

# Blood Lead Screening Practices Among US Pediatricians

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**ABSTRACT.** *Objectives.* In 1991, the Centers for Disease Control and Prevention (CDC) decreased the blood lead level of concern to 10  $\mu\text{g}/\text{dL}$  (0.48  $\mu\text{mol}/\text{L}$ ) and recommended universal screening. Because these guidelines continue to provoke controversy, we conducted a study to: 1) estimate the proportion of pediatricians who are members of the American Academy of Pediatrics (AAP) who report screening for elevated blood lead levels; 2) describe their clinical practices regarding screening for elevated blood lead levels; 3) compare attitudes of universal screeners, selective screeners, and nonscreeners; and 4) identify characteristics of pediatricians who universally screen.

*Design.* Confidential, cross-sectional survey of a nationally representative random sample of 1610 pediatricians conducted through the AAP Periodic Survey.

*Subjects.* The study included 1035 responders (64% response rate). Analysis was limited to the 734 pediatricians who provide well-child care (ie, primary-care pediatricians).

*Results.* Fifty-three percent of pediatricians reported screening all their patients aged 9 to 36 months, 39% reported screening some, and 8% reported screening none. Among those who screen, 96% use a blood lead assay. The primary risk factors for which selective screeners screen are: history of pica (94%); living in an older home with recent renovations (92%); living in an older home with peeling paint (93%); and having a sibling who had an elevated blood lead level (88%). Among primary-care pediatricians, 73% agree that blood lead levels  $\geq 10$   $\mu\text{g}/\text{dL}$  should be considered elevated, and 16% disagree. However, 89% of primary-care pediatricians believe that epidemiologic studies should be performed to determine which communities have high proportions of children with elevated blood lead levels, and 34% of primary-care pediatricians believe that the costs of screening exceed the benefits.

*Conclusions.* Three years after the Centers for Disease Control and Prevention issued new guidelines for the management of elevated blood lead levels, a slight majority of primary-care pediatricians in the United States who are members of the AAP report that they universally screen their appropriately aged patients, while most of the remaining pediatricians report screening high-risk patients. Many pediatricians may want additional guidance about circumstances under which se-

lective screening should be considered. *Pediatrics* 1996; 98:372-377; *elevated blood lead levels, screening.*

ABBREVIATIONS. CDC, Centers for Disease Control and Prevention; AAP, American Academy of Pediatrics; US, United States.

In 1991, responding to increased evidence of adverse effects due to low-dose exposure to lead,<sup>1-5</sup> the Centers for Disease Control and Prevention (CDC) lowered the blood lead level of concern to 10  $\mu\text{g}/\text{dL}$  (0.48  $\mu\text{mol}/\text{L}$ ) and revised the guidelines for screening and management of elevated blood lead levels.<sup>6</sup> These guidelines call for universal screening of children under 6 years of age for elevated blood lead levels unless the community does not have a childhood lead poisoning problem, using a risk assessment questionnaire to determine whether children are at increased risk for elevated blood lead levels, screening with blood lead assays instead of porphyrin assays, and a multi-tiered approach for intervention. In July 1993, the American Academy of Pediatrics (AAP) adopted similar guidelines.<sup>7</sup>

Some of these recommendations are controversial. Anecdotal reports suggest that pediatricians are concerned about the clinical utility, costs, and practicality of implementing the new screening guidelines.<sup>8-11</sup> In addition, some pediatricians argue that screening for elevated blood lead levels does not meet strict criteria for a screening test.<sup>12</sup> To date, no national survey has been conducted to determine the proportion of pediatricians who screen for elevated blood lead levels, their screening practices, or their attitudes regarding low-level lead exposure and the 1991 CDC guidelines.

In this article, we report the results of a survey of a nationally representative sample of members of the AAP. Our objectives were to: 1) estimate the proportion of AAP-member pediatricians who report screening for elevated blood lead levels; 2) describe their clinical practices regarding screening for elevated blood lead levels; 3) compare the attitudes of universal screeners, selective screeners, and nonscreeners; and 4) identify characteristics of pediatricians who universally screen.

