

Surveillance of Adult Lead Exposure April 1990 - December 1997

by

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The data would not be possible without the cooperation of participating laboratories, local health departments, industries and subjects interviewed.

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EXECUTIVE SUMMARY

The Illinois Department of Public Health has maintained the Adult Blood Lead Registry (ABLR) since April 1990. The registry, which collects reports on persons 16 years of age and older who have blood lead levels equal to or greater than 25 micrograms per deciliter ($\mu\text{g}/\text{dl}$), contributes to reduced lead exposure in the workplace. By collecting data on individuals exposed to lead, the ABLR helps to identify worksites where lead levels are a problem. Once these sites are identified, regulatory agencies can intervene with worksite management to reduce the lead exposures. This report summarizes the laboratory data received by ABLR and the referrals for intervention the registry has made between April 1990 and December 1997.

DATA COLLECTION

The Adult Blood Lead Registry is a laboratory-based surveillance system that collects data from all laboratories in Illinois licensed to perform blood lead analyses. In addition, the federal Occupational Safety and Health Administration (OSHA) requires all laboratories it approves to report to those state health departments that have lead registries. OSHA requires worksites to use an approved laboratory for testing of blood lead levels.

Laboratories are required to provide information on the case's name; the dates the blood sample was collected, received, and tested by the testing laboratory; the blood lead level; and the name of the party submitting the blood sample to the laboratory. Follow-up data collection is done by local health departments that voluntarily participate in ABLR activities. The local health departments collect data on the case's race, sex, date of birth, employer and occupation, and the presence of children or pregnant women in the household.

A system has been developed to identify multiple reporting of the same individual and duplicate reporting of the same blood sample. Reports are considered absolute matches for multiple reports when the following fields are identical:

last name, first name, date of birth, street number, and street name; or
last name, first name, date of birth, and submitting party.

The first report of an individual is used for case surveillance purposes. Reports are considered duplicate reports from the same blood sample when the following fields are identical:

last name, first name, sample date, score and date of birth.

ROUTINE SURVEILLANCE REPORTS

On a quarterly basis, summary statistics are sent to each health department participating in the ABLR follow-up program. Each department receives a list of all reports submitted to date. Included on these lists are the patient identification number, sample date, blood lead level, employer, and name of the party submitting the report.

IDPH's Childhood Lead Poisoning Prevention Program is sent monthly reports identifying cases with pregnant women or children in the household. The report shows the case's name and address, blood lead level, number of children in the household, whether a pregnant female resides in the household, and the date the blood lead sample was received by the testing laboratory.

Referrals to the Department's Division of Environmental Health are made for a worksite if a report indicates a person with a blood lead level in excess of 80 µg/dl or if any individual has had at least three reports of a level 50 µg/dl or greater during the past six months. The monthly report to the Division of Environmental Health shows the case identification number, name, employer, submitting party, sample received date, and the blood lead level.

The Illinois Department of Labor receives a report for persons employed with a state or local government as the industry code. These reports are mailed monthly.

ABLR staff sends a monthly report to OSHA area offices for individuals with blood lead levels above 40 µg/dl. These reports identify company name, company address, identification number, blood lead level, and blood sample date.

Summary statistics were provided to the U.S. Centers for Disease Control and Prevention (CDC) between 1991 and 1995. Due to the loss of federal funding in 1996 and CDC's increased demand for intervention data, data reports for CDC have not been prepared since 1996.

DATA ANALYSIS

The data were analyzed by reviewing the total number of reports received by laboratories between April 1, 1990, and December 31, 1997. A system was developed to track records from the time they are reported on the laboratory reporting form through local health department case follow-up. Records were analyzed by the status of the record as of December 31, 1997:

- A. Records waiting for more follow-up from the submitting party
- B. Records waiting for follow-up from the local health department
- C. Complete records that include local health department follow-up
- D. Incomplete records, information not available for one or more of the following reasons
 - 1. Unable to obtain demographic data from the submitting party
 - 2. No local health department
 - 3. Local health department does not participate in ABLR
 - 4. Record is a multiple report for a person previously reported to ABLR.

Record completeness is different for each data element and is dependant on the record status. Data on 'C' status reports are more complete than data on 'D' status reports.

Reports of lead levels between 25 and 39 µg/dl levels, which OSHA does not consider out of compliance, are put into one category. The second category contains reports of lead levels ranging

from 40 to 49 µg/dl. The third category of blood lead level is 50 to 59 µg/dl. The final category is lead levels of 60 µg/dl or greater. Reports in the last two categories are considered a violation of OSHA standards if three are received for the same person in a six-month interval.

