

# PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

## **A Statewide Assessment of Lead Screening Histories of Preschool Children Enrolled in a Medicaid Managed Care Program**

Patrick M. Vivier, Joseph W. Hogan, Peter Simon, Tricia Leddy, Lynne M. Dansereau  
and Anthony J. Alario

*Pediatrics* 2001;108:e29

DOI: 10.1542/peds.108.2.e29

The online version of this article, along with updated information and services, is  
located on the World Wide Web at:

<http://www.pediatrics.org/cgi/content/full/108/2/e29>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2001 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



# A Statewide Assessment of Lead Screening Histories of Preschool Children Enrolled in a Medicaid Managed Care Program

Patrick M. Vivier, MD, PhD\*‡; Joseph W. Hogan, ScD‡§; Peter Simon, MD, MPH\*||; Tricia Leddy, MS¶; Lynne M. Dansereau, MSPH\*‡; and Anthony J. Alario, MD\*

**ABSTRACT.** *Objectives.* Despite the prominence of lead poisoning as a public health problem, recent Government Accounting Office reports indicate that only one fifth of children who are covered by Medicaid have been screened for lead poisoning. The purpose of this study was to examine the lead screening histories of children who were enrolled in a statewide, Medicaid managed care plan to determine the relative impact of the type of primary care provider site and family sociodemographic characteristics on the likelihood of being screened. The study also examined the prevalence of and risk factors for lead poisoning of children who had been screened.

*Methods.* A random sample of 2000 preschool-age children was chosen from those who were enrolled continuously in the statewide, expanded, Medicaid managed care program for a 1-year period and between the ages of 19 and 35 months at the end of that year. Sociodemographic characteristics and lists of primary care providers were obtained from administrative data sets. Medical record audits at primary care provider sites were performed to obtain the lead screening histories of the children, including test dates and results.

*Results.* Data on 1988 children were used for study analyses, and 80% of these children had at least 1 documented blood lead level. Children whose primary care provider was an office-based physician were less likely to be screened as compared with patients of health centers, hospital-based clinics, and staff model health maintenance organizations (68%, 86%, 89%, and 91% respectively). Variation in screening rates persisted in a multivariate analysis controlling for family sociodemographic characteristics and practice level variation. Of the 1587 children who had a documented blood lead test, 467 children (29%) had a blood lead level of  $\geq 10$  mg/dL on at least 1 test.

*Conclusions.* Blood lead screening rates in Rhode Island's Medicaid managed care program are dramatically higher than national estimates for children who are enrolled in Medicaid. Potential explanations for this finding are 1) a high sensitization to the problem of lead poisoning in Rhode Island, 2) the primary care focus of the Medicaid program in Rhode Island facilitates the delivery of preventive services, and 3) the medical record audit approach used in this study was more

comprehensive in identifying blood lead screens than techniques used in national studies. The high prevalence of elevated blood lead levels found in this study emphasizes the importance of screening among children who are enrolled in Medicaid. *Pediatrics* 2001;108(2). URL: <http://www.pediatrics.org/cgi/content/full/108/2/e29>; lead screening, Medicaid managed care.

---

ABBREVIATIONS. NHANES, National Health and Nutrition Examination Survey; HMO, health maintenance organization; MCO, managed care organization; CI, confidence interval; OR, odds ratio.

---

The deleterious effects of lead poisoning on young children have been well documented.<sup>1-6</sup> Blood lead levels as low as 10  $\mu$ g have been associated with negative effects on a child's development, and it has been estimated that a blood lead level of 20  $\mu$ g can lead to a loss of 2 to 3 IQ points in young children.<sup>1</sup> Although mean blood lead levels have been on the decline, lead poisoning remains a prevalent public health problem in the United States.<sup>7-11</sup> According to a recent analysis of the Third National Health and Nutrition Examination Survey (NHANES), 8.6% of children aged 1 to 2 years have blood lead levels of  $\geq 10$   $\mu$ g/dL.<sup>7</sup> Despite the seriousness of lead poisoning as a public health problem and national recommendations to screen all children<sup>2,12</sup> or at least all children who do not live in clearly documented low prevalence areas,<sup>1,13</sup> many children are not screened. A 1994 national telephone survey estimated that less than one quarter of children younger than 6 years had been tested for elevated blood lead levels.<sup>14</sup> Data from NHANES III indicated that only 10% of 1- to 5-year-old children in the United States had been tested before participation in the NHANES III survey.<sup>7</sup>

