

CHILDHOOD LEAD POISONING

Thomas Schlenker, MD

If lead poisoning is such a big problem, why don't I ever see it?

The prevalence of lead poisoning among children 0 to 6 years old in Milwaukee's highest risk neighborhoods is only 5%. Were all children in this age group tested city-wide, the prevalence would likely be only 1% to 2%. However, even at these relatively low rates, over one thousand children are poisoned annually.

Other communities in Wisconsin may be in the 1% or less range. Thus, a physician would expect to screen 100 or more children in order to find one case of lead poisoning. Moreover, 4 out of 5 cases identified, would be completely asymptomatic. In other words, to see lead poisoning, one must look quite diligently.

Is screening worth the time and effort (and cost)?

The screening "yield" is relative to the blood lead level of concern. The U.S. Centers for Disease Control is about to lower this level of concern from 25 mgm/dl to 15 mgm/dl or lower. This will increase the yield by at least a factor of 10. Instead of 1 out of 100, the case finding rate in many populations would be 1 out of 10 or greater.

What is the evidence that low level lead exposure actually does any harm?

Several studies have shown decreased intelligence and slower neurobehavioral development associated with blood levels as low as 15 mgm/dl. A decrease in IQ can be measured at levels as low as 25 mgm/dl. In a recent long-term follow-up study (Needleman, 1990) for children who had been exposed to moderate lead levels in preschool years, the odds of those children dropping out of high school were seven times higher, and the odds of a significant reading disability were six times higher than for children exposed to lower levels.

When was the last time a child actually died of lead poisoning?

September 13, 1990. A two year old boy, living in a very dilapidated household in Waukesha, Wisconsin, consumed large amounts of paint chips, presented to the hospital with a four day history of lethargy and reduced appetite and died 26 hours post admission. His blood level was 144 mgm/dl. This is a very rare occurrence, the first lead poisoning death in the United States in over ten years. Yet, this child represents the tip of an iceberg that has an estimated base of 3 to 4 million lead poisoned children in the U.S. who, for the most part, remain asymptomatic and undiagnosed.

My patient population does not include poor, inner-city children who live in dilapidated housing, why should I be screening?

Lead is ubiquitous. It may be present even in relatively well kept homes (especially those that were built before 1950). Remodeling can be an especially hazardous process that generates lead laden dust and dirt within and beside the house. In addition to lead in paint, there are industrial and hobby uses of lead that find their way into the home. Inappropriate food and water containers may be in use. Infant formula made directly from hot water from the faucet or first morning draw, boiled down can cause toxic levels if there is lead in the piping system. Some folk medicines from Latin America and Asia contain lead.

A brief history and blood test is the only way to detect significant lead exposure. Every child deserves such a screen at least once.

Is screening a practical office procedure?

When venipuncture is not easily obtained, a fingerstick micro sample of 0.5 ml (10 drops) of capillary blood is perfectly adequate to measure blood lead. The Milwaukee Health Department Lab, the State Laboratory of Hygiene and some commercial labs are able to process "micro" samples. The FEP test is no

longer appropriate.

Short of chelation, what can I do for children with lower level lead exposure?

Education that leads to even modest changes in family behavior and environmental repair and maintenance can, in most cases, solve the problem. The child's primary care physician can provide this in a very efficient and timely way when screening for lead is a routine part of office practice.

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Public health

A rationale for universal screening for childhood lead poisoning

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SCREENING ALL AGE-appropriate children in the United States for lead poisoning has recently been established by the Centers for Disease Control (CDC) as a national goal and a standard of care for practitioners.¹ This population-based universal screening policy raises both theoretical and practical considerations that merit informed discussion among physicians who care for children.

Screening in the practice of medicine means the application of standard diagnostic tests to entire populations of well individuals to detect, by definition, hidden disease. This contrasts with the use of diagnostic tests on individuals who, in some way, indicate that they might be ill. Population-based screening for childhood

lead poisoning implies testing all children 6 months old through 6 years old for blood lead at least once, preferably twice and in some cases repeatedly.

Screening is an accepted routine practice in the United States for many different diseases. Papanicolaou smears for cervical cancer and stool heme tests for colonic cancer are the standard of care for age-appropriate adults. The American Academy of Pediatrics advocates a routine screen for anemia for all children 1 and 5 years of age. The CDC recommends hepatitis B serological tests for all pregnant women. All newborns in the United States are currently screened with blood tests to rule out several serious congenital diseases.

In contrast, other proposed routine, population-based screening tests are rejected by most authorities. Routine chest roentgenograms to screen for cancer of the lung, routine urinalysis for bacteriuria in women, blood tests for the cystic fibrosis gene and HIV testing when proposed for people without apparent sign of illness or risk factors are generally considered inappropriate. On what basis should the decision to screen or not to screen be made? The following are offered as appropriate criteria for population-based screening.

Criterion 1

Is the disease in question a serious one?

