NH Occupational Health Surveillance Program

Institute on Disability
RESEARCH

Characterization of Lower Blood Lead Levels Reported for New Hampshire Adults from 2014-2016

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Background

Despite significant reductions in lead exposure in the United States, elevated blood lead levels (EBLLs) in adults remain a significant occupational health problem. Lead exposure causes acute and chronic adverse effects in multiple organ systems ranging from subclinical changes in function to symptomatic life-threatening intoxication. Moreover, evidence indicates that lead exposure at low doses can lead to adverse cardiovascular and kidney effects, cognitive dysfunction, and adverse reproductive outcomes. Current research has found decreased renal function associated with blood lead levels (BLLs) at 5 µg/dL and lower, and increased risk of hypertension and essential tremor at BLLs below 10 µg/dL. (1)

According to the Centers for Disease Control and Prevention (CDC), about 95% of elevated blood lead levels (EBLLs) in adults are related to their work. Lead is used in over 100 industries, including battery manufacturing, foundry, lead and zinc ore mining, and painting and construction/restoration industries. The National Institute for Occupational Safety and Health (NIOSH) has designated 5 µg/dL (five micrograms per deciliter) of whole blood, in a venous blood sample, as the reference blood lead level for adults. An elevated blood lead level (EBLL) is defined as a BLL > 5 µg/dL. The U.S. Occupational Safety and Health Administration (OSHA) Lead Standards require workers to be removed from lead exposure when BLLs are equal or greater than 50 µg/dL (construction industry) or 60 µg/dL (general industry) and allow workers to return to work when the BLL is below 40 µg/dL. (2)

Currently, the Healthy Homes and Lead Poisoning Prevention Program (HHLPPP) at the Division of Public Health Services in the New Hampshire Department of Health and Human Services receives all adult blood lead reports for New Hampshire residents from labs and medical providers in accordance with State law. Adult blood lead levels >40 µg/dL are reported to the Occupational Safety and Health Administration (OSHA), as per the federal OSHA Lead Standard.

This study was conducted to better characterize blood lead levels in the New Hampshire adult population. The objective is to gain additional insights into the occupational risk for lower level exposures to lead.

Methods

A total of 7,981 individual adults were tested (some of these adults may have had more than 1 test submitted in each of the 3 years) and submitted to NH HHLPPP during the three years identified for this study (2014-2016). For the purposes of this study, adult blood lead level tests ≥ 10 µg/dL (n=346) were analyzed by blood lead level, demographics, and industry type. When applicable, trends were analyzed across previous years (2009-2013) as well. Data, including age, gender, blood lead level, and employer, was collected through test results submitted to the State of New Hampshire Healthy Homes and Lead Poisoning Prevention Program (HHLPPP) in accordance with New Hampshire Statue 130-A-3. This law states that any laboratory performing blood lead analysis on adults shall supply "the occupation of individuals aged 16 years and older; and the name of the individual's employer at the time that the blood lead test is performed when testing is a requirement of the individual's occupation." For cases where no employer data was included, HHLPPP staff called providers to determine patients' employers. Each case was classified into industry group using the 2017 North American Industry Classification System

(NAICS) codes; the first two digits determine the General Industry Category while full codes were used to classify Industry Subcategory for further analysis.

All cases were ordered by unique client ID number, and duplicate tests were removed. When possible, venous blood draw test results were used for analysis, but the few cases with only a capillary test or an unknown sample type were also included (n=27). The final data set included 346 cases, representing the highest blood lead level result for each patient, and blood lead levels were split into three categories: 10-24 µg/dL, 25-39 µg/dL, and ≥ 40 µg/dL. Due to the low number of blood lead levels ≥ 40 µg/dL, the upper two categories were combined for some analyses. The data was analyzed by age, gender, blood lead level, and employer industry.

Of the 346 total cases within the three-year period, employment information was obtained for 299, including individuals who were retired (n=8), self-employed (n=5), disabled (n=2), and unemployed (n=2).

Figure 1 shows the yearly number of New Hampshire adults 16 years and older who had a BLL test result ≥ 10 µg/dL from 2014 to 2016.

