

2000

Annual Report on Blood Lead Levels Among Adults in Michigan



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Summary:

This is the third 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 2000, 11,764 reports were received for 10,791 individuals ≥ 16 years of age. One thousand five (9.3%) individuals had blood lead levels greater than or equal to 10 $\mu\text{g/dL}$; 235 of those 1005 had lead levels greater than or equal to 25 $\mu\text{g/dL}$ and 13 of those 235 had blood lead levels greater than or equal to 50 $\mu\text{g/dL}$.

There were 1,322 more reports (on 1,307 individuals) received in 2000 compared to 1999. However, the total number of individuals with blood lead levels greater than or equal to 10 $\mu\text{g/dL}$ was unchanged from 1999 but percent ≥ 10 $\mu\text{g/dL}$ decreased from 10.6% in 1999 to 9.3% in 2000. The number and percent of individuals with blood lead levels greater than or equal to 25 $\mu\text{g/dL}$ decreased from 273 (2.8%) in 1999 to 235 (2.2%) in 2000. However, the number of individuals with blood lead levels greater than or equal to 50 $\mu\text{g/dL}$ increased slightly, while the percent was unchanged, 11 (0.1%) in 1999 and 13 (0.1%) in 2000. This is the second year in a row that blood lead levels greater than or equal to 25 $\mu\text{g/dL}$ decreased from the previous year.

Individuals with blood lead levels greater than or equal to 10 $\mu\text{g/dL}$ were more likely to be men (94.2%), white (90.8%), and have an average age of 42. They were most likely to live in Wayne (21.2%), St. Clair (8.8%), Montcalm (7.5%), Muskegon (6.9%), and Oakland (5.9%) 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, performing abrasive blasting on outdoor metal structures such as bridges, overpasses or water towers or exposed to lead fumes from guns at shooting ranges.

In 2000, inspection reports were finalized on 18 companies where individuals worked, with blood lead levels greater than or equal to 25 $\mu\text{g/dL}$. These reports showed that 13 of 18 (72%) were in violation of the lead standard. Initial evaluation of these inspections shows 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. We will continue to evaluate and follow this trend to determine if the initial findings remain over a more prolonged period of time after a greater number of inspections have been completed.

The third 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. Ongoing surveillance in future years will determine if the favorable trend in lower blood lead levels found between 1998,

1999 and 2000 will continue.

Background:

This is the third 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 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 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 2001, 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 6 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. 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. 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 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. A summary of blood lead results from 2000 on children less than 16 years old is in Appendix II.

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 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 25 $\mu\text{g/dL}$ or higher are routinely contacted for an interview. This past year we contacted a sample of individuals with blood lead levels ranging from 10 to 24 $\mu\text{g/dL}$. 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 $\mu\text{g/dL}$ or an average of three blood lead levels greater than 50 $\mu\text{g/dL}$ before being removed

(i.e. taken pursuant to the standard or the average of all blood tests conducted over the previous six months, whichever is longer). For construction, an individual needs to have only two consecutive blood lead level measurements taken pursuant to the standard above 50 $\mu\text{g/dL}$. 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 $\mu\text{g/dL}$. See Appendix IV 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 $\mu\text{g/dL}$ (1).

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 V for most recent quarterly summary).

Results:

2000 is the third 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 2000 as well as more detailed information from interviews of those adults with BLLs 25 $\mu\text{g/dL}$ and greater and the sample of individuals interviewed who had blood lead levels ranging 10-24 $\mu\text{g/dL}$. 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 2000

Number of Reports and Individuals

Between January 1 and December 31, 2000, the State of Michigan received 11,764 blood lead level reports for individuals 16 years of age or older. Because an individual may be tested more than once each year, the 11,764 reports received were for 10,791 individuals (Table 1). Of the 10,791 individuals, 9,995 were first reported to the state in 2000. The following descriptive statistics are based on the 10,791 individuals reported in 2000, and are based on the highest BLL reported for each of these adults.

Distribution of Blood Lead Levels

In 2000, 1,005 (9.3%) of the 10,791 adults reported had blood lead levels greater than or equal to

10 $\mu\text{g/dL}$; 235 of those 1,005 had blood lead levels greater than or equal to 25 $\mu\text{g/dL}$ and 13 of those 235 had blood lead levels greater than or equal to 50 $\mu\text{g/dL}$ (Table 1). A total of 9,786 (90.7%) of the adults reported in 2000 had BLLs less than 10 $\mu\text{g/dL}$.

Gender and Age Distribution

All Blood Lead Levels

Approximately two-thirds of the adults reported to the Registry were male (66.3%), with females representing one-third of the reports (33.7%). Gender was unknown for 6 adults reported (Table 2). The age distribution is shown in Table 3. The average age was 42.

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

For the 1,005 adults reported to the Registry with blood lead levels greater than or equal to 10 $\mu\text{g/dL}$, 947 (94.2%) were men and 58 (5.8%) were women (Table 2). The age distribution for these adults was similar to the reports of all BLLs. The average age was 42 (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 6,696 (62.1%) of the 10,791 adults reported. Where race was known, 3,327 (81.2%) were reported as white, 664 (16.2%) were reported as African American, 74 (1.8%) were reported as Native American, 13 (0.3%) were reported as Asian/Pacific Islander, and 17 (0.4%) were reported as multiracial (Table 4).

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

For adults with blood lead levels greater than or equal to 10 $\mu\text{g/dL}$ where race was indicated, 648 (90.8%) were reported as white, 56 (7.8%) were reported as African American, 8 (1.1%) were reported as Native American, 0 (0.0%) were reported as Asian/Pacific Islander, and 2 (0.3%) were reported as multiracial (Table 4).

Geographic Distribution

The 9,861 adults were reported to the Registry from all of Michigan's 83 counties. The largest number of adults reported in 2000 lived in Wayne county (1,867, 18.9%), followed by Oakland (991, 10.1%), Ingham (644, 6.5%), and Macomb (642, 6.5%). County was unknown for 930 adults (Figure 1 and Table 5).

Figure 2 and Table 6 show the county of residence of the 962 adults with blood lead levels greater than or equal to 10 $\mu\text{g/dL}$. The largest number of adults reported with a BLL of 10 $\mu\text{g/dL}$ and greater were from Wayne county (204, 21.2%), followed by St. Clair (85, 8.8%), Montcalm (72, 7.5%), Muskegon (66, 6.9%), and Oakland (57, 5.9%). County was unknown for 43 adults.

Figure 3 and Table 7 show the county of residence for the 227 adults with blood lead levels greater than or equal to 25 $\mu\text{g/dL}$. The largest number of adults reported with a BLL of 25 $\mu\text{g/dL}$ and above were from Wayne county (40, 17.6%), followed by St. Clair (39, 17.2%), Macomb (17, 7.5%), and Muskegon (16, 7.0%). County was unknown for 8 adults.

Figure 4 and Table 8 show the percentage of adults tested for blood lead within each county with BLLs of 10 $\mu\text{g/dL}$ or greater. Montcalm (72, 55.8%), Ionia (55, 44.4%), Clinton (47, 42.0%), Gratiot (17, 39.5%), and St. Clair (85, 39.0%) counties had the highest percentages of adults with BLLs of 10 $\mu\text{g/dL}$ or greater.

Figure 5 and Table 9 show the percentage of adults tested for blood lead within each county with BLLs of 25 $\mu\text{g/dL}$ or greater. Iron (1, 25.0%), St. Clair (39, 17.9%), Ontonagon (2, 15.4%), and Gratiot (5, 11.6%) counties had the highest percentage of adults with BLLs of 25 $\mu\text{g/dL}$ or greater.

Figure 6 and Table 10 show the incidence rates of BLLs of 10 $\mu\text{g/dL}$ and above, by county, for women. There were 56 women reported in 2000 with a BLL of 10 $\mu\text{g/dL}$ or greater. Muskegon (11/100,000), Ionia (10/100,000), and Clinton (9/100,000) had the 3 highest incidence rates.

Figure 7 and Table 11 show the incidence rates of BLLs of 10 $\mu\text{g/dL}$ and above, by county, for men. There were 906 men reported in 2000 with a BLL of 10 $\mu\text{g/dL}$ or greater. Montcalm (353/100,000), Ionia (229/100,000), and Clinton (213/100,000) had the 3 highest incidence rates. The overall incidence rate for men was 13.5 times higher than that for women (27/100,000 vs 2/100,000).

Industry

Table 12 shows the industries of 2,357 of the 10,791 adults who had blood lead levels tested in 2000, by blood lead levels. Industry was unknown for 8,361 adults. Seventy-three individuals were not included in Table 12 since the source of lead exposure was known to be non-work.

The recreation industry (Standard Industrial Classification (SIC) 79) which involves firearms has the highest percentage of workers with blood lead levels greater than 25 $\mu\text{g/dL}$. Similar exposure occurred among the police (SIC 92) and in other retail trade (SIC 59) where 11.3% and 16.7%, respectively were greater than 25 $\mu\text{g/dL}$. The next highest percentages were in facilities that do radiator manufacturer or repair (SIC 75). Primary metals (SIC 33) and machinery manufacturing (SIC 35) had workers with elevated blood lead levels exposed to lead from similar brass/bronze casting or machining operations unlike primary metal companies, the casting operation was only one part of the machinery manufacturing industries' overall operations. Hunting supply stores with

firing ranges (other retail trade, SIC 59) also had a high percentage of workers with a BLL greater than 25 $\mu\text{g/dL}$. Construction trades (SIC 15-16 and 17) involved in the removal of lead paint had 10% or more of their blood lead results $\geq 25 \mu\text{g/dL}$.

Figure 8 shows the distribution of non-construction companies that reported at least one adult with a BLL of 25 $\mu\text{g/dL}$ or greater in Michigan during 2000. These companies primarily perform brass/bronze casting operations or radiator repair activities.

Summary of All Industrial Hygiene Inspections

Since the 1999 report, the statewide surveillance system identified 39 companies where MIOSHA had not performed an inspection for lead in at least three years (Table 13). Eighteen of these companies have now been inspected. Inspections of these 18 companies resulted in 13 of the 18 (72%) companies receiving citations for a violation of an occupational health standard (Table 14). Thirteen of the 18 (72%) companies were issued citations for violations of the lead standard. Violations of the lead standard by industry type is shown in Table 15.

Of the 39 companies identified 21 were identified by elevated blood lead reports collected because of a company's medical surveillance program and 15 from an individual having the test performed by their personal health care provider. For 3 we were unable to determine why the blood lead sample was collected. Seven of the 15 companies identified because an individual had the blood lead test performed by their personal health care provider were inspected. Five of the 7 (71%) companies were cited for a lead violation.

Interviews of Adults with Blood Lead Levels of 10 $\mu\text{g/dL}$ or Greater

Between October 15, 1997 and February 1, 2001 there were 460 reports received on adults with blood lead levels $\geq 10 \mu\text{g/dL}$ that completed an interview by telephone. The following summary of interview data is based on the 460 questionnaires completed by telephone. These 460 adults were reported to the Registry from October 15, 1997 to December 31, 2000.

Table 16 lists the demographic characteristics of the 460 adults with completed questionnaires by highest lead level reported. Most of the completed questionnaires were of males (94.8%), which parallels the gender distribution of the number of lead level reports $\geq 10 \mu\text{g/dL}$ submitted for adults in 2000. 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 17 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, having nightmares, waking up at night, being irritable, and unable to concentrate were associated with increasingly higher levels of blood lead. Having any gastro-intestinal, musculoskeletal, nervous system symptom or any symptom was associated with increasingly higher levels of blood lead. Table 18 shows the reporting of anemia, kidney disease and high blood pressure by lead level category.

Table 19 presents the type of industry by lead level reported among those interviewed. Overall, 31% worked in brass/bronze foundries, followed by 30% working in construction. However, there was a higher percentage of workers in construction (44.4%) at the highest lead levels reported, compared to foundries. Table 20 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 21 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. In 7 companies we had responses to the working condition questions before and after an inspection of the facility. Generally the responses post-inspection indicated improvements in working conditions had occurred after the time of the inspection (Table 22).

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 23). Twelve of the 27 (44.4%) households with children tested had an elevated blood lead level. Thirteen of the 22 (59.1%) children in these 12 households had elevated blood lead levels. A letter was sent to the home of the responding adult encouraging them to test the child for lead.

Case Histories

The most common sources of work place lead exposure in Michigan are from removing paint from outdoor metal structures, such as overpasses, bridges and water towers and, casting brass or bronze parts and repairing radiators. The 1999 annual report highlighted a case of adult lead poisoning from exposure to lead at a shooting range. This year, we have included a case of adult lead poisoning from exposure to lead during renovation of an office building.

Case History

A man in his late 30's was reported with a blood lead level of 46 µg/dL. He had asked his personal doctor to test him for lead because he was concerned about lead exposure at his job. He reported the following symptoms: abdominal pain after eating and with constipation, loss of appetite and loss

of more than 10lbs of weight, being tired, unable to concentrate, irritability, waking up at night, feeling nervous and sad, joint pain, muscle weakness, and dizziness. He denied headaches or nightmares. He had exposure to lead during removal of lead paint using a chemical stripper, sander and pneumatic powered needle gun at a governmental building. He was not provided special work clothes. He smoked cigarettes. He indicated he smoked in his work area and kept his cigarettes in his pocket.

The work site was inspected by MIOSHA and cited for: 1) not developing and implementing a lead compliance program; 2) exceeding the permissible air levels of lead; 3) not performing air monitoring for lead; 4) not implementing a hazard communication program and training employees; 5) failure to use a high efficiency particulate air (HEPA) filter vacuum or other equally effective method to remove lead accumulations which were found throughout the facility; 6) not providing adequate respiratory protection; 7) absence of a medical monitoring program; 8) not providing work clothes; 9) not providing a clean change area; 10) not providing showers; and 11) not ensuring that employees do not bring food, beverages or cigarettes into the work area.

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. Individuals with a blood lead level of 25 $\mu\text{g}/\text{dL}$ or greater, and a sample of individuals with blood lead levels of 10-24 $\mu\text{g}/\text{dL}$ 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. 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 27 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 (2). 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 (3). A further problem is that workers can bring lead home on their clothes and expose children to lead. Forty-four percent of households with children under the age of 6 where the adult had an elevated blood lead and the child was tested had an elevated blood level (Table 23). 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 $\mu\text{g}/\text{dL}$ (1). 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 (1). 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. Laboratories performing blood lead analyses in the state report normal ranges that vary from 9-39 $\mu\text{g}/\text{dL}$. This variation in normal ranges between laboratories is confusing. Values above 9 $\mu\text{g}/\text{dL}$ indicate exposure to lead beyond that found in the background environment. See Appendix VI for a recent newsletter on “normal” blood lead levels.

In 2000, there were 1,005 adults reported in Michigan with blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$. Ninety-four percent were men. The average age was 42. They were predominately white (90.8%). 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, among workers repairing car radiators or individuals who work in indoor firing ranges.

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). 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 (5). Overall it was estimated that less than 3% of employees in California exposed to lead were provided blood lead testing by their employer (5). On a national basis it was estimated that less than 12% of companies using lead provided blood lead testing for their employees (4).

Thirteen adults had blood lead levels above 50 $\mu\text{g}/\text{dL}$, which is the maximum blood lead level allowed in the work place. Two of the 13 adults were exposed to lead while grinding parts covered with leaded paint, 2 from firearms sales, 1 from welding, 1 as a laborer, 1 as a machinist, 1 as a molder, and 1 while target shooting as a hobby. Four are still being investigated; 2 of the 4 are suspected to be from abrasive blasting on outdoor metal structures.

An inspection was conducted at 18 companies where a worker was reported with a blood lead level $\geq 25 \mu\text{g}/\text{dL}$. Thirteen of 18 (72%) of these companies were cited for violations of the lead standard (Table 15).

