2011

Annual Report on Blood Lead Levels on Adults in Michigan

May 24, 2013

2011 ANNUAL REPORT

Adult Blood Lead Epidemiology Surveillance (ABLES) Program

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In 2011, Michigan ABLES received 16,018 blood lead tests for 13,850 individuals ≥16 years of age and older. There were 160 more blood lead tests and 574 less individuals reported in 2011 compared to 2010.

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There are many resources available to help employers, employees, healthcare professionals and others understand more about lead exposure, prevention and medical management. Links to these resources can be found at: www.oem.msu.edu.

Acronyms

BLLs Blood Lead Levels
ABLES Adult Blood Lead Epidemiology Surveillance
MDCH Michigan Department of Community Health
CDC Centers for Disease Control and Prevention
CLPPP Childhood Lead Poisoning Prevention Program
CDC Centers for Disease Control and Prevention
LARA Michigan Department of Licensing and Regulatory Affairs
MIOSHA Michigan Occupational Safety & Health Administration
MSU Michigan State University
NAICS North American Industrial Classification System
NDI National Death Index
NIOSH National Institute for Occupational Safety & Health
OSHA Occupational Safety & Health Administration (Federal)
PEL Permissible Exposure Limit
USRDS United States Renal Data System
SIC Standard Industrial Classification System (1987)

Summary

This is the fourteenth annual report on surveillance of blood lead levels (BLLs) of Michigan residents and adults whose blood was tested in Michigan. It is based on data collected as a result of regulations promulgated October 11, 1997 by the Michigan Department of Community Health (MDCH) to address the health hazard of exposure to inorganic lead. MDCH regulations require laboratories to report all blood lead analyses for both adults and children. The Adult Blood Lead Epidemiology and Surveillance (ABLES) Program was founded nationally in 1992 to track laboratory reports of elevated BLLs in U.S. adults. Michigan is one of the 41 states that participate in this program.

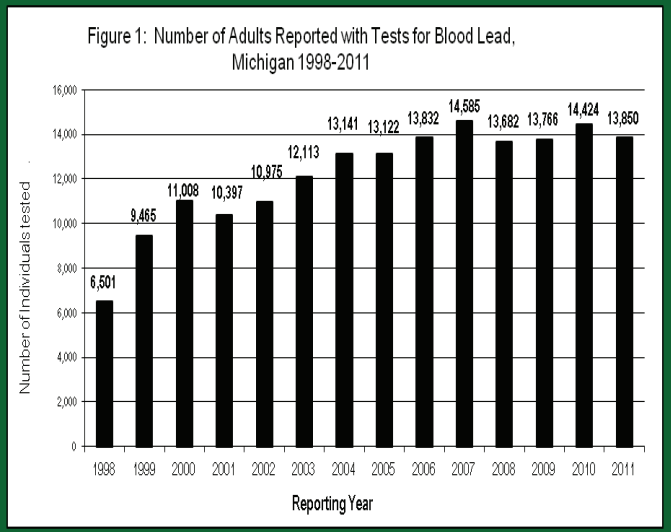
Summary, continued...

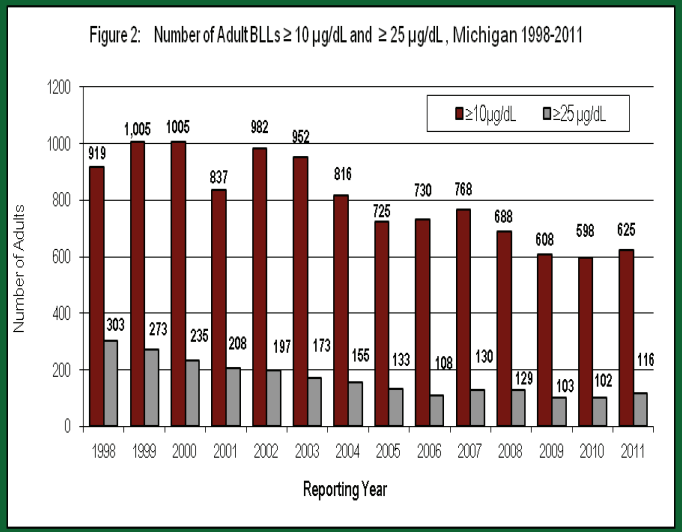
This report summarizes BLLs of Michigan residents and adults whose blood was tested in Michigan defined as sixteen years and older. In 2011, Michigan ABLES received 16,018 blood lead tests for 13,850 individuals ≥16 years of age. Six hundred and twenty-five (4.5%) individuals had BLLs ≥ 10 µg/dL; 116 (18.6%) of those 625 had lead levels ≥ 25 µg/dL and 13 (11.2%) of the 116 had BLLs ≥ 50 µg/dL.

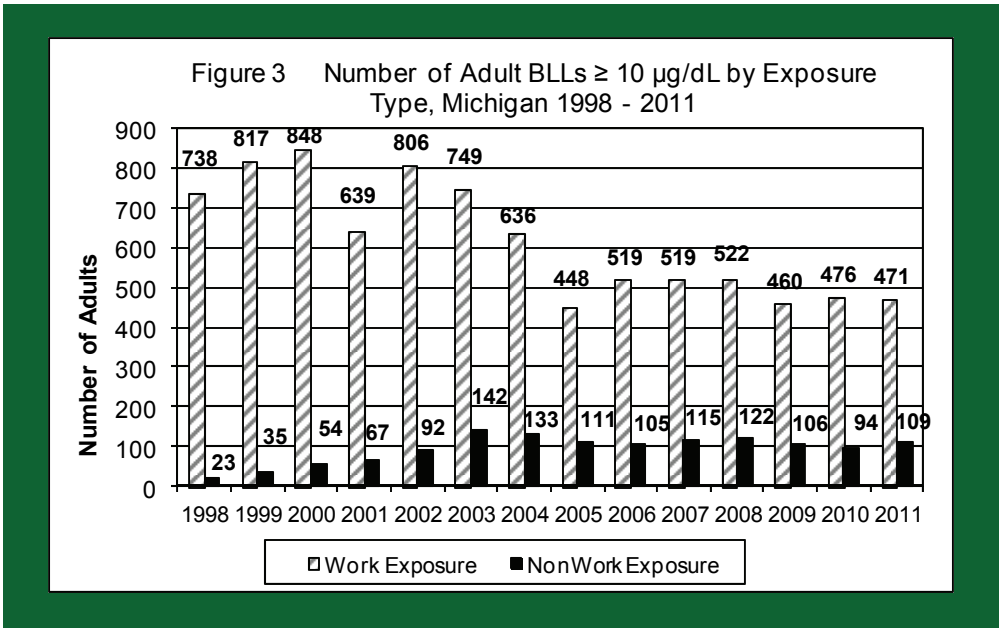
There were 160 more blood lead tests and 574 less individuals reported in 2011 compared to 2010 (Figure 1). The number and the percent of individuals with BLLs ≥10 µg/dL increased from 598 (4.1%) in 2010 to 625 (4.5%) in 2011. The number and percent of individuals with BLLs ≥25 µg/dL increased from 102 (0.7%) in 2010 to 116 (0.8%) in 2011. The number of individuals with BLLs ≥ 50 µg/dL went from six (0.04%) in 2010 to thirteen (0.09%) in 2011. For twelve consecutive years, from 1999 to 2010, there was a downward trend for BLLs ≥ 10 µg/dL and BLLs ≥ 25 µg/dL from the previous year (Figure 2). However, in 2011 the number of BLLs ≥ 25 µg/dL were increased from 103 in 2009 and 102 in 2010 to 116 in 2011. These trends occurred among both occupational and non-occupational exposures (Figure 2). Examining trend separately for work and non work exposures showed a downward trend until 2005 with no further decrease in BLLs ≥ 10 µg/dL from 2006 onward (Figure 3).

The adults with BLLs ≥10 µg/dL were likely to be men (95.4%) and white (83.5%). Their mean age was 44.9. They were most likely to live in Wayne (19.9%), Macomb (8.2%) or Oakland (7.5%) counties. Occupational exposure remains the predominant source of lead exposure (81.2%). In Michigan, lead exposure resulting in BLLs ≥ 10 µg/dL typically occurs where individuals: perform abrasive blasting to remove lead paint on outdoor metal structures such as bridges, overpasses or water towers; cast brass or bronze fixtures; fabricate metal products; or are exposed to lead fumes or dust from firing guns or retrieving spent bullets at firing ranges.

Among adults with BLLs ≥ 10 µg/dL, lead exposure from firing ranges, as well as reloading and casting activities associated with firearms, is the most common cause of non-occupational exposure (79.6%) and 14.9% of all reported known exposure, both occupational and non-occupational.







Firing ranges are a source of lead exposure where individuals qualify for both work and recreational marksmanship standards in commercial as well as private recreation ranges. Private gun clubs and ranges, run by members and volunteers, are not under the jurisdiction of workplace regulations as these regulations only cover businesses with paid employees. Outreach efforts to educate this group of lead-exposed hobbyists remains a challenge.

The fourteenth year of operation of an adult blood lead surveillance system in Michigan proved successful in continuing to identify individuals with elevated BLLs and sources of exposures that could be remediated to reduce lead exposure. Outreach and intervention activities this past year included written contact with 170 individuals, follow-up interviews with 105 lead-exposed individuals and distributing resources on diagnosis and management of lead exposure to 52 healthcare providers who tested patients with elevated blood lead levels. A "how to" guide for home maintenance and renovation from the U.S. Department of Housing and Urban Development was provided to individuals, when renovation was the source of exposure to lead. Three educational brochures continued to be distributed this past year: one on working safely with lead, the second on controlling lead exposure in firing ranges and a third brochure for reducing lead exposure when reloading firearms or casting lead as a hobby. Copies of these brochures and informational literature are at www.oem.msu.edu under "Resources for Adult Blood Lead (ABLES)." In addition, collaboration with MDCH provided a brochure for women of childbearing age and information on the risk of take home lead exposure to occupationally-exposed adults identified with children under the age of six.

In 2011, MIOSHA inspections were conducted and reports completed at eight companies due to elevated blood lead laboratory reports with seven (87.5%) resulting in lead-related citations. Details of inspections completed in 2011 are included in this report.

Occupational exposure remains the predominant source of lead exposure (81.2%). In Michigan, lead exposure resulting in BLLs ≥10 µg/dL typically occurs where individuals: perform abrasive blasting to remove lead paint on outdoor metal structures such bridges, overpasses or water towers; cast brass or bronze fixtures; fabricate metal products; or are exposed to lead fumes or dust from firing guns or retrieving spent bullets at firing ranges.

Background

This is the fourteenth annual report on surveillance of BLLs of Michigan residents and adults whose blood was tested in Michigan. BLLs, including children, have been monitored by the state since 1992. From 1992 to 1995, laboratories performing analyses of blood lead levels, primarily of children, voluntarily submitted reports to the State. The Michigan Department of Community Health (MDCH) 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 the promulgation of this regulation in 1997, Michigan received federal funding from the Centers for Disease Control and Prevention (CDC), to monitor adult BLLs as part of the ABLES program. Currently 41 states have established lead registries through the ABLES program for surveillance of adult lead absorption, primarily based on reports of elevated BLLs from clinical laboratories. The most recent report of adult blood lead surveillance from 40 states that was published in the *Morbidity and Mortality Weekly Report*, July 1, 2011 / 60(25);841-845 is in Appendix A.

2011 is the fourteenth year with complete laboratory reporting in Michigan since Michigan Department of Community Health lead regulations became effective on October 11, 1997.

THE MICHIGAN ADULT BLOOD LEAD REGISTRY

Reporting Regulations and Mechanism

Since October 11, 1997, laboratories performing blood lead analyses are required to report the results of all blood lead tests to the MDCH (R325.9081-.9087 – Appendix B). Prior to these 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 to MDCH in an electronic file (Appendix B). The health-care provider ordering the blood lead analysis is responsible for forwarding the patient information, the physician/provider information and the specimen collection information to the laboratory. Upon receipt of the blood sample for lead analysis, the clinical laboratory is responsible for completion of the laboratory information. All clinical laboratories conducting business in Michigan that analyze blood samples for lead must report all adult and child blood lead results to the MDCH, Childhood Lead Poisoning Prevention Program (CLPPP) within five working days.

All clinical laboratories conducting business in Michigan that analyze blood samples for lead must report all Michigan residents' blood lead results to the Michigan Department of Community Health, Childhood Lead Poisoning Prevention Program (MDCH/

All blood lead results on individuals 16 years or older are forwarded to MSU for a potential interview and then to the Michigan Occupational Safety and Health Administration (MIOSHA) in Michigan Department of Licensing and Regulatory Affairs (LARA) for a potential work-place follow-up. MSU is designated a bona fide agent of the State to conduct this activity.

Laboratories

Employers providing blood lead analysis on their employees, as required by MIOSHA must use a laboratory which meets OSHA proficiency testing for blood lead analysis to be in compliance with the lead standard. Figure 4 details the eight OSHA approved laboratories

in Michigan.

Data Management

When files of BLL results are received at the MDCH, they are reviewed for completeness. For those records where information is missing, paper copies are created and returned to the physician/provider to complete. Lead Registry staff import files of BLL results into a computerized database. Each file imported into the database is visually checked for any data entry errors, duplicate entries, missing data, and illogical data. These quality control checks are performed weekly.

Case Follow-Up

Adults whose BLL is 25 µg/dL or greater are contacted for an interview. Interviews are conducted of individuals with BLLs ranging from 10 to 24 µg/dL if the source of their lead exposure cannot be identified from the reporting form. A letter is sent to individuals 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 interviewers administer the questionnaire.

Figure 4 Michigan Laboratories meeting OSHA proficiency testing for blood lead analysis

MICHIGAN BLOOD LEAD LABORATORIES*

Laboratory Name	*City*
DMC University Laboratories	Detroit
Marquette General Health Systems	Marquette
Michigan Department of Community	Lansing
Mt Clemens General Hospital	Mt. Clemens
Quest Diagnostics	Auburn Hills
Regional Medical Laboratories	Battle Creek
Sparrow Health System	Lansing
Warde Medical Laboratories	Ann Arbor

*Laboratories which meet OSHAs accuracy requirements in blood lead proficiency testing as of January 25, 2013. For a complete listing of OSHA approved blood lead laboratories, visit the OSHA web site at http//www.osha.gov/SLTC/bloodlead/program.html

MICHIGAN OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REQUIREMENTS

Medical Monitoring and Medical Removal

The MIOSHA requirements for medical surveillance (i.e. biological monitoring) and medical removal are identical to those of Federal OSHA. The requirements for medical removal differ for general industry and construction. For general industry, an individual must have two consecutive BLLs above 60 µg/dL or an average of three BLLs greater than 50 µg/dL before being removed (i.e. taken pursuant to the standard or the average of all blood tests conducted over the previous six months, whichever is longer). For construction, an individual needs to have only two consecutive blood lead level measurements taken pursuant to the standard above 50 µg/dL. However, an employee shall not be required to be removed if the last blood-sampling test indicates a blood lead level ≤ 40 µg/dL. If monitoring shows lead levels above 30 µg/m^3 of air (MIOSHA's action limit) but below 50 µg/m^3 of air (PEL), an employer also must repeat monitoring every six months, repeat training annually, provide medical surveillance, including blood analysis for lead and zinc protoporphyrin, medical exams and consultation, provide medical removal pro-

tection for employees with excessively elevated blood lead levels. See Appendix C for a more detailed description of the requirements. It should be noted that in the absence of a specific exposure to lead, 95% of BLLs in the adult general population in the U.S. are below 3.8 µg/dL for men and below 2.8 µg/dL for women (1). Also of note, in this past year CDC recommended that BLLs five µg/dL or greater in children should be considered elevated. CDC did not review this issue for adults (2). They had previously considered blood leads of ten µg/dL or greater as a level of concern.

Dissemination of Surveillance Data

Biannual data summaries, without personal identifiers, are forwarded to the Program's funding agency, the National Institute for Occupational Safety and Health (NIOSH). NIOSH compiles reports from all states that require reporting of BLLs and publishes them in the Morbidity and Mortality Weekly Report (MMWR) (3). See Appendix A for the most recent publication of ABLES surveillance results for the period 2008 -2009.

Results

This is the fourteenth year with complete laboratory reporting in Michigan since the lead regulations became effective on October 11, 1997. A summary of all the reports of adult BLLs received in 2011, as well as more detailed information from all interviews completed since 1997 of those adults with a BLL of 25 µg/dL or greater, are included in this report. Also included are the Michigan Occupational Safety and Health Administration (MIOSHA) inspections completed in 2011 at the work sites where these individuals were exposed to lead.

This report also provides information on individuals interviewed since 1997 who had BLLs ranging from 10-24 µg/dL where the source of lead exposure was not identified in the original report submitted from the laboratories. Given the medical evidence of health effects at levels as low as 5 µg/dL (4-7), analysis of available information on BLLs ranging from 5-9 µg/dL is also discussed in this report.

Table 1 Distribution of Highest Blood Lead Levels Among Adults and Source of Exposure, Michigan 2011

BLLs (ug/dL)	Work BLLs Number	Work BLLs Percent	Non-Work BLLs Number	Non-Work BLLs Percent	Source Not Yet Identified Number	Source Not Yet Identified Percent	All BLLs Number	All BLLs Percent
<5	179	[a]	12	[a]	12304	[a]	12,495	90.2
5-9	148	[a]	21	[a]	561	[a]	730	5.3
10-24	389	48.7	80	56.3	40	0.3	509	3.7
25-29	31	3.9	9	6.3	2	0.0	42	0.3
30-39	31	3.9	16	11.3	3	0.0	50	0.4
40-49	10	1.3	1	0.7	0	0.0	11	0.1
50-59	4	0.5	2	1.4	0	0.0	6	0.0
≥ 60	6	0.8	1	0.7	0	0.0	7	0.1
TOTAL	**798**	**84.9[e]**	**142**	**15.1[e]**	**12,910**		**13,850 [b]**	**100.0**
TOTAL≥10ug/dL	**471**	**81.2[c]**	**109**	**18.8[c]**	**45**		**625**	
TOTAL≥25ug/dL	**82**	**73.9[d]**	**29**	**26.1[d]**	**5**		**116**	

[a] No follow-up is conducted of individuals with blood leads < 10 ug/dL, but often information is known

[b] In 2011, 16,018 BLL reports were received for 13,850 individuals.

