Table 9 show the percentage of adults tested for blood lead within each county with BLLs of 25 $\mu\text{g}/\text{dL}$ or greater. Ontonagan (4, 30.8%), Muskegon (62, 28.2%), Ionia (19, 23.8%), and Montcalm (22, 22.4%) counties had the highest percentage of adults with BLLs of 25 $\mu\text{g}/\text{dL}$ or greater.

Figure 6 and Table 10 show the incidence rates of BLLs of 10 $\mu\text{g}/\text{dL}$ and above, by county, for women. There were 76 women reported in 1998 with a BLL of 10 $\mu\text{g}/\text{dL}$ or greater. Muskegon (26/100,000), Huron (14/100,000), and Oceana (12/100,000) had the 3 highest incidence rates.

Figure 7 and Table 11 show the incidence rates of BLLs of 10 $\mu\text{g}/\text{dL}$ and above, by county, for men. There were 827 men reported in 1998 with a BLL of 10 $\mu\text{g}/\text{dL}$ or greater. Montcalm (313/100,000),

Ionia (203/100,000) and Chippewa (187/100,000) had the 3 highest incidence rates. The overall incidence rate for men was 12 times higher than that for women (24/100,000 vs 2/100,000).

Industry

Table 12 shows the industries of 3,187 of the 6,373 adults who had blood lead levels tested in 1998, by blood lead levels. Industry was unknown for 3,179 adults. Seven individuals were not included in Table 12 since the source of lead exposure was known to be non-work.

The primary metal industry (Standard Industrial Classification (SIC) 33) which involves the casting of lead-containing brass (copper/zinc) and bronze (copper/tin) parts has the highest percentage of workers with blood lead levels greater than 25 $\mu\text{g}/\text{dL}$. Radiator repair businesses (SIC 55 and 75) had the next highest percentage of workers with a BLL greater than 25 $\mu\text{g}/\text{dL}$. Metal fabrication (SIC 34) and machinery manufacturing (SIC 35) had workers with elevated blood lead levels exposed to lead from similar casting operations as the primary metal companies; however the casting operation was only one part of these industries' overall operations. The company classified as conducting repair activities (SIC 76) provided welding services to a brass foundry. Construction companies performing abrasive blasting of outdoor metal structures such as bridges, overpasses and water towers had a high percentage (10.5%) of workers with blood lead levels greater than 25 $\mu\text{g}/\text{dL}$.

For a number of industries such as food stores (SIC 54), eating and drinking establishments (SIC 58), and education (SIC 82) there was no information on the source of lead exposure.

Figure 8 shows the distribution of non-construction companies that reported at least one adult with a BLL of 30 $\mu\text{g}/\text{dL}$ or greater in Michigan during 1998. These companies primarily perform brass/bronze casting operations or radiator repair activities.

Interviews of Adults with Blood Lead Levels of 30 $\mu\text{g}/\text{dL}$ or Greater

Between October 15, 1997 and March 1, 1999 there were 227 reports received of adults with blood lead levels ≥ 30 $\mu\text{g}/\text{dL}$. One hundred forty-two of these individuals completed an interview by telephone and 35 had questionnaires completed from a review of their medical records. Forty-two adults are still in the process of being contacted. Another eight adults were followed up by a local

health department because their exposure to lead occurred from ingestion of a spice that was contaminated with lead (4). The following summary of interview data is based on the 177 questionnaires completed by telephone or using medical records. These 177 adults were reported to the Registry from October 15, 1997 to February 23, 1999.

Table 13 lists the demographic characteristics of the 177 adults with completed questionnaires by highest lead level reported. Most of the completed questionnaires were of males (95.5%), which parallels the gender distribution of the total number of lead level reports submitted for adults in 1998. 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 14 presents the types of lead-related symptoms reported during the interviews, by lead level. Continued loss of appetite, muscle weakness, and feeling depressed were associated with increasingly higher levels of blood lead. Table 15 shows the reporting of lead-related diseases by lead level category.

Table 16 presents the type of industry by lead level reported among those interviewed. Overall, almost half worked in brass/bronze foundries, followed by over 30% working in construction. However, there was a higher percentage of workers in construction (80%) at the highest lead levels reported, compared to foundries. Table 17 presents the number of years worked by highest lead level reported for the adults who completed a questionnaire. The shorter term workers (i.e. worked in a lead exposed job for 5 or fewer years) were more likely to have higher blood lead level results.

Table 18 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 a showering facility and a separate 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. One-third of the adults interviewed reported children age 6 and younger living or spending time in the home (Table 19). Four of the 48 children potentially exposed had an elevated lead level.

Twenty-eight workplace inspections were conducted to follow-up on the report of an adult blood lead level of 30 $\mu\text{g}/\text{dL}$ or greater. Twenty-two of the 28 (79%) companies inspected were cited for violations of the lead standard (Table 20). The most common citations were failure to train employees (68.2%), failure to perform air monitoring for lead (50.0%) and failure to provide showers (41.0%) (Table 21).

Six companies were not found to be in violation of the lead standard for the following reasons: lead operation had been shut down (1 company); lead exposure occurred out of state (1 company); and the company inspected turned out not to be the source of the lead exposure (4 companies).

Case Histories

The most common source of work place lead exposure in Michigan is from removing paint from outdoor metal structures, such as overpasses, bridges and water towers. Exposure to lead while casting brass or bronze is the second most common source of work exposure reported. Two examples of both the clinical presentation and industrial hygiene follow up are illustrated below.

Case History #1: Elevated Lead Levels in an Abrasive Blaster

A man in his early 30's was reported with a blood lead level of 39 $\mu\text{g}/\text{dL}$. He reported the following symptoms: loss of more than 10 pounds without dieting, weekly headaches, feeling sad, being tired all the time, feeling nervous, waking up nightly, being irritable, being unable to concentrate, having frequent pain or soreness in his joints and muscle weakness. He denied loss of appetite, pains in his belly, dizziness, nightmares, reduced blood count, kidney disease or high blood pressure.

He had been working for four years as a sandblaster and doing painting of water towers. He had been removed from work three years prior because of blood lead levels in the 40 $\mu\text{g}/\text{dL}$ range. He had never been chelated. He was a cigarette smoker and smoked in his work area. He wore a respirator at work for six hours a day.

The painting company was inspected by MIOSHA and cited for the following: 1) failure to determine air lead exposure levels during work, 2) failure to provide adequate respirator protection, 3) failure to include zinc protoporphyrin (ZPP) monitoring as part of medical surveillance, 4) failure to have a written compliance program to control lead exposure, 5) failure to update the company's written compliance program, 6) failure to develop and implement a hazard communication program (training of workers on exposures and health effects), 7) failure to have material safety data sheets for hazardous chemicals being used, and 8) failure to maintain a record of recordable work-related injuries and illnesses. The company was fined \$600. There were 50 other workers who worked in the same area and six who did the same jobs as the index case who potentially benefitted from the inspection.

Case History #2: Elevated Lead Level in a Brass Foundry Worker

A woman in her late 40's was reported with a blood lead level of 44 $\mu\text{g}/\text{dL}$. She reported the following symptoms: pains in her belly associated with eating and constipation; frequent pain or soreness in her joints; muscle weariness; daily headaches; infrequent dizziness; being tired all the time and being irritable. She denied weight loss, loss of appetite, feeling nervous, waking up at night, nightmares and being unable to concentrate. She had never been told her blood count was reduced. She had kidney problems for 14 years and had been diagnosed and was being treated for high blood pressure which began after her blood lead level was noted to be elevated.

She worked at a brass foundry for 10 years, the last six years as a grinder. She had never been removed from her job because of high blood lead levels and had never received chelation. She smoked cigarettes but did not bring her cigarettes into work.

The company was inspected by MIOSHA and cited for the following: 1) failure to evaluate the workplace to determine if any spaces were permit-required confined spaces, 2) failure to inform workers of the existence of and danger posed by confined spaces, 3) failure to develop a written confined space entry program, 4) failure to train workers on confined space entry, 5) failure to provide hepatitis B vaccination to members of the company's medical emergency response team, 6) failure to provide training to members of the company's medical emergency response team, 7) failure to perform air monitoring for lead, 8) failure to maintain work surfaces free of lead-containing powder, 9) failure provide a high efficiency particulate filter vacuum to remove lead accumulations, 10) failure to institute a medical surveillance program for each employee exposed to lead, and 11) failure to provide training to employees on the hazards of lead. The company was fined \$8,250. There were 300 other workers who worked in the same area and 30 who did the same jobs as the index case who potentially benefitted from the inspection.

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 MDCIS and maintained in the ABLES Program Lead Registry. If the individual has a blood lead level of 30 $\mu\text{g}/\text{dL}$ or greater, they are then interviewed by a trained medical interviewer by telephone. The interview details demographic information, exposure history and the presence and nature of lead related symptoms. In some instances a MIOSHA enforcement inspection is conducted to document current exposures to lead at work and the company's compliance with the lead standard.

Michigan is one of 28 states conducting surveillance of elevated blood lead levels. Michigan requires the reporting of all 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 (1). 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 (2). A further problem is that workers can bring lead home on their clothes and expose children to lead. Children can experience serious health effects from lower levels of lead exposure compared to adults.

Average blood lead levels in the United States general population range from 2.1 to 3.4 $\mu\text{g}/\text{dL}$ with 1.5 to 4.6% of adults tested for blood lead having blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$ (3). 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 $\mu\text{g}/\text{dL}$ for these sub populations are not clinically significantly different (3). A blood lead level greater than or equal to 10 $\mu\text{g}/\text{dL}$ is an indication of exposure and increased absorption of lead regardless of age, race and gender.

In 1998, there were 919 adults reported in Michigan with blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$. Ninety-two percent were men. The average age was 40. They were predominately white (84.3%). They predominately resided in a band of counties stretching across the state from Muskegon and Oceana to Wayne and Macomb. 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, or among workers repairing car radiators.

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 (4,5).

Thirty-one adults had blood lead levels above 50 $\mu\text{g}/\text{dL}$, which is the maximum blood lead level allowed in the work place. Ten of these 31 adults were exposed to lead while performing abrasive blasting on outdoor metal structures, 12 while casting brass or bronze, 2 while doing radiator repair, and 7 from ingesting a food spice.

Industries which casted brass or bronze had the highest percentage of workers with blood lead levels

greater than or equal to 25 $\mu\text{g}/\text{dL}$ (45.2%), followed by radiator repair (23.8%), metal fabrication facilities that had brass or bronze casting as part of their operation (12.7%), and bridge and water tower contract painters with 10.5% of their workers having a 25 $\mu\text{g}/\text{dL}$ or greater blood lead levels.

An inspection was conducted at 28 companies where a worker was reported with a blood lead level $\geq 30 \mu\text{g}/\text{dL}$. Twenty-two of 28 (79%) of these companies were cited for violations of the lead standard (Table 20). Citations were for all aspects of the standard including lack of training, lack of air and medical monitoring, lack of respiratory protection, lack of proper housekeeping procedures, and lack of hygiene facilities such as showers and separate lockers for street and work clothes (Table 21).

Highlights of the interview results include finding that individuals with the higher blood lead levels were significantly less likely to have a shower facility or lead-free lunch room at their workplace (Table 18).

In its first year of operation the surveillance system for lead proved successful in identifying large numbers of adults with elevated lead levels and sources of exposure that could be remediated to reduce exposures. Plans in the coming year include monitoring laboratories to assure complete reporting and to continue the evaluation of the sources of adult exposures to lead in order to identify strategies to reduce lead exposure among Michigan residents.

References

1. Adult Blood Lead Epidemiology and Surveillance. Morbidity and Mortality Weekly Report . MMWR. 1996; 45:919-920.
2. ATSDR. Toxicological Profile for Lead. US Department of Health Human Services. Agency for Toxic Substances and Disease Registry. August 1997.
3. Pirkle J.L., Kaufmann R.B., Brody D.J., Hickman T., Gunter E.W., Paschal D.C. Exposure of the US Population to Lead, 1991-1994. Environmental Health Perspectives 1998; 106:745-750.
4. Baser ME. The Development of Registries for Surveillance of Adult Lead Exposure, 1981 to 1992. American Journal of Public Health. 1992; 82: 1113-1118.
5. Rudolph L, Sharp DS, Samuels S, Perkins C, Rosenberg J. Environmental and Biological Monitoring for Lead Exposure in California Workplaces. American Journal of Public Health 1990; 80: 921-925.

