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Nearly a half million children in the US are believed to have an elevated blood lead level. Pediatric health-care providers can intervene in a variety of ways to prevent and reduce the risk of lead exposure and lower the body's lead burden. Includes a Guide for Parents.

Lead poisoning is one of the most important preventable pediatric health problems in the United States.[1] Despite the remarkable reduction in average blood lead levels in children that followed elimination of lead as a gasoline additive in the late 1970s,[2] lead poisoning persists, largely because of aging housing, especially in inner cities, older suburbs, and rural areas. Additional cases are sometimes the result of cultural customs, such as the use of certain folk remedies.[3,4] Although lead poisoning affects children of all socioeconomic levels, those at the low end of the spectrum are affected disproportionately.[5–7]

For children who live in deprived or chaotic circumstances, an elevated lead level, with its harmful effects on intelligence and behavior,[8–10] can only compound the many social, economic, educational, and environmental threats they already face. Although chelation therapy of lead poisoning has become a fairly standard medical practice,[11] primary prevention—that is, not placing lead into the child's environment—is the only certain way to avoid the toxic effects of lead.[12–14] Secondary prevention (removing or isolating lead already present in the environment) requires a high degree of persistence and attention to detail and a cooperative effort among the health-care provider, family, and local health department.[15]

Children at risk, notably those in areas known for old housing and a high incidence of lead poisoning, continue to have routine blood screening performed at an unacceptably low rate.[16,17] Both at-risk children and children not considered at risk need to be screened using a personal risk questionnaire (Table 1). If the answer to *any* of the questions is "yes," a screening lead level should be obtained.

TABLE 1
Assessing the risk of lead poisoning: Three key questions for parents

Does your child live in, or regularly visit, a house that was built before 1950? (This question could apply to a facility such as a home day-care center or the home of a babysitter or relative.)
Does your child live in or regularly visit a house built before 1978 with recent or ongoing renovations or remodeling (within the last six months)?

Does your child have a sibling or playmate who has, or had, lead poisoning?

Source: Centers for Disease Control and Prevention

Since its inception in 1991, the Pediatric Lead Clinic at MetroHealth Medical Center, an inner-city teaching hospital in Cleveland where we practice, has treated hundreds of children for lead poisoning. Our patients live in a high-risk environment, defined by the Centers for Disease Control and Prevention (CDC) as an area in which 27% or more of the housing was built before 1950.[1] In Cleveland, 85% of the houses were built before 1950. A second criterion for high risk is a population in which 12% or more of the children have a blood lead level ≥10 µg/dL. In Cleveland in 2002, that figure was 20%. With the health care of approximately 75% of our pediatric clinic population covered by the state's Medicaid program, economic limitations are also routine.

In the course of our work, we have learned some hard lessons about the outpatient management of lead poisoning. Interventions are often complex and time-consuming and draw on unfamiliar skills. But we have also developed a keen appreciation of the numerous opportunities for health-care providers to make a difference in the lives of affected children. Here, we discuss issues that confronted actual families and medical personnel dealing with lead poisoning, along with the benefits and limitations of different interventions.

Case 1: The unconfirmed test

It's the Friday before a holiday weekend when a pediatrician phones the hospital to admit a child with a screening blood lead level of 45 µg/dL (normal, <10 µg/dL). Admission is deferred until a confirmatory blood test can be obtained. That test is done four days later, with a result of 6 µg/dL. It turns out that the reference laboratory had incorrectly recorded the initial result.

Laboratory errors can and do occur. Blood lead testing is a demanding technical process, although in this case the error was a simple clerical mistake. Always confirm elevated capillary blood tests by taking a more accurate venous sample. The CDC recommends confirming an elevated blood lead level before initiating therapy unless the screening level is ≥70 µg/dL or the child exhibits acute encephalopathic symptoms.[11] In keeping with these recommendations, our clinic obtains a confirmatory (venous) lead level before admission and therapy in all but the most extreme cases. Had the child in this case been admitted without confirmatory testing, he would have received four days of unnecessary hospital care and calcium disodium versenate (EDTA) chelation.