[c] percent of known exposures >10 µg/dL

[d] percent of known exposures >25 µg/dL

[e] percent of total known exposures

Blood Lead Levels Reported in 2011

Number of Reports and Individuals

Between January 1 and December 31, 2011, the State of Michigan received 16,018 blood lead test reports for individuals 16 years of age or older. Because an individual may be tested more than once each year, the 16,018 reports received were for 13,850 individuals (Table 1). Until 2007, the overall trend for the number of individuals tested each year has shown a gradual increase (Figure 1). The initial steeper increase in 1999 and 2000 probably was secondary to better compliance by the laboratories with the 1997 reporting regulation. The increase in more recent years is assumed secondary to increased testing while the drop in numbers of tests noted in 2008 and 2009 was likely a reflection of the recent Michigan economic downturn rather than reduced testing compliance.

The following descriptive statistics are based on adults (≥ 16 years) tested in 2011. Where more than one BLL result was reported in 2011, statistics are based on the highest BLL reported for each individual.

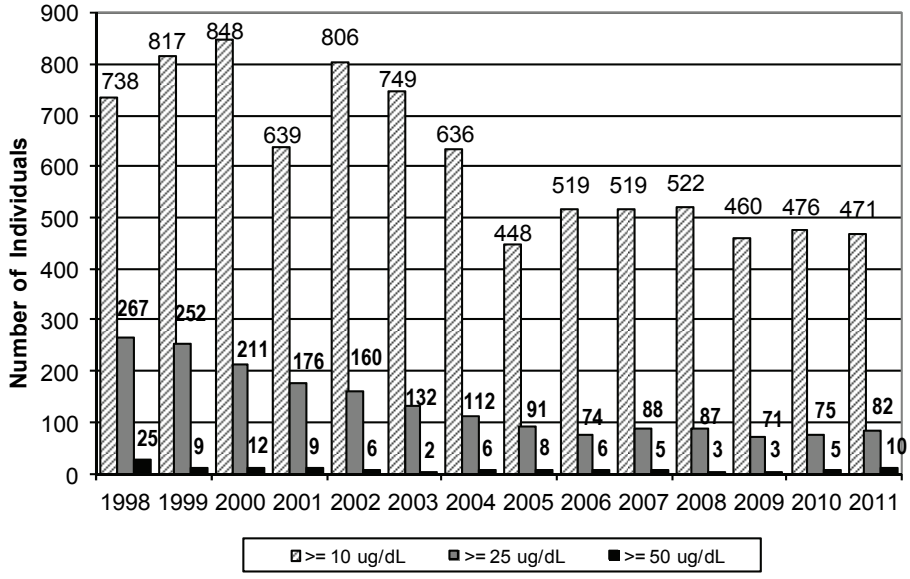
Distribution of Blood Lead Levels

In 2011, 625 (4.5%) of the 13,850 adults reported had BLLs ≥ 10 µg/dL; 116 of those 625 had BLLs ≥ 25 µg/dL and 13 of 116 had BLLs≥ 50 µg/dL (Table 1).

A total of 12,495 (90.2%) of adults reported in 2011 had BLL less than 5 µg/dL, and 730 (5.3%) were from individuals whose blood lead was 5 – 9 µg/dL. Individuals with BLL 5 – 9 µg/dL are not routinely contacted, however when the source of lead exposure was identified, 148 of 169 (87.6%) individuals were identified as occupationally exposed. One hundred and twenty-one (81.8%) of these 148 had been tested in previous years and 51 (42.1%) showed a decrease in their BLL. Among the 509 individuals whose blood lead was 10 – 24 µg/dL, 389 (76.4%) individuals had their source of lead exposure identified as occupational as compared to the 116 individuals with BLLs ≥ 25 µg/dL where 82 (70.7%) individuals had their source of lead exposure identified as occupational.

There was a marked decline in the overall number of individuals with elevated blood lead from occupational exposure from 2000 to 2005, with the number remaining fairly stable from 2006 to 2011 (Figure 5). For non-work exposures, elevated blood lead showed a decline from 2003 to 2006, a slight increase in 2007 and 2008 and then a little change from 2009 to 2011 (Figure 6).

Figure 5 Number of Adults with Elevated BLLs due to WORK Exposure, Michigan 1998-2011



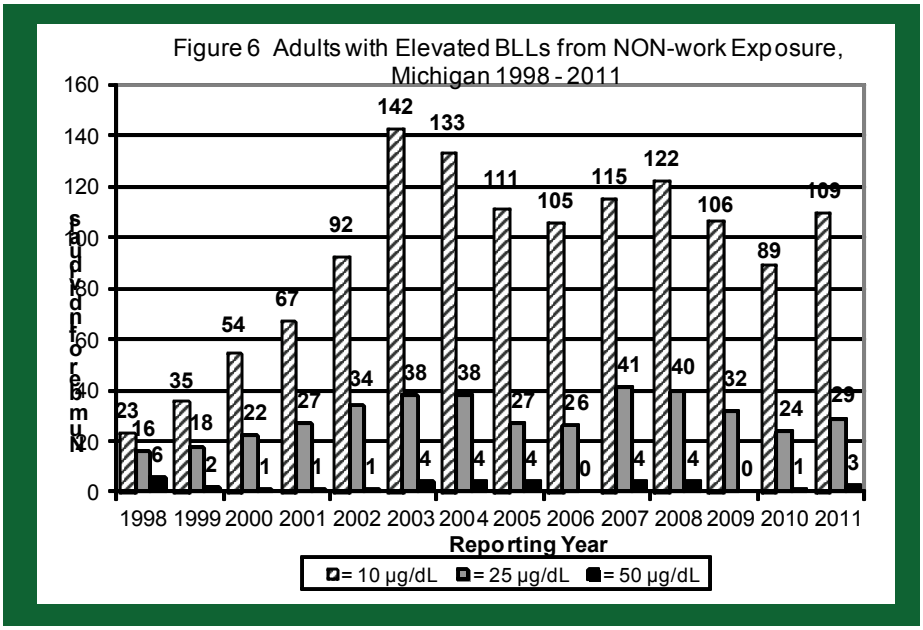


Table 2 Distribution of Gender Among Adults Tested for BLLs, Michigan 2011

	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 µg/dL		Blood Lead Levels≥ 25 µg/dL	
Gender	Number	Percent	Number	Percent	Number	Percent
Male	8,343	60.3	596	95.4	112	96.6
Female	5,492	39.7	29	4.6	4	3.4
Total	**13,835 ***	**100.0**	**625**	**100.0**	**116**	**100.0**

*Gender was unknown for 15 additional individuals.

Table 3 Distribution of Age Among Adults Tested for Blood Lead, Michigan 2011

	All Blood Lead Level Tests		Blood Lead Levels > 10 ug/dL	
Age Range	Number	Percent	Number	Percent
16-19	1,007	7.3	6	1.0
20-29	2,377	17.2	78	12.5
30-39	2,495	18.0	161	25.8
40-49	2,702	19.5	139	22.2
50-59	2,627	19.0	150	24.0
60-69	1,476	10.7	69	11.0
70-79	764	5.5	20	3.2
80-89	349	2.5	2	0.3
90-99	33	0.2	0	0.0
100+	19	0.1	0	0.0
TOTAL	**13,849***	**100.0**	**625**	**100.0**

*Age was unknown for 1 additional individual.

GENDER AND AGE DISTRIBUTION

All Blood Lead Levels

Sixty percent of the adults reported to the Registry were male, and almost forty percent were females (Table 2). The mean age was 44.0 and median age 43. The age distribution is shown in Table 3.

BLLs ≥ 10 µg/dL

For the 625 adults reported to the Registry with BLLs ≥ 10 µg/dL, 596 (95.4%) were men and 29 (4.6%) were women. The mean age was 44.9 and median age was 45.

RACE DISTRIBUTION

All Blood Lead Levels

Although laboratories are required to report the patients' race, this information is frequently not provided. Race was missing for 8,825 (63.7%) of the 13,850 adults reported. Where race was known, 4,231 (84.2%) were reported as Caucasian, 640 (12.7%) were reported as African American, 59 (1.2%) were reported as Asian/ Pacific Islander, 58 (1.2%) were reported as Native American, and 37 (0.7%) were reported as Multiracial/ Other (Table 4).

BLLs ≥ 10 µg/dL

For adults with BLLs greater than or equal to 10 µg/dL where race was indicated, 338 (83.5%) were

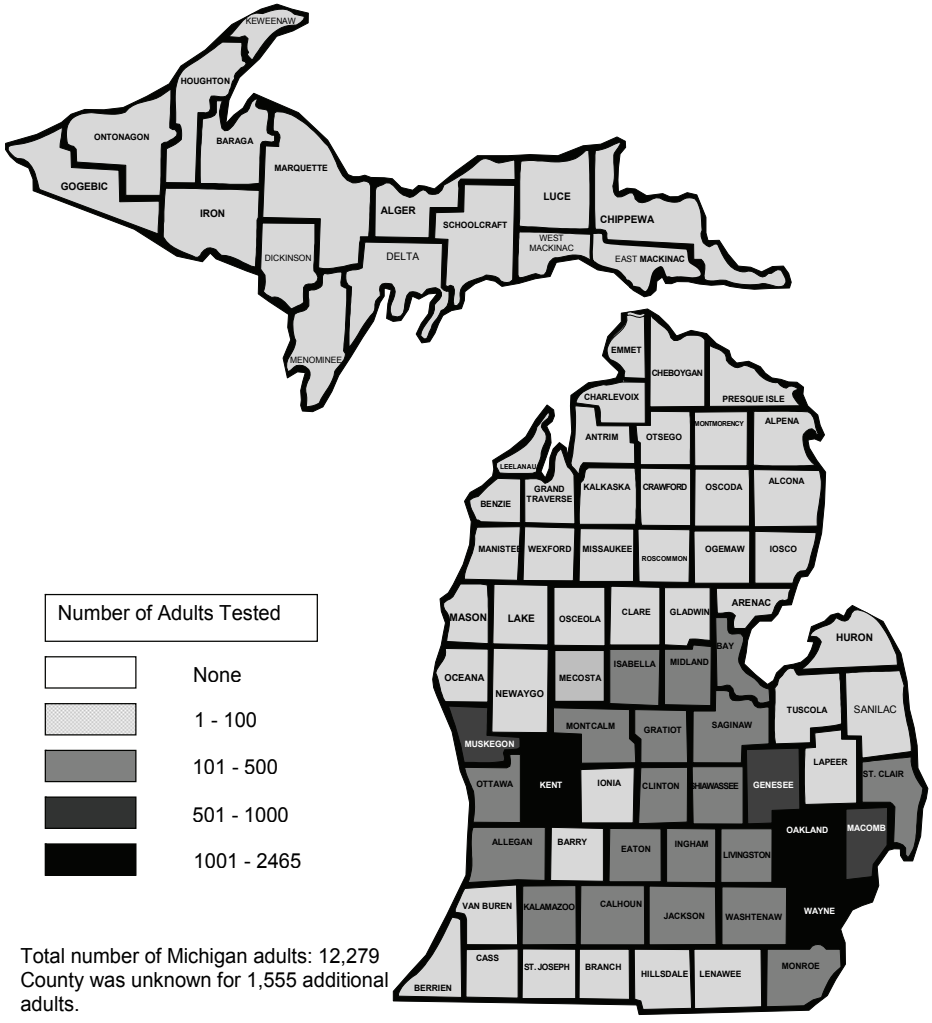
Table 4 Distribution of Race Among Adults Tested for Blood Lead, Michigan 2011

	All Blood Lead Levels		Blood Lead Levels ≥10 µg/dL	
Race	Number	Percent	Number	Percent
Caucasian	4,231	84.2	338	83.5
African American	640	12.7	34	8.4
Native American	58	1.2	13	3.2
Asian/Pacific Islander	59	1.2	7	1.7
Multiracial/Other	37	0.7	13	3.2
TOTAL	**5,025 ***	**100.0**	**405 ****	**100.0**

*Race was unknown for 8,825 additional individuals.

**Race was unknown for 220 additional individuals.

Figure 7 **Geographic Distribution of Adults Tested for Lead by County of Residence, Michigan 2011**



Total number of Michigan adults: 12,279
County was unknown for 1,555 additional adults.

Wayne and Kent counties had the highest number of adults tested with 2,603 and 1,250 respectively.

reported as Caucasian, 34 (8.4%) were reported as African American, 13 (3.2%) were reported as native American, 13 (3.2%) were reported as Multiracial/Other, and 7 (1.7%) were reported as Asian/Pacific Islander, (Table 4).

GEOGRAPHIC DISTRIBUTION

County of residence was determined for 12,279 of the 13,850 adults reported to the Registry. They lived in all of Michigan's 83 counties. The largest number of adults tested in 2011 lived in Wayne County (2,603, 21.2%), followed by Kent County (1,250, 10.2%) and Oakland County (1079, 8.8%). The county was unknown for 1,555 adults tested for blood lead. (Figure 7 and Table 5).

Figure 8 and Table 5 show the county of residence of the 564 adults with BLLs ≥ 10 µg/dL where county of residence could be determined. The largest number of adults reported with a BLL ≥ 10

(Continued on page 12)

County of residence was determined for 12,279 of the 13,850 adults reported to the Registry. They lived in all of Michigan's 83 counties.

Table 5 Number and Percent of Adults With All BLLs, BLLs ≥ 10 ug/dL and ≥ 25 ug/dL by County of Residence and Percent of Adults with BLLs ≥ 10 ug/dL and ≥ 25 ug/dL Among All Adults Tested for BLL in Each County of Residence, Michigan 2011

	All BLLs		BLLs ≥ 10 ug/dL			BLLs ≥ 25 ug/dL		
County	Number	Percent	Number	Percent of all BLLs in State	Percent of all BLLs in County	Number	Percent of all BLLs in State	Percent of all BLLs in County
Alcona	9	0.1	1	0.2	11.1	1	1.0	11.1
Alger	7	0.1	0	0.0	0.0	0	0.0	0.0
Allegan	115	0.9	4	0.7	3.5	1	1.0	0.9
Alpena	23	0.2	3	0.5	13.0	0	0.0	0.0
Antrim	29	0.2	0	0.0	0.0	0	0.0	0.0
Arenac	21	0.2	1	0.2	4.8	0	0.0	0.0
Baraga	14	0.1	1	0.2	7.1	0	0.0	0.0
Barry	45	0.4	2	0.4	4.4	1	1.0	2.2
Bay	151	1.2	4	0.7	2.6	1	1.0	0.7
Benzie	11	0.1	1	0.2	9.1	1	1.0	9.1
Berrien	65	0.5	7	1.2	10.8	1	1.0	1.5
Branch	16	0.1	3	0.5	18.8	0	0.0	0.0
Calhoun	158	1.3	2	0.4	1.3	0	0.0	0.0
Cass	20	0.2	0	0.0	0.0	0	0.0	0.0
Charlevoix	27	0.2	1	0.2	3.7	0	0.0	0.0
Cheboygan	46	0.4	2	0.4	4.3	0	0.0	0.0
Chippewa	54	0.4	4	0.7	7.4	1	1.0	1.9
Clare	71	0.6	0	0.0	0.0	0	0.0	0.0
Clinton	133	1.1	3	0.5	2.3	0	0.0	0.0
Crawford	59	0.5	0	0.0	0.0	0	0.0	0.0
Delta	30	0.2	1	0.2	3.3	0	0.0	0.0
Dickinson	18	0.1	4	0.7	22.2	0	0.0	0.0
Eaton	161	1.3	3	0.5	1.9	1	1.0	0.6
Emmet	31	0.3	2	0.4	6.5	0	0.0	0.0
Genesee	589	4.8	23	4.1	3.9	2	2.0	0.3
Gladwin	65	0.5	1	0.2	1.5	0	0.0	0.0
Gogebic	12	0.1	0	0.0	0.0	0	0.0	0.0
Grand Traverse	63	0.5	8	1.4	12.7	5	5.1	7.9
Gratiot	113	0.9	1	0.2	0.9	0	0.0	0.0
Hillsdale	31	0.3	0	0.0	0.0	0	0.0	0.0
Houghton	17	0.1	3	0.5	17.6	1	1.0	5.9
Huron	25	0.2	7	1.2	28.0	0	0.0	0.0
Ingham	379	3.1	13	2.3	3.4	2	2.0	0.5
Ionia	92	0.7	22	3.9	23.9	3	3.0	3.3
Iosco	19	0.2	0	0.0	0.0	0	0.0	0.0
Iron	3	0.0	0	0.0	0.0	0	0.0	0.0
Isabella	143	1.2	0	0.0	0.0	0	0.0	0.0
Jackson	108	0.9	5	0.9	4.6	0	0.0	0.0
Kalamazoo	335	2.7	12	2.1	3.6	4	4.0	1.2
Kalkaska	26	0.2	1	0.2	3.8	0	0.0	0.0
Kent	1,250	10.2	26	4.6	2.1	5	5.1	0.4
Keweenaw	1	0.0	0	0.0	0.0	0	0.0	0.0
Lake	8	0.1	0	0.0	0.0	0	0.0	0.0
Lapeer	92	0.7	6	1.1	6.5	2	2.0	2.2

Table 5 Number and Percent of Adults With All BLLs, BLLs ≥ 10 ug/dL and ≥ 25 ug/dL by County of Residence and Percent of Adults with BLLs ≥ 10 ug/dL and ≥ 25 ug/dL Among All Adults Tested for BLL in Each County of Residence, Michigan 2011

