CDC
CENTERS FOR DISEASE CONTROL

May 1, 1992 / Vol. 41 / No. 17

MMWR

MORBIDITY AND MORTALITY WEEKLY REPORT

Effectiveness in Disease and Injury Prevention

Surveillance of Elevated Blood Lead Levels Among Adults — United States, 1992

As of May 1, 1992, health departments of 18 states required reporting of elevated blood lead levels (BLLs) in adults (Table 1). State-based lead surveillance activities have the following common features: 1) a regulation specifying a reportable level, 2) designation of reporting sources (e.g., laboratories and health-care providers), 3) a means for gathering further essential information about reported cases, and 4) a mechanism for linking case reports with follow-up activities (e.g., educational efforts and epidemiologic field investigations). In response to the recent changes in CDC's guidelines for preventing lead poisoning in children (*1*) and to recommendations of CDC's National Institute for Occupational Safety and Health (NIOSH) to reduce occupational lead exposures (*2*), many states are revising downward their reportable BLLs.

During 1991, 13 states provided 18,879 reports of elevated BLLs in adults to NIOSH (Table 2). However, lead monitoring programs may perform multiple BLL tests for individual workers: during 1991, the 10,117 reports from Illinois, New Jersey, and New York* represented 4406 persons (i.e., an average of 2.3 reports per person).

The reports in this issue of *MMWR* highlight the role of the field investigation in the control of occupational lead poisoning and address unique aspects of the control of lead in the workplace and in the environment. During 1992, NIOSH will begin reporting blood lead data for adults (as prevalence and incidence) on a quarterly basis in *MMWR*.

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*The only states for which this information is available.

Surveillance — Continued

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Editorial Note: NIOSH assists states in establishing lead surveillance and has begun to collect data from states and to routinely disseminate national data on elevated BLLs in adults. Surveillance activities 1) document the magnitude of the lead exposure problem in the workplace, 2) assist public health agencies in focusing on industries where control of lead exposure remains a problem, 3) identify new sources of industrial lead poisoning, 4) guide engineers in the design of technologies to

TABLE 1. States with reporting requirements for elevated blood lead levels (BLLs), by reporting source, and reportable level, by age of persons — May 1, 1992

		Reportable BLL	
State	Reporting sources	μg/dL	(age [yrs])
Alabama	Physicians, laboratory directors, hospitals, medical examiners	≥15	(all ages)
California	Medical laboratories	≥25	(all ages)
Colorado	Laboratories, physicians, health facilities	≥25 ≥10	(>18) (≤18)
Connecticut	Clinical laboratories, medical practitioners	≥25	(all ages)
Illinois	Clinical/hospital laboratories, local heatlh authorities	≥25 ≥10	(≥16) (<16)
Iowa	Clinical laboratories, physicians	≥25	(all ages)
Maryland	Clinical laboratories	≥25 all levels*	(≥18) (<18)
Massachusetts	Clinical laboratories	≥15	(all ages)
Michigan	Clinical laboratories	all levels*	(all ages)
New Hampshire	Clinical laboratories, physicians	≥25 ≥10	(≥13) (<13)
New Jersey	Laboratories, physicians, hospitals	≥25	(all ages)
New York	Physicians, clinical laboratories, health facilities	≥25	(all ages)
Oregon	Laboratories	≥25 ≥15	(≥18) (<18)
Pennsylvania	Laboratories	≥40 ≥25	(≥6) (<6)
South Carolina	Laboratories	≥40 ≥10	(>6) (≤6)
Texas	Physicians, clinical laboratories	≥40	(≥15)
Utah	Clinical laboratories, hospitals, physicians	≥15	(all ages)
Wisconsin	Physicians, nurses, hospital administrators, clinical laboratories, public health officers	≥25	(all ages)

*Laboratories are required to report all BLL testing, regardless of findings.

Surveillance — Continued

TABLE 2. Reports of blood lead levels (BLLs) ≥25 μg/dL in adults — selected states,* 1989–1991

State	1989	1990	1991
Alabama	NA†	8§	244
California	5,832	4,911	4,686
Connecticut	31	135	65
Illinois	NA	938§	3,337
Iowa	15	16	18
Maryland	542	613	517
Massachusetts	NA	NA	1,008¶
New Jersey	4,589	4,274	3,379
New York	4,200	3,608	3,401
Oregon	NA	64§	226
Pennsylvania**	928	1,375	NA
Texas**	1,418	1,231	601
Utah	NA	43	59
Wisconsin	2,337	2,014	1,338
Total	**19,892**	**19,230**	**18,879**

*States in which BLLs were reportable and data are available.
†No reports available.
§Reports from one quarter only.
¶Reports from three quarters only.
**Reports of BLLs ≥40 μg/dL only.

control lead in the workplace, and 5) focus public attention and education efforts on excessive lead exposure as an ongoing occupational health problem. Efforts have been initiated to use surveillance data to monitor trends in the incidence of workplace-associated lead poisoning and to provide evaluation of prevention programs to reduce lead exposure.

Lead-induced health effects are known to occur in children and adults across a wide range of exposures. Laboratory-based surveillance is the preferred approach because symptoms of lead poisoning are not particularly sensitive or specific for lead exposure. The lowest observed health effects for children and adults have been compiled (see box, next page).

One of the national health objectives for the year 2000 is to eliminate occupational lead exposures that result in workers having blood lead concentrations >25 μg/dL (objective 10.8) (*2*). Both the Council of State and Territorial Epidemiologists and the American Medical Association have endorsed positions encouraging health departments to make elevated BLLs in children and adults a notifiable condition nationwide.

References

1. CDC. Preventing lead poisoning in young children: a statement by the Centers for Disease Control—October 1991. Atlanta: US Department of Health and Human Services, Public Health Service, CDC, 1991.
2. Public Health Service. Healthy people 2000: national health promotion and disease prevention objectives—full report, with commentary. Washington, DC: US Department of Health and Human Services, Public Health Service, 1991; DHHS publication no. (PHS)91-50212.
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Surveillance — Continued

Summary of lowest observed effect levels for lead-induced health effects in adults and children*

BLL† (μg/dL)		Health effect
>100	Adults:	Encephalopathic signs and symptoms
>80	Adults:	Anemia
	Children:	Encephalopathic signs and symptoms
		Chronic nephropathy (e.g., aminoaciduria)
>70	Adults:	Clinically evident peripheral neuropathy
	Children:	Colic and other gastrointestinal (GI) symptoms
>60	Adults:	Female reproductive effects
		Central nervous system symptoms (i.e., sleep disturbances, mood changes, memory and concentration problems, headaches)
>50	Adults:	Decreased hemoglobin production
		Decreased performance on neurobehavioral tests
		Altered testicular function
		GI symptoms (i.e., abdominal pain, constipation, diarrhea, nausea, anorexia)
	Children:	Peripheral neuropathy
>40	Adults:	Decreased peripheral nerve conduction
		Elevated blood pressure (white males aged 40–59 years)
		Chronic nephropathy
	Children:	Reduced hemoglobin synthesis
>25	Adults:	Elevated erythrocyte protoporphyrin levels in males
15–25	Adults:	Elevated erythrocyte protoporphyrin levels in females
	Children:	Decreased intelligence and growth
>10§	Fetus:	Preterm delivery
		Impaired learning
		Reduced birth weight
		Impaired mental ability

*Adapted from references *3–5*.
†Blood lead level.
§Safe BLLs have not been determined for fetuses.

Implementation of the Lead Contamination Control Act of 1988

The U.S. Department of Health and Human Services has set as an objective the elimination of elevated blood lead levels (BLLs) in children in the United States by the year 2010 (*1*); an interim goal, specified as a national health objective for the year 2000, is to reduce BLLs >15 μg/dL and >25 μg/dL among children aged 6 months–5 years to no more than 500,000 and zero, respectively (objective 11.4) (*2*). The Lead Contamination Control Act of 1988 authorized CDC to make grants to state and local agencies for comprehensive programs designed to 1) screen infants and children for elevated BLLs, 2) ensure referral for medical and environmental intervention for lead-poisoned infants and children, and 3) provide education about childhood lead poisoning. This report summarizes efforts to implement the Lead Contamination Control Act.

Lead Contamination Control Act — Continued

Funds for this program were first appropriated in fiscal year 1990. In fiscal year 1991, these funds supported expansion of screening efforts and program development in 13 states and two cities.* Funded programs are required to report quarterly on the number of children screened, number identified with BLLs ≥25 µg/dL, number of housing units receiving environmental inspections, and number of housing units in which hazard-reduction activities have been implemented. (Reporting requirements for grantees are being modified for consistency with guidelines that require individual follow-up in children with BLLs ≥15 µg/dL [*3*]).

Cleveland, Ohio, is one example of an area with a lead identification and prevention program. In fiscal year 1991, among Cleveland children who were screened by health-care workers who went door-to-door in high-risk areas, the incidence of BLLs ≥25 µg/dL was 3.4 times greater than that among children who were screened by the programs at fixed-site facilities (Table 1). In addition, door-to-door screening provided an introduction into the health-care system for many children, thereby facilitating receipt of benefits of other child health programs, such as vaccination programs.