Particular concern has focused on low screening rates among children who are enrolled in Medicaid as they are at substantially increased risk of having elevated blood lead levels.<sup>15-17</sup> According to an analysis of the NHANES III, 62% of children in the United States who were between the ages of 1 and 5 years and had elevated blood lead levels ( $\geq 10$   $\mu$ g/dL) were enrolled in Medicaid.<sup>7</sup> The findings are even more pronounced at higher lead levels: 83% of preschool-age children with blood lead levels at 20  $\mu$ g/dL or greater are enrolled in Medicaid.<sup>15</sup> Health Care Financing Administration regulations require that all children who are enrolled in Medicaid be screened for lead poisoning.<sup>15</sup> The blood lead screen-

From the Departments of \*Pediatrics and ‡Community Health and §Center for Statistical Sciences, Brown University, Providence, Rhode Island; ||Division of Family Health, State of Rhode Island, Providence, Rhode Island; and ¶Department of Human Services, State of Rhode Island, Cranston, Rhode Island.

Received for publication Jan 24, 2001; accepted Apr 9, 2001.

Reprint Requests to (P.M.V.) Department of Pediatrics, Hasbro Children's Hospital/Rhode Island Hospital, 593 Eddy St, Providence, RI 02912. E-mail: [patrick.vivier@brown.edu](mailto:patrick.vivier@brown.edu)

PEDIATRICS (ISSN 0031 4005). Copyright © 2001 by the American Academy of Pediatrics.

ing recommendations of both the American Academy of Pediatrics and the Centers for Disease Control and Prevention call for special consideration of screening of children who are enrolled in Medicaid,<sup>1,13</sup> as does a recent recommendation from the Advisory Committee on Childhood Lead Poisoning.<sup>18</sup> Even with the increased disease burden and recommendations to screen, recent Government Accounting Office reports indicate that fewer than one fifth of children who are enrolled in Medicaid or other federal health programs are screened for elevated blood lead levels.<sup>15,16</sup> Two thirds of the children who were enrolled in Medicaid and had elevated blood lead levels in the NHANES survey had not been tested previously.<sup>16</sup>

The study presented here is a statewide assessment of blood lead screening for children who are enrolled in Rhode Island's expanded Medicaid managed care program. In light of national surveys showing low screening rates, the purpose of this study was to determine through medical record audits the extent to which children who are enrolled in Medicaid are tested for elevated blood lead levels in a state with a significant lead burden and a clear universal screening recommendation from its Department of Health. The study also attempted to identify sociodemographic characteristics of children that may put them at risk for not being screened. In addition, the study determined the impact of the type of primary care provider site (office-based, neighborhood health center, hospital-based clinic, or staff model health maintenance organization [HMO]) on the likelihood of being screened and attempts to measure the relative impact of the type of primary care provider site while controlling for family sociodemographic factors. Finally, for children who were screened, we examined the prevalence of lead poisoning to determine the extent of the blood lead burden and to identify potential risk factors for having an elevated blood lead level.

## METHODS

### Study Setting

The Rhode Island Medicaid managed care program, RItE Care, began in August 1994 and was phased in over 1 year. All Medicaid beneficiaries in Rhode Island are enrolled in the RItE Care program except for the elderly, individuals with disabilities, and children in foster care. In addition, pregnant women and children up to the age of 6 years with family incomes below a set level of the federal poverty line (250% for children; 350% for pregnant women) were defined as a newly eligible group that qualified to participate in RItE Care. Eligibility subsequently was expanded, so as of 1997, all children (up to 18 years of age) with family incomes below 250% of the poverty line qualify for RItE Care. New enrollees are guaranteed 6 months of coverage and then must be recertified for participation, with biannual reviews of eligibility.

At the time of this study, the RItE Care Program contracted with 4 managed care organizations (MCOs) that provide a defined package of services for a monthly capitated rate. As the 4 MCOs had substantially different RItE Care enrollment limits, families did not always have the choice of all 4 MCOs. In each of the MCOs, following state regulations, the RItE Care beneficiary selects or is assigned to a primary care provider within 3 weeks of enrollment. The financial arrangements between MCOs and their primary care providers vary, although true capitation is rare, but in all cases the primary care provider is responsible for providing a comprehensive range of services. Families can change primary care providers by requesting this from the MCO. Use of primary

care services is restricted to the child's current primary care provider, and authorization generally is required for specialty referral and emergency department visits. A key aspect of the RItE Care program is that it includes primary care providers who practice in 4 different settings: office-based practice, staff model HMO, community health centers, and hospital-based clinics. The Rhode Island Department of Health recommends routine blood lead screening for all preschool children.<sup>19</sup>

### Study Sample

The Office of Managed Care in the Rhode Island Department of Human Services reviewed their computerized records to identify all children who were 1) enrolled continuously in RItE Care from July 1, 1996, through June 30, 1997, and 2) between the ages of 19 and 35 months as of June 30, 1997. "Continuously enrolled" was defined as no gaps in enrollment that were greater than 30 days. A total of 3456 children met the criteria, and a random sample of 2000 was chosen for inclusion in the study.

