2010

Annual Report on Blood Lead Levels on Adults in Michigan

2010 ANNUAL REPORT

Adult Blood Lead Epidemiology Surveillance (ABLES) Program

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In 2010, Michigan ABLES received 15,858 blood lead tests for 14,424 individuals ≥16 years of age and older. There were 983 more blood lead tests and 658 more individuals reported in 2010 compared to 2009 .

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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.

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
MDLARA 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 thirteenth annual report on surveillance of blood lead levels (BLLs) of Michigan citizens. 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, both among adults and children. The Adult Blood Lead Epidemiology and Surveillance (ABLES) Program was founded nationally in 1992 and tracks laboratory reports of elevated BLLs in U.S. adults.

This report summarizes BLLs of

Summary, continued...

Michigan adults, defined as sixteen years and older. In 2010, Michigan ABLES received 15858 blood lead tests for 14,424 individuals ≥16 years of age. Five hundred and ninety-eight (4.1%) individuals had BLLs ≥ 10 µg/dL; 102 of those 598 had lead levels ≥ 25 µg/dL and six of the 102 had BLLs ≥ 50 µg/dL.

There were 983 more blood lead tests and 658 more individuals reported in 2010 compared to 2009 (Figure 1). The number and the percent of individuals with BLLs ≥10 µg/dL decreased from 608 (4.4%) in 2009 to 598 (4.1%) in 2010. The number and percent of individuals with BLLs ≥25 µg/dL dropped from 103 (0.75%) in 2009 to 102 (0.71%) in 2010. The number of individuals with BLLs ≥ 50 µg/dL went from three (0.02%) in 2009 to six (0.04%) in 2010. For eight consecutive years, from 1999 to 2006, the BLLs ≥25 µg/dL showed a decrease from the previous year (Figure 2) and 2009 and 2010 continue this trend. In 2007 and 2008 there was a slight increase in BLLs ≥25 µg/dL. These trends occurred among both occupational and non-occupational exposures (Figure 3).

The adults with BLLs ≥10 µg/dL were likely to be men (96.5%) and white (86.5%). Their mean age was 44.8. They were most likely to live in Wayne (21.0%), St. Clair (8.1%) or Macomb (7.4%) counties. Occupational exposure remains the predominant source of lead exposure (83.8%). 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.

For eight consecutive years, from 1999 to 2006, the BLLs ≥25 µg/dL showed a decrease from the previous year (Figure 2) .

Among Michigan 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 (71.7 %) and 11.6% 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

Figure 1: Number of Adults Reported with Tests for Blood Lead, Michigan 1998-2010

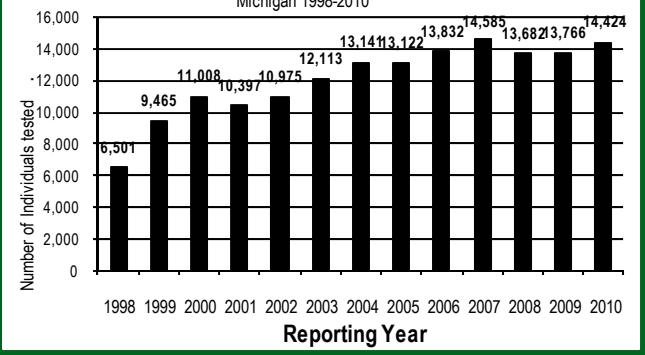
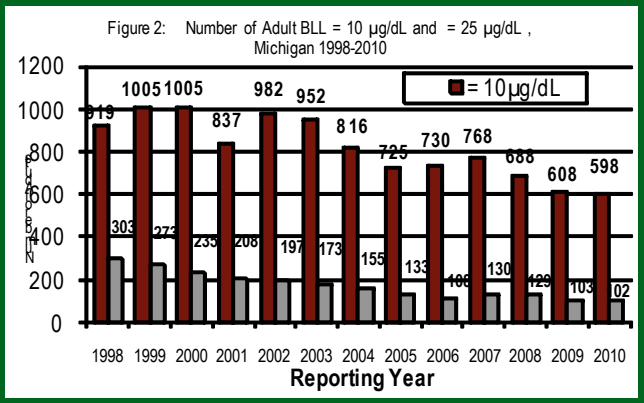
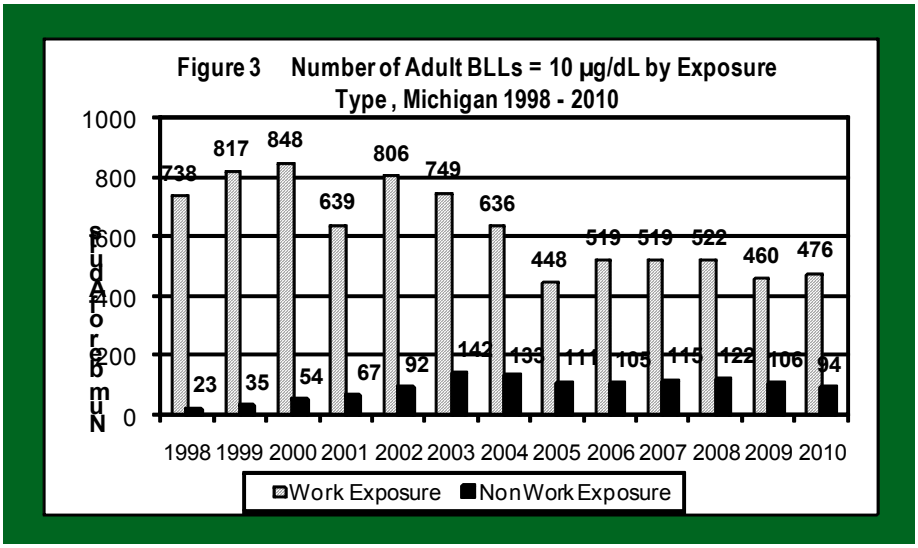


Figure 2: Number of Adult BLL = 10 µg/dL and = 25 µg/dL , Michigan 1998-2010





ranges. Private gun clubs and ranges, run by members and volunteers, are not under the jurisdiction of State regulations as these regulations only cover businesses with paid employees. Outreach effort to educate this group of lead-exposed hobbyists remains a challenge.

The thirteenth 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 221 individuals, follow-up interviews with 120 lead exposed individuals and distributing resources on diagnosis and management of lead exposure to 33 health care 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 Lead." In addition, collaboration with MDCH provided a brochure for women of childbearing age and information on risk of take home lead exposure to occupationally-exposed adults identified with children under the age of six.

In 2010, Michigan Occupational Safety and Health Administration (MIOSHA) inspections were conducted and reports completed at nine companies referred by ABLES due to elevated blood lead laboratory reports with seven (77.8%) resulting in lead related citations. As part of our effort to evaluate compliance with the MIOSHA regulation requiring blood lead testing of employees of companies using lead, eighteen facilities with industry codes indicating brass/bronze activities and not reporting BLLs were referred to MIOSHA for inspection. Details of inspections completed in 2010 are included in this report.

Occupational exposure remains the predominant source of lead exposure (83.5%). 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.

Background

This is the thirteenth annual report on surveillance of BLLs in Michigan residents. BLLs of Michigan residents, including children, have been monitored by the state since 1992. From 1992 to 1995, laboratories performing analyses of blood lead levels, primarily of children, voluntarily submitted reports to the State. The 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 this in 1997, Michigan received federal funding from the 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.

2010 is the thirteenth 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 of Michigan residents 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 on a standard MDCH Lead Reporting Form (Appendix B). The health care provider ordering the blood lead analysis is responsible for completing the patient information, the physician/provider information and the specimen collection information. 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/CLPPP) within five working days..

All blood lead results on individuals 16 years or older are forwarded to MSU for a potential interview and then to the MIOSHA in the Michigan Department of Licensing and Regulatory Affairs (MDLARA) for a potential work-place follow-up. MSU is designated a bona fide agent of the State to conduct this activity. A summary of blood lead results from 2010 on children less than six years old is published in the first section of this report.

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

Case Follow-Up

Adults whose BLL is 25 µg/dL or greater are contacted for an interview. 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.

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,

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

MICHIGAN BLOOD LEAD LABORATORIES*

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

*Laboratories which meet OSHAs accuracy requirements in blood lead proficiency testing as of September 1, 2011. For a complete listing of OSHA approved blood lead laboratories, visit the OSHA web site at http//www.osha.gov/SLTC/bloodlead/program.html

Background, continued . . .

repeat training annually, provide medical surveillance, including blood analysis for lead and zinc protoporphyrin, medical exams and consultation, provide medical removal protection 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 4.8 µg/dL for men and below 3.5 µg/dL for women (1).

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) (2). See Appendix A for the most recent publication of ABLES surveillance results for the period 2008 - 2009.

Results

This is the thirteenth 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 2010 as well as more detailed information from all interviews completed since 1997 of those adults with BLL 25 µg/dL and greater are included in this report. Also included are the 2010 MIOSHA inspections 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 (3-7), analysis of available information on BLL 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 in Michigan: 2010

	Work BLLs		Non-Work BLLs		Source Not Yet Identified		All BLLs	
BLLs (ug/dL)	Number	Percent	Number	Percent	Number	Percent	Number	Percent
<5	200	[a]	16	[a]	12770	[a]	12,986	90.0
5-9	311	[a]	24	[a]	505	[a]	840	5.8
10-24	401	40.6	67	50.8	28	0.2	496	3.4
25-29	27	2.7	11	8.3	0	0.0	38	0.3
30-39	31	3.1	8	6.1	2	0.0	41	0.3
40-49	12	1.2	5	3.8	0	0.0	17	0.1
50-59	3	0.3	1	0.8	0	0.0	4	0.0
≥ 60	2	0.2	0	0.0	0	0.0	2	0.0
TOTAL	**987**	**88.2[e]**	**132**	**11.8[e]**	**13,305**		**14,424 [b]**	**100.0**
TOTAL≥10ug/dL	**476**	**83.8[c]**	**92**	**16.2[c]**	**30**		**598**	
TOTAL≥25ug/dL	**75**	**75.0[d]**	**25**	**25.0[d]**	**2**		**102**	

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

[b] In 2010, 15,858 BLL reports were received for 14,424 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 2010

Number of Reports and Individuals

Between January 1 and December 31, 2010, the State of Michigan received 15,858 blood lead test reports for individuals 16 years of age or older. Because an individual may be tested more than once each year, the 15,858 reports received were for 14,424 individuals (Table 1). Up to 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 to 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 2010. Where more than one BLL result was reported in 2010, statistics are based on the highest BLL reported for each individual.

The drop in numbers of BLL test reports noted in 2010 is likely a reflection of the current Michigan economic downturn rather than reduced testing compliance.

Distribution of Blood Lead Levels

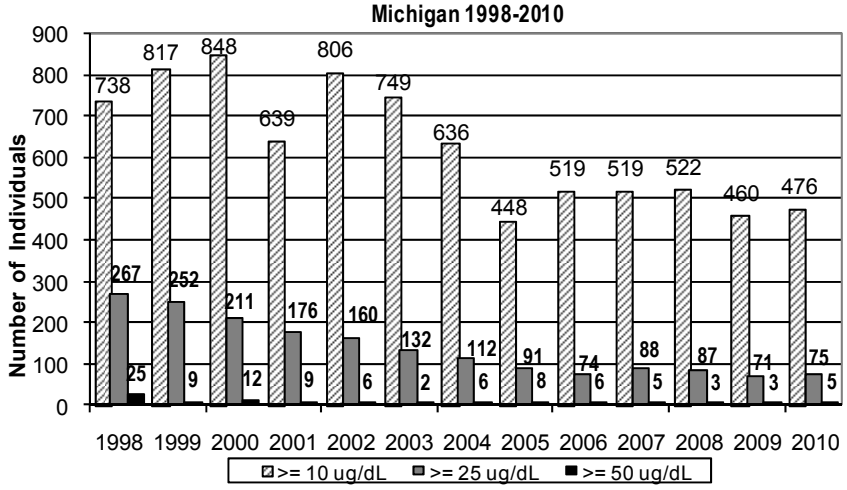
In 2010, 598 (4.1%) of the 14,424 adults reported had BLLs ≥ 10 µg/dL; 102 of those 598 (17.1%) had BLLs ≥ 25 µg/dL and 6 of 102 (5.9%) had BLLs≥ 50 µg/dL (Table 1).