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Editorial Note: Lead poisoning of children in their home environments was first reported in the 1890s in Australia (*4*). Although the problem was reported in subsequent decades in the United States, public health resources were not directed to the problem until the 1950s, when case-finding efforts began. During 1966, the first mass screening program was initiated in Chicago, followed by New York City and other cities (*4*).

During 1971, the Lead-Based Paint Poisoning Prevention Act initiated a national effort to identify children with lead poisoning and abate the sources of lead in their environments. CDC administered approximately $89 million in federal funds appro-

*Connecticut, District of Columbia, Illinois, Indiana, Kentucky, Maryland, Massachusetts, New Jersey, New York City, New York State, Ohio, Pennsylvania, Rhode Island, South Carolina, and Wisconsin.

TABLE 1. Number of children screened and number and percentage identified with blood lead levels (BLLs) ≥25 µg/dL, by type of screening — Cleveland, Ohio, fiscal year 1991

Type of screening	No. children screened	Children with confirmed BLLs ≥25 µg/dL	
		No.	(%)
Fixed-site screening by childhood lead poisoning prevention programs	5,822	79	(1.4)
Door-to-door screening by lead poisoning prevention program staff	533	25	(4.7)
Screening by other health-care providers	14,135	314	(2.2)
Total	**20,490**	**418**	**(2.0)**

Lead Contamination Control Act — Continued

priated under this act; these funds enabled identification of more than 250,000 children with lead poisoning and facilitated referrals for environmental and medical intervention.

In 1981, when categorical programs, such as that for childhood lead poisoning prevention, were consolidated into the Maternal and Child Health (MCH) Services Block Grant Program, administrative responsibility for the Lead-Based Paint Poisoning Prevention Act was transferred to the Office of Maternal and Child Health (now the Maternal and Child Health Bureau) of the Health Resources and Services Administration. Under the provisions of the MCH Services Block Grant Act, each state decides how to use these federal funds. Until 1992, however, there was no federal requirement for reporting actual use of these funds for childhood lead poisoning prevention activities, and only limited emphasis had been placed on data collection and analysis by the state and local childhood lead poisoning prevention programs.

The Lead Contamination Control Act of 1988 again authorized a CDC grant program in childhood lead poisoning prevention. There are three fundamental differences between the current program and the childhood lead poisoning prevention program of the 1970s. First, the CDC program has increased emphasis on data collection and analysis by childhood lead poisoning prevention programs to evaluate completeness and timeliness of follow-up and effectiveness of screening activities. For example, special software (System for Tracking Elevated Lead Levels and Remediation [STELLAR]) has been developed to assist childhood lead poisoning prevention programs in case and data management. Second, increased emphasis has been placed on evaluating the impact of interventions. For example, although reduction of hazards from lead-based paint and lead paint-contaminated dust in the home is central to the treatment of a lead-poisoned child, the effect of these actions on the reduction of BLLs had not been well evaluated. Accordingly, CDC and state and local health departments are evaluating such lead paint and dust hazard reduction actions. Third, efforts have been increased to collect data on BLLs for all children who are screened—not just those screened through lead poisoning prevention programs—and CDC is funding an increased number of states to conduct surveillance for BLLs among children; this effort is being coordinated with efforts to conduct surveillance for elevated BLLs in workers.

Additional information about implementation of the Lead Contamination Control Act is available from CDC's Lead Poisoning Prevention Branch, Division of Environmental Hazards and Health Effects, National Center for Environmental Health and Injury Control, Mailstop F-28, 1600 Clifton Road, NE, Atlanta, GA 30333.

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1. CDC. Strategic plan for the elimination of childhood lead poisoning. Atlanta: US Department of Health and Human Services, Public Health Service, 1991.
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Current Trends

Blood Lead Levels Among Children in High-Risk Areas — California, 1987–1990

In the United States, elevated blood lead levels (BLLs) are a major health risk for children; this risk is totally preventable (*1*). To better characterize lead poisoning among children at high risk for lead exposure in California, the California Department of Health Services (CDHS) conducted lead-screening surveys that measured lead levels in children's blood, household paint, and soil in three selected high-risk areas in northern, southern, and central California. This report summarizes the survey findings and describes CDHS's efforts to reduce lead exposure among children in California, especially among those in high-risk areas.

CDHS selected three areas for the surveys based on the likelihood that old housing in these areas contained lead paint (42%–72% of the housing in the survey areas was built before 1950): Oakland in Alameda County (1987); Wilmington and Compton in Los Angeles County (1988); and Sacramento in Sacramento County (1990). In the Oakland and Sacramento survey areas, CDHS attempted to enroll all households with children aged 12–59 months. In the two communities in Los Angeles County, a systematic sample of every fourth block was selected, and CDHS attempted to enroll all households with children aged 12–59 months in those sample blocks. The proportion of eligible households agreeing to participate in each area included 358 (71%) of 506 in Oakland, 350 (56%) of 621 in Wilmington/Compton, and 232 (47%) of 495 in Sacramento. Overall, these households included 973 families with 1397 children in the target age range (ages of children were equally distributed).*

In Oakland, initial blood lead testing was performed by collecting capillary blood samples from the children. To reduce the possibility of sample contamination caused by lead on children's hands, their hands were vigorously washed before the capillary sample was obtained; a confirmatory venous sample was obtained from 74% of the Oakland children with an initial capillary BLL $\geq$15 μg/dL. In Wilmington/Compton and Sacramento, venous blood samples were collected from 96% of the participating children; capillary samples were collected from the other 4% of children surveyed.

In Oakland and Wilmington/Compton, household paint samples were collected only when peeling or chipping paint was observed; in Sacramento, paint samples were collected from surfaces regardless of condition. At each household, soil samples of the top inch of soil were collected from one to five locations (i.e., midsection of front, back, and side yards; directly beneath a rain drain; and near a building not attached to the house on the household property); soil lead level was defined as the geometric mean of all samples collected at the household. Paint lead levels reported were the maximum level found at a home. Lead content in blood and environmental samples was measured using graphite-furnace atomic-absorption spectrophotometry.

*In Los Angeles County, of 471 children surveyed, 272 were excluded because the blood collection tube lot used for their samples was later found to be contaminated with lead; the remaining 199 children included in the study had household environmental lead levels and demographic characteristics similar to those of the excluded children. Paint and soil lead levels are presented for all 350 households.

Blood Lead Levels Among Children — Continued

In these three areas, 40%–84% of children were Hispanic and members of families with reported annual family incomes of <$15,000. BLLs of ≥10 µg/dL[†] were detected in 67% of children in Oakland, 32% in Wilmington/Compton, and 14% in Sacramento. BLLs ≥20 µg/dL[§] were detected in 5% of children in Oakland, 4% in Wilmington/Compton, and 1% in Sacramento.

Geometric mean lead levels in household paint were highest in Oakland and lowest in Wilmington/Compton (range for exterior paint: 3100–13,545 parts per million [ppm]) (Table 1). In all three areas, exterior surfaces were substantially higher in paint lead levels than were interior surfaces. However, lead,levels for some interior paint samples exceeded 5000 ppm (37% in Oakland, 25% in Sacramento, and 13% in Wilmington/Compton).[¶] Soil lead levels were highest in Oakland where 46% of household soil lead levels exceeded 1000 ppm.

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†Levels at which adverse health effects in children have been demonstrated (*2*).

§Levels high enough to require medical evaluation according to CDC guidelines (*2*).

¶According to guidelines established by the U.S. Department of Housing and Urban Development (*3*), surfaces with paint lead levels of ≥5000 ppm should be abated during comprehensive modernization activities.

TABLE 1. Lead concentrations in paint from survey households in selected high-risk areas — California, 1987–1990

Category	Oakland	Wilmington/ Compton	Sacramento
No. households	358	350	232
No. with at least one interior paint sample	188	280	222
Geometric mean interior paint lead concentration (parts per million [ppm])	2,540	817	1,412
Range (ppm)	25–309,700	20–101,000	17–201,000
% with interior paint lead concentration ≥5000 ppm*	37%	13%	25%
No. with at least one exterior paint sample	215	268	218
Geometric mean exterior paint lead concentration (ppm)	13,545	3,100	8,430
Range (ppm)	9–347,900	9–216,200	57–320,000
% with exterior paint lead concentration ≥5000 ppm*	72%	45%	65%
No. with at least one soil sample	292	327	227
Geometric mean soil lead concentration (ppm)	897	188	236
Range (ppm)	50–88,000	30–2,000	26–2,700
% with soil lead concentration ≥1000 ppm†	46%	1%	5%

*According to U.S. Department of Housing and Urban Development guidelines, this is the level at which lead paint in public and Indian housing should be abated in comprehensive modernization programs (*3*).

†Threshold for hazardous waste under the California Department of Health Services' Toxic Substance Control Program.

Blood Lead Levels Among Children — Continued

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Editorial Note: Because recent research findings indicate that adverse health effects may occur among children with BLLs ≥10 µg/dL, CDC guidelines recommend actions to reduce lead exposure in communities where such levels are prevalent (*2*). Before the CDHS assessment, the potential risk for childhood lead poisoning had not been widely recognized in California or other western states. However, the CDHS findings summarized in this report indicate a high prevalence of elevated BLLs among children in high-risk communities in California and are consistent with reports elsewhere (*4*). Although many children participating in these surveys had BLLs that exceeded the guidelines, the levels were too low to cause overt symptoms; thus, in the absence of the CDHS survey, the high prevalence of this problem in Oakland may not have been recognized.