Appendices

Appendix I	Michigan Occupational Disease Reporting Form & Law
Appendix II	Blood Lead Analysis Report Form
Appendix III	OSHA Blood Lead Laboratories
Appendix IV	MMWR Summary

Table 1. Distribution of Highest Blood Lead Levels (BLLs) Among Adults* Reported During 1998

<u>BLLs (µg/dL)</u>	<u>Number</u>	<u>Percent</u>
<10	5,454	85.6
10-24	616	9.7
25-29	111	1.7
30-39	120	1.9
40-49	41	0.6
50-59	24	0.4
≥ 60	7	0.1
TOTAL	6,373	100.0

*In 1998, 6,934 BLL reports were received for 6,373 individuals.

Table 2. Distribution of Gender Among Adults Tested for Blood Lead in Michigan: 1998

<u>Gender</u>	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 $\mu\text{g/dL}$	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Male	4,315	68	839	91.7
Female	2,043	32	76	8.3
TOTAL	6,358*	100	915**	100.0

* Gender was unknown for 15 individuals.

** Gender was unknown for 4 individuals.

Table 3. Distribution of Decade of Birth Among Adults Tested for Blood Lead in Michigan: 1998

<u>Decade of Birth</u>	<u>All Blood Lead Level Tests</u>		<u>Blood Lead Levels ≥ 10 $\mu\text{g/dL}$</u>	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
1980s	346	5.4	3	0.3
1970s	1,119	17.5	156	17.0
1960s	1,583	24.8	283	30.8
1950s	1,628	25.5	250	27.2
1940s	931	14.6	167	18.2
1930s	357	5.6	43	4.7
1920s	270	4.2	13	1.4
1910s	123	1.9	4	0.4
1900s	16	0.3		
TOTAL	6,373	99.8*	919	100.0

*Percentages do not add to 100% due to rounding.

**Table 4. Distribution of Race Among Adults Tested
for Blood Lead in Michigan: 1998**

<u>Race</u>	All Blood Lead Level Tests		Blood Lead Levels \geq 10 μg/dL	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Caucasian	3,026	82.9	508	84.3
African American	499	13.7	75	12.5
Native American	76	2.1	12	2.0
Asian/Pacific Islander	27	0.7	4	0.7
Multiracial	22	0.6	3	0.5
TOTAL	3,650*	100.0	602**	100.0

*Race was unknown for 2,723 individuals.

**Race was unknown for 317 individuals.

Table 5. Distribution of Adults Tested for Blood Lead in Michigan by County of Residence: 1998

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	6	0.1	Keweenaw	-	-
Alger	8	0.1	Lake	4	0.1
Allegan	42	0.7	Lapeer	37	0.6
Alpena	22	0.4	Leelanau	4	0.1
Antrim	5	0.1	Lenawee	78	1.2
Arenac	4	0.1	Livingston	56	1.0
Baraga	6	0.1	Luce	5	0.1
Barry	17	0.3	Mackinac	21	0.3
Bay	62	1.0	Macomb	304	4.8
Benzie	4	0.1	Manistee	12	0.2
Berrien	71	1.1	Marquette	50	1.0
Branch	21	0.3	Mason	5	0.1
Calhoun	66	1.1	Mecosta	15	0.2
Cass	8	0.1	Menominee	8	0.1
Charlevoix	33	0.5	Midland	43	0.7
Cheboygan	22	0.4	Missaukee	5	0.1
Chippewa	114	1.8	Monroe	193	3.1
Clare	49	0.8	Montcalm	98	1.6
Clinton	52	0.8	Montmorency	11	0.2
Crawford	9	0.1	Muskegon	220	3.5
Delta	19	0.3	Newaygo	28	0.4
Dickinson	15	0.2	Oakland	675	10.8
Eaton	28	0.4	Oceana	15	0.2
Emmet	31	0.5	Ogemaw	4	0.1
Genesee	383	6.1	Ontonagon	13	0.2
Gladwin	22	0.4	Osceola	8	0.1
Gogebic	9	0.1	Oscoda	2	0.3
Grand Traverse	38	0.6	Otsego	10	0.2
Gratiot	20	0.3	Ottawa	155	2.5
Hillsdale	26	0.4	Presque Isle	8	0.1
Houghton	21	0.3	Roscommon	4	0.1
Huron	12	0.2	Saginaw	119	1.9
Ingham	242	3.9	St Clair	168	2.7
Ionia	80	1.3	St Joseph	21	0.3
Iosco	11	0.2	Sanilac	24	0.4
Iron	1	0.02	Schoolcraft	11	0.2
Isabella	17	0.3	Shiawassee	36	0.6
Jackson	103	1.6	Tuscola	21	0.3
Kalamazoo	129	2.1	Van Buren	22	0.4
Kalkaska	7	0.1	Washtenaw	181	2.9
Kent	382	6.1	Wayne	1,344	21.4
			Wexford	18	0.3
			TOTAL	6,273*	100.5**

*County was unknown for 100 adults.

**Percentages do not add to 100% due to rounding.

Table 6. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 10 $\mu\text{g}/\text{dL}$ in Michigan by County of Residence: 1998

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	-	-	Keweenaw	-	-
Alger	2	0.2	Lake	-	-
Allegan	1	0.1	Lapeer	3	0.3
Alpena	-	-	Leelanau	-	-
Antrim	1	0.1	Lenawee	7	0.8
Arenac	-	-	Livingston	6	0.7
Baraga	-	-	Luce	-	-
Barry	1	0.1	Mackinac	2	0.2
Bay	1	0.1	Macomb	44	4.9
Benzie	-	-	Manistee	1	0.1
Berrien	6	0.7	Marquette	13	1.4
Branch	2	0.2	Mason	1	0.1
Calhoun	1	0.1	Mecosta	4	0.4
Cass	1	0.1	Menominee	2	0.2
Charlevoix	1	0.1	Midland	6	0.7
Cheboygan	1	0.1	Missaukee	1	0.1
Chippewa	29	3.2	Monroe	12	1.3
Clare	1	0.1	Montcalm	65	7.1
Clinton	26	2.9	Montmorency	-	-
Crawford	1	0.1	Muskegon	112	12.3
Delta	2	0.2	Newaygo	6	0.7
Dickinson	2	0.2	Oakland	48	5.3
Eaton	2	0.2	Oceana	6	0.7
Emmet	3	0.3	Ogemaw	-	-
Genesee	34	3.7	Ontonagon	6	0.7
Gladwin	1	0.1	Osceola	-	-
Gogebic	2	0.2	Oscoda	-	-
Grand Traverse	-	-	Otsego	-	-
Gratiot	6	0.7	Ottawa	29	3.2
Hillsdale	6	0.7	Presque Isle	5	0.6
Houghton	2	0.2	Roscommon	-	-
Huron	10	1.1	Saginaw	11	1.2
Ingham	79	8.7	St Clair	27	3.0
Ionia	49	5.4	St Joseph	1	0.1
Iosco	1	0.1	Sanilac	4	0.4
Iron	-	-	Schoolcraft	1	0.1
Isabella	1	0.1	Shiawassee	8	0.9
Jackson	14	1.5	Tuscola	-	-
Kalamazoo	3	0.3	Van Buren	1	0.1
Kalkaska	1	0.1	Washtenaw	10	1.1
Kent	32	3.5	Wayne	140	15.4
			Wexford	-	-
			TOTAL	907*	99.6**

*County was unknown for 12 adults.

**Percentages do not add to 100% due to rounding.

Table 7. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 25 $\mu\text{g}/\text{dL}$ in Michigan by County of Residence: 1998

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	-	-	Keweenaw	-	-
Alger	-	-	Lake	-	-
Allegan	-	-	Lapeer	1	0.3
Alpena	-	-	Leelanau	-	-
Antrim	1	0.3	Lenawee	2	1.0
Arenac	-	-	Livingston	1	0.3
Baraga	-	-	Luce	-	-
Barry	-	-	Mackinac	-	-
Bay	1	0.3	Macomb	12	4.1
Benzie	-	-	Manistee	-	-
Berrien	3	1.0	Marquette	4	1.4
Branch	2	1.0	Mason	-	-
Calhoun	-	-	Mecosta	-	-
Cass	-	-	Menominee	-	-
Charlevoix	-	-	Midland	1	0.3
Cheboygan	-	-	Missaukee	1	0.3
Chippewa	7	2.4	Monroe	3	1.0
Clare	1	0.3	Montcalm	22	7.5
Clinton	8	2.7	Montmorency	-	-
Crawford	-	-	Muskegon	62	21.0
Delta	-	-	Newaygo	2	1.0
Dickinson	2	1.0	Oakland	14	4.7
Eaton	-	-	Oceana	3	1.0
Emmet	-	-	Ogemaw	-	-
Genesee	10	3.4	Ontonagon	4	1.4
Gladwin	-	-	Osceola	-	-
Gogebic	-	-	Oscoda	-	-
Grand Traverse	-	-	Otsego	-	-
Gratiot	3	1.0	Ottawa	14	4.7
Hillsdale	1	0.3	Presque Isle	-	-
Houghton	1	0.3	Roscommon	-	-
Huron	2	1.0	Saginaw	4	1.4
Ingham	10	3.4	St Clair	14	4.7
Ionia	19	6.4	St Joseph	-	-
Iosca	-	-	Sanilac	1	0.3
Iron	-	-	Schoolcraft	-	-
Isabella	-	-	Shiawassee	-	-
Jackson	8	2.7	Tuscola	-	-
Kalamazoo	-	-	Van Buren	1	0.3
Kalkaska	1	0.3	Washtenaw	2	1.0
Kent	7	2.4	Wayne	40	13.6
			Wexford	-	-
			TOTAL	295*	101.5**

*County was unknown for 8 adults.

** Percentages do not add to 100% due to rounding.

Table 8. Percentage* of Adults with Blood Lead Levels (BLLs) ≥ 10 $\mu\text{g}/\text{dL}$ in Michigan by County of Residence: 1998

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	-	-	Keweenaw	-	-
Alger	2	25.0	Lake	-	-
Allegan	1	2.4	Lapeer	3	8.1
Alpena	-	-	Leelanau	-	-
Antrim	1	20.0	Lenawee	7	9.0
Arenac	-	-	Livingston	6	10.7
Baraga	-	-	Luce	-	-
Barry	1	5.9	Mackinac	2	9.5
Bay	1	1.6	Macomb	44	14.5
Benzie	-	-	Manistee	1	8.3
Berrien	6	8.5	Marquette	13	26.0
Branch	2	9.5	Mason	1	20.0
Calhoun	1	1.5	Mecosta	4	26.7
Cass	1	12.5	Menominee	2	25.0
Charlevoix	1	3.0	Midland	6	14.0
Cheboygan	1	4.5	Missaukee	1	20.0
Chippewa	29	25.9	Monroe	12	6.2
Clare	1	2.0	Montcalm	65	66.3
Clinton	26	50.0	Montmorency	-	-
Crawford	1	11.1	Muskegon	112	51.0
Delta	2	10.5	Newaygo	6	21.4
Dickinson	2	13.3	Oakland	48	7.2
Eaton	2	7.1	Oceana	6	40.0
Emmet	3	9.7	Ogemaw	-	-
Genesee	34	8.9	Ontonagon	6	46.2
Gladwin	1	4.5	Osceola	-	-
Gogebic	2	22.2	Oscoda	-	-
Grand Traverse	-	-	Otsego	-	-
Gratiot	6	30.0	Ottawa	29	18.7
Hillsdale	6	23.1	Presque Isle	5	62.5
Houghton	2	10.0	Roscommon	-	-
Huron	10	83.3	Saginaw	11	9.2
Ingham	79	32.6	St Clair	27	16.1
Ionia	49	61.3	St Joseph	1	4.8
Iosco	1	9.1	Sanilac	4	16.7
Iron	-	-	Schoolcraft	1	10.0
Isabella	1	5.9	Shiawassee	8	22.2
Jackson	14	13.6	Tuscola	-	-
Kalamazoo	3	2.3	Van Buren	1	4.5
Kalkaska	1	14.3	Washtenaw	10	5.5
Kent	32	8.4	Wayne	140	10.5
			Wexford	-	-
			TOTAL	907**	14.5

*Denominator used was the total number of adults tested for blood lead within each county (Table 5).