Case 2: The peripatetic child

A 3-year-old has a blood lead level of 35 µg/dL. A zinc protoporphyrin (ZnP) test, which is done routinely locally (in Cleveland) if the lead level is >20 µg/dL, shows a level of 60 µg/dL (normal, <35 µg/dL). Just a few months ago, the child's lead level was 24 µg/dL. The apartment to which he and his mother recently moved has peeling lead paint on the banisters and windows, and paint is peeling on the exterior surfaces of the building. The patient has also been spending significant time in four other residences while his mother works.

The mother soon moves again, this time to an apartment with no identifiable sources of available lead. A follow-up lead level three months later is 21 µg/dL.

The office visit for a lead-poisoned child and his family should cover several specific topics (Table 2) and should help identify where the child is being exposed to lead (Table 3). The questionnaire [http://#1] below can be used by the provider to verbally query families about potential sources of lead. The local health department should be contacted to perform a home lead inspection. This process can often identify exact sources of lead exposure. Most large city health departments have this capability; alternatively, it may be necessary to request this help from the county or state health department. Certainly, establishing a positive working relationship with the health department, and understanding the range of services they

can provide, is important.

TABLE 2
Educating families about the hazards of lead
Promptly provide families of children who have an elevated blood lead level with individualized education about the following:

- Their child's blood lead level and what it means
- Potential adverse health effects of the elevated blood lead level
- Sources of lead exposure and suggestions for how to reduce exposure
- The importance of wet cleaning to remove lead dust on floors, windowsills, and other surfaces; the ineffectiveness of dry methods of cleaning, such as sweeping
- The importance of good nutrition in reducing the absorption and effects of lead. If poor nutritional patterns exist, discuss adequate intake of calcium and iron and encourage regular meals.
- The need for follow-up lead testing to monitor the child's lead level as appropriate
- The results of environmental inspection, if applicable
- The hazards of improper removal of lead-based paint. Particularly hazardous are open-flame burning, power sanding, water blasting, methylene chloride-based stripping, and dry sanding and scraping

Source: Centers for Disease Control and Prevention

TABLE 3
How children are exposed to lead

Common sources
Lead-based paint and paint dust
Ingestion of paint chips
Sanding or burning of painted wood
Home remodeling
Contaminated soil from chipping exterior house paint
Contaminated soil from old automobile emissions
Lead water pipes
Uncommon sources
Firing ranges
Gunshot wounds
Occupation or hobby of a family member

Battery and aircraft manufacturing
Lead smelting
Brass foundry
Radiator repair
Construction and bridge repair and painting
Stained-glass making
Boat restoration
Art restoration
Mini-blinds
Playground chalk and crayons (made in foreign countries)
Jewelry
Imported spices and foods; lead soldered cans
Dishware that contains lead: pottery, ceramics, lead crystal
Some antique pewterware
Some dyes used in newspapers, food wrappers
Folk remedies and cosmetics containing lead such as greta, azarcon, kohl, pay-loo-ah, ghasard, balagoli, kandu
Candles with lead wicks

Parents who are relocating with young children should be advised what to look for in an older apartment to help them avoid renting one with an obvious lead hazard, such as deteriorating paint. When a family needs to relocate because their home has extensive lead contamination, the health department should perform an inspection of the new home before the move. This can keep a child from moving from one contaminated environment to a new one with an even greater lead hazard.

Lead inspection or abatement of one location may, of course, leave other problematic sites unattended to and unsafe. Children may, for example, spend significant time in the home of a relative or babysitter. Homes of licensed day-care providers are not necessarily inspected or even required to be lead free.

It can be frustrating to offer treatment, only to have the family persist in living in a lead-contaminated home. To help prevent this problem, educate families about ways to safely reduce the available lead in their environment. Providing Department of Housing and Urban Development (HUD) and Environmental Protection Agency (EPA) handouts on safe renovations, and directing families with Internet access to Web sites such as www.HUD.gov and www.EPA.gov , are practical interventions (see the resource listing [http://#res] below). In a case of severe lead poisioning, refer the family to government-funded programs (such as those offered by HUD) that can carry out lead abatement. Local health departments can help identify access to such programs. See the Guide for Parents on preventing lead poisoning [http://#lead].