### Data Collection

Sociodemographic data on the children and their families were obtained from computerized records maintained by the Rhode Island Department of Human Services. This information is obtained from families at the time of enrollment and is updated with reenrollment. The children's MCOs and all of their defined primary care providers while enrolled in RItE Care also were determined from computerized enrollment databases maintained by the Rhode Island Department of Human Services. Medical record audits were performed at the offices of primary care providers identified from the enrollment files. Only 2 primary care providers did not allow access to their medical records for this assessment; the 11 children who had those providers were eliminated from the study. In cases in which the accuracy of the enrollment information was questioned during the medical record audit either because the child had never been seen or because notes indicated other primary care providers, the list of the child's primary care providers was confirmed with the MCOs. When additional primary care providers were identified by this means or by information in the medical records, these sites were audited as well if they were local (ie, Rhode Island and nearby Massachusetts). Data obtained in the medical record audits included the dates and results of all documented blood lead during the child's life, immunizations received, and the dates of primary care visits.

All families who are enrolled in RItE Care sign a consent form allowing access to their medical records for evaluation purposes. This study was approved by the Institutional Review Board at Rhode Island Hospital.

### Study Variables

Two main dependent variables were examined in this study. The first was whether the children had had a documented blood lead screening. All screenings that were performed from birth to June 30, 1997, as identified in the medical record audit, were included. The second dependent variable was the results of the blood lead screening. For the purposes of this study, an elevated blood lead level was defined as  $\geq 10 \mu\text{g}/\text{dL}$ .

The main independent variable was the type of primary care provider site with which the child was enrolled during the 1-year period that qualified the child for enrollment in the study (ie, July 1, 1996, through June 30, 1997). In cases in which children had changed primary care providers, the primary care provider who was responsible for the child for the greatest amount of time from July 1, 1996, through June 30, 1997, was used for study analyses. When a child was enrolled with a primary care provider but had never been seen by that provider, they were still considered a patient of that provider for analysis purposes. This was in keeping with the concept of responsibility for the health care of their defined patient panel, not merely those who are seen in a given period of time or with a specific periodicity. A 1-year enrollment period was chosen to give a sufficient time interval for the primary care providers to have assumed responsibility for the study children. A minimum of a 1-year enrollment in the RItE Care program should be sufficient time for providers to perform indicated blood lead screening and to document previous blood lead tests for children who were new to their practice.

Additional independent variables were sociodemographic

characteristics, including information on the child (date of birth, gender, and race/ethnicity), the head of the household (education level and citizenship status), and the household (language spoken). Race/ethnicity included 5 categories: white, black, Hispanic, Asian, and Indian/Alaskan. As the number of children identified as Asian and Indian/Alaskan was small, these were combined into an "other" category for study analyses unless otherwise noted. The location of the child's home also was obtained. A mapping software package, Mapitude (Version 4.0; Caliper Corporation, Newton, MA), was used to determine the distance from the child's home to the primary care provider. The location of the child's home also was classified as being a core city or a non-core city; a core city was defined as a municipality in which >15% of the children live below the poverty level according to the 1990 census.<sup>20</sup>

## Data Analysis

Initially, we determined the screening rate for the sample as a whole. This was followed by a bivariate analysis to determine the proportion of children screened by the type of primary care provider site. A  $\chi^2$  test was used to determine whether there was a statistically significant difference in screening rate among the 4 provider types at the  $P < .05$  level. Similar analyses were performed to examine the proportion of children screened by categorical sociodemographic variables (including parental education, primary language, citizenship of the head of the household, and race/ethnicity) and the immunization status of the child. For sociodemographic variables that were continuous numeric variables (specifically, distance to the provider and age of the child) and for the number of visits to the primary care provider, we compared the mean values of these variables for children screened versus those not screened. Student  $t$  tests were performed to determine whether differences in means were significant at the  $P < .05$  level.

After bivariate analyses, a multilevel regression model was developed to examine the relationship between blood lead screening and type of primary care provider, while adjusting for selected child/family characteristics.<sup>21,22</sup> The model allows separate characterization of both subject-level and practice-level variations, permitting comparisons of average screening rates by provider while taking into account practice level variation. The model specification is

$$\log\left[\frac{P_{ij}}{1 - P_{ij}}\right] = u_j + \sum_{t=1}^4 \beta_t X_{jt} + \alpha_1 E_{ij} + \alpha_2 L_{ij} + \alpha_3 C_{ij} + \alpha_3 R_{ij}$$