**County was unknown for 12 adults.

Table 9. Percentage* of Adults with Blood Lead Levels (BLLs) ≥ 25 $\mu\text{g}/\text{dL}$ in Michigan by County of Residence: 1998

<u>County</u>	<u>Number</u>	<u>Percentage</u>	<u>County</u>	<u>Number</u>	<u>Percentage</u>
Alcona	-	-	Keweenaw	-	-
Alger	-	-	Lake	-	-
Allegan	-	-	Lapeer	1	2.7
Alpena	-	-	Leelanau	-	-
Antrim	1	20.0	Lenawee	2	2.6
Arenac	-	-	Livingston	1	1.8
Baraga	-	-	Luce	-	-
Barry	-	-	Mackinac	-	-
Bay	1	1.6	Macomb	12	3.9
Benzie	-	-	Manistee	-	-
Berrien	3	4.2	Marquette	4	8.0
Branch	2	9.5	Mason	-	-
Calhoun	-	-	Mecosta	-	-
Cass	-	-	Menominee	-	-
Charlevoix	-	-	Midland	1	2.3
Cheboygan	-	-	Missaukee	1	20.0
Chippewa	7	6.3	Monroe	3	1.6
Clare	1	2.0	Montcalm	22	22.4
Clinton	8	15.4	Montmorency	-	-
Crawford	-	-	Muskegon	62	28.2
Delta	-	-	Newaygo	2	7.1
Dickinson	2	13.3	Oakland	14	2.1
Eaton	-	-	Oceana	3	20.0
Emmet	-	-	Ogemaw	-	-
Genesee	10	2.6	Ontonagon	4	30.8
Gladwin	-	-	Osceola	-	-
Gogebic	-	-	Oscoda	-	-
Grand Traverse	-	-	Otsego	-	-
Gratiot	3	15.0	Ottawa	14	9.0
Hillsdale	1	3.8	Presque Isle	-	-
Houghton	1	5.0	Roscommon	-	-
Huron	2	16.7	Saginaw	4	3.4
Ingham	10	4.1	St Clair	14	8.3
Ionia	19	23.8	St Joseph	-	-
Iosco	-	-	Sanilac	1	4.2
Iron	-	-	Schoolcraft	-	-
Isabella	-	-	Shiawassee	-	-
Jackson	8	7.8	Tuscola	-	-
Kalamazoo	-	-	Van Buren	1	4.5
Kalkaska	1	14.3	Washtenaw	2	1.1
Kent	7	1.8	Wayne	40	3.0
			Wexford	-	-
			TOTAL	295**	4.7

*Denominator used was the total number of adults tested for blood lead within each county (Table 5).

**County was unknown for 8 adults.

**Table 10. Annual Incidence of Blood Lead Levels (BLLs)
 ≥ 10 ug/dL Among Women in Michigan
 by County of Residence: 1998**

<u>County</u>	<u>Number Reported</u>	<u>Michigan Population Women</u>	<u>Rate per 100,000 women</u>
Dickinson	1	10,686	9
Genesee	4	171,668	2
Huron	2	13,837	14
Ingham	2	116,067	2
Ionia	2	19,544	10
Kalamazoo	1	91,903	1
Kent	3	195,307	2
Lenawee	1	35,478	3
Macomb	3	294,538	1
Marquette	2	26,932	7
Mecosta	1	14,576	7
Montcalm	2	19,511	10
Muskegon	16	61,686	26
Newaygo	1	14,487	7
Oakland	12	440,572	3
Oceana	1	8,451	12
Ottawa	8	70,929	11
Shiawassee	1	27,194	4
Wayne	13	861,959	2
TOTAL	76*	3,712,439**	2***

*Gender was unknown for 4 adults.

**Total number of women in all 83 counties of Michigan age 16+ years; 1990 US. Census population data.

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

Table 11. Annual Incidence of Blood Lead Levels (BLLs) ≥ 10 ug/dL Among Men in Michigan by County of Residence: 1998

<u>County</u>	<u>Number Reported</u>	<u>Michigan Population Men</u>	<u>Rate per 100,000 Men</u>
Alger	2	3,616	55
Allegan	1	32,498	3
Antrim	1	6,747	15
Barry	1	18,651	5
Bay	1	40,726	2
Berrien	6	57,584	10
Branch	2	14,851	13
Calhoun	1	49,100	2
Cass	1	18,187	5
Charlevoix	1	7,848	13
Cheboygan	1	7,829	13
Chippewa	29	15,524	187
Clare	1	9,133	11
Clinton	26	21,118	123
Crawford	1	4,739	21
Delta	2	13,715	15
Dickinson	1	9,911	10
Eaton	2	33,625	6
Emmet	3	9,043	33
Genesee	30	151,753	20
Gladwin	1	8,091	12
Gogebic	2	7,098	28
Gratiot	6	14,078	43
Hillsdale	6	15,665	38
Houghton	2	15,071	13
Huron	8	12,771	63
Ingham	77	104,140	74
Ionia	47	23,154	203
Iosco	1	11,341	9
Isabella	1	20,414	5
Jackson	14	58,480	24
Kalamazoo	2	82,532	2
Kalkaska	1	4,914	20
Kent	29	176,836	16
Lapeer	3	27,394	11
Lenawee	6	33,298	18
Livingston	6	43,352	14
Mackinac	2	4,014	50
Macomb	41	270,303	15
Manistee	1	8,045	12
Marquette	11	27,467	40
Mason	1	9,342	11
Mecosta	3	15,424	19

Table 11. Annual Incidence of Blood Lead Levels (BLLs) ≥ 10 ug/dL Among Men in Michigan by County of Residence: 1998

<u>County</u>	<u>Number Reported</u>	<u>Michigan Population Men</u>	<u>Rate per 100,000 Men</u>
Menominee	2	9,273	22
Midland	6	27,812	22
Missaukee	1	4,363	23
Monroe	12	48,450	25
Montcalm	63	20,116	313
Muskegon	95	57,143	166
Newaygo	5	13,609	37
Oakland	33	404,134	8
Oceana	5	8,062	62
Ontonagon	6	3,543	169
Ottawa	21	67,092	31
Presque Isle	5	5,180	97
Saginaw	11	74,145	15
St Clair	28	52,442	53
Sanilac	4	14,495	28
Schoolcraft	1	3,032	33
Shiawassee	7	25,031	28
Van Buren	1	24,797	4
Washtenaw	10	111,653	9
Wayne	127	743,467	17
TOTAL	827*	3,391,310**	24***

*Gender was unknown for 4 adults and county was unknown for 12 male adults.

**Total number of men in all 83 counties of Michigan age 16+ years; 1990 US. Census population data.

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

**Table 12. Distribution of Industry Among Adults in Michigan
by Blood Lead Level (ug/dL): 1998**

Standard Industrial Classification (SIC)	<10 ug/dL	10-24 ug/dL	25-39 ug/dL	40-49 ug/dL	50-59 ug/dL	60+ ug/dL	Total	% 25+ ug/dL
AGRICULTURE (01-07)	5	0	0	0	0	0	5	0.0
CONSTRUCTION AND MINING (10-17)	510	124	51	13	6	4	708	10.5
Mining (10-14)	1	0	0	0	0	0	1	0.0
Other Construction (15-16)	13	1	1	0	0	0	15	6.7
Special Trade Construction (17)	496	123	50	13	6	4	692	10.5
MANUFACTURING (20-39)	992	261	127	23	12	1	1,416	11.5
Food (20)	8	1	0	0	0	0	9	0.0
Textile Mill Products (22)	1	0	0	0	0	0	1	0.0
Lumber and Wood (24)	10	1	0	0	0	0	11	0.0
Furniture and Fixtures (25)	4	0	0	0	0	0	4	0.0
Paper (26)	2	0	0	0	0	0	2	0.0
Printing (27)	30	1	2	0	0	0	33	6.1
Chemicals (28)	188	1	0	0	0	0	189	0.0
Rubber (30)	10	3	0	0	0	0	13	0.0
Stone/Clay/Glass(32)	22	2	0	0	0	0	24	0.0
Primary Metals (33)	66	85	96	16	10	1	274	44.9
Metal Fabrication (34)	75	119	22	5	0	0	221	12.2
Machinery (35)	58	6	3	0	2	0	69	7.2
Electronics (36)	35	2	0	0	0	0	37	0.0
Transportation (37)	411	22	1	2	0	0	436	0.7
Measuring Instruments (38)	7	0	0	0	0	0	7	0.0
Miscellaneous Mfg Industries (39)	65	18	3	0	0	0	86	3.5
TRANSP., & PUBLIC UTILITIES (40-49)	168	16	1	0	0	0	185	0.5
WHOLESALE AND RETAIL TRADE (50-59)	69	9	4	0	0	0	82	4.9
Wholesale-Durable Goods (50)	25	1	0	0	0	0	26	0.0
Wholesale-Nondurable Goods (51)	1	0	0	0	0	0	11	0.0
General Merchandise Stores (53)	13	0	0	0	0	0	13	0.0
Food Stores (54)	5	0	1	0	0	0	6	16.7
Automotive Dealers, Gasoline Services (55)	5	7	2	0	0	0	14	14.3
Miscellaneous Apparel, Accessory Stores (56)	3	0	0	0	0	0	3	0.0
Eating and Drinking Places (58)	8	0	1	0	0	0	10	11.1
Other Retail Trade (59)	9	1	0	0	0	0	10	0.0

**Table 12. Distribution of Industry Among Adults in Michigan
by Blood Lead Level (ug/dL): 1998**

Standard Industrial Classification (SIC)	<10 ug/dL	10-24 ug/dL	25-39 ug/dL	40-49 ug/dL	50-59 ug/dL	60+ ug/dL	Total	% 25+ ug/dL
FINANCE, INSURANCE, REAL ESTATE (60-67)	15	0	0	0	0	0	15	0.0
SERVICES (70-89)	510	36	8	2	2	0	558	2.2
Hotels (70)	2	0	0	0	0	0	2	0.0
Business (73)	15	1	0	0	0	0	16	0.0
Automotive Repair (75)	6	14	4	1	2	0	27	26.0
Repair (76)	3	0	0	1	0	0	4	25.0
Recreation (79)	2	0	0	0	0	0	2	0.0
Health (80)	70	0	1	0	0	0	71	1.4
Education (82)	86	3	2	0	0	0	91	2.2
Social Services (83)	0	3	0	0	0	0	3	0.0
Engineering Services (87)	285	15	1	0	0	0	301	0.3
Other Services (72, 84, 86, 88)	41	0	0	0	0	0	41	0.0
PUBLIC ADMINISTRATION (91-97)	213	4	1	0	0	0	218	0.5
General Government (91)	79	0	0	0	0	0	79	0.0
Police (92)	40	3	0	0	0	0	43	0.0
Human Resources (94)	7	0	0	0	0	0	7	0.0
Environmental Quality (95)	14	0	0	0	0	0	14	0.0
Admin. Of Economic Programs (96)	13	0	1	0	0	0	14	7.1
Military (97)	60	1	0	0	0	0	61	0.0
TOTAL	2,482	450	192	38	20	5	3,187*	8.0

*Industry was unknown for 3,179 patients. Seven adults with a source of lead exposure known to be non-work related were excluded.