In its third 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. We are encouraged both by the increased compliance of the reporting law as evidenced by the increased number of laboratory reports and by the reduction in blood lead levels greater than or equal to 25 $\mu\text{g}/\text{dL}$ (Figure 9). We will continue to monitor for this trend in the year 2001.

References

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Appendices

Appendix I	Blood Lead Analysis Reporting
Appendix II	MDCH/CLPPP Summary
Appendix III	OSHA Blood Lead laboratories
Appendix IV	Summary of Michigan's Lead Standards
Appendix V	MMWR Summary
Appendix VI	"Normal" Blood Lead Level

Table 1. Distribution of Highest Blood Lead Levels (BLLs) Among Adults Reported During 2000

<u>BLLs (µg/dL)</u>	<u>Number</u>	<u>Percent</u>
<10	9,786	90.7
10-24	770	7.1
25-29	94	0.9
30-39	93	0.9
40-49	35	0.3
50-59	9	0.1
≥ 60	4	0.04
TOTAL	10,791*	100.04**

*In 2000, 11,764 BLL reports were received for 10,791 individuals.

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

Table 2. Distribution of Gender Among Adults Tested for Blood Lead in Michigan: 2000

<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	7,153	66.3	947	94.2
Female	3,632	33.7	58	5.8
TOTAL	10,785*	100.0	1,005	100.0

*Gender was unknown for 6 individuals.

**Table 3. Distribution of Age Among Adults Tested
for Blood Lead in Michigan: 2000**

<u>Age Range</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>
16-19	607	5.6	13	1.3
20-29	1,916	17.8	151	15.0
30-39	2,541	23.5	252	25.1
40-49	2,629	24.4	331	32.9
50-59	1,610	14.9	184	18.3
60-69	652	6.0	52	5.2
70-79	516	4.8	16	1.6
80-89	271	2.5	4	0.4
90-99	38	0.4	0	0.0
100 +	11	0.1	2	0.2
TOTAL	10,791	100.0	1,005	100.0

**Table 4. Distribution of Race Among Adults Tested
for Blood Lead in Michigan: 2000**

<u>Race</u>	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 μg/dL	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Caucasian	3,327	81.2	648	90.8
African American	664	16.2	56	7.8
Native American	74	1.8	8	1.1
Asian/Pacific Islander	13	0.3	0	0.0
Multiracial	17	0.4	2	0.3
TOTAL	4,095*	99.9***	714**	100.0

*Race was unknown for 6,696 individuals.

**Race was unknown for 291 individuals.

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

Table 5. Distribution of Adults Tested for Blood Lead in Michigan by County of Residence: 2000

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	5	0.05	Keweenaw	1	0.01
Alger	8	0.08	Lake	2	0.02
Allegan	36	0.4	Lapeer	48	0.5
Alpena	14	0.1	Leelanau	4	0.04
Antrim	8	0.08	Lenawee	131	1.3
Arenac	24	0.2	Livingston	71	0.7
Baraga	10	0.1	Luce	16	0.2
Barry	26	0.3	Mackinac	40	0.4
Bay	125	1.3	Macomb	642	6.5
Benzie	15	0.2	Manistee	32	0.3
Berrien	143	1.5	Marquette	111	1.1
Branch	18	0.2	Mason	30	0.3
Calhoun	118	1.2	Mecosta	35	0.4
Cass	7	0.07	Menominee	6	0.06
Charlevoix	26	0.3	Midland	232	2.4
Cheboygan	21	0.2	Missaukee	7	0.07
Chippewa	55	0.6	Monroe	204	2.1
Clare	66	0.7	Montcalm	129	1.3
Clinton	112	1.1	Montmorency	4	0.04
Crawford	18	0.2	Muskegon	509	5.2
Delta	26	0.3	Newaygo	34	0.3
Dickinson	24	0.2	Oakland	991	10.1
Eaton	46	0.5	Oceana	13	0.1
Emmet	62	0.6	Ogemaw	8	0.08
Genesee	553	5.6	Ontonagon	13	0.1
Gladwin	33	0.3	Osceola	9	0.09
Gogebic	10	0.1	Oscoda	3	0.03
Grand Traverse	165	1.7	Otsego	12	0.1
Gratiot	43	0.4	Ottawa	96	0.1
Hillsdale	21	0.2	Presque Isle	6	0.06
Houghton	25	0.3	Roscommon	11	0.1
Huron	24	0.2	Saginaw	189	1.9
Ingham	644	6.5	Saint Clair	218	2.2
Ionia	124	1.3	Saint Joseph	16	0.2
Iosco	14	0.1	Sanilac	35	0.4
Iron	4	0.04	Schoolcraft	9	0.09
Isabella	38	0.4	Shiawassee	110	1.1
Jackson	81	0.8	Tuscola	28	0.3
Kalamazoo	305	3.1	Van Buren	54	0.6
Kalkaska	15	0.2	Washtenaw	438	4.4
Kent	319	3.2	Wayne	1,867	18.9
			Wexford	16	0.2
			TOTAL	9,861*	99.3**

*County was unknown for 930 adults.

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

Table 6. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 10 $\mu\text{g/dL}$ in Michigan by County of Residence: 2000

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	1	0.1	Keweenaw	-	-
Alger	1	0.1	Lake	-	-
Allegan	6	0.6	Lapeer	1	0.1
Alpena	-	-	Leelanau	-	-
Antrim	-	-	Lenawee	6	0.6
Arenac	2	0.2	Livingston	2	0.2
Baraga	2	0.2	Luce	-	-
Barry	-	-	Mackinac	4	0.4
Bay	9	0.9	Macomb	41	4.3
Benzie	2	0.2	Manistee	4	0.4
Berrien	24	2.5	Marquette	2	0.2
Branch	2	0.2	Mason	5	0.5
Calhoun	3	0.3	Mecosta	2	0.2
Cass	-	-	Menominee	-	-
Charlevoix	-	-	Midland	4	0.4
Cheboygan	1	0.1	Missaukee	-	-
Chippewa	12	1.2	Monroe	10	1.0
Clare	4	0.4	Montcalm	72	7.5
Clinton	47	4.9	Montmorency	-	-
Crawford	1	0.1	Muskegon	66	6.9
Delta	2	0.2	Newaygo	2	0.2
Dickinson	3	0.3	Oakland	57	5.9
Eaton	4	0.4	Oceana	1	0.1
Emmet	3	0.3	Ogemaw	2	0.2
Genesee	32	3.3	Ontonagon	4	0.4
Gladwin	2	0.2	Osceola	-	-
Gogebic	-	-	Oscoda	-	-
Grand Traverse	2	0.2	Otsego	1	0.1
Gratiot	17	1.8	Ottawa	13	1.4
Hillsdale	6	0.6	Presque Isle	2	0.2
Houghton	1	0.1	Roscommon	-	-
Huron	7	0.7	Saginaw	13	1.4
Ingham	32	3.3	Saint Clair	85	8.8
Ionia	55	5.7	Saint Joseph	1	0.1
Iosco	-	-	Sanilac	5	0.5
Iron	1	0.1	Schoolcraft	-	-
Isabella	2	0.2	Shiawassee	9	0.9
Jackson	5	0.5	Tuscola	2	0.2
Kalamazoo	8	0.8	Van Buren	4	0.4
Kalkaska	1	0.1	Washtenaw	7	0.7
Kent	31	3.2	Wayne	204	21.2
			Wexford	-	-
			TOTAL	962*	99.4**

*County was unknown for 43 adults.

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

Table 7. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 25 $\mu\text{g/dL}$ in Michigan by County of Residence: 2000

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	-	-	Keweenaw	-	-
Alger	-	-	Lake	-	-
Allegan	3	1.3	Lapeer	-	-
Alpena	-	-	Leelanau	-	-
Antrim	-	-	Lenawee	2	0.9
Arenac	-	-	Livingston	1	0.4
Baraga	-	-	Luce	-	-
Barry	-	-	Mackinac	1	0.4
Bay	3	1.3	Macomb	17	7.5
Benzie	-	-	Manistee	-	-
Berrien	6	2.6	Marquette	-	-
Branch	2	0.9	Mason	1	0.4
Calhoun	-	-	Mecosta	-	-
Cass	-	-	Menominee	-	-
Charlevoix	-	-	Midland	-	-
Cheboygan	-	-	Missaukee	-	-
Chippewa	6	2.6	Monroe	1	0.4
Clare	-	-	Montcalm	13	5.7
Clinton	3	1.3	Montmorency	-	-
Crawford	-	-	Muskegon	16	7.0
Delta	-	-	Newaygo	1	0.4
Dickinson	1	0.4	Oakland	11	4.8
Eaton	-	-	Oceana	-	-
Emmet	-	-	Ogemaw	-	-
Genesee	7	3.1	Ontonagon	2	0.9
Gladwin	-	-	Osceola	-	-
Gogebic	-	-	Oscoda	-	-
Grand Traverse	-	-	Otsego	-	-
Gratiot	5	2.2	Ottawa	4	1.8
Hillsdale	-	-	Presque Isle	-	-
Houghton	-	-	Roscommon	-	-
Huron	1	0.4	Saginaw	5	2.2
Ingham	7	3.1	Saint Clair	39	17.2
Ionia	10	4.4	Saint Joseph	-	-
Iosca	-	-	Sanilac	3	1.3
Iron	1	0.4	Schoolcraft	-	-
Isabella	-	-	Shiawassee	2	0.9
Jackson	1	0.4	Tuscola	-	-
Kalamazoo	-	-	Van Buren	1	0.4
Kalkaska	1	0.4	Washtenaw	-	-
Kent	10	4.4	Wayne	40	17.6
			Wexford	-	-
			TOTAL	227*	99.4**

*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 $\mu\text{g/dL}$ in Michigan by County of Residence: 2000

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	1	20.0	Keweenaw	-	-
Alger	1	12.5	Lake	-	-
Allegan	6	16.7	Lapeer	1	2.1
Alpena	-	-	Leelanau	-	-
Antrim	-	-	Lenawee	6	4.6
Arenac	2	8.3	Livingston	2	2.8
Baraga	2	20.0	Luce	-	-
Barry	-	-	Mackinac	4	10.0
Bay	9	7.2	Macomb	41	6.4
Benzie	2	13.3	Manistee	4	12.5
Berrien	24	16.8	Marquette	2	1.8
Branch	2	11.1	Mason	5	16.7
Calhoun	3	2.5	Mecosta	2	5.7
Cass	-	-	Menominee	-	-
Charlevoix	-	-	Midland	4	1.7
Cheboygan	1	4.8	Missaukee	-	-
Chippewa	12	21.8	Monroe	10	4.9
Clare	4	6.1	Montcalm	72	55.8
Clinton	47	42.0	Montmorency	-	-
Crawford	1	5.6	Muskegon	66	13.0
Delta	2	7.7	Newaygo	2	5.9
Dickinson	3	12.5	Oakland	57	5.8
Eaton	4	8.7	Oceana	1	7.7
Emmet	3	4.8	Ogemaw	2	25.0
Genesee	32	5.8	Ontonagon	4	30.8
Gladwin	2	6.1	Osceola	-	-
Gogebic	-	-	Oscoda	-	-
Grand Traverse	2	1.2	Otsego	1	8.3
Gratiot	17	39.5	Ottawa	13	13.5
Hillsdale	6	28.6	Presque Isle	2	33.3
Houghton	1	4.0	Roscommon	-	-
Huron	7	29.2	Saginaw	13	6.9
Ingham	32	5.0	Saint Clair	85	39.0
Ionia	55	44.4	Saint Joseph	1	6.3
Iosco	-	-	Sanilac	5	14.3
Iron	1	25.0	Schoolcraft	-	-
Isabella	2	5.3	Shiawassee	9	8.2
Jackson	5	6.2	Tuscola	2	7.1
Kalamazoo	8	2.6	Van Buren	4	7.4
Kalkaska	1	6.7	Washtenaw	7	1.6
Kent	31	9.7	Wayne	204	10.9
			Wexford	-	-
TOTAL			962*	9.8**	

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

**County was unknown for 43 adults.

Table 9. Percentage* of Adults with Blood Lead Levels (BLLs) ≥ 25 $\mu\text{g/dL}$ in Michigan by County of Residence: 2000

<u>County</u>	<u>Number</u>	<u>Percent</u>	<u>County</u>	<u>Number</u>	<u>Percent</u>
Alcona	-	-	Keweenaw	-	-
Alger	-	-	Lake	-	-
Allegan	3	8.3	Lapeer	-	-
Alpena	-	-	Leelanau	-	-
Antrim	-	-	Lenawee	2	1.5
Arenac	-	-	Livingston	1	1.4
Baraga	-	-	Luce	-	-
Barry	-	-	Mackinac	1	2.5
Bay	3	2.4	Macomb	17	2.6
Benzie	-	-	Manistee	-	-
Berrien	6	4.2	Marquette	-	-
Branch	2	11.1	Mason	1	3.3
Calhoun	-	-	Mecosta	-	-
Cass	-	-	Menominee	-	-
Charlevoix	-	-	Midland	-	-
Cheboygan	-	-	Missaukee	-	-
Chippewa	6	10.9	Monroe	1	0.5
Clare	-	-	Montcalm	13	10.1
Clinton	3	2.7	Montmorency	-	-
Crawford	-	-	Muskegon	16	3.1
Delta	-	-	Newaygo	1	2.9
Dickinson	1	4.2	Oakland	11	1.1
Eaton	-	-	Oceana	-	-
Emmet	-	-	Ogemaw	-	-
Genesee	7	1.3	Ontonagon	2	15.4
Gladwin	-	-	Osceola	-	-
Gogebic	-	-	Oscoda	-	-
Grand Traverse	-	-	Otsego	-	-
Gratiot	5	11.6	Ottawa	4	4.2
Hillsdale	-	-	Presque Isle	-	-
Houghton	-	-	Roscommon	-	-
Huron	1	4.2	Saginaw	5	2.6
Ingham	7	1.1	Saint Clair	39	17.9
Ionia	10	8.1	Saint Joseph	-	-
Iosca	-	-	Sanilac	3	8.6
Iron	1	25.0	Schoolcraft	-	-
Isabella	-	-	Shiawassee	2	1.8
Jackson	1	1.2	Tuscola	-	-
Kalamazoo	-	-	Van Buren	1	1.9
Kalkaska	1	6.7	Washtenaw	-	-
Kent	10	3.1	Wayne	40	2.1
			Wexford	-	-
TOTAL			227*	2.3**	

*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: 2000**

County	Number Reported	Michigan Population Women	Rate per 100,000 women
Allegan	1	33,884	3
Bay	2	44,941	4
Clinton	2	21,995	9
Genesee	3	171,668	2
Ingham	2	116,067	2
Ionia	2	19,544	10
Jackson	1	56,814	2
Kalamazoo	3	91,903	3
Kent	5	195,307	3
Macomb	4	294,538	1
Monroe	1	51,273	2
Montcalm	1	19,511	5
Muskegon	7	61,686	11
Oakland	5	440,572	1
Ottawa	1	70,929	1
St Joseph	1	22,714	4
Tuscola	1	21,256	5
Washtenaw	1	116,254	1
Wayne	13	861,959	2
TOTAL	56 *	3,712,439 **	2 ***

*County was unknown for 2 female 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: 2000**