where  $X_{jt}$  is a dummy variable that equals 1 if provider  $j$  is type  $t$  (0 = private office, 1 = health center, 2 = hospital clinic, 3 = staff model HMO),  $E_{ij}$  is parental education status (0 if finished high school, 1 if not),  $L_{ij}$  is primary language status (0 if English, 1 if not),  $C_{ij}$  is the location of the child's residence (0 if the child does not live in a core city, 1 if the child lives in a core city), and  $R_{ij}$  is the child's race/ethnicity (0 = white, 1 = black, 2 = Hispanic, 3 = other). The  $u_j$  are latent variables that characterize underlying screening rate for practice  $j$ . At level 2, practice-level variation is modeled by assuming that the  $u_j$  follow a normal distribution with mean 0 and variance that depends on practice type. The  $\beta$  parameters are used to derive odds ratios (ORs) for comparing mean practice-specific screening rate by practice type. For example, the OR for comparing rates between the staff model HMO and private office settings is  $\exp(\beta_4 - \beta_1)$ . Ninety-five percent confidence intervals (CIs) were calculated for the ORs and are reported in the text and tables. In addition, given that there are 4 primary care provider types, a Bonferroni correction was made for multiple comparisons in the logistic regression model and 99.17% CIs also were calculated for the ORs for the primary care provider. These CIs did not lead to a difference in conclusions and therefore are not reported.

The next phase of analyses were restricted to children who had a documented blood lead level, to determine the proportion who had an elevated blood lead level. Bivariate and multivariate analyses similar to those described above were used to determine potential risk factors for having at least 1 elevated blood lead level among those who had been tested.

## RESULTS

### Patient Characteristics

The sample used for study analyses was reduced to 1988 as 1 child was in the database twice (under different insurance numbers and date of birth), and 11 children were excluded because their primary care providers would not allow access to their records. The study sample contained similar numbers of boys and girls (1020 and 968, respectively). The education level of the head of the household was known for 1981 study children. For 56% of these families, the head of household had completed a high school education. Data on race/ethnicity were available for 1673 of the children. Fifty-five percent of children were identified as white, 28% as Hispanic, 13% as black, 5% as Asian, and <1% as Indian/Alaskan. Of the 1977 children for whom the citizenship status of the head of household was known, 20% were not US citizens. A language other than English was the primary language in the homes of 20% of study children.

The defined primary care provider site was an office-based practice for 762 children (38%), a community health center for 662 children (33%), a hospital-based clinic for 465 children (23%), and a staff model HMO for 99 children (5%). Ninety-seven percent of children had only 1 primary care provider site during the study year.

### Blood Lead Screening for the Sample as a Whole

Of the 1988 study children, 1587 (79.8%) had at least 1 documented blood lead test and 879 (44.2%) had at least 2 tests. The mean number of blood lead tests for those children who were tested was 1.9 (range: 1–12). The mean age at the time of the first test was 13 months, and 85% of all children who were tested before 9 months of age were retested.

### Type of Primary Care Provider Site, Other Primary Care Factors, Sociodemographic Factors, and the Likelihood of Blood Lead Testing

Blood lead testing varied significantly by type of primary care provider site (Table 1). The proportion of children with at least 1 documented blood test was 67.8% for office-based practices (517 of 762), 85.8% for neighborhood health centers (568 of 662), 88.6% for hospital-based clinics (412 of 465), and 90.9% for staff model HMOs (90 of 99).

Children who had not been screened had fewer primary care visits in their life (mean visits: 12.7 vs 16.9 visits;  $P < .0001$ ) and during the 1-year period that qualified them for the study (mean visits: 4.5 vs 5.6;  $P < .0001$ ) as compared with those who had a documented blood lead test, although the mean number of visits was relatively high regardless of screening status. Children without a blood lead test lived farther from their primary care provider (4.3 miles vs 3.2 miles;  $P = .0003$ ). If a child was up to date for immunizations, then he or she was more likely to have had a blood lead test. Eighty-six percent of children with up-to-date immunizations had a documented blood lead test as compared with 59% of underimmunized children.

**TABLE 1.** Percentage of Children Who Had a Documented Blood Lead Test by Sociodemographic Characteristics and Type of Primary Care Provider Site