Table 13. Demographic Characteristics of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

<u>Gender</u>	30-39 $\mu\text{g}/\text{dL}$		40-49 $\mu\text{g}/\text{dL}$		50-59 $\mu\text{g}/\text{dL}$		≥ 60 $\mu\text{g}/\text{dL}$		TOTAL		<u>Chi Square</u>
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	
Male	112	(96.6)	33	(91.7)	19	(95.0)	5	(100)	169	(95.5)	
Female	4	(3.4)	3	(8.3)	1	(5.0)	-	-	8	(4.5)	0.16 (P=0.69)
Hispanic origin	1	(1.1)	2	(6.7)	-	-	-	-	3	(2.1)	0.15 (P=0.70)
White	95	(92.2)	25	(73.5)	15	(88.2)	3	(60.0)	138	(86.8)	
African American	7	(6.8)	7	(20.6)	1	(5.9)	2	(40.0)	17	(10.7)	
Asian/Pacific Islander	-	-	-	-	-	-	-	-	-	-	
Native American/Alaskan	1	(1.0)	-	-	1	(5.9)	-	-	2	(1.3)	
Other	-	-	2	(5.9)	-	-	-	-	2	(1.3)	5.40 (P=0.02)
Average Age	41 (n=116)		45 (n=36)		44 (n=20)		34 (n=5)		42 (n=177)		
Ever smoked	64	(76.2)	22	(81.5)	9	(90.0)	4	(100)	99	(79.2)	2.23 (P=0.14)
Now smoke	42	(56.8)	18	(69.2)	7	(53.8)	3	(75.0)	70	(59.8)	0.38 (P=0.54)

Table 14. Symptoms of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

	30-39 $\mu\text{g}/\text{dL}$		40-49 $\mu\text{g}/\text{dL}$		50-59 $\mu\text{g}/\text{dL}$		≥ 60 $\mu\text{g}/\text{dL}$		TOTAL		Chi Square
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
GASTRO- INTESTINAL											
Lost 10+ lbs without dieting	11	(12.0)	8	(26.7)	3	(23.1)	-	-	22	(15.9)	1.25 (P=0.26)
Continued loss of appetite	13	(13.7)	8	(26.7)	4	(28.6)	2	(50.0)	27	(18.9)	5.70 (P=0.02)
Pains in belly	14	(14.7)	12	(40.0)	4	(28.6)	-	-	30	(21.0)	1.93 (P=0.17)
MUSCULO- SKELETAL											
Frequent pain/soreness in joints	36	(37.5)	18	(62.1)	6	(46.2)	2	(50.0)	62	(43.7)	2.15 (P=0.14)
Muscle weakness	19	(20.2)	15	(50.0)	5	(38.5)	2	(50.0)	41	(29.1)	7.12 (P=0.01)
NERVOUS											
Headaches	18	(19.4)	12	(40.0)	4	(28.6)	-	-	34	(24.1)	0.61 (P=0.44)
Dizziness	4	(4.3)	5	(16.7)	1	(7.7)	-	-	10	(7.2)	0.78 (P=0.38)
Depressed	12	(13.0)	6	(20.0)	5	(35.7)	2	(0.0)	25	(17.9)	7.02 (P=0.01)
Tired	45	(48.4)	21	(72.4)	7	(50.0)	3	(75.0)	76	(54.3)	1.97 (P=0.16)
Nervous	16	(17.2)	8	(26.7)	3	(23.1)	1	(25.0)	28	(20.0)	0.84 (P=0.36)
Waking up at night	33	(35.1)	13	(43.3)	6	(42.9)	3	(75.0)	55	(38.7)	2.27 (P=0.13)
Nightmares	1	(1.1)	4	(13.3)	-	-	-	-	5	(3.6)	0.84 (P=0.36)
Irritable	28	(29.8)	15	(51.7)	5	(38.5)	2	(50.0)	50	(35.7)	2.55 (P=0.11)
Unable to concentrate	20	(21.5)	9	(30.0)	2	(14.3)	-	-	31	(22.0)	0.38 (P=0.54)
REPRODUCTIVE											
Unable to have an erection	4	(4.9)	3	(11.1)	1	(7.7)	-	-	8	(6.3)	0.16 (P=0.69)
Trouble having a child	3	(3.4)	-	-	-	-	-	-	3	(2.2)	1.25 (P=0.26)

Table 14. Symptoms of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

	30-39 $\mu\text{g}/\text{dL}$		40-49 $\mu\text{g}/\text{dL}$		50-59 $\mu\text{g}/\text{dL}$		≥ 60 $\mu\text{g}/\text{dL}$		TOTAL		<u>Chi Square</u>
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	
Gastro-intestinal Symptoms	22	(23.2)	15	(50.0)	8	(57.1)	2	(50.0)	47	(32.9)	10.0 (P=.00)
Musculoskeletal Symptoms	40	(41.7)	20	(66.7)	7	(53.8)	3	(75.0)	70	(49.0)	4.38 (P=0.04)
Nervous Symptoms	62	(66.0)	23	(76.7)	10	(71.4)	3	(75.0)	98	(69.0)	0.72 (P=0.40)
Reproductive Symptoms	7	(7.5)	3	(10.0)	1	(7.1)	-	-	11	(7.8)	0.03 (P=0.90)
Any Symptoms	69	(71.1)	25	(83.3)	13	(92.9)	3	(75.0)	110	(75.9)	2.92 (P=0.09)
Average Number Symptoms		2.86		5.23		4.00		4.25		3.50	

Table 15. Lead Related Health Conditions of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g/dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)

<u>LEAD RELATED DISEASES</u>	<u>30-39 $\mu\text{g/dL}$</u>		<u>40-49 $\mu\text{g/dL}$</u>		<u>50-59 $\mu\text{g/dL}$</u>		<u>≥ 60 $\mu\text{g/dL}$</u>		<u>TOTAL</u>		<u>Chi Square</u>
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	
Anemia	1	(1.1)	1	(3.3)	2	(14.3)	-	-	4	(3.0)	3.45 (P=0.06)
Kidney disease	2	(2.1)	1	(3.3)	-	-	-	-	3	(2.1)	0.13 (P=0.72)
High blood pressure	14	(15.2)	7	(25.0)	3	(23.1)	-	-	24	(17.5)	0.17 (P=0.68)

Table 16. Industry of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

<u>INDUSTRY (SIC Code)*</u>	<u>30-39 $\mu\text{g}/\text{dL}$</u>		<u>40-49 $\mu\text{g}/\text{dL}$</u>		<u>50-59 $\mu\text{g}/\text{dL}$</u>		<u>≥ 60 $\mu\text{g}/\text{dL}$</u>		<u>TOTAL</u>	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Other Construction (15)	1	(0.9)	-	-	-	-	-	-	1	(0.6)
Special Trade Construction (17)	30	(26.1)	12	(33.3)	7	(35.0)	4	(80.0)	53	(30.1)
Printing and Publishing (27)	1	(0.9)	-	-	-	-	-	-	1	(0.6)
Foundries (33)	62	(53.9)	15	(41.7)	9	(45.0)	1	(20.0)	87	(49.4)
Fabricated Metal Products (34)	8	(7.0)	4	(11.1)	-	-	-	-	12	(6.8)
Machinery (35)	2	(1.7)	1	(2.8)	2	(10.0)	-	-	5	(2.8)
Automobile (37)	2	(1.7)	2	(5.6)	-	-	-	-	4	(2.3)
Other Durables (39)	2	(1.7)	-	-	-	-	-	-	2	(1.1)
Transportation, Utilities (40)	1	(0.9)	-	-	-	-	-	-	1	(0.6)
Transportation, Utilities (49)	1	(0.9)	-	-	-	-	-	-	1	(0.6)
Retail Trade (55)	1	(0.9)	-	-	-	-	-	-	1	(0.6)
Automotive Repair (75)	2	(1.7)	2	(5.6)	1	(5.0)	-	-	5	(2.8)
Human Resources (94)	1	(0.9)	-	-	-	-	-	-	1	(0.6)
Unknown	1	(0.9)	-	-	1	(5.0)	-	-	2	(1.1)

*Standard Industrial Classification.

Table 17. Number of Years Worked of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

<u>Number of Years Worked</u>	<u>30-39 $\mu\text{g}/\text{dL}$</u>		<u>40-49 $\mu\text{g}/\text{dL}$</u>		<u>50-59 $\mu\text{g}/\text{dL}$</u>		<u>≥ 60 $\mu\text{g}/\text{dL}$</u>		<u>TOTAL</u>		<u>Chi Square</u>
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	
≤ 5	35	(38.0)	16	(53.3)	9	(64.3)	2	(50.0)	62	(44.3)	
6 – 10	15	(16.3)	4	(13.3)	3	(21.4)	1	(25.0)	23	(16.4)	
11 – 20	20	(21.7)	4	(13.3)	1	(7.1)	1	(25.0)	26	(18.6)	
21 – 30	19	(20.7)	2	(6.7)	1	(7.1)	-	-	22	(15.7)	
≥ 31	3	(3.3)	4	(13.3)	-	-	-	-	7	(5.0)	

4.5 (P=0.04)

Table 18. Working Conditions Reported by Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

WORKING CONDITIONS	30-39 $\mu\text{g}/\text{dL}$		40-49 $\mu\text{g}/\text{dL}$		50-59 $\mu\text{g}/\text{dL}$		≥ 60 $\mu\text{g}/\text{dL}$		TOTAL		Chi Square
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Separate lockers: dirty and clean*	67	(73.6)	19	(63.3)	11	(78.6)	2	(50.0)	99	(71.2)	0.46 (P=0.50)
Work clothes laundered: work*	60	(61.2)	15	(50.0)	7	(46.7)	1	(25.0)	83	(56.5)	1.38 (P=0.24)
Shower facility*	78	(84.8)	16	(53.3)	9	(69.2)	3	(75.0)	106	(76.3)	5.08 (P=0.02)
Lunch room*	79	(86.8)	19	(63.3)	9	(64.3)	1	(25.0)	108	(77.7)	13.67 (P=0.0)
Clean off dust and wash hands before eating*	86	(93.5)	23	(79.3)	12	(85.7)	4	(100)	125	(89.9)	1.18 (P=0.28)
Eat in lunchroom*	49	(57.0)	15	(51.7)	6	(42.9)	1	(25.0)	71	(53.4)	2.19 (P=0.14)
Wear respirator*	72	(79.1)	21	(70.0)	8	(57.1)	4	(100)	105	(75.5)	0.93 (P=0.34)
Smoke in work area**	28	(62.2)	8	(44.4)	3	(42.9)	3	(100)	42	(57.5)	0.03 (P=0.87)
Keep cigarettes in pocket while working**	23	(52.3)	7	(38.9)	1	(14.3)	2	(66.7)	33	(45.8)	1.15 (P=0.28)
Exposed to Lead now*	72	(80.0)	17	(68.0)	9	(69.2)	2	(50.0)	100	(75.8)	2.95 (P=0.09)
Removal from job*	13	(14.4)	8	(28.6)	4	(28.6)	2	(50.0)	27	(19.9)	5.24 (P=0.02)

*Based on positive questionnaire responses.

**Based on negative questionnaire responses.

Table 19. Number of Children Potentially Exposed to Take-Home Lead from Michigan Adults with Blood Lead Levels (BLLs) of ≥ 30 $\mu\text{g}/\text{dL}$, Interviewed from 10-15-97 to 3-1-99, by Highest Reported Blood Lead Level ($\mu\text{g}/\text{dL}$)

	30-39 $\mu\text{g}/\text{dL}$		40-49 $\mu\text{g}/\text{dL}$		50-59 $\mu\text{g}/\text{dL}$		≥ 60 $\mu\text{g}/\text{dL}$		TOTAL		<u>Chi Square</u>
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	
Children living or spending time in house	34	(36.6)	8	(26.7)	5	(35.7)	1	(25.0)	48	(34.0)	0.41 (P=0.52)
Children tested for lead	6	(18.2)	4	(50.0)	2	(33.3)	-	-	12	25.0)	0.88 (P=0.35)
Children had elevated lead levels	2	(28.6)	2	(66.7)	-	-	-	-	4	(33.3)	0.07 (P=0.80)

Table 20. Twenty-Eight Companies Inspected Resulting from Michigan Adults with Blood Lead Levels (BLLs) of $\geq 30 \mu\text{g/dL}$, Interviewed from 10-15-97 to 3-1-99

<u>Industry (SIC)*</u>	<u>Companies</u>		<u>Cited for Violation of Lead Standard</u>	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Construction (15-17)				
Other Construction (16)	1	3.6	1	100
Special Trade Construction (17)	8	28.6	7	88
Manufacturing (20-39)				
Printing (27)	1	3.6	1	100
Primary Metals (33)	4	14.3	4	100
Metal Fabrication (34)	5	17.9	2	40
Machinery (35)	1	3.6	1	100
Transportation (37)	1	3.6	-	-
Misc. Mfg. Industries (39)	1	3.6	1	100
Services (70-89)				
Automotive Repair (75)	3	10.7	3	100
Repair (76)	1	3.6	1	100
Recreation (79)	1	3.6	1	100
Government (91-97)				
Human Resources (94)	1	3.6	-	-
Total	28	100.3**	22***	79

*Standard Industrial Classification.