Lead-based paint, the most common source of high-dose lead exposure for children (*4*), was present in a high proportion of the dwellings surveyed by CDHS. In the western U.S. census region, an estimated 80% of privately owned housing units built before 1980 contain some lead-based paint, and the prevalence and concentration of lead in paint is proportionate to the age of the housing units (*5*). In California, an estimated 560,000 children aged <6 years reside in housing units built before 1950 that probably contain high levels of lead in paint (*4*).

In addition to lead-based paint, there are at least three other important potential sources for lead exposure in California. First, lead-contaminated soil was common in the communities surveyed; in urban areas, such contamination may result from deteriorating exterior lead-based paint and/or from emissions from automobiles using leaded gasoline (*2*). Second, in California, seven secondary lead smelters may contribute to contamination of nearby soil. Third, in addition to environmental sources, the use of folk medicines (*6*) and pottery containing lead is prevalent among some minority groups and has caused severe cases of childhood lead poisoning.

In January 1992, the use of leaded gasoline was banned by law in California. In addition, CDHS is exploring other strategies to remove lead from consumer products and to identify and remove lead hazards from high-risk communities. The CDHS is implementing a comprehensive lead-poisoning prevention program that includes periodic blood lead testing for children aged <6 years; case management by local health agencies; laboratory-based reporting (*2*); and educational programs for local health departments, health-care providers, and the public. During 1992, CDHS has been preparing regulations for residential lead-paint abatement. CDHS also is implementing strategies to reduce occupational lead poisoning, prevent the use of lead-based folk medicines, and eliminate other sources of lead exposure.

References

1. Public Health Service. Healthy people 2000: national health promotion and disease prevention objectives—full report, with commentary. Washington, DC: US Department of Health and Human Services, Public Health Service, 1991; DHHS publication no. (PHS)91-50212.
2. CDC. Preventing lead poisoning in young children: a statement by the Centers for Disease Control—October 1991. Atlanta: US Department of Health and Human Services, Public Health Service, 1991.
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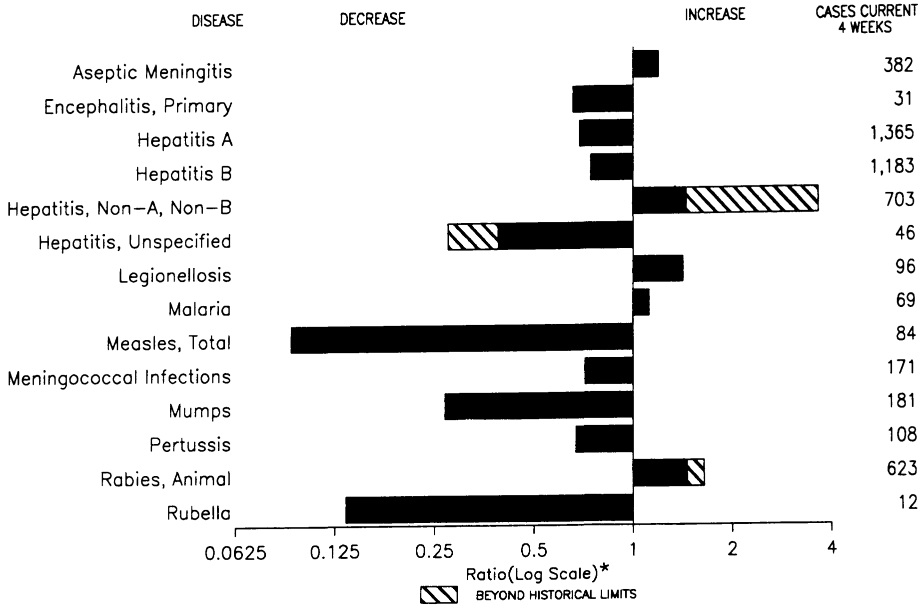
FIGURE I. Notifiable disease reports, comparison of 4-week totals ending April 25, 1992, with historical data — United States



*Ratio of current 4-week total to mean of 15 4-week totals (from previous, comparable, and subsequent 4-week periods for the past 5 years). The point where the hatched area begins is based on the mean and two standard deviations of these 4-week totals.

TABLE I. Summary — cases of specified notifiable diseases, United States, cumulative, week ending April 25, 1992 (17th Week)

	Cum. 1992		Cum. 1992
AIDS	15,438	Measles: imported	53
Anthrax	-	indigenous	553
Botulism: Foodborne	7	Plague	-
Infant	18	Poliomyelitis, Paralytic*	-
Other	-	Psittacosis	21
Brucellosis	6	Rabies, human	-
Cholera	26	Syphilis, primary & secondary	11,210
Congenital rubella syndrome	4	Syphilis, congenital, age < 1 year	-
Diphtheria	2	Tetanus	4
Encephalitis, post-infectious	32	Toxic shock syndrome	80
Gonorrhea	155,508	Trichinosis	11
Haemophilus influenzae (invasive disease)	537	Tuberculosis	6,034
Hansen Disease	44	Tularemia	18
Leptospirosis	10	Typhoid fever	93
Lyme Disease	1,197	Typhus fever, tickborne (RMSF)	48

*Nine suspected cases of poliomyelitis were reported in 1991; 4 of the 8 suspected cases in 1990 were confirmed, and all were vaccine associated.

TABLE II. Cases of selected notifiable diseases, United States, weeks ending April 25, 1992, and April 27, 1991 (17th Week)

Reporting Area	AIDS	Aseptic Menin-gitis	Encephalitis: Primary	Encephalitis: Post-in-fectious	Gonorrhea		Hepatitis (Viral), by type: A	B	NA,NB	Unspeci-fied	Legionel-losis	Lyme Disease
	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1991	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1992
UNITED STATES	15,438	1,483	164	32	155,508	186,163	5,896	4,757	1,570	206	420	1,197
NEW ENGLAND	569	96	13	-	3,373	4,853	221	200	22	14	34	85
Maine	18	8	-	-	34	38	28	12	3	-	2	-
N.H.	19	4	2	-	-	117	14	16	6	-	3	5
Vt.	3	3	1	-	8	16	2	3	2	-	2	1
Mass.	314	35	7	-	1,272	2,039	104	141	8	14	18	30
R.I.	37	46	3	-	269	387	48	15	3	-	9	28
Conn.	178	-	-	-	1,790	2,256	25	13	-	-	-	21
MID. ATLANTIC	3,558	186	9	4	15,142	23,711	497	659	138	12	132	899
Upstate N.Y.	446	82	-	-	2,454	4,128	134	159	83	6	56	642
N.Y. City	1,959	22	1	-	5,171	9,479	158	76	3	-	2	-
N.J.	746	4	-	-	2,271	3,578	68	172	37	-	20	79
Pa.	407	78	8	4	5,246	6,526	137	252	15	6	54	178
E.N. CENTRAL	1,395	214	49	3	24,553	35,630	683	613	72	10	86	26
Ohio	290	69	20	-	8,815	10,846	163	95	39	-	44	19
Ind.	155	18	4	-	2,853	3,542	213	159	2	3	4	4
Ill.	517	36	10	-	8,972	11,018	124	44	9	1	4	2
Mich.	364	87	14	3	2,980	7,917	49	201	5	6	24	1
Wis.	69	4	1	-	933	2,307	134	114	17	-	10	-
W.N. CENTRAL	471	94	4	4	8,378	8,831	654	263	117	6	17	37
Minn.	66	6	1	-	969	923	214	18	3	2	1	1
Iowa	27	20	-	2	606	577	19	13	1	-	3	6
Mo.	266	34	-	-	4,801	5,348	143	202	109	4	5	25
N. Dak.	1	1	-	-	25	24	27	1	-	-	1	2
S. Dak.	3	3	-	1	67	124	145	1	-	-	-	-
Nebr.	18	9	1	1	3	623	49	12	-	-	7	1
Kans.	90	21	2	-	1,907	1,212	57	16	4	-	-	2
S. ATLANTIC	3,521	338	29	13	56,195	55,049	374	833	128	30	58	69
Del.	38	10	4	-	521	736	11	75	-	1	9	30
Md.	477	46	7	-	5,074	5,719	79	137	14	6	9	6
D.C.	283	7	-	-	2,700	3,393	7	39	-	-	7	-
Va.	233	61	6	5	6,420	5,406	36	68	12	14	6	19
W. Va.	25	-	1	-	279	400	4	22	-	5	-	1
N.C.	174	40	8	-	7,943	10,297	25	129	35	-	10	5
S.C.	145	5	-	-	3,079	4,110	9	18	-	-	12	-
Ga.	464	36	1	-	17,268	14,132	39	107	37	-	-	1
Fla.	1,682	133	2	8	12,911	10,856	164	238	30	4	5	7
E.S. CENTRAL	510	69	6	-	14,738	16,348	105	371	561	1	20	13
Ky.	49	31	4	-	1,482	1,787	24	29	-	-	10	4
Tenn.	145	15	1	-	4,646	6,334	49	301	557	-	8	9
Ala.	218	16	-	-	4,833	3,875	19	39	4	1	2	-
Miss.	98	7	1	-	3,777	4,352	13	2	-	-	-	-
W.S. CENTRAL	1,488	110	13	3	15,426	20,710	502	509	22	40	4	13
Ark.	61	8	7	-	2,967	2,129	34	35	5	3	-	1
La.	266	8	-	-	1,969	4,025	29	51	-	1	-	-
Okla.	100	-	1	2	1,557	2,047	73	87	15	2	2	5
Tex.	1,061	94	5	1	8,933	12,509	366	336	2	34	2	7
MOUNTAIN	465	46	7	1	3,389	3,786	856	209	67	23	34	1
Mont.	2	-	1	-	31	24	25	18	11	-	5	-
Idaho	7	5	-	-	41	55	19	23	1	-	3	-
Wyo.	3	-	-	-	17	41	1	2	5	-	1	-
Colo.	177	14	3	1	1,132	1,034	230	40	24	14	4	-
N. Mex.	45	6	2	-	290	342	65	43	4	3	2	-
Ariz.	119	15	1	-	1,171	1,452	428	40	10	2	11	-
Utah	41	-	-	-	65	115	63	3	7	4	1	1
Nev.	71	6	-	-	642	723	25	40	5	-	7	-
PACIFIC	3,461	330	34	4	14,314	17,245	2,004	1,100	443	70	35	54
Wash.	135	-	-	-	1,232	1,530	187	88	40	4	2	2
Oreg.	99	-	-	-	484	661	132	93	20	5	-	-
Calif.	3,167	291	31	3	12,041	14,579	1,604	912	381	60	32	52
Alaska	7	2	3	-	240	243	12	4	2	1	-	-
Hawaii	53	37	-	1	317	232	69	3	-	-	1	-
Guam	-	-	-	-	36	-	5	2	-	2	-	1
P.R.	107	51	-	-	49	205	8	109	5	4	1	-
V.I.	2	-	-	-	40	210	5	4	-	-	-	-
Amer. Samoa	-	-	-	-	10	20	-	1	-	-	-	-
C.N.M.I.	-	-	-	-	26	2	-	-	-	-	-	-