A total of 12,986 (90.0%) of adults reported in 2010 had BLL less than 5 µg/dL, and 840 (5.8%) 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, 311 of 335 (92.8%) individuals were identified as occupationally exposed. Follow up review showed that 179 (57.5%) of these 311 had been tested in previous years and 94 (52.5%) showed a decrease in their BLL.

Among the 496 individuals whose blood lead was 10 – 24 µg/dL, 401 (85.7%) individuals had their source of lead exposure identified as occupational as compared to the 102 individuals with BLLs ≥ 25 µg/dL where 75 (75.0%) 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 2010 (Figure 5). For non-work exposures, elevated blood lead showed a decline from 2003 to 2006, a

FIGURE 5 Number of Adults with Elevated BLLs due to WORK Exposure, Michigan 1998-2010



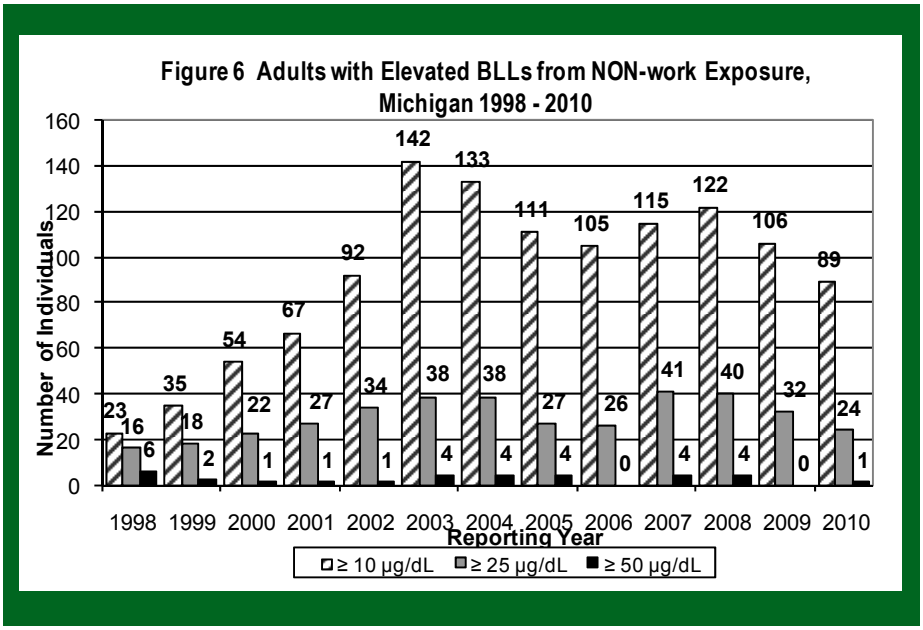


Table 2 Distribution of Gender Among Adults Tested for BLLs in Michigan: 2010

	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	8,567	59.5	577	96.5	99	97.1
Female	5,840	40.5	21	3.5	3	2.9
Total	**14,407***	**100.0**	**598**	**100.0**	**102**	**100**

*Gender was unknown for 17 additional individuals.

Table 3 Distribution of Age Among Adults Tested for Blood Lead in Michigan: 2010

	All Blood Lead Level Tests		Blood Lead Levels ≥ 10 ug/dL	
Age Range	**Number**	**Percent**	**Number**	**Percent**
16-19	1,149	8.0	8	1.3
20-29	2,304	16.0	72	12.0
30-39	2,511	17.4	133	22.2
40-49	2,929	20.3	137	22.9
50-59	2,759	19.1	163	27.3
60-69	1,556	10.8	68	11.4
70-79	791	5.5	14	2.3
80-89	379	2.6	3	0.5
90-99	42	0.3	0	0.0
100+	4	0.0	0	0.0
TOTAL	14,424	100.0	598	100.0

slight increase in 2007 and 2008 and then a drop in 2010 to the lowest level since 2002. (Figure 6).

GENDER AND AGE DISTRIBUTION

All Blood Lead Levels

Fifty-nine and a half percent of the adults reported to the Registry were male, and 40.5 percent were females (Table 2). The mean age was 43.7 and median age 43.0. The age distribution is shown in Table 3.

BLLs ≥ 10 µg/dL

For the 598 adults reported to the Registry with BLLs ≥ 10 µg/dL, 577 (96.5%) were men and 21 (3.5%) were women. The mean age was 44.8 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 8923 (61.9%) of the 14,424 adults reported. Where race was known, 4,670 (84.7%) were reported as Caucasian, 675 (12.2%) were reported as African American, 70 (1.3%) were reported as Asian/ Pacific Islander, 67 (1.2%) were reported as Native American, and 31 (0.6%) 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

Table 4 Distribution of Race Among Adults Tested for Blood Lead in Michigan: 2010

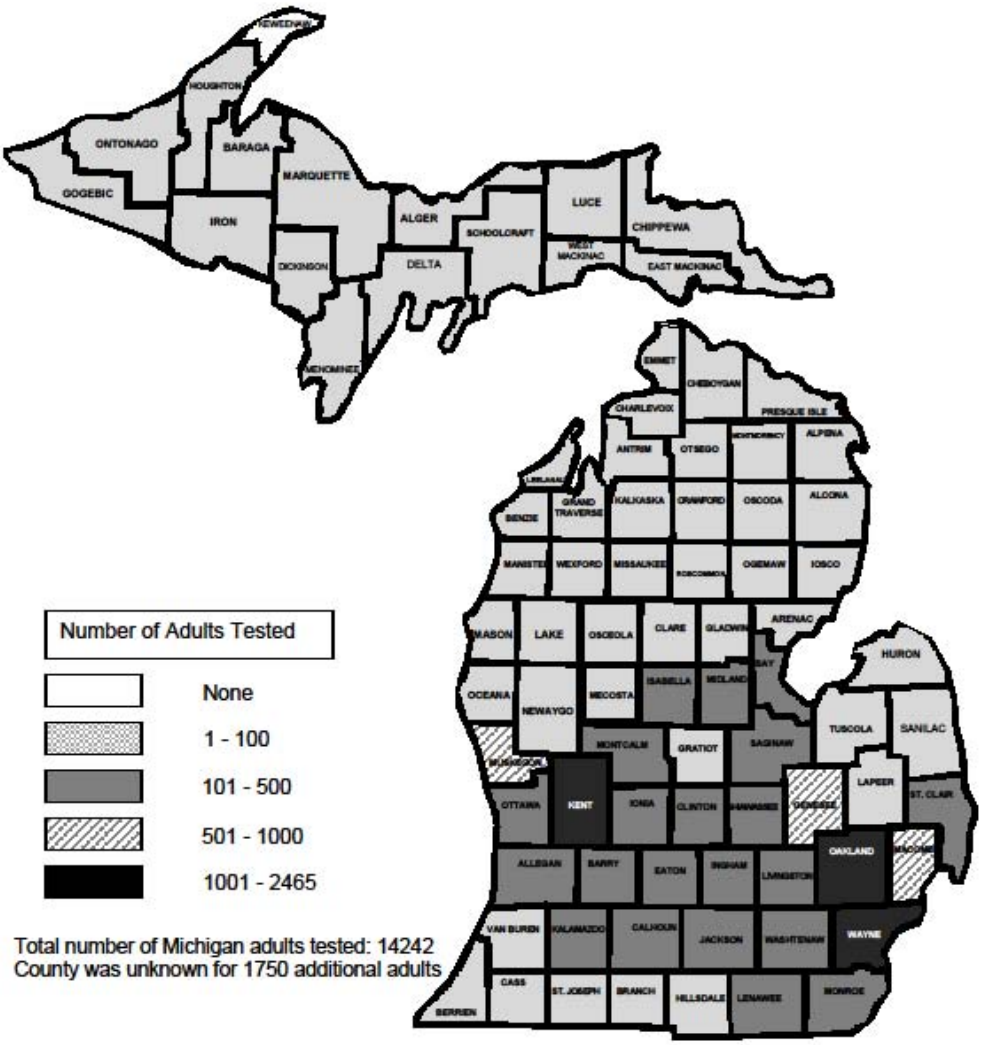
	All Blood Lead Level Tests			Blood Lead Levels ≥10 µg/dL	
Race	Number	Percent		Number	Percent
Caucasian	4,670	84.7		351	86.5
African American	675	12.2		28	6.9
Native American	67	1.2		9	2.2
Asian/Pacific Islander	70	1.3		4	1.0
Multiracial/Other	31	0.6		14	3.4
TOTAL	**5,513 ***	**100.0**		**406 ****	**100.0**

*Race was unknown for 8923 additional individuals.

**Race was unknown for 192 additional individuals.

was indicated, 351 (86.5%) were reported as Caucasian, 28 (6.9%) were reported as African American, 14 (3.4%) were reported as Multiracial/Other, 9 (2.2%) were reported as Native American, and 4 (1.0%) were reported as Asian/Pacific Islander, (Table 4).

Figure 7 Geographic Distribution of Adults Tested for Lead In Michigan by County of Residence, 2010



Wayne and Kent counties had the highest number of adults tested with 2465 and 1288 respectively.

GEOGRAPHIC DISTRIBUTION

County of residence was determined for 12,652 of the 14,424 adults reported to the Registry. They lived in 82 of Michigan's 83 counties. The largest number of adults tested in 2010 lived in Wayne County (2,465, 19.5%), followed by Kent County (1288, 10.2%) and Oakland County (1019, 8.1%). The county was unknown for 1750 adults tested for blood lead. Figure 7 and Table 5).

Figure 8 and Table 5 show the county of residence of the 580 adults with BLLs ≥ 10 µg/dL where county of residence could be determined. The largest number of adults

(Continued on page 13)

County of residence was determined for 12,652 of the 14, 424 adults reported to the Registry. They lived in 82 of Michigan's 83 counties.

Table 5 Number and Percent of Adults With BLLs ≥ 10 ug/dL and 25 ug/dL by County of Residence Among All Adults Tested for BLL in Michigan: 2010