Characteristic	Percentage Screened
Total sample ( <i>n</i> = 1988)	79.8
Type of primary care provider site*	
Office-based ( <i>n</i> = 762)	67.8
Health center ( <i>n</i> = 662)	85.8
Hospital-based clinic ( <i>n</i> = 465)	88.6
Staff model HMO ( <i>n</i> = 99)	90.9
Child's race/ethnicity ( <i>n</i> = 1673)*	
White ( <i>n</i> = 921)	75.6
Black ( <i>n</i> = 209)	83.3
Hispanic ( <i>n</i> = 465)	87.7
Other ( <i>n</i> = 78)	83.3
Language spoken at home ( <i>n</i> = 1980)*	
English ( <i>n</i> = 1590)	77.8
Other ( <i>n</i> = 390)	88.2
Parental citizenship ( <i>n</i> = 1977)†	
US citizen ( <i>n</i> = 1578)	78.5
Non-US citizen ( <i>n</i> = 399)	85.5
Parental education ( <i>n</i> = 1981)	
≥High school graduate ( <i>n</i> = 1110)	78.6
<High school graduate ( <i>n</i> = 871)	81.4
Location of the residence ( <i>n</i> = 1960)*	
Not a core city ( <i>n</i> = 648)	71.8
Core city ( <i>n</i> = 1312)	83.9

\* *P* < .001; † *P* < .05.

In bivariate analyses, screening rates also varied significantly by a number of categorical sociodemographic variables (Table 1). Children whose race/ethnicity was identified as white were less likely to have a documented blood lead level as compared with those who were identified as black, Hispanic, Asian, or Indian/Alaskan (75.6% vs 86.0%, respectively). Children from homes in which English was the primary language were less likely to be screened as compared with children from homes in which English was not the primary language (77.8% vs 88.2%, respectively). The educational level of the head of the household was not significantly associated with blood lead testing; 78.6% of children from homes in which the head of the household had completed high school had a documented blood lead level as compared with 81.4% for children from homes in which the head of household had not completed high school. Children who lived in a core city were more likely to have a documented blood lead test as compared with those who lived in other areas (83.9% vs 71.8%, respectively).

In the multivariate analysis, there was significant variation in blood lead testing rates by type of primary care provider site, even when controlling for sociodemographic factors and practice level variation (Table 2). Using children of office-based practices as the referent group, the odds of having a documented blood lead test were 3.00 times greater for children of health centers (95% CI: 1.77–5.07), 3.61 times greater for children of hospital-based clinics (95% CI: 1.46–8.92), and 5.44 times greater for children enrolled in staff model HMOs (95% CI: 3.98–7.43). These differences persisted even after controlling for multiple comparisons. Sociodemographic characteristics including primary language, race/ethnicity and location of the residence, all of which

**TABLE 2.** Odds of Having at Least 1 Documented Blood Lead Test

Characteristic	OR	95% CI
Provider type		
Office-based	1.00	
Health center	3.00	1.77–5.07
Hospital clinic	3.61	1.46–8.92
Staff model HMO	5.44	3.98–7.43
Parental education		
≥High school graduate	1.00	
<High school graduate	0.99	0.82–1.21
Primary language		
English	1.00	
Non-English	1.09	0.74–1.59
Race/ethnicity		
White	1.00	
Black	0.96	0.65–1.40
Hispanic	1.09	0.75–1.61
Other	0.82	0.47–1.43
Location of residence		
Not a core city	1.00	
Core city	1.02	0.78–1.35

seemed to be associated with being tested for blood lead level in the bivariate analyses, were not significantly associated in the multivariate model, which takes into account the type of primary care provider site and practice level variation.

#### Lead Poisoning Prevalence and Risk Factors Among Children Who Were Tested

Of the 1587 children who had a documented blood lead test, 19.5% had an elevated blood lead level (≥10 μg/dL) on their first test and 467 (29.4%) had an elevated blood lead level on at least 1 test. Of 467 children with at least 1 elevated blood lead level, 312 (66.8%) were retested and more than half of these children continued to have an elevated blood lead level. Blood lead levels of ≥25 μg/dL were less common; 23 (1.4%) had a blood lead test elevated to that level on their first test and 63 (4.0%) on at least 1 test.

In bivariate analyses, a number of variables seemed to be related to the risk of having an elevated blood lead level on at least 1 test, including the type of primary care provider site, the child's race/ethnicity, the primary language spoken at home, parental education, and the location of the residence (Table 3). In particular, the prevalence of blood lead poisoning varied substantially by race/ethnicity (25.3%, 41.4%, 26.7%, and 53.9% for white, black, Hispanic, and other, respectively). As expected, children who lived in a core city had a much higher prevalence of lead poisoning as compared with children who lived in other areas (34.1% vs 18.8%, respectively). Of the 4 types of primary care provider sites, office-based practices had the lowest proportion of children with elevated blood lead among those tests. However, even in the office-based group, the proportion of children who had at least 1 elevated blood lead level (among those tested) was substantial at 21.7%.