## METHODS

### Study Design and Sample

This study was the 28th in the series of Periodic Surveys of Fellows conducted by the Division of Child Health Research of the AAP. Periodic Surveys of the AAP membership are conducted four times annually on topics of interest to the AAP and its members. Each survey queries a random sample of active AAP

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members who live in the United States; those selected to participate in a Periodic Survey are not selected again for a period of at least 4 years. AAP membership in the United States (US) at the time of this survey was approximately 42 000 pediatricians; about 75% of US board-certified pediatricians are members of the AAP.

The survey instrument was an 8-page, self-administered, forced-choice questionnaire that was mailed to 1610 members of the AAP. An original mailing and four follow-up mailings to recontact nonrespondents were conducted from November 1994 to February 1995. Each mailing was accompanied by an introductory letter from the executive director of the AAP and a postage-paid return envelope, and respondents were assured confidentiality. The survey instrument was developed in cooperation with the AAP Committee on Environmental Health.

### Questionnaire Design

The questionnaire was made up of three sections: 1) physician demographic and practice characteristics; 2) screening and educational practices; and 3) statements regarding elevated blood lead levels (Table 1). Screening was defined as the application of a blood test to an asymptomatic child. Statements were based on issues raised in the literature.<sup>8-12</sup> Two statements focused on a potential decrease of 5 IQ points; this magnitude of IQ decrease was based on the literature and the 1991 CDC Statement.<sup>16</sup> Opinions to each statement were answered using a 5-point Likert scale (strongly agree, agree, neither agree or disagree, disagree, strongly disagree).<sup>13</sup>

### Analyses

Bivariate analyses were used to summarize and compare responses of pediatricians by demographic characteristics, and to compare the proportion of universal screeners, selective screeners, and nonscreeners who agreed to the statements. The  $\chi^2$  statistic was used to test the significance of categorical variables.

Multivariate logistic regression was used to identify independent variables that differentiate pediatricians who report screening universally from pediatricians who report screening selectively; nonscreeners were excluded because they comprised a small proportion of the total sample. The independent variables in the regression were selected by conducting bivariate comparisons between the aforementioned dichotomous variable and the variables presented in Tables 3, 5, and 6; only those comparisons with a *P* value  $\leq .01$  in the bivariate analyses were entered into the regression model. Logistic regression was used to calculate odds

TABLE 1. Sections in Questionnaire

Physician demographic and practice characteristics	
Age	
Gender	
Years in practice	
Type of practice	
Third-party payer mix	
Patient population mix	
Size of community	
Screening and educational practices	
Screen universally, selectively or not at all?	
Circumstances under which screening is not performed	
Patient groups are screened	
Frequency of screening	
Type of screening test used	
Method of blood collection	
Whether the pediatrician uses a risk assessment questionnaire	
Whether the pediatrician educates parents	
At what blood lead level education is initiated	
Awareness of local health department services	
Statements regarding elevated blood lead levels	
Blood lead levels at which significant effects may occur	
Prevalence of elevated blood lead levels in the pediatrician's practice and community	
Effectiveness of interventions for low-level lead exposure	
Relative importance of other anticipatory guidance issues	
Local laws	
Third-party reimbursement policies	
Logistics of obtaining and processing blood samples	
Costs of screening	

ratios and confidence intervals for variables associated with whether a pediatrician screens universally.

## RESULTS

### Response Rate and Demographics

A total of 1035 completed questionnaires were received, for a response rate of 64.3%. The response rate of the five previous AAP Periodic Surveys ranged from 64.5% to 72.2% (personal communication, Karen O'Connor, AAP, 1995). The respondents of this survey are comparable to respondents of the five previous AAP Periodic Surveys with respect to gender, age, location of practice, proportion of time spent in general pediatrics, professional activity and regional distribution, and they are comparable to the AAP membership with respect to gender and regional distribution (personal communication, Karen O'Connor, AAP, 1995).

The analyses was restricted to the 734 respondents who provide well-child care ("primary-care pediatricians"). Their demographic and practice characteristics are presented in Table 2.