	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	11	0.09	1	0.17	9.09	0	0.00	0.00
Alger	16	0.13	1	0.17	6.25	0	0.00	0.00
Allegan	142	1.12	3	0.52	2.11	1	1.06	0.70
Alpena	20	0.16	1	0.17	5.00	0	0.00	0.00
Antrim	32	0.25	1	0.17	3.13	0	0.00	0.00
Arenac	22	0.17	2	0.34	9.09	2	2.13	9.09
Baraga	9	0.07	0	0.00	0.00	0	0.00	0.00
Barry	83	0.66	1	0.17	1.20	0	0.00	0.00
Bay	120	0.95	6	1.03	5.00	2	2.13	1.67
Benzie	6	0.05	0	0.00	0.00	0	0.00	0.00
Berrien	78	0.62	9	1.55	11.54	1	1.06	1.28
Branch	23	0.18	2	0.34	8.70	1	1.06	4.35
Calhoun	171	1.35	5	0.86	2.92	1	1.06	0.58
Cass	30	0.24	1	0.17	3.33	1	1.06	3.33
Charlevoix	22	0.17	2	0.34	9.09	1	1.06	4.55
Cheboygan	60	0.47	4	0.69	6.67	1	1.06	1.67
Chippewa	93	0.74	7	1.21	7.53	0	0.00	0.00
Clare	44	0.35	2	0.34	4.55	0	0.00	0.00
Clinton	125	0.99	4	0.69	3.20	0	0.00	0.00
Crawford	61	0.48	1	0.17	1.64	0	0.00	0.00
Delta	24	0.19	1	0.17	4.17	1	1.06	4.17
Dickinson	19	0.15	3	0.52	15.79	1	1.06	5.26
Eaton	142	1.12	4	0.69	2.82	0	0.00	0.00
Emmet	38	0.30	0	0.00	0.00	0	0.00	0.00
Genesee	657	5.19	24	4.14	3.65	3	3.19	0.46
Gladwin	56	0.44	0	0.00	0.00	0	0.00	0.00
Gogebic	10	0.08	0	0.00	0.00	0	0.00	0.00
Grand Traverse	73	0.58	6	1.03	8.22	0	0.00	0.00
Gratiot	99	0.78	2	0.34	2.02	0	0.00	0.00
Hillsdale	42	0.33	1	0.17	2.38	0	0.00	0.00
Houghton	39	0.31	0	0.00	0.00	0	0.00	0.00
Huron	26	0.21	6	1.03	23.08	1	1.06	3.85
Ingham	400	3.16	8	1.38	2.00	0	0.00	0.00
Ionia	106	0.84	25	4.31	23.58	2	2.13	1.89
Iosco	19	0.15	0	0.00	0.00	0	0.00	0.00
Iron	4	0.03	0	0.00	0.00	0	0.00	0.00
Isabella	115	0.91	0	0.00	0.00	0	0.00	0.00
Jackson	111	0.88	8	1.38	7.21	2	2.13	1.80
Kalamazoo	363	2.87	15	2.59	4.13	6	6.38	1.65
Kalkaska	15	0.12	0	0.00	0.00	0	0.00	0.00
Kent	1,288	10.18	24	4.14	1.86	7	7.45	0.54
Keweenaw	0	0.00	0	0.00	0.00	0	0.00	0.00
Lake	20	0.16	0	0.00	0.00	0	0.00	0.00
Lapeer	91	0.72	3	0.52	3.30	0	0.00	0.00

Table 5 Number and Percent of Adults With BLLs ≥ 10 ug/dL and 25 ug/dL by County of Residence Among All Adults Tested for BLL in Michigan: 2010

	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	24	0.19	0	0.00	0.00	0	0.00	0.00
Lenawee	105	0.83	5	0.86	4.76	0	0.00	0.00
Livingston	250	1.98	6	1.03	2.40	1	1.06	0.40
Luce	1	0.01	0	0.00	0.00	0	0.00	0.00
Mackinac	60	0.47	13	2.24	21.67	3	3.19	5.00
Macomb	733	5.79	43	7.41	5.87	9	9.57	1.23
Manistee	25	0.20	0	0.00	0.00	0	0.00	0.00
Marquette	53	0.42	1	0.17	1.89	0	0.00	0.00
Mason	17	0.13	0	0.00	0.00	0	0.00	0.00
Mecosta	41	0.32	1	0.17	2.44	0	0.00	0.00
Menominee	16	0.13	1	0.17	6.25	0	0.00	0.00
Midland	153	1.21	0	0.00	0.00	0	0.00	0.00
Missaukee	14	0.11	1	0.17	7.14	0	0.00	0.00
Monroe	308	2.43	16	2.76	5.19	2	0.00	0.65
Montcalm	177	1.40	36	6.21	20.34	5	5.32	2.82
Montmorency	17	0.13	2	0.34	11.76	0	0.00	0.00
Muskegon	525	4.15	19	3.28	3.62	2	2.13	0.38
Newaygo	50	0.40	1	0.17	2.00	0	0.00	0.00
Oakland	1,019	8.05	36	6.21	3.53	10	10.64	0.98
Oceana	42	0.33	0	0.00	0.00	0	0.00	0.00
Ogemaw	12	0.09	0	0.00	0.00	0	0.00	0.00
Ontonagon	8	0.06	1	0.17	12.50	0	0.00	0.00
Osceola	26	0.21	1	0.17	3.85	0	0.00	0.00
Oscoda	7	0.06	0	0.00	0.00	0	0.00	0.00
Otsego	27	0.21	1	0.17	3.70	0	0.00	0.00
Ottawa	193	1.53	4	0.69	2.07	0	0.00	0.00
Presque Isle	12	0.09	0	0.00	0.00	0	0.00	0.00
Roscommon	61	0.48	2	0.34	3.28	0	0.00	0.00
Saginaw	239	1.89	5	0.86	2.09	0	0.00	0.00
Saint Clair	334	2.64	47	8.10	14.07	1	1.06	0.30
Saint Joseph	33	0.26	1	0.17	3.03	1	1.06	3.03
Sanilac	54	0.43	7	1.21	12.96	2	2.13	3.70
Schoolcraft	3	0.02	0	0.00	0.00	0	0.00	0.00
Shiawassee	132	1.04	2	0.34	1.52	1	1.06	0.76
Tuscola	39	0.31	5	0.86	12.82	1	1.06	2.56
Van Buren	96	0.76	2	0.34	2.08	0	0.00	0.00
Washtenaw	325	2.57	15	2.59	4.62	4	4.26	1.23
Wayne	2,465	19.48	122	21.03	4.95	18	19.15	0.73
Wexford	31	0.25	1	0.17	3.23	0	0.00	0.00
TOTAL	**12,652** *	100.00	**580** **	100.00	4.58	**94** ***	100.00	0.74

*County was unknown for 1750 additional adults and 23 lived out of state.

**County was unknown for 18 additional adults.

***County was known for adults ≥ 25 and 8 lived out of state.

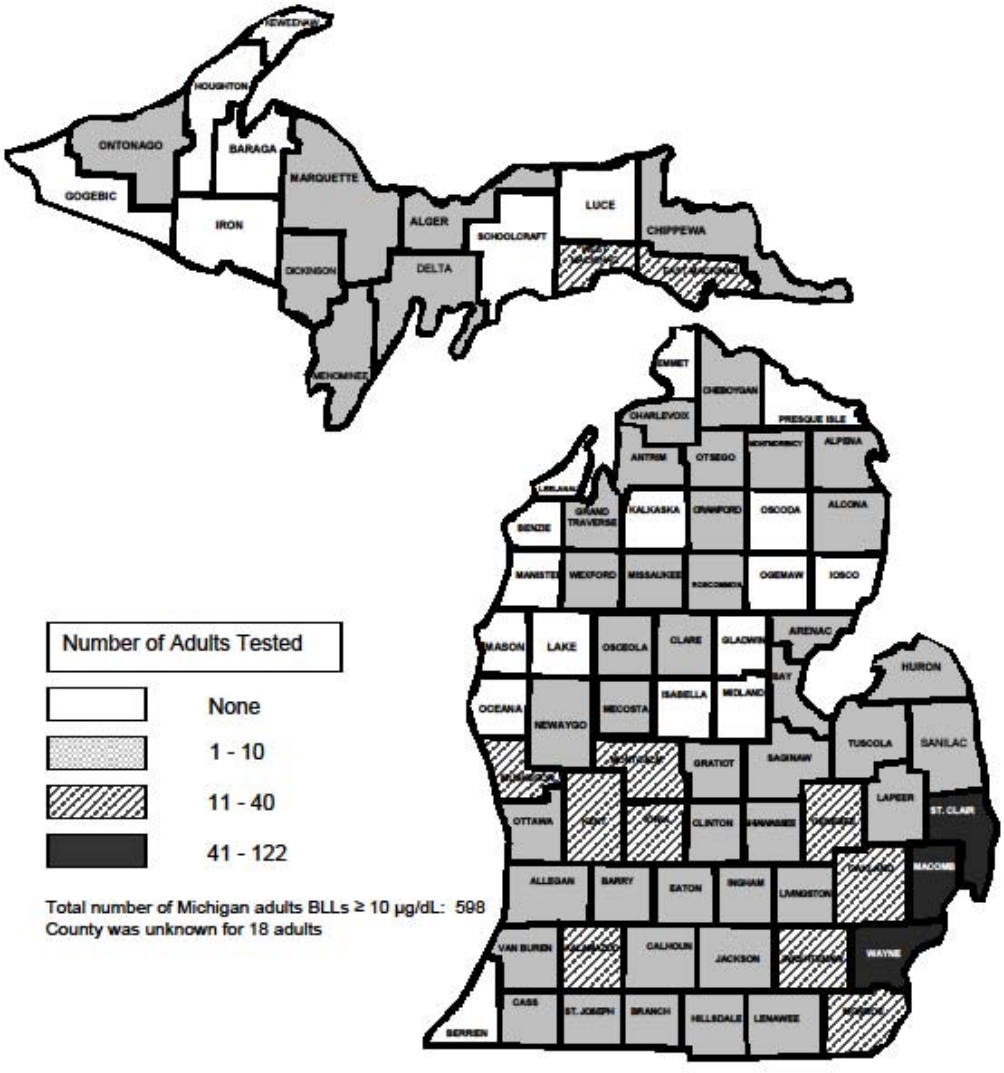
(Continued from page 10)

reported with a BLL ≥ 10 µg/dL were from Wayne County (122, 21.0%), followed by St. Clair County (47, 8.1%) and Macomb County (43, 7.4%). The county was unknown for 18 adults with BLLs ≥ 10 µg/dL.

Figure 9 and Table 5 show the county of residence for the 94 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 (18, 19.2%), followed by Oakland County (10, 10.6%) and Macomb (9, 9.6%). The county was known for all adults with

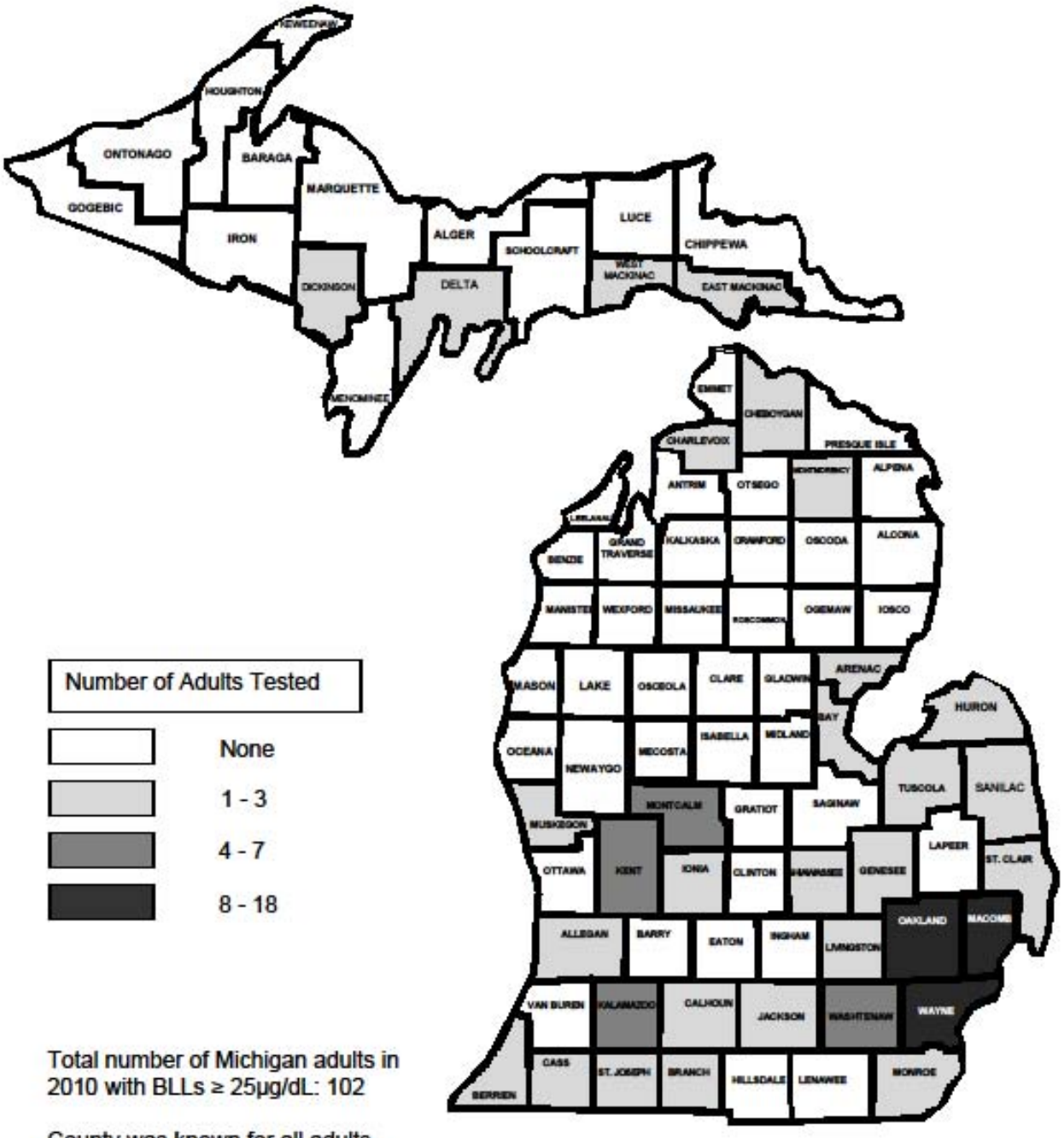
The largest number of adult BLLs reported in 2009 lived in Wayne County (2,034, 17.9%), followed by Kent County (1,332, 11.7%) and Oakland County (881, 7.7%).

