



---

# MMWR<sup>TM</sup>

**Morbidity and Mortality Weekly Report**

[www.cdc.gov/mmwr](http://www.cdc.gov/mmwr)

---

Recommendations and Reports

August 7, 2009 / Vol. 58 / No. RR-9

---

## **Recommendations for Blood Lead Screening of Medicaid-Eligible Children Aged 1–5 Years: an Updated Approach to Targeting a Group at High Risk**

The *MMWR* series of publications is published by the Coordinating Center for Health Information and Service, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30333.

**Suggested Citation:** Centers for Disease Control and Prevention. [Title]. *MMWR* 2009;58(No. RR-#):[inclusive page numbers].

**Centers for Disease Control and Prevention**

Thomas R. Frieden, MD, MPH  
*Director*

Tanja Popovic, MD, PhD  
*Chief Science Officer*

James W. Stephens, PhD  
*Associate Director for Science*

Steven L. Solomon, MD  
*Director, Coordinating Center for Health Information and Service*

Jay M. Bernhardt, PhD, MPH  
*Director, National Center for Health Marketing*

Katherine L. Daniel, PhD  
*Deputy Director, National Center for Health Marketing*

**Editorial and Production Staff**

Frederic E. Shaw, MD, JD  
*Editor, MMWR Series*

Christine G. Casey, MD  
*Deputy Editor, MMWR Series*

Susan F. Davis, MD  
*Associate Editor, MMWR Series*

Teresa F. Rutledge  
*Managing Editor, MMWR Series*

David C. Johnson  
*(Acting) Lead Technical Writer-Editor*

Catherine B. Lansdowne, MS  
*Project Editor*

Martha F. Boyd  
*Lead Visual Information Specialist*

Malbea A. LaPete  
*Visual Information Specialist*

Stephen R. Spriggs  
*Visual Information Specialist*

Kim L. Bright, MBA  
Quang M. Doan, MBA  
Phyllis H. King  
*Information Technology Specialists*

**Editorial Board**

- William L. Roper, MD, MPH, Chapel Hill, NC, Chairman
- Virginia A. Caine, MD, Indianapolis, IN
- Jonathan E. Fielding, MD, MPH, MBA, Los Angeles, CA
- David W. Fleming, MD, Seattle, WA
- William E. Halperin, MD, DrPH, MPH, Newark, NJ
- King K. Holmes, MD, PhD, Seattle, WA
- Deborah Holtzman, PhD, Atlanta, GA
- John K. Iglehart, Bethesda, MD
- Dennis G. Maki, MD, Madison, WI
- Sue Mallonee, MPH, Oklahoma City, OK
- Patricia Quinlisk, MD, MPH, Des Moines, IA
- Patrick L. Remington, MD, MPH, Madison, WI
- Barbara K. Rimer, DrPH, Chapel Hill, NC
- John V. Rullan, MD, MPH, San Juan, PR
- William Schaffner, MD, Nashville, TN
- Anne Schuchat, MD, Atlanta, GA
- Dixie E. Snider, MD, MPH, Atlanta, GA
- John W. Ward, MD, Atlanta, GA

**CONTENTS**

Introduction ..... 1

Methods ..... 2

Blood Lead Levels and Exposure Patterns Among Children..... 2

    National Prevalence Estimates and Trends ..... 2

    State Surveillance Data and Trends ..... 2

    Medicaid Eligibility and Risk for Lead Exposure ..... 3

Blood Lead Screening Policies ..... 3

    CDC Policies ..... 3

    CMS Policies: The Early and Periodic Screening, Diagnostic, and Treatment Service ..... 4

Recommendations ..... 4

    1. Update Blood Lead Screening Policies for Medicaid-Eligible Children ..... 4

    2. Improve Rates of Blood Lead Screening Among Medicaid-Eligible Children Determined To Be at Increased Risk for Lead Exposure..... 6

    3. Design and Implement Updated Surveillance and Evaluation Strategies ..... 8

Conclusion..... 9

References ..... 10

**Disclosure of Relationship**

CDC, our planners, and our content experts wish to disclose they have no financial interests or other relationships with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters. Presentations will not include any discussion of the unlabeled use of a product or a product under investigational use.

# Recommendations for Blood Lead Screening of Medicaid-Eligible Children Aged 1–5 Years: an Updated Approach to Targeting a Group at High Risk

Anne M. Wengrovitz, MPH, Mary Jean Brown, ScD

Advisory Committee on Childhood Lead Poisoning, Division of Environmental and Emergency Health Services, National Center for Environmental Health

## Summary

*Lead is a potent, pervasive neurotoxicant, and elevated blood lead levels (EBLLs) can result in decreased IQ, academic failure, and behavioral problems in children. Eliminating EBLLs among children is one of the 2010 U.S. national health objectives. Data from the National Health and Nutrition Examination Survey (NHANES) indicate substantial decreases both in the percentage of persons in the United States with EBLLs and in mean BLLs among all age and ethnic groups, including children aged 1–5 years. Historically, children in low-income families served by public assistance programs have been considered to be at greater risk for EBLLs than other children. However, evidence indicates that children in low-income families are experiencing decreases in BLLs, suggesting that the EBLL disparity between Medicaid-eligible children and non-Medicaid-eligible children is diminishing. In response to these findings, the CDC Advisory Committee on Childhood Lead Poisoning Prevention is updating recommendations for blood lead screening among children eligible for Medicaid by providing recommendations for improving BLL screening and information for health-care providers, state officials, and others interested in lead-related services for Medicaid-eligible children. Because state and local officials are more familiar than federal agencies with local risk for EBLLs, CDC recommends that these officials have the flexibility to develop blood lead screening strategies that reflect local risk for EBLLs. Rather than provide universal screening to all Medicaid children, which was previously recommended, state and local officials should target screening toward specific groups of children in their area at higher risk for EBLLs. This report presents the updated CDC recommendations and provides strategies to 1) improve screening rates of children at risk for EBLLs, 2) develop surveillance strategies that are not solely dependent on BLL testing, and 3) assist states with evaluation of screening plans.*

## Introduction

Substantial improvements have been made in reducing lead in the environment. During 1999–2004, 1.4% of children in the United States aged 1–5 years had elevated blood lead levels (EBLLs) (1), compared with 8.6% of children during 1988–1991. Despite this progress, some children remain at risk, and eliminating EBLLs among all children aged 1–6 years is a 2010 national health objective (objective 8–11) (2). To meet this objective, the limited available resources must be focused on the populations at highest risk for EBLLs. Since 1989, children who are eligible for Medicaid have been identified as having an increased risk for lead exposure. This finding forms the basis for the current national Medicaid policy, which targets Medicaid-eligible children for preventive and screening measures, including routine blood lead testing. However, evidence from several states indicates that children in low-income families are experiencing decreases in BLLs. This underscores the need for closer analysis of the lead risk patterns within vari-

ous jurisdictions and suggests that children who are eligible for Medicaid can no longer be assumed to have an increased risk for EBLLs. Therefore, a new blood lead screening strategy is needed that accounts for local variations in risk and disparities at the local level. This report reviews available data on childhood lead exposure in the United States, especially among children aged 1–5 years who are eligible for Medicaid, updates screening recommendations for this population, and describes relevant Medicaid program requirements and changes.