County	Number Reported	Michigan Population Men	Rate per 100,000 Men
Alcona	1	4,050	25
Alger	1	3,616	28
Allegan	5	32,498	15
Arenac	2	5,516	36
Baraga	2	3,040	66
Bay	7	40,726	17
Benzie	2	4,676	43
Berrien	24	57,584	42
Branch	2	14,851	13
Calhoun	3	49,100	6
Cheboygan	1	7,829	13
Chippewa	12	15,524	77
Clare	4	9,133	44
Clinton	45	21,118	213
Crawford	1	4,739	21
Delta	2	13,715	15
Dickinson	3	9,911	30
Eaton	4	33,625	12
Emmet	3	9,043	33
Genesee	29	151,753	19
Gladwin	2	8,091	25
Grand Traverse	2	23,175	9
Gratiot	17	14,078	121
Hillsdale	6	15,665	38
Houghton	1	15,071	7
Huron	7	12,771	55
Ingham	30	104,140	29
Ionia	53	23,154	229
Iron	1	4,982	20
Isabella	2	20,414	10
Jackson	4	58,480	7
Kalamazoo	5	82,532	6
Kalkaska	1	4,914	20
Kent	26	176,836	15
Lapeer	1	27,394	4
Lenawee	6	33,298	18
Livingston	2	43,352	5
Mackinac	4	4,014	100
Macomb	37	270,303	14
Manistee	4	8,045	50
Marquette	2	27,467	7
Mason	5	9,342	54
Mecosta	2	15,424	13
Midland	4	27,812	14

**Table 11. Annual Incidence of Blood Lead Levels (BLLs)
 ≥ 10 ug/dL Among Men in Michigan
by County of Residence: 2000**

<u>County</u>	<u>Number Reported</u>	<u>Michigan Population Men</u>	<u>Rate per 100,000 Men</u>
Monroe	9	48,450	19
Montcalm	71	20,116	353
Muskegon	59	57,143	103
Newaygo	2	13,609	15
Oakland	52	404,134	13
Oceana	1	8,062	12
Ogemaw	2	6,832	29
Ontonagon	4	3,543	113
Otsego	1	6,469	15
Ottawa	12	67,092	18
Presque Isle	2	5,180	39
Saginaw	13	74,145	18
Saint Clair	85	52,442	162
Sanilac	5	14,495	34
Shiawassee	9	25,031	36
Tuscola	1	20,242	5
Van Buren	4	24,797	16
Washtenaw	6	111,653	5
Wayne	191	743,467	26
TOTAL	906 *	3,391,310 **	27 ***

*County was unknown for 41 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): 2000**

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)	3	0	0	0	0	0	3	0.0
CONSTRUCTION AND MINING (10-17)	327	162	34	16	4	0	543	9.9
Mining (10-14)	2	1	0	0	0	0	3	0.0
Other Construction (15-16)	22	19	3	1	1	0	46	10.9
Special Trade Construction (17)	303	142	31	15	3	0	494	9.9
MANUFACTURING (20-39)	652	338	95	10	3	2	1,100	10.0
Food (20)	4	0	0	0	0	0	4	0.0
Textile Mill Products (22)	1	0	0	0	0	0	1	0.0
Lumber and Wood (24)	4	1	0	0	0	0	5	0.0
Furniture and Fixtures (25)	5	1	0	0	0	0	6	0.0
Paper & Allied Products (26)	6	0	0	0	0	0	6	0.0
Printing (27)	39	1	1	0	0	0	41	2.4
Chemicals (28)	138	1	1	0	0	0	140	0.7
Rubber (30)	5	2	0	0	0	0	7	0.0
Stone/Clay/Glass(32)	25	7	1	1	0	0	34	5.9
Primary Metals (33)	132	164	72	8	1	1	378	21.7
Metal Fabrication (34)	53	115	13	0	0	0	181	7.2
Machinery (35)	21	4	4	0	2	1	32	21.9
Electronics (36)	27	5	0	0	0	0	32	0.0
Transportation (37)	183	33	3	0	0	0	219	1.4
Measuring Instruments (38)	2	0	0	0	0	0	2	0.0
Miscellaneous Mfg Industries (39)	7	4	0	1	0	0	12	8.3
TRANSP., & PUBLIC UTILITIES (40-49)	49	27	3	0	0	0	79	3.8
WHOLESALE AND RETAIL TRADE (50-59)	139	19	5	1	0	0	164	3.7
Wholesale-Durable Goods (50)	93	12	2	1	0	0	108	2.8
Wholesale-Nondurable Goods (51)	1	0	0	0	0	0	1	0.0
General Merchandise Stores (53)	13	1	0	0	0	0	14	0.0
Food Stores (54)	5	0	0	0	0	0	5	0.0
Automotive Dealers, Gasoline Services (55)	6	5	2	0	0	0	13	15.4
Home Furniture & Equipment Stores (57)	1	0	0	0	0	0	1	0.0
Eating and Drinking Places (58)	16	0	0	0	0	0	16	0.0
Other Retail Trade (59)	4	1	1	0	0	0	6	16.7

**Table 12. Distribution of Industry Among Adults in Michigan
by Blood Lead Level (ug/dL): 2000**

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)	8	0	0	0	0	0	8	0.0
SERVICES (70-89)	261	36	12	3	1	1	314	5.4
Hotels (70)	2	0	0	0	0	0	2	0.0
Business (73)	11	0	0	0	0	0	11	0.0
Automotive Repair (75)	8	6	4	2	0	0	20	30.0
Repair (76)	8	2	1	0	0	0	11	9.1
Recreation (79)	4	3	2	1	1	1	12	41.7
Health (80)	22	2	0	0	0	0	24	0.0
Education (82)	61	9	0	0	0	0	70	0.0
Social Services (83)	4	0	0	0	0	0	4	0.0
Engineering Services (87)	123	14	5	0	0	0	142	3.5
Other Services (72, 78, 81, 84, 86, 88, 89)	18	0	0	0	0	0	18	0.0
PUBLIC ADMINISTRATION (91-97)	127	13	6	0	0	0	146	4.1
General Government (91)	41	2	0	0	0	0	43	0.0
Police (92)	38	9	6	0	0	0	53	11.3
Human Resources (94)	2	0	0	0	0	0	2	0.0
Environmental Quality (95)	12	0	0	0	0	0	12	0.0
Admin. Of Economic Programs (96)	1	0	0	0	0	0	1	0.0
Military (97)	33	2	0	0	0	0	35	0.0
TOTAL	1,566	595	155	30	8	3	2,357*	8.3

*Industry was unknown for 8,361 adults. Seventy-three adults with a source of lead exposure known to be non-work related were excluded.

Table 13. Inspection Status of Thirty-Nine New Companies that were Identified Since the 1999 Annual Analysis from a Blood Lead Report of ≥ 25 $\mu\text{g/dL}$ in Michigan

<u>Inspection Status</u>	<u>Number</u>	<u>Percent</u>	
Completed Inspections	18 *	46.2	
Scheduled for Inspection	20 *	51.3	
No Follow-Up Planned	1 **	2.6	
Total	39	100.1	***

*One completed inspection was the result of a blood lead report of 23 $\mu\text{g/dL}$; one scheduled inspection was the result of a blood lead report of 18 $\mu\text{g/dL}$.

**No follow-up planned: sister location inspected; potential violations corrected for second location.

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

Table 14. Results of Eighteen New Companies that were Inspected Since the 1999 Annual Analysis from a Blood Lead Report of ≥ 25 $\mu\text{g/dL}$ in Michigan

<u>Inspection Results</u>	<u>Number</u>	<u>Percent</u>
Cited for Lead Standard Violation(s) Only	4	22.2
Cited for Lead Standard and Other Violation(s)	9 *	50.0
Not Cited for any Violation(s)	5	27.8
Total	18	100.0

*One completed inspection was the result of a blood lead report of 23 $\mu\text{g/dL}$.

Table 15. Eighteen New Companies Inspected Since the 1999 Annual Analysis Resulting from Michigan Adults with Blood Lead Levels (BLLs) of ≥ 25 $\mu\text{g/dL}$

<u>Industry (SIC)*</u>	<u>Companies Number</u>	<u>Cited for Violation of Lead Standard</u>	
		<u>Number</u>	<u>Percent</u>
Construction (15-17)			
Special Trade Construction (17)	4	3	75
Manufacturing (20-39)			
Stone/Clay/Glass (32)	1	1	100
Primary Metals (33)	2	-	-
Metal Fabrication (34)	1	1	100
Transportation (37)	1	1	100
Transp., & Public Utilities (40-49)	2	2	100
Wholesale and Retail Trade (50-59)			
Other Retail Trade (59)	1	1	100
Services (70-89)			
Automotive Repair (75)***	2	2	100
Recreation (79)	3	1	33
Government (91-97)			
Police (92)	1	1	100
Total	18	13	** 72

*Standard Industrial Classification.

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

***One completed inspection was the result of a blood lead report of 23 $\mu\text{g/dL}$.

Table 16. Demographic Characteristics of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001, by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)

Demographic Characteristics	10-24 $\mu\text{g/dL}$		25-29 $\mu\text{g/dL}$		30-39 $\mu\text{g/dL}$		40-49 $\mu\text{g/dL}$		50-59 $\mu\text{g/dL}$		≥ 60 $\mu\text{g/dL}$		TOTAL	
	Number	Percent	Number	Percent	Number	Number	Percent	Percent	Number	Percent	Number	Percent	Number	Percent
Male	123	(94.6)	81	(95.3)	153	(95.6)	49	(90.7)	21	(95.5)	9	(100)	436	(94.8)
Female	7	(5.4)	4	(4.7)	7	(4.4)	5	(9.3)	1	(4.5)	-	-	24	(5.2)
Hispanic Origin	5	(4.3)	2	(2.7)	3	(2.0)	4	(7.4)	1	(4.5)	-	-	15	(3.5)
White	108	(83.7)	75	(89.3)	140	(88.1)	46	(85.2)	20	(90.9)	6	(66.7)	395	(86.4)
African American	12	(9.3)	6	(7.1)	13	(8.2)	6	(11.1)	2	(9.1)	3	(33.3)	42	(9.2)
Asian/Pacific Islander	-	-	-	-	1	(0.6)	-	-	-	-	-	-	1	(0.2)
Native American/Alaskan	1	(0.8)	1	(1.2)	4	(2.5)	-	-	-	-	-	-	6	(1.3)
Other	8	(6.2)	2	(2.4)	1	(0.6)	2	(3.7)	-	-	-	-	13	(2.8)
Average Age	43	n=130	44	n=85	43	n=160	47	n=54	48	n=22	39	n=9	44	n=460
Ever Smoked	78	(63.9)	57	(70.4)	107	(75.9)	38	(79.2)	15	(83.3)	7	(87.5)	302	(72.2)*
Now Smoke	44	(56.4)	34	(59.6)	78	(72.9)	31	(81.6)	11	(73.3)	5	(71.4)	203	(67.2)*

*P= < 0.05 for linear trend.

**Table 17. Symptoms of Michigan Adults with Blood Lead Levels (BLLs)
of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001,
by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)**

<u>Symptoms</u>	<u>10-24 $\mu\text{g/dL}$</u>		<u>25-29 $\mu\text{g/dL}$</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>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
GASTRO-INTESTINAL														
Lost 10+ lbs without diet	15	(12.1)	7	(8.4)	25	(16.0)	16	(29.6)	4	(20.0)	1	(12.5)	68	(15.3)*
Continued loss of appetite	13	(10.3)	8	(9.4)	28	(17.7)	15	(27.8)	5	(22.7)	2	(22.2)	71	(15.6)*
Pains in belly	24	(18.9)	11	(12.9)	29	(18.4)	20	(37.0)	5	(23.8)	-	-	89	(19.6)
MUSCULOSKELETAL														
Frequent pain/soreness	47	(37.6)	27	(32.1)	65	(41.4)	33	(62.3)	10	(47.6)	4	(44.4)	186	(41.4)*
Muscle weakness	31	(24.6)	13	(15.7)	37	(24.0)	24	(44.4)	8	(38.1)	4	(44.4)	117	(26.2)*
NERVOUS														
Headaches	22	(17.3)	9	(10.6)	38	(24.1)	20	(37.0)	7	(31.8)	2	(22.2)	98	(21.5)*
Dizziness	10	(7.9)	6	(7.1)	10	(6.5)	11	(20.4)	2	(9.5)	2	(22.2)	41	(9.1)
Depressed	22	(17.6)	6	(7.3)	27	(17.5)	10	(19.2)	7	(31.8)	4	(44.4)	76	(17.1)*
Tired	51	(40.5)	28	(33.3)	86	(54.8)	37	(69.8)	13	(59.1)	5	(55.6)	220	(48.8)*
Nervous	15	(11.8)	8	(9.4)	27	(17.2)	15	(27.8)	7	(33.3)	3	(33.3)	75	(16.6)*
Waking up at night	31	(24.8)	17	(20.0)	57	(36.5)	24	(44.4)	10	(45.5)	4	(44.4)	143	(31.7)*
Nightmares	3	(2.4)	-	-	6	(3.9)	5	(9.4)	1	(4.8)	1	(11.1)	16	(3.6)*
Irritable	20	(15.9)	18	(21.7)	51	(32.9)	25	(47.2)	10	(47.6)	4	(44.4)	128	(28.6)*
Unable to concentrate	14	(11.2)	9	(10.8)	35	(22.2)	13	(24.5)	4	(18.2)	2	(22.2)	77	(17.1)*
REPRODUCTIVE														
Unable to have an erection	8	(18.2)	5	(8.2)	10	(8.1)	5	(12.8)	7	(36.8)	-	-	35	(11.9)
Trouble having a child	9	(7.1)	5	(6.1)	8	(5.4)	-	-	-	-	1	(12.5)	23	(5.3)
Gastro-Intestinal Symptoms	34	(26.6)	14	(16.5)	50	(31.4)	27	(50.0)	10	(45.5)	3	(33.3)	138	(30.2)*
Musculoskeletal Symptoms	53	(41.7)	28	(33.3)	72	(45.9)	37	(68.5)	11	(52.4)	5	(55.6)	206	(45.6)*
Nervous Symptoms	70	(55.1)	41	(48.2)	110	(69.6)	41	(75.9)	17	(77.3)	5	(55.6)	284	(62.4)*
Reproductive Symptoms	13	(25.5)	7	(11.3)	15	(11.9)	3	(7.7)	2	(10.5)	1	(14.3)	41	(13.5)
Any Symptoms	87	(68.0)	52	(61.2)	118	(74.2)	45	(83.3)	20	(90.9)	6	(66.7)	328	(71.8)*
Average Number Symptoms	2.6	n=128	2.0	n=85	3.4	n=159	5.0	n=54	4.3	n=22	4.3	n=9	3.2	n=457

*P= < 0.05 for linear trend.