	All BLLs		BLLs ≥ 10 ug/dL			BLLs ≥ 25 ug/dL		
County	Number	Percent	Number	Percent of all BLLs in State	Percent of all BLLs in County	Number	Percent of all BLLs in State	Percent of all BLLs in County
Leelanau	17	0.1	0	0.0	0.0	0	0.0	0.0
Lenawee	90	0.7	3	0.5	3.3	1	1.0	1.1
Livingston	216	1.8	16	2.8	7.4	5	5.1	2.3
Luce	6	0.0	0	0.0	0.0	0	0.0	0.0
Mackinac	65	0.5	19	3.4	29.2	6	6.1	9.2
Macomb	738	6.0	46	8.2	6.2	12	12.1	1.6
Manistee	28	0.2	0	0.0	0.0	0	0.0	0.0
Marquette	56	0.5	3	0.5	5.4	0	0.0	0.0
Mason	22	0.2	1	0.2	4.5	0	0.0	0.0
Mecosta	36	0.3	2	0.4	5.6	0	0.0	0.0
Menominee	12	0.1	1	0.2	8.3	0	0.0	0.0
Midland	174	1.4	3	0.5	1.7	1	1.0	0.6
Missaukee	18	0.1	2	0.4	11.1	0	0.0	0.0
Monroe	294	2.4	10	1.8	3.4	2	0.0	0.7
Montcalm	128	1.0	23	4.1	18.0	4	4.0	3.1
Montmorency	13	0.1	1	0.2	7.7	1	1.0	7.7
Muskegon	510	4.2	14	2.5	2.7	3	3.0	0.6
Newaygo	40	0.3	0	0.0	0.0	0	0.0	0.0
Oakland	1,079	8.8	42	7.4	3.9	8	8.1	0.7
Oceana	40	0.3	0	0.0	0.0	0	0.0	0.0
Ogemaw	16	0.1	1	0.2	6.3	1	1.0	6.3
Ontonagon	11	0.1	1	0.2	9.1	1	1.0	9.1
Osceola	25	0.2	0	0.0	0.0	0	0.0	0.0
Oscoda	8	0.1	0	0.0	0.0	0	0.0	0.0
Otsego	34	0.3	3	0.5	8.8	0	0.0	0.0
Ottawa	158	1.3	6	1.1	3.8	0	0.0	0.0
Presque Isle	10	0.1	0	0.0	0.0	0	0.0	0.0
Roscommon	66	0.5	4	0.7	6.1	1	1.0	1.5
Saginaw	258	2.1	7	1.2	2.7	1	1.0	0.4
Saint Clair	167	1.4	40	7.1	24.0	2	2.0	1.2
Saint Joseph	24	0.2	2	0.4	8.3	0	0.0	0.0
Sanilac	49	0.4	4	0.7	8.2	0	0.0	0.0
Schoolcraft	4	0.0	1	0.2	25.0	0	0.0	0.0
Shiawassee	107	0.9	6	1.1	5.6	0	0.0	0.0
Tuscola	48	0.4	3	0.5	6.3	0	0.0	0.0
Van Buren	84	0.7	2	0.4	2.4	0	0.0	0.0
Washtenaw	302	2.5	8	1.4	2.6	1	1.0	0.3
Wayne	2,603	21.2	112	19.9	4.3	17	17.2	0.7
Wexford	38	0.3	1	0.2	2.6	0	0.0	0.0
TOTAL	**12,279** *	100.00	**564** **	100.00	4.6	**99** ***	100.00	0.8

*County was unknown for 1,555 additional adults and 16 lived out of state.

**County was unknown for 51 additional adults and 10 lived out of state.

***County was unknown for 16 adults and 1 lived out of state.

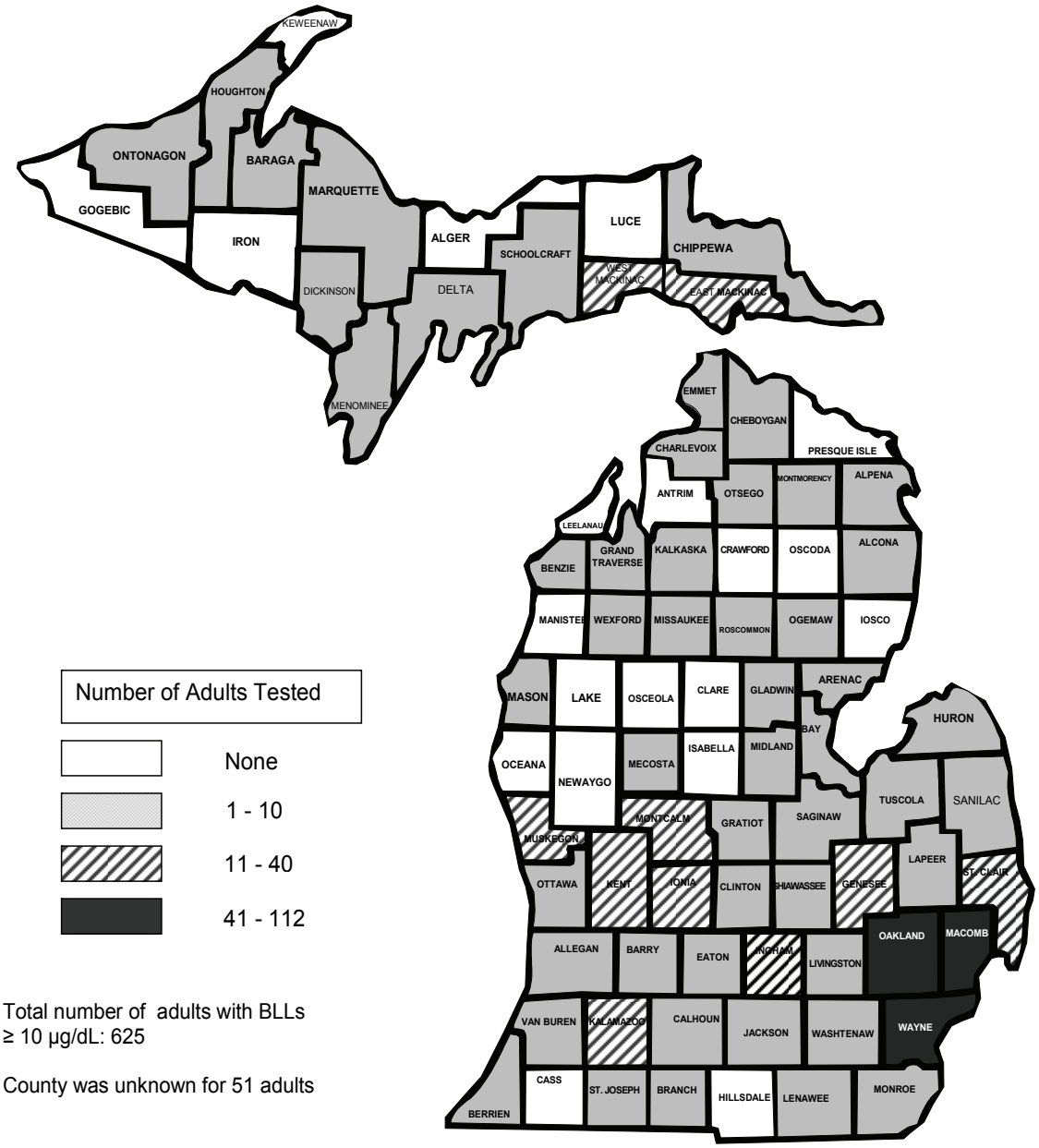
(Continued from page 9)

µg/dL were from Wayne County (112, 19.9%), followed by Macomb County (46, 8.2%) and Oakland County (42, 7.4%). The county was unknown for 51 adults with BLLs ≥ 10 µg/dL.

Figure 9 and Table 5 show the county of residence for the 99 adults with BLLs ≥ 25 µg/dL where county of residence could be determined. The largest number of adults reported with a BLL ≥ 25 µg/dL were from Wayne County (17, 17.2%), followed by Macomb County (12, 12.1%) and Oakland (8, 8.1%). The county was unknown for 16 adults with BLLs ≥ 25 µg/dL.

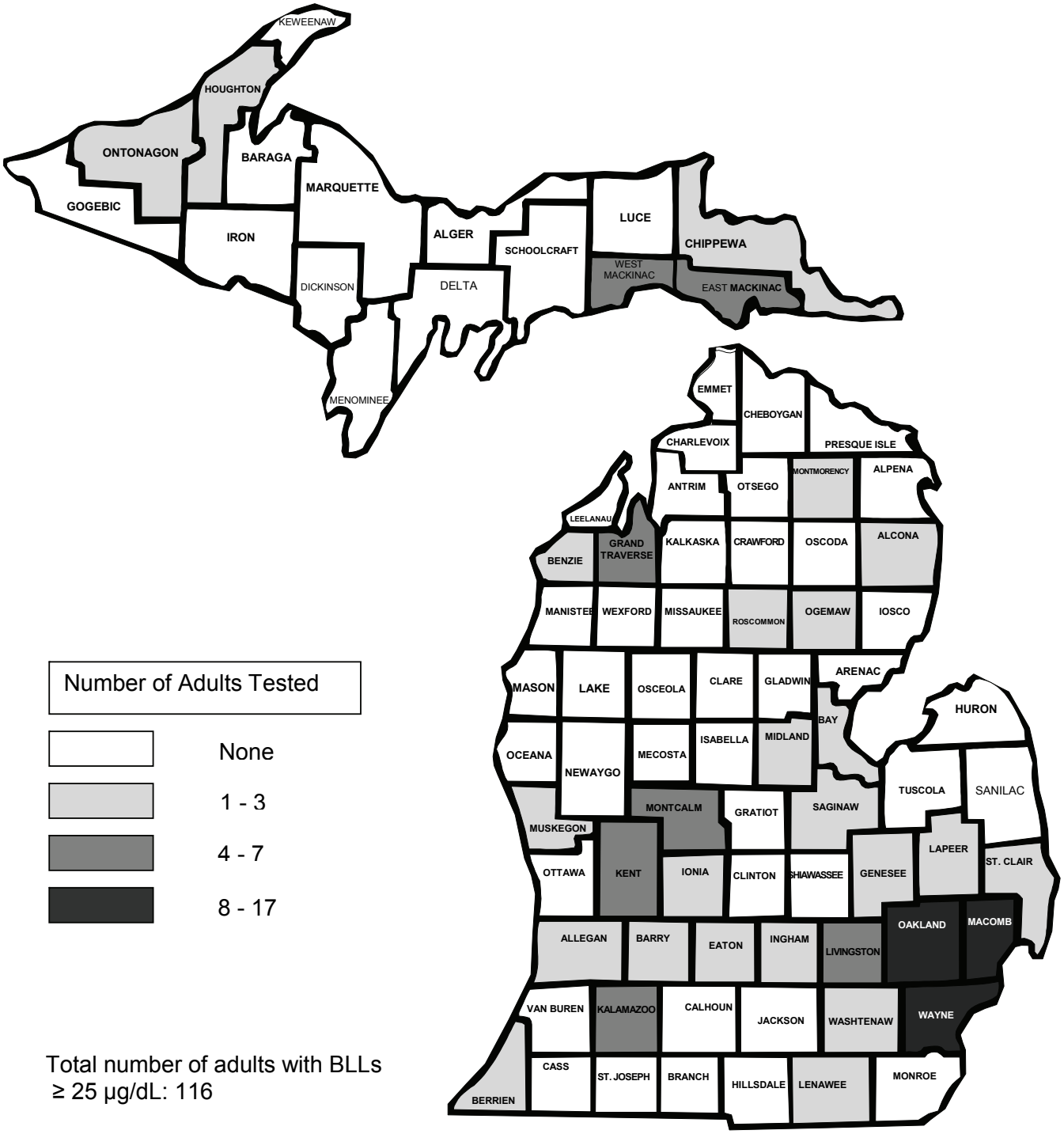
The largest number of adult BLLs reported in 2011 lived in Wayne County (2,603, 21.2%), followed by Kent County (1,250, 10.2%) and Oakland County (1,079, 8.8%).

Figure 8 **Geographic Distribution of Adults Tested with BLLs ≥ 10 µg/dL by County of Residence, Michigan 2011**



Wayne, Macomb and Oakland had the largest number with 112, 46 and 42 respectively.

Figure 9 **Geographic Distribution of Adults Tested with BLLs ≥ 25µg/dL by County of Residence, Michigan 2011**



Total number of adults with BLLs ≥ 25 µg/dL: 116

County was unknown for 16 adults

Wayne, Macomb and Oakland counties had the largest number with 17, 12 and 8 respectively.

Table 6 Number and rate of BLLs ≥ 10 µg/dL Among Women by County of Residence, Michigan 2011

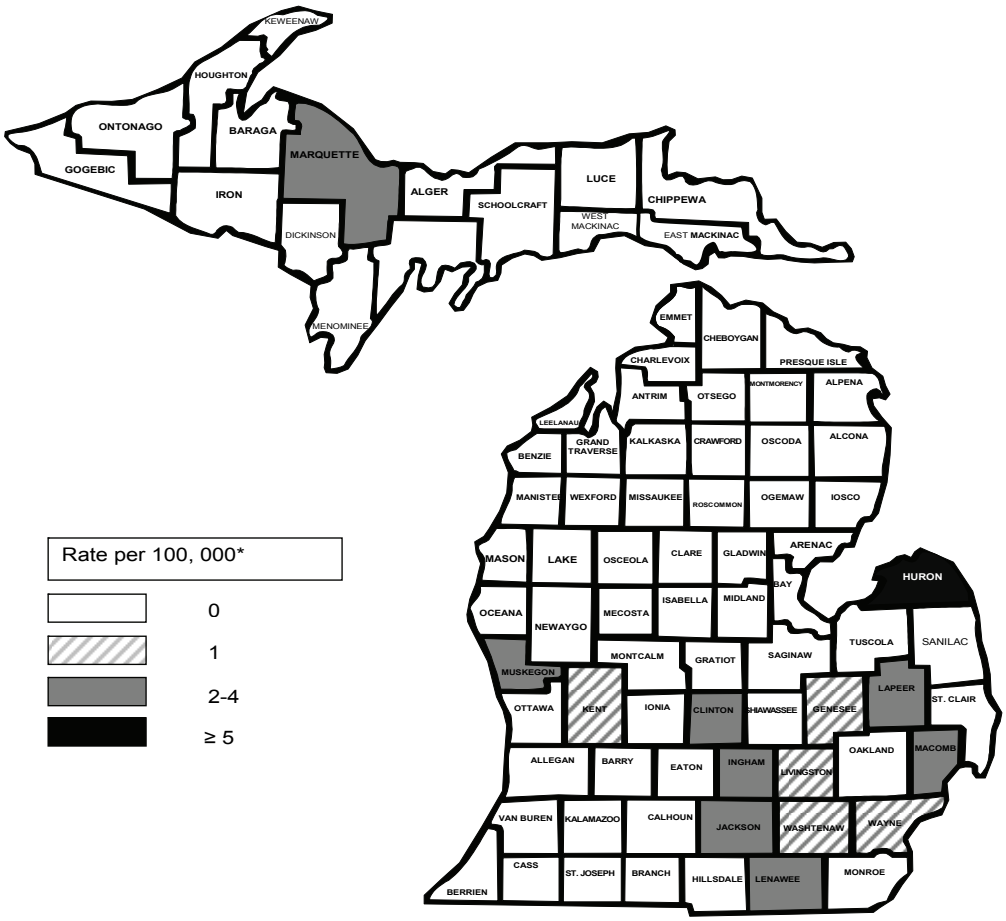
County	Number Reported	Michigan Population Women	Rate per 100,000 women
Clinton	1	30,442	3
Genesee	1	174,258	1
Huron	1	13,663	7
Ingham	2	120,170	2
Jackson	1	62,614	2
Kent	3	241,825	1
Lapeer	1	35,014	3
Lenawee	1	39,613	3
Livingston	2	351,446	1
Macomb	2	69,017	3
Marquette	1	28,185	4
Muskegon	2	68,231	3
Oakland	2	504,543	0
Washtenaw	1	146,199	1
Wayne	7	743,829	1
TOTAL	**28***	4,047,355**	1***

* County was unknown for 1 woman.

**Total number of women in all 83 counties of Michigan age 16+ years; 7/1/2011 County Characteristics Resident Population Estimates, U.S. Census Bureau

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

Figure 10 **Annual Incidence of BLLs ≥ 10 µg/dL Among Women by County of Residence, Michigan 2011**



*Denominator is Rate per 100,000 women age 16+ from US Census Bureau of County Resident Population, Annual Estimate for July 1, 2011

Table 5 shows the percentage of tested adults, within each county, with BLLs ≥10 µg/dL and BLLs ≥ 25 µg/dL. Mackinac (29.2%), Huron (28.0%), Schoolcraft (25.0%) and Saint Clair (23.9%) counties had the highest percentages of adults with BLL ≥10 µg/dL within their respective counties. Alcona (11.1%), Mackinac (9.2%), Benzie and Ontonagon (9.1%) counties had the highest percentage of tested adults with BLL ≥ 25 µg/dL.