### Reported Screening Rates and Practices

Of the primary-care pediatrician respondents, 389 (53%) reported screening all of their patients aged 9

TABLE 2. Demographic Characteristics of Pediatricians Who Provide Well-child Care (N = 734)

Demographics	Percentage
Professional activity	
Solo, or two physician	21.6
Group (includes health maintenance organizations)	42.5
Neighborhood health center	3.3
Medical school	9.0
Hospital	13.3
Clinic	4.7
Other patient care	4.7
Other nonpatient care	0.8
Community setting	
Metropolitan city (50 000-1 million)	83.3
Nonmetropolitan city (2500-50 000)	15.4
Rural (<2500)	1.3
Location of practice	
Urban	50.2
Suburban	38.6
Rural	11.3
Insurance coverage of patients	
Blue Cross/Blue Shield	14.3
Other private insurance (including health maintenance organizations)	41.4
Medicaid	31.2
Uninsured	8.2
Other	4.9
Ethnic makeup of patients	
Native American	2.2
Asian	5.3
African-American	22.5
Hispanic	16.4
White, Non-Hispanic	53.1
Other	0.5
Male gender	52.3
Decade graduated from medical school	
1940-1949	0.5
1950-1959	5.1
1960-1969	12.9
1970-1979	23.7
1980-1989	35.4
1990-1994	22.4
Mean age (years)	41.8

to 36 months, 285 (39%) reported screening some, and 60 (8%) reported screening none. Table 3 reports the demographic characteristics of pediatricians according to level of screening. Pediatricians who practice in urban locations, graduated from medical school within the past 10 years, or are female are more likely to screen universally.

Among pediatricians who screen selectively (N = 285), the most common patient characteristics prompting them to initiate screening, and the proportion who report screening when the characteristic is present are: having a history of pica (98%); living in an older home with peeling paint (96%); having a sibling who had an elevated blood lead level (95%); living in or regularly visiting an older home with recent or ongoing renovations (94%); and being enrolled in Medicaid (94%).

Of the pediatricians who do not screen (N = 60), the leading reasons for not screening are beliefs that: the prevalence of elevated blood lead levels is low in the pediatrician's practice (83%); there are other more important issues to discuss with parents (40%); screening is too costly (34%); public health authorities offer little for affected children (27%); and it is too difficult to collect blood samples (22%).

Among the 674 pediatricians who screen (ie, the 389 universal screeners plus the 285 selective screeners), 42% use a risk assessment questionnaire. The providers who use a risk assessment questionnaire report that they do so for the following reasons: to focus education for the parent (64%); to decide whether to screen (59%); and to decide the frequency of screening (44%).

Eighty-nine percent of pediatricians who screen begin screening high-risk patients by age 12 months, and 67% begin screening low-risk patients by age 12 months. Ninety-six percent of pediatricians who screen use a blood lead assay for screening, and 3% use a porphyrin assay. Thirty-nine percent collect blood for screening via fingerstick, and 52% collect blood via venipuncture. Ninety-nine percent screen

at well-child care visits and 48% screen at follow-up visits for chronic illness.

#### Educational Practices and Health Department Services

Sixty-eight percent of pediatricians who screen provide information regarding elevated blood lead levels to parents, and 32% do not. The estimated prevalence of blood lead levels  $\geq 10$   $\mu\text{g}/\text{dL}$  among patients seen in the practices of pediatricians who provide this information is 7.3% and in the practices of pediatricians who do not, it is 4.8% ( $P < .01$ , Mann-Whitney U Test). Sixty-three percent of pediatricians who provide education initiate it before screening, while 37% initiate education after receiving the results of the blood lead assay; among the latter group, 91% initiate education when blood lead levels are  $\leq 15$   $\mu\text{g}/\text{dL}$ . Among pediatricians who provide information, the following topics are discussed: sources of lead (99%), effects of elevated blood lead levels (91%), and methods to limit lead exposure (87%).

Sixty-four percent of primary-care pediatricians report that their local health department provides services for children who have elevated blood lead levels, 6% state that the local health department does not provide services, and 30% do not know. Pediatricians reporting that their local health department provides services state that the services include: evaluation of lead sources (86%); home inspections (84%); and education (82%). Eighty-five percent of pediatricians report that home inspections are initiated when children's blood lead level are  $\leq 20$   $\mu\text{g}/\text{dL}$ .

