

Medical Management of Lead-Exposed Workers: Results of Physician Interviews in New Jersey

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Between July 1990 and April 1992, a questionnaire was administered to the physicians who saw 62 individuals with a blood lead (PbB) level equal to or higher than 2.40 $\mu\text{mol/liter}$ with occupational inorganic lead exposure, to ascertain the medical management of workers with elevated PbB levels. Most of the 62 cases were seen by their personal physician (50%) or a private physician under contract with the company for which the patient worked (40%). Only eight (13%) patients were seen by a physician in a medical specialty assumed to include training relevant to occupational lead exposure. Fifteen percent of the patients' physicians reported taking no action for the elevated PbB level. Twenty-nine percent did not report retesting the patient (all should have been retested). Twenty-one percent of the 62 patients' physicians reported informing no one, including the patient, of the elevated PbB level. The majority of the physicians did not know the answer or declined to answer a question about what PbB level would prompt them to take six follow-up actions. The results of the physician interviews indicate that medical follow-up on workers with elevated PbB levels may not be adequate to prevent lead poisoning of the workers and their co-workers. Recommendations include methods to increase physician and employer knowledge of the medical management of workers with elevated PbB levels and to increase employer compliance with OSHA standards regarding medical surveillance of lead-exposed workers.

Lead affects the hematopoietic system and damages the central and peripheral nervous systems in occupationally exposed workers. Chronic occupational exposure to lead can cause renal impairment and adverse effects on reproductive capability in both sexes.¹ Despite knowledge of the effects of lead exposure and efforts to address it, occupational lead toxicity remains a public health problem in the United States. To address the problem in New Jersey, the New Jersey Department of Health (NJDOH) adopted regulations requiring reporting of cases of lead toxicity to the NJDOH by laboratories² and by physicians.³ The NJDOH Occupational Health Service (OHS) has an active program, the Occupational Lead Surveillance Project, to prevent occupational lead poisoning.^{4,5} As of August 1993, approximately 4000 individuals had been reported to the NJDOH with blood lead (PbB) levels over 1.20 $\mu\text{mol/liter}$ due to occupational exposure.

Occupational lead exposure is regulated by two OSHA lead standards, one for general industry and one for the construction industry.⁶⁻⁸ The OSHA Lead Standard for general industry requires employers to establish a medical surveillance program for employees who are or may be exposed above the action level of 30 $\mu\text{g}/\text{m}^3$. A physician must supervise the medical surveillance program and take primary responsibility for evaluating potential lead toxicity in the workers. Thus, physicians have

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an important role in ensuring that lead-exposed workers are medically monitored and that appropriate actions are taken for workers with lead toxicity.

Physicians of workers reported to the NJDOH with PbB levels of 2.40 $\mu\text{mol/liter}$ or higher were interviewed to ascertain what actions they took for the workers and their knowledge of the medical management of workers with elevated PbB levels.

Methods

A questionnaire was administered to the physicians who saw 62 individuals (hereafter referred to as cases) with a PbB level equal to or higher than 2.40 $\mu\text{mol/liter}$ due to occupational inorganic lead exposure. Cases were reported to the NJDOH by laboratories between January 1990 and March 1992. All 62 physician interviews were conducted between July 1990 and April 1992 via telephone by a physician specialized in occupational medicine. One physician was interviewed for each of the 62 cases. However, only 45 different physicians were interviewed; 38 physicians were interviewed for one case each and the seven other physicians were interviewed for two to seven cases.

The 62 cases represent 29% of the total 212 individuals reported to the NJDOH between January 1990 and March 1992 with PbB levels equal to or higher than 2.40 $\mu\text{mol/liter}$. The remaining 150 individuals are not included because their physician was interviewed with a different questionnaire (16, 8% of 212), the case was seen by a physician in the NJDOH's referral network* (24, 11%), the physician could not be interviewed (21, 10%), or no physician was identified (87, 41%). The reason for noninclusion is unknown for two individuals (1%).

* The referral network included four physicians trained in occupational medicine to whom workers with lead toxicity who did not have a primary care physician were referred, and with whom the OHS communicated regularly.

The physician questionnaire included questions about the physician (specialty, relationship to case), why the case had the elevated PbB level, action(s) taken for the case, who the physician informed of the case's elevated PbB level, whether the physician visited the workplace of the case, and what PbB level would prompt the physician to take certain actions. Frequencies of answers were generated and compared by relationship of the physician to the case, specialty of the physician, and the case's PbB level.