Figure 8 **Geographic Distribution of Adults Tested with BLLs ≥ 10 µg/dL In Michigan by County of Residence, 2010**



Wayne, St Clair and Macomb had the largest number with 122, 47 and 43 respectively.

Figure 9 Geographic Distribution of Adults Tested with BLLs ≥ 25µg/dL In Michigan by County of Residence, 2010



Total number of Michigan adults in 2010 with BLLs ≥ 25µg/dL: 102

County was known for all adults

Wayne, Oakland and Macomb counties had the largest number with 18, 10 and 9 respectively.

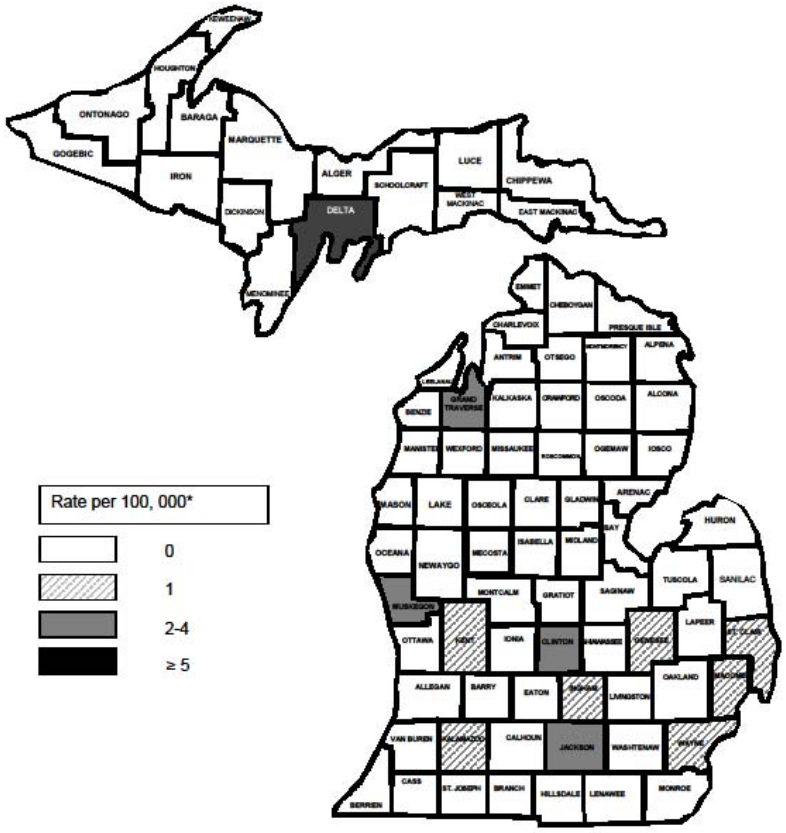
Table 6 Number and Rate of BLL ≥ 10 µg/dL Among Women in Michigan by County of Residence : 2010

County	Number Reported	Michigan Population Women	Rate per 100,000 women
Clinton	1	27,613	4
Delta	1	15,509	6
Genesee	1	174,600	1
Grand Traverse	1	35,704	3
Ingham	1	118,066	1
Jackson	1	62,734	2
Kalamazoo	1	104,160	1
Kent	3	239,849	1
Macomb	2	341,987	1
Muskegon	2	69,017	3
St Clair	1	67,761	1
Wayne	6	790,223	1
TOTAL	**21**	4,061,345 **	1 ***

**Total number of women in all 83 counties of Michigan age 16+ years; 7/1/2009 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 In Michigan by County of Residence, 2010**



*Denominator is Rate per 100,000 women age 16+ from US Census Bureau of County Resident Population, Annual Estimate for July 1, 2009

BLLs ≥ 25 µg/dL.

Table 5 shows the percentage of tested adults, within each county, with BLLs ≥10 µg/dL and BLLs ≥ 25 µg/dL. Ionia (23.6%), Huron (23.1%), Mackinac (21.7%) and Montcalm (20.3%) counties had the highest percentages of adults with BLL ≥10 µg/dL within their respective counties. Arenac (9.1%), Dickenson (5.3%) and Mackinac (5.0%) counties had the highest percentage of tested adults with BLL ≥ 25 µg/dL.

GENDER DISTRIBUTION

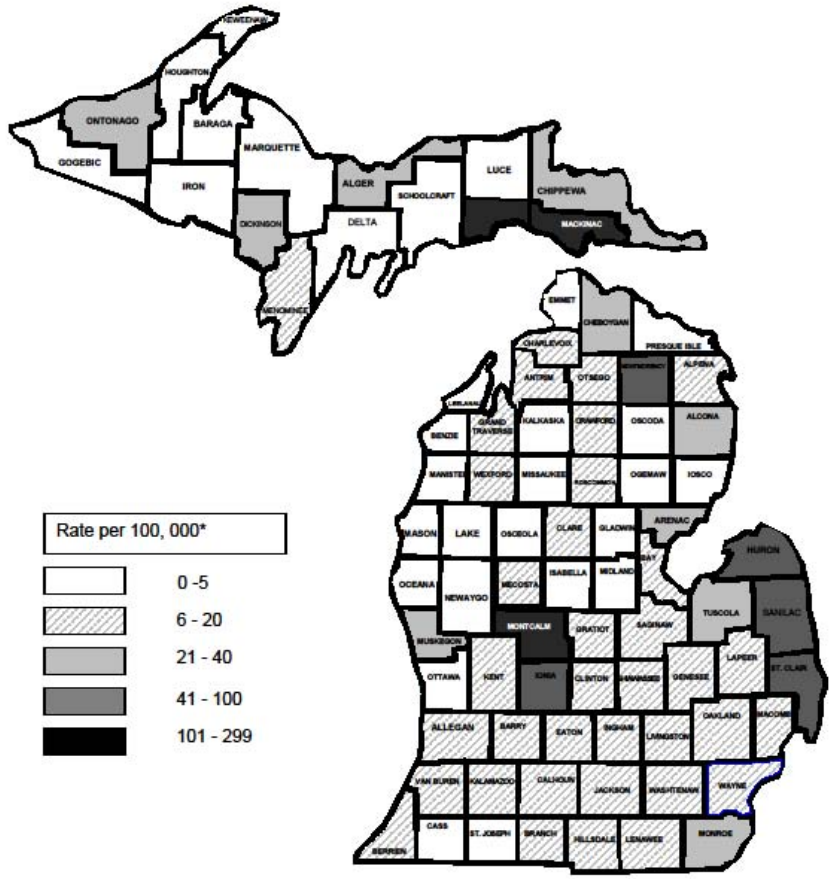
Figure 10 and Table 6 show the incidence rates of BLL ≥ 10 µg/dL, by county, for women. There were 21 women reported in 2010 with a BLL ≥ 10 µg/dL, where county was known. Delta (6/100,000), Clinton (4/100,000), Grand Traverse and Muskegon (3/100,000) had the four highest incidence rates.

Four women (19.0%) with elevated blood lead had their exposure from work: one from a battery recycling process, one from public safety, one from a sporting goods firing range and one from construction.

Eight women (38.1%) with elevated blood leads had non-work exposures: one from an identified source of Mexican pottery, two from remodeling performed in their homes, two

(Continued on page 18)

Figure 11 **Annual Incidence of BLLs ≥ 10 µg/dL Among Men In Michigan by County of Residence, 2010**



*Denominator is Rate per 100,000 men age 16+ from US Census Bureau of County Resident Population, Annual Estimate for July 1, 2009

Table 7 Number and Rate of BLL ≥ 10 µg/dL Among Men in Michigan by County of Residence : 2010

County	Number Reported	Michigan Population Men	Rate per 100,000 Men	County	Number Reported	Michigan Population Men	Rate per 100,000 Men
Alcona	1	4,839	21	Keweenaw	0	1,013	0
Alger	1	4,144	24	Lake	0	4,619	0
Allegan	3	43,822	7	Lapeer	3	36,306	8
Alpena	1	11,621	9	Leelanau	0	9,142	0
Antrim	1	9,695	10	Lenawee	4	39,779	10
Arenac	2	6,798	29	Livingston	6	72,106	8
Baraga	0	3,952	0	Luce	0	3,158	0
Barry	1	22,981	4	Mackinac	13	4,352	299
Bay	6	41,767	14	Macomb	41	321,703	13
Benzie	0	6,909	0	Manistee	0	10,480	0
Berrien	9	60,479	15	Marquette	1	27,652	4
Branch	2	18,024	11	Mason	0	11,377	0
Calhoun	5	51,669	10	Mecosta	1	17,408	6
Cass	1	20,015	5	Menominee	1	9,758	10
Charlevoix	2	10,255	20	Midland	0	32,002	0
Cheboygan	4	10,574	38	Missaukee	1	5,855	17
Chippewa	7	18,707	37	Monroe	16	59,882	27
Clare	2	11,956	17	Montcalm	36	25,631	140
Clinton	3	27,063	11	Montmorency	2	4,217	47
Crawford	1	6,140	16	Muskegon	17	67,705	25
Delta	0	14,741	0	Newaygo	1	18,882	5
Dickinson	3	10,651	28	Oakland	36	465,374	8
Eaton	4	41,335	10	Oceana	0	10,738	0
Emmet	0	13,253	0	Ogemaw	0	8,715	0
Genesee	23	156,405	15	Ontonagon	1	2,837	35
Gladwin	0	10,391	0	Osceola	1	8,775	11
Gogebic	0	7,248	0	Oscoda	0	3,524	0
GrdTraverse	5	34,385	15	Otsego	1	9,261	11
Gratiot	2	18,218	11	Ottawa	4	98,654	4
Hillsdale	1	18,008	6	Presque Isle	0	5,657	0
Houghton	0	15,748	0	Roscommon	2	10,298	19
Huron	6	13,059	46	Saginaw	5	75,194	7
Ingham	7	107,653	7	Saint Clair	46	65,246	71
Ionia	25	26,728	94	Saint Joseph	1	23,438	4
Iosco	0	10,520	0	Sanilac	7	16,517	42
Iron	0	4,924	0	Schoolcraft	0	3,272	0
Isabella	0	26,441	0	Shiawassee	2	27,120	7
Jackson	7	64,883	11	Tuscola	5	21,960	23
Kalamazoo	14	95,558	15	Van Buren	2	29,914	7
Kalkaska	0	6,746	0	Washtenaw	15	140,541	11
Kent	21	228,808	9	Wayne	116	709,942	16
				Wexford	1	12,354	8
				TOTAL	**559 ***	**3,849,471 ****	15***

*County was unknown for 18 additional male adults.

**Total number of men in all 83 counties of Michgan age 16+ years; 7/1/2009 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.

from firearms, one from other hobbies, one case of pica and one from a gunshot wound. Source of exposure was unknown for nine of the 21 women, although for two of these nine the elevated BLL was attributed to a laboratory error.