GENDER DISTRIBUTION

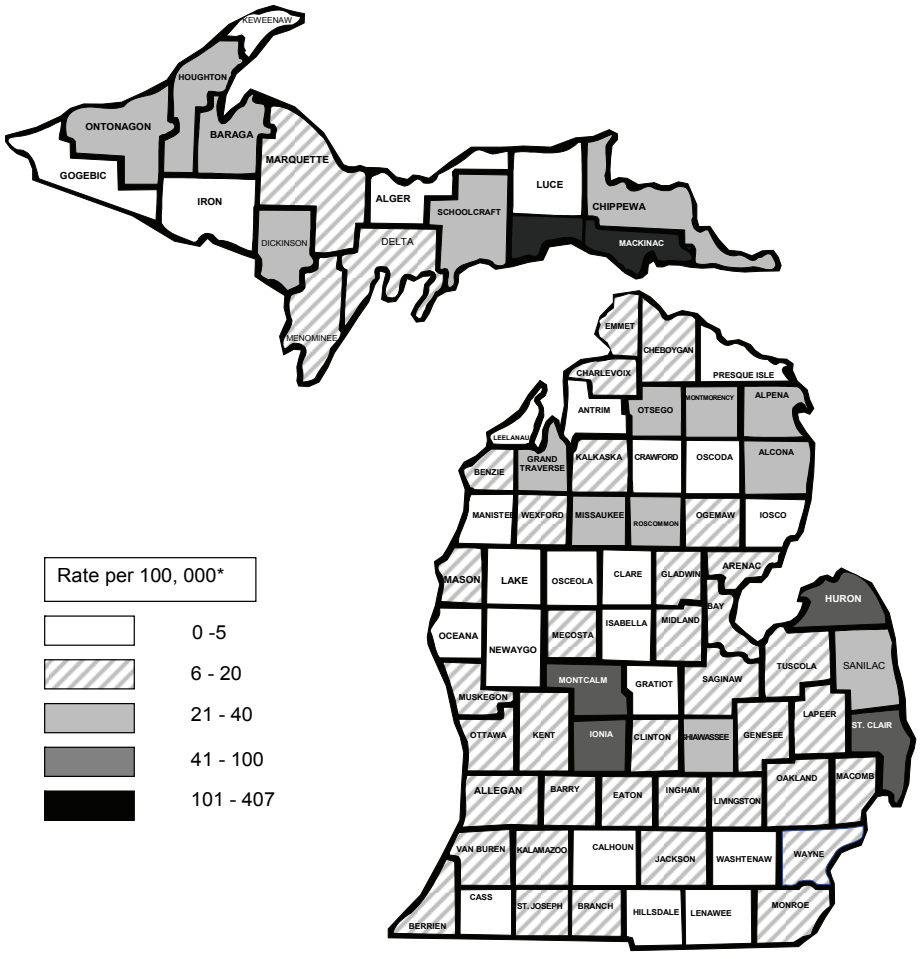
Figure 10 and Table 6 show the incidence rates of BLL ≥ 10 µg/dL by county for women. There were 28 women reported in 2010 with a BLL ≥ 10 µg/dL, where county was known. Huron (7/100,000), Marquette (4/100,000), Clinton, Lapeer, Lenawee, Macomb and Muskegon (3/100,000) had the seven highest incidence rates.

Three women (10.7%) with elevated blood lead had their exposure from work: one from a correctional institution, one from a sporting goods firing range and one from construction remodeling. One woman (3.6%) with elevated blood lead had her exposure both from work (public safety) and hobby (firearms).

Twelve women (42.9%) with elevated blood leads had non -work exposures: six from firearms, two from pottery

(Continued on page 17)

Figure 11 **Annual Incidence of BLLs ≥ 10 µg/dL Among Men by County of Residence, Michigan 2011**



*Denominator is Rate per 100,000 men age 16+ from US Census Bureau of County Resident Population, Annual Estimate for July 1, 2011

Table 7 Number and Rate of BLL ≥ 10 µg/dL Among Men by County of Residence, Michigan 2011

County	Number Reported	Michigan Population Men	Rate per 100,000 Men	County	Number Reported	Michigan Population Men	Rate per 100,000 Men
Alcona	1	4,783	21	Keweenaw	0	920	0
Alger	0	4,499	0	Lake	0	5,012	0
Allegan	4	42,397	9	Lapeer	5	35,244	14
Alpena	3	11,761	26	Leelanau	0	8,891	0
Antrim	0	9,483	0	Lenawee	2	40,132	5
Arenac	1	6,617	15	Livingston	14	70,850	20
Baraga	1	4,074	25	Luce	0	3,294	0
Barry	2	23,290	9	Mackinac	19	4,664	407
Bay	4	41,907	10	Macomb	44	323,596	14
Benzie	1	7,033	14	Manistee	0	10,801	0
Berrien	7	60,039	12	Marquette	2	28,604	7
Branch	3	18,973	16	Mason	1	11,399	9
Calhoun	2	51,706	4	Mecosta	2	18,010	11
Cass	0	20,581	0	Menominee	1	9,844	10
Charlevoix	1	10,360	10	Midland	3	32,799	9
Cheboygan	2	10,639	19	Missaukee	2	5,959	34
Chippewa	4	17,898	22	Monroe	10	58,888	17
Clare	0	12,583	0	Montcalm	23	25,981	89
Clinton	2	29,087	7	Montmorency	1	4,136	24
Crawford	0	5,822	0	Muskegon	12	66,361	18
Delta	1	14,936	7	Newaygo	0	18,988	0
Dickinson	4	10,576	38	Oakland	40	462,380	9
Eaton	3	41,915	7	Oceana	0	10,410	0
Emmet	2	12,920	15	Ogemaw	1	8,837	11
Genesee	22	156,834	14	Ontonagon	1	2,937	34
Gladwin	1	10,645	9	Osceola	0	9,199	0
Gogebic	0	7,494	0	Oscoda	0	3,570	0
Grand Traverse	8	34,985	23	Otsego	3	9,494	32
Gratiot	1	18,452	5	Ottawa	6	99,749	6
Hillsdale	0	18,260	0	Presque Isle	0	5,668	0
Houghton	3	16,445	18	Roscommon	4	10,537	38
Huron	6	13,314	45	Saginaw	7	75,822	9
Ingham	11	110,963	10	Saint Clair	40	63,396	63
Ionia	22	27,447	80	Saint Joseph	2	23,333	9
Iosco	0	10,695	0	Sanilac	4	16,808	24
Iron	0	4,951	0	Schoolcraft	1	3,464	29
Isabella	0	28,597	0	Shiawassee	6	27,218	22
Jackson	4	65,112	6	Tuscola	3	22,138	14
Kalamazoo	12	98,154	12	Van Buren	2	29,166	7
Kalkaska	1	6,995	14	Washtenaw	7	139,959	5
Kent	23	226,490	10	Wayne	105	666,426	16
				Wexford	1	12,862	8
				TOTAL	**536 ***	**3,817,458 ****	14 ***

*County was unknown for 50 additional male adults.

**Total number of men in all 83 counties of Michigan age 16+ years; 7/1/2011 County Characteristics Resident Population Estimates, U.S. Census Bureau *http://www.census.gov/popest/counties/asrh/files/cc-est2009-agesex-26.csv*

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

making , one from leather tooling, one from home remodeling, one from making stained glass, and one from a gunshot wound. Source of exposure was unknown for twelve of the 28 women.

Figure 11 and Table 7 show the incidence rates of BLL of 10 µg/dL and above by county for men. There were 536 men reported in 2011 with a BLL ≥ 10 µg/dL where county of residence could be determined. Mackinac (407/100,000), Montcalm (89/100,000) and Ionia, (80/100,000) had the highest incidence rates per 100,000 men based on the 2011 County Characteristics Resident Population Estimates from the U.S. Census Bureau. The overall incidence rate for men was 14 times higher than that for women (14/100,000 vs. 1/100,000) in 2011.

SOURCE OF EXPOSURE

For 471 (81.2%) individuals, work was the identified source. For 109 (18.8%) individuals non-occupational activities were identified as the source of exposure. Table 8 shows the non-work related source of exposure of lead for 108 individuals with BLLs ≥10 µg/dL reported in 2011. Of those 109, three non-occupational activities predominated. Eighty-six (78.9%) individuals were exposed from a hobby related to guns, seven (6.4%) were exposed due to a retained bullet fragment and six (5.5%) were exposed due to home remodeling. For an additional 15 individuals, source of exposure is still being investigated. For 30, the source was still unknown after an interview with the individual or review of medical records.

Table 9 shows the occupational sources of lead for individuals reported in 2011. The most frequent reports were on individuals in the construction sector (44.6%) and manufacturing (31.7%).

Figure 12 shows the geographic distribution of the twenty-five non-construction companies that reported at least one adult with a BLL of 25 µg/dL or greater in Michigan during 2011. For two of these companies, we were unable to determine county and one was located out of state. These twenty-five companies included an auto and home supply store, a university and police department shooting ranges, an automotive repair shop, distribution

Table 8 Non-Work Source of Exposure Among Adults with BLLs ≥ 10 µg/dL, Michigan 2011

Exposure Source Description	Number	Percent	%NonWork
Work-Related	471	81.2	
Hobby: Firearms, Reloading, Casting	86	14.8	78.9
Gun Shot Wound	7	1.2	6.4
Remodeling	6	1.0	5.5
Hobby: Stained Glass	2	0.3	1.8
Hobby: Leather Tooling, Sinkers	2	0.3	1.8
Lead Paint Ingestion (Pottery, ceramics, food)	2	0.3	1.8
Unknown, Not work	3	0.5	2.8
Hobby: Unknown	1	0.2	0.9
TOTAL	**580 ***	**100.0**	**100.0**

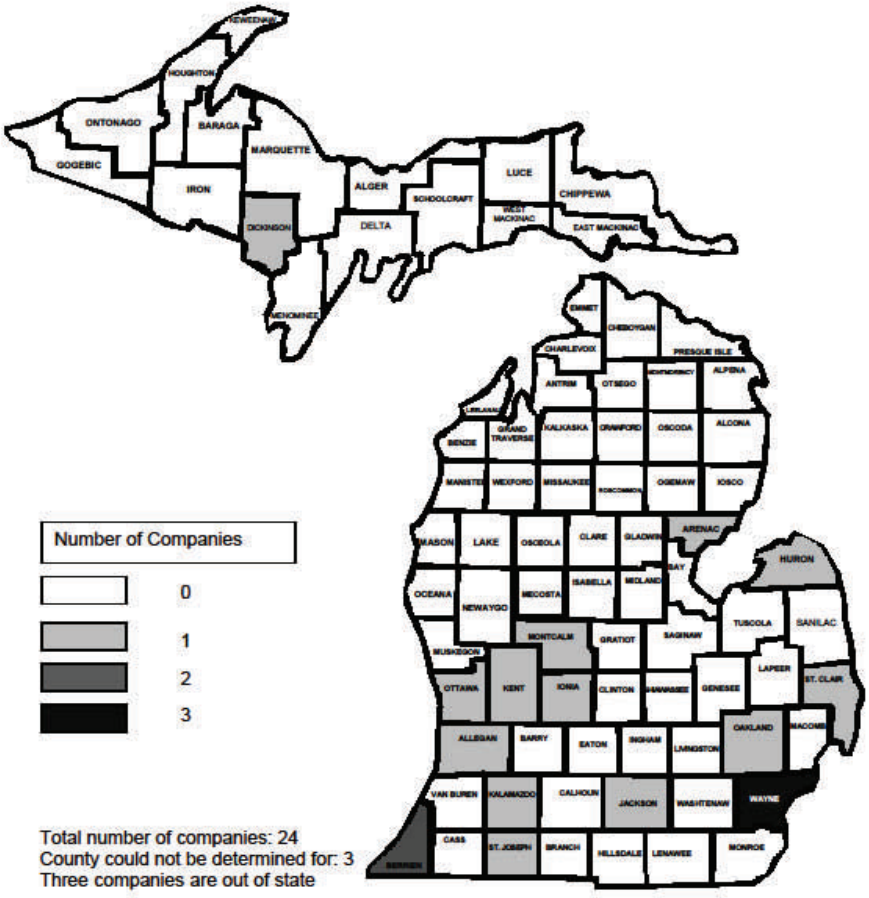
*For 7 additional adults source is pending an interview and for 8 medical records; for 9 additional adults source was inconclusive based on interview; for 21 additional adults, source was inconclusive and no patient interview was possible.

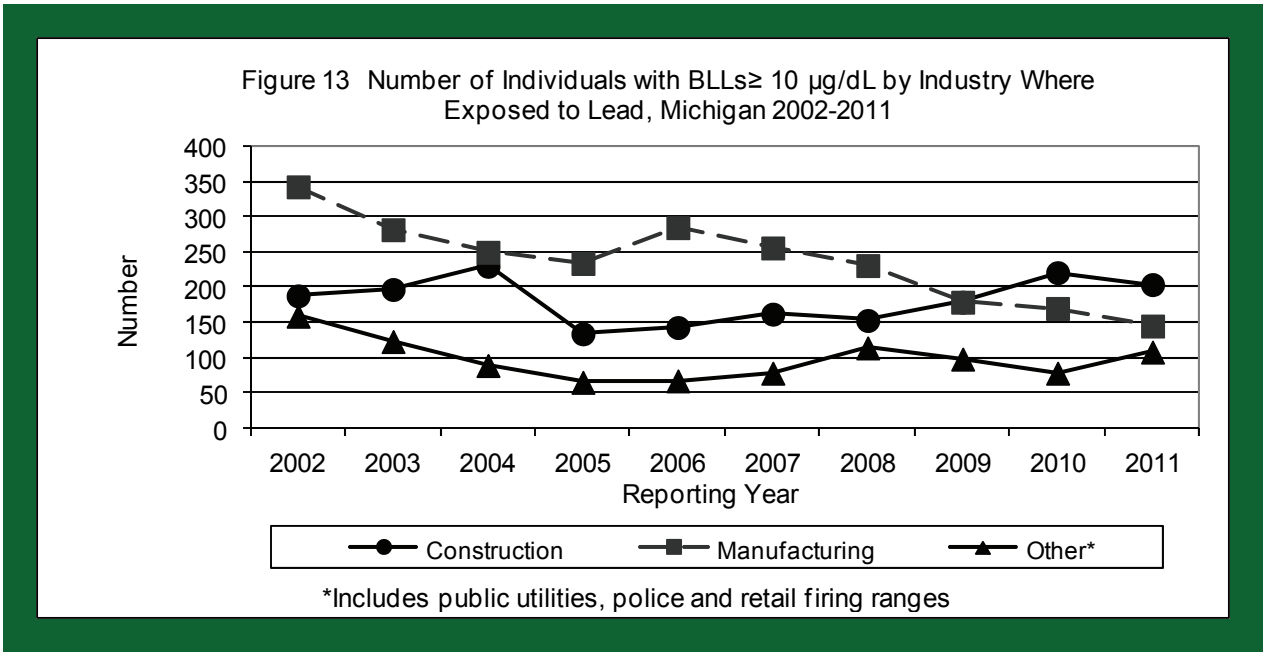
Table 9 Industry Source of Exposure Among Adults with BLLs ≥10 µg/dL, Michigan 2011

Exposure Source --- Industry (SIC Code)*	Number		Percent
Construction (15-17)	**204**		**44.6**
Painting (17)		191	41.8
Manufacturing (20-39)	**145**		**31.7**
Fabricated and Primary Metals (33-34)		130	28.4
Transportation and Public Utilities (40-49)	**21**		**4.6**
Wholesale and Retail Trade (50-59)	**27**		**5.9**
Services (60-89)	**28**		**6.1**
Automotive Repair Services (75)		5	1.1
Public Administration (91-97)	**32**		**7.0**
Justice, Public Order, Safety (92)		14	3.1
TOTAL	**457 ****		**100.0**

*Standard Industrial Classification.
**Another 14 were work-related, however, the industry was unknown.

Figure 12 Geographic Distribution of Non-Construction Companies Reporting Adult BLLs ≥ 25 µg/dL In Michigan, 2011





and warehousing of scrap and waste materials, wholesale distribution of electrical power equipment, primary metal industries, metal stamping companies, and indoor firing ranges. Of the 471 individuals with blood lead ≥ 10 µg/dL where exposure occurred at work, 134 (28.5%) were from these twenty-five companies. Of the 82 individuals with blood lead ≥ 25 µg/dL and exposure occurred at work, 42 (51.2%) were also from these twenty-five companies.

The recent BLLs have generally been decreasing across all types of occupational sources. Although some of this reduction is due to improvements in work place controls, some of the decrease is presumed to be secondary to closure of manufacturing facilities. Construction is a more frequent source of lead exposure than manufacturing and if the previous trend continues, "Other" which includes public utilities, police and public firing ranges will also be a more frequent source than manufacturing (Figure 13).

SUMMARY OF INDUSTRIAL HYGIENE INSPECTIONS

Follow up of elevated blood lead testing --- 2011

Two of the eight 2011 inspections were conducted in the construction industry, the other six inspections were done by the MIOSHA general industry division and included a university's shooting range, a battery plant, two commercial firearm shooting ranges, a facility that rebuilds and fabricates water turbine engines, and an electroplating facility. There was an additional general industry inspection of a non-ferrous metals processing plant conducted in 2010 that was included in this report because it was not included in the 2010 Annual Report.

One of the construction inspections was completed at a general contractor as the result of four employees with blood lead levels of 33, 40, 47 and 51µg/dL. All seven citations issued pertained to lead exposure due to a job that involved removing a staircase and cleaning de-

SUMMARY OF INDUSTRIAL HYGIENE INSPECTIONS, con't . . .

bris within the structure. The employer was cited for not determining if any employee performing manual demolition within a structure built prior to the 1900s, was exposed to lead at or above the action level of 30 µg/m^3; for not providing employees adequate respiratory protection, adequate personal protective clothing, change areas, biological monitoring, or training; not implementing engineering and work practice controls, including administrative controls, to reduce and maintain employee exposure to lead to or below the permissible exposure limit to the extent such controls are feasible; not establishing a written compliance program for lead prior to commencement of the job; not providing an adequate training program concerning lead hazards; not making a copy of the "Lead Exposure in Construction" rules and appendices readily available to all affected employees.

In 2011 MIOSHA inspections were conducted and reports completed at eight companies referred by ABLES due to elevated blood lead laboratory reports. Seven of the eight (87.5%) received lead related citations for violation of lead-related standards.

A university's department of military science was inspected as the result of a retired employee with a blood lead level of 39 µg/dL. The indoor rifle range had four shooting lanes. Its ventilation system was not working and had never been used. No respiratory protection was worn by students, the university's police, local municipal police or members of the National Guard who used the range. The MIOSHA inspection found detectable amounts of lead on commonly touched surfaces. The university did not establish a continuing and effective housekeeping protocol to minimize accumulations of lead at the range. One lead citation was issued.