In the multivariate model, 3 factors were found to be associated with having an elevated blood lead level (Table 4). The odds of having an elevated blood lead level among those tested were 1.88 times greater in the neighborhood health center group as compared with the office-based group (95% CI: 1.21–

**TABLE 3.** Percentage of Children Screened Who Had Elevated Blood Lead Levels ( $\geq 10$   $\mu\text{g}/\text{dL}$ ) by Sociodemographic Characteristics and Type of Primary Care Provider Site

Characteristic	% Screened With Lead $\geq 10$ $\mu\text{g}/\text{dL}$
Total sample ( $n = 1587$ )	29.4
Type of primary care provider site ( $n = 1587$ )*	
Office-based ( $n = 517$ )	21.7
Health center ( $n = 568$ )	35.9
Hospital-based clinic ( $n = 412$ )	28.2
Staff model HMO ( $n = 90$ )	38.9
Child's race/ethnicity ( $n = 1343$ )*	
White ( $n = 696$ )	25.3
Black ( $n = 174$ )	41.4
Hispanic ( $n = 408$ )	26.7
Other ( $n = 65$ )	53.9
Language spoken at home ( $n = 1581$ )†	
English ( $n = 1237$ )	28.1
Other ( $n = 344$ )	34.0
Parental education ( $n = 1581$ )†	
$\geq$ High school graduate ( $n = 872$ )	26.6
<High school graduate ( $n = 709$ )	32.9
Location of the residence ( $n = 1566$ )*	
Not a core city ( $n = 465$ )	18.5
Core city ( $n = 1101$ )	34.1

\*  $P < .001$ ; †  $P < .05$ .

**TABLE 4.** Odds of Having an Elevated Blood Lead Level ( $\geq 10$   $\mu\text{g}/\text{dL}$ ) on at Least 1 Test for Children Who Had a Documented Blood Lead Test

Characteristic	OR	95% CI
Provider type		
Office-based	1.00	
Health center	1.88	1.21–2.91
Hospital clinic	0.81	0.48–1.39
Staff model HMO	1.41	0.70–2.84
Parental education		
$\geq$ High school graduate	1.00	
<High school graduate	1.06	0.85–1.34
Primary language		
English	1.00	
Non-English	1.01	0.69–1.47
Race/ethnicity		
White	1.00	
Black	1.43	1.08–1.89
Hispanic	0.62	0.45–0.87
Other	1.91	1.09–3.36
Location of residence		
Not a core city	1.00	
Core city	2.20	1.51–3.23

2.91). Unlike the findings for the likelihood of being screened, the risk of having an elevated blood lead level among those who were tested varied significantly by race even after controlling for differences by type of primary care provider. Using children categorized as white as the referent group, children identified as black had 1.43 greater odds of having an elevated blood lead level (95% CI: 1.08–1.89). Children in the “other” category also seemed to have a greater risk of having an elevated blood lead level (OR: 1.91; 95% CI: 1.09–3.36), but when controlling for multiple comparisons, the CI contains 1 for this group with a relatively small sample size (65 children tested). Hispanic children had lower odds of having an elevated blood lead level as compared with the white referent group (OR: 0.62; 95% CI: 0.45–0.87). High blood lead also differed by the lo-

cation of residence; children who lived in core cities had 2.20 greater odds of having an elevated blood lead level as compared with children who lived in other areas (95% CI: 1.51–3.23).

## DISCUSSION

Blood lead screening rates in this population of children who were enrolled in a statewide Medicaid managed care program were dramatically higher than those published from national surveys. This demonstrates that it is possible to achieve high blood lead screening rates among preschool-age children who are enrolled in Medicaid on a statewide level. There are a number of factors that may explain the high screening rates found in this study. One potential explanation is methodologic, in that the study presented here used extensive medical record audits to document blood lead tests rather than relying on parental report, claims data, or small-scale auditing at only 1 provider site. Research has demonstrated the important effect of different methodologies on the measurement of immunization coverage.<sup>23–27</sup> In particular, the limitations of using parental report have been well documented for immunization assessments, and a similar issue probably exists for lead screening. The use of medical record audits in this study overcomes that limitation and may partially explain the higher screening rates.

The results also may reflect a special sensitivity to the problem of lead poisoning in Rhode Island. As the study results clearly demonstrate, children who are enrolled in RItE Care carry a heavy blood lead burden. More than 29% of children tested had at least 1 blood lead level of  $\geq 10$   $\mu\text{g}/\text{dL}$ . That prevalence is more than twice the threshold, indicating the need for routine screening of children, as stated by the American Academy of Pediatrics and the Centers for Disease Control and Prevention.<sup>1,13</sup> The Rhode Island Department of Health actively promotes the need for routine blood lead screening of all children, not just those enrolled in Medicaid. Given these factors, primary care providers may be particularly sensitive to the problem and incorporate blood lead screening into their practice more thoroughly than elsewhere in the country. The high screening rate also may be related to the RItE Care program, in which children have a clearly defined primary care provider and there has been an explicit programmatic emphasis on preventive services.