N: Not notifiable U: Unavailable C.N.M.I.: Commonwealth of the Northern Mariana Islands

TABLE II. (Cont'd.) Cases of selected notifiable diseases, United States, weeks ending April 25, 1992, and April 27, 1991 (17th Week)

Reporting Area	Malaria	Measles (Rubeola)					Meningococcal Infections	Mumps		Pertussis			Rubella		
		Indigenous		Imported*		Total									
	Cum. 1992	1992	Cum. 1992	1992	Cum. 1992	Cum. 1991	Cum. 1992	1992	Cum. 1992	1992	Cum. 1992	Cum. 1991	1992	Cum. 1992	Cum. 1991
UNITED STATES	231	42	553	2	53	4,486	821	52	938	36	394	698	4	57	358
NEW ENGLAND	11	-	3	-	5	18	49	-	1	5	40	88	-	4	1
Maine	-	-	-	-	-	-	3	-	-	-	2	4	-	-	-
N.H.	1	-	1	-	-	-	4	-	-	1	15	11	-	-	1
Vt.	-	-	-	-	-	5	1	-	-	-	-	3	-	-	-
Mass.	5	-	2	-	3	7	21	-	1	3	19	64	-	-	-
R.I.	2	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Conn.	3	-	-	-	2	6	20	-	-	1	4	6	-	-	-
MID. ATLANTIC	66	6	88	-	6	2,853	83	-	67	-	50	75	1	10	233
Upstate N.Y.	10	2	3	-	1	112	39	-	29	-	18	43	1	6	224
N.Y. City	30	-	26	-	1	825	9	-	4	-	2	-	-	-	-
N.J.	16	4	58	-	1	707	14	-	14	-	9	7	-	4	-
Pa.	10	-	1	-	3	1,209	21	-	20	-	21	25	-	-	9
E.N. CENTRAL	11	-	10	-	2	55	122	9	106	4	29	146	-	5	15
Ohio	1	-	2	-	1	1	28	8	43	4	12	55	-	-	-
Ind.	3	-	8	-	-	-	10	-	4	-	8	23	-	-	1
Ill.	2	-	-	-	-	24	46	-	28	-	3	32	-	5	3
Mich.	4	-	-	-	-	25	31	1	29	-	1	20	-	-	11
Wis.	1	-	-	-	1	5	7	-	2	-	5	16	-	-	-
W.N. CENTRAL	12	-	5	-	-	26	36	-	25	5	32	58	1	3	8
Minn.	5	-	3	-	-	5	6	-	5	4	13	21	-	-	4
Iowa	2	-	-	-	-	15	3	-	5	-	1	5	-	-	3
Mo.	3	-	1	-	-	-	13	-	10	1	13	20	-	-	1
N. Dak.	-	-	-	-	-	-	-	-	1	-	2	1	-	-	-
S. Dak.	1	-	-	-	-	-	1	-	-	-	1	1	-	-	-
Nebr.	-	-	-	-	-	-	3	-	2	-	2	4	-	-	-
Kans.	1	-	1	-	-	6	10	-	2	-	-	6	1	3	-
S. ATLANTIC	49	30	92	-	5	242	150	28	412	9	57	35	-	3	3
Del.	3	-	1	-	-	18	2	1	1	-	-	-	-	-	-
Md.	15	-	1	-	4	84	16	1	35	-	14	6	-	-	1
D.C.	2	-	-	-	-	-	-	-	2	-	-	-	-	1	-
Va.	13	-	5	-	1	20	23	-	20	-	4	5	-	-	-
W. Va.	-	-	-	-	-	-	12	2	15	-	3	6	-	-	-
N.C.	6	1	20	-	-	1	27	14	82	7	13	7	-	-	-
S.C.	-	29	29	-	-	12	11	-	45	-	9	-	-	-	-
Ga.	2	-	-	-	-	-	20	-	24	-	4	6	-	-	-
Fla.	8	-	36	-	-	107	39	10	188	2	10	5	-	2	2
E.S. CENTRAL	4	5	244	-	17	1	60	1	27	3	9	19	1	3	-
Ky.	-	5	242	-	-	-	24	-	-	-	-	-	-	-	-
Tenn.	1	-	-	-	1	1	14	-	12	3	7	9	1	3	-
Ala.	3	-	-	-	-	-	20	-	4	-	2	10	-	-	-
Miss.	-	-	2	-	16	-	2	1	11	-	-	-	-	-	-
W.S. CENTRAL	2	-	62	-	-	5	60	7	134	-	13	17	-	-	1
Ark.	-	-	-	-	-	5	10	-	4	-	7	-	-	-	1
La.	-	-	-	-	-	-	10	1	12	-	-	7	-	-	-
Okla.	2	-	-	-	-	-	7	2	4	-	6	10	-	-	-
Tex.	-	-	62	-	-	-	33	4	114	-	-	-	-	-	-
MOUNTAIN	9	-	1	2	4	277	47	2	60	1	51	90	-	1	2
Mont.	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-
Idaho	-	-	-	-	-	1	6	1	2	-	13	15	-	1	-
Wyo.	-	-	1	-	-	-	2	-	-	-	-	3	-	-	-
Colo.	5	-	-	2†	4	2	7	-	4	-	19	40	-	-	-
N. Mex.	2	-	-	-	-	88	3	N	N	1	13	14	-	-	1
Ariz.	2	-	-	-	-	170	10	-	37	-	-	8	-	-	-
Utah	-	-	-	-	-	6	4	-	13	-	5	10	-	-	-
Nev.	-	-	-	-	-	10	6	1	4	-	1	-	-	-	1
PACIFIC	67	1	48	-	14	1,009	214	5	106	9	113	170	1	28	95
Wash.	5	-	-	-	7	4	29	1	6	1	30	44	-	-	-
Oreg.	6	-	2	-	-	18	36	N	N	-	10	28	-	1	-
Calif.	51	-	37	-	6	985	139	4	97	7	68	64	1	25	94
Alaska	1	-	8	-	1	-	6	-	-	-	-	9	-	-	-
Hawaii	4	1	1	-	-	2	4	-	3	1	5	25	-	2	1
Guam	1	U	1	U	3	-	-	U	5	U	-	-	U	-	-
P.R.	-	-	5	-	-	27	3	-	-	-	8	12	-	-	-
V.I.	-	-	-	-	-	2	-	-	10	-	-	-	-	-	-
Amer. Samoa	-	-	-	-	-	24	-	-	-	-	6	-	-	-	-
C.N.M.I.	-	U	-	U	-	-	-	U	-	U	1	-	U	-	-

*For measles only, imported cases includes both out-of-state and international importations.