Figure 1

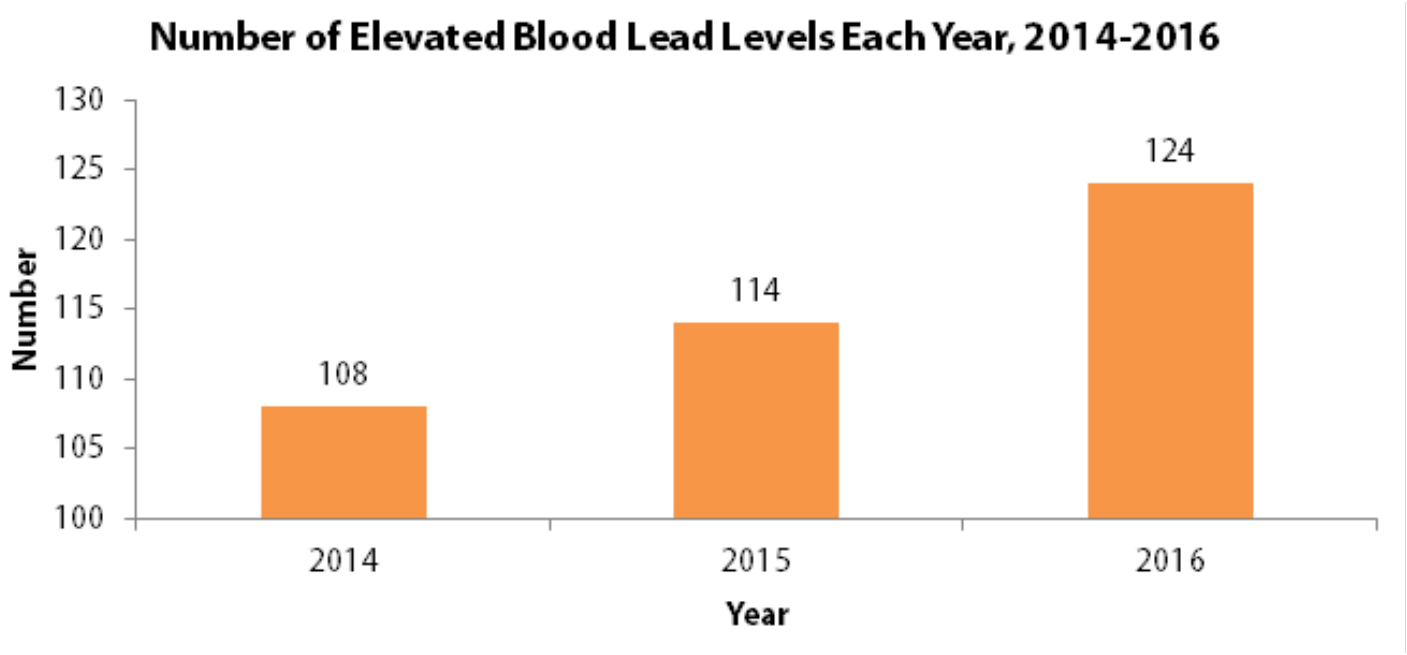


Figure 2 shows the yearly number of New Hampshire adults 16 years and older who had a BLL test result ≥ 10 µg/dL from 2009 to 2016.