Results

Case and Physician Information

The 62 cases worked for 41 different employers, including four who were self-employed. Most of the 62 cases worked in the construction (26, 42%) or manufacturing (24, 39%) industry. The 62 cases' PbB levels that prompted the physician interviews ranged from 2.40 to 6.38 $\mu\text{mol/liter}$, with 28 (45%) equal to or greater than 2.90 $\mu\text{mol/liter}$.

The 62 cases were seen by their personal physician (31 cases, 50%), by a private physician under contract with the company for which the case worked (25 cases, 40%, hereafter referred to as company contract physicians), by a full-time company physician (one case), or by a physician the case was referred to (five cases, hereafter called referral physicians). Thirty (48%) of the 62 cases' physicians reported that they specialized in family/general practice, and 18 (29%) specialized in internal medicine. The remainder specialized in surgery (four), occupational medicine (three), toxicology (five), and pediatrics (one). One was a chiropractor. Sixty-four percent of the 25 cases' company contract physicians specialized in family/general practice, and 42% and 45% of the 31 cases' personal physicians specialized in family/general practice and internal medicine, respectively.

Physician Actions Related to the Elevated Blood Lead Level

Nine (15%) cases' physicians reported taking no action for the elevated PbB level (four of the nine cases had PbB levels $\geq 2.90 \mu\text{mol/liter}$). These nine cases were seen by four different physicians—one company contract physician saw six of the nine cases, two other company contract physicians each saw one case, and one personal physician saw one case. The six cases seen by the same company contract physician worked for one company. The physicians for 18 (29%) cases did not report retesting the case, including the physicians of the nine cases who reported doing nothing. Of these eighteen cases, seven cases had a PbB level of 2.90 $\mu\text{mol/liter}$ or higher.

The actions that were taken included a request for temporary removal from lead exposure and retest (35 cases, 56%); observation and retest (27 cases, 44%); and chelation (11 cases, 18%), eight with hospitalization and three without hospitalization. Five were chelated with *meso*-2,3-dimercaptosuccinic acid (DMSA, succimer), four with 3-mercaptop-D-valine (MSD, penicillamine), and two with edetate calcium disodium. (See Table 1 for the actions taken, according to relationship of the physician to the case.)

Thirteen (21%) of the 62 cases' physicians reported informing no one, including the case, of the elevated PbB level. The remaining 49 cases' physicians reported informing the following of the case's elevated PbB level: the case (42 cases, 68%), the company's personnel office or management (19 cases, 31%), the company's health and safety officer (11 cases, 18%), and the company physician or nurse (5 cases, 8%). In five of the nine cases for whom the physician reported taking no action (mentioned above), the physician also reported not telling anyone. (See

TABLE 1
Actions Taken by Physicians for Elevated Blood Lead Level by Relationship to Case (n = 62 Cases)

| Action | Personal MD | | Contract Physician | | Full-time Company Physician | | Referral Physician | | Total | |
|---|-------------|----|--------------------|----|-----------------------------|-----|--------------------|-----|-------|----|
| | No. | %* | No. | %* | No. | %* | No. | %* | No. | %* |
| Nothing | 1 | 3 | 8 | 32 | — | — | — | — | 9 | 15 |
| Unknown | — | — | 1 | 4 | — | — | — | — | 1 | 2 |
| Temporary removal and retest | 16 | 52 | 13 | 52 | 1 | 100 | 5 | 100 | 35 | 56 |
| Observation and retest | 16 | 52 | 8 | 32 | 1 | 100 | 2 | 40 | 27 | 44 |
| Chelation with or without hospitalization | 6 | 19 | 1 | 4 | — | — | 4 | 80 | 11 | 18 |
| Referral to another physician | 6 | 19 | 1 | 4 | — | — | — | — | 7 | 11 |
| Other† | 14 | 45 | 1 | 4 | — | — | — | — | 15 | 24 |
| Total (Cases) | 31 | ‡ | 25 | ‡ | 1 | ‡ | 5 | ‡ | 62 | ‡ |

* Percentage of total cases.

† Includes observation alone (2), temporary removal alone (1), hospitalization for observation alone (1), hospitalization for observation and retest (1), permanent removal from job and retest (4), patient did not follow physicians' advice (3), physician just informed of elevated PbB level (1), physician gathering more information from another physician (1), and follow-up physical examination (1).

‡ Percentages add to over 100 because many physicians took more than one action.