Although the proportion of children who had been tested for lead poisoning is higher than national estimates, 20.2% of these high-risk, preschool-age children had no documented blood lead test. Children whose primary care provider site was an office-based practice were at particular risk for not having a documented blood lead test. The reason for this is not clear. Although patients of office-based practices had a lower prevalence of blood lead poisoning, at 21.7% the risk is still very high and well above the level justifying routine screening. It is possible that office-based practitioners, who care primarily for commercially insured children, may not be as sensitive to the high risk of lead poisoning among children who are enrolled in Medicaid. If this were the case, then one might also expect the staff model

HMOs to have a lower screening rate, but that was not what was found in this study. A more plausible explanation has to do with the mechanics of blood lead testing in the different settings. Hospital-based clinics, health centers, and staff model HMOs tend to have onsite laboratories or phlebotomy for blood lead testing, whereas office-based practices are more likely to refer families to an offsite laboratory. This extra step may reduce the chances that a child would have a blood test and also may lower the possibility that the test results will be documented in the primary care provider chart when the test is performed.

It is interesting that when the type of primary care provider site was controlled for, the selected family sociodemographic characteristics in this study were not associated with screening status. This result indicates that in this Medicaid system, in which all children have a defined medical home, the primary care provider rather than family sociodemographic factors is the key factor in determining whether children are screened for blood lead. This finding may have implications for studies finding racial/ethnic or other sociodemographic risk factors, without examining the source of primary care.

In addition to children who had never been tested, repeat blood lead testing was not optimal, even for children who had an initially elevated blood lead level. These results demonstrate the need to find new mechanisms to increase screening rates further and to ensure that elevated levels are managed appropriately. The Rhode Island Department of Health is working with the MCOs to develop a system to identify children who have not been screened for lead poisoning and target them for outreach.

### CONCLUSION

This study demonstrates that it is possible to obtain high blood lead screening rates for children who are enrolled in a statewide, expanded-eligibility, Medicaid managed care program. The results also demonstrate the importance of the primary care provider site in determining whether children are tested for lead poisoning. That finding along with the substantial lead burden in this population emphasizes the importance of providers to focus on the problem of lead poisoning for children who are enrolled in Medicaid.

### ACKNOWLEDGMENTS

This research was supported by the Robert Wood Johnson Generalist Physician Faculty Scholar Program, the Rhode Island Department of Health, and the Rhode Island Hospital research fund. This research was presented at the Pediatric Academic Societies and American Academy of Pediatrics Joint Meeting, Boston, Massachusetts, May 13, 2000.

We thank the Rhode Island primary care providers whose cooperation made this study possible. We also thank the staff and consultants at the Rhode Island Department of Health and Human Services (especially William White, MPH; William McQuade, MPH; John Young; Randy Rosati; and Jane Griffin, MPH) and the Rhode Island Department of Health (especially Thomas Bertrand). Finally, we acknowledge research assistants Christen O'Haire; Tanya Oliver; Cheryl Lynch, RN; and Birkin James Diana, who all made valuable contributions to the project.

