Recommendation Statement

Screening for Elevated Blood Lead Levels in Children and Pregnant Women

U.S. Preventive Services Task Force

The U.S. Preventive Services Task Force (USPSTF) is redesigning its recommendation statement in response to feedback from primary care clinicians. The USPSTF plans to release, early in 2007, a new, updated recommendation statement that is easier to read and incorporates advances in USPSTF methods. The recommendation statement below is an interim version that combines existing language and elements with a new format. Although the definitions of grades remain the same, other elements have been revised.

SUMMARY OF RECOMMENDATIONS

Children

1. The U.S. Preventive Services Task Force (USPSTF) concludes that evidence is insufficient to recommend for or against routine screening for elevated blood lead levels in asymptomatic children aged 1 to 5 who are at increased risk. (I recommendation). (See "Clinical Considerations" for a discussion of risk.)

2. The USPSTF recommends against routine screening for elevated blood lead levels in asymptomatic children aged 1 to 5 years who are at average risk (D Recommendation).

Pregnant Women

3. The USPSTF recommends against routine screening for elevated blood lead levels in asymptomatic pregnant women. (D recommendation).

RATIONALE

Importance

Blood lead levels in children have declined dramatically in the United States over the past two decades. However, segments of the population remain at increased risk for higher blood lead levels. Even relatively low blood lead levels are associated with neurotoxic effects in children. Severely elevated blood lead levels in symptomatic pregnant women are associated with poor health outcomes; however, lead levels in this range are rare in the U.S. population.

Detection
There is good evidence that venous sampling accurately detects elevated blood lead levels and fair evidence that validated questionnaires are modestly useful in identifying children at increased risk for elevated blood lead levels.

Benefits of Detection and Early Intervention
The USPSTF found good quality evidence that interventions do not result in sustained decreases in blood lead levels and found insufficient evidence (no studies) evaluating residential lead hazard control efforts (ie, dust or paint removal, soil abatement, counseling, or education) or nutritional interventions for improving neurodevelopmental outcomes in children with mild to moderately elevated blood lead levels. The USPSTF found no evidence examining the effectiveness of screening or interventions in improving health outcomes in asymptomatic pregnant women. Given the low prevalence of elevated blood lead levels in children at average risk and asymptomatic pregnant women, the magnitude of potential benefit cannot be greater than small.

A theoretical benefit of screening is that identification may prevent lead poisoning of other individuals in a shared environment, but the magnitude of this theoretical benefit is uncertain.

Harms of Detection and Early Treatment
There is good quality evidence that chelation treatment in asymptomatic children does not improve neurodevelopmental outcomes and is associated with a slight diminution in cognitive performance. Chelation therapy may result in transient renal, hepatic, and other toxicity, mild gastrointestinal symptoms, sensitivity reactions, and rare life-threatening reactions. Residential lead-based paint and dust hazard control treatments may lead to acutely increased blood lead levels from improper removal techniques. Potential harms of screening are false-positive results, anxiety, inconvenience, work or school absenteeism, and financial costs associated with repeated testing. Although the exact magnitude of these known and potential harms is uncertain, the overall magnitude is at least small.

No studies have directly addressed the harms of screening and interventions for pregnant women. Although there is little specific evidence concerning the potential harms of interventions for pregnant women with elevated blood lead levels, the magnitude of harms from such interventions is also at least small.

USPSTF Assessment
The USPSTF concludes that the evidence is insufficient to assess the balance between potential benefits and harms of routine screening for elevated blood lead levels in children at increased risk. Given the significant potential harms of treatment and residential lead hazard abatement, and no evidence of treatment benefit, the USPSTF concluded that the harms of screening for elevated blood lead levels in children at average risk and in asymptomatic pregnant women outweigh the benefits.