Figure 11 and Table 7 show the incidence rates of BLL of 10 µg/dL and above by county, for men. There were 559 men reported in 2010 with a BLL ≥ 10 µg/dL where county of residence could be determined. Mackinac (299/100,000), Montcalm (140/100,000) and Ionia, (94/100,000) had the highest incidence rates per 100,000 men based on the 7/1/2009 County Characteristics Resident Population Estimates from the U.S. Census Bureau. The overall incidence rate for men was 15 times higher than that for women (15/100,000 vs. 1/100,000) in 2010.

SOURCE OF EXPOSURE

For 476 (83.8%) individuals, work was the identified source. For 92 (16.2%) individuals non-occupational activities were identified as the source of exposure. Table 8 shows the non -work related source of exposure of lead for 92 individuals with BLLs ≥10 µg/dL reported in 2010. Of those 92, two non-occupational activities predominated. Sixty-six (71.7%) individuals were exposed from a hobby related to guns and ten (10.9%) were exposed due to a retained bullet fragment. For an additional two individuals, source of exposure is still being investigated. For 28 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 2010. The most frequent reports were on individuals in the construction sector (47.1%) and manufacturing (36.2%). This is the first year since 2002 where construction lead exposure surpassed manufacturing exposure in Michigan.

Figure 12 shows the geographic distribution of the twenty-four non-construction companies that reported at least one adult with a BLL of 25 µg/dL or greater in Michigan during 2010. For three of these companies we were unable to determine county and three were located out of state. These twenty-four companies included wholesale trade scrap

Table 8 Non-Work Source of Exposure Among Adults with BLL ≥ 10 µg/dL in Michigan: 2010

Exposure Source Description	Number		Percent	%NonWork
Work-Related	476		83.8	
Hobby: Firearms, Reloading, Casting	66		11.6	71.74
Gun Shot Wound	10		1.8	10.87
Remodeling	2		0.4	2.17
Hobby: Leather Tooling, Race Cars, Airplane fuel, unknown	4		0.7	4.35
Other, Non-work, Immigrant screening	3		0.5	3.26
Lab Error	3		0.5	3.26
Hobby: Sinkers & Diving Weights	2		0.4	2.17
Lead Paint Ingestion (Pottery, spices & Pica)	2		0.4	2.17
TOTAL	**568**	*	**100.0**	**100.00**

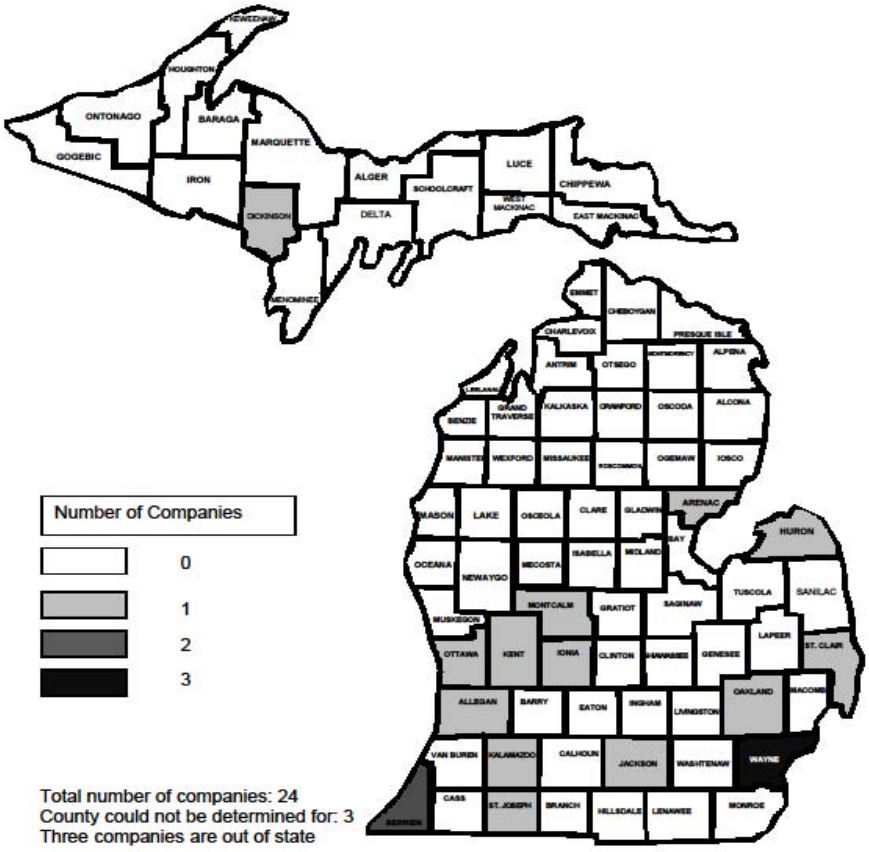
*For 2 additional adults source is pending an interview; for 8 additional adults source was inconclusive based on interview; for 20 additional adults, source was inconclusive and no patient interview was possible.

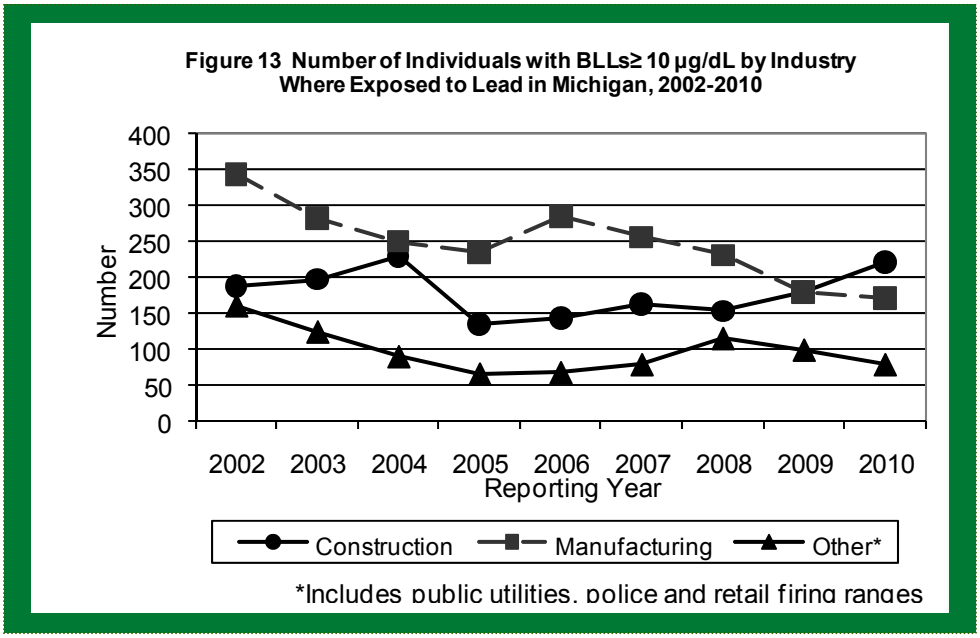
Table 9 Industry Source of Exposure Among Adults with BLL ≥ 10 µg/dL in Michigan : 2010

Exposure Source --- Industry (SIC Code)*			
	Number		**Percent**
Mining (10)	**1**		**0.2**
Construction (15-17)	**221**		**47.1**
Painting (17)		214	45.6
Manufacturing (20-39)	**170**		**36.2**
Fabricated and Primary Metals (33-34)		144	30.7
Transportation and Public Utilities (40-49)	**16**		**3.4**
Wholesale and Retail Trade (50-59)	**18**		**3.8**
Services (60-89)	**21**		**4.5**
Automotive Repair Services (75)		6	1.3
Public Administration (91-97)	**22**		**4.7**
Justice, Public Order, Safety (92)		13	2.8
TOTAL	**469 ****		**100.0**

*Standard Industrial Classification.
**Another 7 were work-related, however, the industry was unknown.

Figure 12 Geographic Distribution of Non-Construction Companies Reporting Adult BLLs ≥ 25 µg/dL In Michigan, 2010





and waste operations, metal forging and stamping companies, brass/bronze casting operations, coating and engraving operations, radiator repair facilities, a stained glass workshop and an indoor firing range. Of the 476 individuals with blood lead ≥ 10 µg/dL where exposure occurred at work, 145 (30.7%) were from these twenty-four companies.

Of the 92 individuals with blood lead ≥ 25µg/dL and exposure occurred at work, 35 (38.0%) were also from these twenty-four 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 Michigan's economic shift with closure of manufacturing facilities. The increase employment in the construction sector needs further investigation. A slight decrease also continues in the number of individuals with lead exposure reported from category "Other" which includes public utilities, police and public firing ranges. (Figure 13)

SUMMARY OF INDUSTRIAL HYGIENE INSPECTIONS

Follow up of elevated blood lead testing --- 2010

In 2010 MIOSHA inspections were conducted and reports completed at nine companies referred by ABLES due to elevated blood lead laboratory reports. Seven of the nine (77.8%) received lead related citations for violation of lead-related standards.

Three of the nine inspections were conducted in the construction industry, one of these was an HVAC construction company that was contracted to work at a battery manufacturer, the other six inspections were done by the MIOSHA General Industry Safety and Health Division and included a window repair shop, a construction trade scrap and waste yard, one manufacturing facility, one stained glass shop, one radiator shop, and one gun range. In hind sight, a gun range referred in 2010 but not inspected because it had filed for bankruptcy turned out to be the source for a major inspection in 2011 as the fixtures of this site were dismantled and relocated to a newly established gun range and employees involved in the reassembly of this range had elevated BLLs as high as 66 µg/dL.

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

One of the construction inspections occurring in 2010 was conducted in Ohio by Federal OSHA as the result of a construction company subcontracted to an Ohio battery facility with a Michigan resident employee. An elevated blood lead level of 43 µg/dL was reported for this employee. The contract job involved emptying 80,000 pounds of lead oxide from a storage silo over the course of 14 days and while respirators and tyvek suits were provided, the construction company did not fully implement a respiratory protection program, provide training on lead hazards or perform personal air sampling to determine employee exposures. Because employees were not exposed for more than 30 days per year to this hazard, biological monitoring could not be mandated. Two of six citations issued were related to lead.

In 2010 MIOSHA inspections were conducted and reports completed at nine companies referred by ABLES due to elevated blood lead laboratory reports. Seven of the nine (77.8%) received lead related citations for violation of lead-related standards.

Another construction company was inspected in 2010 as the result of an employee with a blood lead level of 41 µg/dL. The company restricted the employee from performing work where there was any potential of lead exposure, performed blood lead testing for the next few months and lead levels decreased to 26 µg/dL by the end of July, thus meeting MIOSHA Lead Exposure in Construction standard and no citations were issued.

A third Construction Safety and Health inspection was conducted due to an elevated BLL of 34 µg/dL. The MIOSHA inspection determined that proper air and biological monitoring were being conducted and employees had good knowledge of lead, cadmium, arsenic and silica issues pertaining to their work. No citations were issued.

A General Industry Safety and Health Division inspection was completed at a residential construction shop where windows were being restored, repaired and rebuilt following an elevated blood lead report of 38 µg/dL. All seventeen citations issued pertained to lead exposure and included: employee exposed to lead at concentration of more than 50 $\mu g/m^3$ time weighted average; employees exposed in excess of the action level to airborne concentrations of lead and employees not provided the required respirator; the employer did not develop or implement a written compliance program to reduce exposures to at or below the PEL by means of engineering and work practice controls; exhaust from the down draft table was re-circulated back into the general work area without a high-efficiency filter and reliable back-up filter and controls were not installed, operating or maintained to monitor the concentration of lead in the return air to bypass the recirculation system automatically if it failed; employer used dry sweeping to remove debris from workroom floor; containers were not labeled for contaminated protective clothing and equipment; clean change rooms were not provided; employer did not ensure employees showered at the end of their work shift when exposed to airborne concentrations of lead dust in excess of the PEL; employees left worksite without washing their hands and face prior to leaving the work in preparation for

lunch; warnings for lead work area was not posted; when ventilations was used, measurements that demonstrated the effectiveness in controlling exposure were not made at least quarterly; medical surveillance program and training was not instituted for each employee exposed to concentrations of lead at or above action level.