The national objective to eliminate EBLLs among children by 2010 is part of a larger national goal to eliminate health disparities among various segments of the population (Goal 2) (2). Improved blood lead screening policies and practices also support the “healthy people in healthy places” component of CDC’s core health protection goals, which aim to promote and protect health through safe and healthy home environments (3). In 2000, CDC, the Department of Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), and other agencies developed a federal interagency strategy to eliminate EBLLs among children by 2010. An important element of this interagency strategy is identification and care of children with EBLLs, especially Medicaid-eligible children (4).

**Corresponding preparer:** Mary Jean Brown, ScD, Division of Environmental and Emergency Health Services, National Center for Environmental Health, CDC, 4770 Buford Highway, MS F-40, Atlanta, GA 30341. Telephone: 770-488-7492; Fax: 770-488-3635; E-mail: mjb5@cdc.gov.

## Methods

The National Health and Nutrition Examination Survey (NHANES) is an ongoing series of cross-sectional surveys on health and nutrition designed to be nationally representative of the noninstitutionalized, U.S. civilian population by using a complex, multistage probability design. All NHANES surveys include a household interview followed by a detailed physical examination. NHANES data indicate substantial decreases since 1976 in both the percentage of persons in the United States with EBLs and in mean BLLs among all age and ethnic groups.

The CDC Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) makes recommendations to improve lead poisoning prevention measures. In 2001, in response to the decreased prevalence of EBLs in the United States, ACCLPP formed a workgroup to 1) review the published research regarding screening of children at high risk for EBLs and 2) outline recommendations for state Medicaid agencies to determine whether risk for lead exposure among Medicaid-eligible children overall is higher than for non-Medicaid-eligible children in their jurisdictions. The Centers for Medicare & Medicaid Services (CMS), which is the administrator of the Medicaid program, reviewed the recommendations developed by the workgroup. The recommendations were approved by ACCLPP in September 2008.

## Blood Lead Levels and Exposure Patterns Among Children

Lead has been associated with numerous adverse health effects in humans (5). In children, even BLLs <10 µg/dL can result in decreased cognitive function, developmental delays, and behavior problems (6). These adverse effects reinforce the importance of screening and continued measures to eliminate or control lead sources in children's environments. Regulations that limit the use of lead in gasoline, paint, plumbing solder, food cans, and other consumer products and that control or eliminate residential lead paint hazards not only support the 2010 goal of eliminating EBLs but also help prevent adverse health effects at lower exposure levels (7,8).

## National Prevalence Estimates and Trends

Data from NHANES indicate that during 1976–2004, a substantial decrease occurred in the percentage of young children aged 1–5 years with EBLs (77.8% during 1976–1980, 4.4% during 1991–1994, and 1.4% during 1999–2004) (1,9).

BLLs have decreased among all age and ethnic groups (10). However, NHANES data indicate that disparities continue to exist in mean BLL by race, income level, age of residence, and other available risk factors. Data from the 1991–1994 NHANES indicated that the highest rates of EBLs occurred among children living in homes built before 1946, among children in low-income families, and among children who were either non-Hispanic black or Mexican-American (9). The percentage of EBLs among black children aged 1–5 years (11.2%) was significantly higher than among white children (2.3%) ( $p < 0.05$ ). By 1999–2004, the difference between black (3.4%) and white (1.2%) children in this age group had decreased substantially (1).<sup>\*</sup> In addition, in the 1991–1994 NHANES survey, black, non-Hispanic children had a geometric mean (GM) BLL of 4.3 µg/dL, compared with 2.3 µg/dL for white, non-Hispanic children. In the 1999–2004 NHANES survey, the GM BLL for black, non-Hispanic children was 2.8 µg/dL, compared with a GM BLL of 1.7 µg/dL for white, non-Hispanic children (1). In the 1999–2004 NHANES survey, children in low-income families had a GM BLL of 2.4 µg/dL, compared with 1.5 µg/dL for children aged 1–5 years in higher-income families (1).

## State Surveillance Data and Trends

As disparities among subpopulations have decreased, accurately assessing the risk for lead exposure among children has become more difficult, especially on a national level, because NHANES is not constructed to measure prevalence in small populations. Thus, state and local data have gradually become more important than national data for developing lead exposure prevention policies at the state and local level.

The downward national trend in BLLs indicated by the NHANES survey data is substantiated by lead surveillance data collected by states and reported to CDC (11). Results from tests of children aged <72 months who were screened for lead at least once during January 1, 1997, through December 31, 2004, show similar patterns in most states: decreasing numbers of confirmed EBL cases and decreasing percentages of confirmed EBLs among children tested (12). The nationwide decrease in the number of new EBL cases in states that screen numerous children (both in the general and Medicaid-eligible populations) as well as states that screen fewer children suggests that the decrease in EBL cases is not merely a function of increased proportions of lower-risk children being tested or fewer children at high risk for EBLs being tested.

<sup>\*</sup> Because of small proportions and variability of the estimates, the statistical significance of the difference between these percentages could not be determined.

## Medicaid Eligibility and Risk for Lead Exposure

Studies conducted during the 1980s and 1990s indicated that children eligible for Medicaid were at increased risk for lead exposure (13) and that children living in poverty had higher levels of lead exposure than those who were not living in poverty (14). Using data from the 1991–1994 NHANES, the U.S. General Accounting Office found that 60% of children with BLLs  $\geq 10$   $\mu\text{g}/\text{dL}$  and 83% of those with BLLs  $\geq 20$   $\mu\text{g}/\text{dL}$  were eligible for Medicaid (13,15). A separate CDC analysis of the same NHANES data estimated that approximately 93% of children with BLLs  $\geq 20$   $\mu\text{g}/\text{dL}$  were Medicaid eligible (16). A subsequent analysis of all 1988–1994 NHANES data found that families who reported having Medicaid coverage were more likely to have EBLs than those who were not enrolled in Medicaid (16). Such findings supported a focus on identifying cases of EBL among Medicaid children to provide early intervention and treatment and develop focused prevention strategies (17). Medicaid eligibility, as well as eligibility for other programs for low-income families, is a proxy for poverty and therefore for living in old, poorly maintained housing, which is more likely to contain lead paint hazards.