Table 18. Lead Related Health Conditions of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001, by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)

<u>Lead Related Disease</u>	<u>10-24 $\mu\text{g/dL}$</u>		<u>25-29 $\mu\text{g/dL}$</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>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Anemia	8	(6.5)	3	(3.7)	4	(2.6)	3	(5.8)	2	(9.1)	-	-	20	(4.6)
Kidney Disease	3	(2.4)	-	-	2	(1.3)	1	(1.9)	-	-	-	-	6	(1.3)
High Blood Pressure	14	(11.2)	5	(5.9)	23	(15.0)	10	(19.6)	4	(19.0)	1	(12.5)	57	(12.9)

**Table 19. Industry of Michigan Adults with Blood Lead Levels (BLLs)
of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001,
by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)**

<u>Industry (SIC Code*)</u>	<u>10-24 $\mu\text{g/dL}$</u>		<u>25-29 $\mu\text{g/dL}$</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>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Mining (13)	-	-	-	-	1	(0.7)	-	-	-	-	-	-	1	(0.2)
Other Construction (15)	-	-	1	(1.3)	-	-	-	-	-	-	-	-	1	(0.2)
Other Construction (16)	6	(5.3)	-	-	1	(0.7)	-	-	-	-	-	-	7	(1.7)
Special Trade Construction (17)	36	(31.6)	14	(18.2)	45	(29.4)	19	(38.0)	8	(38.1)	4	(44.4)	126	(29.7)
Lumber and Wood (24)	1	(0.9)	-	-	-	-	-	-	-	-	-	-	1	(0.2)
Furniture and Fixtures (25)	1	(0.9)	-	-	-	-	-	-	-	-	-	-	1	(0.2)
Printing and Publishing (27)	1	(0.9)	-	-	1	(0.7)	-	-	-	-	-	-	2	(0.5)
Chemicals (28)	2	(1.8)	-	-	-	-	-	-	-	-	-	-	2	(0.5)
Stone/Clay/Glass (32)	2	(1.8)	1	(1.3)	4	(2.6)	1	(2.0)	-	-	-	-	8	(1.9)
Foundries (33)	8	(7.0)	28	(36.4)	67	(43.8)	18	(36.0)	7	(33.3)	3	(33.3)	131	(30.9)
Fabricated Metal Products (34)	7	(6.1)	8	(10.4)	12	(7.8)	5	(10.0)	-	-	-	-	32	(7.5)
Machinery (35)	4	(3.5)	2	(2.6)	2	(1.3)	1	(2.0)	2	(9.5)	1	(11.1)	12	(2.8)
Electronics (36)	7	(6.1)	1	(1.3)	-	-	-	-	-	-	-	-	8	(1.9)
Automobile (37)	7	(6.1)	3	(3.9)	4	(2.6)	2	(4.0)	-	-	-	-	16	(3.8)
Other Durables (39)	2	(1.8)	1	(1.3)	1	(0.7)	-	-	-	-	-	-	4	(0.9)
Transportation, Utilities (40)	-	-	1	(1.3)	1	(0.7)	-	-	-	-	-	-	2	(0.5)
Transportation, Utilities (45)	-	-	-	-	1	(0.7)	-	-	-	-	-	-	1	(0.2)
Transportation, Utilities (49)	3	(2.6)	2	(2.6)	2	(1.3)	-	-	-	-	-	-	7	(1.7)
Wholesale-Durable Goods (50)	1	(0.9)	-	-	1	(0.7)	-	-	-	-	-	-	2	(0.5)
Automotive Dealers, Gas (55)	1	(0.9)	1	(1.3)	-	-	-	-	-	-	-	-	2	(0.5)
Eating and Drinking Places (58)	1	(0.9)	-	-	-	-	-	-	-	-	-	-	1	(0.2)
Other Retail Trade (59)	1	(0.9)	-	-	1	(0.7)	-	-	-	-	-	-	2	(0.5)
Finance, Insurance,Real Estate (65)	1	(0.9)	-	-	-	-	-	-	-	-	-	-	1	(0.2)
Automotive Repair (75)	5	(4.4)	6	(7.8)	2	(1.3)	4	(8.0)	3	(14.3)	-	-	20	(4.7)
Repair (76)	1	(0.9)	-	-	1	(0.7)	-	-	-	-	-	-	2	(0.5)
Recreation (79)	1	(0.9)	-	-	1	(0.7)	-	-	1	(4.8)	1	(11.1)	4	(0.9)
Education (82)	7	(6.1)	1	(1.3)	1	(0.7)	-	-	-	-	-	-	9	(2.1)
Engineering Services (87)	4	(3.5)	-	-	1	(0.7)	-	-	-	-	-	-	5	(1.2)
General Government (91)	1	(0.9)	-	-	-	-	-	-	-	-	-	-	1	(0.2)
Police (92)	2	(1.8)	6	(7.8)	1	(0.7)	-	-	-	-	-	-	9	(2.1)
Human Resources (94)	-	-	-	-	1	(0.7)	-	-	-	-	-	-	1	(0.2)
Admin Of Economic Programs(96)	-	-	1	(1.3)	-	-	-	-	-	-	-	-	1	(0.2)
Military (97)	1	(0.9)	-	-	1	(0.7)	-	-	-	-	-	-	2	(0.5)
TOTAL	114	(100)	77	(100)	153	(100)	50	(100)	21	(100)	9	(100)	424	(100)

*Standard Industrial Classification.

Table 20. Number of Years Worked of Michigan Adults with Blood Lead Levels (BLLs) of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001, by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)

<u>Number of Years Worked</u>	<u>10-24 $\mu\text{g/dL}$</u>		<u>25-29 $\mu\text{g/dL}$</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>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
≤ 5	65	(58.6)	44	(59.5)	74	(49.7)	28	(56.0)	11	(55.0)	5	(55.6)	227	(55.0)
6 – 10	14	(12.6)	14	(18.9)	21	(14.1)	6	(12.0)	6	(30.0)	2	(22.2)	63	(15.3)
11 – 20	21	(18.9)	11	(14.9)	25	(16.8)	8	(16.0)	1	(5.0)	1	(11.1)	67	(16.2)
21 – 30	6	(5.4)	5	(6.8)	24	(16.1)	2	(4.0)	1	(5.0)	1	(11.1)	39	(9.4)
≥ 31	5	(4.5)	-	-	5	(3.4)	6	(12.0)	1	(5.0)	-	-	17	(4.1)

Table 21. Working Conditions Reported by Michigan Adults with Blood Lead Levels (BLLs) of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001, by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)

<u>Working Conditions</u>	<u>10-24 $\mu\text{g/dL}$</u>		<u>25-29 $\mu\text{g/dL}$</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>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Separate lockers: dirty and clean*	55	(52.9)	52	(69.3)	102	(71.3)	29	(59.2)	14	(66.7)	3	(37.5)	255	(63.8)
Work clothes laundered: work*	47	(45.6)	47	(62.7)	91	(63.2)	24	(49.0)	9	(42.9)	2	(25.0)	220	(55.0)
Shower facility*	52	(49.5)	47	(63.5)	113	(77.9)	26	(52.0)	9	(45.0)	4	(50.0)	251	(62.4)
Lunch room*	74	(69.2)	56	(75.7)	118	(81.4)	27	(54.0)	11	(52.4)	3	(37.5)	289	(71.4)
Clean off dust and wash hands before eating*	98	(92.5)	65	(86.7)	136	(93.2)	42	(85.7)	18	(85.7)	8	(100)	367	(90.6)
Eat in lunchroom*	57	(60.0)	44	(68.8)	79	(61.7)	22	(51.2)	7	(36.8)	2	(28.6)	211	(59.3)
Wear respirator*	67	(62.0)	48	(64.9)	112	(77.2)	39	(78.0)	14	(66.7)	7	(87.5)	287	(70.7)
Smoke in work area**	31	(64.6)	22	(64.7)	51	(66.2)	14	(45.2)	4	(36.4)	4	(80.0)	126	(61.2)
Keep cigarettes in pocket while working**	21	(46.7)	11	(31.4)	38	(49.4)	11	(35.5)	3	(27.3)	3	(60.0)	87	(42.6)
Exposed to Lead now*	58	(56.3)	49	(67.1)	102	(71.3)	25	(55.6)	14	(77.8)	2	(25.0)	250	(64.1)
Removal from job*	8	(7.4)	7	(9.3)	23	(16.0)	13	(27.1)	7	(33.3)	4	(50.0)	62	(15.3)

*Based on positive questionnaire responses.

**Based on negative questionnaire responses.

Table 22. Changes in Response to Questions on Working Conditions in Facilities Before and After a MIOSHA Enforcement Inspection

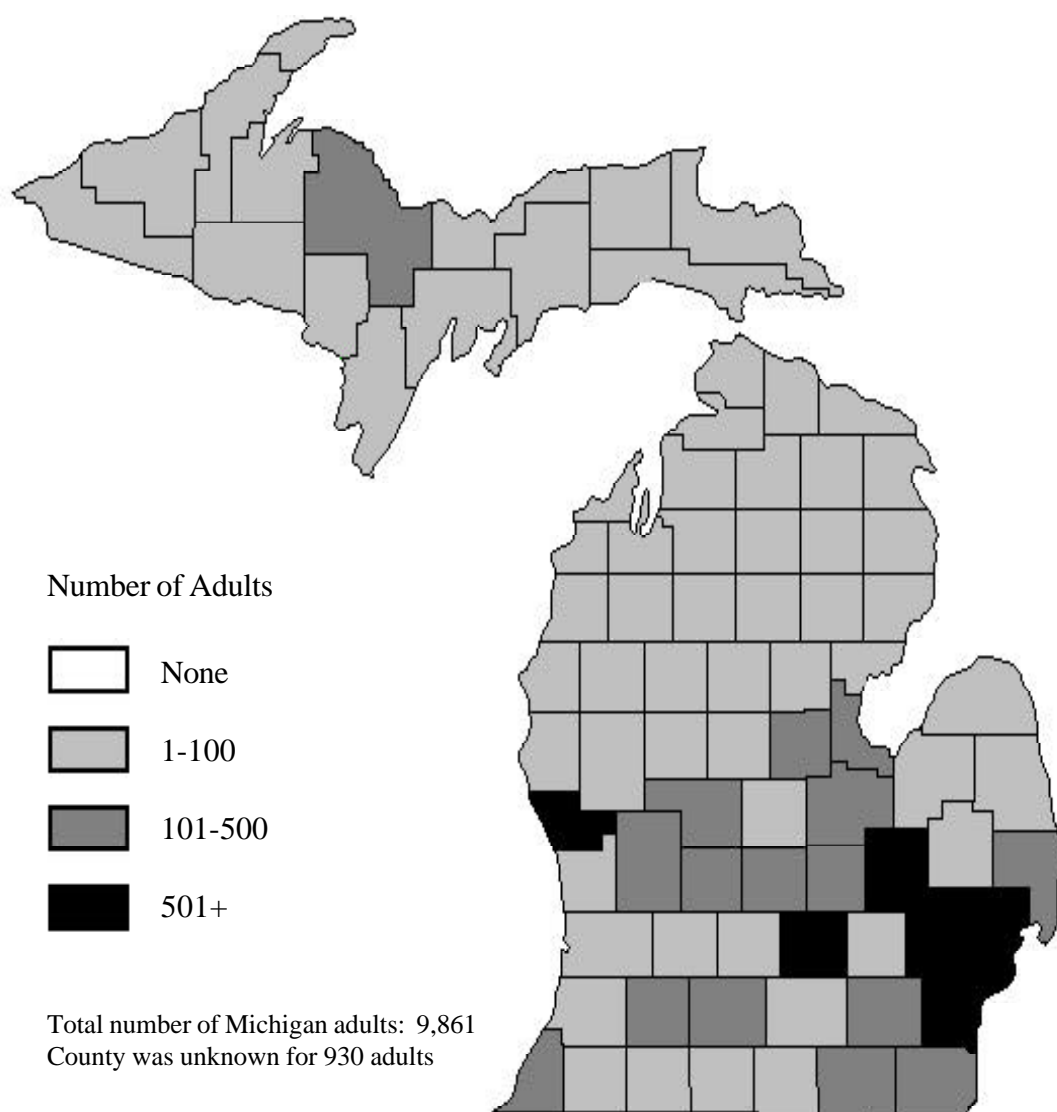
<u>Working Conditions</u>	<u>Number of Facilities</u>	<u>Status of Working Conditions</u>					
		<u>Better</u>		<u>No Change</u>		<u>Worse</u>	
		<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Separate lockers: dirty and clean*	7	5	(71)	1	(14)	1	(14)
Work clothes laundered: work*	6	3	(50)	1	(17)	2	(33)
Shower facility*	6	4	(67)	0	--	2	(33)
Lunch room*	5	0	--	4	(80)	1	(20)
Clean off dust and wash hands before eating*	9	3	(33)	4	(44)	2	(22)
Eat in lunchroom*	5	3	(60)	0	--	2	(40)
Wear respirator*	8	1	(13)	3	(38)	4	(50)

*Based on positive questionnaire responses.

Table 23. Number of Households with Children Potentially Exposed to Take-Home Lead from Michigan Adults with Blood Lead Levels (BLLs) of ≥ 10 $\mu\text{g/dL}$, Interviewed from 10-15-1997 to 02-01-2001, by Highest Reported Blood Lead Level ($\mu\text{g/dL}$)

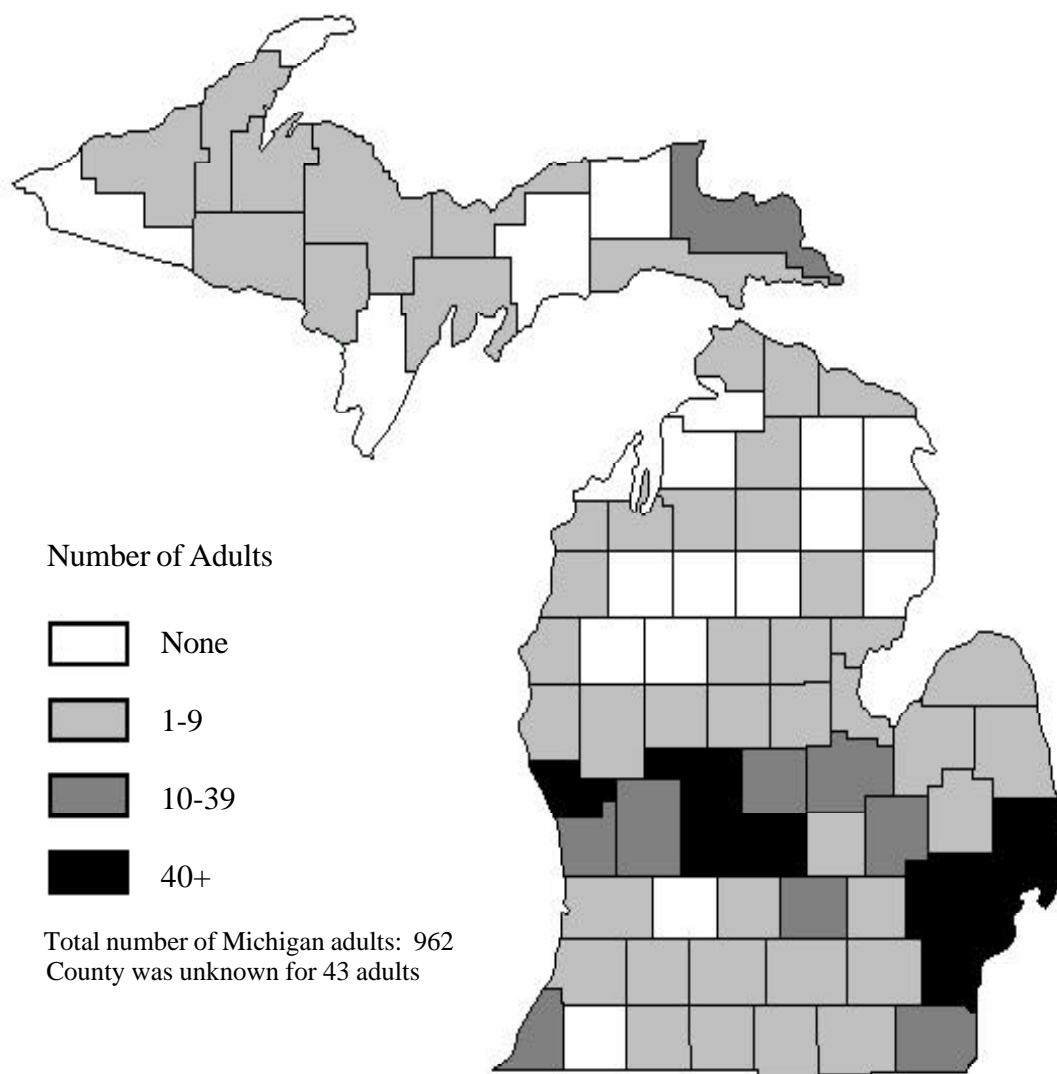
<u>Households with Children Potentially Exposed</u>	10-24 $\mu\text{g/dL}$		25-29 $\mu\text{g/dL}$		30-39 $\mu\text{g/dL}$		40-49 $\mu\text{g/dL}$		50-59 $\mu\text{g/dL}$		≥ 60 $\mu\text{g/dL}$		TOTAL	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Households with Children living or spending time in house	38	(29.7)	27	(32.1)	55	(34.6)	15	(28.3)	7	(31.8)	2	(22.2)	144	(31.6)
Households with Children tested for Lead	6	(18.2)	3	(12.5)	9	(17.0)	6	(50.0)	2	(28.6)	1	(50.0)	27	(20.6)
Households where Children had elevated Lead levels	2	(40.0)	1	(33.3)	6	(54.5)	2	(40.0)	-	-	1	(100)	12	(44.4)