Figure 2

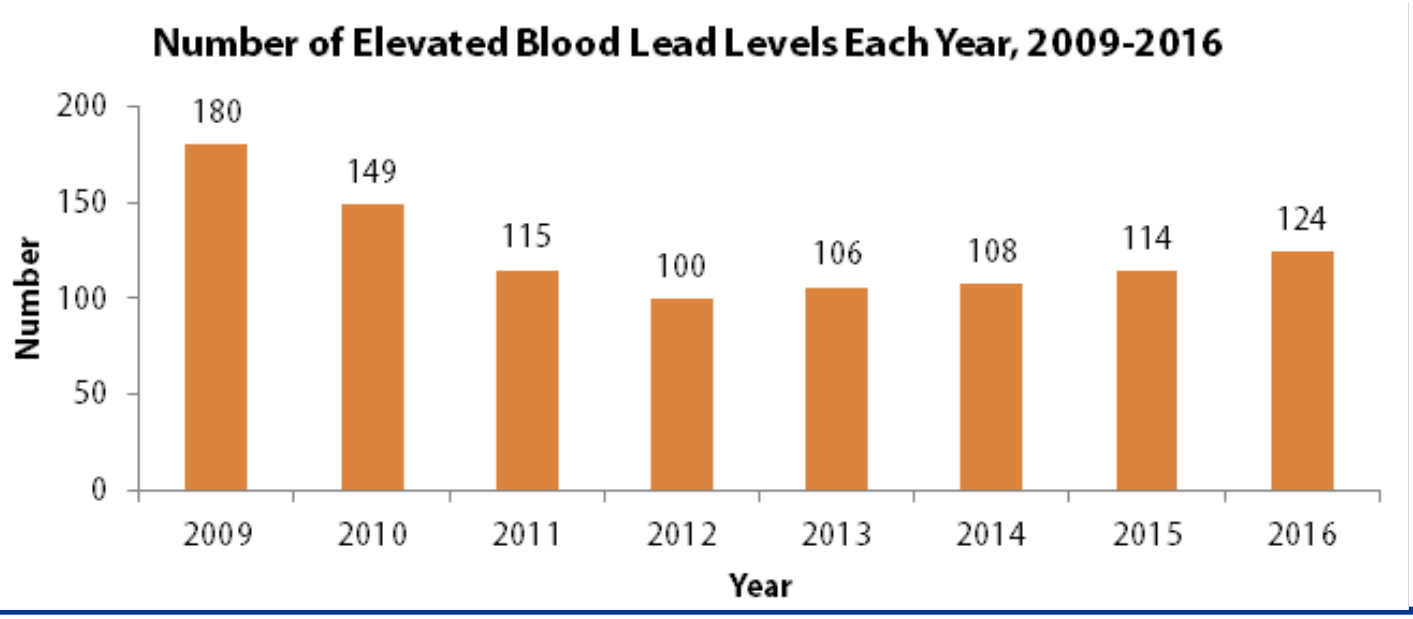


Table 1 shows the percentage breakdown of BLLs from 2014-2016. Years 2014 and 2015 follow earlier trends with between 80 and 90% of cases represented by lower BLL results (10-24 µg/dL) and only 1-2% at 40 or above. 2016 saw an increase in the percentage shared by higher results, with over 20% of cases above 25 µg/dL and 4% of cases at 40 or above.

Table 1: Blood Lead Test Results by Level by Year

Year	Blood Lead Level Test Result						Total No. of Cases for Year
	10-24 µg/dL		25-39 µg/dL		≥ 40 µg/dL		
	No. of Cases	% of Total Cases	No. of cases	% of total cases	No. of Cases	% of total cases	
2014	90	83.33%	17	15.74%	1	0.93%	108
2015	103	90.35%	9	7.89%	2	1.75%	114
2016	97	78.23%	22	17.74%	5	4.03%	124
Total	**290**	**83.82%**	**48**	**13.87%**	**8**	**2.31%**	**346**

Table 2 shows the distribution of lead levels by gender and age. Of the 346 cases, 21.7% (n=75) were between the ages 21 and 30 and 95% (n=329) were males. Among males, 22% (n=73) of cases were in the 21 to 30 age group while in females, only 12% (n=2) of cases were in this age group. The majority of female cases (59%; n=10) were above 51 years in age. 16% (n=54) of male cases and 12% (n=2) of female cases were ≥25 µg/dL.

Table 2: Lead Test Result by Gender and Age

Age Group	Blood Lead Level Test Result				Total No. Cases per Age Group
	10 to 24 µg/dL		≥25 µg/dL		
	No. of Males	No. of Females	No. of Males	No. of Females	
16 to 20	6	1	2	0	9
21 to 30	64	1	9	1	75
31 to 40	56	1	15	0	72
41 to 50	54	3	7	0	64
51 to 60	56	4	12	1	73
61+	39	5	9	0	53
Total	**275**	**15**	**54**	**2**	**346**

Figure 3 shows the average elevated BLL for each year 2014-2016 (does not include more than one test per adult). In 2016, the average BLL was 18.7 µg/dL, which is over 8 µg/dL higher than the recommended action level of 10 µg/dL and the highest average BLL in the reporting period beginning in 2009 (see below).