As a result of increased lead screening for Medicaid children, recent data are available that provide a more detailed characterization of this population's risk for EBLs. An analysis of Minnesota data indicated that the percentage of tested children aged <72 months who had EBLs decreased from 7.8% to 3.5% during 1999–2003 among children enrolled in Medicaid and from 4.1% to 1.9% among children not enrolled in Medicaid. This suggests that, in Minnesota, BLLs are decreasing in children eligible for Medicaid as well as in the general population (18). A study of children enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC program) in Wisconsin (i.e., a population of children from lower-income families) found decreasing rates of EBLs during 1996–2000 (19). A CDC analysis of 1999–2004 NHANES data found that the distribution of BLLs by poverty status, as indicated by both a household income <1.3 times the poverty threshold for the year of the interview and Medicaid enrollment, had shifted toward lower values, and the percentage of children with EBLs enrolled in Medicaid was not statistically significantly higher than the percentage of children with EBLs not enrolled in Medicaid (1). These studies are consistent with programmatic experience and suggest that children in low-income families served by Medicaid and WIC have experienced a decrease in BLLs similar to the decrease in the general population. In addition,

the disparity in risk for lead exposure between Medicaid-eligible children and non-Medicaid-eligible children might be decreasing. These results indicate that children who are eligible for Medicaid can no longer be assumed to have an increased risk for EBLs. Thus, rather than a single national policy that is used for all Medicaid children, a new blood lead screening strategy is needed that accounts for local variations in risk and disparities at the local level.

## Blood Lead Screening Policies

### CDC Policies

The primary purpose of childhood blood lead screening has been to identify asymptomatic children with EBLs so that they can promptly receive services to reduce lead exposure and improve health outcomes. As early as 1978, CDC recommended universal screening of all children aged 9 months–6 years but emphasized screening children with specific risk factors, such as children living in substandard housing or those in low-income families (20).

In 1997, CDC recognized that the prevalence of EBLs among young children had decreased substantially and that the risk for lead exposure varied substantially by geographic location. CDC replaced its recommendation for universal screening of all children aged 9 months–6 years with a recommendation for targeted screening to identify children most likely to have EBLs and to benefit from screening. The 1997 CDC recommendation called for states to analyze their BLL data and develop state screening plans consistent with state and local risk patterns (21). CDC also recommended continued universal screening of Medicaid-eligible children, assuming that all such children were at risk for EBLs, “unless there [are] reliable, representative BLL data that demonstrate the absence of lead exposure in this population” (21).

As an interim measure, until state or local data became available, CDC recommended two blood lead tests for children determined to be at higher risk for EBLs, one at age 9–12 months and one at age 2 years, because on average, BLLs peak at 24 months (22). In addition, CDC recommended that children at high risk for EBLs who have never been tested be tested at age 3 years. Since 1997, officials in certain states and jurisdictions have developed blood lead testing requirements that also require testing for children at older ages. Information on state-specific blood lead screening plans is available at <http://www.cdc.gov/nceh/lead>.



## CMS Policies: The Early and Periodic Screening, Diagnostic, and Treatment Service

Since 1989, federal Medicaid law has included the requirement that states provide blood lead assessments, as indicated by age and risk factors, as part of the medical screening, health education, and anticipatory guidance regarding EBLs and to provide medically necessary treatment services.<sup>†</sup> The law requires lead screening of young children eligible for Medicaid, one element of Medicaid's Early and Periodic Screening, Diagnostic, and Treatment (EPSDT) service, a program that entitles children to comprehensive preventive health care and necessary diagnosis and treatment. The *State Medicaid Manual* is the principal CMS document that provides guidance to states on specific program requirements; agency policy interpretations and clarifications are occasionally issued through a letter signed by a CMS official (23). Consistent with federal law and CDC recommendations, current CMS policy requires that 1) all children receive a blood lead test at ages 12 months and 24 months, and 2) children aged 36–72 months receive a blood lead test if they have not been previously tested (24). CMS also specifies that “states may not adopt a statewide plan for screening children for EBLs that does not require lead screening for all Medicaid-eligible children” (23).

Implementing a change in policy for lead screening of Medicaid-eligible children will involve an update of the *State Medicaid Manual* by CMS. In 2009 and 2010, CDC will advise CMS regarding which states have sufficient data to assess differences between the prevalence of EBLs in children eligible for Medicaid and the general population of children in the state. In states where the risk for EBLs is determined to be no higher for Medicaid-eligible children than for other children in the state, CMS will either update the *State Medicaid Manual* directly or provide a letter to the Medicaid directors in these states informing them that blood lead screening is no longer required for all Medicaid-eligible children.

## Recommendations

Following are the updated CDC recommendations for blood lead screening of children aged 1–5 years who are eligible for Medicaid. CDC recommends that state and local public health officials 1) update blood lead screening policies for Medicaid-eligible children, 2) improve rates of blood lead screening among Medicaid-eligible children determined to be

at increased risk for lead exposure, and 3) design and implement updated surveillance and evaluation strategies (Box).

### 1. Update Blood Lead Screening Policies for Medicaid-Eligible Children

Since the 1997 CDC recommendation for targeted blood lead screening, certain jurisdictions have collected reliable BLL data that do not show higher rates of EBLs among children enrolled in Medicaid compared with children not enrolled in Medicaid. Such data challenge the assumption that all Medicaid-eligible children are at increased risk for EBLs, an assumption that forms the basis of the current national Medicaid policy for blood lead screening. The findings underscore the need for closer analysis of the lead risk patterns within various jurisdictions and suggest that blood lead screening of children in Medicaid populations should be targeted toward subgroups at higher risk rather than all Medicaid-eligible children.

In 1997, CDC endorsed continued universal screening of Medicaid children unless reliable data demonstrated “the absence of lead exposure in this population.” Developing policies consistent with this recommendation is challenging because of the difficulty of proving an absence of lead exposure. A more effective policy would be to enable state-level flexibility in developing screening policies appropriate for local patterns of risk for lead exposure and to give states the option of integrating their Medicaid-eligible populations into other targeted lead screening plans. With this policy change, the decision regarding whether to screen all Medicaid-eligible children for lead exposure would be made at the state and local levels, rather than the national level. State and local public health authorities are more familiar than federal agencies with local lead-risk exposure patterns and are therefore better able to develop and implement screening strategies to identify specific groups of children who are at risk. Such a policy would decrease the number of children tested who are not at risk, which would reduce health-care costs and address concerns among health-care providers regarding unwarranted blood lead testing for children.

To implement this new policy, state and local public health authorities should review data associated with risk for lead exposure (e.g., age of housing, percentage of rental properties and young children in a community, and sources of lead in the environment) and from blood lead surveillance to identify geographic areas where children are at risk for EBLs. Public health authorities must ensure the validity and reliability of the data and analyses used to justify screening policy decisions and should seek assistance from CDC when needed.

<sup>†</sup> Social Security Act, Title 42. The public health and welfare. Chapter 7, Title XIX. Grants to states for medical assistance programs. 42 U.S.C. Sect 1396d (1999).