An electrical apparatus and equipment wiring supplies, and construction materials company was inspected as the result of two employees with blood lead levels of 32 and 46 µg/dL. The company repairs and sells new batteries for industrial-type trucks and other industrial applications. The employees used propane and oxygen to weld lead terminals and other equipment onto batteries being serviced. All seven citations issued pertained to lead exposure and included: one employee was exposed to lead at a concentration of more than 50 µg/m^3 of air, averaged over an 8-hour period; the employer had employees exposed to lead above the permissible exposure limit and the action level and the employer did not perform the required exposure monitoring; a written compliance program was not established and implemented to reduce exposures to, at or below the permissible employee exposure limit solely by means of engineering and work practice controls; the employer had not provided and required the use of appropriate respiratory protection; surfaces in the workplace were not maintained as free as practicable from accumulation of lead; employees who worked in areas where airborne exposures to lead were greater than the permissible employee exposure limit did not shower at the end of each work shift; the following warning sign was not posted in each work area where the permissible employee exposure limit was exceeded: "WARNING; LEAD WORK AREA; POISON; NO SMOKING OR EATING."

A gun range was inspected as a result of an

employee with an elevated blood lead level of 66 µg/dL. All four citations issued pertained to lead exposure and included: employee monitoring that was conducted demonstrated that an employee was exposed above the action level, and that employees had potential exposure to lead from surfaces and there was a possibility of skin and eye irritation, and the facility did not institute a training program for the affected employees; surfaces in the workplace were not maintained as free as practicable from accumulations of lead; a medical surveillance program was not instituted for each employee who was or may have been exposed to concentrations of lead greater than the action level for more than 30 days a year.

An internal combustion engines company was inspected as a result of an employee with elevated blood lead level of 30 µg/dL. The company was cited for four lead citations and eight non-lead citations. The lead citations included: when initial monitoring revealed that an employee's exposure to lead-containing dust was at or above the action level, monitoring was not repeated at least once every six months; the firm had no written compliance program to reduce the airborne lead level to, at or below the PEL; the firm had not provided employees with any information and training on the health effects of lead exposure; the firm had not performed routine housekeeping to prevent the lead-containing dust from accumulating on surfaces outside the blasting/painting room.

A firearm shooting range was inspected as a result of two employees with elevated blood lead levels of 84 and 39 µg/dL. The company was cited for 10 lead and three non-lead violations. The lead citations included: an employee was exposed to lead at a concentration of more than 50 µg/m^3 of air, averaged over an 8-hour period; range assistants were exposed to lead greater than the exposure limit while assisting customers in the gun range; when an employee was exposed to lead above the permissible exposure limit for more than 30 days each year, engineering and work practice controls were not implemented to reduce and maintain employee exposure to at or below 50 µg/m^3; a written respiratory protection program was not established and implemented for required respirator use; surfaces in the workplace were not maintained as free as practicable from accumulation of lead – wipe samples showed surface contamination of lead as high as 13,000 µg/100cm^2 behind the range, and 2,200 µg/100cm^2 on the sales floor; it was not ensured that food or beverages were not present or consumed, tobacco products were not present or used, and cosmetics were not applied in areas where employees were exposed to lead concentrations greater than the permissible employee exposure limit; clean change rooms were not provided for employees who worked in areas where airborne exposure to lead was greater than the permissible employee exposure limit without regard to the use of respirators; showers were not provided; biological monitoring was not made available in the form of blood sampling and analysis for lead and zinc protoporphyrin levels to each employee who was or may have been exposed to concentrations of lead greater than the action level for more than 30

When an individual from a company is identified with a blood lead value of 25 µg/dL or greater, a MIOSHA enforcement inspection is conducted to assess that company's compliance with the lead standard.

SUMMARY OF INDUSTRIAL HYGIENE INSPECTIONS, con't . . .

days a year; a training program was not instituted for all employees who were subjected to exposure to lead at or above the action level or for whom the possibility of skin irritation existed from exposure to lead; a written compliance program was not established and implemented to reduce exposures to, at or below the permissible employee exposure limit solely by means of engineering and work practice controls; a written hazard communication program was not developed or implemented for employees using cleaning chemicals to clean restrooms and other common areas; no written certification was identified for sales associates who cleaned the restrooms and other common areas using personal protective equipment.

A plating and polishing manufacturer that makes lead anodes two days a year was inspected as a result of an employee with an elevated blood lead level of 25 µg/dL. The company was cited for 2 lead and 3 non-lead violations. The lead citations included: not determining if an employee might have been exposed to lead at or above the action level; the employees were not informed of the contents of appendices A and B of part 310, Lead regulation.

An inspection of a highway, bridge and street construction company found no violations of MIOSHA regulations identified while inspecting a small bridge blasting and re-painting job as a result of an employee with elevated blood lead level of 30 µg/dL.

A scrap and waste materials wholesale distribution company was inspected as a result of an elevated blood lead of 65 µg/dL. The company was cited for 28 non-lead violations. No inspection was conducted in 2011 because the 2010 inspection addressed many violations.

Of the nine companies inspected, eight were identified by an elevated blood lead report collected because of a required medical surveillance program and one was reported by a private health care provider.

Case Narratives

Thirteen Individuals with a BLL ≥ 50 µg/dL in 2011

Work-Related (10 Individuals)

A Caucasian male in his 50s, employed at a company that does wrecking and demolition work, had an elevated BLL of 58 µg/dL in February 2011. His March BLL was 51 µg/dL. He was tested eleven more times and his BLLs varied between 11 and 45 µg/dL. He reported that he has been cutting steel with a cutting torch for three and a half years. When the blood test was taken, he reported that he has been working as a metal recycler and that he had been working outside in the torching area.

A Caucasian male in his mid 40s, employed as a carpenter for a construction company, had an elevated BLL of 51 µg/dL in March 2011. His June BLL was 33 µg/dL. He had a history of previous lead exposure in 2006 when his BLL was 29 µg/dL.

Three men employed at an indoor shooting range had elevated BLLs. The first employee, a Caucasian male of Hispanic origin in his late 30s, employed as the manager, had an elevated BLL of 72 µg/dL in April 2011. The second employee, a male in his early 20s had an elevated BLL of 84 µg/dL in March and 79 in April 2011. The third employee, a Caucasian male in his early 20s had an elevated BLL of 61 µg/dL in April 2011.

A Caucasian male in his mid 20s, employed as the manager at an indoor shooting range, had an elevated BLL of 66 µg/dL in April 2011. He has been employed there for 7 months.

A Caucasian male of Hispanic origin in his late 20s had an elevated BLL of 65 µg/dL in May 2011. He has been employed at a manufacturing company of alloy carbon and resulfurized steel bars and rolled steel as a "picker/sorter". The employee reported working in a small area with no respirator.

An African-American male in his mid 60s, diagnosed with lead toxicity in 2009, continued to have a high BLL, 64 µg/dL, in 2011. His exposure to lead was suspected to be from several sources which include independent employment in renovation of older homes and bullet fragments lodged near his spine since 1985. In August 2009, he reported that doctors removed all operable bullet fragments. His highest BLL of 144 µg/dL, was in January 2009, his lowest level of 52 µg/dL in April 2010. He also reported stopping all renovation and work activities due to his failing kidney function and overall health. Contact was made with Detroit Health Department for further investigation of other possible sources.

In 2011, Michigan ABLES received 16,018 blood lead tests for 13,850 individuals ≥16 years of age. Six hundred and twenty-five (4.5%) individuals had BLLs ≥ 10 µg/dL; 116 (18.6%) of those 625 had lead levels ≥ 25 µg/dL and 13 (11.2%) of the 116 had BLLs ≥ 50 µg/dL.

A Caucasian male in his late 20s, employed at a bridge painting and sandblasting company, had an elevated BLL of 56 µg/dL in September 2011. The employee had been sandblasting bridges to remove paint and cleaning up sand. The employee reported working with no respirator or earplugs.

A Caucasian male in his mid 50s, diagnosed with lead toxicity in 1999, continued to have high BL, 51, in November 2011. He used to be employed at a company repairing and selling industrial equipment for trucks. He is a battery repair technician and has been employed at a battery factory for more than 10 years.

Non Work-Related (3 Individuals)

A Caucasian male in his mid 60s, diagnosed with lead toxicity in 2003, continued to have high BLL, 51 µg/dL, in September 2011. His exposure to lead was suspected to be from casting. He has been melting lead for casting bullets, and diving weights.

A Caucasian male in his mid 60s had an elevated BLL of 59 in April 2011. He is a competitive shooter. He also reported that he stripped paint from wooden doors at home two years ago, and paint from windows of a house built in 1912, six years ago.

An African American female in her mid 50s, had an elevated BLL of 70 µg/dL in November 2011. The source of exposure could not be determined from patient's interview or from patient's doctor but no work exposure was identified.

Fourteen Years of Interviews of Adults with BLLs of 10 µg/dL or Greater

Between October 15, 1997, and December 31, 2011, there were 2,016 questionnaires completed over the telephone of adults with BLLs ≥ 10 µg/dL. The following summary of interview data is based on the 2,016 completed questionnaires.

Most of the 2,016 completed questionnaires were of males (90.2%), which is slightly higher but parallels the gender distribution from the 2011 year lead level reports ≥ 10 µg/dL. Although based on small numbers, the very highest BLLs (≥ 60 µg/dL) showed a higher percentage of African-Americans compared to lower blood lead levels. The percentage of current smokers increased with increasing blood lead levels. The group with the highest lead levels had the youngest mean age of 37.5 (Table 10).

The types of lead-related symptoms reported during the interviews, by lead level, are presented in Table 12. Only individuals who had daily or weekly

Table 10 Demographic Characteristics of Adults with BLLs ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

Demographic Characteristics	10-24 ug/dL		25-29 ug/dL		30-39 ug/dL		40-49 ug/dL		50-59 ug/dL		≥60 ug/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Male	1083	87.8	254	93.7	318	95.2	103	91.2	39	95.1	20	90.9	1817	90.2
Female	151	12.2	17	6.3	16	4.8	10	8.8	2	4.9	2	9.1	198	9.8
Hispanic Origin	63	5.3	10	3.9	11	3.4	14	12.7	1	2.5	1	4.8	100	5.2
Caucasian	1029	84.4	235	88.7	289	87.8	95	84.1	38	92.7	17	77.3	1703	85.6
African American	112	9.2	16	6	20	6.1	9	8	3	7.3	5	22.7	165	8.3
Asian/Pacific Islander	6	0.5	1	0.4	3	0.9	0	—	0	—	0	—	10	0.5
Native American/Alaskan	12	1	5	1.9	11	3.3	0	—	0	—	0	—	28	1.4
Other	60	4.9	8	3	6	1.8	9	8	0	—	0	—	83	4.2
Mean Age (#)	45.3	(1234)	43.9	(271)	42.1	(334)	43.3	(113)	43.1	(41)	37.5	(22)	44.3	(2015)
Ever Smoked	768	63.7	190	72.8	222	70.9	78	72.9	30	81.1	13	68.4	1301	67*
Now Smoke**	364	47.5	105	55.6	150	67.9	51	65.4	23	76.7	9	69.2	702	54.1*

**p < 0.05 for linear trend*

** The percentages of *now smoke are calculated using the denominator of those who ever smoked.*

The distribution of blood leads by education is shown in Table 11.

Table 11 Highest Education of Adults with BLLs ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

Highest Education Level	10-24 µg/dL		25-29 µg/dL		30-39 µg/dL		40-49 µg/dL		50-59 µg/dL		≥ 60 µg/dL		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
7th Grade or less	27	2.4	5	2.6	3	1.6	4	6.2	0	--	0	--	**39**	**2.4**
8th – 11th Grade	133	11.7	12	6.2	24	12.6	9	13.8	2	10	4	30.8	**184**	**11.3**
High School Grad	386	33.8	75	38.7	72	37.9	17	26.2	9	45	3	23.1	**562**	**34.6**
1-3 yrs College/Tech	381	33.4	70	36.1	54	28.4	23	35.4	7	35	4	30.8	**539**	**33.2**
4+ yrs College/Tech	214	18.8	32	16.5	37	19.5	12	18.5	2	10	2	15.4	**299**	**18.4**

Table 12 Symptoms of Michigan Adults with BLLs ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

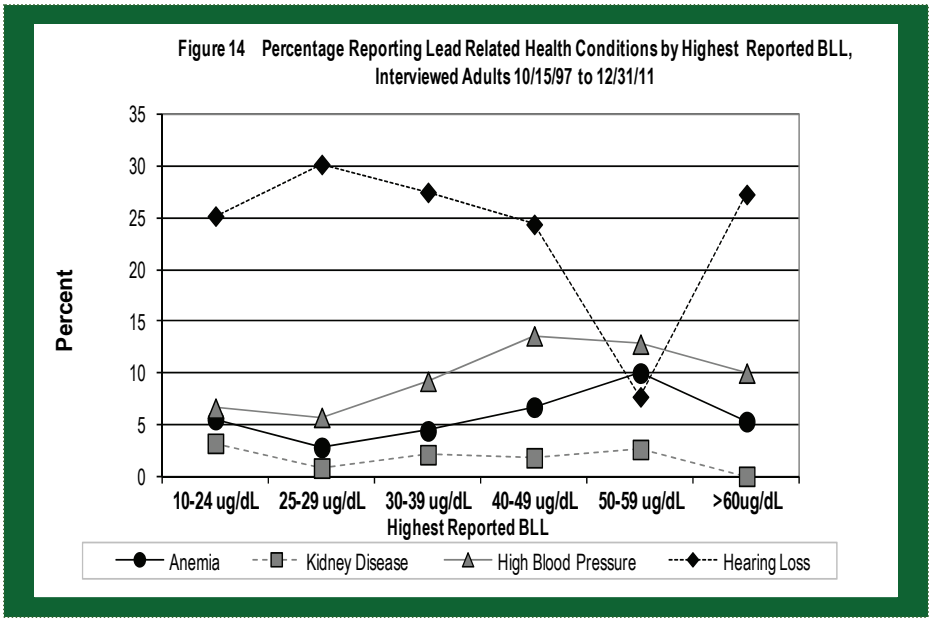
	10-24µg/dL		25-29 µg/dL		30-39µg/dL		40-49 µg/dL		50-59 µg/dL		≥ 60 µg/dL		Total	
Symptoms	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
GASTRO-INTESTINAL														
Lost 10+lbs w/o diet	135	11.2	25	9.7	39	11.9	25	22.7	8	20.5	6	30	238	12.1*
Continued loss of appetite	143	11.8	27	10.3	46	13.9	22	20.2	8	20	6	28.6	252	12.8*
Pains in belly	200	16.4	28	10.6	51	15.5	28	25.2	11	27.5	7	33.3	325	16.4*
MUSCULOSKELETAL														
Frequent pin/soreness joint	406	33.9	88	33.8	122	37.2	55	51.4	15	37.5	11	55	697	35.7*
Muscle weakness	280	23.3	37	14.2	62	19.1	36	32.7	14	35	10	50	439	22.5
NERVOUS														
Headaches	201	16.5	35	13.2	70	21.1	30	26.8	12	29.3	9	42.9	357	17.9*
Dizziness	124	10.3	16	6.1	18	5.5	14	12.6	6	15	8	38.1	186	9.4
Depressed	181	15	28	10.8	51	15.7	24	21.8	12	29.3	9	42.9	305	15.5*
Tired	449	37.1	85	32.2	146	44.2	60	54.1	23	56.1	14	66.7	777	39.3*
Nervous	174	14.4	28	10.7	52	16	27	24.3	11	27.5	8	38.1	300	15.3*
Waking up night	347	28.6	54	20.5	107	32.5	37	33.3	17	41.5	10	50	572	28.9*
Nightmares	97	8	8	3.1	16	4.9	8	7.3	4	10	4	19	137	6.9
Irritable	240	19.8	53	20.4	88	27	37	33.3	17	42.5	11	52.4	446	22.7*
Unable to concentrate	205	17	32	12.2	63	19	22	20.2	11	26.8	8	38.1	341	17.3*
REPRODUCTIVE														
Trouble having a child	52	4.4	15	5.9	17	5.3	2	1.9	0	—	1	5.3	87	4.5
Gastro-Intestinal Symptoms	310	25.3	52	19.6	81	24.3	43	38.4	17	41.5	11	52.4	514	25.8*
Musculoskeletal Symptoms	475	39.1	93	35.4	132	40	61	55	18	45	14	66.7	793	40.1*
Nervous Symptoms	681	55.8	129	48.7	203	61.1	72	64.3	30	73.2	14	66.7	1129	56.7*
Any Symptoms	**801**	**65.2**	**159**	**60**	**221**	**66.4**	**84**	**75**	**33**	**80.5**	**15**	**71.4**	**1313**	**65.6***
Average No. Symptoms	**2.63**	**n=1229**	**2.11**	**n=265**	**2.85**	**n=333**	**3.81**	**n=112**	**4.12**	**n=41**	**5.81**	**n=21**	**2.73**	**n=2001**

*p < 0.05 for linear trend

Table 13 Lead Related Health Conditions of Adults with BLLs ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

Lead Related Disease	10-24 ug/dL		25-29 ug/dL		30-39 ug/dL		40-49 ug/dL		50-59 ug/dL		≥60 ug/dL		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Anemia	65	5.5	7	2.8	14	4.4	7	6.7	4	10	1	5.3	98	5.1
Kidney Disease	38	3.2	2	0.8	7	2.1	2	1.8	1	2.6	0	—	50	2.6
High Blood Pressure	79	6.6	15	5.7	30	9.2	14	13.6	5	12.8	2	10	145	7.4*
Hearing Loss	254	25.2	39	30.2	36	27.5	11	24.4	1	7.7	3	27.3	344	25.7

symptoms were included in this table. Loss of 10+ pounds without dieting, continued loss of appetite, frequent joint pain/ soreness, pains in belly, headache, depression, being tired, feeling nervous, waking up at night, ,being irritable and unable to concentrate were statistically significant associated with increasingly higher levels of blood lead. Having any gastro-intestinal, musculoskeletal or nervous symptoms was also statistically associated with increas-



the primary metals industry (non-ferrous foundries). These two industries also showed the highest percentage of workers with the higher blood leads (≥ 25 µg/dL) (Table 15). Table 16 lists the types of working conditions by highest reported lead level. Workers with the highest lead levels reported they were less likely to be tested at work as part of a company screening, have work clothing laundered at work, wash

(Continued from page 26)

ingly higher levels of blood lead.