**Percentages do not add to 100% due to rounding.

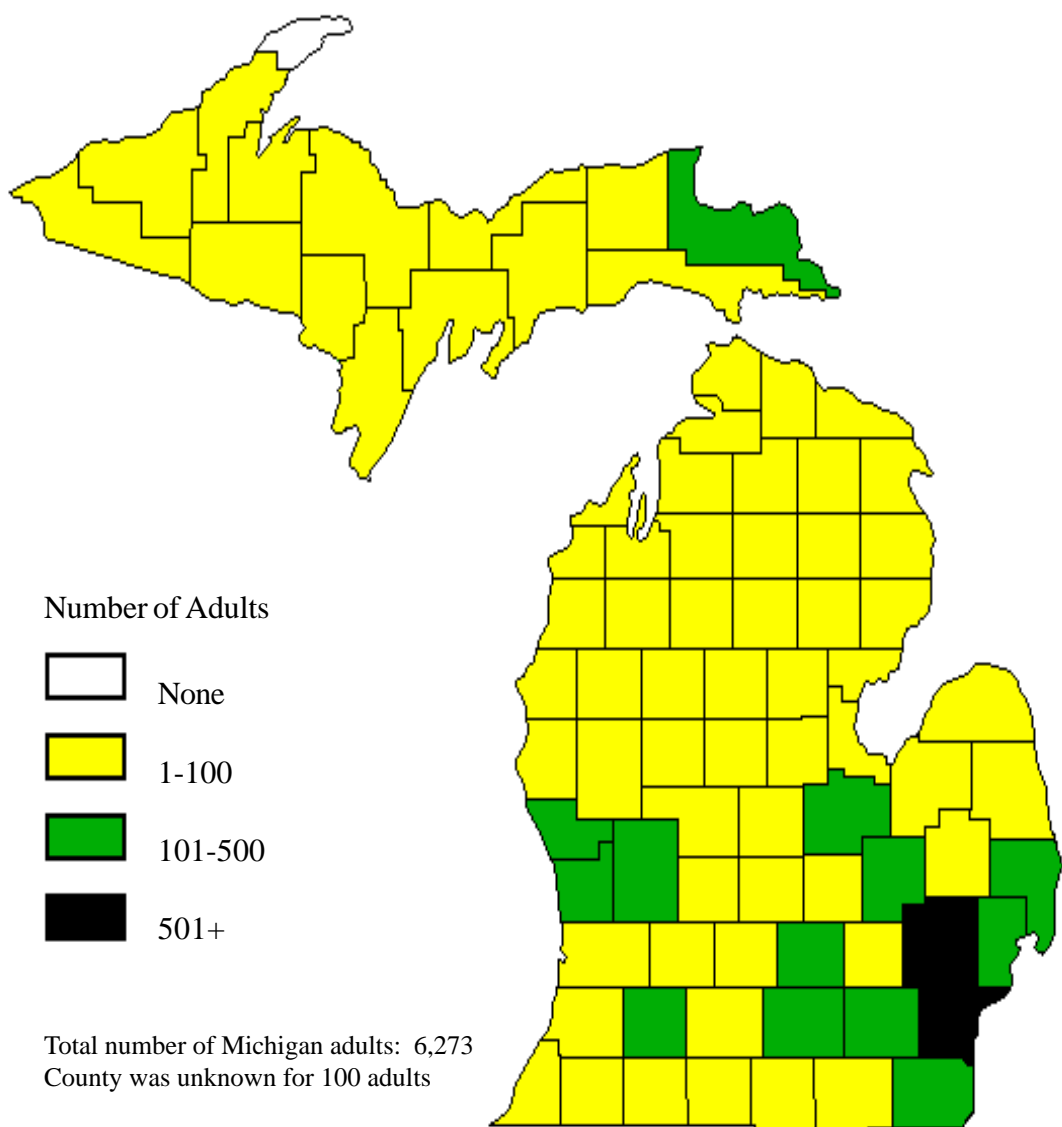
***Six companies were not cited in violation of the Lead Standard.

Table 21. Lead Standard Violations Among Twenty-Two Companies that were Inspected Because of a Blood Lead Report of $\geq 30 \mu\text{g/dL}$ in Michigan

<u>Standard Violated</u>		<u>Number of Citations</u>	<u>Percent*</u>
Airborne concentrations;			
permissible employee exposure limits	R325.51903	5	22.7
Exposure monitoring generally	R325.51905	2	9.1
Exposure monitoring; initial determination	R325.51906	11	50.0
Exposure monitoring; basis of initial determination	R325.51907	1	4.5
Exposure monitoring; positive initial determination	R325.51908	1	4.5
Exposure monitoring; negative initial determination	R325.51909	1	4.5
Exposure monitoring; frequency	R325.51910	5	22.7
Additional exposure monitoring	R325.51911	2	9.1
Methods of compliance;			
engineering and work practice controls	R325.51914	2	9.1
Methods of compliance; compliance program	R325.51915	8	36.4
Methods of compliance; mechanical ventilation	R325.51916a	4	18.2
Respiratory protection generally	R325.51917	7	31.8
Respiratory protection; respirator selection	R325.51918	1	4.5
Respirator protection; respirator usage	R325.51919	3	13.6
Respirator protection; respiratory program; change of filter elements; employee washing;	R325.51921	6	27.3
Protective work clothing and equipment; provision and use	R325.51922	5	22.7
Protective work clothing and equipment; cleaning and replacement	R325.51923	4	18.2
Protective work clothing and equipment; modification; labeling of containers	R325.51924	4	18.2
Housekeeping; workplace surfaces	R325.51925	6	27.3
Housekeeping; floor cleaning; vacuuming	R325.51926	6	27.3
Prohibition of certain types of personal items in lead work areas	R325.51928	2	9.1
Hygiene facilities; change rooms	R325.51929	3	13.6
Hygiene facilities; showers	R325.51930	9	41.0
Hygiene facilities; lunchrooms	R325.51931	5	22.7
Medical surveillance generally	R325.51932	6	27.3
Medical surveillance; biological monitoring; blood lead and ZPP; level sampling and analysis	R325.51933	8	36.4
Medical surveillance; biological monitoring Follow-up blood sampling tests	R325.51934	1	4.5
Medical surveillance; biological monitoring Accuracy of BLL sampling and analysis	R325.51935	1	4.5
Medical surveillance; biological monitoring Employee notifications	R325.51936	3	13.6
Medical surveillance; medical examinations And consultations; frequency	R325.51937	3	13.6
Medical removal protection; temporary medical removal; elevated blood lead levels	R325.51943	2	9.1
Medical removal protection; return of an employee To former job status	R325.51945	1	4.5
Employee information and training; training program	R325.51949	15	68.2
Employee information and training; access to Information and training materials	R325.51950	3	13.6
Sign requirements	R325.51950b	6	27.3
Recordkeeping; exposure monitoring	R325.51951	5	22.7
Recordkeeping; medical surveillance	R325.51952	1	4.5
Recordkeeping; medical removals	R325.51953	1	4.5
Availability of records	R325.51954	1	4.5

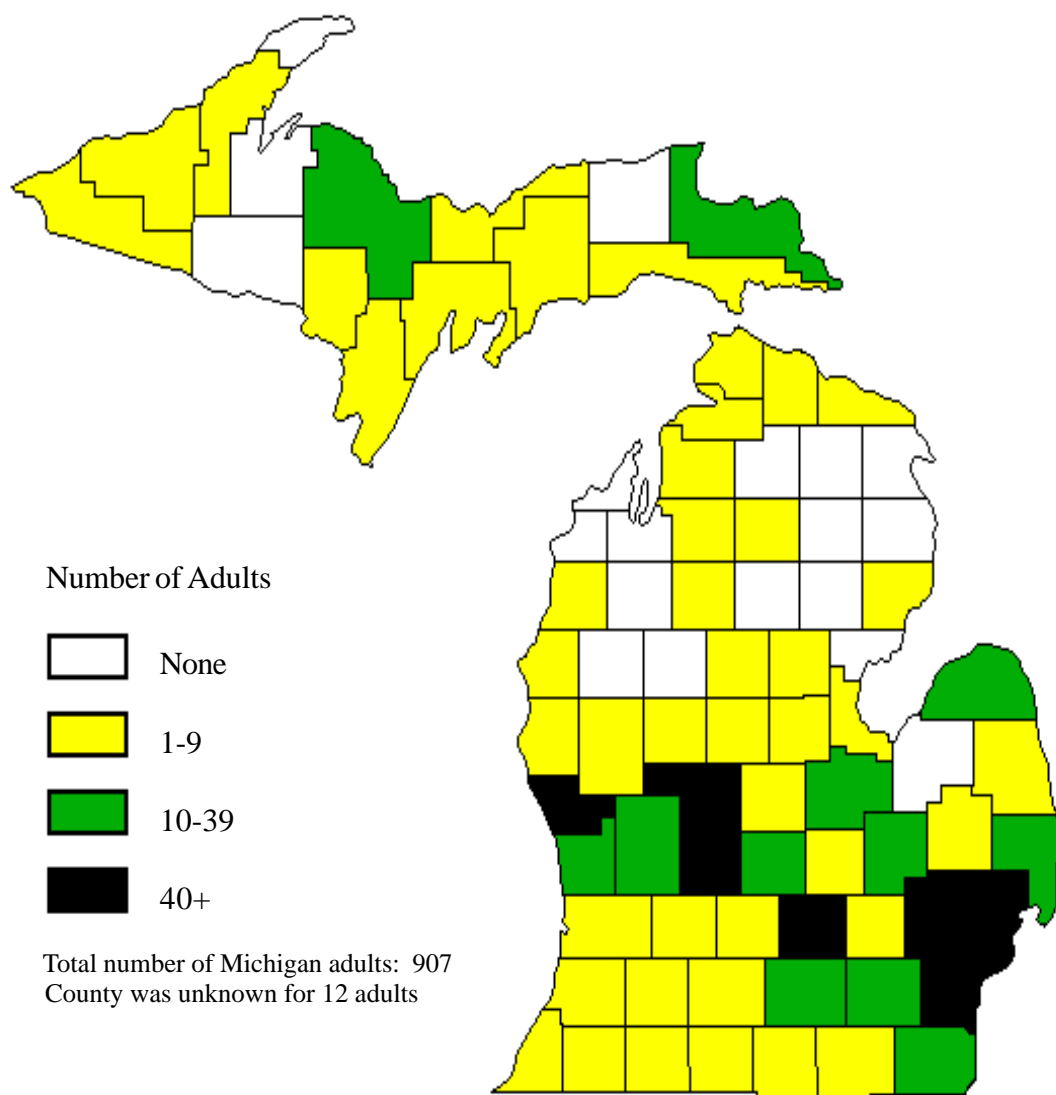
*A company may be cited for more than one type of violation, therefore these percentages are based on a total of 22 companies cited.

Figure 1. Distribution of Adults Tested for Blood Lead in Michigan by County of Residence: 1998



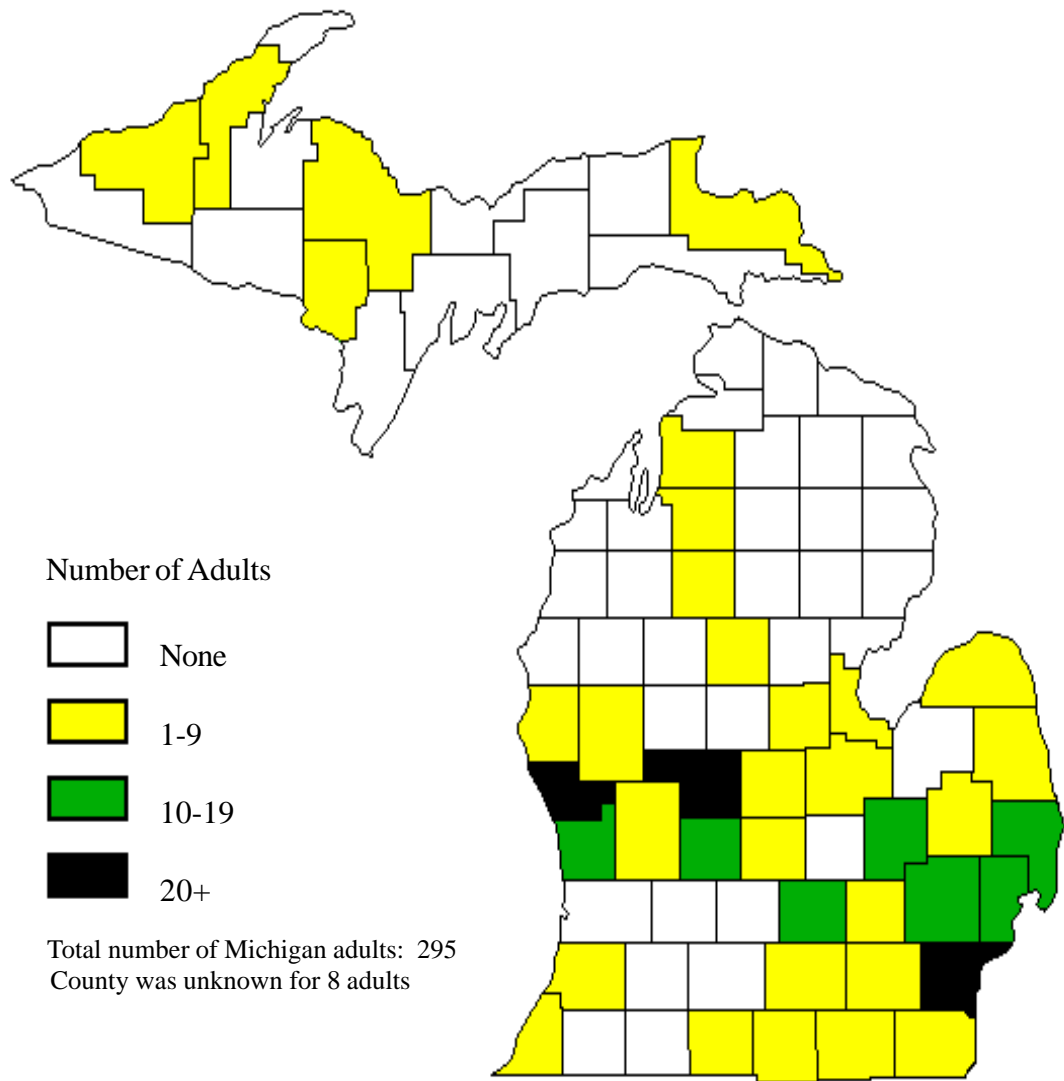
Oakland and **Wayne** counties had the highest number of adults reported, with 675 and 1,344 adults, respectively.