In 2008, the National Committee for Quality Assurance (NCQA) began collecting data for a new Health-Care Effectiveness Data and Information Set (HEDIS) performance measure of blood lead testing for children enrolled in Medicaid managed care plans. Data from NCQA HEDIS surveys are used by consumers, health plan administrators, and purchasers of employee-based group health insurance to compare the quality and effectiveness of health-care services provided by various managed care plans and individual health-care providers. HEDIS data are used as the basis for health plan report cards and rankings that are published in newspapers and magazines<sup>§</sup>; therefore, HEDIS results can be a powerful incentive for health-care plans to provide quality care. The HEDIS performance measure for lead screening among Medicaid-eligible children will provide baseline data that states can use to determine geographic areas where increased blood lead testing is needed, as well as areas where BLLs are low enough that universal testing is no longer warranted. Initial data from a 2005 review of six geographically diverse health plans with varying numbers of enrolled children indicate that blood lead testing rates in the plans ranged from 49% to 85% during the year (25).

### States with Data-Driven Lead Screening Recommendations for Non-Medicaid-Eligible Children

Since the 1997 CDC recommendations were made, all 42 CDC-funded childhood lead poisoning prevention programs in 37 states have developed data-driven targeted screening recommendations. Agencies in these states and localities have assessed local lead exposure risks, reviewed surveillance and census data, identified relevant factors of local importance, and developed infrastructures for involving relevant persons in the assessment process. In addition, state blood lead surveillance systems have improved through more complete collection and analysis of blood lead data (11), and many states have established community-wide lead exposure assessment and analysis programs.

After the *State Medicaid Manual* is updated to allow targeted, rather than universal, blood lead testing of children enrolled in Medicaid, state-level lead poisoning prevention programs, in partnership with state Medicaid agencies and members of state lead advisory committees, should analyze available data on lead screening and exposure patterns in the Medicaid-eligible population and modify their lead screening recommendations on the basis of local factors. For example, one such analysis

### BOX. Blood lead screening of Medicaid-eligible children aged 1–5 years: recommendations for state and local public health officials

#### 1. Update blood lead screening policies for Medicaid-eligible children.

- At the population level, evaluate risk data among all children and the risk for lead exposure among Medicaid-eligible children.
- In states with data-driven lead screening recommendations for non-Medicaid-eligible children, health officials should initiate a participatory process among all stakeholders that involves screening Medicaid-eligible children according to established local risk factors per the targeted statewide lead screening recommendations.
- In states without data-driven lead screening recommendations for non-Medicaid-eligible children, health officials should provide basic lead screening guidance online and through other communication channels that reach health-care providers.

#### 2. Improve rates of blood lead screening for Medicaid-eligible children determined to be at increased risk for lead exposure.

- Alert health-care providers to known risks for lead exposure.
- Link data from the blood lead surveillance system and Medicaid encounter system to monitor screening performance, track blood lead levels (BLLs), and identify gaps in screening.
- Provide incentives or penalties for health-care providers according to rates of blood lead screening.
- Collaborate with the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) to encourage blood lead testing at WIC sites.
- Consider alternative screening technologies as part of a strategy to increase testing of children at high risk for lead exposure.

#### 3. Design and implement updated surveillance and evaluation strategies.

- Design and implement surveillance systems not only for BLLs but also for environmental lead levels.
- Evaluate blood lead screening policies by using the Health-Care Effectiveness Data and Information Set (HEDIS) and other performance measures.

involved a study of physician screening practices in Michigan to determine risk factors associated with rates of blood lead testing and the proportion of children with EBLLs among Medicaid-enrolled children. Results indicated that specific

<sup>§</sup> Information on HEDIS and measurement of health-care quality available at <http://www.ncqa.org/tabid/59/default.aspx>.

risk factors for lead exposure were associated with higher rates of lead screening and increased BLLs within subgroups of children, suggesting that assessments in pediatric health-care settings can be used to identify subpopulations of Medicaid-enrolled children who are at risk for EBLLs (26). In addition to considering unique local lead hazard data, states should examine whether specific targeted screening strategies should be incorporated for children in populations who have been identified as being at risk for EBLLs, such as recent immigrants, refugees, or foreign adoptees (27–29).

Until state-level lead screening recommendations are revised to include targeted strategies for subpopulations of the Medicaid-eligible population, states that already have recommendations in place for targeted screening of children who are not eligible for Medicaid should decide whether to continue to require testing of all Medicaid-eligible children (i.e., continue to assume that all these children are at increased risk) or to immediately subsume Medicaid-eligible children under the existing targeted screening strategy for the non-Medicaid-eligible population (i.e., assume that Medicaid-eligible children have the same risk as non-Medicaid-eligible children within the state). For example, an interim state plan for a state that decides to screen Medicaid-eligible children using the existing strategy for the non-Medicaid-eligible population might include testing all Medicaid-eligible children who live in zip codes with high proportions of persons at high risk for EBLLs, as well as testing children who meet the screening criteria for Medicaid-eligible children.

### **States Without Data-Driven Lead Screening Recommendations for Non-Medicaid-Eligible Children**

States that do not have lead screening recommendations in place or that have no CDC funding for such plans should analyze community-level data on risk for lead exposure, including the age and condition of local housing (30,31). At the local level, information regarding housing condition might be available from tax assessors or local code enforcement agencies. If the information is unavailable, the percentage of rental or abandoned properties in a neighborhood is a useful proxy for housing condition (32). In addition, over time, local data on age of housing changes as housing ages or is abated, renovated, demolished, or replaced with new construction (4). Periodically, or on an ongoing basis, these states should also conduct comprehensive reviews of potential local environmental lead sources to ensure that prevention policies reflect local risk. Industrial and government data on lead releases or environmental lead measurements are available from various

sources, such as the EPA's National Ambient Air Quality program, Toxic Release Inventory, and Superfund program.<sup>‡</sup>

The nine states without lead screening plans should continue to perform universal blood lead screening of Medicaid-enrolled children until these states have completed assessments of risk for lead exposure among these children, reached consensus on data-driven primary and secondary lead poisoning prevention strategic plans for the community (including blood lead screening), and implemented these plans. The 1997 CDC lead screening recommendations include guidance on involving community stakeholders in such a process (21).

### **Blood Lead Screening Criteria for Medicaid-Eligible Children**

The following screening criteria should be incorporated in all state plans (21). A Medicaid-eligible child who meets any one of the following criteria should receive a blood lead screening test:

- Child is suspected by a parent or a health-care provider to be at risk for lead exposure.
- Child has a sibling or frequent playmate with EBLL.
- Child is a recent immigrant, refugee, or foreign adoptee (27–29).
- Child's parent or principal caregiver works professionally or recreationally with lead (22,33).
- Child has a household member who uses traditional, folk, or ethnic remedies or cosmetics or who routinely eats food imported informally (e.g., by a family member) from abroad (22).
- Child's family has been designated at increased risk for lead exposure by the health department because the family has local risk factors for lead exposure (e.g., residence in a designated high-risk zip code or near a known point source).

