

# Family Lead Poisoning Associated with Occupational Exposure

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## Introduction

Lead is a potent poison that affects multiple body systems. It is well documented that children under age 6 years and the fetus are especially vulnerable to neurologic damage affecting learning and behavior with potential for life-long impact. In 1991, the Centers for Disease Control and Prevention (CDC) lowered the blood lead level (BLL) of concern for children from 25 to 10 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) (CDC 1991).<sup>1</sup> Efforts to reduce lead in the environment, primarily by eliminating lead from gasoline and paint, have resulted in lowering the overall geometric mean BLL for the general population in the United States from approximately 13 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) in the late 1970's to  $<2 \mu\text{g}/\text{dL}$  by 1999

(NCHS 1984; CDC 2001).<sup>2,3</sup> Although the average BLL has markedly declined, National Health and Nutrition Examination Survey (NHANES) 1999–2000 data indicate that 2.2% of U.S. children aged 1 to 5 years had BLLs  $\geq 10 \mu\text{g}/\text{dL}$  (CDC 2003).<sup>4</sup> Recent research suggests that levels once thought safe are considered hazardous as new information emerges about lead's harmful effects at BLLs less than  $10 \mu\text{g}/\text{dL}$ .<sup>5,6</sup> Despite success in reducing the number of children with elevated BLLs, some remain at high risk for lead exposure, including those living in homes containing lead-contaminated dust.

Invisible toxins may be carried home to household members by inadequately protected workers on their clothes, shoes, or bodies, called "take-home exposure." Documented cases of take-home exposure include lead, beryllium,

asbestos, pesticides, and other toxic materials.<sup>7</sup> In this case series, we describe take-home lead exposure incidents in California from 1992 to 2002.

Lead is used in more than 100 industries. Lead dust carried from work settles on surfaces in the vehicle and home where it can be ingested or inhaled by young children with normal mouthing behavior and by household members handling workers' clothing. Children of lead-exposed workers have disproportionately high BLLs when compared to other children.<sup>8–10</sup> One study estimated that 48,000 families have children under age 6 living with household members occupationally exposed to lead.<sup>11</sup> Reports of take-home lead exposure include work in mining,<sup>8,12</sup> automotive radiator repair,<sup>13</sup> battery reclamation,<sup>14</sup> construction,<sup>9</sup> and antique furniture refinishing.<sup>15</sup>

## Patient Reports

### *Patient 1: Exposure from Battery Repair*

On reading a magazine article about lead causing behavior and learning problems, a mother recognized similar difficulties in her 6-year-old son and requested testing. His BLL was 36 micrograms

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per deciliter ( $\mu\text{g}/\text{dL}$ ). Follow-up BLLs for the mother and father were 18 and 121  $\mu\text{g}/\text{dL}$ , respectively. The father's occupation in battery repair for more than 4 years was the sole identified source of the family's lead exposure. His work involved melting, casting, and soldering of lead without proper protections. He wore his work clothes home. Three co-workers had BLLs ranging from 26 to 52  $\mu\text{g}/\text{dL}$ ; none had prior testing.

Both child and father had multiple signs and symptoms of chronic lead poisoning and suffered significant, permanent neurologic damage. The child needs ongoing specialized medical care and schooling. The father was removed from work and at last report remained unemployed. The employer resisted making required workplace improvements and was cited for numerous violations by the Occupational Safety and Health Administration (OSHA).

#### *Patient 2: Exposure from Firing Range Demolition*

A laborer requested a lead test on his third day on a firing range demolition job when seen in the emergency room for a work-related injury; his BLL was 74  $\mu\text{g}/\text{dL}$ . The workers were not told lead was present on the job; they lacked proper protections and wore their heavily contaminated work clothes home. Subsequent BLLs for 4 co-workers ranged from 57 to 98  $\mu\text{g}/\text{dL}$ ; the worker with the highest BLL was on the job the longest at 2 weeks. None reported prior work with lead. Nine children, aged 18 months to 12 years, of 3 workers had BLLs ranging from 13 to 34  $\mu\text{g}/\text{dL}$ ; the youngest child had the highest BLL. One spouse, who hand-washed her husband's work

clothes, had a BLL of 36  $\mu\text{g}/\text{dL}$ . No other lead source was identified.