Figure 2. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 10 ug/dL in Michigan by County of Residence: 1998



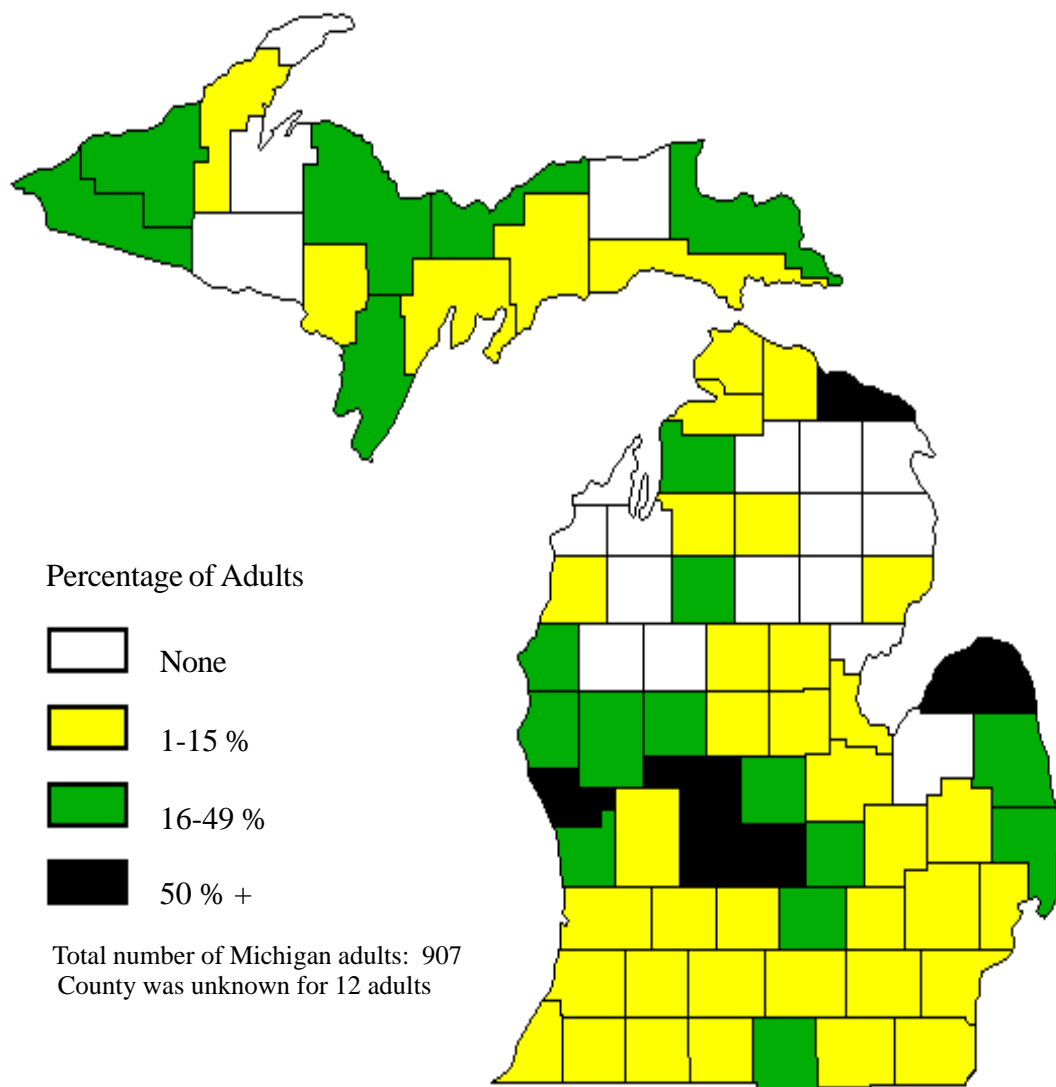
Muskegon and **Wayne** counties had the highest number of adults with blood lead levels of 10 ug/dL or greater reported, with 112 and 140 adults, respectively.

Figure 3. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 25 ug/dL in Michigan by County of Residence: 1998



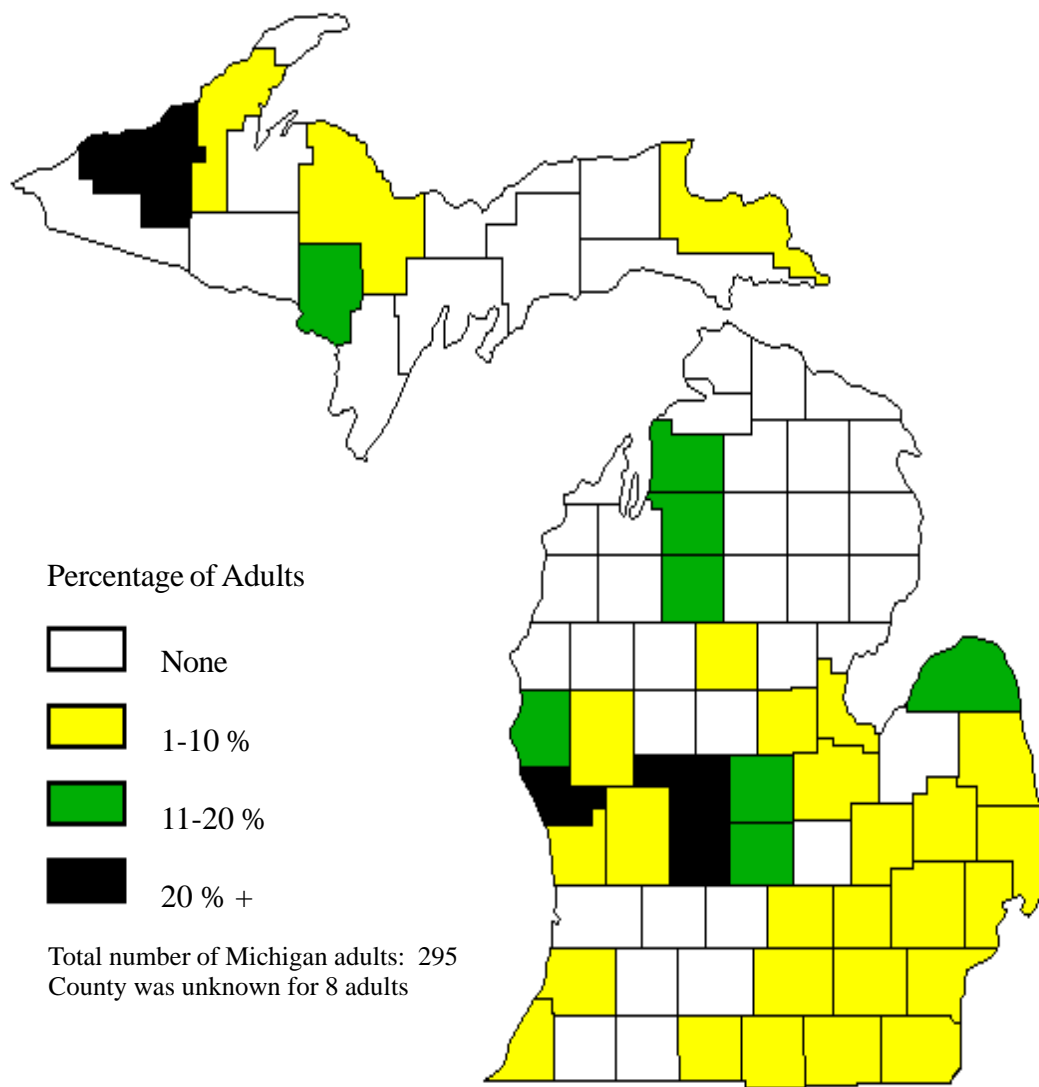
Muskegon and **Wayne** counties had the highest number of adults with blood lead levels of 25 ug/dL or greater reported, with 62 and 40 adults, respectively.

Figure 4. Percentage of Adults with Blood Lead Levels (BLLs) ≥ 10 ug/dL in Michigan by County of Residence: 1998*



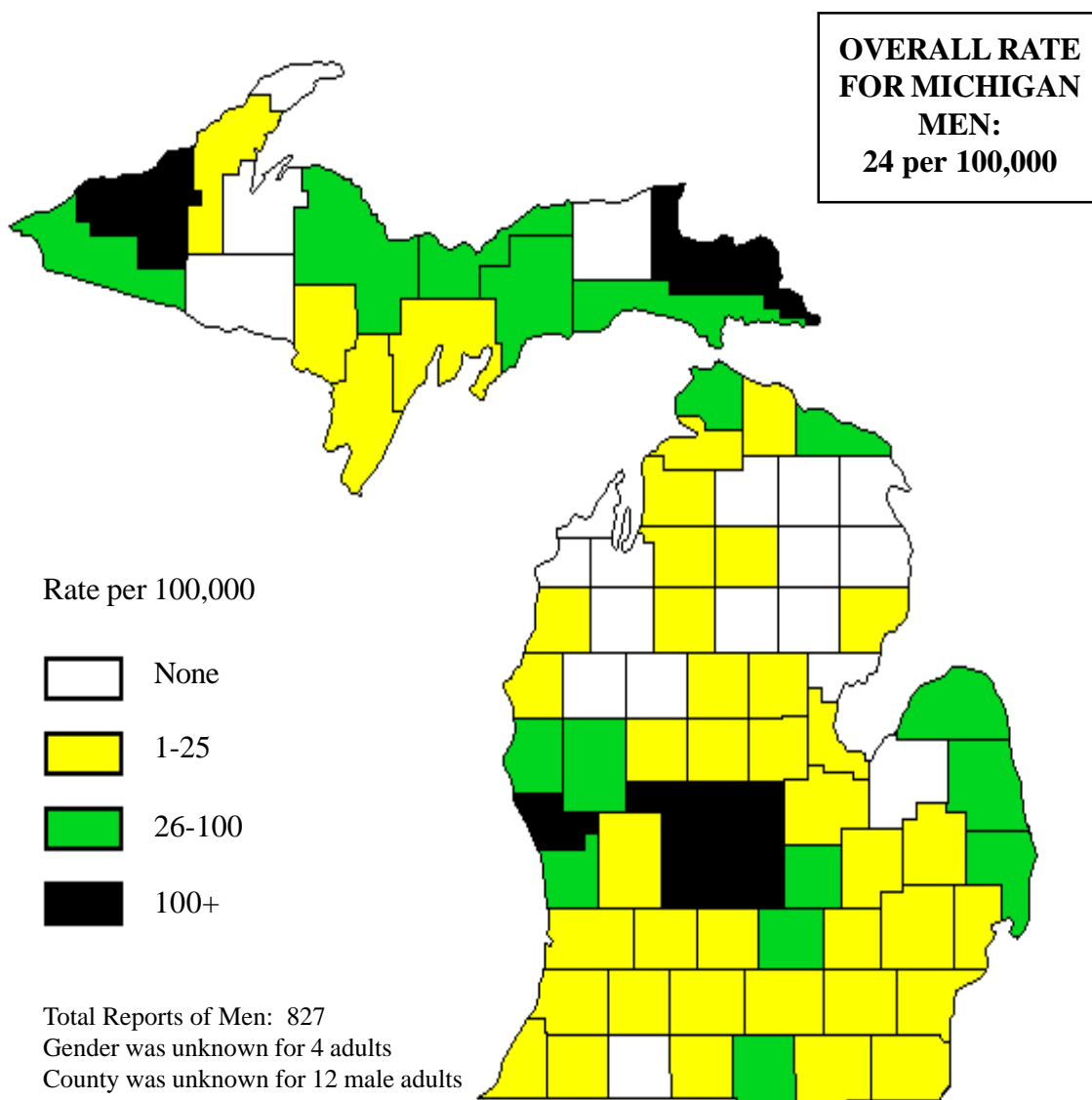
*Denominator used was the total number of adults tested for blood lead within each county.