Figure 3

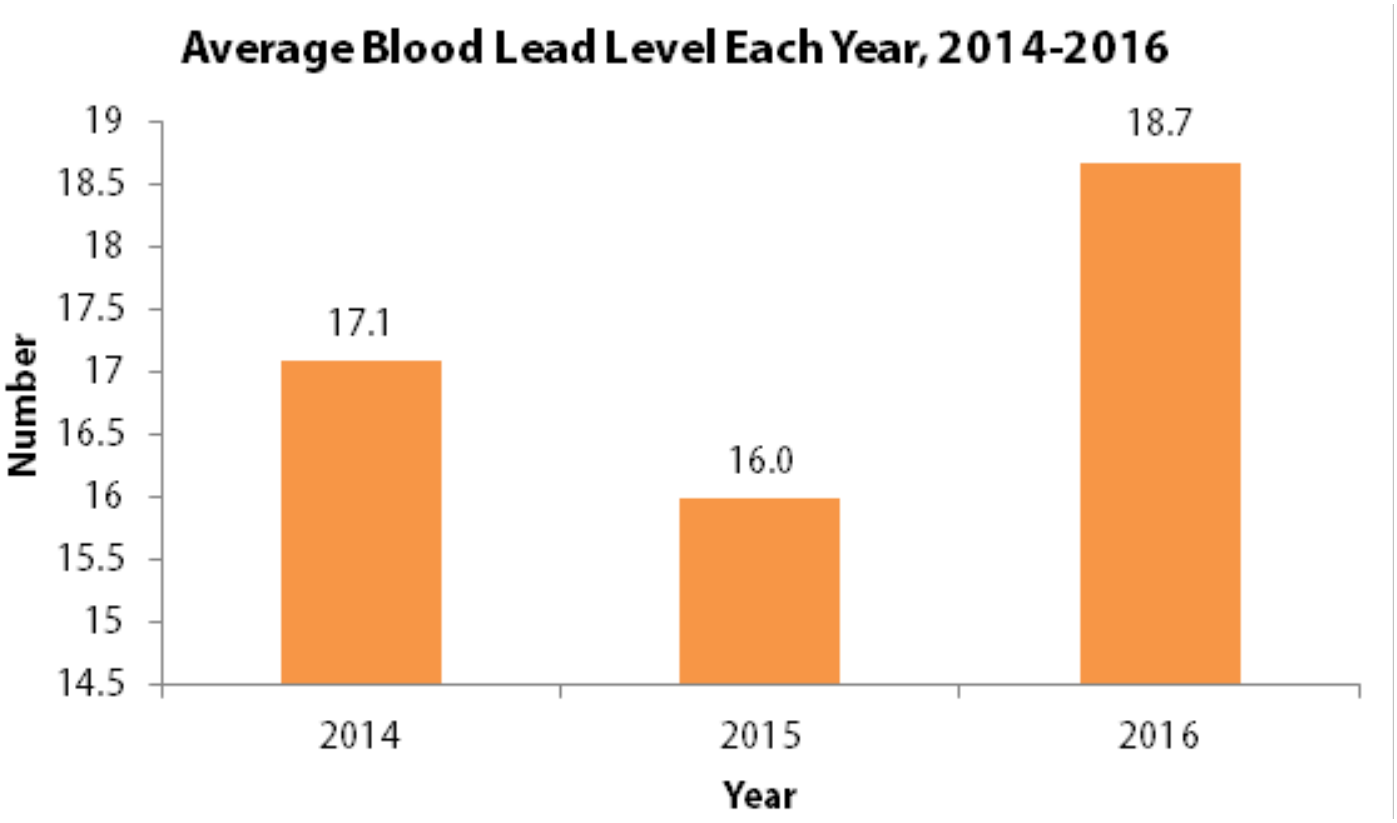
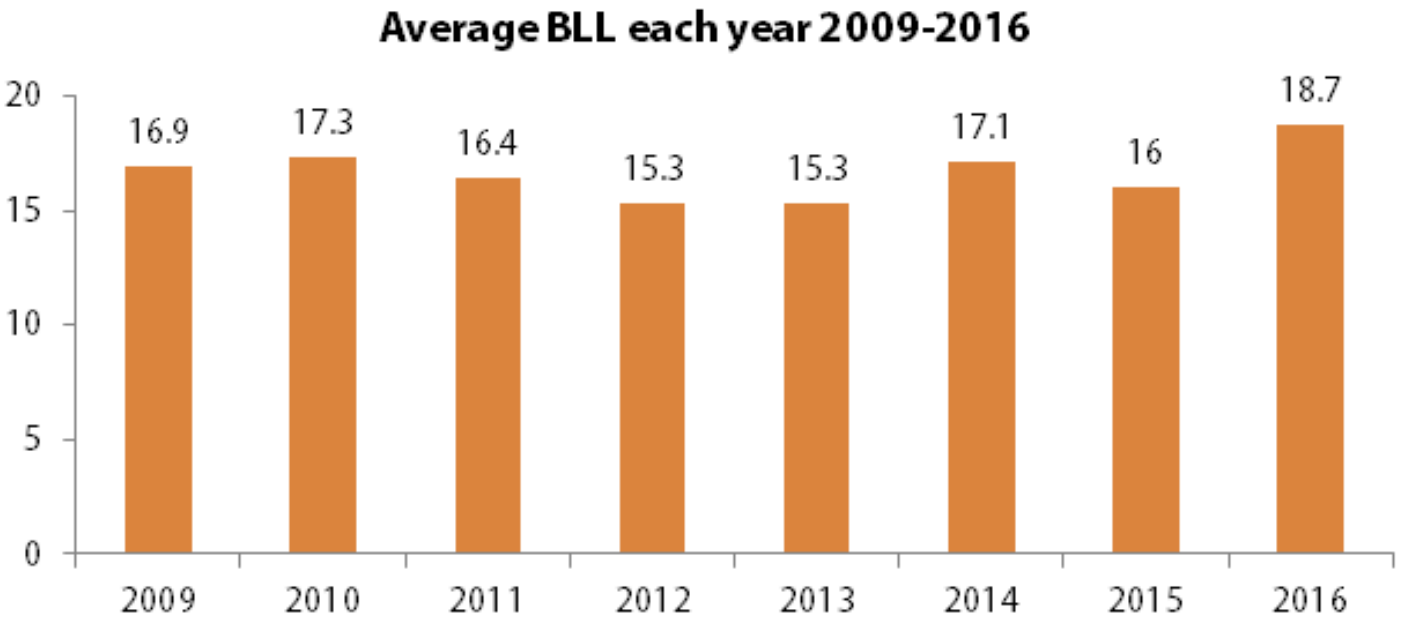


