Public Health Briefs

The Initial Impact of a Workplace Lead-Poisoning Prevention Project

Jim Bellows, MPH, CIH, and Linda Rudolph, MD, MPH

ABSTRACT

The California Department of Health Services began an occupational lead poisoning prevention project in cooperation with 275 radiator service companies. The agency developed and marketed resources to facilitate companies' own efforts, tracked the progress of each company, and urged the companies to conduct blood lead testing. Testing by participating employers increased from 9% to 95%, and 10 times as many companies with likely overexposures were identified as had been reported to the state's lead registry in the previous year. The success of this project indicates that the model should be applied more extensively. (*Am J Public Health.* 1993;83:406–410)

Introduction

Lead poisoning has been recognized as an occupational illness for centuries, and it is linked with both severe and subtle health damage.[1,2] Exposure reduction has long been recognized as the principal means of prevention. Although the US Occupational Safety and Health Administration (OSHA) adopted comprehensive lead regulations in 1978,[3] occupational lead poisoning remains a serious and persistent public health problem.[4,5]

From 1987 to 1990, the California Occupational Lead Registry—a laboratory-based surveillance system—received reports of 1503 adults with blood lead levels of 1.93 μmol/L (40 μg/dL) or higher.[6,7] The true number of workers with blood lead above that level may be much higher, because only a small fraction of lead-exposed workers receive routine blood lead testing.[8] Other workers are likely to be untested and thus unreported even if they have seriously elevated blood lead levels.

In 1989 on-site surveys verified lead overexposures in many companies where no blood lead testing had been done.[9] Many employers indicated that they were unaware of OSHA requirements and lacked the knowledge or resources to develop lead-poisoning prevention programs. Other barriers to such programs include the scarcity of physicians familiar with lead monitoring, lack of low-cost ventilation, and lack of effective training resources.

The project described in this paper was conducted by the California Department of Health Services, which operates the Registry. Its goal was to reduce the prevalence of overexposures in a high-risk industry by developing and applying a new occupational illness prevention model. Improving the sensitivity of the Registry in order to better guide intervention activities was essential to this goal.

The radiator service industry was selected as the focus of this project. Overexposures to lead and noncompliance with OSHA lead regulations have been well documented in this industry.[7,10,11] More companies in this industry than in any other have had workers reported to the Registry,[7] despite the low proportion of companies providing routine blood lead testing.[8] The radiator repair industry consists mainly of extremely small businesses, and many owners and employees have limited English skills. The project was conducted in Los Angeles and San Bernardino counties. During 1989, the Registry received reports of blood lead levels exceeding 1.93 μmol/L (40 μg/dL) for 10 radiator repair workers employed by five companies in these counties. A Los Angeles County study identified 55 radiator repair companies with potentially significant lead exposures, more than in any other industry.[12]

Methods

The intervention program focused on three areas: identifying companies, developing and marketing resources to facilitate employers' own lead-poisoning prevention activities, and maintaining regular contact with individual companies to stimulate and monitor their progress.

At the time of the study, both authors were associated with the California Department of Health Services, Berkeley, Calif.

Requests for reprints should be sent to Jim Bellows, MPH, State Compensation Insurance Fund, 1275 Market St, Room 630, San Francisco, CA 94103.

This paper was submitted to the Journal January 21, 1992, and accepted with revisions November 11, 1992.

The project's strategy was to get companies started with the relatively simple step of blood lead testing. OSHA regulations imply that air monitoring should be the initial means of hazard evaluation, but blood lead testing offers several advantages over air monitoring. It is indicative of both ingestion and inhalation exposures[13] and has less daily variability than air monitoring. It is also less expensive, allowing companies to save limited funds for exposure control. Blood lead testing also provided a key link between the companies involved in the project and the existing Registry with its established mechanisms for follow-up of individuals with high blood lead levels. Perhaps most important, documented high blood lead levels could provide strong motivation for employers to reduce workplace exposures.