Figure 5. Percentage of Adults with Blood Lead Levels (BLLs) ≥ 25 ug/dL in Michigan by County of Residence: 1998*



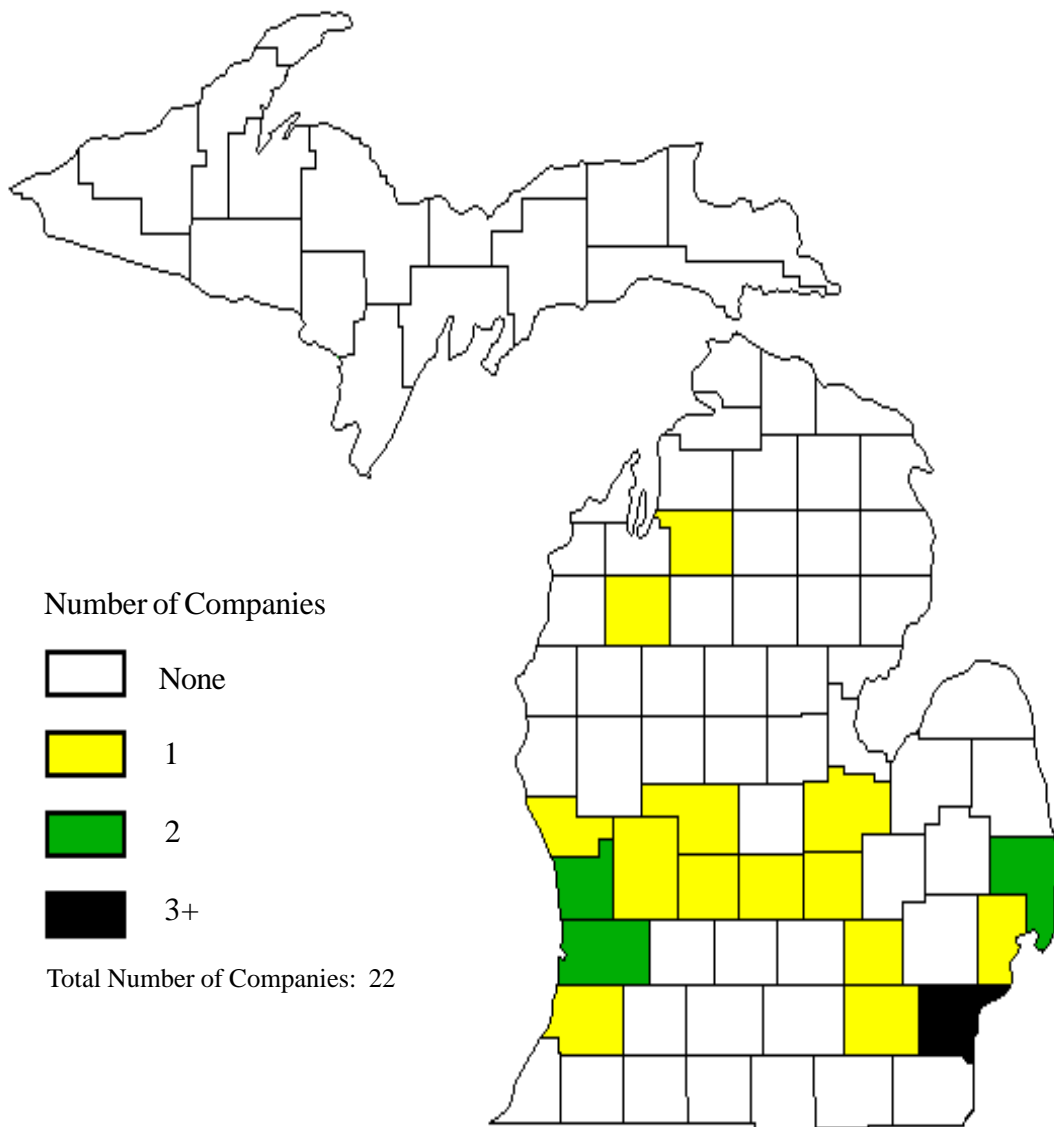
*Denominator used was the total number of individuals tested for blood lead in each county.

Figure 7. Annual Incidence of Blood Lead Levels (BLLs) ≥ 10 ug/dL Among Men in Michigan by County of Residence: 1998*



*Rate per 100,000 men age 16+; denominator is the 1990 US. Census population data.

Figure 8. Geographic Distribution of Non-Construction Companies Reporting Adults with Blood Lead Levels (BLLs) ≥ 30 ug/dL in Michigan: 1998



Appendix I

Known or Suspected Occupational Disease Report

(Information will be held confidential as prescribed in Act.)

EMPLOYEE AFFECTED

Name (Last, First, Middle)	Age	Sex M F	Race: <input type="radio"/> White <input type="radio"/> Black <input type="radio"/> Hispanic <input type="radio"/> Other
Street	City		State Zip
Home Phone Number	Social Security Number		

CURRENT EMPLOYER

Current Employer Name	Worksite County		
Worksite Address	City	State	Zip
Business Phone	If Known, Indicate Business Type (products manufactured or work done)		
Number of Employees <input type="radio"/> <25 <input type="radio"/> 25-100 <input type="radio"/> 100-500 <input type="radio"/> >500			
Employee's Work Unit/Department	Dates of Employment From: _____ To: _____ Mo Day Year Mo Day Year		
Employee's Job Title or Description of Work			

ILLNESS INFORMATION

Nature of Illness or Health Condition (Examples: Headache, Nausea, Difficulty Breathing, Cough, etc.)	Date of Diagnosis _____ Mo Day Year	
Suspected Causative Agents (Chemicals, Physical Agents, Conditions)	Did Employee Die? Yes <input type="radio"/> No <input type="radio"/>	If Yes, Date of Death _____ Mo Day Year
If Physician, Indicate Clinical Impression for Suspected Occupational Disease, or Diagnosis of Confirmed Occupational Disease		

ADDITIONAL COMMENTS

_____ _____ _____

REPORT SUBMITTED BY

If Report Submitted by Non-Physician, Did Employee See a Physician? <i>If yes, record information below.</i>	Yes <input type="radio"/> No <input type="radio"/> Don't Know <input type="radio"/>
Physician's Name	Phone
Office Address	City State Zip
Name of Person Submitting Report	Physician <input type="radio"/> Non-Physician <input type="radio"/>
Address	City State Zip
Signature	Phone Date

The Michigan Department of Consumer and Industry Services is an equal opportunity, affirmative action employer, service provider and buyer.

Return completed form to:

Michigan Department of Consumer and Industry Services
Division of Occupational Health
Bureau of Safety and Regulation
7150 Harris Drive P.O. Box 30649
Lansing, MI 48909-8149

Authority: P.A. 368 of 1978
Completion: Required
Penalty: Misdemeanor

Article 5. Prevention and Control of Diseases and Disabilities

Part 56. Occupational Diseases

Sec. 5601. (1) As used in this part, "occupational disease" means an illness of the human body arising out of and in the course of an individual's employment and having one or more of the following characteristics:

(a) It is caused by a frequently repeated or continuous exposure to a hazardous substance or agent or to a specific industrial practice which is hazardous and which has continued over an extended period of time.

(b) It is caused by an acute exposure to a hazardous substance or agent.

(c) It presents symptoms characteristic of an occupational disease known to have resulted in other cases from the same type of specific exposure.

(2) In addition, article 1 contains general definitions and principles of construction applicable to all articles in this code and part 51 contains definitions applicable to this part.

Sec. 5611. (1) A physician, hospital, clinic, or employer knowing of an individual having a case of occupational disease or a health condition aggravated by workplace exposures shall report the case to the department within 10 days after the discovery of the occupational disease or condition.

(2) A physician, hospital, clinic, or employer knowing of a suspected case of occupational disease or a health condition aggravated by workplace exposures shall report the case to the department within 10 days after the discovery of the occupational disease or condition.

(3) The report shall state the name and address of the individual, the name and business address of the employer, the business of the employer, the place of the individual's employment, the length of time of employment in the place where the individual became ill, the nature of the disease, and other information required by the department.

(4) The department shall prepare and furnish the report forms and instructions for their use to physicians, hospitals, clinics, and employers.

Sec. 5613. (1) The department, upon receiving a report under section 5611 or believing that a case or suspected case of occupational disease exists in this state, may investigate to determine the accuracy of the report and the cause of the disease.

(2) To aid in the diagnosis or treatment of an occupational disease, the department shall advise the physician in charge of a patient of the nature of the hazardous substance or agent and the conditions of exposure of the patient as established by the investigation. In so doing the department shall protect the confidentiality of trade secrets or privileged information disclosed by the investigations in accordance with section 13 of Act No. 442 of the Public Acts of 1976, being section 15.243 of the Michigan Compiled Laws.

Sec. 5621. (1) Reports submitted to the department under section 5611 are not public records and are exempt from disclosure pursuant to section 13 (1)(d) of Act No. 442 of the Public Acts of 1976.

(2) The bureau of worker's disability compensation and the compensation appeal board in the department of labor shall have access to the record of an actual case of occupational disease in a compensation case before it.

Sec. 5623. (1) Not less than once each year, the department shall compile statistical summaries of all occupational diseases reported and accepted as covering true occupational diseases, and the kinds of employment leading to the occurrence of the diseases.

(2) The department shall disseminate to appropriate employers in this state appropriate instructions and information to prevent the occurrence of occupational diseases.

Sec. 5639. A physician, hospital or clinic administrator, or employer who fails to make a report or who wilfully makes a false statement in a report required by section 5611 (1) is guilty of a misdemeanor punishable by a fine of not more than \$50.00.

Appendix II

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.

June 24, 1997

Effective: October 11, 1997

(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 III

OSHA BLOOD LEAD LABORATORIES: MICHIGAN

Laboratory Name	City	County
Warde Medical Laboratory	Ann Arbor	Wahtenaw
Quest Diagnostics	Auburn Hills	Oakland
Regional Medical Laboratories	Battle Creek	Calhoun
Comprehensive Health Services Inc	Detroit	Wayne
Detroit Health Department	Detroit	Wayne
DMC University Laboratories	Detroit	Wayne
Smithkline Beecham Clinical Labs	Farmington Hills	Wayne
AAC Trinity Inc	Farmington Hills	Wayne
Blodgett Toxicology Lab	Grand Rapids	Kent
Michigan Department of Community Health	Lansing	Ingham
Sparrow Regional Laboratories	Lansing	Ingham
Hackley Hospital Laboratory	Muskegon	Muskegon

Appendix IV



October 30, 1998 / 47(42);907-911

Adult Blood Lead Epidemiology and Surveillance -- United States, First Quarter 1998, and Annual 1994-1997

CDC, in collaboration with state and local health departments, monitors laboratory-reported elevated blood lead levels (BLLs) among adults in the United States. During 1998, 27 states * reported surveillance data to the Adult Blood Lead Epidemiology and Surveillance (ABLES) program. This report presents ABLES data for the first quarter of 1998 compared with the first quarter of 1997, annual data for 1997 compared with 1996, and prevalence and incidence of elevated BLLs from 1994 through 1997. The findings indicate that approximately 4000 adults per quarter and an estimated 12,000 adults per year continue to have elevated BLLs; there does not appear to be a trend in these data from 1994 through 1997.

Beginning with the previous ABLES report (1), emphasis has been placed on the number of persons with elevated BLLs (prevalence); prior ABLES reports focused primarily on the number of laboratory reports of elevated BLLs (there are often multiple laboratory reports for the same person). The number of new cases of elevated BLLs (incidence) is reported as cumulative annual data.

States in the ABLES program mandate that laboratories report elevated BLLs for adults to the state health department or another designee. The minimum BLL required to be reported varies among the states; the ABLES definition of an elevated BLL is greater than or equal to 25 ug/dL. ABLES follow-back procedures for identifying source of exposures and preventing future exposures have been described previously (2).