#### *Patient 3: Exposure from Scrap Metal Recycling*

A worker in scrap metal-recycling saw his personal physician for muscle pains of a few months' duration. His BLL was 37  $\mu\text{g}/\text{dL}$ . He went home twice daily in his work clothes. His 10-month-old child's BLL was 26  $\mu\text{g}/\text{dL}$ . The worker informed his employer; 16 co-workers were tested. In all, 10 of 17 workers had BLLs  $\geq 40$   $\mu\text{g}/\text{dL}$  (2 > 60  $\mu\text{g}/\text{dL}$ ); 7 had BLLs ranging from 26 to 39  $\mu\text{g}/\text{dL}$ . Five workers each had a child ranging in age from 8 months to 2 years with BLLs 14 to 26  $\mu\text{g}/\text{dL}$ . In total, 22 individuals were identified with significant lead exposure.

The work involved cutting and bailing lead-sheathed cable. The company relied on initial air monitoring with low airborne lead levels of 2 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) and did not implement a lead safety program. Repeat air-monitoring results were up to 240  $\mu\text{g}/\text{m}^3$ ; all workers cutting cable were exposed to air levels above the OSHA Permissible Exposure Limit of 50  $\mu\text{g}/\text{m}^3$ .

## Discussion

In California, analytical laboratories have been required to report BLLs greater than 25  $\mu\text{g}/\text{dL}$  to the California Department of Health Services (CDHS) since 1987, and all BLLs since 2003. Beginning in 1992, reports of suspected take-home lead exposure were investigated by the state and local health departments' lead programs. Cases are defined as having a household member and a working adult in the home with BLLs  $\geq 10$   $\mu\text{g}/\text{dL}$  and an identi-

fied workplace source of lead. Blood lead analyses were performed on venous samples by approved laboratories. In some instances, other sources of lead, such as lead-based paint, were identified in the home potentially resulting in mixed exposures.

CDHS interviews the worker and the employer to confirm workplace lead exposure and to review hygiene measures necessary to prevent carrying lead dust home. Efforts are made to protect the worker's identity if reprisal is a concern. The local health department (LHD) conducts a home assessment, assists with BLL testing for household members and medical follow-up, and educates the family about cleanup of lead contamination and prevention measures. CDHS recommends employer-sponsored BLL testing for all lead-exposed workers and measures needed to correct workplace hazards, including practices that resulted in lead being carried home. Employer failure to implement these recommendations may result in referral to OSHA for enforcement.

Thirty-nine incidents were confirmed by investigation as take-home lead exposure during the period from May 1992 to August 2002 (Table 1). The LHDs identified and reported suspected take-home exposure to CDHS in 90% of the incidents. These incidents represent 51 workers in 39 different workplaces linked to 74 household members, all with BLLs  $\geq 10$   $\mu\text{g}/\text{dL}$ . The 51 workers include 11 individuals who were owner/operators of 9 workplaces. Of the 39 workplaces, the most common types were radiator repair shops (31%) and metal casting operations (15%). Peak BLLs reported for the 51 workers linked to poisoned household members ranged from 10 to 121

**Table 1**

**TYPE OF WORKPLACE AND NUMBER OF WORKERS AND THEIR HOUSEHOLD MEMBERS IDENTIFIED WITH BLOOD LEAD LEVELS (BLLS)  $\geq$  10  $\mu\text{g}/\text{dL}$  IN 39 TAKE-HOME EXPOSURE INVESTIGATIONS, CALIFORNIA, 1992 TO 2002**

Type of Workplace	Workplaces, n (%)	Workers, n (%)	Household Members, n (%)
Radiator repair	12 (31)	13 (25)	16 (22)
Metal casting	6 (15)	7 (14)	9 (12)
Scrap metal recycling	4 (10)	8 (16)	8 (11)
Ceramics manufacture, tile painting	4 (10)	5 (10)	4 (5)
Battery manufacture	3 (8)	3 (6)	4 (5)
Painting	3 (8)	3 (6)	7 (9)
Antique furniture refinishing/carpentry	2 (5)	3 (6)	7 (9)
Demolition	1 (3)	3 (6)	10 (14)
Cable removal	1 (3)	3 (6)	4 (5)
Battery repair	1 (3)	1 (2)	2 (3)
Steel retrofit	1 (3)	1 (2)	2 (3)
Plastics compounding	1 (3)	1 (2)	1 (1)
<b>Total</b>	<b>39 (102)*</b>	<b>51 (101)*</b>	<b>74 (99)*</b>

\*Percentage does not total 100 because of rounding

$\mu\text{g}/\text{dL}$  with 47% having BLLs  $\geq$  40  $\mu\text{g}/\text{dL}$ , a level requiring medical intervention under the OSHA lead standards.