N: Not notifiable U: Unavailable †International §Out-of-state

TABLE II. (Cont'd.) Cases of selected notifiable diseases, United States, weeks ending April 25, 1992, and April 27, 1991 (17th Week)

Reporting Area	Syphilis (Primary & Secondary)		Toxic-shock Syndrome	Tuberculosis		Tula-remia	Typhoid Fever	Typhus Fever (Tick-borne) (RMSF)	Rabies, Animal
	Cum. 1992	Cum. 1991	Cum. 1992	Cum. 1992	Cum. 1991	Cum. 1992	Cum. 1992	Cum. 1992	Cum. 1992
UNITED STATES	11,210	14,083	80	6,034	6,439	18	93	48	2,513
NEW ENGLAND	205	385	6	110	173	-	10	2	233
Maine	-	-	-	23	16	-	-	-	-
N.H.	-	10	3	-	-	-	-	-	1
Vt.	1	1	-	-	1	-	-	-	-
Mass.	92	191	2	52	85	-	7	1	1
R.I.	13	16	1	10	18	-	-	1	-
Conn.	99	167	-	25	53	-	3	-	231
MID. ATLANTIC	1,719	2,382	11	1,388	1,447	-	31	1	808
Upstate N.Y.	120	103	4	53	107	-	5	-	481
N.Y. City	903	1,234	-	889	872	-	11	-	-
N.J.	220	394	-	226	269	-	11	-	235
Pa.	476	651	7	220	199	-	4	1	92
E.N. CENTRAL	1,334	1,615	22	565	720	-	3	5	34
Ohio	238	197	8	103	107	-	2	4	1
Ind.	76	31	2	55	51	-	-	-	2
Ill.	639	786	3	329	387	-	-	-	7
Mich.	185	427	9	51	140	-	1	-	2
Wis.	196	174	-	27	35	-	-	1	22
W.N. CENTRAL	458	246	11	111	182	3	1	1	474
Minn.	29	25	2	24	33	-	-	-	111
Iowa	11	21	3	9	26	-	-	-	58
Mo.	351	151	1	45	75	3	1	1	2
N. Dak.	1	-	1	2	4	-	-	-	28
S. Dak.	-	1	-	9	12	-	-	-	28
Nebr.	1	6	2	2	6	-	-	-	2
Kans.	65	42	2	20	26	-	-	-	245
S. ATLANTIC	3,173	4,203	9	1,212	1,135	3	9	12	500
Del.	69	51	2	5	8	-	-	-	88
Md.	247	350	1	84	96	2	1	-	167
D.C.	159	256	-	48	67	-	1	-	5
Va.	252	376	1	98	99	1	-	-	82
W. Va.	5	10	-	21	31	-	1	-	14
N.C.	780	642	2	176	131	-	-	10	2
S.C.	350	498	1	116	130	-	1	-	37
Ga.	688	1,002	1	276	233	-	-	-	100
Fla.	623	1,018	1	388	340	-	5	2	5
E.S. CENTRAL	1,643	1,472	-	320	464	5	2	1	47
Ky.	44	28	-	123	103	1	-	1	29
Tenn.	425	537	-	7	136	4	-	-	-
Ala.	727	532	-	139	121	-	-	-	18
Miss.	447	375	-	51	104	-	2	-	-
W.S. CENTRAL	2,053	2,581	1	540	646	6	1	24	195
Ark.	327	179	-	40	63	3	-	6	13
La.	830	786	-	27	49	-	-	-	-
Okla.	74	48	-	29	42	3	-	18	106
Tex.	822	1,568	1	444	492	-	1	-	76
MOUNTAIN	139	172	7	184	155	1	2	1	48
Mont.	2	1	-	-	-	-	-	-	6
Idaho	1	3	1	10	2	-	1	-	-
Wyo.	1	1	-	-	2	-	-	-	20
Colo.	19	24	2	16	6	-	1	-	-
N. Mex.	17	13	-	26	9	1	-	-	2
Ariz.	60	127	2	90	85	-	-	-	20
Utah	2	3	2	20	25	-	-	1	-
Nev.	37	-	-	22	26	-	-	-	-
PACIFIC	486	1,027	13	1,604	1,517	-	34	1	174
Wash.	32	54	-	105	96	-	2	-	-
Oreg.	21	27	-	33	34	-	-	-	-
Calif.	419	940	13	1,376	1,298	-	30	1	164
Alaska	1	2	-	17	25	-	-	-	10
Hawaii	13	4	-	73	64	-	2	-	-
Guam	1	-	-	34	-	-	1	-	-
P.R.	81	150	-	55	71	-	-	-	17
V.I.	20	40	-	2	1	-	-	-	-
Amer. Samoa	-	-	-	-	1	-	-	-	-
C.N.M.I.	3	-	-	10	4	-	1	-	-

U: Unavailable

TABLE III. Deaths in 121 U.S. cities,* week ending April 25, 1992 (17th Week)

Reporting Area	All Causes, By Age (Years)						P&I†
	All Ages	≥65	45-64	25-44	1-24	<1	Total
NEW ENGLAND	617	443	110	47	7	9	38
Boston, Mass.	167	107	35	18	4	2	7
Bridgeport, Conn.	31	21	6	2	-	2	-
Cambridge, Mass.	30	21	8	1	-	-	2
Fall River, Mass.	38	32	6	-	-	-	2
Hartford, Conn.	53	38	10	4	-	1	1
Lowell, Mass.	31	24	3	4	-	-	4
Lynn, Mass.	23	16	4	3	-	-	3
New Bedford, Mass.	17	14	2	1	-	-	-
New Haven, Conn.	43	29	6	3	2	3	3
Providence, R.I.	52	43	6	3	-	-	2
Somerville, Mass.	4	3	-	1	-	-	-
Springfield, Mass.	39	25	11	3	-	-	2
Waterbury, Conn.	37	29	6	2	-	-	3
Worcester, Mass.	52	41	7	2	1	1	9
MID. ATLANTIC	2,607	1,688	527	278	64	50	133
Albany, N.Y.	51	28	17	3	1	2	4
Allentown, Pa.	14	9	4	1	-	-	-
Buffalo, N.Y.	103	71	22	5	4	1	5
Camden, N.J.	40	25	11	3	1	-	4
Elizabeth, N.J.	31	17	7	6	1	-	-
Erie, Pa.§	46	32	9	3	-	2	2
Jersey City, N.J.	50	27	8	10	2	3	1
New York City, N.Y.	1,319	835	260	180	27	17	47
Newark, N.J.	61	26	18	10	4	3	5
Paterson, N.J.	34	16	10	3	-	5	-
Philadelphia, Pa.	396	262	75	30	15	14	29
Pittsburgh, Pa.§	71	46	18	3	3	1	3
Reading, Pa.	53	34	10	7	2	-	8
Rochester, N.Y.	110	86	18	5	-	1	8
Schenectady, N.Y.	24	17	4	3	-	-	2
Scranton, Pa.§	30	28	2	-	-	-	2
Syracuse, N.Y.	93	67	21	3	2	-	7
Trenton, N.J.	42	28	9	2	2	1	2
Utica, N.Y.	10	7	2	1	-	-	-
Yonkers, N.Y.	29	27	2	-	-	-	4
E.N. CENTRAL	2,266	1,409	417	215	129	96	133
Akron, Ohio	63	45	9	8	1	-	3
Canton, Ohio	42	36	3	2	1	-	7
Chicago, Ill.	562	224	116	92	81	49	15
Cincinnati, Ohio	137	101	26	6	3	1	16
Cleveland, Ohio	173	108	35	14	6	10	6
Columbus, Ohio	170	115	35	13	5	2	12
Dayton, Ohio	116	91	14	7	1	3	7
Detroit, Mich.	218	124	44	28	11	11	5
Evansville, Ind.	56	45	9	-	1	1	3
Fort Wayne, Ind.	45	24	11	4	4	2	2
Gary, Ind.	17	8	4	2	2	1	-
Grand Rapids, Mich.	73	55	16	2	-	-	5
Indianapolis, Ind.	156	103	28	12	5	8	16
Madison, Wis.	34	24	6	2	1	1	1
Milwaukee, Wis.	132	93	25	8	3	3	11
Peoria, Ill.	44	36	5	1	-	2	6
Rockford, Ill.	45	35	5	3	2	-	5
South Bend, Ind.	60	50	8	2	-	-	3
Toledo, Ohio	123	92	18	9	2	2	10
Youngstown, Ohio	U	U	U	U	U	U	U
W.N. CENTRAL	779	568	117	56	20	18	35
Des Moines, Iowa	53	45	6	2	-	-	4
Duluth, Minn.	23	17	4	1	1	-	-
Kansas City, Kans.	22	12	4	3	1	2	1
Kansas City, Mo.	111	82	17	8	4	-	3
Lincoln, Nebr.	29	20	4	2	3	-	1
Minneapolis, Minn.	192	138	27	15	5	7	12
Omaha, Nebr.	116	83	25	5	1	2	6
St. Louis, Mo.	126	98	14	8	2	4	-
St. Paul, Minn.	54	40	6	6	-	2	5
Wichita, Kans.	53	33	10	6	3	1	3
S. ATLANTIC	1,409	890	279	161	38	40	73
Atlanta, Ga.	169	100	43	18	3	5	3
Baltimore, Md.	201	135	34	24	5	3	11
Charlotte, N.C.	63	42	13	6	1	1	3
Jacksonville, Fla.	139	94	24	13	4	4	12
Miami, Fla.	115	71	27	13	3	1	1
Norfolk, Va.	42	22	10	6	1	3	5
Richmond, Va.	62	42	13	5	2	-	4
Savannah, Ga.	52	34	10	3	2	3	7
St. Petersburg, Fla.	86	57	14	9	2	4	2
Tampa, Fla.	163	116	24	15	4	3	11
Washington, D.C.	292	158	62	48	11	13	11
Wilmington, Del.	25	19	5	1	-	-	3
E.S. CENTRAL	666	434	135	52	22	23	54
Birmingham, Ala.	102	70	17	8	5	2	2
Chattanooga, Tenn.	56	40	14	1	-	1	5
Knoxville, Tenn.	59	39	15	5	-	-	4
Louisville, Ky.	80	55	17	1	2	5	5
Memphis, Tenn.	144	89	26	17	8	4	22
Mobile, Ala.	61	37	11	6	2	5	7
Montgomery, Ala.	46	34	5	4	1	2	1
Nashville, Tenn.	118	70	30	10	4	4	8
W.S. CENTRAL	1,234	771	250	134	44	35	78
Austin, Tex.	55	30	14	5	4	2	5
Baton Rouge, La.	49	33	12	2	2	-	5
Corpus Christi, Tex.	57	42	8	5	1	1	4
Dallas, Tex.	169	93	35	25	10	6	3
El Paso, Tex.	72	46	13	6	5	2	7
Ft. Worth, Tex.	83	52	18	10	2	1	3
Houston, Tex.	292	170	64	34	12	12	29
Little Rock, Ark.	74	47	17	7	-	3	1
New Orleans, La.	35	23	2	6	1	3	-
San Antonio, Tex.	143	92	26	19	3	3	8
Shreveport, La.	71	52	13	4	1	1	8
Tulsa, Okla.	134	91	28	11	3	1	5
MOUNTAIN	756	502	125	90	17	22	52
Albuquerque, N.M.	102	63	17	19	-	3	1
Colo. Springs, Colo.	45	36	6	2	-	1	5
Denver, Colo.	103	62	16	17	3	5	13
Las Vegas, Nev.	111	62	29	12	3	5	-
Ogden, Utah	15	13	2	-	-	-	2
Phoenix, Ariz.	146	99	19	19	6	3	14
Pueblo, Colo.	15	12	3	-	-	-	3
Salt Lake City, Utah	94	57	16	15	4	2	8
Tucson, Ariz.	125	98	17	6	1	3	6
PACIFIC	1,834	1,221	320	189	60	36	115
Berkeley, Calif.	29	21	5	1	1	1	4
Fresno, Calif.	70	51	8	9	1	1	4
Glendale, Calif.	23	13	8	2	-	-	1
Honolulu, Hawaii	82	58	16	4	4	-	8
Long Beach, Calif.	87	61	12	10	4	-	11
Los Angeles, Calif.	479	294	85	64	20	8	19
Pasadena, Calif.	41	28	6	6	1	-	6
Portland, Oreg.	126	89	19	9	3	6	5
Sacramento, Calif.	152	106	24	13	6	3	12
San Diego, Calif.	136	90	27	10	5	4	20
San Francisco, Calif.	145	80	28	30	4	3	1
San Jose, Calif.	161	115	27	10	7	2	10
Santa Cruz, Calif.	21	14	7	-	-	-	6
Seattle, Wash.	143	101	24	16	1	1	2
Spokane, Wash.	50	35	8	2	-	5	4
Tacoma, Wash.	89	65	16	3	3	2	2
TOTAL	12,168¶	7,926	2,280	1,222	401	329	711