A key step in eliciting companies' cooperation was presenting a step-by-step approach by which they could achieve compliance with the principal OSHA regulations. This approach encouraged employers to work first on measures that were likely to be the most cost-effective in reducing exposures.

Company Identification

Four hundred fifty-nine Los Angeles County and San Bernardino County radiator industry companies were identified from local telephone directories and local agencies. A baseline survey of these companies was conducted during July and August 1990. Of the 459 companies surveyed, 275 were apparently engaged in radiator repair or manufacture and were entered into the intervention phase of the project. Excluded were 76 companies that were reportedly out of business, 94 that were engaged in wholesale or retail trade only, and 14 that did not respond.

Resource Development

A local ad hoc advisory committee was convened to enhance the project's sensitivity to the needs of the industry, to encourage the use of newly developed resources, and to establish a foundation for continuing local efforts after the project's conclusion.

The project provided no direct professional services (such as blood lead testing or air monitoring). Instead, existing providers were urged to tailor their services to the needs of participating companies. These resources were publicized by project staff and cosponsoring organizations.

The new or expanded resources that resulted directly from the project included the following:

- A comprehensive manual produced by the California Department of Health Services (*Prevent Lead Poisoning . . . Before It Poisons Your Business*) to guide companies step-by-step in creating a lead-poisoning prevention program
- A low-cost blood lead screening program sponsored by the National Automotive Radiator Service Association and the Western Occupational Medicine Association
- A model contract for use by employers and physicians establishing medical surveillance programs
- Seminars for participating employers, sponsored by the California Department of Health Services
- Worker health and safety training classes in English and Spanish, sponsored by Los Angeles City College
- A bilingual motivational video (*He's Not the Man I Married . . . Could It Be Lead?*) for workers and their employers, produced by the California Department of Health Services and funded in part by California's State Compensation Insurance Fund
- Continuing medical education courses sponsored by local medical groups

Indirect results of the project's activities included the following:

- Marketing of low-cost ventilation systems developed by private vendors specifically for use in radiator repair
- Testing of lead-free solders for radiator repair, sponsored by the Copper Development Association

Tracking of Companies' Progress

Companies were first notified of the intervention project in October 1990. They were informed that active participation in the model project was voluntary but that compliance with OSHA regulations was mandatory, and that failure to cooperate might result in referral to California's Division of Occupational Safety and Health (Cal/OSHA). The companies were encouraged to initiate lead-poisoning prevention activities by conducting blood lead testing. They were asked to submit their test results on progress report forms. Employers that provided no evidence of testing were sent a friendly reminder letter 5 weeks after the initial contact, followed 3 weeks later by a bluntly worded letter warning that they might soon be identified to Cal/OSHA and then a final warning sent via certified mail. Companies without employees are exempt from Cal/OSHA regulations, so they were not sent the warnings. During this period, project staff responded to many telephone requests for information. Intensive case follow-up (similar to that for other cases reported through the Registry[6]) was conducted for individuals with reported blood lead levels of 2.90 μmol/L (60 μg/dL) or higher.

Data Collection and Analysis

Information about the companies' business activities and any previous blood lead testing or air monitoring was abstracted from their baseline survey responses. Information about new blood lead testing (and air monitoring) was taken from the companies' progress reports. Registry data provided a basis for validating information on the progress reports through comparison of results for each individual identified in both systems.

Data analysis followed a written plan prepared in advance, based on standard statistical methods. Statistical analysis was conducted with commercial microcomputer software packages. In describing companies' blood lead levels, maximum values were used rather than means or medians, because a company was considered to have a lead exposure problem if any worker had a high blood lead level.

Results

Study Group

Of the 275 companies enrolled in the intervention phase, 23 were dropped because they went out of business or because they repaired fewer than 10 radiators per week. Of the 252 active companies, 148 (58%) had employees (a mean of six employees per company, of which two were engaged in radiator repair work); 104 (42%) were owner-operators without employees. Two-hundred forty-seven companies repaired used radiators; five manufactured new radiators or cores.