Prevalence is defined as all cases (new plus existing) of persons with at least one BLL greater than or equal to 25 ug/dL during the year. Incidence is defined as all new cases of persons with at least one BLL greater than or equal to 25 ug/dL appearing in state surveillance data in the year who were not recorded during the preceding year. Denominators for prevalence and incidence were derived by subtracting the number of persons aged greater than or equal to 65 years in the state from the total number of persons aged greater than or equal to 16 years in the state. **

First Quarter Reports, 1998

During January 1-March 31, 1998, 3895 persons were reported with BLLs greater than or equal to 25 ug/dL, representing a 20% decrease compared with 4885 persons reported for the first quarter of 1997 (3), *** and a 3% decrease compared with 4010 reported for the fourth quarter of 1997 (1) ([Figure 1](#)). Of the 3895, 155 (4%) were reported with BLLs greater than or equal to 50 ug/dL, the level designated by the Occupational Safety and Health Administration (OSHA) for medical removal from the workplace (4), representing a 37% decrease compared with 245 reported for the first quarter of 1997, and a 34% decrease compared with the 236 reported for the fourth quarter of 1997 ([Figure 1](#)).

Annual Reports, 1997

The number of persons with BLLs greater than or equal to 25 ug/dL reported to the ABLES program increased by 5% from 12,073 in 1996 to 12,716 in 1997, with the same 27 states reporting in each year (3). **** The number of persons with BLLs greater than or equal to 50 ug/dL decreased by 1% from 787 in 1996 to 777 in 1997.

The reported number of new cases with BLLs greater than or equal to 25 ug/dL decreased by 12% from 6115 in 1996 to 5397 in 1997, with the same 27 states reporting in each year. New cases with BLLs greater than or equal to 50 ug/dL decreased by 9% from 456 in 1996 to 417 in 1997.

Prevalence and Incidence, 1994-1997

The number of states reporting to ABLES increased from four in 1987 to 23 in 1994 and 27 in 1997. Because of this increase, comparing current ABLES raw numeric data with raw numeric data from previous years has required adjustment for the number of states reporting. Beginning with this report, prevalence and incidence will be used to facilitate comparisons of ABLES data over time.

Overall prevalence rates ranged from 104 per million adults aged 16-64 years in 1994 to 111 in 1997 ([Figure 2](#)). Of the 22 states that reported throughout 1994-1997, 11 had lower prevalence rates in 1997 than in 1994, and 11 had higher rates. Overall incidence ranged from 53 per million adults aged 16-64 years in 1994 to 47 in 1997 ([Figure 2](#)). Of the 22 states that reported throughout 1994-1997, the incidence in 1997 compared with 1994 was lower in 13 states, higher in eight states, and unchanged in one.

Reported by: JP Lofgren, MD, Alabama Dept of Public Health. K Schaller, Arizona Dept of Health Svcs. S Payne, MA, Occupational Lead Poisoning Prevention Program, California Dept of Health Svcs. BC Jung, MPH, Div of Environmental Epidemiology and Occupational Health, Connecticut Dept of Public Health. R Gergely, Iowa Dept of Public Health. W Davis, MPA, Occupational Health Program, Bur of Health, Maine Dept of Human Svcs. E Keyvan-Larijani, MD, Lead Poisoning Prevention Program, Maryland Dept of Health and Mental Hygiene. R Rabin, MSPH, Div of Occupational Safety, Massachusetts Dept of Labor and Industries. A Allemier, Dept of Medicine, Michigan State Univ, East Lansing, Michigan. M Falken, PhD, Minnesota Dept of Health. C DeLaurier, Div of Public Health Svcs, New Hampshire State Dept of Health and Human Svcs. B Gerwel, MD, Occupational Disease Prevention Project, New Jersey State Dept of Health. R Prophet, PhD, New Mexico Dept of Health. R Stone, PhD, New York State Dept of Health. S Randolph, MSN, North Carolina Dept of Health and Human Svcs. A Migliozi, MSN, Bur of Health Risk Reduction, Ohio Dept of Health. E Rhoades, MD, Oklahoma State Dept of Health. A Sandoval, MS, State Health Div, Oregon Dept of Human Resources. J Gostin, MS, Occupational Health Program, Div of Environmental Health, Pennsylvania Dept of Health. M Stoeckel, MPH, Rhode Island Dept of Health. A Gardner-Hillian, Div of Health Hazard Evaluations, South Carolina Dept of Health and Environmental Control. D Salzman, MPH, Bur of Epidemiology, Texas Dept of Health. W Ball, PhD, Bur of Epidemiology, Utah Dept of Health. L Toof, Div of Epidemiology and Health Promotion, Vermont Dept of Health. P Rajaraman, MS, Washington State Dept of Labor and Industries. J Tierney, Wisconsin Dept of Health and Family Svcs. T Kliez, Wyoming Dept of Health. Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC.

Editorial Note

Editorial Note: The quarterly data for the 27 ABLES states for the first quarter of 1997 through the first quarter of 1998 show approximately 4000 persons each quarter with BLLs greater than or equal to 25

ug/dL and approximately 200 persons each quarter with BLLs greater than or equal to 50 ug/dL.

The annual data for 1997 for the 27 ABLES states show a 5% increase in the number of persons and a 12% decrease in the number of new cases with BLLs greater than or equal to 25 ug/dL compared with 1996 and adjusted for the increase in the number of participating states in 1997. Based on data for 1994-1997, however, these changes from 1996 to 1997 do not seem to represent a change from the overall pattern of prevalence and incidence during 1994-1997; a recognizable trend in the combined ABLES data during this period is not evident.

Variation in the number of detected cases reported to ABLES may reflect 1) changes in the year-to-year efforts of the various participating states, and lead-using industries within them, to identify lead-exposed workers and prevent new lead exposures; 2) changes in occupational exposures to lead; 3) changes in compliance with OSHA requirements regarding blood lead monitoring; and/or 4) changes in the size of the workforce in lead-using industries. Variation in quarterly and annual nationwide reporting totals also might represent normal fluctuations in case reporting, which may result from changes in staffing and funding in state-based surveillance programs, interstate differences in worker BLL testing by lead-using industries, or random variation.

The findings in this report document the continuing hazard of lead exposures as an occupational health problem in the United States. ABLES enhances surveillance for this preventable condition by expanding the number of participating states, exploring ways to increase the usefulness of reporting, and alerting the public to potential new sources of lead exposure.

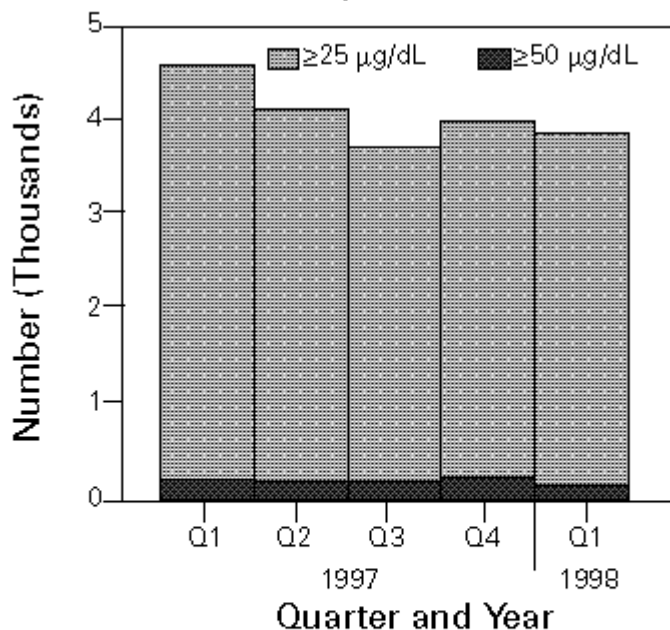
References

1. CDC. Adult blood lead epidemiology and surveillance -- United States, fourth quarter, 1997. MMWR 1998;47:570-3.
2. CDC. Surveillance for occupational lead exposure -- United States, 1987. MMWR 1989;38:642-6.
3. CDC. Adult blood lead epidemiology and surveillance -- United States, first quarter 1997, and annual 1996. MMWR 1997;46:643-7.
4. US Department of Labor, Occupational Safety and Health Administration. Final standard for occupational exposure to lead. Federal Register 1978;43:52952-3014 (29 CFR 1910.1025).

Alabama, Arizona, California, Connecticut, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming. ** Population figures are available from the World-Wide Web site <http://www.census.gov/population/estimates/state/97agesex.txt>. *** To compare the number of persons for a constant roster of 27 states in 1998 and 1997, an estimate of first quarter 1997 data for Illinois, which discontinued reporting in 1996, was subtracted from previously reported totals for the first quarter of 1997 (3). **** To compare data for a constant roster of 27 states in 1996 and 1997, data for 1997 for New Mexico, Rhode Island, and Wyoming were added to the previously reported totals for 1996, and data for 1996 for Illinois (which discontinued reporting at the end of 1996) were subtracted from the previously reported totals for 1996 (3). Previously reported 1996 data for Minnesota and Ohio were updated for this report.

Figure_1

FIGURE 1. Number of persons* with blood lead levels (BLLs) ≥ 25 $\mu\text{g}/\text{dL}$, by quarter and year — 27 states,[†] 1997 and first quarter 1998



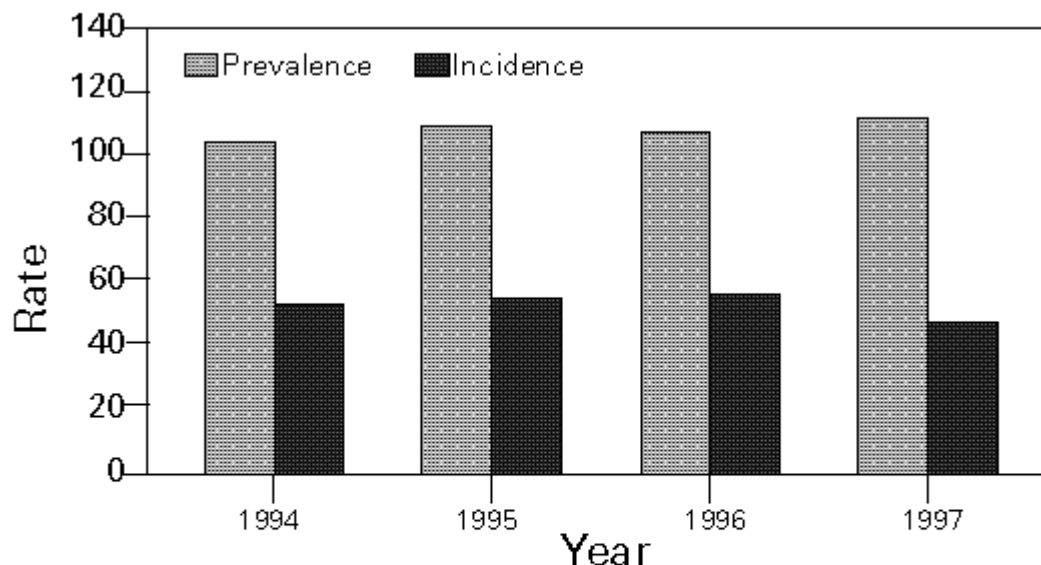
*Persons are categorized according to the highest reported BLL for the person during the given quarter. Data for the third and fourth quarter of 1997 and the first quarter of 1998 for New Mexico were missing; third and fourth quarter data for 1996 and first quarter data for 1997, respectively, were used as estimates. An estimate of first quarter 1997 data for Illinois, which discontinued reporting in 1996, was subtracted from previously reported totals for the first quarter of 1997 (3).

[†]Alabama, Arizona, California, Connecticut, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming.

[Return to top.](#)

Figure_2

FIGURE 2. Prevalence* and incidence† of blood lead levels (BLLs) ≥ 25 $\mu\text{g}/\text{dL}$ among adults‡, by year — 1994–1997¶



*Prevalence is defined as all cases (new plus existing) of persons with at least one BLL ≥ 25 $\mu\text{g}/\text{dL}$ during the year.

†Incidence is defined as all new cases of persons with at least one BLL ≥ 25 $\mu\text{g}/\text{dL}$ appearing in state surveillance data in the year who were not recorded in the immediately preceding year.

‡Per 1 million adults aged 16–64 years.

¶In 1994 and 1995, adults with BLLs ≥ 25 $\mu\text{g}/\text{dL}$ were reported in the following states: Alabama, Arizona, California, Connecticut, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, South Carolina, Texas, Utah, Vermont, Washington, and Wisconsin; in 1996, Minnesota and Ohio were added; and in 1997, New Mexico, Rhode Island, and Wyoming were added and Illinois was subtracted.

[Return to top.](#)

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