## **2. Improve Rates of Blood Lead Screening Among Medicaid-Eligible Children Determined To Be at Increased Risk for Lead Exposure**

State and federal Medicaid agencies and their partners should work to improve screening rates of Medicaid-eligible children at risk for lead exposure. Although children who are eligible for Medicaid can no longer be assumed to have an increased risk for EBLLs, certain Medicaid-eligible children will still need blood lead screening and would benefit from follow-up services. Results from the 1999–2004 NHANES survey indicate that 41.9% of Medicaid-enrolled children aged

<sup>‡</sup> Data regarding lead in consumer products is available from CDC at <http://www.cdc.gov/nceh> or from the Consumer Product Safety Commission at <http://www.cpsc.gov>.



1–5 years had received at least one blood lead test before their NHANES examination (1). Data from other studies indicate a broader range of compliance with routine Medicaid screening policies (10,34–36). In the years since Medicaid-eligible children were identified as a group at high risk for EBLs, numerous strategies to improve blood lead screening rates for this population have been suggested (16,37). Many of these strategies have been implemented, and some have been evaluated for effectiveness (38–40).

### **Establish Screening Policies that Reflect Local Risk for Lead Exposure**

State-issued lead screening recommendations might be more likely to be followed than the current national Medicaid policy and might increase blood lead screening rates. Health-care providers might be more likely to follow screening recommendations that they believe more accurately reflect local risk for lead exposure and that they helped develop. In addition, state and local health authorities are likely to be more familiar with local conditions and therefore in a better position than national authorities to monitor and improve screening performance for Medicaid-eligible children at high risk for EBLs. In most CDC-funded, state-level lead poisoning prevention programs, state lead surveillance data and Medicaid enrollment records of children can be matched electronically to assess rates of lead screening and examine BLLs in this group (41). State and local health authorities should consider practicality when developing screening recommendations for Medicaid populations and ensure that recommendations are feasible and realistic. Many screening policies that could be adopted at the state or local level might not require health-care providers to assess individual patient risk before testing. States could decide to 1) screen all Medicaid-eligible children, 2) use the same screening policies for Medicaid-eligible children and children in the general population, or 3) use objective criteria to determine which populations should be screened (e.g., residence in a certain zip code, membership in a certain health maintenance organization, or immigration status). The effectiveness of personal risk assessment questionnaires administered to persons in the offices of health-care providers is often limited, and such questionnaires might be impractical in certain practice settings (42–44).

### **Provide Scientific Risk Information to Health-Care Providers**

In 2000, CDC recommended that scientific information be provided to health-care providers regarding Medicaid blood lead screening policies and related data, assuming that health-care providers are more likely to implement clinical

practice guidelines if they know that the guidelines are based on scientific evidence. In addition, evidence suggests that lead screening practices are influenced by physician perceptions of the level of importance of lead poisoning prevention (45). Studies of lead screening behaviors of physicians have supported these assumptions and findings (45,46). Successful risk communication models also have been described, such as the development of locally customized maps of lead hazard data created by the Wisconsin Childhood Lead Poisoning Prevention Program, using Geographic Information Systems (GIS) software to plot data on EBLs and housing age (47). For example, GIS can be used to generate maps that identify where children at high risk for EBLs live by showing BLLs of resident children for a given time period, as well as the age and location of each housing unit in an area. These GIS maps can be used to clarify changes in neighborhood risk status over time and evaluate the impact of lead screening strategies on local BLLs. CDC has developed guidance for the use of GIS in lead poisoning prevention (48).

### **Link and Share Data Between Medicaid and State Lead Surveillance Systems**

Since 1998, CDC has been encouraging states to link their blood lead surveillance databases with their databases for Medicaid encounters by requiring CDC-funded childhood lead poisoning prevention programs to have a system for ongoing identification of Medicaid-eligible children in the surveillance system.\*\* Successfully linking these databases can improve screening of children at high risk for EBLs by identifying gaps in service delivery (e.g., by generating lists of unscreened Medicaid-enrolled children by their name and the name of their health-care provider) and improve the accuracy of surveillance and Medicaid reports (e.g., by including Medicaid status with test results in the surveillance system). When data systems are linked and the records have information about characteristics such as Medicaid status, health plan enrollment, race/ethnicity, and address, more focused analyses can be conducted (e.g., determining screening rates by zip code or by managed care plan). The information also can be provided to health-care providers, managed care organizations, and others who can use the information to improve service delivery. Although states have begun linking data and can track screening tests for Medicaid enrollees, almost none of the programs have reported on their use of these systems to track and analyze rates of EBLs among the Medicaid-enrolled children who are tested.

\*\* Grants to states for medical assistance programs: definitions. 42 U.S.C. Sect. 1396d (1999).

## Motivate Health-Care Providers

Strategies to motivate health-care providers to provide lead screening to Medicaid-eligible children, such as measuring performance and providing feedback or providing financial incentives or penalties, are being used in many areas. Studies have shown that measuring performance and providing feedback on the delivery of health-care services affect the practices of health-care providers and health-care plans, including increasing screening rates (49,50). Linked databases have previously been used to analyze screening rates or EBLL rates among patients of individual health plans or physicians and to provide feedback to health-care providers on their screening performance. Certain jurisdictions (e.g., New York and Rhode Island) or Medicaid managed care plans provide individual health-care plans and physicians with names of children who need screening (51,52). The state of Wisconsin prepares customized report cards that provide data on lead screening performance and risk for lead exposure to health-care providers. In addition, a performance measure for lead screening of Medicaid-enrolled children was added to HEDIS in 2008 (53). Finally, task-specific financial incentives or penalties are being used in several states (e.g., Maine, Minnesota, New York, and Wisconsin) to increase performance of lead screening, such as state contracts offering incentives or penalties to managed care plans and health plans offering incentives or penalties to participating health-care providers (45,54,55).

## Establish Partnerships with WIC

A strategy that was previously recommended by CDC is increasingly being used to provide blood lead testing services to children who are in low-income families and at high risk for EBLs. WIC enrollment, which is a useful proxy for Medicaid enrollment, is used to increase screening rates among Medicaid-eligible children (56,57). A new law in Michigan requires that all children whose families receive WIC benefits be given lead screening tests.<sup>††</sup> CDC has provided technical assistance to states in testing, designing, and evaluating such collaborative strategies. Several successful measures have recently been reported in the state Medicaid directors' newsletter (57). The primary challenge with the WIC enrollment strategy is that WIC and health agencies must work together to reimburse WIC clinics that test Medicaid-eligible children for lead poisoning. The city of Chicago, Illinois; the city of Newark, New Jersey; and the states of Ohio and Wisconsin have all collaborated with WIC to increase Medicaid screening rates for target populations (57). Collaboration with WIC also has been used as an effective blood lead screening strategy among Native American children (58).

<sup>††</sup> Michigan Public Act 286 of 2006. Sect. 111I, 93rd Legis., Reg. Sess. (2006).