*Mortality data in this table are voluntarily reported from 121 cities in the United States, most of which have populations of 100,000 or more. A death is reported by the place of its occurrence and by the week that the death certificate was filed. Fetal deaths are not included.

†Pneumonia and influenza.

§Because of changes in reporting methods in these 3 Pennsylvania cities, these numbers are partial counts for the current week. Complete counts will be available in 4 to 6 weeks.

¶Total includes unknown ages.

U: Unavailable

Lead Poisoning Among Battery Reclamation Workers — Alabama, 1991

In March 1991, the Alabama Department of Public Health lead surveillance program received a report from a participating laboratory of an elevated blood lead level (BLL) in an employee of a company engaged in a battery-breaking operation. The health department referred the case to the Occupational Safety and Health Administration (OSHA), which initiated an investigation of company medical-monitoring records and identified 13 workers with elevated BLLs. In May 1991, OSHA requested technical assistance from CDC's National Institute for Occupational Safety and Health (NIOSH) to evaluate the workers for lead intoxication. This report summarizes the findings of the investigation.

The company processes automobile and industrial batteries to reclaim their lead and plastic content. Exposures to lead fumes and dust routinely occur during the procedures in which metallic lead plates coated with lead oxide and lead sulfate are removed from the plastic cases. Automotive battery decasing requires manual labor and mechanical activities to cut open the batteries and remove their contents. To decase industrial batteries, which typically are larger than automotive batteries, torches are used to cut through an outer steel case, creating additional lead fumes.

Personal air sampling measurements, based on a 9.5-hour shift, obtained at the worksite during March 1991, indicated that time-weighted average exposures ranged from 30 $\mu g/m^3$ to 156 $\mu g/m^3$; the OSHA permissible exposure limit (PEL) for lead in general industry is 50 $\mu g/m^3$. At the time of this investigation, battery-breaking operations were considered a remand industry* and were granted a variance, allowing a PEL of up to 200 $\mu g/m^3$ with the use of engineering controls but requiring reduction of individual worker exposures below 50 $\mu g/m^3$ through a combination of respiratory protection and work practices (*1*).†

None of the employees examined reported symptoms suggestive of lead intoxication. On physical examination, five had gingival discoloration consistent with a "lead line." Of the 15 battery-breaking workers from whom blood samples were obtained, BLLs were >60 µg/dL in 12 persons (Table 1). When the NIOSH BLL data were analyzed in conjunction with company BLL data (collected monthly from April 1989 through April 1991), 13 (87%) workers were identified whose three most recent BLLs averaged ≥50 µg/dL (elevated BLLs ranged from 50 µg/dL to 82 µg/dL; mean value: 66 µg/dL).§ Review of the company blood-monitoring data showed a gradual increase in BLLs from January 1989 through May 1991 (Figure 1). In 14 workers, zinc protoporphyrin (ZPP) levels were >100 µg/dL (reference range: 0–79 µg/dL), values consistent with moderate lead poisoning; in three of these workers, ZPPs were >600 µg/dL, levels often associated with severe lead poisoning. Because employees

*As a remand industry, this facility is exempted from certain requirements of the OSHA lead standard regarding airborne lead levels but is not exempted from the other provisions of the lead standard, such as those requiring medical monitoring and training of employees.

†A recent district court ruling in the District of Columbia, which takes effect in July 1993, requires battery reclamation operations to meet the PEL of 50 $\mu g/m^3$ solely through engineering controls.

§The OSHA lead standard requires medical removal of an employee from the worksite when the employee's BLL is ≥60 µg/dL on a single occasion or an average of ≥50 µg/dL on three separate occasions during a 6-month period (*2*).

Battery Reclamation Workers — Continued

rotated through all jobs according to production needs and the availability of personnel, differences in BLL and ZPP associated with the various work stations were not analyzed.

Serum creatinine levels were measured for all 15 workers and ranged from 0.8 µg/dL to 1.6 µg/dL (reference range: 0.8–1.3 µg/dL) (Table 1). For seven workers, calculated creatinine clearance rates were outside the referent (i.e., <90 mL per minute) and ranged from 67 mL to 170 mL per minute; two had evidence of mild impairment of renal function (<80% of predicted normal).

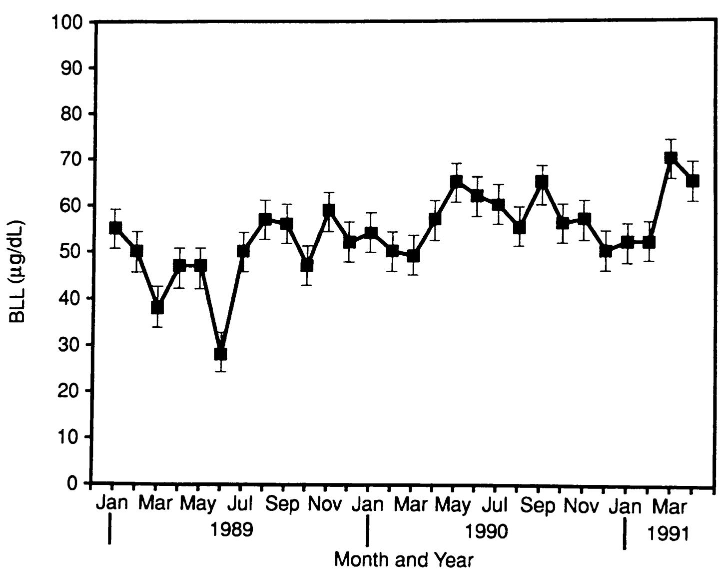
The environmental investigation and BLLs indicated that employees were inadequately protected from lead exposure because of poorly designed equipment that permitted excessive generation of sulfuric acid mist and lead dust, improper use of respirators, and inadequate hygiene practices (i.e., employees failed to shower at the

TABLE 1. Blood specimen analysis for 15 workers at a battery reclamation plant — Alabama, 1991

Analysis	Mean	(SD*)	Observed range	Reference range	Abnormal No.	Abnormal (%)
Blood lead level (µg/dL)	65.8	(± 18.6)	9–86	0–40	14	(93)
Zinc protoporphyrin level (µg/dL)	268.7	(±185.7)	27–616	0–79	14	(93)
BUN (mg/dL)	16.7	(± 4.5)	9–29	8–22	1	(7)
Hemoglobin (g/dL)	13.6	(± 1.3)	11.1–16.1	13.5–17.7	4	(27)
Hematocrit (%)	43.4	(± 3.9)	37.5–52.8	40.0–52.0	4	(27)
Creatinine (mg/dL)	1.3	(± 0.2)	0.8– 1.6	0.8–1.3	6	(40)
Uric acid (mg/dL)	6.6	(± 1.3)	3.2– 8.4	2.6–8.1	1	(7)

*Standard deviation.