CLINICAL CONSIDERATIONS

- This USPSTF recommendation addresses screening for elevated blood lead levels in children aged 1 to 5 years who are both at average and increased risk, and in asymptomatic pregnant women.
- The highest mean blood lead levels the U.S. occur in children aged 1-5 years (geometric mean 1.9 μg/dL). Children under 5 years of age are at greater risk for elevated blood lead levels and lead toxicity because of increased hand-to-mouth activity, increased lead absorption from the gastrointestinal tract, and the greater vulnerability of the developing central nervous system. Risk factors for increased blood lead levels in children and adults include: minority race/ethnicity; urban residence; low income; low educational attainment; older (pre-1950) housing; recent or ongoing home renovation or remodeling; pica exposure; use of ethnic remedies, certain cosmetics, and exposure to lead-glazed pottery; occupational and para-occupational exposures; and recent immigration. Additional risk factors for pregnant women include alcohol use, smoking, pica, and recent immigration status.
- Blood lead levels in childhood, after peaking at about 2 years of age, decrease during short- and long-term follow-up without intervention. Most lead is stored in bone. High bone lead levels can be present with normal blood lead levels, so that blood lead levels often do not reflect the total amount of lead in the body . This could explain the lack of effect of blood lead level-lowering measures on reducing neurotoxic effects.
- Screening tests for elevated blood lead levels include free erythrocyte (or zinc) protoporphyrin levels and capillary or venous blood lead levels. Erythrocyte (or zinc) protoporphyrin is insensitive to modest elevations in blood lead levels and lacks specificity. Blood lead concentration is more sensitive than erythrocyte protoporphyrin for detecting modest lead exposure, but its accuracy, precision, and reliability can be affected by environmental lead contamination. Therefore, venous blood lead level testing is preferred to capillary sampling. Screening questionnaires may be of value in identifying children at risk for elevated blood lead levels but should be tailored for and validated in specific communities for clinical use.
- Treatment options in use for elevated blood lead levels include residential lead hazard-control efforts (ie, counseling and education, dust or paint removal, and soil abatement), chelation, and nutritional interventions. In most settings, education and counseling is offered for children with blood lead levels from 10 to 20 μg /dL . Some experts have also recommended nutritional counseling for children with blood lead levels in this range. Residential lead hazard control is usually offered to children with blood lead levels $\geq$20 μg/dL, while chelation therapy is offered to children with blood lead levels $\geq$45 μg/dL.
- Community-based interventions for the primary prevention of lead exposure are likely to be more effective, and may be more cost-effective, than office-based screening, treatment, and counseling. Relocating children who do not yet have elevated blood lead levels but who live in settings with high lead exposure may be especially helpful. Community, regional, and national environmental lead hazard reduction efforts, such as reducing lead in industrial emissions, gasoline, and cans, have proven highly effective in reducing population blood lead levels.

DISCUSSION

Burden of Illness

The prevalence of blood lead levels ≥10 μg/dL among children 1 to 5 years of age in the United States has declined from 9% between 1988 and 1991 to 1.6% between 1999 and 2002. The decline is due primarily to significant reductions of lead in gasoline, air, dietary sources, and residential paint. However, the prevalence varies substantially among different communities and populations: mean blood lead levels of African-American children (2.8 μg/dL) remain significantly higher than those of Mexican-American (1.9 μg/dL) and non-Hispanic white children (1.8 μg/dL). Approximately 24 million housing units still contain substantial lead hazards, with 1.2 million of these units occupied by low-income families with young children. An estimated 310,000 children remain at risk for exposure to harmful levels of lead. Population mean blood lead levels in women of childbearing age and pregnant women have fallen over the past two decades. In 1992, two large surveys of low-income pregnant women found that between 0% and 6% of these women had blood lead levels >15 μg/dL. In a recent sample of respondents to the of National Health and Nutrition Examination Survey (NHANES) including 4394 women of child-bearing age, the geometric mean blood lead level was 1.78 μg /dL.[1,2]

Elevated amounts of lead in the body affect various organ systems, including the cardiovascular, renal, and hepatic, with most symptoms occurring with blood lead levels ≥ 50 μg /dL. Very high levels of inorganic lead exposure may result in death or long-term neurologic sequelae in children. However, neurodevelopmental dysfunction is associated with blood lead levels as low as 10 μg/dL in young children. The adverse effects of very high maternal blood lead levels during pregnancy include abortion, stillbirth, preterm delivery, decreased neonatal head circumference, and decreased birth weight. Studies also suggest that mildly elevated maternal blood lead levels may be associated with increased risk for spontaneous abortion, hypertension in pregnancy, and adverse effects on fetal growth. [3] Although very high blood lead levels during pregnancy are harmful, the adverse effects of antepartum lead levels on the fetus in the range typically found in the U.S. have not been established.

Scope

The USPSTF examined new evidence published since it addressed the following overarching question in its 1996 recommendation: does screening children and pregnant women for elevated blood lead levels result in improved neurodevelopmental outcomes? With this update, the USPSTF also reviewed the evidence on the accuracy of screening tests, and the harms of screening and treatment.

Accuracy of Tests

Blood tests or questionnaires may be used to screen for elevated blood lead levels. Blood lead concentration is more sensitive and specific than free erythrocyte protoporphyrin levels, but can be affected by environmental lead contamination and laboratory analytic variation. Erythrocyte (or zinc) protoporphyrin is insensitive to modest elevations in blood lead level and lacks specificity. Capillary blood lead sampling has false-positive rates of 3% to 9% and false-negative rates of 1% to 8%. The sensitivity and specificity of

questionnaires vary considerably with the prevalence of elevated blood lead levels in the population surveyed and the cutoff blood lead level that is used. In urban and suburban populations, Centers for Disease Control and Prevention (CDC) screening questionnaires detected 64% to 87% of children with blood lead levels of ≥10 μg/dL; higher sensitivities (81%–100%) were reported for blood lead levels ≥15 to 20 μg/dL. Specificity of these questionnaires ranged from 32% to 75%. False negative results were low (0.2%–3.5%) in lower prevalence populations (2%–7%) for levels of ≥10 μg/dL, but increased to 19% when the population prevalence of elevated lead levels was higher (17–28%). [4-6]

Intervention – Treatment

Treatment options for elevated blood lead levels include residential lead hazard-control efforts (ie, dust or paint removal, soil abatement, counseling, and education), chelation, and nutritional interventions. Most studies of asymptomatic children evaluate the effects of these interventions on blood lead levels instead of on clinically relevant neurocognitive outcomes. The USPSTF found no studies evaluating neurocognitive outcomes after residential lead hazard control efforts or nutritional interventions. These interventions were found to have small, inconsistent, or unsustained effects on blood lead levels in asymptomatic children with mildly to moderately increased lead levels (<45 μg/dL).