TABLE 2
Who Physician Informed of Elevated Blood Lead Level by Relationship to Case (n = 62 Cases)

| Who was told | Personal MD | | Contract Physician | | Full-time Company Physician | | Referral Physician | | Total | |
|----------------------------|-------------|----|--------------------|----|-----------------------------|-----|--------------------|-----|-------|----|
| | No. | %* | No. | %* | No. | %* | No. | %* | No. | %* |
| No one | 9 | 29 | 4 | 16 | — | — | — | — | 13 | 21 |
| The case | 20 | 65 | 16 | 64 | 1 | 100 | 5 | 100 | 42 | 68 |
| Personnel/management | 2† | 6 | 14 | 56 | 1 | 100 | 2† | 40 | 19 | 31 |
| Health and safety officer | 2† | 6 | 7 | 28 | 1 | 100 | 1† | 20 | 11 | 18 |
| Company physician or nurse | —† | — | 4 | 16 | 1 | 100 | —† | — | 5 | 8 |
| Other‡ | 4 | 13 | 1 | 4 | — | — | 2 | 40 | 7 | 11 |
| Total (Cases) | 31 | § | 25 | § | 1 | § | 5 | § | 62 | § |

* Percentage of total cases.

† Two of the 31 cases with personal physicians were self-employed, two of the five cases with referral physicians were self-employed.

‡ Includes New Jersey Department of Health (5), OSHA (1), and case's personal physician (1).

§ Percentages add to over 100 because some physicians told more than one person.

Table 2 for who was told, according to relationship of the physician to the case.)

Twelve (19%) of the cases' physicians reported that they did not eval-

uate why the case had an elevated PbB level. Thirty-six percent of the 25 company contract physicians versus 10% of the 31 personal physicians reported that they did not eval-

uate why the case's PbB level was elevated. The remaining 50 cases' physicians thought the elevated PbB level was due to chronic exposure to lead at work (37, 60%) and/or to an

incident/accident involving lead at work (15, 24%).

Six (10%) of the 62 cases' physicians visited the workplace as a result of the elevated PbB level that led to the physician interview. The 56 cases' physicians who reported not visiting the workplace as a result of the elevated PbB level also reported not ever visiting the workplace. The physicians who did visit were company contract physicians (four cases), a full-time company physician (one case), and a referral physician (one case).

Physician Knowledge

The 62 cases' physicians were asked what PbB level would prompt them to take six actions: follow-up physical examination, worker education, requesting a follow-up industrial hygiene inspection, retest, removal from work, return to work. Only the answers given on the first interview were used for the seven physicians who saw more than one case, resulting in 45 unique physician answers. The majority (56% to 64%, depending on the action) of the 45 physicians said they did not know, and another 16% declined to answer. (See Table 3 for details.)

Discussion

The results of this physician interview study indicate that in New Jersey (a) many workers with lead toxicity do not receive medical attention and (b) for workers who do receive medical attention, follow-up may not be adequate to prevent future lead poisoning.

Regarding the lack of medical attention: 212 individuals were reported to the NJDOH between January 1990 and March 1992 with PbB levels greater than or equal to 2.40 $\mu\text{mol/liter}$. Of the 162 individuals who were interviewed, 31 (19%) did not see a physician, could not remember the physician, or saw a physician who had no record of the individual. Forty-six percent of 248 individuals who were reported to the NJDOH with PbB levels greater than

or equal to 1.93 $\mu\text{mol/liter}$ due to an occupational exposure and interviewed between April 1986 and July 1990 reported that they did not see a physician about their elevated PbB level.⁴ In addition, many workers' lead toxicity may be unrecognized because the workers do not have PbB tests in the first place.⁹

Several observations regarding workers who do receive medical attention follow. Only eight (13%) of the 62 cases were seen by a physician in a medical specialty in which it can be assumed the physician had had training relevant to occupational lead exposure (three in occupational medicine, five in toxicology). This would not be unexpected for the personal physicians, but was also true for the company contract physicians, most of whom specialized in family/general practice. This is probably related to the short supply of occupational medicine physicians in New Jersey—only 23 board-certified and 24 board-eligible as of September 1993. Other studies have noted the shortage of occupational medicine physicians, which has resulted in physicians from other specialties diagnosing and treating occupational disease.^{10,11}

Most of the 45 physicians for the 62 cases appeared to lack knowledge of the appropriate follow-up of a worker with elevated PbB levels, as shown by their inability to answer the question about what PbB level would prompt them to take six specific actions (see Table 3). The physicians' apparent lack of knowledge is probably due to a lack of training in occupational medicine. Several studies have found minimal occupational medicine training among medical students, internists, and residents, including those specializing in internal medicine and family practice.^{12,13}