**Figure 1. Distribution of Adults Tested for Blood Lead
in Michigan by County of Residence: 2000**



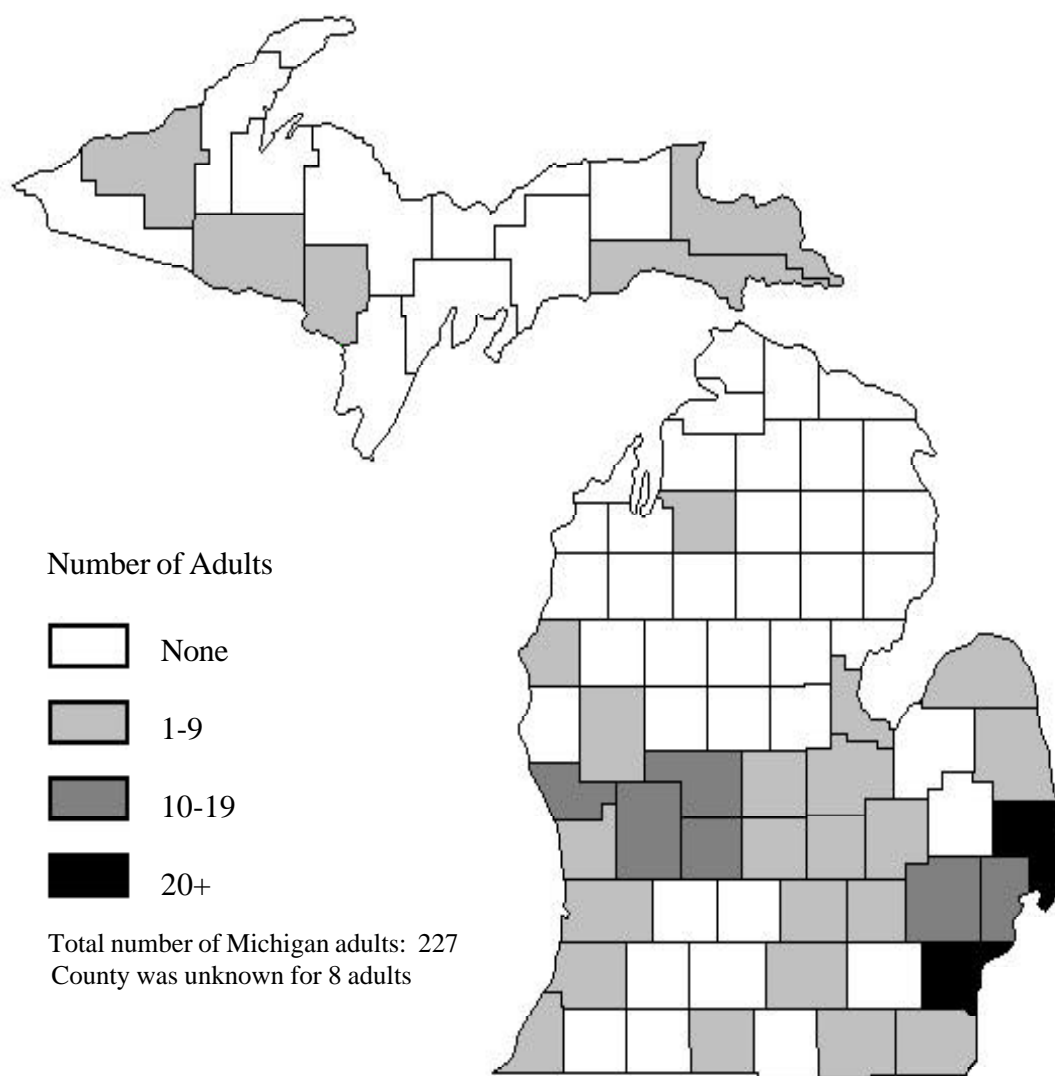
Oakland and **Wayne** counties had the highest number of adults reported,
with 991 and 1,867 adults, respectively.

Figure 2. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 10 ug/dL in Michigan by County of Residence: 2000



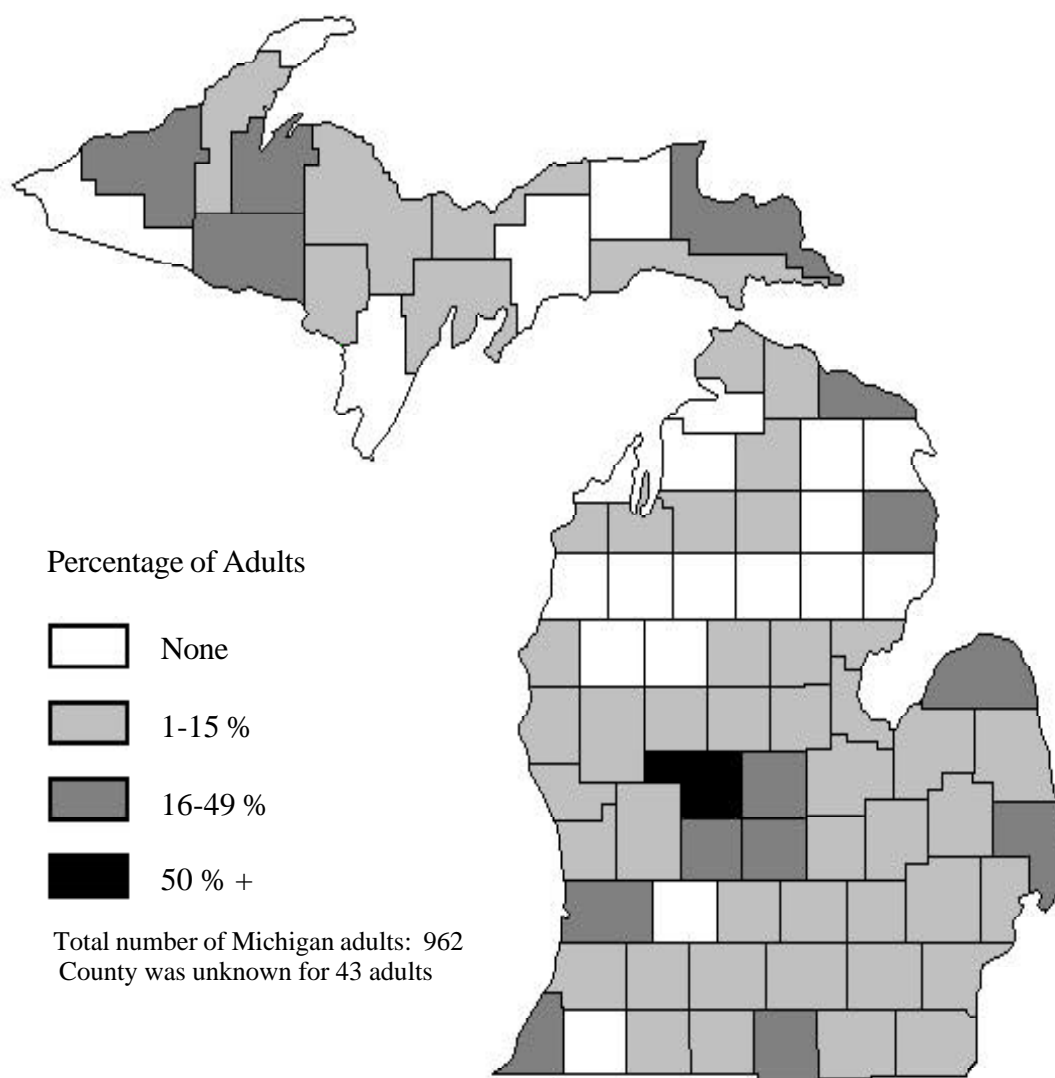
St. Clair and **Wayne** counties had the highest number of adults with blood lead levels of 10 ug/dL or greater reported, with 85 and 204 adults, respectively.

Figure 3. Distribution of Adults with Blood Lead Levels (BLLs) ≥ 25 ug/dL in Michigan by County of Residence: 2000



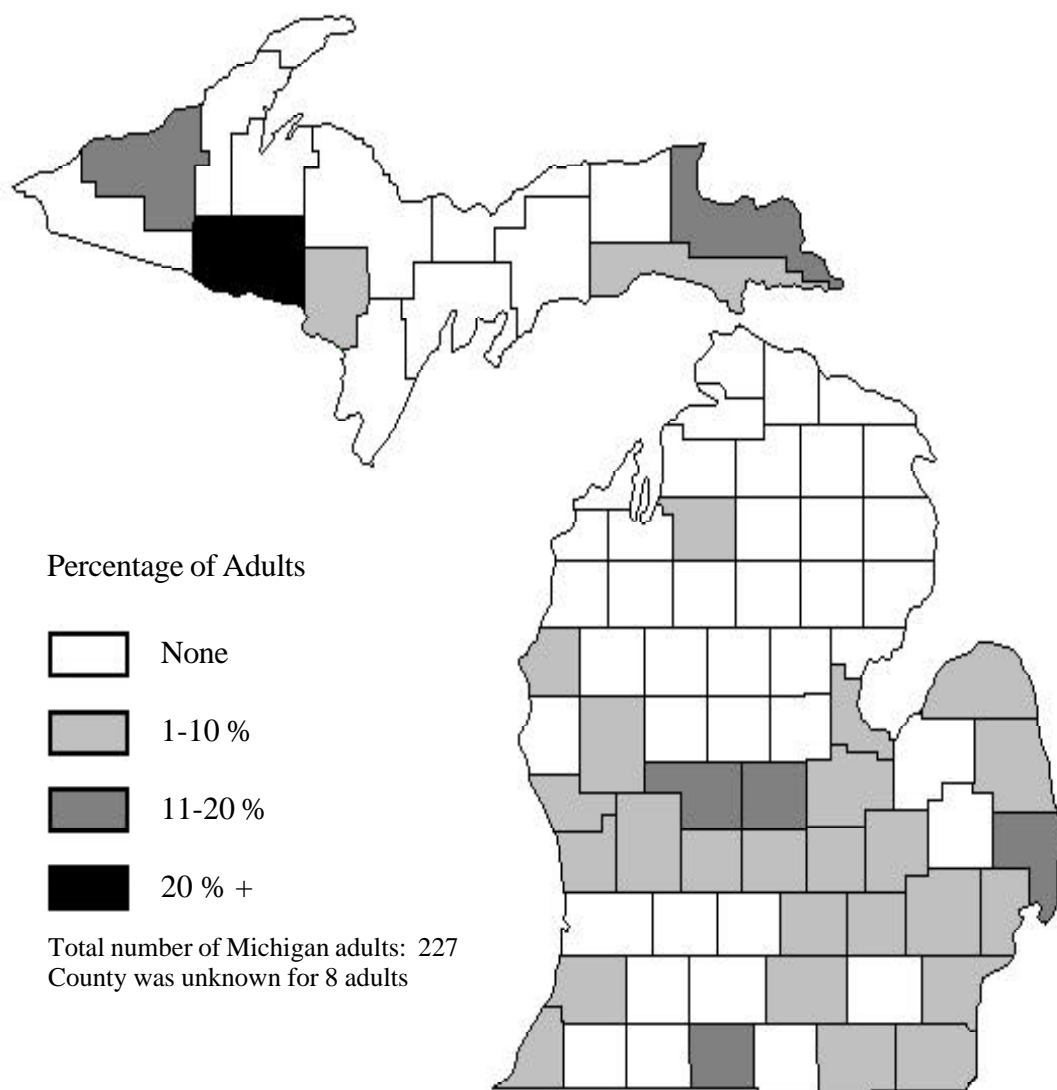
St. Clair and **Wayne** counties had the highest number of adults with blood lead levels of 25 ug/dL or greater reported, with 39 and 40 adults, respectively.

Figure 4. Percentage of Adults with Blood Lead Levels (BLLs) ≥ 10 ug/dL in Michigan by County of Residence: 2000*



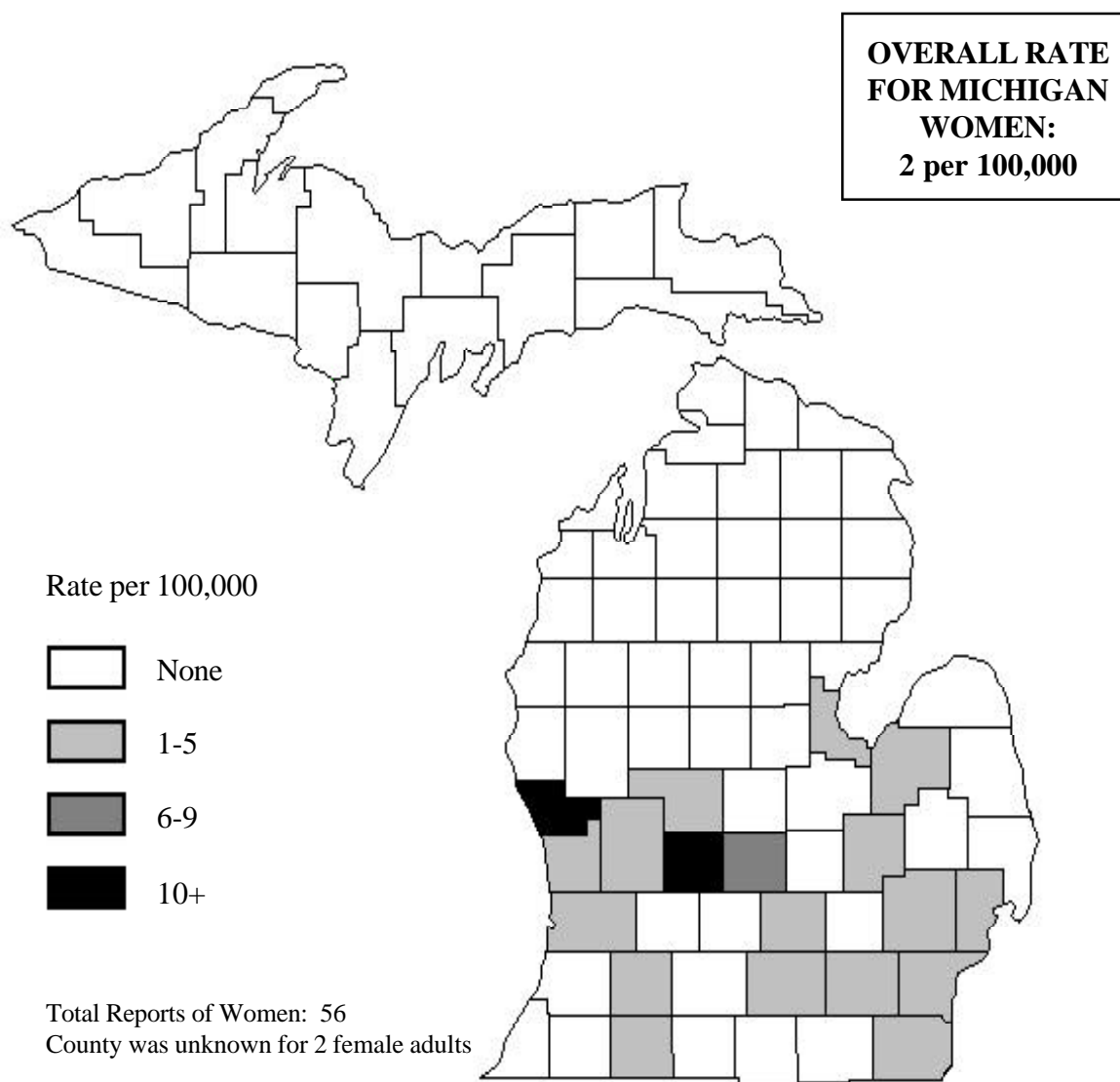
*Denominator used was the total number of adults tested for blood lead within each county.