Progress reports submitted by 171 companies indicated that 495 individuals participated in blood lead testing (386 employees and 109 owners and managers). Over half of the companies used the trade association's low-cost screening program. Twenty-four individuals reportedly declined to be tested, and 141 were considered unexposed by their employers. Most

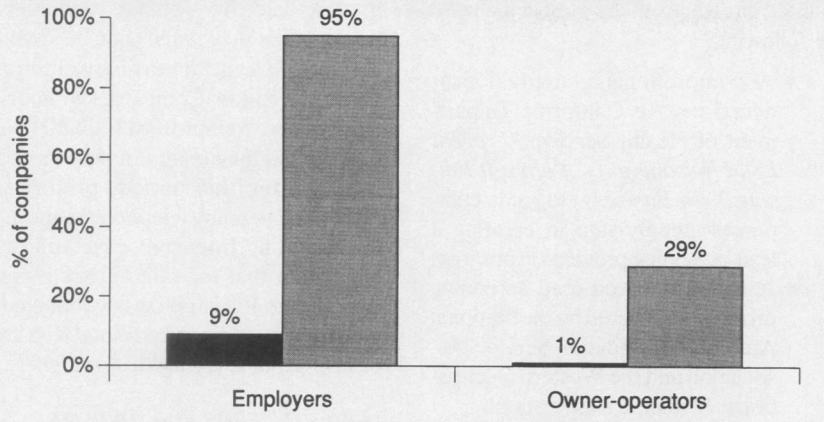
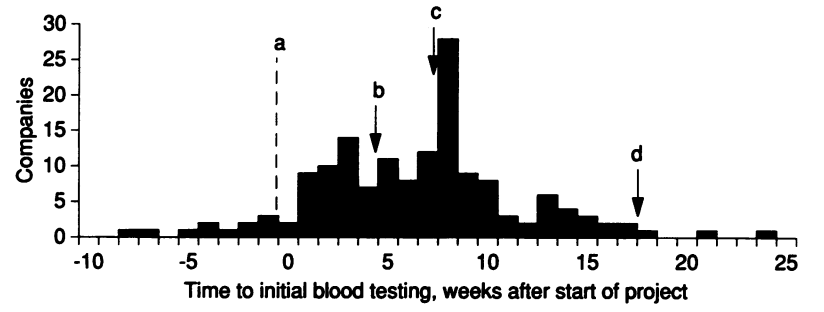


FIGURE 1—Percentage of companies that conducted blood lead testing before the intervention project (dark bars) and during the project (light bars).



Note. a = Time at which packets announcing the intervention program were received by participating companies.
b = Time at which first reminder letters were received.
c = Time at which second reminder letters were received, including first blunt warnings about Cal/OSHA enforcement.
d = Time at which the process for referring noncooperating companies to Cal/OSHA was initiated.

FIGURE 2—Relationship between timing of project activities and initiation of company-sponsored blood lead testing at 171 companies.

TABLE 1—Individuals' Blood Lead Levels and Companies' Maximum Blood Lead Levels

	No. Participating	% ≥ 1.21 μmol/L[a]	% ≥ 1.93 μmol/L	% ≥ 2.90 μmol/L[b]	% ≥ 3.86 μmol/L
Individuals					
Radiator repair workers	246	60	22	6	1
Owners and managers	109	38	12	5	1
Employees in all other jobs	140	21	1	0	0
Companies' maximum levels					
Employers	141	71	31	11	4
Owner-operators	30	63	17	7	0

Note. The companies are 171 radiator service companies in Los Angeles and San Bernardino Counties, Calif.
[a]1.21 μmol/L (25 μg/dL) is the threshold for mandatory reporting by California laboratories.
[b]2.90 μmol/L (60 μg/dL) is the threshold for immediate removal from exposure until the worker's blood lead level declines below 1.93 μmol/L.

individuals tested were radiator repair workers (50%) or owners or managers (22%). They averaged 36 years of age and had been at their current companies for a mean of 3.2 years. Sixty percent had Hispanic surnames. Eight (1.6%) were female.