## Use Alternative Screening Technologies

Research indicates that performing blood lead screening in physicians' offices reduces barriers to screening (45), both for parents, who have reported that testing in a physician's office is preferable to traveling elsewhere (59), and for physicians, who do not have to send samples to outside laboratories to obtain results. To make the process of lead screening easier and more accessible for families, programs have experimented with testing alternatives, such as providing screening at WIC sites and using blood lead testing instruments in clinical offices (60,61). Since 1997, a portable device approved by the Food and Drug Administration (FDA) for blood lead analysis has been available that provides instant blood lead screening results, enabling rapid follow-up care and immediate collection of a venous blood sample to confirm an EBLL result from a capillary sample. The most recent version of this portable device does not require specific laboratory certifications. Even with the previous device, which required certification, certain states (e.g., Washington) increased lead screening rates (61). Another method of on-site sample collection involves using filter paper to store and transmit blood samples for analysis. CDC has encouraged study of the use of filter paper, which is being used in several states routinely (e.g., Kansas, Minnesota, and Wisconsin) or for special projects (e.g., New Jersey). Both the portable device and filter paper can be used with capillary or venous blood samples. Concerns about sample contamination are associated with failure to adequately clean the skin site, not the device that transports or analyzes the sample. In areas where the benefits (e.g., increased screening rates) of capillary sample collections outweigh the drawbacks, CDC encourages use of capillary sampling, following recommended protocols, to encourage increased screening (62). CDC provides technical support and training for proper capillary sampling, including a DVD on proper sample technique.<sup>§§</sup> Elevated capillary BLLs should be confirmed through venous blood testing and sound analytic methods, such as graphite furnace atomic absorption.

## 3. Design and Implement Updated Surveillance and Evaluation Strategies

### Use Surveillance Strategies to Track Blood Lead Levels

NHANES remains an effective tool for generating national estimates of children aged 1–5 years with EBLs and evaluating nationwide primary prevention interventions. CDC also has begun working with states to develop alternative

<sup>§§</sup> Sampling information available at <http://www.cdc.gov/nceh/lead>.

surveillance strategies to detect increases in the proportion of populations with EBLLs and to identify new lead sources in communities.

After the *State Medicaid Manual* is updated, states that discontinue universal lead screening of Medicaid-eligible children because these children have been determined to be at low risk for lead exposure should conduct active surveillance of known groups and geographic areas at high risk for EBLLs to monitor trends and confirm that risk remains low. In such areas, state health departments and Medicaid programs are encouraged to monitor lead exposure risk by reviewing BLL laboratory data, alerting the public about newly identified sources of lead exposure, and initiating focused BLL prevalence surveys. For example, local prevalence studies can be designed to be representative of the area studied. One CDC-supported study in Chicago, prompted by a request from local health officials, found that in one community, approximately 30% of children aged 1–5 years had EBLLs (63). Children who are recent immigrants, refugees, or foreign adoptees also should be monitored for EBLLs (27–29). These types of assessments help ensure that existing screening policies are adequate and appropriate and can provide an early warning of an increase in or reemergence of EBLLs in a particular community.

Another important component of EBLL surveillance is identifying other subpopulations of Medicaid-eligible children who are at increased risk for EBLLs (e.g., children of parents who work with lead or children who live close to a lead smelter or mine) but are not receiving needed lead screening. Identification of these children should be based primarily on data that indicate whether children who were thought to be at low risk for EBLLs remain at low risk. Sources of such data might include census data, nutritional evaluations (e.g., WIC records), housing surveys, adult and occupational lead registry data, and identification of new products or practices resulting in lead exposure within the community. New or increased risk for EBLLs identified in a subpopulation might prompt updated screening recommendations.

An EBLL surveillance system should include routine collection of data on well-defined populations and environmental indicators. For example, data might routinely be collected on the number of prescriptions filled for lead-chelating agents in a sample of cities so that a substantial increase in prescriptions could be identified. Because EBLLs have an environmental origin, environmental indicators (e.g., lead dust in housing that receives federal subsidies) also should be included. An EBLL surveillance system should help states identify previously unrecognized lead exposures, especially in states without lead screening plans; CDC and its federal and state partners are well positioned to identify a core set of measures for an EBLL surveillance system.

## Evaluate CDC and CMS Blood Lead Screening Policies

To make appropriate policy modifications after the *State Medicaid Manual* is updated and provide useful technical assistance to state partners, CDC and CMS will evaluate regularly the effectiveness of federal lead screening and treatment policies to determine whether children who would benefit from blood lead screening are being tested and, if they are not, will take steps to ensure this goal is accomplished. Simultaneously, CDC and CMS will develop an evaluation framework to measure the results of the changed screening policies and programs. In accordance with CDC's *Framework for Program Evaluation in Public Health* (64), the evaluation will include the following:

- Number and proportion of children targeted for screening who received screening
- Number and proportion of tested children who are identified as having EBLLs
- Number and proportion of children with EBLLs who received complete environmental investigations, for whom lead hazards were identified, and for whom lead hazards were remediated
- Information about follow-up services provided, including the number of children with EBLLs who received case management services
- Data system measures and goals

CDC and CMS will use numerous data sources to evaluate federal blood lead screening policies, including CDC-funded and non-CDC-funded state surveillance systems and program documentation, state Medicaid agencies (e.g., data from the CMS EPSDT report [form 416] on the number of lead screening tests reported for Medicaid enrollees), GIS analysis of environmental and health data, focused survey results, private-sector data collection instruments (e.g., Medicaid HEDIS), and other federal agencies (the Consumer Product Safety Commission, FDA, EPA, or HUD).

## Conclusion

BLLs decreased in the United States population overall and in every subpopulation during 1976–2004. BLLs decreased among certain Medicaid-enrolled children, but the geographic disparities increased. These findings suggest that a national blood lead screening policy that requires universal screening of all young Medicaid-eligible children is not justified. State and local public health authorities are better positioned, with assistance from CDC, to assess local risk variations, develop appropriate screening policies to identify EBLLs among Medicaid-eligible children, and develop and evaluate lead screening strategies. To help ensure that Medicaid-eligible



children who are at risk for lead poisoning are identified and treated appropriately, 1) decisions regarding the level of risk for EBLLs among Medicaid-eligible children should be made by state and local health departments; 2) lead screening tests should be provided at WIC sites, and new blood lead testing technologies should be considered; and 3) existing surveillance systems should be refined to include other measures of risk of exposure, including environmental measures, so that they are not solely dependent on BLL testing for identifying risk for lead poisoning.