There is good evidence that chelating agents benefit children with symptomatic lead poisoning, but there is little evidence available to demonstrate a clinical benefit from chelation therapy for children with lead levels <45 μg/dL. A large, multicenter randomized controlled trial assessed the effect of oral chelation therapy with succimer on IQ in children with venous blood lead concentrations of 20 to 45 μg/dL.[7] At 36 months' follow-up, no statistically significant differences were found between treatment and control groups in mean IQ, parental rating of behavior, or tests of learning ability. In this trial, blood lead levels decreased in both the treatment and placebo groups, and by 24 months the difference between treatment and placebo groups was not statistically significant. [8,9]

The USPSTF found no studies that examined the effectiveness of interventions in pregnant women.

Harms of Screening and Treatment

No new evidence was found regarding the harms of screening in children or pregnant women. The most common harms of screening for elevated lead levels are false-positive capillary results, anxiety, inconvenience, work or school absenteeism, and financial costs associated with return visits and repeated tests. In one randomized controlled trial, succimer was associated with a slight decrease in cognitive performance.[8,9] No studies have directly addressed the harms of interventions for pregnant women.

Research Needs

Community-based interventions for the primary prevention of lead exposure are likely to be more effective, and may be more cost-effective, than office-based screening, treatment, and counseling. Evaluation of the effectiveness of community-based

interventions and recommendations regarding their use are important areas of future research.

Recommendations of Others

The CDC recommends universal screening in communities where ≥12% of children aged 1 to 3 years have elevated blood levels; or, in communities that do not have prevalence data, if ≥27% of the housing was built before 1950. The CDC recommends targeed screening for all other children based on an individual risk assessment, including whether children receive Medicaid, Supplemental Food Program for Women, Infants and Children (WIC), or other forms of governmental assistance.[10] This approach is also supported by the American College of Preventive Medicine. [11]

The American Academy of Pediatrics (AAP) recommends that pediatricians learn whether city or State health departments provide guidance for screening children who are not eligible for Medicaid. If no such guidance is available, the AAP recommends that pediatricians consider screening all children. Children should, ideally, be tested at 1 and 2 years of age.[12]

The American Academy of Family Physicians recommends screening 12-month-old infants for lead poisoning if they live in communities in which the prevalence of lead levels requiring intervention is high or undefined; if they live in or frequently visit a home built before 1950 that has dilapidated paint or recent or ongoing renovations or remodeling; if they have close contact with a person who has an elevated blood lead level or who lives near lead industry or heavy traffic; or if they live with someone whose job or hobby involves lead exposure, uses lead-based pottery, or takes traditional remedies that contain lead. [13]

Medicaid's Early and Periodic Screening, Diagnostic, and Treatment Program requires that all children receive a screening blood lead test at 12 months and 24 months of age; children between the ages of 36 months and 72 months of age must receive a screening blood lead test if they have not been previously screened for lead poisoning.[14, 15]

No national organizations currently recommend screening pregnant women for elevated lead levels.

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APPENDIX A

U.S. PREVENTIVE SERVICES TASK FORCE RECOMMENDATIONS AND RATINGS

The Task Force grades its recommendations according to one of 5 classifications (A, B, C, D, I) reflecting the strength of evidence and magnitude of net benefit (benefits minus harms):

A. The USPSTF strongly recommends that clinicians provide [the service] to eligible patients. The USPSTF found good evidence that [the service] improves important health outcomes and concludes that benefits substantially outweigh harms.

B. The USPSTF recommends that clinicians provide [the service] to eligible patients. The USPSTF found at least fair evidence that [the service] improves important health outcomes and concludes that benefits outweigh harms.

C. The USPSTF makes no recommendation for or against routine provision of [the service]. The USPSTF found at least fair evidence that [the service] can improve health outcomes but concludes that the balance of benefits and harms is too close to justify a general recommendation.

D. The USPSTF recommends against routinely providing [the service] to asymptomatic patients. The USPSTF found at least fair evidence that [the service] is ineffective or that harms outweigh benefits.

I. The USPSTF concludes that the evidence is insufficient to recommend for or against routinely providing [the service]. Evidence that [the service] is effective is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.

APPENDIX B

U.S. PREVENTIVE SERVICES TASK FORCE
STRENGTH OF OVERALL EVIDENCE

The USPSTF grades the quality of the overall evidence for a service on a 3-point scale (good, fair, poor):

Good: Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes.

Fair: Evidence is sufficient to determine effects on health outcomes, but the strength of the evidence is limited by the number, quality, or consistency of the individual studies, generalizability to routine practice, or indirect nature of the evidence on health outcomes.

Poor: Evidence is insufficient to assess the effects on health outcomes because of limited number or power of studies, important flaws in their design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes.

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