Figure 4 shows the trend in average elevated BLL for each year from 2009-2016.

Figure 4



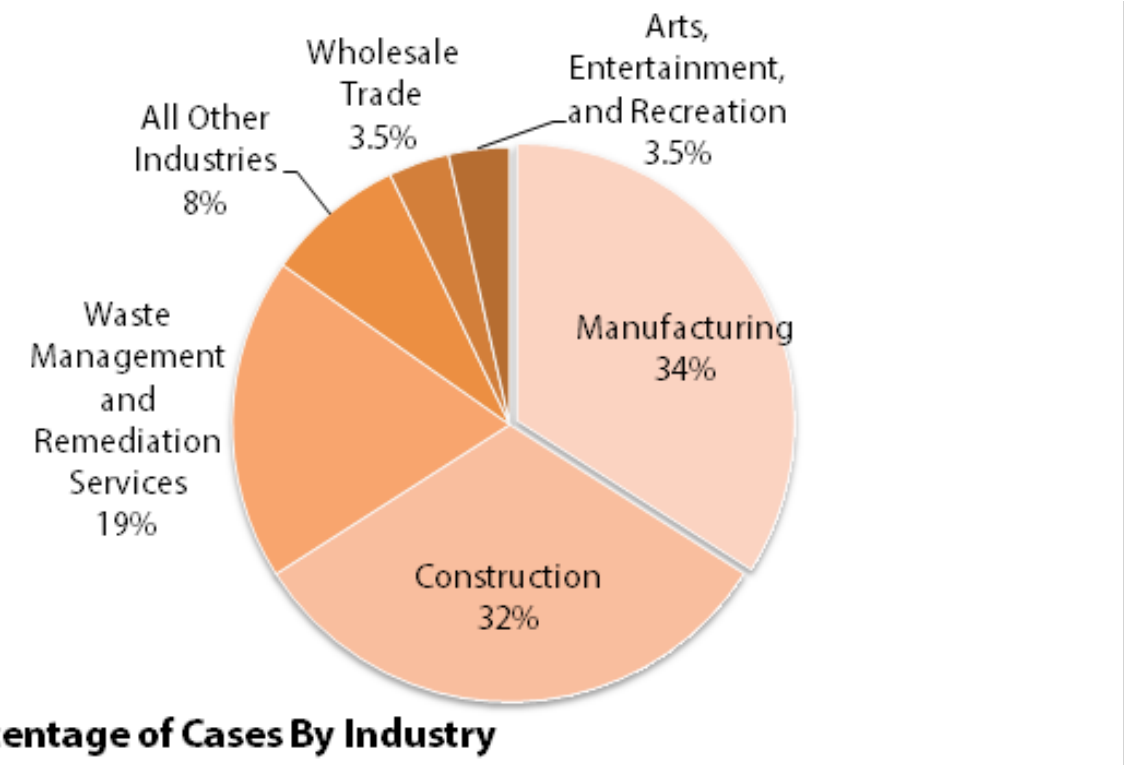
Of the 346 cases, 299 had employment information (47 cases had an unknown employer); 8 were retired, 5 self-employed, 2 disabled, and 2 unemployed. Table 3 shows the 282 cases coded with NAICS general industry codes.