Because lead in contaminated homes is seldom abated by experts, one must rely on families to act on general guidance about how to clean up deteriorating paint and reduce lead-rich dust. Numerous studies have identified not only visible chips of high-lead paint as being hazardous but also fine, lead-rich dust on a child's fingers as being a toxic ingestant. Moreover, although lead contamination may be widespread inside the home or outside (for example, in dirt contaminated by exterior paint chips, emissions of leaded gasoline, or industrial wastes), the concentration of lead is generally several orders of magnitude greater on windowsills and window wells—areas easily accessible to young children. Weekly cleaning of windowsills and wells with either a phosphate or phosphate-free cleanser (such as Cascade, Electrasol, TSP, or Spic and Span) has been recommended.[18,19] The literature gives mixed reviews to the efficacy of home cleaning efforts, however.[20,21] Whether these results reflect the child's more global exposure to uncontrolled sources of lead in other locations, or the migration of lead stored in bone and other body tissues, is unknown. What is known is that inexpert remodeling of older homes can dramatically increase the amount of available lead.[22–25] Counsel families planning to remodel older, lead-contaminated homes to proceed with caution, and direct them to appropriate technical recommendations provided by the EPA and HUD.[19,26,27]

Case 3: The challenged parent

William made no well-child care visits between 6 months and 24 months of age. He was delinquent in immunizations. Although he lived in older housing, a lead test was never done. His first lead level, reported at 24 months, was 82 µg/dL, and the confirmatory level was 92 µg/dL. Zinc protoporphyrin was elevated (571 µg/dL). A radiograph revealed abdominal radio-opacities consistent with ingested flecks of lead. He was admitted for inpatient intestinal cleansing and chelation therapy.

On direct questioning, the mother stated that the boy had been eating loose plaster. He had not been ill, but his gait had recently become unsteady. He had not walked until 18 months, and at 24 months had no expressive language and could not follow simple spoken commands. The Bayley Scales of Infant Development and the Vineland Adaptive Behavior Scales showed significant delays. His diet consisted mainly of bottles of formula, and he was found to have iron deficiency anemia.

William received three courses of inpatient chelation with intramuscular BAL, intravenous EDTA, and oral dimercaptosuccinic acid (DMSA), plus an additional course of outpatient chelation with DMSA. He was prescribed an iron supplement and the anemia resolved. But therapeutic efforts have been complicated by his re-exposure to lead both at his home and his babysitter's home. The mother has difficulty meeting the challenges of daily life and is easily overwhelmed when presented with lists of suggested interventions. The medical staff has focused on the most important recommendations and reviewed them repeatedly in a supportive manner. They also arranged for lead abatement of the home environment through the local health department and for early developmental intervention.

Now 7 years old, William continues to suffer language delay, and he has been diagnosed with attention deficit hyperactivity disorder.

William's lead level of 82 µg/dL required immediate action: hospitalization, chelation, and a confirmatory lead level (Table 4). Chelation therapy (Table 5) is recommended for children with a lead level ≥45 µg/dL.[1] Although lead poisoning can occur in the absence of other problems, in our experience it often presents as one problem among a multitude. Case 3 raises many of the issues that typically confront pediatric health-care providers who manage children with lead poisoning:

TABLE 4
Medical management of children with an elevated lead level
When treating a patient for a confirmed (venous) elevated lead level, address the possibility of continued lead exposure. A home inspection is necessary if the child is receiving chelation, and is recommended in all other cases. If the home does not pass inspection, an alternative, lead-safe home must be identified.