Table 13 and Figure 14 show the reporting of other health conditions, anemia, kidney disease, high blood pressure and hearing loss, by lead level category. Of these health conditions, only high blood pressure was significantly associated with increasing blood lead levels.

The number of years worked by highest lead level showed that higher blood lead level results were more likely to occur in shorter term workers (i.e. workers in a lead exposed job for five or fewer years) (Table 14). The type of industry by lead level shows that 32.6% worked in special trade construction and 19.0% worked in

Of the types of lead-related symptoms reported during the interviews, loss of 10+ pounds without dieting, continued loss of appetite, frequent joint pain/soreness, pains in belly, headache, depression, being tired, feeling nervous and being irritable and unable to concentrate were statistically significant as associated with increasingly higher levels of blood lead. Having any gastro-intestinal, musculoskeletal or nervous symptoms was also statistically associated with increasingly higher levels of blood lead.

Table 14 Number of Years Worked Adults with BLLs ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

Number of Years Worked	10-24 ug/dL		25-29 ug/dL		30-39 ug/dL		40-49 ug/dL		50-59 ug/dL		≥60 ug/dL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
?5	406	58.3	124	64.6	147	56.8	46	57.5	19	55.9	12	66.7
6—10	93	13.4	30	15.6	41	15.8	10	12.5	8	23.5	2	11.1
11—20	99	14.2	26	13.5	36	13.9	13	16.3	5	14.7	2	11.1
21—30	56	8	9	4.7	29	11.2	3	3.8	1	2.9	1	5.6
?30	42	6	3	1.6	6	2.3	8	10	1	2.9	1	5.6

Table 15 Industry of Adults with BLLs of ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

Standard Industrial Classification	10-24 µg/dL		25-29 µg/dL		30-39µg/dL		40-49µg/dL		50-59µg/dL		≥ 60 µg/dL		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Metal Mining (10)	1	0.1	0		0		0		0		0		1	0.1
Construction, General Contractors(15)	23	3.2	3	1.5	1	0.4	1	1.2	0	—	1	5.9	29	2.2
Construction, Heavy (16)	24	3.4	1	0.5	5	1.9	1	1.2	1	2.9	0	—	32	2.5
Special Trade Construction (17)	228	32.1	55	27.8	89	34.4	32	39	14	40	7	41.2	425	32.6
Food and Kindred Products (20)	0	—	1	0.5	0	—	0	—	0	—	0	—	1	0.1
Lumber and Wood (24)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Furniture and Fixtures (25)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Printing, Publishing & Allied Inds. (27)	1	0.1	0	—	1	0.4	0	—	0	—	0	—	2	0.2
Chemicals and Allied Products (28)	0	—	0	—	1	0.4	0	—	0	—	0	—	1	0.1
Stone/Clay/Glass(32)	11	1.5	3	1.5	5	1.9	3	3.7	2	5.7	0	—	24	1.8
Primary Metals Industry (33)	69	9.7	56	28.3	87	33.6	23	28	8	22.9	4	23.5	247	19
Fabricated Metal Products (34)	70	9.8	24	12.1	18	6.9	4	4.9	1	2.9	0	—	117	9
Industrial, Comm. Machnry(35)	18	2.5	4	2	5	1.9	1	1.2	2	5.7	1	5.9	31	2.4
Electronics (36)	16	2.3	1	0.5	0	—	1	1.2	0	—	0	—	18	1.4
Transportation Equipment (37)	15	2.1	3	1.5	5	1.9	2	2.4	1	2.9	0	—	26	2
Measuring, Analyzing, Crtl Instr(38)	2	0.3	0	—	0	—	0	—	0	—	0	—	2	0.2
Misc. Manufacturing Industries (39)	2	0.3	1	0.5	0	—	0	—	0	—	0	—	3	0.2
Railroad Transportation (40)	3	0.4	3	1.5	3	1.2	0	—	0	—	0	—	9	0.7
Motor Freight Trans, Whs(42)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Water Transportation (44)	2	0.3	0	—	0	—	0	—	0	—	0	—	2	0.2
Trans.Electric,Gas&SanSvcs.(49)	39	5.5	9	4.5	5	1.9	4	4.9	0	—	0	—	57	4.4
Wholesale-Durable Goods (50)	21	3	2	1	3	1.2	0	—	1	2.9	0	—	27	2.1
Building Materials, Hardware (52)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Automotive Dealers, Gas (55)	2	0.3	3	1.5	2	0.8	0	—	0	—	0	—	7	0.5
Other Retail Trade (59)	4	0.6	0	—	2	0.8	1	1.2	0	—	0	—	7	0.5
Depository Institutions (60)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Finance, Insurance , Real Estate (65)	3	0.4	0	—	0	—	0	—	0	—	0	—	3	0.2
Business Services (73)	13	1.8	0	—	0	—	0	—	0	—	0	—	13	1
Automotive repair Services (75)	25	3.5	7	3.5	6	2.3	5	6.1	2	5.7	0	—	45	3.5
Misc. Repair Services (76)	8	1.1	1	0.5	4	1.5	1	1.2	0	—	0	—	14	1.1
Amusement and Recreation (79)	20	2.8	5	2.5	6	2.3	3	3.7	3	8.6	4	23.5	41	3.1
Health Services (80)	2	0.3	0	—	0	—	0	—	0	—	0	—	2	0.2
Educational Services (82)	13	1.8	3	1.5	2	0.8	0	—	0	—	0	—	18	1.4
Social Services (83)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Museum, Art Galleries (84)	1	0.1	1	0.5	0	—	0	—	0	—	0	—	2	0.2
Engineering Services (87)	15	2.1	3	1.5	2	0.8	0	—	0	—	0	—	20	1.5
Services, NEC (89)	2	0.3	0	—	0	—	0	—	0	—	0	—	2	0.2
General Government (91)	4	0.6	0	—	0	—	0	—	0	—	0	—	4	0.3
Justice, Public Order, Safety (92)	33	4.6	8	4	6	2.3	0	—	0	—	0	—	47	3.6
Human resources (94)	0	—	0	—	1	0.4	0	—	0	—	0	—	1	0.1
Admin Environmental Quality (95)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Admin Economic Programs (96)	9	1.3	1	0.5	0	—	0	—	0	—	0	—	10	0.8
National Security Int'l Affairs (97)	5	0.7	0	—	0	—	0	—	0	—	0	—	5	0.4
TOTAL	**711**	**100**	**198**	**100**	**259**	**100**	**82**	**100**	**35**	**100**	**17**	**100**	**1302**	100

hands before eating or wear respirators as part of their lead work practices. As expected, workers more likely to have been removed from the job had the higher blood lead levels.

Figures 15 and 16 shows the trends in the percent of working conditions and personal habits, by interview year, for the last fourteen years of surveillance. There is variation between years in both the working conditions and personal habits reported over time with no clear overall improvement (Figures 15 and 16).

The questionnaire also asks about children in the household, in order to document the potential for and extent of take-home lead. Five hundred and one (25.4%) of the households where an adult had an elevated lead level had children age 6 and younger living or spending time in the home (Table 17). Children from only 146 (33.0%) of these 501 households were tested for blood lead. Among the 146 households where the child's blood test results were reported, 48 (34.5%) reported a

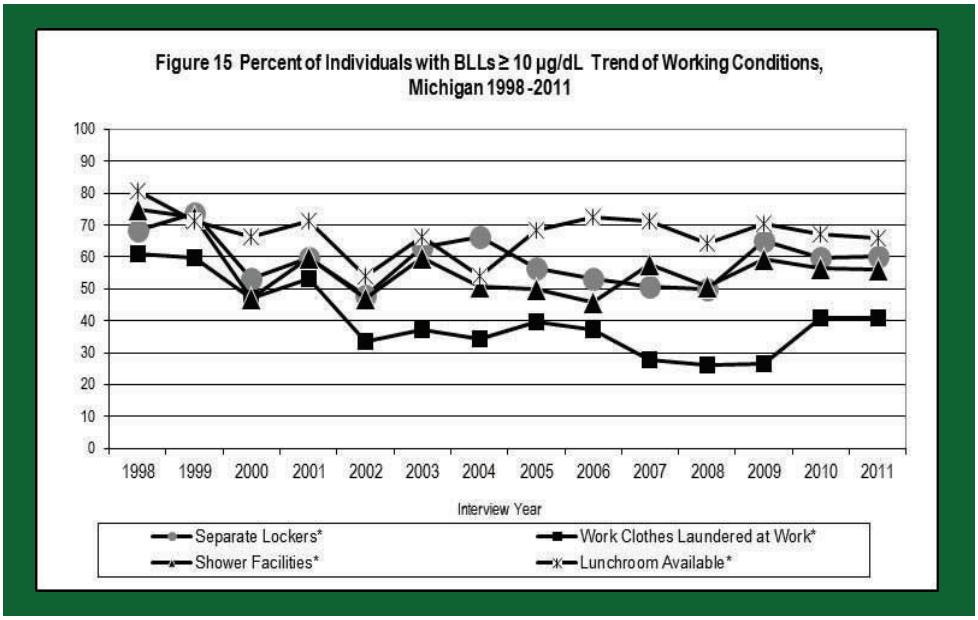


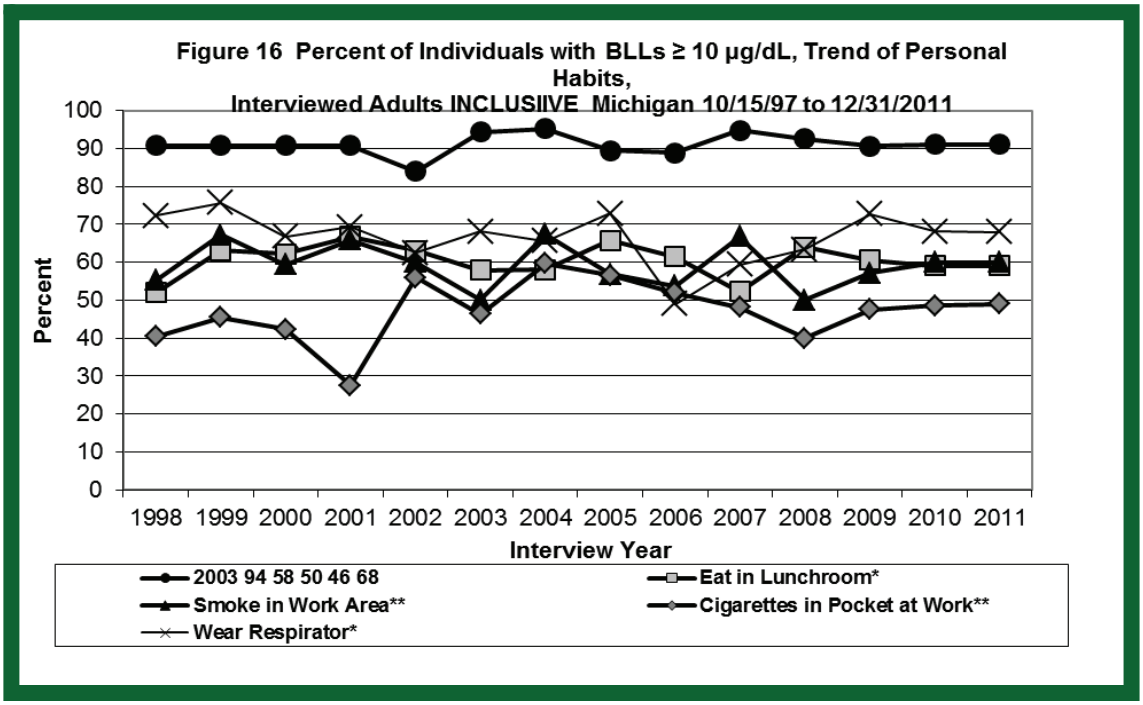
Table 16 Working Conditions of Adults with BLLs of ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/97 to 12/31/011

WORKING CONDITIONS	10-24µg/dL		25-29µg/dL		30-39µg/dL		40-49µg/dL		50-59 µg/dL		≥ 60 µg/dL		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Separate Lockers: dirty and clean+	378	55.3	133	70.4	173	68.7	42	52.5	22	61.1	7	41.2	755	60
Work clothes laundered: work+	217	32	105	55.6	136	53.8	30	38	14	38.9	7	41.2	509	40.7*
Shower facility +	344	50.2	125	65.4	173	68.4	40	48.8	15	42.9	7	41.2	704	55.7
Lunch room available +	440	64.4	135	71.1	189	74.7	45	54.9	19	54.3	9	52.9	837	66.4
Clean off dust & wash hands before eating +	623	92.8	168	88.4	232	91	68	86.1	31	86.1	13	76.5	1135	90.9*
Eat in lunchroom +	291	57.4	104	68.9	128	61.2	37	53.6	10	34.5	6	40	576	58.8
Wear respirator +	440	63.7	139	72.4	193	74.8	63	77.8	24	66.7	11	64.7	870	68.2*
Smoke in work area ++	206	59.5	67	64.4	95	66.9	19	38.8	13	56.5	5	55.6	405	60.2
Keep cigarettes in pocket while working++	166	49	46	44.7	78	56.1	20	40.8	8	34.8	4	44.4	322	48.6
Exposed to lead now +	389	57.9	113	60.8	162	64.3	42	56	20	62.5	3	18.8	729	59.1
Removal from job +	31	4.5	14	7.4	32	12.6	19	24.1	12	33.3	6	35.3	114	9*
Tested as part of Co Med Screening+	524	42.7	168	62.7	224	67.5	59	52.7	27	67.5	10	45.5	1012	50.6*

*p<0.05 for linear trend

+Based on positive questionnaire responses

++Based on **negative** questionnaire responses



child with an elevated blood lead level (≥ 10 µg/dL). Contact information for individuals reporting young children in their household who had not tested the children for lead was forwarded to MDCH so that a letter could be sent encouraging adults in those households to have the children tested for lead.

Twenty-five percent of the adults interviewed reported children age 6 and younger living or spending time in the

Table 17 Number of Households with Children (6 or under) Potentially exposed to Take Home-Lead from Adults with BLLs ≥ 10 µg/dL Interviewed by Highest Reported BLL, Michigan 10/15/1997 to 12/31/2011

	10-24 µg/dL		25-29 µg/dL		30-39 µg/dL		40-49 µg/dL		50-59 µg/dL		≥ 60 µg/dL		Total	
Description of Households	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Households with Children Living or Spending Time	288	23.9	72	27.2	93	28.3	31	27.9	11	26.8	6	28.6	501	25.4
Households with Children Tested for Lead	89	35.7	16	24.2	21	24.7	14	51.9	4	36.4	2	40	146	33
Households Where Children had Elevated Lead	27	32.9	3	20	9	39.1	7	50	1	33.3	1	50.0	48	34.5

*Among individuals within blood lead category, percentage of their households with children living or spending time in house. n=1974

**Among individuals within blood lead category, percentage of "Households with Children Living/Spending Time", where the children were tested for lead. Because of missing data, the denominator may be less than the number "Households w/ Children Living/Sp

***Among individuals within blood lead category, percentage of "Households w/Children Living/Spending Time ", where " Children Tested for Lead", had blood lead levels ≥ 10 µg/dL. Because of missing data, the denominator may be less than the "Children Tes

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 MSU and maintained in the ABLES program lead registry. Individuals with a blood lead level of 25 µg/dL or greater, and individuals with BLLs of 10-24 µg/dL, where lead exposure source is not already known, are contacted by mail and then by a trained interviewer for a voluntary telephone interview. The interview includes detailed demographic information, exposure history and the presence and nature of lead related symptoms. When an individual with a blood lead value of 25 µg/dL or greater is occupationally exposed at a company that has not had a recent MIOSHA inspection, an enforcement inspection is conducted to assess that company's compliance with the lead standard.

In 2011, there were 625 adults with BLLs ≥ 10 µg/dL. Approximately 95.5% were men. The mean age was 44.9. They were predominately white (83.5%) and lived in a band of counties stretching across the southern part of the state from Muskegon to St. Clair. The source of exposure to lead was predominately occupational in origin (81.2%). Exposure occurred during demolition of lead painted metal structures and abrasive blasting to remove paint or during the fabricating of non-ferrous metal parts and metal products.

Evaluation of fourteen years of interviews shows that individuals with the highest blood leads were more likely to be younger (Table 10). We attribute this finding to a higher percentage of younger workers in construction doing abrasive blasting on metal structures. Also younger, less experienced workers may be given the dirtier, less desirable tasks.

In 2011, thirteen adults were reported with BLLs over 50 µg/dL, the maximum blood lead level allowed in the workplace. Nine of the thirteen adults were exposed to lead exclusively at work (four from shooting ranges, one from a wrecking and demolition company, one from carpentry in a construction industry, one from bridge painting and sandblasting in the construction industry, one from repairing and selling industrial equipment for trucks, one from sorting activities in an alloy carbon and resulfurized steel bars and rolled steel shape manufacturer). A retained bullet from a gunshot wound and home renovation activities contributed to the tenth individual's elevated blood lead level. There were three individuals with non-work exposure to lead. Casting activities caused an individual to have blood lead levels elevated over 50 µg/dL. Competitive shooting activities and home remodeling caused elevated blood lead levels. The source of exposure that caused elevated blood lead levels in the thirteenth individual could not be determined, although no work exposure was identified.