Figure 5. Percentage of Adults with Blood Lead Levels (BLLs) ≥ 25 ug/dL in Michigan by County of Residence: 2000*



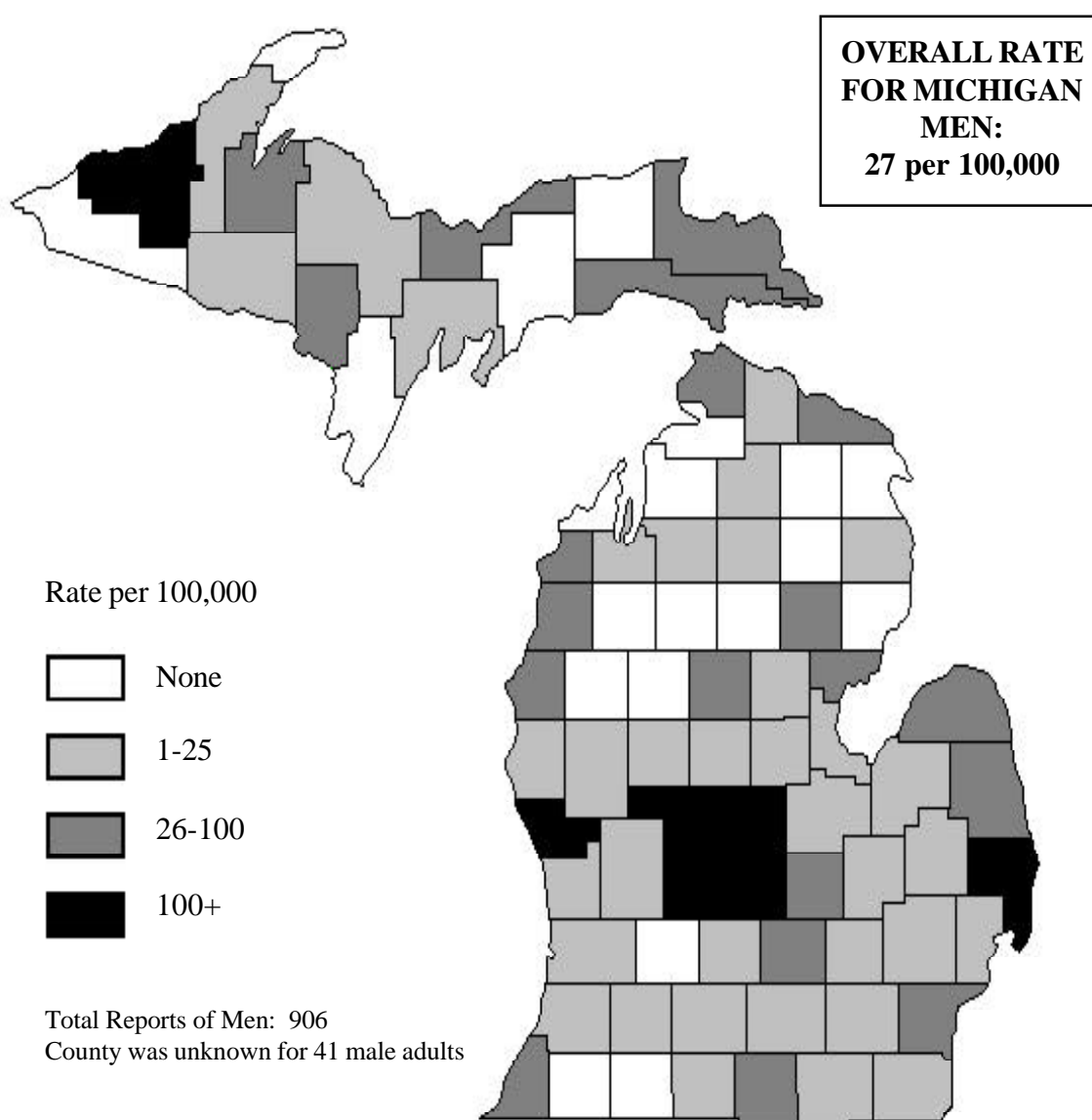
*Denominator used was the total number of individuals tested for blood lead in each county.

Figure 6. Annual Incidence of Blood Lead Levels (BLLs) ≥ 10 ug/dL Among Women in Michigan by County of Residence: 2000*



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

Figure 7. Annual Incidence of Blood Lead Levels (BLLs) ≥ 10 ug/dL Among Men in Michigan by County of Residence: 2000*



*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) ≥ 25 ug/dL in Michigan: 2000

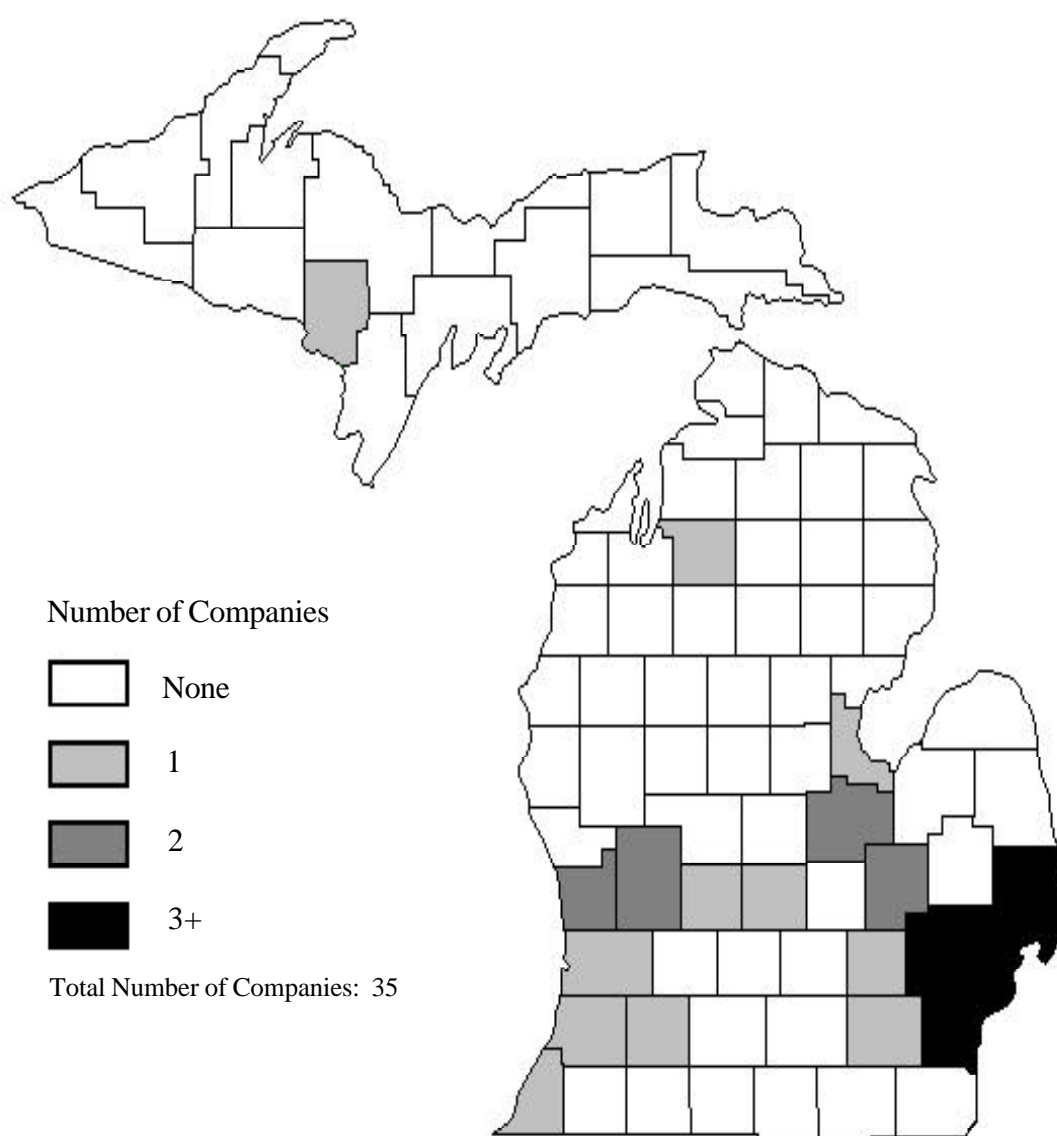
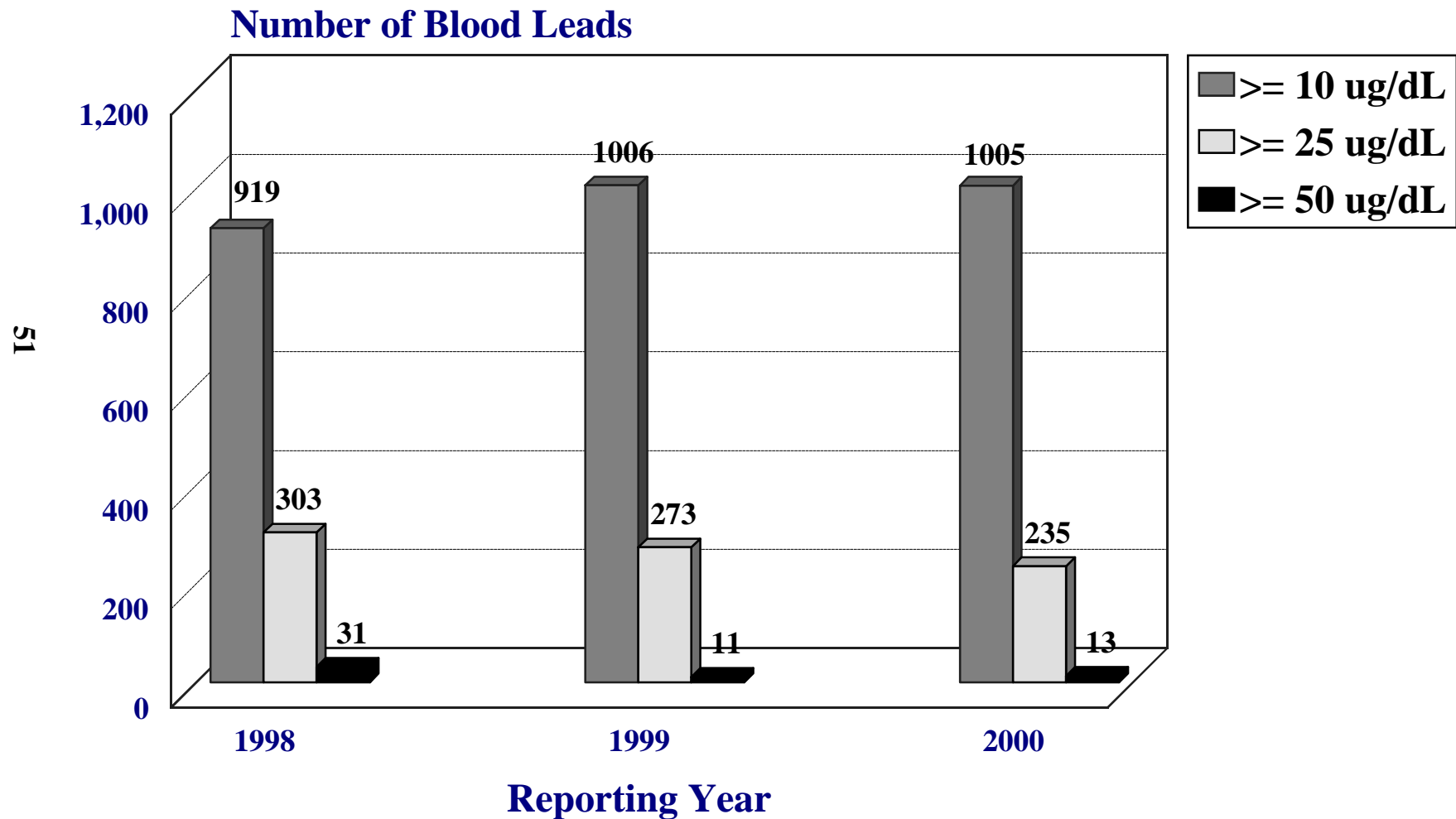


Figure 9. Number of Blood Levels ≥ 10 ug/dL, ≥ 25 ug/dL and ≥ 50 ug/dL, Michigan, 1998-2000



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.

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:

June 24, 1997

Effective: October 11, 1997

(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. CLIENT 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? <input type="checkbox"/> yes <input type="checkbox"/> no		
Sex <input type="checkbox"/> Male <input type="checkbox"/> Female		Race <input type="checkbox"/> Native American (1) <input type="checkbox"/> Asian/Pacific Islander (2) <input type="checkbox"/> Black (3) <input type="checkbox"/> White (5) <input type="checkbox"/> Multiracial (7)		Ethnic Group <input type="checkbox"/> 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 <small>To be Completed by Person who draws Specimen</small>	
Specimen Collection Date _____	Type of Specimen: <input type="checkbox"/> Capillary <input type="checkbox"/> Venous

III. LABORATORY INFORMATION <small>Completion required by testing laboratory</small>	
BLOOD LEAD LEVEL _____ MICROGRAMS PER DECILITER	Specimen Number _____
Laboratory Name _____	Date of Analysis _____
Area Code and Phone Number _____	

Appendix II

Michigan Department of Community Health (MDCH) Childhood Lead Poisoning Prevention Project (CLPPP)

The Michigan Department of Community Health (MDCH) Childhood Lead Poisoning Prevention Project (CLPPP) focuses its efforts on children less than six years of age. These efforts include: 1) implementation of the statewide plan for childhood blood lead testing; 2) maintaining the statewide surveillance system, including collection, assurance of accuracy, analysis and dissemination of screening data, prevalence of elevated blood lead (EBL) levels, sources of lead exposure, and follow-up care for children; 3) overseeing policy development to bring about screening and follow-up care of identified EBL children, while encouraging remediation of lead hazards through cooperation with local authorities; 4) developing public and professional health education materials and strategies for a variety of targeted audiences; 5) continuing to develop policies for primary prevention of childhood lead poisoning, providing oversight of primary prevention activities in selected sites that have proven to be effective, and working with housing authorities and landlords to provide safe housing for children.

The overwhelming source of lead exposure for children in Michigan is lead paint, especially in older homes where paint is chipping, peeling or crumbling. Deteriorating lead paint creates a fine lead dust that lands on windowsills, floors, porches, and outside dirt areas. Young children ingest this lead dust through normal hand-to-mouth activity.

Because young children's nervous systems are still developing, the effects of lead are particularly devastating to them, and are for the most part irreversible. Long-term effects of lead poisoning in children include reduced IQ, learning disabilities, behavioral problems, hearing loss, reduced potential and an increased tendency toward violence.

MDCH CLPPP recommends that children be tested at 12 and 24 months of age (or between 36 and 72 months if not tested previously) if he or she

- is Medicaid-eligible, OR
- resides in a CLPPP-designated high-risk ZIP code area (particularly those with concentrations of old housing and/or poverty), OR
- is living in a situation where the answer is "Yes" to any of the following questions:
 1. Does the child live in (or often visit) a house built before 1950 with peeling or chipping paint? This could include a day care, preschool, or home of a relative.
 2. Does the child live in (or often visit) a house built before 1978 that has been remodeled within the last year?
 3. Does the child have a brother or sister (or playmate) with lead poisoning?
 4. Does the child live with an adult whose job or hobby involves lead?
 5. Does the child's family use any home remedies that may contain lead?