FIGURE 1. Monthly average blood lead levels (BLLs) (and 95% confidence intervals) of 15 battery reclamation workers — Alabama, January 1989–May 1991



Battery Reclamation Workers — Continued

end of the shift or change into clean clothes before leaving the worksite). In addition, there was no respirator fit-testing program.

Because of inadequate hygiene practices at the facility, the Jefferson County Department of Public Health evaluated the effect of lead exposure on families of workers. BLLs among workers' children ranged from 6.0 µg/dL to 42.0 µg/dL (mean: 22.4 µg/dL); in comparison, BLLs among a group of neighborhood children ranged from 2.0 µg/dL to 18 µg/dL (mean: 9.8 µg/dL) and were significantly different ($t=2.1$; $p=0.05$).

As a result of this investigation, OSHA obtained a court order requiring the employer to remove all workers with elevated BLLs from the premises. This is the first time OSHA has required an employer to remove an entire workforce because of health violations.

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Editorial Note: OSHA classifies battery-breaking facilities under the standard industrial classification (SIC) code 5093, which includes scrap and waste materials establishments "primarily engaged in assembling, breaking up, sorting, and wholesale distribution of scrap and waste materials" (*3*). The Bureau of the Census reported that, in 1987, the 8248 establishments in the United States classified in this code together employed more than 93,000 workers (*4*). However, the total number of these sites where workers are actually engaged in battery-breaking jobs and potentially exposed to excessive amounts of lead is unknown. Currently, the U.S. Environmental Protection Agency provides 26 secondary smelters (SIC code 3341) with permits to operate battery-breaking operations in the United States (G. Streit, EPA, personal communication, 1991). The SIC codes do not specify operations engaged solely in battery reclamation. Sixteen states have enacted legislation regulating battery recycling, which may assist with identification and enumeration of workers at battery reclamation facilities.

One national health objective for the year 2000 targets elimination of occupational lead exposures associated with BLLs >25 µg/dL (objective 10.8). Workers at increased risk for lead toxicity include those in primary and secondary lead smelters, storage-battery–manufacturing plants, plastic-compounding factories, and nonferrous foundries (*5*). Other jobs characterized by excessive amounts of lead include construction workers who cut through lead-coated metal structures, workers who repair and disassemble ships (*6*) and roofs (*7*), and those who dismantle subway lines and demolish or strip paint from bridges (*8*). In 18 states, including Alabama, the state health departments require the routine reporting of elevated BLLs.

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Lead Chromate Exposures and Elevated Blood Lead Levels in Workers in the Plastics Pigmenting Industry — Texas, 1990

In June 1990, the Dallas (Texas) County Health Department received a physician's report of an elevated blood lead level (BLL) (52 µg/dL) for an employee of a company that formulates color concentrates for the plastics industry. The physician had been evaluating the employee for severe headaches of uncertain etiology; however, he requested a BLL analysis when the employee's occupational history suggested possible lead exposure.

The physician also reported the exposure to the Occupational Safety and Health Administration (OSHA) and contacted the medical toxicologist at the North Texas Poison Control Center to obtain treatment and management recommendations. Because the company lacked an ongoing medical-monitoring program for employees, as mandated by OSHA,* the physician consulted with the company officials, then performed blood-lead analyses for 22 additional employees. For seven of these employees, BLLs exceeded 40 µg/dL (range: 43–107 µg/dL; mean: 62 µg/dL). Two employees, with BLLs of 78 µg/dL and 107 µg/dL, were hospitalized for chelation therapy (the first with calcium ethylenediaminetetraacetic acid [EDTA] and penicillamine; the second with EDTA, penicillamine, and dimercaprol). Two others (with BLLs of 60 µg/dL and 59 µg/dL) received chelation therapy with penicillamine as outpatients.

During August 1990, to determine the sources of exposure to lead and other chemicals, the Environmental Epidemiology Program, Epidemiology Division, Texas Department of Health (TDH), conducted an industrial hygiene inspection of the facility. In the plant, powdered metal-based pigments are mixed in a formulation laboratory and blended with plastic pellets in 500- to 2000-gallon mixers located in the production area. The pigment-pellet mixes are then heated and extruded, forming colored pellets; these completed pellets are sold and then used to produce colored plastic products.

The TDH determined that ventilation and other engineering measures in the plant inadequately controlled dusts generated by the process. Employees were equipped with half-mask, air-purifying respirators fitted with organic vapor cartridges and particulate filters; however, in several environmental samples, airborne lead exposures exceeded the protective capacity of the respirators. Based on environmental monitoring, the highest exposures occurred during the following operations: hand

*The OSHA lead standard requires that employers monitor for airborne lead exposures in workplaces where lead is used; when airborne lead levels exceed 30 µg/m^3 (as an 8-hour, time-weighted average [TWA]), employers must provide an industrial hygiene program and a medical-monitoring program that includes monitoring of BLLs (*1*).

Plastics Pigmenting — Continued

weighing the pigments, blending, emptying the blenders into open bins, cleaning the blenders with compressed air, and manually agitating the mixes when blenders and extruders clogged.

Personal-breathing–zone exposure samples documented that employees had substantial airborne exposure to lead, chromium (as lead chromate), and cadmium—components of the various pigments used in the process. Exposure to airborne lead in the extruding area was 648 $\mu g/m^3$ (as a 10-hour, time-weighted average) and 226 $\mu g/m^3$ in the blending area.[†] Chromium exposure (as chromates) in the extruding area was 132 $\mu g/m^3$, above the OSHA permissible exposure limit (PEL) of 100 $\mu g/m^3$ (as a ceiling concentration)[§]. The highest airborne cadmium exposure was 48 $\mu g/m^3$ (the current PEL is 200 $\mu g/m^3$[¶]). In addition, contamination with lead and chromium was detected in wipe samples obtained from a desk next to the pigment table, the top of the coffee maker in the formulation laboratory, and different sites in the lunchroom. The highest lead (0.24 $\mu g/cm^2$) and chromium (0.04 $\mu g/cm^2$) levels were detected on the handle, door, and controls of the lunchroom microwave oven.

The TDH made specific recommendations to correct the observed violations of OSHA standards, including substantial improvements in work practices, implementation of a respirator program, and medical treatment of the affected workers. As of April 1991, the mean BLL for the eight workers with elevated BLLs had decreased to 36 $\mu g/dL$ (range: 23–46 $\mu g/dL$). Nonetheless, repeat environmental monitoring indicated that airborne lead exposures remained high in many areas of the facility and required further efforts to reduce exposures.

The TDH is investigating to determine whether the exposures in this plant are characteristic of this industry elsewhere in Texas.

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Editorial Note: Although the U.S. Consumer Products Safety Commission banned lead in residential paints in 1977,** pigments containing lead continue to be used in many industrial and commercial applications and pose a substantial risk to workers and their families. During 1983, 24 industries used lead chromate (National Occupational Exposure Survey of CDC's National Institute for Occupational Safety and Health [NIOSH], unpublished data, 1991); during May 1991, 30,600 U.S. workers in these industries potentially were exposed to lead chromate—12,500 of whom worked in the miscellaneous plastics products industry (Table 1).

This investigation documents the first identified cases of elevated BLLs among workers in the plastics industry in Texas. In addition to the risk for lead exposure for workers involved in this process, the subsequent use of the pigment-infused pellets

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[†]The OSHA permissible exposure limit (PEL) for lead is 50 $\mu g/m^3$, as an 8-hour TWA. If an employee is exposed to lead for more than 8 hours in a work day, the PEL is adjusted according to this formula: maximum permissible limit = 400 $\mu g/m^3$ divided by hours worked in a day. Because employees at this facility worked 10-hour shifts, the applicable PEL was 40 $\mu g/m^3$ (*1*).

[§]CDC's National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit for chromates is 1 $\mu g/m^3$. NIOSH considers chromates as potential occupational carcinogens.

[¶]NIOSH considers cadmium to be a potential occupational carcinogen and recommends that exposure be reduced to the lowest feasible level.

**16 Code of Federal Regulations, part 1303. Ban of lead-containing paint and certain consumer products bearing lead-containing paint.