Lead exposure remains an important public health concern in the U.S. Environmental Protection Agency (EPA) regulations requiring removal of lead from commercial products such as gasoline, house paint and solder in plumbing pipes and food cans, have greatly reduced exposure to lead in the general population. Average BLLs in the general

population have dropped from 15 ug/dL in the 1970s to the current 1.12 µg/dL (1).

Occupational exposure has not declined as steeply as environmental lead exposure. Data from 40 state lead surveillance systems shows that nationally, 95% of adult elevated lead exposure is work-related (3). Occupational Safety and Health Administration (OSHA) lead standards, established in 1978 for general industry and in 1993 for construction, set the level for removal of a worker from lead exposure in general industry at 60 µg/dL or two consecutive values above 50 µg/dL and construction at 50 µg/dL. These levels were established when general population levels from environmental exposure were much higher than they are today.

Michigan is one of 41 states conducting surveillance of elevated blood lead levels. Michigan requires the reporting of all BLL results, not just elevated levels. Major benefits for reporting all BLLs are the ability to calculate the rates of elevated BLLs in specific groups of interest, to monitor compliance with the testing requirements of the lead standard, and to facilitate the tracking of reports from particular employers to monitor their progress in reducing workers' exposures to lead.

Thirty years of lead toxicity research has demonstrated that lead exposure at levels previously thought to be of little concern can result in an increased risk of adverse chronic health effects, especially if the exposure is maintained for many years, thereby resulting in a progressively larger cumulative dose (4-7). Levels as low as 5 ug/dL have been associated with adverse cardiovascular and neurologic health effects (4-7).

Our interviews with workers show that the current allowable level of lead is also associated with acute symptoms involving the gastrointestinal, musculoskeletal and nervous systems (Table 12). The presence of these symptoms is additional support for the need to lower the allowable blood lead level. Sixty-four percent of individuals in Michigan with blood lead below the general industry allowable level of 60 µg/dL had daily or weekly symptoms consistent with lead toxicity (Table 12). Long term adverse effects of lead can occur even without overt symptoms.

Both the International Agency for Cancer (IARC) and the National Toxicology Program have classified lead to be a probable human carcinogen (8,9), primarily based on findings for lung and stomach cancer, with brain and kidney cancer also being elevated in some studies. Others studies show that lead exposure increases blood pressure in adults (3), making both mortality from stroke and heart disease outcomes of interest. High lead exposure is known to cause non-malignant kidney disease (10), but it is not known if lower levels contribute to this outcome.

Michigan occupations with lead exposure include abrasive blasting to remove lead paint from outdoor metal structures such as bridges, overpasses or water towers; casting brass or bronze fixtures; fabricating metal products; or exposure to lead fumes or dust from firing guns or retrieval of spent bullets at firing ranges. While the use of lead in non-battery products has declined in the U.S., the use of lead worldwide continues to grow, especially in battery applications. Recycling the growing amount of

"e-waste" created by discarded electronic and lead battery consumer products and the increased demand for raw metals and specifically recycled lead worldwide puts a new group of workers at risk to significant exposure to lead.

Since 2002, the Michigan ABLES project has sent letters to laboratories which provide blood lead analysis for Michigan residents, recommending the laboratories lower their upper limit of normal blood lead levels to correspond with current medical knowledge of the adverse health effects of lead. All but one of the laboratories providing blood lead analyses in Michigan, have lowered the upper limit of normal to 10 µg/dL. Given the recent decision by CDC to consider blood leads in children of 5 µg/dL or greater to be elevated and the increasing scientific knowledge about the toxicity of lead at these low levels, we plan to once again contact labs about lowering the upper limit of normal they report out to health care-providers. Recommendations for medical management on lead exposed individuals begin at 5 µg/dL and interpretative language for the health-care providers who ordered the blood lead needs to be compatible with these recommendations since laboratory reports are often their main source of information (11). The March 2013 update of the Fourth Annual CDC Report shows that blood leads in the general population are continuing to fall and the 95th confidence limit for the upper limit of normal in 2009-2010 was 3.57 µg/dL (1.52-2.03) (1).

A further problem for Michigan families is that adults working in lead occupations may bring lead home on their shoes or clothes and expose their spouse and children. Only one in three families with someone exposed to lead at work report that their young children are tested for elevated lead. When these children are tested, almost 35% are found to have an elevated blood lead level (Table 17). While the number of children being tested for lead statewide has markedly increased, there has only been a slight increase of blood lead testing for the children of lead-exposed workers. Michigan's Childhood Lead Prevention Program reports in the 2009 Annual Report on Blood Lead Levels on Adults and Children in Michigan, a successful reduction of the percentage of confirmed elevated BLLs from 7.2% in 1999 to less than 1% of the children tested in 2009. The main focus of Michigan's childhood lead program has been to increase blood lead testing in lower socioeconomic children who predominantly reside in older Michigan housing, which is most likely to contain lead paint. Increased focus needs to be made on lead workers' children who, when tested, have confirmed BLLs ≥ 10 µg/dL 34.5% of the time. There has been ongoing collaboration with the Michigan Childhood Lead Prevention Program to improve this situation and workers exposed to lead should be encouraged to test their children for lead exposure.

In its fourteenth year of operation, the surveillance system for lead continued to prove successful in identifying large numbers of adults with elevated lead levels and sources of exposure that could be remediated to reduce exposures in Michigan. The reduction in elevated blood lead levels, particularly from occupational exposures with an exception of BLLs ≥ 50 µg/dL which has doubled since last year, has appeared to plateau (Figure 5). This plateau along with the reports of individuals that show a lack of improvement in workplace conditions and preventive personal habits to reduce lead exposure at the facilities where they are employed (Figures 15 and 16) has us con-

cerned that the progress in previous years to reduce lead exposure has stalled.

Continued outreach is planned to the medical community on the recognition and management of potential lead-related medical problems in both individuals and their young families. A new OSHA PEL, substitutes of safer compounds, along with expanding education and outreach for employers and workers and their families would all contribute to lower blood lead levels. Ongoing surveillance in future years will continue to target and evaluate intervention activity to reduce exposure to lead.

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APPENDICES

Appendix A Morbidity and Mortality Weekly Report (MMWR): Adult Blood Lead Epidemiology Surveillance --- United States, 2008-2009

Appendix B Blood Lead Analysis Reporting

Appendix C Summary of Michigan's Lead Standards

Appendix D Table 1: Health Based Management Recommendations for Lead Exposed Adults, Environmental Health Perspective Vol. 115, No. 3 March 2007.

APPENDIX A

Centers for Disease Control and Prevention **Morbidity and Mortality Weekly Report (*MMWR*)**
CDC 24/7: Saving Lives, Protecting People, Saving Money Through Prevention.

Adult Blood Lead Epidemiology and Surveillance --- United States, 2008--2009

Weekly
July 1, 2011 / 60(25);841-845

Lead exposure can result in acute or chronic adverse effects in multiple organ systems, ranging from subclinical changes in function to symptomatic, life-threatening toxicity. Despite improvements in public health policies and substantial reductions in blood lead levels (BLLs) in adults, lead exposure remains an important health problem worldwide. Approximately 95% of all elevated BLLs reported among adults in the United States are work-related (*1*), and recent research has raised concerns regarding the toxicity of BLLs as low as 5 µg/dL (*2,3*). CDC's state-based Adult Blood Lead Epidemiology and Surveillance (ABLES) program tracks laboratory-reported elevated BLLs. To update rate trends and identify industry subsectors and nonoccupational activities with high lead exposures, CDC collected and analyzed 2008--2009 data from 40 state ABLES programs. The results of that analysis indicated that a decline in the prevalence of elevated BLLs (≥25 µg/dL) was extended, from 14.0 per 100,000 employed adults in 1994 to 6.3 in 2009. Industry subsectors with the highest numbers of lead-exposed workers were battery manufacturing, secondary smelting and refining of nonferrous metals, and painting and paper hanging. The most common nonoccupational exposures to lead were shooting firearms; remodeling, renovating, or painting; retained bullets (gunshot wounds); and lead casting. The findings underscore the need for government agencies, employers, public health professionals, health-care providers, and worker-affiliated organizations to increase interventions to prevent workplace lead exposure, and the importance of conducting lead exposure surveillance to assess the effectiveness of these interventions.

State ABLES programs 1) collect data on adult BLLs from laboratories and physicians through mandatory reporting requirements; 2) assign unique identifiers to each adult to account for multiple BLL records; 3) follow-up on adults with BLLs ≥25 µg/dL with laboratories, health-care providers, employers, or workers to ensure completeness of information (e.g., the industry where the adult is employed and whether the exposure source is occupational, nonoccupational, or both); and 4) code the industry where the adult worked using the 1987 Standard Industrial Classification (SIC) or the 2002 North American Industry Classification System (NAICS). The requirement for laboratories and health-care providers to notify state authorities about BLLs varies among ABLES states, ranging from the reporting of all BLLs to only BLLs ≥40 µg/dL.* Most ABLES states submit data on all BLLs to CDC's National Institute for Occupational Safety and Health (NIOSH), including records from adults whose BLLs fall below the state reporting requirement.

Adults were defined as persons aged ≥16 years. For adults with more than one BLL record in a given year, only the highest BLL was included. Elevated BLLs were defined as blood lead concentrations ≥25µg/dL. Prevalence numerators were either "state residents" (adults residing in the reporting state) or "state residents and nonresidents" (all adults reported by a state) with elevated BLLs (a distinction in the data since 2002); both employed and unemployed persons were included in the numerators. Denominators were the annual employed population aged ≥16 years for the period 2008--2009, as obtained from the U.S. Bureau of Labor Statistics (*4*). To calculate annual state

prevalences, the numbers of adults with elevated BLLs from each of the 40 states reporting† were divided by the state's annual employed population and expressed as a rate per 100,000 employed adults. The combined state numerators and denominators for each year were then used to calculate national (40-state) prevalence rates for 2008--2009. The percentage of adults with BLL ≥40 μg/dL among adults with BLL ≥25μg/dL in each industry subsector was used to identify industry subsectors with the highest lead exposures. Additional information regarding interpretation of specific state ABLES data, definitions, and rate calculations is available at the ABLES program website (5).

A total of 40 states submitted data in both 2008 and 2009. Overall, the prevalence of elevated BLLs (≥25 μg/dL) among state residents and nonresidents declined from 14.0 adults per 100,000 employed adults in 1994 (4) to 7.4 in 2008 and 6.3 in 2009. Rates were slightly lower (7.1 and 6.1 respectively) when only state resident adults were included (Figure 1). The number of states with high prevalence of elevated BLLs (i.e., ≥20 adults per 100,000 employed adults) decreased from six of 17 states in 1994 to three of 40 states in 2009 (Figure 2). ABLES states reported 9,325 and 7,674 state resident adults with elevated BLLs in 2008 and 2009, respectively. State resident prevalence of elevated BLLs for 2008 ranged from 0.5 per 100,000 employed adults (Hawaii) to 37.6 (Pennsylvania); and for 2009, from 0.3 (Hawaii) to 32.0 (Pennsylvania). Prevalence of state resident and nonresident adults with BLLs ≥40 μg/dL declined from 3.5 in 1994 to 1.2 in 2008 and 0.9 in 2009. In 2008, these rates ranged from 0.2 (Arizona) to 6.5 (Pennsylvania) and in 2009, from zero (Alaska and Wyoming) to 4.2 (Pennsylvania).

Thirty-seven states in 2008 and 38 states in 2009 submitted data on industry and exposure source (8,450 and 7,112 state resident adults with elevated BLLs, respectively).§ Among all reported cases of elevated BLLs, exposures at work accounted for 6,081 (71.9%) in 2008 and 4,998 (70.1%) in 2009 (Table). Among only those cases with known exposure type (i.e., occupational or nonoccupational), occupational exposures accounted for 94.8% of cases in 2008 and 93.8% in 2009. The greatest proportions of adults with elevated BLLs were employed in three main industry sectors: manufacturing (72.1% in 2008 and 72.3% in 2009), construction (13.2% in 2008 and 14.4% in 2009), and mining (6.6% in 2008 and 5.1% in 2009). Industry subsectors with the highest numbers of workers with elevated BLLs were manufacturing of storage batteries, secondary smelting and refining of nonferrous metals, and painting and paper hanging (Table). Industry subsectors with the greatest proportions of adults with BLLs ≥40 μg/dL among adults with BLLs ≥25 μg/dL were painting and paper hanging; bridge, tunnel, and elevated highway construction; copper foundries; special trade contractors; and heavy construction industries (Table). Nonoccupational exposures accounted for 337 (4.0%) and 328 (4.6%) of all adult cases in 2008 and 2009, respectively. The most common nonoccupational exposures were from shooting firearms; remodeling, renovating, or painting; retained bullets; and lead casting (Table).

Reported by

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Editorial Note

Job activities known to involve the use or disturbance of lead include the following: handling of lead-containing powders, liquids, or pastes; production of dust or fumes by melting, burning, cutting, drilling, machining, sanding, scraping, grinding, polishing, etching, blasting, torching, or welding lead-containing solids; and dry sweeping of lead-containing dust and debris (3). Since 1994, ABLES surveillance results indicate an overall decreasing trend in the prevalence of elevated BLLs in U.S. adults and a decrease in the number of states with the highest rates (i.e., ≥20 adults per 100,000).

This decrease, in part, might be attributable to a decline in the number of manufacturing jobs with potential for lead exposure over time and prevention measures that have been enacted since the early 1990s, including 1) improved interventions by state ABLES programs,[†] worker-affiliated organizations, and federal programs such as the Occupational Safety and Health Administration (OSHA) National Emphasis Program to reduce lead exposure[**] and 2) measures implemented by industry (e.g., engineering and work practice controls,[††] and respiratory protection). However, the decrease in rates also might reflect low employer compliance with testing and reporting requirements (*6*).

ABLES data also underscore that elevated BLLs among adults are almost exclusively an occupational health problem in the United States. Those states with higher rates of elevated BLLs might represent 1) states where higher proportions of workers are employed in high-risk industries (e.g., lead-related manufacturing, construction activities involving lead paint exposure, and lead mining), 2) states where workers in high-risk areas are less likely to be protected by engineering and workplace controls, or 3) states where greater compliance with testing requirements by employers and reporting requirements by laboratories result in larger numbers of reported cases of elevated BLLs. Similar to findings in previous years, the 2008--2009 data indicate that five industry subsectors accounted for approximately 65% and 14 subsectors accounted for approximately 80% of adults with elevated BLLs who were exposed at work. Higher lead exposures likely are present in those industries with the greatest proportions of elevated BLLs ≥40 μg/dL.

ABLES data are used to track *Healthy People 2020* objective OSH-7, to reduce the prevalence of persons who have elevated BLLs from work exposures (*7*). The *Healthy People 2020* target incorporates the new ≥10 μg/dL operational definition for elevated BLLs established by ABLES consistent with guidance from the Association of Occupational and Environmental Clinics and the Council of State and Territorial Epidemiologists (*8*).

The findings in this report are subject to at least four limitations. First, the number of adults with elevated BLLs reported to ABLES likely is underreported because some employers might not provide BLL testing to all lead-exposed workers as required by OSHA regulations and because some laboratories might not report all tests as required by state regulations (*9*). Second, because denominators are the numbers of employed persons, aged ≥16 years, unemployed adults who might be at risk for lead exposure, although included in the numerator, are not included in the denominator. Third, although state ABLES programs ascertain the work-relatedness of a lead exposure by following up with laboratories, physicians, employers, or workers, the possibility of misclassification of occupational versus nonoccupational cases cannot be excluded. Finally, analyzing lead exposures using a threshold of 25 μg/dL likely underestimates harmful occupational lead exposure because lead-related toxicity can occur at levels as low as 5 μg/dL and the *Healthy People 2020* target is set at 10 μg/dL

Progress toward meeting the *Healthy People* 2020 target for reducing the prevalence of adults with BLLS ≥10 μg/dL from workplace lead exposures can be aided by improving 1) worker protection programs developed and maintained by employers[§§]; 2) government activities such as ABLES programs, which can effectively intervene to prevent lead exposures and the OSHA National Emphasis Program to reduce lead exposure; 3) research and interventions by stakeholder organizations; and 4) education of the public regarding preventing nonoccupational exposures. Emphasis should be placed on those industries identified in this report with the highest numbers of workers with elevated BLLs: manufacturing of storage batteries, secondary smelting and refining of nonferrous metals, painting and paper hanging, and bridge, tunnel, and elevated highway construction.

Acknowledgments

ABLES program coordinators in 40 states who contributed data in 2008 and 2009.

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† A total of 40 states submitted data in 2008 and 2009: Alabama, Alaska, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming.

§ A total of 38 of the 40 states (all except Indiana and Kentucky) provided data on industry in 2009 and 37 in 2008 (all except Alabama, Indiana, and Kentucky).

¶ Interventions include 1) conducting follow-up interviews with physicians, employers, and workers; 2) investigating worksites; 3) providing technical assistance; 4) providing Occupational Safety and Health Administration (OSHA) referrals for consultation and enforcement; and 5) developing and disseminating educational materials and conducting outreach programs.

** Additional information available at http://www.osha.gov/OshDoc/Directive_pdf/CPL_03-00-0009.pdf.

†† Engineering controls and good work practices are the preferred methods of minimizing exposures to airborne lead at the worksite. Engineering control methods that can be used to reduce or eliminate lead exposures can be grouped into three main categories: 1) substitution, 2) isolation, and 3) ventilation. Additional information available at http://www.osha.gov/dts/osta/otm/otm_v/otm_v_3.html#2.

§§ Additional information available at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=fact_sheets&p_id=161.

What is already known on this topic?

Lead exposure among adults remains almost exclusively an occupational health problem in the United States, although the health effects from lead exposure are well characterized and controls to reduce lead exposure for workers exist.