#### Reported Prevalence of Elevated Blood Lead Levels

Primary-care pediatricians report a mean prevalence of blood lead levels  $\geq 10$   $\mu\text{g}/\text{dL}$  of 7.9% among children 9 to 36 months of age in their communities. The mean estimated prevalence of blood lead levels  $\geq 10$   $\mu\text{g}/\text{dL}$  among children 9 to 36 months of age in the practices of pediatricians who are universal

**TABLE 3.** Characteristics of Responding Primary-Care Pediatricians (N = 734): The Proportion Who Screen for Elevated Blood Lead Levels Universally, Selectively, or Not at All as a Function of Demographic or Practice Characteristics

Characteristics	Universal	Selective	Nonscreener	P Value
Number	389 (53%)	285 (39%)	60 (8%)	...
Community population				
$\geq 50\,000$	54%	38%	8%	.23
$< 50\,000$	46%	45%	9%	
Practice location				
Urban	65%	30%	5%	$< .01$
Suburban and rural	40%	49%	11%	
Years since medical school				
$< 10$ years	65%	31%	4%	$< .01$
$\geq 10$ years	45%	44%	11%	
Gender				
Female	60%	36%	4%	$< .01$
Male	46%	42%	12%	
Geographic distribution*				
West	31%	53%	16%	$< .01$
Midwest	49%	44%	7%	
South	39%	51%	10%	
Northeast	79%	18%	3%	

\* West is AAP Districts VIII and IX, Midwest is AAP Districts V and VI, South is AAP Districts IV and VII, and Northeast is AAP Districts I, II, III.

screeners was 8.7%, and it was 3.5% among both selective screeners and nonscreeners (both the difference between universal and selective screeners, and the difference between universal and nonscreeners were statistically significant [ $P < .01$ ] by Mann-Whitney U Test).

#### Opinions Regarding Screening and Other Variables

Table 4 reports the opinions of primary-care pediatricians in response to the statements regarding elevated blood lead levels. Table 5 reports the proportion of universal screeners, selective screeners, and nonscreeners who agree with these statements.

Thirty-three percent of primary-care pediatricians report being subject to state or local laws requiring screening, 32% report that insurers pay for screening, 52% report having read the 1991 CDC Statements and 61% report having read the 1993 AAP statement. Table 6 shows the proportion of universal screeners, selective screeners, and nonscreeners who concur with each of the aforementioned statements.

#### Comparison Between Pediatricians Who Report Screening Universally and Pediatricians Who Report Screening Selectively

Table 7 lists the significant variables introduced into the regression analysis from Tables 3, 5, and 6, and the odds ratios and confidence intervals for each variable. Geographic distribution was excluded because the estimated prevalence in the pediatrician's practice and the practice location (ie, urban, suburban, rural) were assumed to be more pertinent to a pediatrician's approach to screening. Forced-entry logistic regression resulted in the best model, correctly predicting 71.8% of selective screeners and 78.2% of universal screeners.

### DISCUSSION

This survey indicates that slightly more than half of primary-care pediatricians in the US who are

**TABLE 4.** Opinions to Statements Regarding Elevated Blood Lead Levels: The Proportions of Primary-care Pediatricians (N = 734) Who Agree or Disagree With Each Statement\*

Opinion	Agree	Disagree
Blood lead levels $\geq 10$ $\mu\text{g}/\text{dL}$ should be considered elevated.	73%	16%
A 5-point decrease in IQ may be associated with blood lead levels of 10 $\mu\text{g}/\text{dL}$ .	35%	25%
A 5-point decrease in IQ is clinically important.	51%	20%
Studies are needed to determine communities at risk for elevated blood lead levels.	89%	3%
Parents may be anxious if their children have lead levels 10-19 $\mu\text{g}/\text{dL}$ .	86%	4%
Blood lead levels $\geq 10$ $\mu\text{g}/\text{dL}$ are common in the provider's practice.	19%	67%
The benefits of screening outweigh the costs.	38%	34%
Interventions are effective.	59%	13%
It is easy to conduct screening.	47%	36%