Prior to 1993, IDPH worked with local health departments to identify the individuals' workplace. In 1993, the registry attempted to gain access to employer data by requesting that companies supply employee data on individuals exposed to lead. Prior to 1993, 71 percent of reports identified an individual's employer by means of local health department follow-up.

In 1993, the registry contacted 72 employers, 48 of which agreed to cooperate by identifying their employees or by providing information on the laboratory report form. In 1997, 70 percent of the laboratory reports have company identifiers that can be matched to individuals already on the ABLR database. Local health department follow-up identifies another 5 percent of the reports for personal and company information. These methods have helped the registry to reduce the number of individuals needing lead hazard training (OSHA rules and regulations state the company must furnish this training). In addition, local health departments' personnel do not need to conduct follow-up interviews for individuals receiving company training.

RESULTS

Geographic Data

Table 1 shows the number of reports and persons by county of residence. Some counties have industries that produce lead or use it in the manufacturing process, while others do not. Most of the individuals on the registry work in lead industries that cluster in four counties: Cook, Kankakee, Lake, and Madison. However, several individuals have been identified as having elevated blood lead levels because of recreational lead exposures, such as indoor firing range shooting, stained glass making, lead molding, and home renovation.

Industry and Occupational Data

Table 2 shows the most common industries as grouped by the federal Office of Management and Budget's standard industrial classification. Industry information shows the primary metal industry accounted for the most reports (n = 6,247). Other commonly reported industries were electronic and electrical equipment (lead acid battery making), fabricated metal products (nonferrous castings), and chemical and allied products.

Table 3 shows the most common occupations appearing in the registry, as classified by the U. S. Department of Commerce, Bureau of the Census, coding schema. Operators, fabricators and laborers accounted for the greatest number of reports (n = 1,347) in all blood lead level categories. Other commonly reported occupations include janitors or cleaners and supervisors in production occupations. When observing the percentage of reports at 40 µg/dl and greater to total reports for the occupational category on the registry, two occupational groups show a potential for excessive blood lead scores: (1) Machine operators and tenders and (2) precision production craft and repair occupations presented the greatest percentage (30) of reports with elevated blood lead levels of 40 µg/dl and greater.

Demographic Characteristics

The age distribution for the reports and for persons appear in Table 4. When age was known, 58.8 percent of the reports submitted occurred in persons younger than 45. The age group 35 to 44 years had the most reports of any age group.

The distribution of laboratory reports by gender, race, and blood lead level appears in Table 5. Seventy-one percent of the reports were submitted for whites. These proportions are less than the proportion of whites reported in the 1990 census of population in the Illinois (78 percent).

Submissions for blacks accounted for 25 percent of the laboratory reports. This proportion is higher than the black population in Illinois as shown by the 1990 census (15 percent).

Table 5 shows that females are less likely than males to have elevated blood lead levels. In males, nonwhites were significantly more likely than whites to have an elevated blood lead level more than 40 µg/dl.

The mean blood lead level has declined from 37 µg/dl in 1990 to 34.6 µg/dl in 1997. In addition, the maximum lead levels also have gone down during this time period. The levels are higher than the *Healthy People 2000* goal set by the U. S. Department of Health and Human Services, which calls for the elimination of exposures that result in workers having blood lead concentrations greater than 25 µg/dl of whole blood. Table 6 shows the percentage of reports with blood lead levels divided into four categories as well as the extreme value of blood lead levels by year, while table 7 shows the reduction in mean values.

As the result of the ABLR surveillance in conjunction with OSHA intervention, 20 companies in Illinois have been investigated for elevated blood lead levels in their employees. Table 8 shows the type of industry and the fine assessment. The number of individuals protected by the investigations cannot be estimated as the number of exposed employees is not mentioned in OSHA fine assessment analysis. In some instances, even though OSHA may not have assessed a fine to a particular company, the site investigations resulted in reduced blood lead levels to employees of the company.

REFERENCES

United States Department of Health and Human Services. *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*. Publication. PHS 1996; 96-1256.

United States Department of Commerce's Bureau of the Census. *1990 Census of Population and Housing, Illinois*. Publication. 1990 CPH-1-15.