Regarding the action(s) taken by the cases' physicians: all 62 cases should have been retested, but 18 were not. Seven of these 18 cases had a PbB level of 2.90 $\mu\text{mol/liter}$ or higher and should have been tempo-

rarily removed from exposure as well as retested. Of great concern are the nine cases' physicians who reported taking no action for the cases' elevated PbB levels. Also of concern are the findings about who the physicians informed of the cases' elevated PbB levels, especially that 13 (21%) cases' physicians informed no one, including the case, of the elevated PbB level. Although the reasons for this are not clear, it indicates a lack of communication between the physicians and the cases and the cases' employers. Communication is essential for prevention of lead toxicity in these cases and their co-workers.

The physicians appeared to have little involvement in addressing the exposure/workplace antecedents of the 62 cases' lead toxicity. Twelve (19%) cases' physicians did not try to determine why the case had an elevated PbB level. It is unclear why the company contract physicians did not evaluate the reason(s) for the elevated PbB level in such a high percentage (36%) of their cases. Very few (6, 10%) cases' physicians had ever visited the workplace. Personal physicians would not be expected to visit the workplace. However, that so few company contract physicians had visited the workplace is surprising. Visiting the workplace can aid physicians in understanding the exposure sources of the workers they see and in improving communication with the workers and their employers.

Underlying the concerns about the physicians' involvement with these cases is the employers' discharge of their responsibilities. Over half the cases were seen by their personal physician or a referral physician, rather than a company physician (full-time or contract). The reasons are unknown but may include the fact that there was no lead standard for the construction industry at the time of the study (26 (42%) of the cases were from this industry and most (62%) saw a personal physician); medical surveillance programs

TABLE 3
 What Blood Lead Level Would Prompt Physicians to take Certain Actions by Relationship to Case (n = 45 Physicians)

| Action, blood lead level ($\mu\text{mol/liter}$) | Personal MD | | Contract Physician | | Full-time Company Physician | | Referral Physician | | Total | |
|--|-------------|-----|--------------------|-----|-----------------------------|-----|--------------------|-----|-------|-----|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| A. Follow-up physical examination | | | | | | | | | | |
| Don't know/unsure | 19 | 66 | 6 | 46 | — | — | — | — | 25 | 56 |
| No answer | 4 | 14 | 3 | 23 | — | — | — | — | 7 | 16 |
| <0.96 (and above) | — | — | — | — | — | — | — | — | — | — |
| 0.96–1.87 (and above) | 3 | 10 | — | — | — | — | 1 | 50 | 4 | 9 |
| 1.92 (and above) | 1 | 3 | 3 | 23 | 1 | 100 | 1 | 50 | 6 | 13 |
| >1.92 (and above) | 2 | 7 | 1 | 8 | — | — | — | — | 3 | 7 |
| Total | 29 | 100 | 13 | 100 | 1 | 100 | 2 | 100 | 45 | 101 |
| B. Worker education | | | | | | | | | | |
| Don't know/unsure | 20 | 69 | 6 | 46 | 1 | 100 | — | — | 27 | 60 |
| No answer | 4 | 14 | 3 | 23 | — | — | — | — | 7 | 16 |
| <0.96 (and above) | 1 | 3 | 1 | 8 | — | — | — | — | 2 | 4 |
| 0.96–1.87 (and above) | 2 | 7 | 1 | 8 | — | — | 2 | 100 | 5 | 11 |
| 1.92 (and above) | 2 | 7 | 2 | 15 | — | — | — | — | 4 | 9 |
| >1.92 (and above) | — | — | — | — | — | — | — | — | — | — |
| Total | 29 | 100 | 13 | 100 | 1 | 100 | 2 | 100 | 45 | 100 |
| C. Follow-up industrial hygiene inspection | | | | | | | | | | |
| Don't know/unsure | 22 | 76 | 6 | 46 | 1 | 100 | — | — | 29 | 64 |
| No answer | 4 | 14 | 3 | 23 | — | — | — | — | 7 | 16 |
| <0.96 (and above) | — | — | 1 | 8 | — | — | — | — | 1 | 2 |
| 0.96–1.87 (and above) | 1 | 3 | 1 | 8 | — | — | 2 | 100 | 4 | 9 |
| 1.92 (and above) | 2 | 7 | 2 | 15 | — | — | — | — | 4 | 9 |
| >1.92 (and above) | — | — | — | — | — | — | — | — | — | — |
| Total | 29 | 100 | 13 | 100 | 1 | 100 | 2 | 100 | 45 | 100 |
| D. Retest | | | | | | | | | | |
| Don't know/unsure | 19 | 66 | 6 | 46 | — | — | — | — | 25 | 58 |
| No answer | 4 | 14 | 3 | 23 | — | — | — | — | 7 | 16 |
| <0.96 (and above) | — | — | 1 | 8 | — | — | — | — | 1 | 2 |
| 0.96–1.87 (and above) | 4 | 14 | 1 | 8 | — | — | 2 | 100 | 7 | 16 |
| 1.92 (and above) | 1 | 3 | 2 | 15 | 1 | 100 | — | — | 4 | 9 |
| >1.92 (and above) | 1 | 3 | — | — | — | — | — | — | 1 | 2 |
| Total | 29 | 100 | 13 | 100 | 1 | 100 | 2 | 100 | 45 | 100 |
| E. Remove | | | | | | | | | | |
| Don't know/unsure | 20 | 69 | 6 | 46 | — | — | — | — | 26 | 58 |
| No answer | 4 | 14 | 3 | 23 | — | — | — | — | 7 | 16 |
| <0.96 (and above) | — | — | — | — | — | — | — | — | — | — |
| 0.96–1.87 (and above) | 1 | 3 | 2 | 15 | — | — | — | — | 3 | 7 |
| 1.92 (and above) | 2 | 7 | 1 | 8 | 1 | 100 | — | — | 4 | 9 |
| >1.92 (and above) | 2 | 7 | 1 | 8 | — | — | 2 | 100 | 5 | 11 |
| Total | 29 | 100 | 13 | 100 | 1 | 100 | 2 | 100 | 45 | 100 |
| F. Return | | | | | | | | | | |
| Don't know/unsure | 20 | 69 | 7 | 54 | — | — | — | — | 27 | 60 |
| No answer | 4 | 14 | 3 | 23 | — | — | — | — | 7 | 16 |
| <0.96 (and above) | — | — | 2 | 15 | — | — | — | — | 2 | 4 |
| 0.96–1.87 (and above) | 3 | 10 | — | — | — | — | — | — | 3 | 7 |
| 1.92 (and above) | 1 | 3 | 1 | 8 | 1 | 100 | 2 | 100 | 5 | 11 |
| >1.92 (and above) | 1 | 3 | — | — | — | — | — | — | 1 | 2 |
| Total | 29 | 99 | 13 | 100 | 1 | 100 | 2 | 100 | 45 | 100 |