Table 3: Lead Test Results by General Industry, 2014-2016

NAICS General Industry	BLL Test Result (µg/dL)			Total No. Cases	Percent of Total Cases
	10 to 24	25 to 39	≥40		
Manufacturing	87	8	1	96	34.04%
Construction	70	16	4	90	31.91%
Waste Management & Remediation Services	43	8	2	53	18.79%
Wholesale Trade	8	2		10	3.55%
Arts, Entertainment, & Recreation	7	3		10	3.55%
Public Administration	4	1		5	1.77%
Transportation & Warehousing	3	0		3	1.42%
Educational Services	3	0		3	1.06%
Other Services (Auto Repair)	3	1		4	1.06%
Healthcare & Social Assistance	2	0		2	0.71%
Retail Trade	2	0		2	0.71%
Professional, Scientific, & Technical Services	1	0		1	0.35%
Utilities	1	0		1	0.35%
Real Estate Rental & Leasing	1	0		1	0.35%
Accommodation & Food Services	1	0		1	0.35%
Total	**236**	**46**	**7**	**282**	**100.00%**

Figure 5 indicates the top three most common industries were Manufacturing (34%), Construction (32%), and Waste Management and Remediation (19%).

Figure 5



Blood lead results were then categorized into industry subcategories within each general industry category.

Table 4: Lead Test Results within the Manufacturing Industry

Top 5 Manufacturing Subcategories	BLL Test Result (µg/dL)		Total No. Cases
	10 to 24	≥25	
Industrial Valve Manufacturing	44	6	50
Small Arms, Ordnance, & Ordnance Accessories Manufacturing	25	1	26
Non-ferrous foundry & machine shop	7	0	7
Clay Building Material & Refractories Manufacturing	3	0	3
Power Boiler & Heat Exchanger Manufacturing	3	0	3
All Others	5	2	7
Grand Total	**87**	**9**	**96**

Table 5: Lead Test Results within the Construction Industry

Top 5 Construction Subcategories	BLL Test Result (µg/dL)		Total No. Cases
	10 to 24	≥25	
Painting and Wall Covering Contractors	35	8	43
Residential Building Construction	9	4	13
Residential Remodelers	8	5	13
Highway, Street, & Bridge Construction	6	1	7
Glass & Glazing Contractors	3	1	4
All Others	9	1	10
Grand Total	**70**	**20**	**90**

Table 6: Lead Test Results within the Waste and Remediation Industry

Top 5 Waste and Remediation Industry Subcategories	BLL Test Result (µg/dL)		Total No. Cases
	10 to 24	≥25	
Remediation Services	34	10	44
Materials Recovery Facilities	6	0	6
Security Guards & Patrol Services	1	0	1
Other Nonhazardous Waste Treatment & Disposal	1	0	1
Remediation & clean-up of contaminated buildings, mine sites, soil, or ground water	1	0	1
Grand Total	**43**	**10**	**53**

Table 7: Top 6 Industry Subcategories for Tests over 40 µg/dL

NAICS Industry Text	No. Results ≥40 µg/dL
Residential Remodelers	2
Remediation Services	2
Semiconductor Machinery Manufacturing	1
Residential Building Construction	1
Glass and Glazing Contractors	1
Unemployed	1
Grand Total	**8**

Table 8 shows the BLL test results for the top 10 industry sub categories, as listed in the tables above, including

retired individuals. At the time of testing, 50 adults were employed in Industrial Valve Manufacturing, 44 adults were employed as Painting and Wall Covering Contractors, and 44 adults were employed in Remediation Services.