Illinois Department of Public Health, Division of Epidemiologic Studies. *Surveillance of Adult Lead Exposure April 1, 1990 - September 30, 1991*. Publication. 1992 Epidemiologic Report 92:5

**Table 1. Number of Reports by County by Year of Report
Illinois, 1990 - 1997**

COUNTY	1990	1991	1992	1993	1994	1995	1996	1997	Total
Not available	921	1,484	2,029	1,530	600	550	578	401	8,093
Adams	0	4	0	1	7	6	3	0	21
Alexander	0	0	0	0	0	1	0	0	1
Bond	1	8	2	2	0	1	0	1	15
Boone	1	2	1	3	0	5	4	2	18
Brown	0	0	0	0	0	0	0	2	2
Bureau	0	0	12	3	2	1	0	1	19
Calhoun	0	2	1	2	0	0	0	2	7
Carroll	29	10	2	18	67	46	52	23	247
Cass	0	0	0	0	0	0	1	0	1
Champaign	1	1	3	6	5	3	1	4	24
Christian	6	3	0	4	25	8	4	4	54
Clinton	0	0	0	0	5	1	0	0	6
Coles	1	1	0	1	0	0	1	0	4
Cook	513	828	464	378	355	325	214	209	3,286
DeKalb	2	1	0	0	2	6	32	4	47
DeWitt	1	2	3	0	0	5	1	2	14
Douglas	0	0	0	0	1	0	0	1	2
DuPage	28	31	24	41	19	26	37	57	263
Edgar	0	0	0	3	0	0	0	0	3
Effingham	0	7	2	1	1	0	0	2	13
Ford	2	1	0	3	8	0	0	0	14
Franklin	2	0	0	0	2	0	2	1	7
Fulton	1	2	9	11	16	10	6	5	60
Greene	3	1	0	1	1	1	3	3	13
Grundy	0	0	0	0	0	3	2	0	5
Hancock	0	0	2	6	15	15	15	15	68
Hardin	0	0	0	0	1	0	0	0	1
Henderson	0	0	0	33	94	87	67	76	357
Henry	1	3	11	3	1	1	6	1	27
Iroquois	25	29	5	29	41	42	55	32	258
Jackson	0	0	1	0	0	0	0	2	3
Jefferson	0	0	0	0	0	1	0	0	1
Jersey	17	12	13	11	9	9	8	1	80

**Table 1 (continued). Number of Reports by County by Year of Report
Illinois, 1990 - 1997**

COUNTY	1990	1991	1992	1993	1994	1995	1996	1997	Total
Jo Daviess	0	0	0	1	0	0	0	0	1
Johnson	0	0	0	0	0	1	0	0	1
Kane	9	15	3	17	17	92	322	67	542
Kankakee	230	262	46	318	651	435	585	484	3,011
Kendall	0	0	0	1	3	4	16	10	34
Knox	1	19	4	2	1	2	22	9	60
Lake	24	148	129	175	143	129	142	123	1,013
LaSalle	31	26	53	41	12	4	8	2	177
Lawrence	0	0	0	0	0	1	0	0	1
Lee	0	6	9	0	0	1	0	0	16
Livingston	3	2	0	1	4	1	2	5	18
Logan	0	1	0	2	3	0	1	2	9
McDonough	10	7	6	4	1	1	0	0	29
McHenry	23	17	9	21	19	13	10	5	117
McLean	0	2	5	0	1	0	1	0	9
Macon	137	58	5	71	98	81	26	17	493
Macoupin	26	22	10	15	16	18	7	2	116
Madison	206	154	48	168	323	244	168	68	1,379
Marion	0	0	4	0	1	1	4	3	13
Mason	0	2	1	1	1	2	1	0	8
Massac	0	0	0	0	0	2	0	0	2
Menard	0	0	1	0	0	0	0	0	1
Mercer	0	0	11	13	6	0	16	6	52
Monroe	0	0	0	1	3	5	2	2	13
Montgomery	0	0	3	0	0	4	1	1	9
Morgan	0	1	6	1	7	2	0	0	17
Moultrie	2	0	0	3	3	4	0	3	15
Ogle	0	0	0	0	0	1	0	0	1
Peoria	12	151	168	38	71	71	68	43	622
Piatt	1	1	1	1	2	2	4	0	12
Pike	0	0	0	0	2	0	4	1	7
Putnam	0	0	8	0	1	0	0	0	9
Randolph	0	0	0	2	0	3	1	1	7
Rock Island	6	4	4	4	5	12	6	3	44
St. Clair	35	25	5	19	41	52	46	16	239