in the companies that were nonexistent or incomplete; and workers' nonparticipation in company surveillance programs for fear of adverse job consequences. In an earlier survey of lead-using companies conducted by the OHS, only 31% of the responding companies had a complete medical surveillance program.

It is important to note that the 62 cases whose physicians were interviewed represent a small, albeit significant, proportion (29%) of the total 212 cases reported to the NJDOH with PbB levels of ≥ 2.40 $\mu\text{mol/liter}$. Thus the results cannot be generalized to all workers with lead toxicity. Indeed, the 24 (11%) cases seen by physicians in the NJDOH's referral network were assumed to have been adequately followed up. However, the remaining 126 (60%) cases cannot be assumed to have been adequately followed up, particularly the 31 (15%) who did not appear to have received medical attention at all.

Conclusion

One way to address these concerns is to educate employers and physicians about lead toxicity, medical surveillance including follow-up, the NJDOH reporting regulations, and the OSHA standards. The OHS plans to develop and distribute educational materials about the medical management of workers with lead toxicity to physicians providing occupational health services. The OHS is also expanding its referral network (and with the expansion greater accessibility to physicians). A recently published *Directory of Occupational Medicine Services* listing 137 physicians offices and clinics that provide

occupational medicine services is part of this effort.¹⁴

The OHS will continue to interview and send educational materials to workers with lead toxicity reported to the NJDOH, and to their physicians. In the future, recommendations about the medical management of lead-exposed workers, in addition to the educational mailing, will be sent to physicians who appear to lack knowledge or not to be in communication with the workers and the workers' place of employment. Another educational approach is the Occupational Health Program, the California Department of Health's "Model Contract for a Lead Medical Program," which describes minimum responsibilities for the employer and medical supervisor.¹⁵ The model contract may be modified to suit the needs of the individual company. In addition, employers who do not appear to have a complete medical surveillance program are monitored by the OHS and, if necessary, referred to OSHA.

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