Plastics Pigmenting — Continued

TABLE 1. Estimated number of workers potentially exposed to lead chromate, by industry and standard industrial classification (SIC) — United States, 1991

Industry	SIC	No. workers potentially exposed
Miscellaneous plastics products	3079	12,500
Rubber and plastics footwear	3021	4,000
Ship building and repairing	3731	2,400
Paints and allied products	2851	2,100
Electric services	4911	1,900
Plastics materials and resins	2821	1,600
Motor vehicles and car bodies	3711	1,100
Painting, paper hanging, decorating	1721	1,000
Coated fabrics, not rubberized	2295	700
Farm machinery and equipment	3523	600
All others		2,700
Total		**30,600**

Source: National Occupational Exposure Survey as of May 23, 1991.

by manufacturers of colored plastic products presents a potential for lead exposure through the heating, remolding, and cutting of processed plastic parts. During 1988, states that conducted surveillance of elevated BLLs received 17 reports of elevated BLLs in the plastics materials and resins industry (Standard Industrial Code [SIC] 282 [*2*]) and 11 reports in the miscellaneous plastics products industry (SIC 307) (NIOSH, unpublished data, 1988).

In Texas, state law requires physicians and laboratories to report elevated BLLs (i.e., BLLs of ≥40 μg/dL for adults); from May 27, 1985, through December 31, 1990, the TDH received 5952 such reports for 1054 adults. In cooperation with NIOSH, the TDH participates in the Sentinel Event Notification System for Occupational Risks (SENSOR) (*3*)—a state-based system for surveillance of occupational illness and injury; surveillance for elevated BLLs is conducted in conjunction with SENSOR. The identification and follow-up investigation of cases of elevated BLLs in the plastics pigmenting industry reported here demonstrates the utility of lead surveillance systems for identifying new or unrecognized sources of occupational exposures.

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Lead Exposures Among Lead Burners — Utah, 1991

In July 1991, concerns about lead exposure among lead burners—workers who solder or weld with lead and, therefore, are exposed to potentially high levels of lead—at a construction site in Utah prompted the national office of the lead burners' local union to contact CDC's National Institute for Occupational Safety and Health (NIOSH) for assistance. On July 10, 1991, NIOSH, under the health-hazard evaluation program, initiated an environmental survey of the workplace and medical evaluations of the lead burners working on-site.

The evaluation focused on a crew of 17 lead burners who had been contracted to line the interior of two large steel tanks with lead sheets. The lining operation involved grinding the surface of the tank to remove steel oxidation products followed by tinning—the application of a lead/tin solder paste heated with a torch. After the grinding and tinning processes had been completed, workers used torches to bond lead sheets to the tank; the seams between the lead sheets were then sealed with molten lead solder.

To document the workers' lead-exposure status before they started work at the site, blood specimens from each worker were collected by the employer and analyzed for baseline blood lead levels (BLLs) by an Occupational Safety and Health Administration (OSHA)-certified laboratory (Table 1). Ten of the 16 tested workers had baseline BLLs ≥30 μg/dL, indicating they had had substantial exposure to lead before beginning work on this project (a baseline BLL was not obtained from one worker, a supervisor).

TABLE 1. Blood lead levels (BLLs) of 17 lead burners at preemployment* and at 5–10 weeks after employment†, and number of years employed as lead burners — Utah, 1991

Employee	Preemployment BLL (μg/dL)	During employment BLL (μg/dL)	Years as a lead burner
1	42	82	10
2	44	61	48
3	40	51	17
4	41	51	21
5	33	40	19
6	29	40	25
7	—§	36	29
8	29	34	19
9	30	33	10
10	36	33	<1
11	30	33	<1
12	30	31	16
13	32	27	40
14	24	21	5
15	10	13	<1
16	5	11	<1
17	6	11	<1
Mean	**29**	**36**	

*BLL analyzed by the employer.
†BLL analyzed by CDC's National Institute for Occupational Safety and Health.
§Supervisor, no preemployment BLL analysis performed.

Lead Burners — Continued

During the environmental survey, personal-breathing–zone air samples were collected for eight employees. The mean time-weighted–average (TWA) airborne lead exposure was 270 μg/m³ (range: 140–460 μg/m³).* Short-term air samples were collected to evaluate the relative contribution of each process to the employees' cumulative exposures. For the four samples obtained during the grinding process, the mean lead exposure was 32 μg/m³ (range: 0–46 μg/m³). For the three samples obtained during the tinning process, the mean exposure was 287 μg/m³ (range: 280–290 μg/m³). For the 12 samples obtained during the bonding/burning process, the mean exposure was 260 μg/m³ (range: 50–530 μg/m³). All employees wore respiratory protection (either half- or full-facepiece respirators) with high-efficiency particulate filters and organic vapor/acid gas cartridges.

During the NIOSH site visit (5–10 weeks after the baseline data were gathered) all 17 employees completed a questionnaire about symptoms and provided a blood specimen for blood lead determination. Although no employees reported symptoms suggestive of lead poisoning, the overall mean BLL was 36 μg/dL (range: 11–82 μg/dL), a significant increase from the mean preemployment BLL ($p<0.05$, Kruskil-Wallis test) (Table 1). In four (24%) employees, BLLs were ≥50 μg/dL—levels potentially requiring medical removal.† Among the 12 employees with ≥1 year of lead-burner experience, the mean BLL was 42 μg/dL (range: 21–82 μg/dL); in comparison, among the five employees with less than 1 year of experience, the mean BLL was 20 μg/dL ($p<0.05$, Kruskil-Wallis test).

To evaluate the potential for workers' bringing lead from the workplace into the home, wipe samples were collected from several sources. Concentrations were highest on the floor of the changing room (60 μg/cm²), the sole of one employee's work boot (20 μg/cm²), the toe of a different employee's work boot (4 μg/cm²), and the floor under the gas pedal of a worker's car (4 μg/cm²). For two of the workers, family members who resided with the workers consented to BLL determinations. For one worker, BLLs in all five household members were <4 μg/dL. For the other worker, a 7-month-old child had a BLL of 17 μg/dL; a home inspection revealed no likely environmental source of lead exposure other than the father's employment.

Within 1 month of the NIOSH survey, the company 1) initiated additional engineering controls, 2) reassigned employees with BLLs ≥50 μg/100 g whole blood to tasks not involving lead exposure, 3) enhanced the respirator program, and 4) provided additional hygiene measures (i.e., lockers, facilities for changing clothes, and shower facilities).

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Editorial Note: BLLs are the best available indicator for lead exposure in workers. Although workplace environmental monitoring can identify areas of high lead exposure, this method alone cannot assess day-to-day fluctuations in lead exposures,

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*The OSHA permissible exposure limit (PEL) for lead in general industry is 50 μg/m³, as an 8-hour TWA (*1*); the OSHA PEL for lead in the construction industry is 200 μg/m³ (*2*). In July 1991, the Utah state legislature approved legislation requiring the construction industry in Utah to comply with the OSHA lead standard for general industry.

†The OSHA lead standard requires that employees with an average BLL ≥50 μg/dL (measured on three occasions during 6 months) be removed from the areas where airborne lead concentrations exceed 30 μg/m³ (*1*).

Lead Burners — Continued

the efficacy of personal protection equipment (e.g., respirators, gloves, or work clothes), or the effects of work practices and personal hygiene measures.

In the circumstances described in this report, if the respirators used by workers were properly fit-tested, maintained, and worn, the workers' actual inhalational exposures probably would have been less than the concentrations measured during the worksite investigation. In addition, the levels of contamination detected on the workers' street shoes and other clothing exceeded background levels and indicated that substantial amounts of lead were conveyed from the workplace, resulting in exposure for workers' families as well as additional exposure for the workers. Previous reports have documented lead poisoning among family members of lead-exposed workers in this way (*3*), and recent information regarding the adverse effects of even low BLLs in infants and young children (*4*) underscores the need to address the public health hazards of industrial lead contamination of the home.

Programs to prevent work-related lead poisoning require two basic components: 1) surveillance efforts to identify potential cases of lead poisoning and 2) use of the surveillance information to target intervention efforts to reduce or eliminate the lead exposure. The OSHA lead standard for general industry requires BLLs to be determined annually for any employee exposed to airborne lead levels $\geq 30\ \mu g/m^3$ (*1*). In many states, laboratories performing blood lead analyses are required to report elevated levels to the state health department for potential follow-up activities (*5*). The effectiveness of such surveillance efforts depends both on routine biologic monitoring of employees with known exposure to lead and enforcement of timely laboratory reporting of elevated levels to appropriate state authorities.

In July 1991, Utah OSHA removed the construction industry exemption in its general industry lead standard; this measure should enhance efforts to prevent lead poisoning among lead-exposed construction workers and members of their families by 1) reducing the workers' airborne lead exposure, 2) requiring annual BLL analyses, and 3) requiring workplace hygiene and housekeeping provisions. The federal OSHA construction industry standard maintains a permissible exposure limit (PEL) of 200 $\mu g/m^3$ of airborne lead and has no requirement for routine environmental or biologic monitoring or workplace hygiene and housekeeping provisions (*2*). The federal OSHA is updating PELs for chemicals (including lead) in the construction industry and, in conjunction with NIOSH, has issued a hazard information booklet describing ways to avoid lead exposure in the construction industry (*6*). In addition, NIOSH has published an alert on lead poisoning among construction workers (*7*). Additional information on obtaining these publications is available from the Information Dissemination Section, Division of Standards Development and Technology Transfer, NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226; telephone (513) 533-8287.

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