**Table 1 (continued). Number of Reports by County by Year of Report
Illinois, 1990 - 1997**

COUNTY	1990	1991	1992	1993	1994	1995	1996	1997	Total
Saline	0	0	0	0	0	0	1	0	1
Sangamon	2	6	10	8	15	10	3	3	57
Schuyler	0	0	0	0	0	0	2	0	2
Shelby	6	0	0	1	3	5	1	1	17
Stark	0	0	0	0	0	1	0	0	1
Stephenson	0	0	0	0	0	0	1	1	2
Tazewell	6	26	32	13	12	49	37	23	198
Union	0	0	0	1	0	0	0	0	1
Vermillion	3	4	7	1	0	0	1	2	18
Warren	0	1	1	10	24	20	18	13	87
Washington	0	1	0	0	4	3	1	0	9
Whiteside	12	4	0	3	9	7	13	3	51
Will	12	16	18	14	22	27	33	29	171
Williamson	2	3	2	4	17	14	20	20	82
Winnebago	34	35	8	33	24	40	24	33	231
Woodford	0	3	4	1	0	0	1	0	9
Recreational	99	91	70	53	114	61	23	42	553
Out of State	0	0	0	0	0	4	11	0	15
Total	2,487	3,545	3,275	3,152	2,956	2,582	2,745	1,894	22,636

Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 2. Case Reports by Blood Lead Levels by Industry Group
Illinois, 1990 - 1997**

Industry Group	Blood Lead Levels in $\mu\text{g}/\text{dl}$				Total Reports
	25-39	40-49	50-59	60+	
Building construction	19	4	0	6	29
Heavy construction	41	34	13	13	101
Construction, Special trades	89	23	17	3	132
Lumber and wood products except furniture	2	1	0	0	3
Furniture and fixtures	1	0	0	0	1
Printing and publishing	0	1	0	0	1
Chemicals and allied products	808	200	49	13	1,070
Rubber and misc. plastic products	45	3	2	1	51
Stone, clay, glass, and concrete products	21	4	0	0	25
Primary metal industries	4,307	1,512	351	77	6,247
Fabricated metal products, except machinery and transportation equipment	1,151	259	41	9	1,460
Industrial and commercial equipment and computer equipment	82	13	4	7	106
Electronic and other electrical equipment, except computer equipment	4,748	994	127	28	5,897
Transportation equipment	75	12	0	0	87
Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	108	13	5	0	126
Miscellaneous manufacturing industries	10	2	0	0	12
Railroad transportation	5	4	2	1	12
Local and suburban transit and interurban, highway passenger transportation	292	58	22	4	376
Motor freight transportation and warehousing	2	0	0	0	2
U.S. (Postal Service)	3	0	0	0	3
Transportation by air	0	1	0	0	1
Electric, gas sanitary service	16	6	0	0	22
Wholesale trade-durable goods	21	7	3	1	32
Wholesale trade-non durable goods	0	0	0	1	1
Building materials, hardware, garden supply, and mobile home dealers	1	0	0	0	1
Automotive dealers and gasoline service stations	1	0	0	0	1

**Table 2 (continued). Case Reports by Blood Lead Levels by Industry Group
Illinois, 1990 - 1997**

Industry Group	Blood Lead Levels in $\mu\text{g}/\text{dl}$				Total Reports
	25-39	40-49	50-59	60+	
Home furniture, furnishings, and equipment stores	1	0	0	0	1
Miscellaneous retail	9	6	0	3	18
Business services	18	13	2	5	38
Automotive repair, services and parking	32	12	4	5	53
Misc. repair service	3	0	0	0	3
Amusement and recreation services	5	0	0	0	5
Health services	0	1	0	0	1
Legal services	2	0	0	0	2
Educational services	1	2	0	0	3
Membership organizations	4	0	0	1	5
Engineering, accounting, research, management and related services	7	1	0	0	8
Public administration	0	0	2	0	2
Executive, legislative, and general government, except finance	1	0	0	0	1
Justice, public order and safety	145	19	3	0	167
Administration of environmental quality and housing programs	0	0	1	2	3
National security and international affairs	1	1	1	0	3
Nonclassifiable establishments	32	8	2	0	42

Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 3. Case Reports by Blood Lead Levels by Occupational Group
Illinois, 1990 - 1997**