Another construction company was inspected by the MIOSHA General Industry Safety and Health Division at their scrap yard facility as the result of an employee with an elevated BLL of 32 µg/dL. One citation was issued for not determining if an employee may have been exposed at or above the action level when, over the course of a week, employees torch cut and welded on painted steel racks in which the orange paint contained 17% lead.

An inspection was made at a manufacturing facility as the result of an elevated BLL of 56 µg/dL where a process for forming a fusible link in fire sprinkler systems had been relocated from Illinois to Michigan. Bismuth, tin and lead were smelted and then blown into powder to coat pellets that were used as a link in fire protection systems. The low melt point of the coated pellets created a circuit break when heated, opening a fire sprinkler system. The inspection revealed adequate air monitoring, but surface sample results from a work bench and countertop revealed 8.7 mg/100 cm^2 and 250 mg/100 cm^2 of lead residue and a lead citation was issued for surfaces not maintained as free as practicable from accumulations of lead where the limit recommendation is <.0108 mg/100 cm^2.

A stained glass facility was inspected at both the facility and project sites following a BLL report of 27 µg/dL of an employee involved in restoration of windows. Eleven lead related citations were issued including: Lead exposure greater than 50 µg/m^3 at a project site location; failure to provide adequate respiratory protection; lack of air monitoring for lead action levels; lack of change areas, protective clothing and showers for employees with lead exposure at or above PEL.

A radiator facility was inspected following a lab report of an employee with a BLL of 38 µg/dL. Employee reports working there 26 years repairing heavy equipment radiators without ever having had a blood lead test. Five lead citations were issued but abated because there were no current employees at this facility.

One gun range was inspected in 2010 based on an employee BLL of 36 µg/dL. Of the fifteen citations issued, twelve were lead related. It was determined that employees were exposed to lead through class instruction, sales, and range cleaning and maintenance. Lead related citations included: employees exposed to lead above the action level of 50 ug/m3; air monitoring was not performed to determine exposure; ineffective ventilation; respirators were not provided where an employee was

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 . . .

exposed to lead concentrations above PEL; protective clothing, clean change rooms and training for all employees subjected to exposure to lead were not provided and showers were not ensured at the end of each work shift where employees were exposed to lead above PEL; lead rules and appendices were not made readily available to all affected employees.

Of the nine companies inspected in 2010, six were identified by an elevated blood lead report collected because of a required medical surveillance program, two were reported by a private health care provider and one had an undetermined source.

Evaluation of compliance to blood lead testing in Michigan brass/bronze facilities -- 2010

Review of the medical literature on evaluation of the testing provided to employees in lead-use industries estimates that only 15% of manufacturing companies provide testing and only 34% of employees exposed to lead are being tested for lead levels (8,9).

In 2002, Michigan evaluated whether radiator repair facilities were providing blood lead testing to their lead exposed employees. Results showed that 64% of the facilities inspected were in violation of at least one part of the MIOSHA lead standard, and one was not meeting the requirement to provide blood lead testing.

To evaluate completeness of medical surveillance, as required in the MIOSHA lead regulations, a special project with the brass/bronze industry was instituted. In 2010, almost thirty one percent of work-related BLLs ≥10 µg/dL are from brass/bronze facilities. A special project was initiated to determine the completeness of blood lead testing in this industry. Thirty-two brass/bronze facilities were identified in Michigan using the Michigan Manufacturing Directory and web-based employer locator services. BLLs were being received from 8 of the 32 (25%) facilities. Twelve of the facilities had no activity which involved lead, were out of business or had no production facilities in Michigan. Of the remaining twelve, four have been inspected and eight are scheduled to be inspected.

In summary, results to date have not identified any additional brass/bronze facilities that are required to conduct blood lead testing on their employees. Inspections are still pending on eight facilities.

Case Narratives

Six Individuals with a BLL ≥ 50 µg/dL in 2010

- An African-American male in his 60s, diagnosed with lead toxicity in 2009, continued to have a high BLL of 70 µg/dL, in 2010. 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 discontinuation of all renovation and work activities due to his failing kidney function and overall health. The Detroit Health Department conducted a home visit and found no other source of lead exposure.

- A Caucasian male in his 50's, employed as a special trades remediation worker received two OSHA required lead tests in 2010. His March BLL was 16 µg/dL and his November 2010 was 60 µg/dL. More information about his work activities is being pursued.

- A Caucasian male in his 30's, employed at a local rolling, drawing, and extruded brass manufacturer had an elevated BLL of 56 µg/dL in July 2010. Eleven BLL tests done in 2010 for this worker were all above 25 ug/dL. More information on his work activities is being pursued.

- A Caucasian male in his late 40's, employed at a fusible link and plug manufacturer for the fire protection industry, had an elevated level of 56 µg/dL at his initial test by the company. Fusible links and plugs are thermally operated non-reclosing pressure relief devices that function by the yielding or melting of the fusible alloy, brass or lead. The process to make lead pellets had been recently introduced into this facility. The lead pellets complete an electrical circuit when heated during a fire that turns on the fire sprinkler systems. He reported that training and safety protection did not keep pace with production activities.

- A Caucasian male in his early 40's had a high BLL of 51 µg/dL in April 2010. He has been employed for 14 years at this engineering firm that designs and installs equipment for manufacturing batteries across the USA and China and reports his exposure as a result of technical service in these out of state facilities.

- A thirty year old Caucasian female had her blood tested after restoring woodwork at her residence built over 100 years ago. She reported no symptoms despite an elevated BLL of 50 µg/dL in March 2010. She reported that her three adolescent children were also tested. They had elevated but much lower BLLs.

In 2010, Michigan ABLES received 15,858 blood lead tests for 14,424 individuals ≥16 years of age. Five hundred and ninety-eight (4.1%) individuals had BLLs ≥ 10 µg/dL; 102 (17.1%) of those 598 had lead levels ≥ 25 µg/dL and six (5.9%) of the 102 had BLLs ≥ 50 µg/dL.

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

Between October 15, 1997, and December 31, 2010, there were 1,911 reports received on adults with BLLs ≥ 10 µg/dL who completed an interview by telephone. The following summary of interview data is based on the 1,911 completed questionnaires.

Most of the 1,911 completed questionnaires were of males (87.7%), which is lower but parallels the gender distribution from the 2010 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 ever or current smokers was higher among adults with the higher blood lead levels. The group with the highest lead levels had the youngest mean age of 37.5 (Table 10).

The higher blood leads were most common in high school graduates without any college

Table 10 Demographic Characteristics of Michigan Adults with BLLs ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/1997 to 12/31/2010 by Highest Reported BLLs

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	1025	87.7	239	93.4	304	95.3	100	90.9	37	94.9	17	94.4	1722	90.1
Female	144	12.3	17	6.6	15	4.7	10	9.1	2	5.1	1	5.6	189	9.9
Hispanic Origin	63	5.6	10	4.1	11	3.6	14	13.1	1	2.6	0	—	99	5.4
Caucasian	973	84.4	233	88.8	277	88.2	92	83.6	36	92.3	14	77.8	1615	85.7
African American	103	8.9	15	6	20	6.4	9	8.2	3	7.7	4	22.2	154	8.2
Asian/Pacific Islander	6	0.5	1	0.4	2	0.6	0	—	0	—	0	—	9	0.5
Native American/Alaskan	12	1	4	1.6	9	2.9	0	—	0	—	0	—	25	1.3
Other	59	5.1	8	3.2	6	1.9	9	8.2	0	—	0	—	82	4.4
Mean Age	45.3	n=1169	43.9	n=256	41.9	n=319	43.5	n=110	42.5	n=39	37.5	n=18	44.2	n=1911
Ever Smoked	729	63.9	178	72.1	212	70.9	76	73.1	28	80	11	73.3	1234	67.1*
Now Smoke**	348	47.8	100	56.2	145	68.7	49	64.5	22	78.6	8	72.7	672	54.5*

**p < 0.05 for linear trend*

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

Table 11 Highest Education of Michigan Adults with BLLs ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/1997 to 12/31/2010 by Highest Reported BLLs

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	26	2.4	5	2.8	3	1.7	4	6.5	0	--	0	--	**38**	**2.5**
8th – 11th Grade	130	12	12	6.7	23	13.1	9	14.5	2	11.1	3	33.3	**179**	**11.7**
High School Grad	365	33.8	66	36.7	66	37.7	16	25.8	8	44.4	3	33.3	**524**	**34.4**
1-3 yrs College/Tech	359	33.2	68	37.8	49	28	21	33.9	6	33.3	1	11.1	**504**	**33**
4+ yrs College/Tech	201	18.6	29	16.1	34	19.4	12	19.4	2	11.1	2	22.2	**280**	**18.4**

Table 12 Symptoms of Michigan Adults with BLLs ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/97 to 12/31/10 by Highest Reported BLL

	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	128	11.2	21	8.6	36	11.5	23	21.5	7	18.9	5	31.3	220	11.8*
Continued loss of appetite	139	12.1	23	9.3	43	13.6	22	20.6	7	18.4	4	23.5	238	12.7*
Pains in belly	192	16.7	27	10.8	48	15.3	26	24.1	10	26.3	4	23.5	307	16.3
MUSCULOSKELETAL														
Frequent pain/soreness joint	386	34	85	34.4	117	37.4	53	50.5	14	36.8	9	52.9	664	35.8*
Muscle weakness	267	23.5	33	13.4	58	18.7	34	31.8	12	31.6	8	47.1	412	22.2
NERVOUS														
Headaches	194	16.8	33	13.1	66	20.8	29	26.6	11	28.2	5	29.4	338	17.9*
Dizziness	119	10.4	16	6.4	17	5.4	13	12	5	13.2	6	35.3	176	9.4
Depressed	175	15.3	26	10.5	49	15.8	23	21.5	11	28.2	7	41.2	291	15.6*
Tired	429	37.5	79	31.6	141	44.8	21	53.8	21	53.8	10	58.8	738	39.4*
Nervous	161	14.1	27	10.9	49	15.9	26	23.9	10	26.3	6	35.3	279	15*
Waking up night	333	29	51	20.4	103	32.8	36	33.3	16	41	7	43.8	546	29.1*
Nightmares	87	7.6	6	2.4	15	4.8	7	6.5	4	10.5	4	23.5	123	6.6
Irritable	227	19.8	51	20.7	83	26.6	35	32.4	16	42.1	7	41.2	419	22.5*
Unable to concentrate	195	17	30	12.1	60	19	21	19.8	10	25.6	4	23.5	320	17.1
REPRODUCTIVE														
Trouble having a child	50	4.4	14	5.8	16	5.2	2	1.9	0	—	1	6.7	83	4.5
Gastro-Intestinal Symptoms	296	25.5	47	18.7	77	24.3	41	37.6	15	41	8	47.1	485	25.6*
Musculoskeletal Symptoms	452	39.3	88	35.3	126	40	59	54.6	16	42.1	10	58.8	751	40*
Nervous Symptoms	650	56.2	120	47.8	195	61.5	70	64.2	28	71.8	10	58.8	1073	56.8*
Any Symptoms	**764**	**65.6**	**149**	**59.4**	**212**	**66.7**	**82**	**75.2**	**31**	**79.5**	**11**	**64.7**	**1249**	**65.8**
Average No. Symptoms	**2.65**	**n=1164**	**2.08**	**n=251**	**2.83**	**n=318**	**3.74**	**n=109**	**3.95**	**n=39**	**5.12**	**n=17**	**2.76**	**n=1898**

*p < 0.05 for linear trend

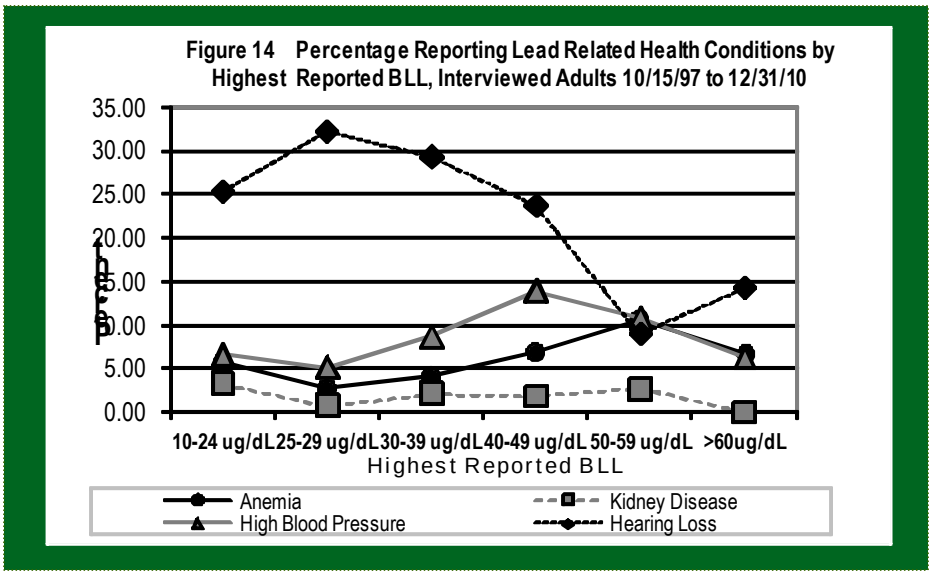
education, and in those who had not graduated high school. Highest blood leads were least common in those who had a 7th grade education or less or had completed 1-3 years of college (Table 11).