The President's Task Force on Environmental Health Risks and Safety Risks to Children has outlined a plan for the elimination of childhood lead poisoning by the year 2010. Recent studies show that, nationwide, progress is being made as blood lead levels in children continue to decline. In Michigan in 2000, 5.5% of children under six who were tested had confirmed EBLs, a reduction from previous years. However, many areas in Michigan still have significant numbers of children with high levels of lead, and it is important that targeted treatment and prevention efforts continue until every child is lead safe.

CHILDHOOD LEAD POISONING DATA FACTS -- ALL MICHIGAN COUNTIES -- JANUARY 1, 2000 THROUGH DECEMBER 31, 2000

March 2001

County	RISK FACTORS				RESULTS OF BLOOD LEAD TESTS							
	Pre-1950 Housing		Age & Poverty		Children < Age 6, Tested for Lead		Children Confirmed >=10ug/dL		Children Confirmed >=15ug/dL		Children Confirmed >=20ug/dL	
	Units*	% of Total Housing	Children Under Age 6**	< Age 6, Below Poverty***	Number of Children	% of Total Children	Number of Children	% of Children Tested	Number of Children	% of Children Tested	Number of Children	% of Children Tested
Alcona	2,451	24%	621	213	54	9%	0	0.0%	0	0.0%	0	0.0%
Alger	2,084	36%	614	179	84	14%	1	1.2%	0	0.0%	0	0.0%
Allegan	#####	33%	9,483	1,337	322	3%	4	1.2%	0	0.0%	0	0.0%
Alpena	4,919	34%	2,158	508	224	10%	0	0.0%	0	0.0%	0	0.0%
Antrim	3,657	28%	1,630	379	42	3%	3	7.1%	1	2.4%	0	0.0%
Arenac	2,110	24%	1,187	416	126	11%	1	0.8%	0	0.0%	0	0.0%
Baraga	2,007	43%	595	194	144	24%	0	0.0%	0	0.0%	0	0.0%
Barry	7,778	37%	4,298	568	233	5%	2	0.9%	1	0.4%	1	0.4%
Bay	#####	40%	8,261	2,271	458	6%	15	3.3%	5	1.1%	1	0.2%
Benzie	2,805	33%	1,113	281	26	2%	3	11.5%	0	0.0%	0	0.0%
Berrien	#####	35%	#####	3,977	2,234	18%	170	7.6%	55	2.5%	15	0.7%
Branch	7,191	39%	3,577	1,165	95	3%	1	1.1%	0	0.0%	0	0.0%
Calhoun	#####	41%	#####	2,949	1,139	10%	43	3.8%	11	1.0%	4	0.4%
Cass	8,010	35%	3,726	979	219	6%	7	3.2%	2	0.9%	0	0.0%
Charlevoix	4,197	32%	2,002	374	35	2%	1	2.9%	0	0.0%	0	0.0%
Cheboygan	4,015	29%	1,756	518	96	5%	0	0.0%	0	0.0%	0	0.0%
Chippewa	5,774	32%	2,481	718	394	16%	3	0.8%	2	0.5%	0	0.0%
Clare	2,989	16%	2,390	889	153	6%	0	0.0%	0	0.0%	0	0.0%
Clinton	7,067	34%	5,093	582	165	3%	2	1.2%	0	0.0%	0	0.0%
Crawford	1,470	17%	1,118	284	17	2%	0	0.0%	0	0.0%	0	0.0%
Delta	7,652	43%	2,708	664	372	14%	8	2.2%	1	0.3%	0	0.0%
Dickinson	5,973	46%	1,982	393	117	6%	0	0.0%	0	0.0%	0	0.0%
Eaton	9,270	26%	7,727	1,076	286	4%	3	1.0%	1	0.3%	1	0.3%
Emmet	4,867	33%	2,359	362	22	1%	0	0.0%	0	0.0%	0	0.0%
Genesee	#####	27%	#####	#####	2,847	8%	88	3.1%	32	1.1%	9	0.3%
Gladwin	2,625	18%	1,913	711	66	3%	0	0.0%	0	0.0%	0	0.0%
Gogebic	6,624	60%	1,023	350	88	9%	1	1.1%	0	0.0%	0	0.0%
Grand Trav	6,677	23%	6,126	720	81	1%	0	0.0%	0	0.0%	0	0.0%
Gratiot	6,399	44%	3,027	828	276	9%	1	0.4%	1	0.4%	1	0.4%
Hillsdale	7,811	42%	3,842	865	255	7%	3	1.2%	1	0.4%	0	0.0%
Houghton	#####	62%	2,393	790	410	17%	9	2.2%	4	1.0%	2	0.5%
Huron	7,437	38%	2,661	653	147	6%	0	0.0%	0	0.0%	0	0.0%
Ingham	#####	30%	#####	5,565	2,675	12%	37	1.4%	16	0.6%	9	0.3%
Ionia	8,575	44%	5,240	1,101	361	7%	9	2.5%	4	1.1%	2	0.6%
Iosco	4,298	22%	2,264	957	127	6%	1	0.8%	0	0.0%	0	0.0%
Iron	4,575	51%	732	287	71	10%	0	0.0%	0	0.0%	0	0.0%
Isabella	4,941	25%	4,237	1,057	298	7%	3	1.0%	0	0.0%	0	0.0%
Jackson	#####	39%	#####	2,850	329	3%	34	10.3%	14	4.3%	10	3.0%
Kalamazoo	#####	30%	#####	3,846	1,653	9%	64	3.9%	20	1.2%	9	0.5%
Kalkaska	1,436	16%	1,319	329	14	1%	0	0.0%	0	0.0%	0	0.0%
Kent	#####	32%	#####	7,821	9,253	18%	536	5.8%	236	2.6%	101	1.1%
Keweenaw	1,366	61%	130	27	20	15%	1	5.0%	0	0.0%	0	0.0%

* 1990 Census Data, U. S. Department of Commerce, Bureau of the Census

** Based on Population Estimates by Single Year of Age for Michigan and Counties, 1999, Michigan Information Center

*** 15% poverty

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: Columns for Children Tested reflects capillary and venous blood tests. Columns for Children Confirmed reflect venous tests only.

County	RISK FACTORS				RESULTS OF BLOOD LEAD TESTS							
	Pre-1950 Housing		Age & Poverty		Children < Age 6, Tested for Lead		Children Confirmed >=10ug/dL		Children Confirmed >=15ug/dL		Children Confirmed >=20ug/dL	
	Units	% of Total Housing	Children Under Age 6**	< Age 6, Below Poverty***	Number of Children	% of Total Children	Number of Children	% of Children Tested	Number of Children	% of Children Tested	Number of Children	% of Children Tested
Lake	2,249	19%	800	295	50	6%	4	8.0%	2	4.0%	0	0.0%
Lapeer	7,259	27%	7,014	979	204	3%	5	2.5%	0	0.0%	0	0.0%
Leelanau	3,084	28%	1,509	227	8	1%	0	0.0%	0	0.0%	0	0.0%
Lenawee	15,352	44%	7,966	1,626	452	6%	14	3.1%	5	1.1%	4	0.9%
Livingston	7,915	19%	12,157	690	104	1%	1	1.0%	1	1.0%	1	1.0%
Luce	1,374	38%	432	159	38	9%	1	2.6%	0	0.0%	0	0.0%
Mackinac	2,781	30%	787	235	109	14%	0	0.0%	0	0.0%	0	0.0%
Macomb	36,730	13%	56,119	5,335	2,624	5%	24	0.9%	10	0.4%	6	0.2%
Manistee	5,193	39%	1,526	552	65	4%	0	0.0%	0	0.0%	0	0.0%
Marquette	11,357	37%	4,761	1,463	506	11%	6	1.2%	2	0.4%	0	0.0%
Mason	5,550	39%	2,111	583	31	1%	2	6.5%	1	3.2%	0	0.0%
Mecosta	4,496	26%	2,903	847	365	13%	2	0.5%	0	0.0%	0	0.0%
Menominee	5,511	44%	1,689	336	178	11%	2	1.1%	2	1.1%	0	0.0%
Midland	5,950	20%	6,423	1,233	218	3%	6	2.8%	1	0.5%	0	0.0%
Missaukee	1,743	25%	1,207	350	26	2%	0	0.0%	0	0.0%	0	0.0%
Monroe	16,133	33%	11,795	1,942	902	8%	14	1.6%	8	0.9%	3	0.3%
Montcalm	7,744	34%	5,128	1,361	595	12%	5	0.8%	1	0.2%	0	0.0%
Montmorency	1,684	19%	629	211	30	5%	0	0.0%	0	0.0%	0	0.0%
Muskegon	22,107	36%	14,644	4,146	1,653	11%	115	7.0%	39	2.4%	20	1.2%
Newaygo	5,242	26%	4,236	1,017	259	6%	2	0.8%	1	0.4%	0	0.0%
Oakland	83,718	19%	90,026	9,197	5,546	6%	71	1.3%	25	0.5%	7	0.1%
Oceana	4,314	34%	2,202	638	93	4%	2	2.2%	0	0.0%	0	0.0%
Ogemaw	3,037	22%	1,555	472	63	4%	0	0.0%	0	0.0%	0	0.0%
Ontonagon	2,270	43%	478	146	36	8%	0	0.0%	0	0.0%	0	0.0%
Osceola	3,136	27%	1,791	549	175	10%	2	1.1%	0	0.0%	0	0.0%
Oscoda	1,442	18%	656	206	21	3%	0	0.0%	0	0.0%	0	0.0%
Otsego	1,680	16%	1,874	297	41	2%	2	4.9%	1	2.4%	0	0.0%
Ottawa	16,683	25%	21,448	1,500	1,026	5%	16	1.6%	5	0.5%	4	0.4%
Presque Isle	2,767	31%	942	249	68	7%	0	0.0%	0	0.0%	0	0.0%
Roscommon	3,497	18%	1,410	384	49	3%	2	4.1%	0	0.0%	0	0.0%
Saginaw	27,719	34%	17,144	5,833	1,761	10%	77	4.4%	31	1.8%	11	0.6%
St Clair	21,069	37%	13,228	2,666	417	3%	7	1.7%	4	1.0%	1	0.2%
St Joseph	9,384	39%	5,258	1,372	209	4%	10	4.8%	3	1.4%	2	1.0%
Sanilac	8,050	41%	3,478	836	197	6%	1	0.5%	1	0.5%	1	0.5%
Schoolcraft	2,126	39%	558	176	121	22%	1	0.8%	0	0.0%	0	0.0%
Shiawassee	10,460	41%	5,594	1,274	343	6%	6	1.7%	2	0.6%	1	0.3%
Tuscola	7,561	36%	4,480	1,110	407	9%	6	1.5%	2	0.5%	0	0.0%
Van Buren	10,953	35%	6,445	1,526	643	10%	16	2.5%	1	0.2%	1	0.2%
Washtenaw	26,210	24%	22,421	3,034	1,005	4%	14	1.4%	4	0.4%	2	0.2%
Wayne ex Det	116,376	28%	68,398	18,243	6,704	10%	189	2.8%	60	0.9%	24	0.4%
Wexford	4,133	32%	2,499	650	58	2%	0	0.0%	0	0.0%	0	0.0%
Detroit, City of	257,260	63%	#####	47,806	#####	22%	2,561	10.5%	904	3.7%	383	1.6%
Unknown	n/a	n/a	n/a	n/a	195	n/a	3	n/a	0	n/a	0	n/a
MICHIGAN	1,228,635	32%	#####	#####	#####	10%	4,243	5.4%	1,523	2.0%	636	0.8%

Appendix III

OSHA BLOOD LEAD LABORATORIES: MICHIGAN

Laboratory Name	City	County
Warde Medical Laboratory	Ann Arbor	Washtenaw
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
AAC Trinity Inc	Farmington Hills	Wayne
Blodgett Toxicology Lab	Grand Rapids	Kent
Michigan Department of Community Health	Lansing	Ingham
Sparrow Regional Laboratories	Lansing	Ingham
Mount Clemens General Hospital	Mount Clemens	Macomb
Hackley Hospital Laboratory	Muskegon	Muskegon

Appendix IV

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 construction and the general industry lead standards establish an "action level" (30 micrograms of lead per cubic meter of air [$\mu\text{g}/\text{m}^3$] averaged over an eight-hour period) and a permissible exposure limit (50 $\mu\text{g}/\text{m}^3$ 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 construction standard 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 construction standard are triggered initially by job tasks and secondarily by actual employee exposure level to lead. Under the General Industry Lead Standard, these potential obligations are triggered by actual employee exposure levels to lead. Medical surveillance and training are triggered by exposures above the action level (A.L.), 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 General Industry lead standard versus those required in Construction Lead Standard do vary. Under the General Industry lead standard, 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 A.L. Under the lead construction standard, 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 A.L. The secondary medical exam is triggered by employee exposures to lead at or above the A.L. for more than 30 days in any 12 consecutive months period.

Michigan's General Industry standard mandates that employees exposed at or above the A.L. 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 ($\mu\text{g}/\text{dl}$) of whole blood.
- Medical removal is also triggered if the average of the last 3 BBL 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 Construction Standard 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 General Industry lead standard 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 2 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 2 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 Construction Standard 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 2 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 General Industry and Construction 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 General Industry and Construction 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 Construction Standard, 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 Construction Standard, 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 (A.L. or P.E.L.).

Respiratory Protection

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

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 Construction Standard.

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 Construction Standard. 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 A.L. for more than 30 days a year. Biological blood sampling and analysis to determine lead and ZPP levels is required initially under the Lead Construction Standard when employee lead exposure is at or exceeds the A.L. on any single day. Under the General Industry Lead Standard, 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 General Industry Lead Standard have the right to be removed from airborne lead exposures at or above the A.L. 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 Construction Lead Standard have the right to be removed from airborne lead exposures at or above the A.L. 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 General Industry and Construction Lead Standards, workers also have the right to be removed from airborne lead exposures at or above the A.L. 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 General Industry Lead Standard, employees exposed to any level of airborne lead must be informed of the contents of appendix A and B from that standard.

Under both the General Industry and Construction Lead Standard, employees who are exposed at or above the A.L. level 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 Construction Standard, 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 V



March 19, 1999 / 48(10);213-6,223

Adult Blood Lead Epidemiology and Surveillance - - United States, Second and Third Quarters, 1998, and Annual 1994-1997

Chronic lead exposure in adults can damage the cardiovascular, central nervous, renal, reproductive, and hematologic systems. CDC's Adult Blood Lead Epidemiology and Surveillance (ABLES) program monitors laboratory-reported elevated blood lead levels (BLLs) among adults in the United States. During 1998, 27 states * reported surveillance data to ABLES. This report presents prevalence data for elevated BLLs for the second and third quarters of 1998 and compares them with corresponding quarters of 1997, and presents annual prevalence data for elevated BLLs from 1994 through 1997 for each participating state. The findings indicate that of the approximately 20,000 persons tested for blood lead and reported to ABLES each quarter, approximately 4000 BLLs were elevated. The 1994-1997 prevalence rates of elevated BLLs among adults provide a crude comparison of the levels and trends among the 27 states participating in the program.

ABLES defines an adult as a person aged greater than or equal to 16 years and an elevated BLL in an adult as greater than or equal to 25 ug/dL, although BLL reporting thresholds vary among the states. Persons with duplicate BLL tests are included once per quarter and once per year at the highest BLL for that person. Denominators for calculating prevalence during 1994-1997 are the population figures (aged 16-64 years) of the individual participating states (1). An upper age cutoff of 64 years is used because 90%-95% of adult lead exposures occur at work. Not all of the current 27 ABLES states reported data over the entire period from 1994 through 1997.