Lead poisoning in children is known to cause serious and permanent damage to the central nervous system. Even at low levels of exposure, learning and behavioral disabilities and reduced intelligence can result.²⁻⁴ Needleman's long term follow-up study showed that lead exposure in early childhood multiplies an individual's risk of failure in school.⁵ Moreover, high level lead poisoning (>70 ug/dL) still occurs and can result in severe acute illness, lasting profound neurological deficit and even death.^{6,7}

Criterion 2

Is the disease in question sufficiently common? It is estimated by the CDC that 17% of all US children (3 to 4 million) have blood lead levels ≥ 15 ug/dL.⁸ In Milwaukee, a random survey of an average private pediatric practice revealed 22% of 6-month to 6-year-old patients had lead levels ≥ 15 ug/dL and 3% were ≥ 25 ug/dL.⁹ This prevalence of lead poisoning (≥ 25 ug/dL) is approximately 400 times that of cystic fibrosis, the most common serious genetic disease in the United States, and 1,200 times the prevalence of hypothyroidism, the most common of the serious congenital diseases currently being

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screened for in newborns. In many populations of infants and toddlers, lead levels above 15 ug/dL will be more common than anemia.

Criterion 3.

Is an adequate screening method available?

A. Safety: Blood samples for lead measurement, whether finger-stick or venipuncture specimens, can be obtained essentially without risk.

B. Practicality: Venipuncture on young children can sometimes be quite difficult. Finger-stick or heel-stick procedures, on the other hand, are easy and a routine part of almost every pediatric practice.

C. Cost: The Milwaukee Health Department Laboratory and the Wisconsin State Laboratory of Hygiene currently charge \$13 for a blood lead measurement.

D. Validity: Although lead levels performed on venous blood specimens of 4 to 5 mL are the gold standard, microspecimens obtained by properly performed finger-stick procedures have shown excellent correlation with simultaneously drawn venous blood leads. Finger-stick leads are very sensitive, ie few elevated venous blood lead levels will be missed by using the finger-stick method in its place. This is in contrast with the old erythrocyte protoporphyrin (EP) test which missed from 25% to 75% of all truly elevated blood leads.¹⁰

Also, unlike EP, finger-sticks are relatively specific. False positives are a function of skin contamination secondary to improper technique and can be held to a minimum by diligent technicians. A Milwaukee Health Department pilot finger-stick study using hand washing with soap and water followed by a dilute nitric acid rinse performed by well trained staff yielded no false positives when compared with simultaneously drawn venous leads.

Criterion 4

Once disease is uncovered, can remedial action be taken that will have a significant positive effect on the outcome? Most elevated lead levels uncovered by screening will be on the low end of the spectrum (between 15 and 25 ug/

dL). At these levels, education by the physician on the danger of lead poisoning, sources of lead in the home environment and interventions to eliminate exposure can prevent further damage to children's health. No good studies quantifying the effectiveness of education received in physicians' offices are yet available. Nevertheless, knowing the consequences of lead levels ≥ 25 ug/dL in early childhood, we are obliged to try. Establishing each age-appropriate child's blood lead level is key. General anticipatory guidance on lead poisoning offered by physicians to families without benefit of blood levels would necessitate a diluted message and would not allow physicians to target their time and effort where it is most needed. In addition, the receptiveness of parents to education must be assumed to be heightened when their child has been identified as lead poisoned.

For children with lead levels above 20-25 ug/dL, many cities and states offer nurse case-management and services to inspect households for lead hazards and enforce abatement. This is a important complement to physician education and it is hoped that stringent abatement standards and aggressive enforcement and follow up will ensure that lead exposures are reduced and most poisoned children quickly be restored to tolerable body lead burdens. The effectiveness of such a three part program is yet to be quantified but again, we are obliged to intervene on behalf of this population of children in urgent need. Similarly, we are obliged to evaluate the effectiveness of all programs to ensure the outcome we desire.

For children with lead levels above 45-50 ug/dL, prompt chelation therapy is standard practice.

Criterion 5

Is the cost of screening and intervention reasonable in relation to the benefit of preventing the disease? According to the CDC, average avoidable costs (medical, special education and life time lost earnings) for each case of lead poisoning above 24 ug/dL are \$16,101.¹¹ In 1991 in Milwaukee, we have screened about 8,000 children with a case finding rate (preva-

Series coordinators

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lence) of about 5% (400 children > 24 ug/dL).

Each blood test for lead costs \$13. We estimate we may spend \$1,000 managing each "case." The total costs of screening plus the public health intervention program would thus be \$504,000 ($\$13 \times 8,000 + \$1,000 \times 400$) as compared to the total costs avoided through prevention \$6,440,400 ($\$16,101 \times 400$). Assuming that the interventions undertaken are successful, the cost-benefit ratio of \$504,000 spent over \$6,440,400 saved, means \$12.78 is earned for every \$1 spent. Even if the costs of repair of household lead hazards, which are borne by the property owner, were factored in the resultant cost-benefit ratio would still weigh heavily toward intervention.

The prevalence of lead poisoning in a population will impact on the cost-benefit ratio of screening. Milwaukee's prevalence of 5% yields a ratio of 1:13. A prevalence of 1% would yield a ratio of 1:7. A prevalence of 0.5% yields a ratio of 1:4.5. The cost-benefit ratio ceases to be greater than one only when the prevalence dips below 0.1%. Therefore, screening pays off (in a purely economic sense) in any community with a lead poisoning prevalence of 0.1% (1 per 1,000) or more.

Although the money saved by preventing a case of lead poisoning and the money spent on public health intervention are estimates, the approximate cost-benefit ratio they yield provides a useful framework to judge the purely fiscal appropriateness of universal screening. In general, only if lead poisoning were an extremely rare disease, which it is not, would it be cost-efficient not to screen for