\* Strongly agree and agree responses were grouped together to make up the agree category in this table; similarly, strongly disagree and disagree responses were grouped together. Percentages do not add up to 100% because some pediatricians responded neither agree or disagree.

members of the AAP report universally screening children for elevated blood lead levels in accordance with current CDC and AAP guidelines. Most of the remaining primary-care pediatricians report screening selectively, and do so among appropriate high-risk groups. Only 8% report that they do not screen; these pediatricians primarily practice in areas where they report low prevalences of children with elevated blood lead levels. When screening, most pediatricians use the more sensitive blood lead assay rather than a porphyrin assay.<sup>14</sup> Most collect blood using venipuncture phlebotomy, rather than fingerstick phlebotomy; the latter is an acceptable method of obtaining blood for lead assay if careful attention is paid to skin cleaning.<sup>15</sup> Most report beginning screening by the time their patients are 12 months old, an age by which blood lead levels have not usually yet peaked,<sup>16</sup> and thus an age at which future increases in blood lead levels may be prevented. Finally, nearly all pediatricians screen at well-child care visits.

The educational practices of many primary-care pediatricians also appear to follow CDC and AAP guidelines. The majority of primary-care pediatricians report that they provide information to parents of children who are screened for elevated blood lead levels. Most do so before screening; the majority of pediatricians who provide information after screening do so at blood lead levels  $\leq 15$   $\mu\text{g}/\text{dL}$ . Education covers appropriate topics including sources of lead, effects of exposure to lead and methods to limit further exposure to lead. However, 32% of primary-care pediatricians who screen report providing no information to parents, and efforts to reduce this proportion should occur.

Finally, the services provided by most local health departments reportedly follow CDC guidelines. The majority of pediatricians state that their local health department provide services for children who have elevated blood lead levels. Among these pediatricians, a high proportion indicate that the local health department conducts home inspections when the index child's blood lead level is  $\leq 20$   $\mu\text{g}/\text{dL}$ , consistent with CDC recommendations that environmental interventions occur when children's blood lead levels meet or exceed 20  $\mu\text{g}/\text{dL}$ , or persistently exceed 15  $\mu\text{g}/\text{dL}$ .<sup>6</sup> It is cause for concern that a high proportion of pediatricians (30%) did not know whether their local health department provides services for children with elevated blood lead levels.

Table 7 reports the variables that are predictive of whether responding pediatricians screen universally or selectively for elevated blood lead levels. For example, pediatricians in localities where laws require screening are 2.8 times more likely to screen universally than are pediatricians in localities without such laws. Although a number of these variables are independently predictive of universal screening, they should not be interpreted as explaining causation. Rather, odds ratios are useful in calculating the probability that a group of pediatricians are universal screeners.<sup>17</sup>

Some studies have documented relatively low prevalences of elevated blood lead levels in some

**TABLE 5.** Opinions to Statements Regarding Elevated Blood Lead Levels: The Proportions of Universal Screeners, Selective Screeners, and Nonscreeners Who Agree With Each Opinion\*

Opinion	Universal	Selective	Nonscreeners	P Value
Blood lead levels $\geq 10 \mu\text{g}/\text{dL}$ should be considered elevated.	78%	69%	59%	< .01
A 5-point decrease in IQ may be associated with blood lead levels of $10 \mu\text{g}/\text{dL}$ .	33%	38%	35%	.04
A 5-point decrease in IQ is clinically important.	50%	54%	41%	.31
Studies are needed to determine communities at risk for elevated blood lead levels.	91%	88%	90%	.53
Parents may be anxious if their children have levels $10\text{--}19 \mu\text{g}/\text{dL}$ .	88%	84%	77%	.07
Blood lead levels $\geq 10 \mu\text{g}/\text{dL}$ are common in provider's practice.	31%	7%	2%	< .01
Benefits of screening outweigh costs.	57%	15%	18%	< .01
Interventions are effective.	67%	51%	44%	< .01
It is easy to conduct screening.	62%	32%	20%	< .01

\* Strongly agree and Agree responses were grouped together to make up the Agree category in this table.