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 symptoms were included in this table. Loss of 10+ pounds without dieting, continued loss of appetite, frequent joint pain/soreness, headache, depression, being tired, feeling nervous and being irritable were statistically significant as associated with increasingly higher levels of blood lead. Having any gastro-intestinal, musculoskeletal or

Table 13 Lead Related Health Conditions of Michigan Adults with BLLs ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/97 to 12/31/10 by Highest Reported BLL

Lead Related	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	64	5.7	7	2.9	13	4.2	7	6.9	4	10.5	1	6.7	96	5.3
Kidney Disease	37	3.3	2	0.8	7	2.2	2	1.9	1	2.7	0	—	49	2.6
High Blood	75	6.6	13	5.2	27	8.7	14	13.9	4	10.8	1	6.3	134	7.2*
Hearing Loss	239	25.3	37	32.2	34	29.3	10	23.8	1	9.1	1	14.3	322	26.1

*p < 0.05 for linear trend



industry by lead level reported among those interviewed overall shows that 32.4% worked in special trade construction and 19.2% worked in the primary metals industry (non-ferrous foundries). These two industries show the highest percentage workers for the higher blood leads (≥ 25 µg/dL), as well (Table 15). Table 16 lists the types of working conditions reported by the interviewed adults, again by highest reported

(Continued from page 26)

nervous symptoms was also statistically associated with increasingly 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 reported for the adults who completed a questionnaire (Table 14) show 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). The type of

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, headache, depression, being tired, feeling nervous and being irritable 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 of Michigan Adults with BLLs ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/97 to 12/31/10 by Highest Reported BLL

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		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
≤5	385	58	117	63.9	141	56.4	44	57.1	18	56.3	9	64.3	714	58.5
6—10	90	13.6	30	16.4	39	15.6	10	13	8	25	2	14.3	179	14.7
11—20	96	14.5	23	13.7	35	14	12	15.6	4	12.5	2	14.3	174	14.3
21—30	54	8.1	9	4.9	29	11.6	3	3.9	1	3.1	1	7.1	97	8
≥30	39	5.9	2	1.1	6	2.4	8	10.4	1	3.1	0	—	56	4.6

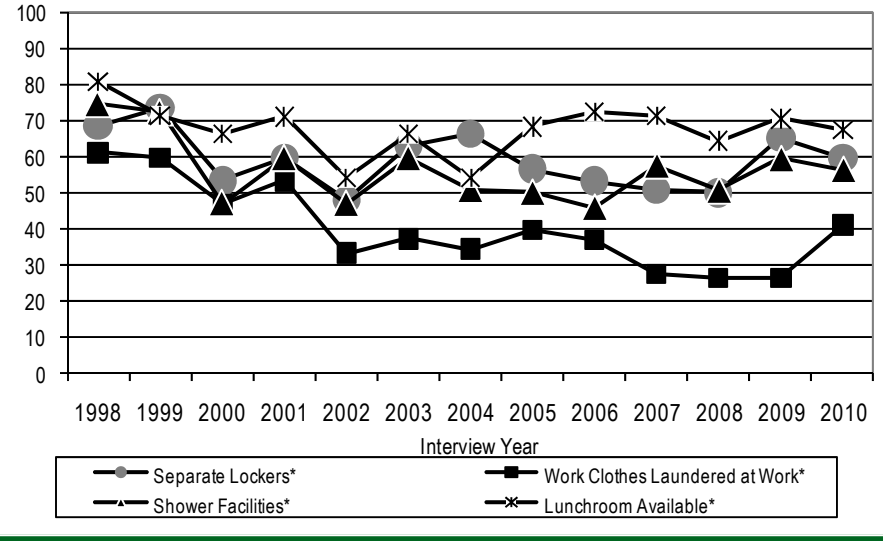
Table 15 Industry of Michigan Adults with BLLs of ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/97 to 12/31/10 by Highest Reported BLL

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)	21	3.1	3	1.6	1	0.4	1	1.3	0	—	1	6.7	27	2.2
Construction, Heavy (16)	24	3.5	1	0.5	5	2	1	1.3	1	3	0	—	32	2.6
Special Trade Construction (17)	217	31.9	50	26.5	85	34.1	32	40.5	13	39.4	7	46.7	404	32.4
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	1.6	3	1.6	5	2	3	3.8	2	6.1	0	—	24	1.9
Primary Metals Industry (33)	65	9.6	54	28.6	85	34.1	23	29.1	8	24.2	4	26.7	239	19.2
Fabricated Metal Products (34)	67	9.9	23	12.2	18	7.2	4	5.1	1	3	0	—	113	9.1
Industrial, Comm. Machnry(35)	18	2.6	4	2.1	5	2	1	1.3	2	6.1	1	6.7	31	2.5
Electronics (36)	14	2.1	1	0.5	0	—	1	1.3	0	—	0	—	16	1.3
Transportation Equipment (37)	15	2.2	3	1.6	5	2	2	2.5	1	3	0	—	26	2.1
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)	2	0.3	3	1.6	3	1.2	0	—	0	—	0	—	8	0.6
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	5.7	9	4.8	5	2	4	5.1	0	—	0	—	57	4.6
Wholesale-Durable Goods (50)	20	2.9	1	0.5	2	0.8	0	—	0	—	0	—	23	1.8
Building Materials, Hardware (52)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Automotive Dealers, Gas (55)	2	0.3	3	1.6	2	0.8	0	—	0	—	0	—	7	0.6
Other Retail Trade (59)	4	0.6	0	—	2	0.8	1	1.3	0	—	0	—	7	0.6
Depository Institutions (60)	1	0.1	0	—	0	—	0	—	0	—	0	—	1	0.1
Finance, Insurance , Real Estate (65)	2	0.3	0	—	0	—	0	—	0	—	0	—	2	0.2
Business Services (73)	13	1.9	0	—	0	—	0	—	0	—	0	—	13	1
Automotive repair Services (75)	24	3.5	7	3.7	6	2.4	4	5.1	2	6.1	0	—	43	3.5
Misc. Repair Services (76)	8	1.2	1	0.5	4	1.6	1	1.3	0	—	0	—	14	1.1
Amusement and Recreation (79)	18	2.6	5	2.6	4	1.6	1	1.3	3	9.1	2	13.3	33	2.7
Health Services (80)	2	0.3	0	—	0	—	0	—	0	—	0	—	2	0.2
Educational Services (82)	13	1.9	3	1.6	1	0.4	0	—	0	—	0	—	17	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)	14	2.1	3	1.6	2	0.8	0	—	0	—	0	—	19	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	4.9	8	4.2	6	2.4	0	—	0	—	0	—	47	3.8
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)	7	1	1	0.5	0	—	0	—	0	—	0	—	8	0.6
National Security Int'l Affairs (97)	5	0.7	0	—	0	—	0	—	0	—	0	—	5	0.4
TOTAL	**680**	**100**	**189**	**100**	**249**	**100**	**79**	**100**	**33**	**100**	**15**	**100**	**1245**	100

lead level. Workers with 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 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 depict the trends in the percent of working conditions and personal habits reported by the interviewed adults, by interview year, for the last thirteen years of surveillance. Figure 15 shows an increase since 2008 in the number of individuals reporting work clothes laundered at work. All other working conditions or work practices that reduce lead exposure show a downward trend in the last year. There appears to be little trend demonstration over the years in personal habits (Figure 16).

Figure 15 Percent of Individuals with BLLs ≥ 10 µg/dL Trend of Working conditions, Michigan 1998 -2010



* Based on positive questionnaire responses

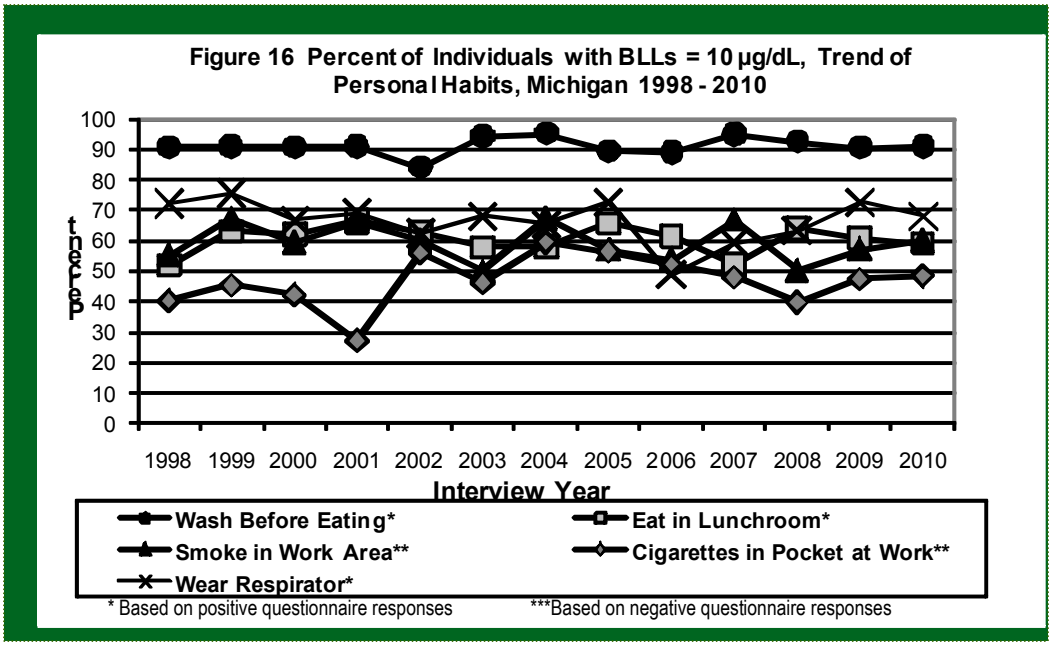
Table 16 Working Conditions of Michigan Adults with BLLs of ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/97 to 12/31/010 by Highest Reported BLL

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+	359	55.3	127	69.8	165	67.9	41	53.2	21	61.8	4	30.8	717	59.8
Work clothes laundered: work+	209	32.5	100	55.6	133	54.5	30	39	13	38.2	4	30.8	489	41.0*
Shower facility +	332	50.8	118	64.8	169	69.3	40	50.6	14	42.4	6	46.2	679	56.4
Lunch room available +	425	65.6	128	70.7	185	75.8	45	57	17	51.5	6	46.2	806	67.3
Clean off dust & wash hands before eating +	593	92.8	160	87.9	225	91.5	65	85.5	30	88.2	10	76.9	1083	91.0*
Eat in lunchroom +	280	57.7	100	69.4	125	61.9	35	53	9	33.3	4	36.4	553	59.1
Wear respirator +	414	63	131	72	185	74.6	62	79.5	23	67.6	10	76.9	825	68.1*
Smoke in work area ++	196	59.2	64	64.6	91	66.4	19	40.4	12	54.5	4	50	386	59.9
Keep cigarettes in pocket while working++	158	48.8	44	44.9	75	56	20	41.7	8	36.4	3	37.5	308	48.6
Exposed to lead now +	366	57.5	107	60.5	158	65.3	41	56.9	19	63.3	3	23.1	694	59.3
Removal from job +	31	4.7	14	7.7	31	12.7	18	23.7	10	29.4	5	38.5	109	9.0*
Tested as part of Co Med Screening+	498	42.9	162	63.5	217	68.5	58	53.2	25	65.8	8	44.4	51	51.0*

+Based on positive questionnaire responses

++ Based on **negative** questionnaire responses

*p<0.05 for linear trend



The questionnaire also asks about children in the household, in order to document the potential for and extent of take-home lead. Twenty-five and a half percent of the adults interviewed reported children age 6 and younger living or spending time in the home (Table 17). Children from 142 (33.3%) of the 478 households where an adult had an elevated lead level and young children who lived or frequently visited were tested for blood lead. Among the 142 households where the child's blood test results were reported, 48 (35.8%) reported a child with an elevated blood lead level (≥ 10 µg/dL). Contact information for individuals reporting young children in their household was forwarded to MDCH so that a letter could be sent encouraging adults in those households to have the children tested for lead.