Blood Lead Testing

Blood lead testing increased sharply during the study period among both employers and owner-operators (Figure 1). Nearly half (47%) of the companies initiated blood lead testing only after the first strong warning of referral to Cal/OSHA if they failed to conduct testing (Figure 2). By January 1991, only seven employers had failed to provide evidence that the required blood lead testing or air monitoring had been conducted. Cal/OSHA initiated enforcement inspections at each of the seven.

The overall distribution of blood lead levels is shown in Table 1. Individuals' blood lead levels ranged from 0.05 to 4.93 μmol/L, with a median of 1.01 μmol/L (21 μg/dL). Radiator repair workers had the highest blood lead levels, with a median of 1.35 μmol/L. Blood lead levels of 1.93 μmol/L (40 μg/dL) or higher were reported for 69 individuals, including 54 radiator repair workers (22% of those tested). More than one quarter of the companies reported blood lead levels of 1.93 μmol/L or higher.

Among radiator repair employees, median blood lead levels were not associated with the number of radiator repair workers in the company (Kruskal-Wallis, $P > .3$). Blood lead levels were slightly higher for older workers than for younger workers (multiple regression, slope = 0.29 μg/dL per year, $P < .02$) but did not vary significantly with length of current employment.

Of the 218 individuals listed on the progress reports as having blood lead levels of 1.21 μmol/L or higher, concurrent Registry reports were received for 162 (74%). The reported values were identical in the two data sources for 93% of these cases. Minor discrepancies accounted for the remainder. For only one company were blood lead levels exceeding 1.93 μmol/L reported through the Registry but not on the corresponding progress report.

Air Monitoring

Six companies conducted air monitoring; each of these also conducted blood lead testing. Data provided for the six companies showed maximum airborne lead exposures of 9 to 97 μg/m^3 (median 21 μg/m^3).

Discussion

The enormous increase in blood lead testing activity resulting from this

project—from 9% of participating employers to 95%—indicates that companies that have been largely out of compliance with required worker protection measures can successfully be urged to begin taking action on lead-poisoning prevention. The increase in testing generated a similar increase in Registry reporting, from 5 companies where blood lead levels exceeded 1.93 μmol/L during 1989 to 49 such companies during the project's first 5 months.

Most public monies spent on occupational illness and injury prevention have gone into development and enforcement of regulations. Most observers concur that in the case of lead, the results of this "command and control" approach have fallen short of the goals of the original OSHA regulations.[14] Existing enforcement programs have been particularly ineffective at changing the practices of very small businesses, such as those targeted in this project. The need for locally based, industry-focused outreach programs has already been recognized, and has been addressed in at least one location with a series of on-site surveys.[15]

This project fills a need for occupational health intervention models that spread limited resources over a substantial number of companies, yet are still able to demonstrate real impact in those companies. The number of companies and workers affected by this project was far larger than the number that could have been affected by on-site consultation at individual workplaces. The project was able to amplify its impact by adopting a community-based approach, drawing on the resources of existing organizations such as trade associations, insurance companies, medical associations, and suppliers of safety-related goods and services.

The reported blood lead levels confirm that lead exposures are inadequately controlled in the Southern California radiator service industry, and that the number of radiator repair workers with elevated blood lead levels is far larger than the number previously reported to the California Occupational Lead Registry. Overexposures are likely in the 28% of participating companies where blood-lead levels of 1.93 μmol/L or higher were reported. Measures to reduce exposures, such as installation of engineering controls, may be complicated and costly. Because of the increased testing stimulated by the project, and enhanced surveillance, subsequent intervention efforts can be focused on companies where the need is greatest.