## References

- Jones R, Homa D, Meyer P, et al. Trends in blood lead levels and blood lead testing among U.S. children aged 1 to 5 years, 1988–2004. *Pediatrics* 2009;123:e376–85.
- US Department of Health and Human Services. Healthy people 2010 (conference ed, in 2 vols). Washington, DC: US Department of Health and Human Services; 2000. Available at <http://www.healthypeople.gov>.
- CDC. Healthy homes initiative. Atlanta, GA: US Department of Health and Human Services, CDC. Available at [www.cdc.gov/healthyplaces/healthyhomes.htm](http://www.cdc.gov/healthyplaces/healthyhomes.htm).
- President's Task Force on Environmental Health Risks and Safety Risks to Children. Eliminating childhood lead poisoning: a federal strategy targeting lead paint hazards. Washington, DC: US Department of Housing and Urban Development and US Environmental Protection Agency; 2000. Available at <http://www.hud.gov/offices/lead/reports/fedstrategy.cfm>.
- National Research Council, Board on Environmental Studies and Toxicology. Measuring lead exposure in infants, children, and other sensitive populations. Washington, DC: National Academy Press; 1993.
- Canfield RL, Henderson CR, Cory-Slechta DA, et al. Intellectual impairment in children with blood lead concentrations below 10 µg per deciliter. *N Engl J Med* 2003;348:1517–26.
- Levin R, Brown MJ, Kashtock ME, et al. U.S. children's lead exposures, 2008: implications for prevention. *Environ Health Perspect* 2008;116:1285–93.
- CDC. Preventing lead poisoning in young children. Atlanta, GA: US Department of Health and Human Services, CDC; 2005. Available at <http://www.cdc.gov/nceh/lead/publications/prevleadpoisoning.pdf>.
- 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;272:284–91.
- CDC. Surveillance for elevated blood lead levels among children—United States, 1997–2001. *MMWR* 2003;52(No. SS-10).
- CDC. CDC surveillance data, 1997–2004. Atlanta, GA: US Department of Health and Human Services, CDC. Available at <http://www.cdc.gov/nceh/lead/surv/stats.htm>.
- CDC. Number of children tested and confirmed EBLLs by state, year, and BLL group, children <72 months old. Atlanta, GA: US Department of Health and Human Services, CDC. Available at [http://www.cdc.gov/nceh/lead/surv/database/state\\_confirmed\\_byyear\\_2004\\_for%20website.xls](http://www.cdc.gov/nceh/lead/surv/database/state_confirmed_byyear_2004_for%20website.xls).
- US General Accounting Office. Medicaid: elevated blood lead levels in children. GAO publication no. GAO/HEHS-98-78. Washington, DC: US General Accounting Office; 1998.
- Brody DJ, Pirkle JL, Kramer RA, et al. Blood lead levels in the U.S. population: phase I of the Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1991). *JAMA* 1994;272:277–83.
- US General Accounting Office. Children's health: elevated blood lead levels in Medicaid and Hispanic children. GAO publication no. GAO/HEHS-98-169R. Washington, DC: US General Accounting Office; 1998.
- Kaufmann RB, Clouse TL, Olson DR, Matte TD. Elevated blood lead levels and blood lead screening among U.S. children aged one to five years: 1988–1994. *Pediatrics* 2000;106:E79.
- CDC. Recommendations for blood lead screening of young children enrolled in Medicaid: targeting a group at high risk—United States. *MMWR* 2000;49(No. RR-14).
- Zabel E, Castellano S. Minnesota's Medicaid programs are called Medical Assistance (MA) and MinnesotaCare (MNCare): lead poisoning in Minnesota Medicaid children. *Minn Med* May 2006:89.
- Zierold KM, Anderson H. Trends in blood lead levels among children enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children from 1996 to 2000. *Am J Public Health* 2004;94:1513–5.
- CDC. Preventing lead poisoning in young children: a statement by the Center for Disease Control. Atlanta, GA: US Department of Health and Human Services, CDC; 1978.
- CDC. Screening young children for lead poisoning: guidance for state and local public health officials. Atlanta, GA: US Department of Health and Human Services, CDC; 1997. Available at <http://www.cdc.gov/nceh/lead/guide/guide97.htm>.
- Tong SL, Baghurst PA, McMichael AL, Sawyer MG, Mudge J. Lifetime exposure to environmental lead and children's intelligence at 11–13 years: the Port Pirie cohort study. *Br Med J* 1996;312:1569–75.
- Centers for Medicare and Medicaid Services. Early and periodic screening and diagnostic treatment benefit: EPSDT benefits. Available at [http://www.cms.hhs.gov/medicaidearlyperiodicscrn/02\\_benefits.asp](http://www.cms.hhs.gov/medicaidearlyperiodicscrn/02_benefits.asp).
- Health Care Financing Administration. Part 5. Early and periodic screening, diagnosis, and treatment (EPSDT). In: State Medicaid manual. Publication no. 45-5. Sect 5123.2. Transmittal no. 12. Baltimore, MD: Health Care Financing Administration; 1998.
- Pillittere D, Rey D, Mierzejewski R, Renner P, Scholle A. Measuring lead screening in children enrolled in Medicaid [Abstract]. In: Annual research meeting 2007 abstracts. Academy Health; 2007. Available at <http://www.academyhealth.org/2007/abstracts.htm>.
- Kemper AR, Cohn LM, Fant KE, Dombkowski KJ. Blood lead testing among Medicaid-enrolled children in Michigan. *Arch Pediatr Adolesc Med* 2005;159:646–50.
- CDC. Elevated blood lead levels in refugee children—New Hampshire, 2003–2004. *MMWR* 2005;54:42–6.
- Geltman P, Brown MJ, Cochran J. Lead poisoning among refugee children resettled in Massachusetts, 1995–1999. *Pediatrics* 2001;108:158–62.
- CDC. Recommendations for lead poisoning prevention in newly arrived refugee children. Atlanta, GA: US Department of Health and Human Services, CDC. Available at <http://www.cdc.gov/nceh/lead/refugee%20recs.htm>.
- Sargent JD, Brown MJ, Freeman JL, et al. Childhood lead poisoning in Massachusetts communities: its association with sociodemographic and housing characteristics. *Am J Public Health* 1995;85:528–34.
- Clark CS, Bornschein RL, Succop P, et al. Condition and type of housing as an indicator of potential environmental lead exposure and pediatric blood lead levels. *Environ Res* 1985;38:46–53.
- Sargent JD, Bailey A, Simon P, Blake M, Dalton MA. Census tract analysis of lead exposure in Rhode Island children. *Environ Res* 1997;74:159–68.
- Committee on Environmental Health, American Academy of Pediatrics. Policy statement: lead exposure in children: prevention, detection, and management. *Pediatrics* 2005;116:1036–46.
- Zabel E, Castellano S. Lead poisoning in Minnesota Medicaid children. *Minn Med* 2006:89.
- Wilken M, Currier S, Abel-Zieg C, Brady LA. A survey of compliance: Medicaid's mandated blood lead screenings for children age 12–18 months in Nebraska. *BMC Public Health* 2004;4:4.