In addition, there were 8 individuals reported as Retired. Of these 8, two cases had additional notations of hobbies potentially responsible for the elevated BLL, hunting and firing range.

Table 8: Top 10 Industry Subcategories from Above (Includes Retired)

NAICS Industry Text	BLL Test Result (µg/dL)		Total No. of Cases for Industry
	10 to 24	≥25	
Industrial Valve Manufacturing	44	6	50
Remediation Services	34	10	44
Painting and Wall Covering Contractors	35	8	43
Small Arms, Ordnance, & Ordnance Accessories Manufacturing	25	1	26
Residential Remodelers	8	5	13
Residential Building Construction	9	4	13
Shooting ranges	7	3	10
Electronics parts, recyclable, merchant wholesalers	6	2	8
Highway, Street, & Bridge Construction	6	1	7
Non-ferrous foundry and machine shop	7	0	7

Discussion

Workers in New Hampshire are at risk for adverse health effects from exposure to lead each year. The majority of adults in our study have a BLL between 10 and 24 µg/dL, with an average 8 µg/dL greater than the recommended level at which adults should have intervention to reduce BLL. The presence of lower BLLs was most significant in males of all ages. Adults employed in the Manufacturing, Construction, and Waste Management and Remediation industries represented a large number of these lower BLLs.

Our analysis indicates that long-term lead exposure continues to be a problem in our New Hampshire businesses and industries. OSHA rules impact those with BLLs > 40 µg/dL, however, no such regulation protects those with lower blood lead levels. OSHA regulations have also not been changed substantially since the late 1970's and thus are primarily based on health studies from over three decades ago. The current occupational standards are not sufficiently protective and should be strengthened.

Adult exposure to lead at work also has implications for the worker's family, especially children, through the possibility of "take-home" lead. Even small amounts of lead can pose a serious threat to the health and development of young children.

State adult lead programs often do not have the resources to follow up on all adult lead cases in their states. Funding cuts in the Adult Blood Lead Epidemiology and Surveillance (ABLES) program have impacted states' ability to collect, code, and analyze data for lower BLLs, including industry information. Intervention activities with individuals, worksites, and others are also impacted. The loss of surveillance support to identify worker exposures could mean fewer referrals to OSHA and therefore a reduction in identifying and addressing lead and other workplace hazards. Surveillance identifying worker exposures in industries with little or no OSHA oversight (e.g., small radiator shops, firing ranges, renovation work) and emerging technologies (e.g., electronics recycling) will leave these workplaces and hazards unidentified as well.

With the knowledge we now have about the health impact of chronic low-level exposure to lead, it is critical that public health experts work with occupational health and safety professionals to not only monitor adults for lead exposure but to also ensure that adequate protections are in place. This includes support of medical staff who can assist with tracking, monitoring, and reporting all adult lead cases, with a focus on follow-up to ensure appropriate protections are taken to reduce or eliminate the risk. Ultimately, however, permissible exposure levels in the workplace need to be reduced in order to provide the most effective protection at the source of exposure.

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www.dhhs.nh.gov/DPHS/bchs/clpp/index.htm

NH Occupational Health Surveillance Program

Institute on Disability, University of New Hampshire

www.nhohsp.unh.edu

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2. National Institute for Occupational Safety and Health (NIOSH) Adult Blood Lead Epidemiology and Surveillance (ABLES) Program. https://www.cdc.gov/niosh/topics/ables/default.html

3. Survey results from 33 ABLES States on the Impact of ABLES Program Funding Cuts, 2014.

About the New Hampshire Occupational Health Surveillance Project

The NH OHSP provides meaningful statistics to identify priority occupational safety and health issues in the state. This includes reports on a variety of core occupational health indicators based on measures of health (work-related disease, injury, or disability) or factors associated with health, such as workplace exposures, hazards or interventions.

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