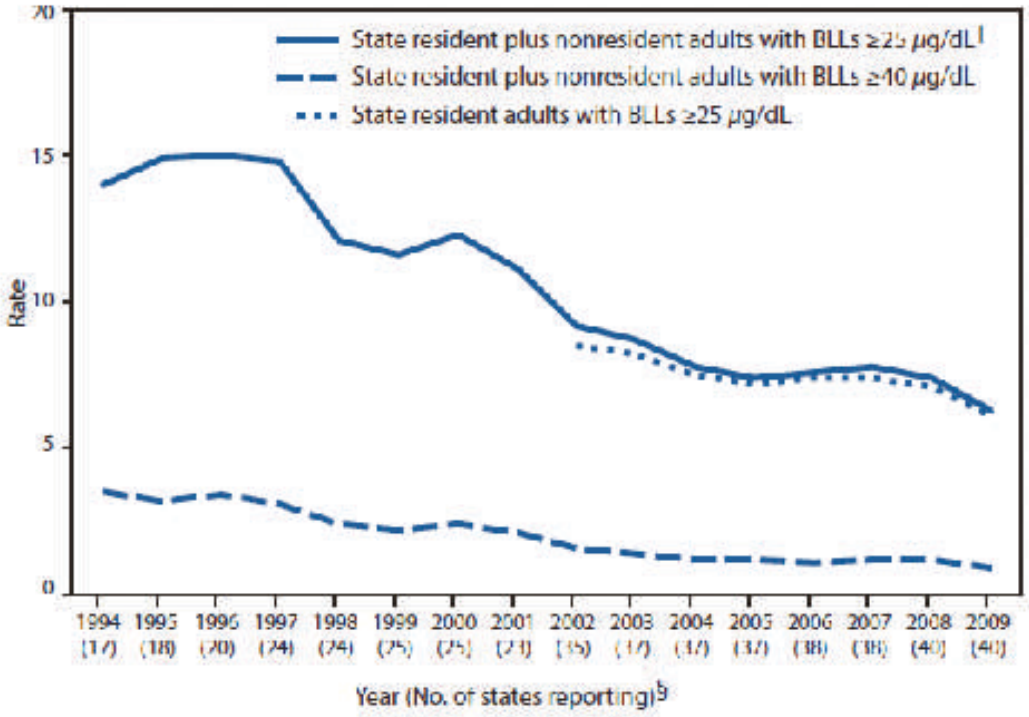
What this report adds?

During 2008--2009, the prevalence of U.S. adults with blood lead levels (BLLs) ≥25 µg/dL continued to decrease, to 6.3 per 100,000 employed adults in 2009 from 14.0 in 1994. The highest prevalences of elevated BLLs continue to be found among workers in the manufacturing, construction, and mining industries.

What are the implications for public health practice?

Measures to improve lead exposure surveillance and preventive interventions focused in the manufacturing, construction, and mining industries should be implemented by government agencies, employers, and worker-affiliated organizations.

FIGURE 1. Prevalence rates* of adults with elevated blood lead levels (BLLs) --- Adult Blood Lead Epidemiology and Surveillance program, United States, 1994--2009



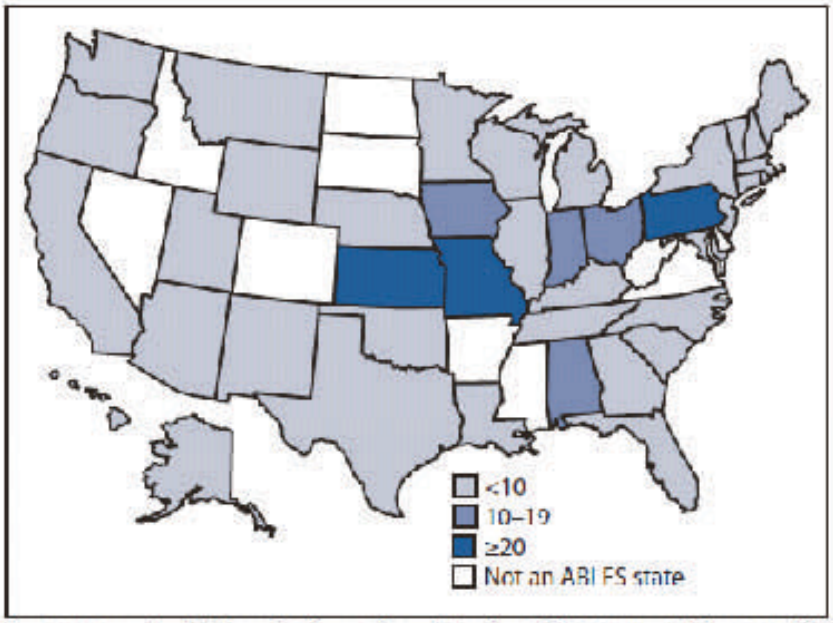
* Per 100,000 employed adults aged ≥16 years. Denominators for 2008--2009 extracted from 2011 U.S. Department of Labor, Bureau of Labor Statistics Local Area Unemployment Statistics program, available at http://www.bls.gov/data.

† State residents are adults residing in the reporting state. State residents and nonresidents are all adults reported by a state.

§ A total of 40 states submitted data in 2008 and 2009: Alabama, Alaska, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming.

Alternate Text: The figure above shows prevalence rates of adults with elevated blood lead levels (BLLs) in the United States during 1994-2009, according to the Adult Blood Lead Epidemiology and Surveillance program.

FIGURE 2. Prevalence rates* of adults with elevated blood lead levels (≥25 µg/dL), among adults residing in the reporting state --- Adult Blood Lead Epidemiology and Surveillance (ABLES) program, United States, 2009†



* Per 100,000 employed adults aged ≥16 years. Denominators for 2008--2009 extracted from 2011 U.S. Department of Labor, Bureau of Labor Statistics Local Area Unemployment Statistics program, available at http://www.bls.gov/data.

† A total of 40 states submitted data in 2008 and 2009: Alabama, Alaska, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming.

Alternate Text: The figure above shows prevalence rates of adults with elevated blood lead levels (≥25 µg/dL), among adults residing in the reporting state in the United States in 2009, according to the Adult Blood Lead Epidemiology and Surveillance (ABLES) program. The number of states with high prevalence of elevated BLLs (i.e., ≥20 adults per 100,000 employed adults) decreased from six of 17 states in 1994 to three of 40 states in 2009.

TABLE. Number and annual percentage of state resident adults with elevated blood lead levels (BLLs) (≥25 µg/dL), by industry subsector and nonoccupational source of exposure --- Adult Blood Lead Epidemiology and Surveillance (ABLES) program, United States, 2008--2009

Exposure type	2008 (37 states)		2009 (38 states)	
	BLLs ≥25 µg/dL	BLLs ≥40 µg/dL	BLLs ≥25 µg/dL	BLLs ≥40 µg/dL

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APPENDIX B

DEPARTMENT OF COMMUNITY HEALTH

HEALTH LEGISLATION AND POLICY DEVELOPMENT

BLOOD LEAD ANALYSIS REPORTING

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

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

R 325.9081 Definitions.

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

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

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

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

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

R 325.9082 Reportable information.

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

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

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

(i) Name.

(ii) Sex.

(iii) Racial/ethnic group.

(iv) Birth date.

(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 # R325.9082 AND R 325.9083

PATIENT INFORMATION
To be completed by Parent/Guardian or Patient
PLEASE PRINT

Last Name _____ First Name _____ M. Initial _____

Address – No PO Boxes, please _____ Apt. # _____ City _____ State MI Zip _____

( ) Area Code and Phone Number _____ Birthdate (month/day/year) _____ Parent/Guardian Name (please print) _____

Race (Check all that apply):
- □ American Indian or Alaskan Native
- □ Asian
- □ Black or African American
- □ Native Hawaiian or Other Pacific Islander
- □ White
- □ Hispanic or Latino
- □ Middle Eastern or Arabic

Sex:
- □ Male
- □ Female

Funding Sources:
- □ Self Pay/Insurance
- □ Medicaid

ID# (Medicaid only): _____

If Patient is an adult (≥ 16 years):
Employer: _____
Social Security #: _____

PROVIDER/PHYSICIAN INFORMATION
To be completed by provider's office

Clinic, Hospital or Agency Name _____ Physician name _____

Mailing Address _____ City _____ State _____ Zip _____

( ) Area Code and Phone Number _____ Fax Number _____

SPECIMEN COLLECTION INFORMATION
To be completed by person who draws specimen

Specimen Collection Date _____ Source of Specimen □ Capillary □ Venous □ Filter Paper

LABORATORY INFORMATION
To be completed by testing laboratory

Laboratory Name _____ Specimen ID Number _____

( ) Area Code and Phone Number _____ Analysis Date _____

BLOOD LEAD LEVEL in Micrograms per Deciliter _____ (round to nearest whole number, please)

MDCH – Childhood Lead Poisoning Prevention Project, 109 W. Michigan Ave., PO Box 30195, Lansing, MI 48909 (517) 335-8885
DCH-0395 (October 2009) Authority: Act 368, PA 1978 Fax (517) 335-8509

APPENDIX C

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., R325.51901 - 325.51958). That standard was most recently amended in October, 2000. In October 1993, MIOSHA adopted by reference the federal Occupational Safety and Health Administration's (OSHA) Lead Standard for Construction (i.e., 29 CFR 1926.62). That standard was most recently amended October 18, 1999. Both the MIOSHA Lead Exposure in Construction Standard (Part 603) and the Lead Exposure in General Industry Standard (Part 310) establish an "action level" (30 micrograms of lead per cubic meter of air [ug/m^3] averaged over an eight-hour period) and a permissible exposure limit (50 ug/m^3 averaged over an eight hour period) for employees. Both standards require employers to conduct initial exposure monitoring and to provide employees written notification of these monitoring results. If employee exposure levels exceed the permissible exposure limit (PEL), employers are required to develop a written compliance program that addresses the implementation of feasible engineering and/or work practice controls to reduce and maintain employee exposures below the PEL. The Lead Exposure in Construction Standard (Part 603) also allows the use of administrative controls to achieve this objective. An employer's obligations concerning hygiene facilities, protective work clothing and equipment, respiratory protection, medical surveillance and training under the Lead Exposure in Construction Standard (Part 603) are triggered initially by job tasks and secondarily by actual employee exposure level to lead. Under the Lead Exposure in General Industry Standard (Part 310), these potential obligations are triggered by actual employee exposure levels to lead. Medical surveillance and training are triggered by exposures above the action level (AL), whereas protective clothing and equipment, respiratory protection and hygiene facilities are triggered by exposures above the PEL.

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

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

- A periodic blood test and follow-up blood test indicate that the blood lead level (BLL) is at or above 60 micrograms per deciliter (μg/dL) of whole blood.
- Medical removal is also triggered if the average of the last three BLL or the average of all blood sampling tests conducted over the previous six months, whichever is longer, indicates the employees blood lead level is at or above 50 μg/dL. Medical removal is not required however, if the last blood sampling test indicates a blood lead level at or below 40 μg/dL of whole blood.
- When a final medical determination reveals that an employee has a detected medical condition which places that employee at an increased risk of material impairment to health from the lead exposure.

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

- A periodic and follow-up blood test indicates that an employee's BLL is at or above 50 μg/dL; or
- There is a final medical determination that an employee has a detected medical condition which places that employee at an increased risk of material impairment to health from the lead exposure.

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

- If the employee's BLL was at or above 70 μg/dL, then two consecutive blood tests must have the BLL at or below 50 μg/dL.
- If the employee's BLL was at or above 60 μg/dL or due to an average BLL at or above 50 μg/dL, then two consecutive BLL must be at or below 40 μg/dL.
- For an employee removed due to a final medical determination, when a subsequent medical determination no longer detects a medical condition which places the employee at an increased risk of material impairment to health from exposure to lead.

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

- If the employee's BLL was at or above 50 μg/dL, then two consecutive blood tests must have the employee's BLL at or below 40 μg/dL.
- For an employee removed due to a final medical determination, when a subsequent medical determination no longer has a detected medical condition which places the employee at an increased risk of material impairment to health from exposure to lead.

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

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

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

Exposure Assessment

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

Respiratory Protection

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

Protective Clothing/Equipment

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

Hygiene Facilities

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

Medical Surveillance

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

Medical Removal

Workers covered by the Lead Exposure in General Industry (Part 310) Standard have the right to be removed from airborne lead exposures at or above the AL when their periodic and follow-up blood lead level is at or above 60 µg/dL or when an average of the last three BLLs 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 µg/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 µg/dL.

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

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

Training

Under the Lead Exposure in General Industry Standard (Part 310) and Lead Exposure in Construction (Part 603), employees exposed to any level of airborne lead must be informed of the contents of appendices A and B from that standard.

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

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

APPENDIX D

Table 1. **Health– based management recommendations for lead-exposed adults**

Volume 115; Number 3; March 2007 Environmental Health Perspectives

Blood lead level (µg/dL)	Short-term risks (lead exposure <1 year)	Long-term risks (lead exposure ≥ 1 year)	Management
<5	None documented	None documented	None Indicated
5-9	Possible spontaneous abortion Possible postnatal developmental delay	Possible spontaneous abortion Possible postnatal developmental delay Possible hypertension and kidney dysfunction	Discuss health risks Reduce lead exposure for women who are or may become pregnant
10-19	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Possible spontaneous abortion Possible postnatal developmental delay Hypertension and kidney dysfunction Reduced birth weight Possible subclinical neurocognitive deficits	Discuss health risks Reduce lead exposure for women who are or may become pregnant Decrease lead exposure Increase biological monitoring Consider removal from lead exposure to avoid long-term risks if exposure control over an extended period does not decrease BLL<10 µg/dL or if medical condition present that increases risk with continued exposure
20-29	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Possible spontaneous abortion Possible postnatal developmental delay Hypertension and kidney dysfunction Reduced birth weight Possible subclinical neurocognitive deficits	Remove from lead exposure if repeat BLL measured in 4 weeks remains ≥20 µg/dL
30-39	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Spontaneous abortion Possible postnatal developmental delay Hypertension and kidney dysfunction Reduced birth weight Possible subclinical neurocognitive deficits Possible nonspecific symptoms*	Remove from lead exposure
40-79	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Nonspecific symptoms* Neurocognitive deficits Sperm abnormalities	Spontaneous abortion Possible postnatal developmental delay Hypertension Kidney dysfunction/neuropathy Subclinical peripheral neuropathy Reduced birth weight Neurocognitive deficits Nonspecific symptoms* Sperm abnormalities Anemia Colic Possible gout	Remove from lead exposure Refer for prompt medical evaluation Consider chelation therapy for BLL > 50 µg/dL with significant symptoms or signs of lead toxicity
≥90	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Nonspecific symptoms* Neurocognitive deficits Sperm abnormalities Encephalopathy Anemia Colic	Spontaneous abortion Possible postnatal developmental delay Hypertension Neuropathy Peripheral neuropathy Reduced birth weight Neurocognitive deficits Nonspecific symptoms* Sperm abnormalities Anemia Colic Gout	Remove from lead exposure Refer for immediate/urgent medical evaluation Probable chelation therapy

*Medical conditions that may increase the risk of continued exposure include chronic renal dysfunctions (serum creatinine > 1.5 mg/dL for women or protein urial, hypertension , neurologic disorders and cognitive dysfunction. Non specific symptoms may include headache, fatigue, sleep disturbance, anorexia, constipation, orthralgia, myalgia, and decreased libido.

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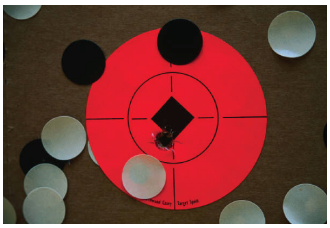
**HHLPPP is responsible for tracking childhood lead poisoning in Michigan.*

Occupational exposure to lead accounts for 95% of adult elevated blood lead levels in the

Michigan's 2011 lead surveillance show that of the 18.8% of individuals with elevated BLLs from non-occupational sources, 78.9% are exposed from a hobby related to guns.



The Adult Blood Lead Epidemiology and Surveillance (ABLES) Program is a state-based surveillance program of laboratory-reported adult blood lead levels. In 2009, the ABLES program updated its case definition for an Elevated Blood Lead Level for surveillance purposes as a blood lead concentration ≥ 10 µg/dl. The public health objective of the ABLES program is objective 20.7 in *Healthy People 2010*, which is to reduce the rate of adults (age 16 or older) who have blood lead levels of 25 micrograms per deciliter (µg/dL) or greater. The ABLES program aims to accomplish this objective by building state capacity to initiate or improve adult blood lead surveillance programs which can accurately measure trends in adult blood lead levels and which can effectively intervene to prevent lead over-exposures.

ABLES
Adult Blood Lead Epidemiology & Surveillance
82 Pb 207.2

There are many resources available to help employers, employees, health care professionals and others understand more about lead exposure, prevention and medical management. Links to these resources can be found at: ***www.oem.msu.edu****.*

The Lead Contamination Control Act of 1988 authorized the Centers for Disease Control and Prevention (CDC) to initiate program efforts to eliminate childhood lead poisoning in the United States. As a result of this Act, the CDC Childhood Lead Poisoning Prevention Program was created, with primary responsibility to:

- *Develop programs and policies to prevent childhood lead poisoning.*
- *Educate the public and health-care providers about childhood lead poisoning.*
- *Provide funding to state and local health departments to determine the extent of childhood lead poisoning by screening children for elevated blood lead levels, helping to ensure that lead-poisoned infants and children receive medical and environmental follow-up, and developing neighborhood-based efforts to prevent childhood lead poisoning.*
- *Support research to determine the effectiveness of prevention efforts at federal, state, and local levels.*

The cost benefit is clear: resources spent to prevent lead poisoning are an investment in each child's life-long health, quality of life, learning, and earning potential. If lead hazards were remediated in every Michigan residence and daycare setting built prior to 1978, childhood lead poisoning from residential paint would be eliminated.

LEAD FREE KIDS

Links to Childhood Lead Prevention Program resources can be found at: **www.michigan.gov/mdch/0,1607,7-132-2942_4911_4913---,00.html**