36. Vivier PM, Hogan JW, Simon P, et al. A statewide assessment of lead screening histories of preschool children enrolled in a Medicaid managed care program. *Pediatrics* 2001;108:E29.
37. CDC. Recommendations for blood lead screening of young children enrolled in Medicaid: targeting a group at high risk—United States. *MMWR* 2000;49(No. RR-14).
38. Howell E, Russette L. An innovative blood lead screening program for Indian children. *Public Health Rep* 2004;119.
39. Kemper AR, Cohn LM, Fant KE, Dombkowski KJ. Blood lead testing among Medicaid-enrolled children in Michigan. *Arch Pediatr Adolesc Med* 2005;159:646–50.
40. Dahlberg RL. Preventing childhood lead poisoning in New Jersey: advocates and state government working together to increase the lead screening of children. *American Civil Liberties Union*; 2005. Available at [http://www.aclu.org/FilesPDFs/nj\\_lead\\_report\\_web.pdf](http://www.aclu.org/FilesPDFs/nj_lead_report_web.pdf).
41. Alliance to End Childhood Lead Poisoning. Building blocks for primary prevention: protecting children from lead-based paint hazards. Washington, DC: Alliance to End Childhood Lead Poisoning; 2005. Available at <http://www.afhh.org/buildingblocks/bb%20intro%20level%20one.asp>.
42. Kazal LA Jr. The failure of CDC screening questionnaire to efficiently detect elevated lead levels in a rural population of children. *J Fam Practice* 1997;45:515–8.
43. Binns HJ, LeBailly SA, Fingar AR, Saunders S. Evaluation of risk assessment questions used to target blood lead screening in Illinois. *Pediatrics* 1999;103:100–6.
44. Snyder DC, Mohle-Boetani JC, Palla B, Fenstersheib M. Development of a population-specific risk assessment to predict elevated blood lead levels in Santa Clara County, California. *Pediatrics* 1995;96:643–8.
45. Kemper AR, Clark SJ. Physician barriers to lead testing of Medicaid-enrolled children. *Ambulat Pediatr* 2005;5:290–3.
46. Feinberg AN, Cummings CK. Blood lead screening. *Clin Pediatr* 2005;44:569–74.
47. Wisconsin Department of Health Services. Lead-safe Wisconsin. Lead poisoning in Wisconsin: where children live makes a difference. Maps. Available at <http://dhs.wisconsin.gov/lead/maps/index.htm>.
48. CDC. Using GIS to assess and direct childhood lead poisoning prevention: guidance for state and local childhood lead poisoning prevention programs. Atlanta, GA: US Department of Health and Human Services, CDC. Available at <http://www.cdc.gov/nceh/lead/04-0991%20using%20gis.pdf>.
49. Simpson L, Kamerow D, Fraser I. Pediatric guidelines and managed care: who is using what and what difference does it make? *Pediatr Ann* 1998;27:234–40.
50. Rothenberg R, Koplan JP, Cutler C, Hillman AL. Changing pediatric practice in a changing medical environment: factors that influence what physicians do. *Pediatr Ann* 1998;27:241–50.
51. Beyer P. An ounce of prevention: best practices for increasing childhood lead screening by New York's managed care plans. Albany, NY: State of New York, Office of the Attorney General, Health Care Bureau; 2005. Available at [http://www.oag.state.ny.us/bureaus/health\\_care/pdfs/lead\\_screening\\_report.pdf](http://www.oag.state.ny.us/bureaus/health_care/pdfs/lead_screening_report.pdf).
52. Rhode Island Department of Health. Rhode Island's plan to eliminate childhood lead poisoning by 2010. Providence, RI: Rhode Island Department of Health; 2004. Available at <http://www.health.state.ri.us/lead/pdf/eliminationplan.pdf>.
53. National Committee for Quality Assurance. HEDIS 2008: Healthcare Effectiveness Data and Information Set. Vol. 2, technical specifications. Washington, DC: National Committee for Quality Assurance; 2007.
54. Minnesota Department of Health, Environmental Health Division. Minnesota's lead poisoning prevention programs: biannual report to the legislature. St. Paul, MN: Minnesota Department of Health; 2003. Available at <http://www.health.state.mn.us/divs/eh/lead/reports/#leg>.
55. Alliance for Healthy Homes (formerly Alliance to End Childhood Lead Poisoning). Track, monitor, and respond: three keys to better lead screening for children in Medicaid. Washington, DC: Alliance For Healthy Homes; 2001. Available at [http://www.afhh.org/res/res\\_pubs/lead%20job%202.pdf](http://www.afhh.org/res/res_pubs/lead%20job%202.pdf).
56. Roberts JR, Riegart JR. Screening for lead poisoning in South Carolina. *J S C Med Assoc* 2001;97:459–64.
57. Vaidyanathan A, Staley F, Shire J, et al. Screening for lead poisoning: a geo-spatial approach to determine testing of children in at-risk neighborhoods. *J Pediatrics* 2009;154:409–14.
58. National Association of Medicaid Directors. Why local women's infants and children's (WIC) nutrition programs should be funded to conduct childhood lead screening. *Medicaid Manage Inst Bull* 2006;12:5.
59. Howell E, Russette L. An innovative blood lead screening program for Indian children. *Public Health Rep* 2004;119:141–3.
60. Polivka BJ, Gottesman MM. Parental perceptions of barriers to blood lead testing. *J Pediatr Health Care* 2005;19:276–84.
61. Alliance for Healthy Homes (formerly Alliance to End Childhood Lead Poisoning). The foundations of better lead screening for children in Medicaid: data systems and collaboration. Washington, DC: Alliance For Healthy Homes; 2001. Available at [http://www.afhh.org/res/res\\_pubs/foundations.htm](http://www.afhh.org/res/res_pubs/foundations.htm).
62. Schonfeld DJ, Rainey PM, Cullen MR, Showalter DR, Cicchetti DV. Screening for lead poisoning by fingerstick in suburban pediatric practices. *Arch Pediatr Adolesc Med* 1995;149:447–50.
63. Dignam TA, Evens A, Eduardo E, et al. High-intensity targeted screening for elevated blood lead levels among children in 2 inner-city Chicago communities. *Am J Public Health* 2004;94:1945–51.
64. CDC. Framework for program evaluation in public health. *MMWR* 1999;48(No. RR-11).





The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR*'s free subscription page at <http://www.cdc.gov/mmwr/mmwrsubscribe.html>. Electronic copy also is available from CDC's Internet server at <http://www.cdc.gov/mmwr> or from CDC's file transfer protocol server at <ftp://ftp.cdc.gov/pub/publications/mmwr>. Paper copy subscriptions are available through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; telephone 202-512-1800.

Data in the weekly *MMWR* are provisional, based on weekly reports to CDC by state health departments. The reporting week concludes at close of business on Friday; compiled data on a national basis are officially released to the public on the following Friday. Data are compiled in the National Center for Public Health Informatics, Division of Integrated Surveillance Systems and Services. Address all inquiries about the *MMWR* Series, including material to be considered for publication, to Editor, *MMWR* Series, Mailstop E-90, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30333 or to [mmwrq@cdc.gov](mailto:mmwrq@cdc.gov).

All material in the *MMWR* Series is in the public domain and may be used and reprinted without permission; citation as to source, however, is appreciated.

Use of trade names and commercial sources is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

References to non-CDC sites on the Internet are provided as a service to *MMWR* readers and do not constitute or imply endorsement of these organizations or their programs by CDC or the U.S. Department of Health and Human Services. CDC is not responsible for the content of these sites. URL addresses listed in *MMWR* were current as of the date of publication.