Possible limitations of these data should be considered. Blood lead values were furnished by the companies themselves and may include intentional or unintentional inaccuracies. However, the good agreement between Registry and company-reported data is encouraging. The blood lead levels presented in this report are somewhat lower than those previously found in the radiator service industry in other states.[10,11] This discrepancy may reflect lower airborne exposures in Southern California workplaces, where much work is done in areas with substantial natural ventilation year-round. Alternatively, because the blood lead data were collected in late fall, they may not reflect peak levels during high-production summer months.

Data from this project reinforce previous studies suggesting that current surveillance systems seriously undercount the number of workers affected by overexposure to lead. Increasing the sensitivity of lead registries would improve estimates of lead poisoning prevalence and strengthen efforts to link surveillance with intervention activities. This project serves as a model for increasing the sensitivity of registries by stimulating greatly expanded blood lead testing.

The project's impact cannot be attributed to any single factor. Although the ongoing contacts with participating companies required continuous effort, the average amount of time devoted to each company was small in comparison with the time that would have been required for individual on-site consultation. The fact that nearly half of the participating companies began their testing only after receiving a blunt warning about enforcement actions suggests that enforcement can be an effective incentive to employer action when it is coupled with a targeting mechanism. Further follow-up will be required to evaluate the effect of enforcement agency referrals and to determine the project's impact on companies' ongoing lead-poisoning prevention activities. The success of the initial phase of the project warrants the extension of the model to other lead-using industries and its use in other locations. The model could well be applied to prevention of other types of occupational injury or illness. □

Acknowledgments

This project was supported in part by the California Department of Health Services (Contract 89-97661), the National Institute for Occupational Safety and Health (Cooperative Agreement U60-CCU-02990-03), and the California Department of Industrial Relations (via interagency agreement).

The substance of this paper was presented at the National Conference on State-Based Occupational Safety and Health Activities, Cincinnati, Ohio, September 1991, and at the annual meeting of the American Public Health Association, Atlanta, Ga, November 1991.

The authors acknowledge the many contributions of the project staff: Elizabeth Abello, Robin Dewey, David Harrington, Lucia Mireles, Kate Nichol, Sarah Royce, Glenn Shor, Joan Sprinson, and Pat Young. Neil Maizlish provided invaluable insight and assistance. The authors also gratefully acknowledge the guidance and feedback of the project's ad hoc advisory committee. The project would not have been possible without the cooperation and contributions of the California Division of Occupational Safety and Health (Cal/OSHA).

References

1. Hamilton A. *Exploring the Dangerous Trades.* Boston, Mass: Little, Brown; 1943.
2. Landrigan PJ. Toxicity of lead at low dose. *Br J Ind Med.* 1989;46:593–596.
3. US Occupational Safety and Health Administration. Occupational exposure to lead: final standard. *Federal Register.* November 14, 1978;43:52952–53014.
4. Froines JR, Baron S, Wegman DH, O'Rourke S. Characterization of the airborne concentrations of lead in U.S. industry. *Am J Ind Med.* 1990;18:1–17.
5. Rudolph L, Maizlish N, Tepper A, et al. Surveillance for occupational lead exposure—United States, 1987. *MMWR.* 1989;38:642–646.
6. Maizlish N, Rudolph L, Sutton P, Jones JR, Kizer KW. Elevated blood lead in California adults, 1987: results of a statewide surveillance program based on laboratory reports. *Am J Public Health.* 1990;80:931–934.
7. Maizlish NM, Rudolph L. California adults with elevated blood lead levels, 1987 through 1990. *Am J Public Health.* 1993;83:402–405.
8. Rudolph L, Sharp DS, Samuels S, Perkins C, Rosenberg J. Environmental and biological monitoring for lead exposure in California workplaces. *Am J Public Health.* 1990;80:921–925.
9. Bellows J, Rudolph L, Kryszak J. *Occupational Lead Exposure in California—Workplace Conditions Underlying the Reported Index Cases.* Berkeley, Calif: California Occupational Health Program, California Department of Health Services; 1992. Publication CDHS (COHP) FI-89-001.
10. Goldman RH, Baker EL, Hannan M, Kamerow DB. Lead poisoning in automobile radiator mechanics. *N Engl J Med.* 1987;317:214–218.
11. Lussenhop DH, Parker DL, Barklind A,