Second Quarter, 1998

During April 1-June 30, 1998, of the 20,212 adults for whom BLLs were reported by the states, 3727 (18%) had levels greater than or equal to 25 ug/dL, a 14% decrease compared with the 4335 reported for the second quarter of 1997 (2) and a 12% decrease compared with the 4243 reported for the first quarter of 1998 (3) (Figure 1). Of the 3727, 182 (5%) were reported with BLLs greater than or equal to 50 ug/dL (the Occupational Safety and Health Administration {OSHA} level for medical removal from the workplace {4}), an 8% decrease compared with 197 reported for the second quarter of 1997 (2) and a 4% increase compared with 175 reported for the first quarter of 1998 (3).

Third Quarter, 1998

During July 1-September 30, 1998, of the 20,511 adults for whom BLLs were reported by the participating states, 3322 (16%) had BLLs greater than or equal to 25 ug/dL, a 21% decrease compared with 4180 persons reported for the third quarter of 1997 (5) and an 11% decrease compared with 3727 reported for the second quarter of 1998 (Figure 1). Of the 3322, 182 (6%) were reported with BLLs greater than or equal to 50 ug/dL, a 13% decrease compared with 209 reported for the third quarter of 1997 (5) and an equal number compared with the second quarter of 1998.

Annual ABLES Prevalence, 1994-1997

The prevalence of adults with BLLs greater than or equal to 25 ug/dL per million adults aged 16-64 years varied among the participating states for 1994 through 1997 (Figure 2). These rates ranged from 15 per million for Arizona (1994) to 442 per million for Pennsylvania (1997). Michigan, New Mexico, Rhode Island, and Wyoming began reporting in 1997; Ohio and Minnesota began reporting in 1996; and Illinois last reported in 1996.

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Editorial Note

Editorial Note: The symptoms of adult lead poisoning include fatigue, irritability, insomnia, and headaches. Occupations known to expose workers to lead include radiator repair, battery manufacture and recycling, smelting, and construction or remodeling involving lead-based paint. Lead exposure can be prevented by engineering controls, good housekeeping, personal protective equipment, and fastidious hygiene. Medical removal from a lead-exposed job is required by OSHA when a workers' BLL is greater than or equal to 50 ug/dL.

Second quarter data for 1997 through the first quarter of 1998 indicate that the number of persons with BLLs greater than or equal to 25 ug/dL reported by participating states was approximately 4000 per quarter. An apparent decrease in the number of persons with BLLs greater than or equal to 25 ug/dL occurred in both the second and third quarters of 1998. Furthermore, the testing level has remained relatively constant, indicating that the decrease probably is not caused by the performance of fewer BLL tests. However, amendments to previous quarterly reports are likely to occur when fourth quarter reports are received. These amendments occur because ABLES is concerned with the diagnosis date of the blood lead laboratory report and not the date the laboratory result was received by the state health department. Therefore, additional data collected through ABLES are needed to interpret the current quarterly data and their implications for projecting trends.

State-specific prevalences presented in this report may not accurately reflect workplace lead exposures because not all employers tested lead-exposed employees for elevated BLLs and not all laboratories reported results. For example, data from the National Health and Nutrition Examination Survey (NHANES III, 1988-1991) (6,7) predicted approximately 700,000 adults with BLLs greater than or equal to 25 ug/dL in the entire United States; ABLES data, adjusted for a national estimate, predicted approximately 18,000 persons with

BLLs greater than or equal to 25 ug/dL in 1994. In addition, the denominators for the prevalence rates are the respective state populations aged 16-64 years, but the percentage of working persons in this age group who were reported to be exposed to lead is unknown and varies from state to state.

All ABLES data are subject to certain limitations and, as with state-specific prevalence data, may not convey a true picture of workplace lead exposure. Variation in the number of persons with BLLs greater than or equal to 25 ug/dL reported quarterly and annually to ABLES may reflect changes in 1) the year-to-year efforts of participating states and lead-using industries within them to identify lead-exposed workers and to prevent new exposures; 2) occupational exposures to lead; 3) compliance with OSHA requirements regarding blood lead monitoring; and 4) workforce size in lead-using industries. Variations in quarterly and annual nationwide reporting totals might represent normal fluctuations in case reporting, which might result from changes in staffing and funding in state-based surveillance programs, interstate differences in worker BLL testing by lead-using industries, or random variations. Individual state contributors must be consulted for accurate interpretations of state-specific prevalences and trends.

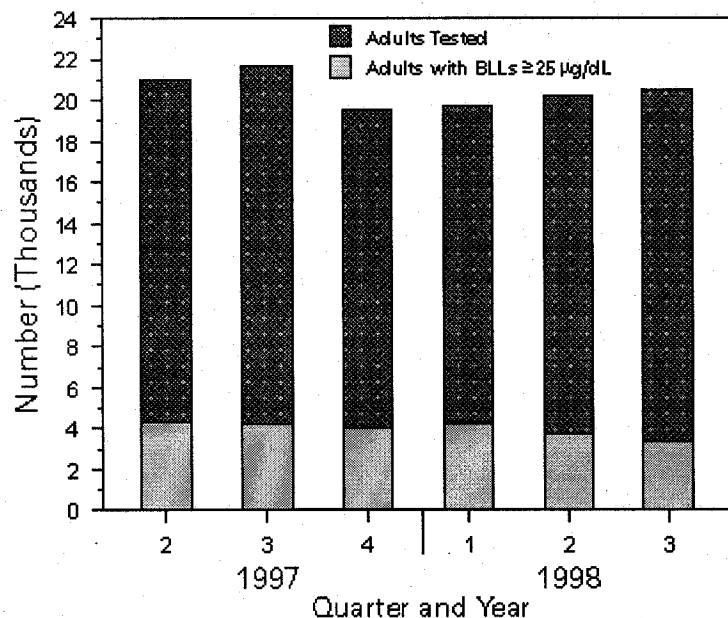
The findings in this report document the continuing hazard of lead exposure as an occupational health problem in the United States. ABLES enhances surveillance for this preventable condition by increasing the number of participating states, exploring ways to increase the usefulness of reporting, and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

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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.

FIGURE 1. Total number of adults* tested† and whose blood lead levels (BLLs) were ≥ 25 $\mu\text{g}/\text{dL}$, by quarter — 27 states participating in Adult Blood Lead Epidemiology and Surveillance,‡ 1997–1998



*Persons aged 16–64 years, categorized according to the highest reported BLL for that person during the given quarter. Data for the second and third quarters of 1998 were not available for New Mexico; the corresponding 1997 quarters were used as estimates.

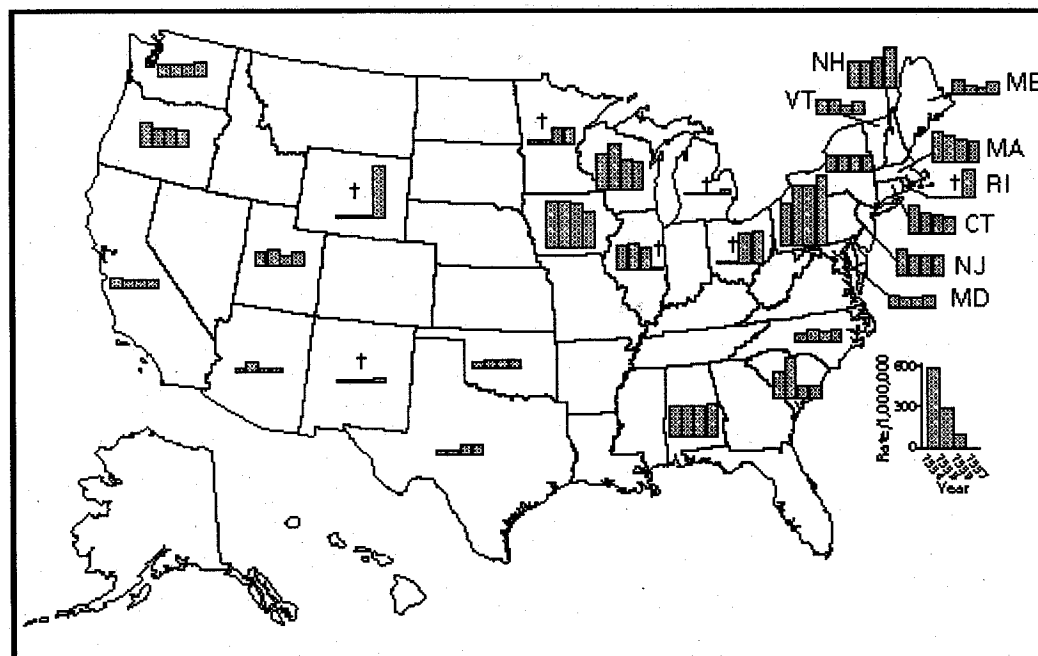
†The reporting threshold varies among the participating states; the value includes persons with BLLs < 25 $\mu\text{g}/\text{dL}$. However, the following states do not report persons with BLLs < 25 $\mu\text{g}/\text{dL}$: Maryland, Massachusetts, New Jersey, North Carolina, and Oregon.

‡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.

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Figure 2

FIGURE 2. Prevalence of blood lead levels ≥ 25 $\mu\text{g}/\text{dL}$ among adults*, reported by states participating in Adult Blood Lead Epidemiology and Surveillance — United States, 1994–1997



*Per 1 million adults aged 16–64 years.

*Minnesota and Ohio began reporting in 1996. Illinois last reported in 1996. Michigan, New Mexico, Rhode Island, and Wyoming reported for the first time in 1997. ABLES program data are known to be underreported. These data represent the level of functioning of the various state ABLES programs, but do not necessarily represent a true picture of workplace lead exposure in individual states.

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APPENDIX VI

New and Improved Ways to Report Known or Suspected Occupational Disease

We have created a *secure* web site to accept on-line reporting and have established a new e-mail address strictly dedicated to the reporting of all occupational disease. If you want to report on-line, go to our web site www.chm.msu.edu/oem/index.htm and click on 'Submit Occupational Disease Report'. Please see box on page 4 for various ways to report Known or Suspected Occupational Disease. If you have any questions about Michigan's reporting law or how to report, please call 1-800-446-7805 or e-mail ODREPORT@ht.msu.edu

What is the Normal Value for Blood Lead?

Laboratories are required to report to the state the results of *all blood lead tests*, whether performed on children or adults. These blood tests are performed by local health departments, private practitioners and companies as part of their occupational health program.

The Centers for Disease Control and Prevention (CDC) has developed guidelines for reporting the laboratory results of blood leads in children (Table I). Lead has no biological function in the body and accumulates over time with continued exposure. Ideally, lead levels would be nondetectable, but because of the previous widespread use of lead, particularly in paint and gasoline, both children and adults will have background values of lead in their blood. The best data for assessing what is a normal background level for lead comes from the National Health and Nutrition Examination Surveys, which is an ongoing program of the National Center for Health Statistics. This program performs medical

examinations and testing on a random sample of the United States population and generates "normal" values for many different parameters. Table II shows "normal" levels of blood lead by age, gender and race. Both for children and adults, all but five percent of the population has a blood lead <10 ug/dL. This five percent cutoff is the usual method for determining laboratory normal ranges.

CDC has not developed management guidelines for lead for adults. This lack of guidelines is reflected in the normal range that laboratories report for adults. Table III shows the normal range for the twelve laboratories in the state that perform blood lead analysis. Four of them use the same normal range for adults as for children, while the other eight indicate an upper limit of normal that ranges from 19-40 ug/dL. Part of the confusion in the upper limit of normal for adults is based on the allowable Occupational Safety and Health Act (OSHA) blood levels. OSHA allows blood lead levels in workers to be up to 49 ug/dL before an employer is required to remove the individual from work. If a blood lead is 40 ug/dL or greater, then OSHA requires that blood lead monitoring be performed more frequently, every two months. Lead accumulates in the body and there is consistent evidence of the adverse effects of lead at levels within allowable OSHA standards. The OSHA allowable blood lead standard was last revised in 1978. This is particularly true for the association with blood pressure, kidney disease, neurological function and semen quality for exposures causing blood lead levels below 40 or 50 ug/dL.¹⁻⁵

Depending on why a blood lead was ordered, an upper limit of normal greater than 10 ug/dL is misleading. Any blood lead result above 10 ug/dL indicates exposure beyond that expected in the general population. Because lead accumulates in the body, exposures leading to blood lead levels ≥ 10 ug/dL increase the risk for developing high blood pressure and kidney, neurologic and sperm

dysfunction. The California Health Department has disseminated the following table for managing blood lead in adults (Table IV). We believe that these guidelines for managing blood lead levels in adults are reasonable and justified by the medical literature. We are encouraging the laboratories to change their upper limit of normal for blood lead to 9 ug/dL for *individuals of all ages*.

If you have questions about interpreting blood lead results or managing patients with lead exposure or elevated blood lead levels, please contact Kenneth D. Rosenman, M.D. at 1-800-446-7805 or e-mail: Rosenman@msu.edu

Table I. Management Guidelines for Blood Lead Levels in Children*

Blood lead (ug/dL)	Significance	Management
<10	Background	Guidance and well-child care
10-14	Low	For 10 or higher, tiered management according to CDC guidelines
15-19	Mild	
20-44	Moderate	For 20 or higher, public health and medical evaluation and treatment (see CDC guidelines)
45-69	High	For 45 or higher, chelation recommended
≥ 70	Severe	Medical emergency

*Centers for Disease Control & Prevention (CDC). Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials. Atlanta, GA: US Department of Health and Human Services, 1997.

Table II. Blood Lead Levels of the Population by Selected Demographic Characteristics: United States 1991-1994

Population Group	Geometric Mean Blood Lead Level (ug/dL)	CI*	Percent Persons with Blood Lead Levels ≥ 10 ug/dL	CI*
All	3.3	2.1-2.4	2.2	1.6-2.8
Age (years)				
1-2	3.1	2.8-3.5	5.9	3.7-9.2
3-5	2.5	2.3-2.7	3.5	2.2-5.4
6-11	1.9	1.8-2.1	2.0	1.2-3.3
12-19	1.5	1.4-1.7	0.8	0.3-1.9
20-49	2.1	2.0-2.2	1.5	1.0-2.2
50-69	3.1	2.9-3.2	2.9	2.1-3.8
≥70	3.4	3.3-3.6	4.6	3.4-6.0
Sex				
Female	1.9	1.8-2.0	0.9	0.6-1.3
Male	2.8	2.6-2.9	3.5	2.6-4.6
Race/ethnicity				
Black, non-Hispanic	2.8	2.6-3.0	5.2	4.0-6.9
Mexican American	2.4	2.3-2.6	2.9	2.1-4.0
White, non-Hispanic	2.2	2.0-2.3	1.5	0.9-2.3
Other	2.3	2.1-2.6	3.0	1.7-5.1

*CI, 95% confidence interval.

(Adopted Pirkle et al 1998)

Table III. Normal Ranges for Adults in the Twelve Michigan Laboratories Performing BloodLead Analysis

Laboratory	Normal Range (ug/dL)
A	0 - 10
B	0 - 40
C	0 - 19; 0 - 39 occupational exposure
D	0 - 9
E	0 - 9
F	0 - 24
G	0 - 9; 0 - 30 occupational exposure
H	0 - 30
I	0 - 25
J	0 - 20
K	0 - 9
L	0 - 19

Table IV. Management Guidelines for Blood Lead Levels in Adults*

Blood Lead (ug/dL)	Management
<10	No action needed.
10-24	Identify and minimize lead exposure.
25-49	Remove from exposure if symptomatic Monitor blood lead and zinc protoporphyrin.
50-79	Remove from work with lead. Immediate medical evaluation indicated. Chelation not indicated unless significant symptoms due to lead poisoning.
≥ 80	As above. Chelation may be indicated if symptomatic. Important to consult on individual case basis.

*California Department of Health Services Occupational Lead Poisoning Prevention Program.

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**P
S Remember to report all cases of occupational disease!*

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