Blood lead level (µg/dL)	Retest interval	Type of lead education and assessment needed	Lab tests, radiographic studies	Multiple vitamins recommended?	Chelation

10□14	3□4 months	Environment Nutrition	Not indicated	Yes	Not indicated
15□19	3 months	Environment Nutrition	Not indicated	Yes	Not indicated
20□44	1 month	Environment Nutrition Developmental evaluation	Hemoglobin and hematocrit; consider iron studies	Yes	Not indicated
45□69	Within 48 hours if first venous test	Environment Nutrition Developmental evaluation	KUB Hemoglobin and hematocrit; consider iron studies Review labs for chelation	Yes	Indicated (see Table 5)
≥70	Immediately if first venous test	Environment Nutrition Developmental evaluation	KUB Hemoglobin and hematocrit; consider iron studies Review labs for chelation	Yes	Indicated (see Table 5)

□ Chelation therapy requires careful attention to the possibility of continued exposure to environmental lead. Before a child can be prescribed outpatient oral chelation with DMSA, or given chelation as an inpatient and then discharged home, it is crucial to ensure a lead-safe environment. Inpatient chelation has minimal benefit if it is followed by resumption of lead exposure, and oral chelation during continued lead ingestion might actually facilitate lead absorption.[28]

□ Although bowel decontamination before chelation therapy is not evidence based, the American Academy of Pediatrics Committee on Drugs recommends it be considered as an adjunct to treatment.[29] Bowel cleansing is our routine if radio-opacities are present on abdominal radiograph.

□ Decisions about inpatient versus ambulatory chelation are based on the child's lead level; whether the home environment is lead-safe or not; the likelihood of compliance; as well as the need to monitor for adverse drug effects. At or above 70 µg/dL, inpatient treatment is required for the administration of BAL and EDTA, and to monitor the patient because of the risk of encephalopathy (Table 5). There are several options for chelation therapy at blood lead levels between 45 and 69 µg/dL, including:

- inpatient intravenous chelation with EDTA; or
- outpatient oral chelation with DMSA (if the home environment has no accessible lead hazards); or
- inpatient oral chelation with DMSA (if lead safety in the home is a concern).[29]

In our own practice, we commonly give five days of inpatient EDTA chelation, and 19 days of oral DMSA (administered at home once the home is proven lead-safe).

TABLE 5
Commonly used chelating agents for lead poisoning

Generic drug name (Brand name)	Indications and dosage	Route of administration	Comments/Precautions
Dimercaprol (British anti-Lewisite in oil)	Lead ≥70 µg/dL	IM with procaine	For blood lead levels ≥70 µg/dL, both BAL and EDTA are to be administered

Chemical name: 2,3-dimercapto-1-propanol Abbreviation: BAL	75 mg/m2 every 4 hr x 3 to 5 days		Contraindications: peanut allergies, glucose-6-phosphate dehydrogenase deficiency, concomitant iron therapy, hepatic insufficiency Side effects: hypersensitivity reactions, hyperpyrexia, tachycardia, hypertension, transient elevations of hepatic transaminases, nausea and vomiting, headache, conjunctivitis, lacrimation, rhinorrhea, salivation, unpleasant breath and urine odor
Edetate disodium calcium (calcium disodium versenate) Chemical name: Calcium disodium ethylenediaminetetraacetate Abbreviation: CaNa2EDTA	Lead ≥45 µg/dL 1,000□1,500 mg/m^2/day	IV x 5 days (preferred) IM with procaine (rarely given IM)	Contraindications: renal insufficiency Side effects: transient elevation of hepatic transaminases, zinc depletion, renal failure at high doses Treatment-induced nephrotoxicity is dose-dependent and may be reduced by assuring adequate diuresis before therapy begins Monitor urine output, sediment, blood urea nitrogen (BUN), serum creatinine, hepatic transaminases, serum electrolytes, post-treatment blood lead level; perform CBC
Succimer (Chemet) Chemical name: Meso-2,3-dimercaptosuccinic acid Abbreviation: DMSA	Lead ≥45 µg/dL 10 mg/kg/dose or 350 mg/m^2 every 8 hr x 5 days, then every 12 hr x 14 days	PO for 19 days	Do not give outpatient succimer if there is ongoing lead exposure in the home Do not give concomitant iron therapy Side effects: transient elevation of hepatic transaminases, nausea, vomiting, and diarrhea, appetite loss, abdominal cramps, rash or pruritus, mild neutropenia Monitor: hepatic transaminases, BUN, and serum creatinine; perform urinalysis, CBC, and differential
d-Penicillamine (Cuprimine) Chemical name: 3-mercapto-D-valine Abbreviation: Penicillamine (d-PCN)	Lead ≥45 µg/dL 30□40 mg/kg/day in 3 or 4 divided doses	PO for 1□6 mo	The American Academy of Pediatrics relegates this drug to a third-line agent indicated only after unacceptable reaction with oral succimer and calcium EDTA Not commonly used for lead chelation, as about one third of