McJilton C. Lead exposure and radiator repair work. *Am J Public Health.* 1989;79: 1558–1560.
12. Papenak PJ, Ward CE, Gilbert KM, Frangos SA. Occupational lead exposure in Los Angeles County: an occupational risk surveillance strategy. *Am J Ind Med.* 1992;21:199–208.
13. *Documentation of the Threshold Limit Values and Biological Exposure Indices.* 5th ed. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists Inc; 1986.
14. Silbergeld EK, Landrigan PJ, Froines JR, Pfeffer RM. The occupational lead standard: a goal unachieved, a process in need of repair. *New Solutions.* 1991 (Spring): 20–30.
15. Tuskes PM, Key MM. Potential hazards in small business—a gap in OSHA protection. *Appl Ind Hyg.* 1988;3:55–57.

Undocumented Aliens and Uncompensated Care: Whose Responsibility?

Kris Siddharthan, PhD, and Sudha Alalasundaram, MBA

ABSTRACT

Undocumented aliens concentrated in metropolitan areas and certain Sunbelt states can financially burden local health agencies and may interfere with access to health care for indigent populations that are legally resident. Data collected from Jackson Memorial Hospital, which provides the bulk of indigent medical services in Dade County, Florida, are used to investigate the problem of providing uncompensated care to undocumented aliens. Policy alternatives concerning immigration issues and reimbursement are discussed. (*Am J Public Health.* 1993;83:410–412)

The 1987 *National Medical Expenditures Survey*[1] revealed that between 35 million and 40 million Americans were uninsured on any given day, but little detailed research has been conducted on insurance coverage and health care utilization patterns of the millions of undocumented aliens who reside in this country. A significant proportion of this population is indigent and depends on publicly funded community health centers and county public hospital systems to meet its health care needs.[2]

Important differences exist between native populations and the approximately 3 million undocumented aliens in the United States,[3] many of whom lack health coverage.[4] First, undocumented aliens cannot participate in government programs such as Medicare or Medicaid (except in the case of emergencies). Second, undocumented resident aliens are concentrated in the Sunbelt states[5] and certain large metropolitan areas in the North, such as New York City. This concentration results in a few Sunbelt states' and local governments' having to absorb a disproportionate cost.

Undocumented Aliens and Uncompensated Care in Dade County

Dade County, Florida, has witnessed a large influx of refugees, mostly from Central and South America and the Caribbean, and an estimated 18% of the county's population consists of people born outside the United States.[6] Undocumented aliens in Dade County are those persons who are in the United States illegally or those who are legally resident but undocumented. The latter group consists mostly of political refugees (mainly from the island of Cuba[6]) who are allowed to stay in the country while pursuing political asylum. They are undocumented because they do not possess a visitor's visa or a green card that establishes temporary or permanent residency in the United States. The majority of Cuban entrants to the United States arrive by commercial flights on tourist visas. It is estimated that 30% to 40% of these "tourists" opt to remain in Dade County after their visas expire and they become eligible to apply for political asylum. A substantial number of illegal aliens from other Carribbean and Latin American countries also live in Dade County.

Jackson Memorial Hospital in Miami, with more than 1400 licensed beds and numerous outpatient clinics, comprises the largest medical complex in the southeastern United States. The Public Health Trust of Dade County contracts with the county for the provision by the hospital of health care services to indigent patients. A significant proportion of nonpaying patients admitted to the hospital as

Kris Siddharthan is with the Department of Health Services Administration, Florida International University, North Miami. Sudha Alalasundaram is a doctoral student in the Department of Public Administration, Florida International University, Miami.

Requests for reprints should be sent to Kris Siddharthan, PhD, Department of Health Services Administration, School of Public Affairs and Services, Florida International University, North Miami Campus, North Miami, FL 33181.

This paper was submitted to the Journal March 10, 1992, and accepted with revisions October 27, 1992.