Occupational Group	25-39 µg/dl		40-49 µg/dl		50-59 µg/dl		60+ µg/dl		Total Score
	No.	%	No.	%	No.	%	No.	%	
Managerial and professional specialty occupations	93	77	20	17	6	5	2	2	121
Technical, sales and administrative support occupations	15	88	0	0	1	6	1	6	17
Sales Occupations	6	86	1	14	0	0	0	0	7
Administrative support occupations including clerical	17	94	1	6	0	0	0	0	18
Private household cleaners and servants	0	0	1	100	0	0	0	0	1
Protective service occupations	13	54	8	33	3	13	0	0	24
Service occupations, except protective and household	96	72	30	22	5	4	3	2	134
Farming, forestry and fishing occupations	6	75	1	13	1	13	0	0	8
Precision productions, craft and repair occupations	111	70	36	23	8	5	3	2	158
Machine operators and tenders, except precision	133	70	37	19	18	9	3	2	191
Explosives workers	5	100	0	0	0	0	0	0	5
Precision production occupations	180	77	52	22	1	0	0	0	233
Operators, fabricators and laborers	962	71	278	21	72	5	35	3	1,347
Truck and bus drivers	2	50	1	25	0	0	1	25	4
Bridge, lock and lighthouse tenders	0	0	0	0	0	0	1	100	1
Operating engineers	63	88	7	10	2	3	0	0	72
Supervisors, handlers, equipment cleaners and laborers	267	77	50	14	20	6	8	2	345
Military occupation, (rank not specified)	1	100	0	0	0	0	0	0	1

Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 4. Laboratory Reports by Sex and Age Groups
Illinois, 1990 - 1997**

Age Groups	Male		Female		Sex Unknown		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
16-24	826	5.8	54	5.8	37	7.6	917	5.9
25-34	3,191	22.5	100	10.7	128	26.4	3,419	21.9
35-44	4,439	31.2	242	25.8	178	36.8	4,859	31.1
45-54	3,440	24.2	330	35.2	85	17.6	3,855	24.7
55-64	2,108	14.8	174	18.6	50	10.3	2,332	14.9
>65	202	1.4	38	4.1	6	1.2	246	1.6
TOTAL	14,206		938		484		15,628	

Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 5. Number of Individuals by Sex and Race
Illinois, 1990 - 1997**

		Blood Lead Levels in $\mu\text{g/dl}$									
Sex	Race	25 - 39		40 - 49		50 - 59		60+		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Male	White	1,850	73.2	444	65.6	111	64.5	49	67.1	2,454	66.8
	Black	568	22.5	200	29.5	50	29.1	23	31.5	841	22.9
	Asian	44	1.7	17	2.5	6	3.5	1	1.4	68	1.9
	Native American	11	0.4	3	0.4	0	0.0	0	0.0	14	0.4
	Other	56	2.2	13	1.9	5	2.9	0	0.0	74	2.0
	Subtotal	2,529		677		172		73		3,451	
Female	White	77	62.6	20	76.9	4	40.0	3	100.0	104	2.8
	Black	43	35.0	5	19.2	6	60.0	0	0.0	54	1.5
	Asian	2	1.6	0	0.0	0	0.0	0	0.0	2	0.1
	Native American	0	0.0	1	3.8	0	0.0	0	0.0	1	0.0
	Other	1	0.8	0	0.0	0	0.0	0	0.0	1	0.0
	Subtotal	123		26		10		3		162	
Unknown	White	43	78.2	2	33.3	0	0.0	0	0.0	45	1.2
	Black	11	20.0	4	66.7	0	0.0	2	100.0	17	0.5
	Asian	1	1.8	0	0.0	0	0.0	0	0.0	1	0.0
	Native American	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Other	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Subtotal	55		6		0		2		63	
Total		2,707		709		182		78		3,676	