Twenty-six percent of the adults interviewed reported children age 6 and younger living or spending time in the home (Table 17).

Table 17 Number of Households with Children (6 or under) Potentially Exposed to Take Home Lead from Michigan Adults with BLLs of ≥ 10 µg/dL Interviewed INCLUSIVE 10/15/97 to 12/31/10 by Highest Reported BLL

	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	271	23.8	69	27.5	93	29.4	31	28.7	11	28.2	3	17.6	478	25.5
Households with Children Tested for Lead	85	35.9	16	25	21	24.7	14	51.9	4	36.4	2	66.7	142	33.3
Households Where Children had Elevated Lead	27	35.1	3	20	9	39.1	7	50	1	33.3	1	50.0	48	35.8

*Among individuals within blood lead category, percentage of their households with children living or spending time in house. n=1872

**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/Spending Time" in the first row. n=427

***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 Tested for Lead" in the second row. n=134

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 2010, there were 598 adults reported in Michigan with BLLs ≥ 10 µg/dL. Approximately ninety-seven percent were men. The mean age was 44.8. They were predominately white (86.5%) 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 (83.8%). 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 thirteen 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 2010 six Michigan adults were reported with BLLs over 50 µg/dL, the maximum blood lead level allowed in the workplace. Four of the six adults were exposed to lead exclusively at work (one from extruded brass manufacturing, one from special trades remediation, one from technical service in manufacturing batteries, one from manufacturing in the fire protection industry). A retained bullet from a gunshot wound contributed to the fifth individual's blood lead level and home renovation activities caused a sixth resident to have blood lead levels elevated over 50 µg/dL.

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 1.43 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 (2). 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 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.

Based on the experience in other states we presume that the number of reports of elevated BLLs we receive is an underestimate of the true number of Michigan citizens with elevated BLLs (8, 9). For example, a study in California in the early 1990s reported that while 95% of lead battery employees had blood lead tests performed by their employers, only 8% of employees from radiator repair facilities and 34% of employees from secondary smelters of nonferrous metal had blood lead testing performed by their employer (9). On a national basis it was estimated that less than 12% of companies using lead provided blood lead testing for their employees (8). Our survey performed 15 years later on 28 Michigan radiator repair facilities showed slightly better results with three of thirty-one (9.7%) performing blood lead testing, MIOSHA inspections of eleven radiator repair facilities, not performing blood tests, found seven (64%) were in violation of at least one component of the MIOSHA lead standard, but only one (9%) of the facilities was cited for being over the action level which required blood lead testing of its employees. Similarly, evaluation of the blood lead testing compliance in four Michigan's brass/bronze facilities found that these four facilities, which were not providing blood lead testing for their employees, were not required by MIOSHA standard to provide such testing because air levels of lead were below the 25 mg/m^3 action level. Health professionals continue to call on OSHA to consider recent health studies which identify the need to lower the allowable workplace lead exposure (3).

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 (3-6). Levels as low as 5 ug/dL have been associated with adverse cardiovascular and neurologic health effects (3,6).

Our interviews with Michigan 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 allowable blood lead level. Eighty-one 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 without these overt symptoms.

In 2010 Michigan ABLES joined ten other ABLES states in a study funded by NIOSH with Kyle Steenland, PhD at Emory University, as the principal investigator. The objective of the research is to study the mortality of approximately 100,000 US workers 18 years or older, who were identified in blood lead surveillance programs in these eleven states during the period 1982-2005. The subjects will be equally divided between those who have had at least one blood lead level at or above 25 ug/dl, and those who have had one or more blood lead level <25 ug/dl and no blood lead >=25 ug/dl. The outcomes of interest will be mortality from cancer, stroke, heart disease, and non-malignant kidney disease. Both the International Agency for Cancer (IARC) and the National Toxicology Program (NTP) have recently declared lead to be a probable human carcinogen (10,11), 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 (12), but it is not known if lower levels lead to this outcome. The mortality of the workers will be compared to that of the US population for both underlying and multiple cause (any mention on the death certificate). In addition those with high blood leads will be compared directly to those with low blood leads. A comparison can also be made to the US population for the incidence of end-stage renal disease (ESRD), and conduct internal analyses of ESRD by blood lead level. The population of interest has the advantage of having documented blood lead levels, and being larger than any previously studied cohort of lead-exposed workers. Data from Michigan ABLES was submitted to both the National Death Index (NDI), and the United States Renal Data System (USRDS) and then forwarded on Emory for evaluation. Data analysis is underway.

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. The 2010 MIOSHA inspection of a Michigan construction company involved in scrap yard recycling demonstrates the need to remain vigilant in relaying lead regulations and health and safety information to this emerging industry.

Since 2002 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. Scientific articles on current medical knowledge of these adverse health effects of lead have also been provided to encourage changes to the interpretative language of reference ranges of lead on their laboratory reports. The change would conform with the recommendations on medical management and prevention of adult blood lead levels as

outlined in Table 3 of an article published in Environmental Health Perspectives (7). This mini-monograph of articles documented the inadequacy of the current OSHA standard to protect against the health effects of lead. Physicians rely on laboratory reports to provide information based on the 95% confidence limit of a laboratory value in the general population in making medical recommendations for their patients. Often laboratory reports are their main source of information. 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 is now at 4.2 µg/dl (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 36% 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 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 35.8% 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 thirteenth 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, has appeared to plateau (Figure 5). This plateau along with a plateau in the number of individuals who report preventive personal habits to reduce lead exposure at the facility where they are employed (Figure 16) has us concerned 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.

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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* Information on blood lead laboratory results reporting requirements by state is available at the ABLES program website http://www.cdc.gov/niosh/topics/ABLES/State-Contacts.html.

† 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.

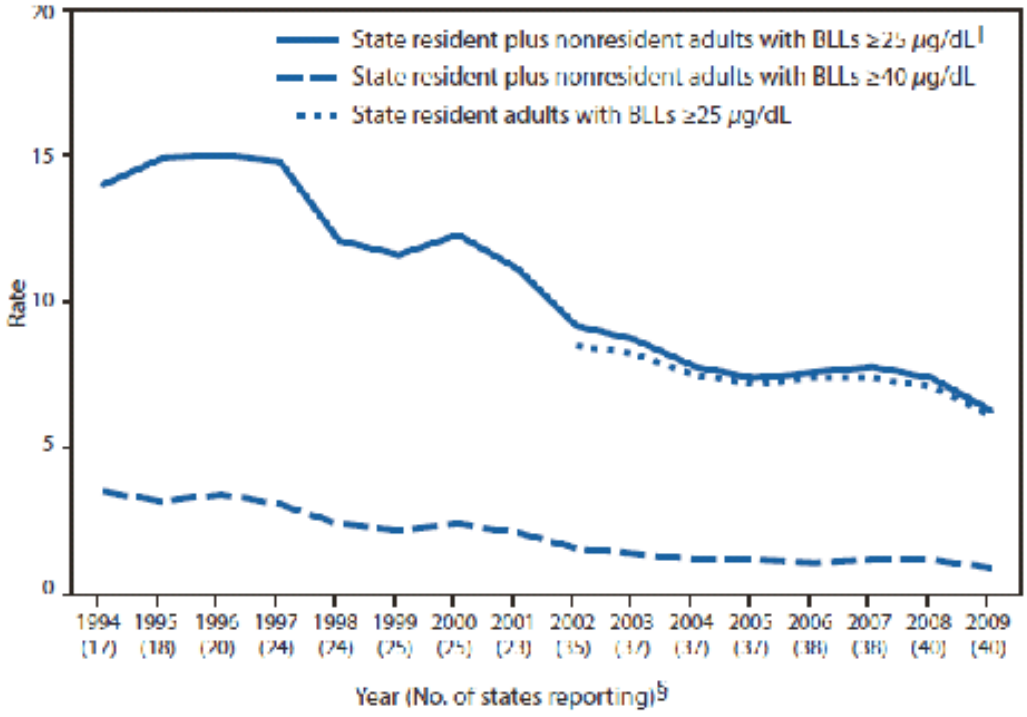
What this report adds?

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



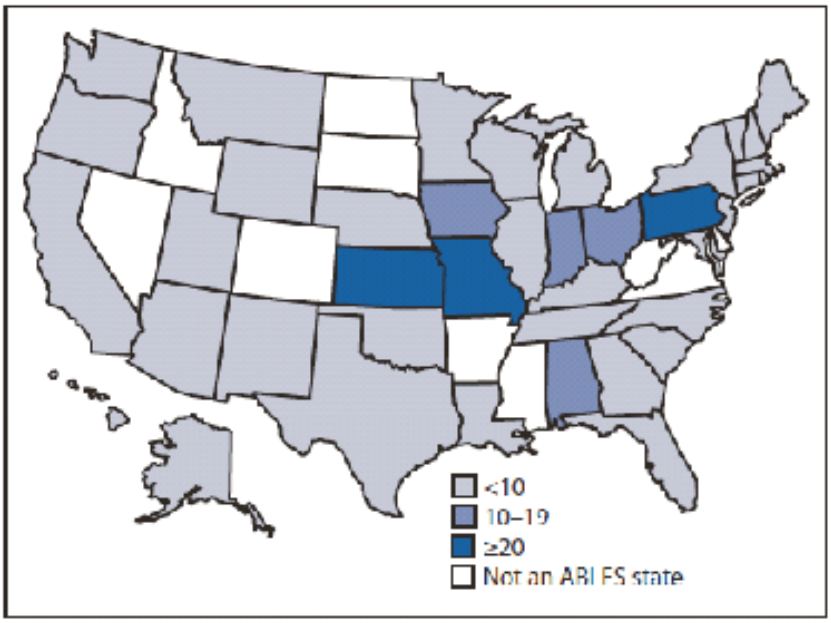
* Per 100,000 employed adults aged ≥16 years. Denominators for 2008--2009 extracted from 2011 U.S. Department of Labor, Bureau of Labor Statistics Local Area Unemployment Statistics program, available at http://www.bls.gov/data.

† 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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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

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.

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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Occupational exposure to lead accounts for 95% of adult elevated blood lead levels in the U.S. (2).

Michigan's 2010 lead surveillance show that of the 16.2% of individuals with elevated BLLs from non-occupational sources, 71.7% 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**