**TABLE 6.** Additional Variables That May Influence Screening: Proportions of Universal Screeners, Selective Screeners, and Nonscreeners Who Report That Variable is Present

Variable	Universal	Selective	Nonscreeners	P Value
Belief that state/local laws require screening*	64%	30%	8%	< .01
Belief that insurers pay for screening*	79%	57%	70%	< .01
Have read CDC Guidelines	54%	55%	34%	.01
Have read AAP Guidelines	59%	68%	44%	< .01

Abbreviations: CDC, Centers for Disease Control and Prevention; AAP, American Academy of Pediatrics.

\* Do not know responses excluded.

**TABLE 7.** Variables Introduced Into Logistic Regression Analysis Comparing Universal Screeners Versus Selective Screeners

Variable	Odds Ratio†	95% Confidence Interval
Urban Location	1.7*	1.4 to 2.1
Years since medical school (<10 y)	2.1*	1.7 to 2.6
Blood lead level $\geq 10 \mu\text{g}/\text{dL}$ should be considered elevated.	1.2	0.9 to 1.5
Blood lead levels $\geq 10 \mu\text{g}/\text{dL}$ are common in provider's practice.	2.4*	1.7 to 3.4
Benefits of screening outweigh costs.	4.6*	3.6 to 5.9
Interventions are effective.	0.9	0.7 to 1.1
It is easy to conduct screening.	2.0*	1.6 to 2.5
Belief that state/local laws require screening‡	2.8*	2.3 to 3.5
Belief that insurers pay for screening‡	2.4*	1.9 to 3.1
Have read AAP Guidelines	0.9	0.7 to 1.1
Gender	1.0	0.8 to 1.3

Abbreviation: AAP, American Academy of Pediatrics.

\*  $P \leq .01$ .

† Odds ratios >1 indicate a positive association with the dependent variable (eg, screen universally).

‡ Do not know responses recoded to No.

populations of children, and have prompted concerns about whether the benefits of universal screening exceed the costs.<sup>18,19</sup> The results of this survey indicate that many pediatricians share these concerns. Among nonscreeners, the most commonly reported reason not to screen is a reported low prevalence of elevated blood lead levels among their patients. Furthermore, a large majority of primary-care pediatricians, regardless of whether or not they screen, believe that further epidemiologic studies should be performed to determine which communities have high proportions of children with elevated blood lead levels. Finally, only 38% of primary-care pediatricians believe that the benefits of screening exceed the costs. These findings suggest that many pediatricians are not convinced that universal screening is needed. Additional guidance about circumstances under which selective screening could be considered may allay this skepticism. The CDC is currently developing such guidelines (personal communication, P. Briss, MD, CDC, 1995).

It is unclear whether the children cared for by the

primary-care respondents of this survey are representative of the pediatric population of the US. This is because we do not know whether data based on recall, as in this survey, can be validly compared with census data. Some variables in this survey are comparable to national figures, while others are not. For example, the mean proportion of the primary-care respondent's patients who are enrolled in Medicaid (31%) is not comparable to the 22.3% reported by the US Census Bureau.<sup>20</sup> In contrast, the primary-care respondent's mean proportion of patients who have blood lead levels  $\geq 10 \mu\text{g}/\text{dL}$  (7.9%) is comparable to the 8.9% estimate from the Third National Health and Nutrition Examination Survey.<sup>21</sup>

This survey evaluated self-reported screening practices and attitudes regarding elevated blood lead levels, but it cannot be used to confirm their actual screening practices. Further, this study is limited to pediatricians who are members of the AAP. A previous study showed that pediatricians who are AAP members had different immunization practices than family physicians.<sup>22</sup> The same may be true of screen-

ing practices for elevated blood lead levels. Thus, the conclusions of this survey may not be generalizable to family physicians or pediatricians who are not members of the AAP.

In summary, while a slight majority of primary-care pediatricians in the United States who are members of the AAP are universally screening children for elevated blood lead levels, most of the remaining pediatricians are only screening high-risk patients. Many pediatricians may want guidelines detailing circumstances under which selective rather than universal screening is acceptable.

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