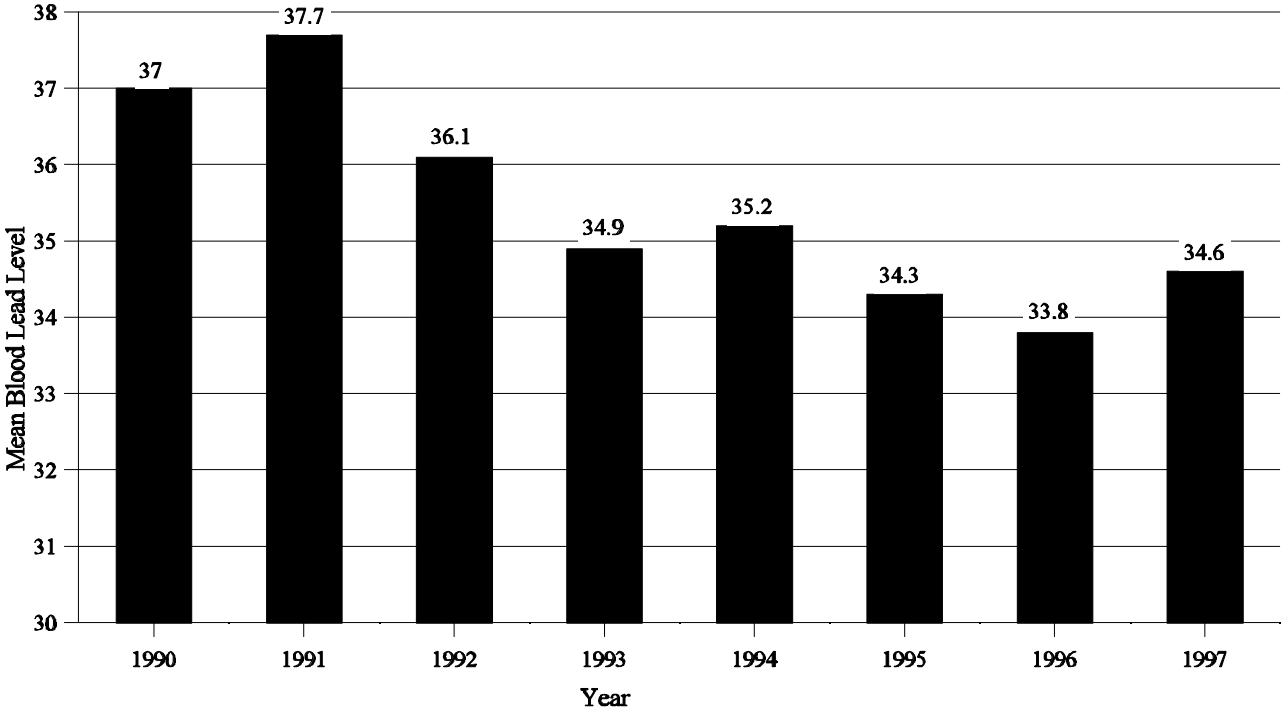
Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 6. Percentage of Blood Lead Levels in $\mu\text{g}/\text{dl}$ by Categories
Illinois, 1990 - 1997**

Year	25-39	40-49	50-59	60+	Highest Reported Value
1990	66.3	24.0	6.8	2.9	109
1991	64.2	23.6	8.4	3.8	193
1992	70.8	20.9	5.9	2.4	265
1993	74.8	20.4	3.8	1.0	170
1994	73.4	21.0	4.3	1.3	136
1995	78.5	17.6	2.8	1.1	104
1996	80.6	16.5	2.3	0.6	88
1997	80.4	14.4	2.5	2.7	142

Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 7. Mean Value of the Blood Lead Level Reports
Illinois, 1990 - 1997**



Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

**Table 8. Regulatory Agencies Investigation Results
Illinois, 1990 - 1997**

Company #	Type of Industry	Inspected by	# of Citations	Fine Assessment
A0141	Aluminum mfg	OSHA	2	\$2,200
P0011	Battery mfg	OSHA	4	\$220,000
A0141	Brass and bronze casting	OSHA	8	\$4,300
K0011	Brass and bronze ingot	OSHA	4	\$4,125
A0101	Brass casting	OSHA	1	\$3,000
C0371	Brass casting	OSHA	4	\$7,375
G0031	Cable and switches	OSHA	3	\$31,725
	Construction	IDPH		
C0031	Faucet manufacture	OSHA	0	\$0
C0411	Lead abatement	OSHA	7	\$7,800
G0131	Lead abatement	OSHA	0	\$0
M0111	Lead abatement	OSHA	2	\$4,375
D0021	Lead product mfg	OSHA	2	\$1,650
	Lead smelting	IDPH		
M0141	Pigment mfg	OSHA	2	\$3,850
C0221	Pigments	OSHA	2	\$6,000
G0021	Railroad equipment mfg	OSHA	1	\$19,000
P0161	Safety cans and pressure tanks	OSHA	19	\$43,050
	Scrap yard	IDPH		
I0051	Scrap yard	OSHA	2	\$10,650
B0081	Steel mill	OSHA	2	\$44,775
G0061	Wire fencing	OSHA	12	\$14,250
	Total			\$428,125

Source: Illinois Department of Public Health, Adult Blood Lead Registry, December 31, 1997

For additional copies or more information, please contact

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