In total, 74 household members ranging in age from newborn to 28 years were linked to the 51 workers described above and had BLLs ranging from 10 to 52  $\mu\text{g}/\text{dL}$  (Table 2). The majority (83%) were children under 6 years of age. Ten children aged 6 to 13 years (14%) had BLLs from 10 to 36  $\mu\text{g}/\text{dL}$ ; 3 adult spouses (4%) had BLLs from 12 to 36  $\mu\text{g}/\text{dL}$ . Fifty percent of these household members were index cases, i.e., individuals first identified with a BLL  $\geq$  10  $\mu\text{g}/\text{dL}$  and

subsequently linked to workplace exposure and others with elevated BLLs. Eighty-nine percent of the index cases were under 6 years old.

Most of the incidents (85%) were discovered by testing a child in primary care. Six incidents (15%) were identified by workers tested in primary care with subsequent testing of household members. No take-home exposure cases were identified through employer-sponsored routine lead medical surveillance, which was provided by only 2 of the 39 companies.

An additional 68 co-workers were newly identified with BLLs  $\geq$  10  $\mu\text{g}/\text{dL}$  through these investigations. Their BLLs ranged from 10

to 164  $\mu\text{g}/\text{dL}$ , with 40% having BLLs  $\geq$  40  $\mu\text{g}/\text{dL}$ .

### Conclusion

This case series demonstrates that occupational and take-home lead poisoning remain important public health problems. Primary care providers play a major role in identifying take-home exposure, especially for children under 6 years old. Many providers are not performing blood lead tests for children at risk as recommended by the Centers for Disease Control and Prevention (CDC) guidelines.<sup>16,17</sup> In addition to following

**Table 2**

**DISTRIBUTION OF HOUSEHOLD MEMBERS BY AGE AND PEAK BLL LINKED TO 51 WORKERS WITH BLLS  $\geq$  10  $\mu\text{g}/\text{dL}$ , CALIFORNIA 1992 TO 2002**

Known peak BLL of household member, $\mu\text{g}/\text{dL}$	Age of Household Members				Total, n (%)
	< 1 Year	1–5 Years	6–13 Years	18 + Years	
	Number				
10–14	5	15	2	1	23 (31)
15–19	1	4	4	1	10 (14)
20–24	2	15	2	-	19 (26)
25–39	2	14	2	1	19 (26)
40–49	-	2	-	-	2 (3)
50+	-	1	-	-	1 (1)
Total No. (%)	10 (14)	51 (69)	10 (14)	3 (4)	74 (101)*

\*Percentage does not total 100 because of rounding.

the CDC guidelines, the clinician should request a BLL at any age if lead exposure is suspected.

These investigations of lead-poisoned individuals resulted in discovering others with lead poisoning from the same occupational source. The true number of take-home lead poisoning incidents is unknown. Limitations of this report include the following: several suspected take-home lead exposure cases were not confirmed owing to inability to obtain a worker BLL or interview; take-home lead exposure incidents may not have been recognized or reported; and laboratories were not required to report BLLs below 26  $\mu\text{g}/\text{dL}$  to CDHS during this 10-year period, resulting in important data gaps.

OSHA requires employers to provide specific protections for

lead-exposed workers. However, provisions for protective work clothing, proper handling of lead-contaminated work apparel, and showers to prevent workers from carrying lead home are required only for workers with airborne lead exposure above 50  $\mu\text{g}/\text{m}^3$ . Thus, the standards are inadequate to prevent take-home exposure because workers with lower exposures may still be carrying lead home. In our group, 12 workers (24%) had BLLs below 25  $\mu\text{g}/\text{dL}$ .

Further efforts are needed to determine the true incidence of take-home lead exposure and to educate employers, workers, and health care professionals about this ongoing problem and the importance of primary prevention of lead poisoning.

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