### REFERENCES

- American Academy of Pediatrics, Committee on Environmental Health. Screening for elevated blood lead levels. *Pediatrics*. 1998;101:1072-1078
- American Academy of Pediatrics, Committee on Environmental Health. Lead poisoning: from screening to primary prevention. *Pediatrics*. 1993; 92:176-183
- Bellinger DC, Stiles KM, Needleman HL. Low-level lead exposure, intelligence and academic achievement: a long-term follow-up study. *Pediatrics*. 1992;90:855-861
- Baghurst PA, McMichael AJ, Wigg NRF, et al. Environmental exposure to lead and children's intelligence at the age of seven years: The Port Pirie Cohort Study. *N Engl J Med*. 1992;327:1279-1284
- McMichael AJ, Baghurst PA, Wigg NR, Vimpani GV, Robertson EF, Roberts RJ. Port Pirie cohort study: environmental exposure to lead and children's abilities at the age of four years. *N Engl J Med*. 1988;319: 468-475
- Needleman HL, Gatsonis CA. Low-level lead exposure and the IQ of children: a meta-analysis of modern studies. *JAMA*. 1990;90:673-678
- Kaufmann RB, Clouse TL, Olson DR, Matte TD. Elevated blood lead levels and blood lead screening among US children aged one to five years: 1988-1994. *Pediatrics*. 2000;106(6). URL: <http://www.pediatrics.org/cgi/content/full/106/6/e79>
- Centers for Disease Control and Prevention. Blood lead levels in young children—United States and selected states, 1996-1999. *MMWR Morb Mortal Wkly Rep*. 2000;49:1133-1137
- Centers for Disease Control and Prevention. Update: blood lead levels—United States, 1991-1994; *MMWR Morb Mortal Wkly Rep*. 1997;46: 141-146 (published erratum in *MMWR Morb Mortal Wkly Rep*. 1997;46: 607)
- Pirkle JL, Brody DJ, Gunter EW, et al. The decline in blood lead levels in the United States. The National Health and Nutrition Examination Surveys (NHANES). *JAMA*. 1994;272:284-291
- Brody DJ, Pirkle JL, Kramer RA, et al. Blood lead levels in the US population: phase 1 of the Third Health and Nutrition Examination Survey (NHANES III, 1988 to 1991). *JAMA*. 1994;272:277-283
- Centers for Disease Control and Prevention. *Preventing Lead Poisoning in Young Children*. Atlanta, GA: Centers for Disease Control and Prevention; 1991
- Centers for Disease Control and Prevention. *Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials*. Atlanta, GA: Centers for Disease Control and Prevention; 1997
- Binder S, Matte TD, Kresnow M, Houston B, Sacks JJ. Lead testing of children and homes: results of a national telephone survey. *Public Health Rep*. 1996;111:342-346
- United States General Accounting Office. *Lead Poisoning: Federal Health Care Programs Are Not Effectively Reaching at Risk Children*. Washington, DC: GAO; 1999. Publ. No. GAO/HEHS-99-18
- United States General Accounting Office. *Medicaid: Elevated Blood Lead Levels in Children*. Washington, DC: GAO; 1998. Publ. No. GAO/HEHS-98-78
- Pears R. States called lax on tests for lead in poor children. *The New York Times*. 1999;August 22:1
- Advisory Committee on Childhood Lead Poisoning Prevention. Recommendations for blood lead screening of young children enrolled in Medicaid: targeting a group at high risk. *MMWR Morb Mortal Wkly Rep*. 2000;49:1-13
- Rhode Island Department of Health. *Pediatric blood lead screening guidelines*. Providence, RI: Rhode Island Department of Health; 1996
- Rhode Island Kids Count. *1998 Rhode Island Kids Count Factbook*. Providence, RI: Rhode Island Kids Count; 1998
- Zeger SL, Liang KY. An overview of methods for the analysis of longitudinal data. *Stat Med*. 1992;11:1825-1839
- Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*. 1986;42:121-130
- Rodewald L, Maes E, Stevenson J, et al. Immunization performance measurement in a changing immunization environment. *Pediatrics*. 1999;103:889-897
- Darden PM, Taylor JA, Slora EJ, et al. Methodological issues in determining rates of childhood immunization in office practice: a study from Pediatric Research in Office Settings (PROS). *Arch Pediatr Adolesc Med*. 1996;150:1027-1031
- Goldstein KP, Kviz FJ, Daum RS. Accuracy of immunization histories provided by adults accompanying preschool children to a pediatric emergency department. *JAMA*. 1993;270:2190-2194
- Suarez L, Simpson DM, Smith DR. Errors and correlates in parental recall of child immunizations: effects on vaccination coverage. *Pediatrics*. 1997;99(5). URL: <http://www.pediatrics.org/cgi/content/full/99/5/e3>
- Watson MA, Feldman KW, Sugar NF, Sommer CJ, Thomas ER, Lin T. Inadequate history as a barrier to immunization. *Arch Pediatr Adolesc Med*. 1996;150:135-139

**A Statewide Assessment of Lead Screening Histories of Preschool Children  
Enrolled in a Medicaid Managed Care Program**

Patrick M. Vivier, Joseph W. Hogan, Peter Simon, Tricia Leddy, Lynne M. Dansereau  
and Anthony J. Alario

*Pediatrics* 2001;108;e29

DOI: 10.1542/peds.108.2.e29

**Updated Information  
& Services**

including high-resolution figures, can be found at:  
<http://www.pediatrics.org/cgi/content/full/108/2/e29>

**References**

This article cites 16 articles, 11 of which you can access for free  
at:  
<http://www.pediatrics.org/cgi/content/full/108/2/e29#BIBL>

**Subspecialty Collections**

This article, along with others on similar topics, appears in the  
following collection(s):  
**Therapeutics & Toxicology**  
[http://www.pediatrics.org/cgi/collection/therapeutics\\_and\\_toxicology](http://www.pediatrics.org/cgi/collection/therapeutics_and_toxicology)

**Permissions & Licensing**

Information about reproducing this article in parts (figures,  
tables) or in its entirety can be found online at:  
<http://www.pediatrics.org/misc/Permissions.shtml>

**Reprints**

Information about ordering reprints can be found online:  
<http://www.pediatrics.org/misc/reprints.shtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