	children receiving penicillamine experience an allergic reaction Avoid concomitant administration with iron, antacids, and food Contraindications: penicillin sensitivity, renal insufficiency Side effects: drug fever, urticarial rash, leukopenia, thrombocytopenia, hematuria, proteinuria, hepatic enzyme elevations, eosinophilia, anorexia, nausea and vomiting, GI upset, death (rare) Monitor renal function and hepatic transaminases; perform CBC and urinalysis; monitor, and replace as needed, essential elements

Adapted from *American Academy of Pediatrics*, 1995[29]

 Children who have lead poisoning are often inadequately nourished or have developmental and behavioral problems.[10,30-32] The literature is replete with references to a causal relationship between even mild lead poisoning and learning and behavioral problems.[10,33 35] Iron deficiency anemia alone, however, has been shown to contribute adversely to a child's development,[36] and children who are developmentally delayed have a tendency to engage in pica.[37] Either or both these factors might, to an unknown degree, be confounding or compounding the apparent cause-effect relationship between lead poisoning and developmental and behavioral problems.

 Mothers of children who are lead poisoned often live with multiple economic and social stresses, which may lessen their concern about routine preventive medical care. As a result, their children may not receive timely immunizations, anticipatory guidance, and screening tests.[38] Children left to play on their own without adequate guidance, supervision, or stimulation are more likely to be exposed to environmental hazards.[39] Whether or not advising parents to provide their young children with richer developmental experiences and closer supervision is effective in reducing hand-to-mouth activity is unknown. Although the literature questions the beneficial effect on intelligence of reducing the lead level once poisoning has developed,[12,13,40] we believe that encouraging supervision and positive developmental experiences is a reasonable component of preventive care. Early referral to a developmental intervention program for children at risk is also appropriate.

 Long-term follow-up is needed because the lead level can, and often does, rise again, secondary to continuing exposure. This rise may indicate the need for even more extensive home abatement or relocation of the child to a lead-safe environment before subsequent courses of chelation are administered. Post-chelation mobilization of stored lead should be anticipated, and can cause a rebound to as much as 75% of the pre-chelation blood level. The ZnP may be useful in distinguishing rebound from re-exposure (in the absence of iron deficiency which, like increased body lead, can cause the ZnP to rise).[41]

Appropriate screening and follow-up of children with an elevated blood lead level are important steps, yet routine screening is frequently overlooked.[42] In Cleveland, with its high density of older housing, the city health department recommends performing annual screening not only at 1 and 2 years of age, as recommended by the CDC, but also at 3 and 4

years of age. This recommendation is based on local (Cleveland) 1996 data that showed a significant number of children with a normal lead level (<10 µg/dL) at 1 and 2 years of age who developed an elevated level at 3 years, and other children with a normal level at 1 through 3 years of age whose blood lead level became elevated when they were 4 years old.

Consider what was observed at our medical center in 2001: Of 1,774 children, 36 to 59 months old, who had a blood lead test, the result was elevated (≥10 µg/dL) in 23%□of whom 22% had previously tested normal in both their first and second years of life. These findings support the idea that the propensity for lead poisoning can extend beyond the first two years of life. Immediate testing of young siblings of index patients should always be done. It is, however, possible to overlook the indications for lead screening or miss the need for a follow-up test, especially in a busy practice or with families who are not very adherent. Sick visits and appointments at Women, Infants and Children (WIC) centers can provide additional opportunities for lead screening, just as they do for catch-up immunizations.[43]

Case 4: The reluctant landlord

A 19-month-old male with a confirmed lead level of 125 µg/dL (ZnP, 515 µg/dL) is treated as an inpatient with intramuscular BAL, intravenous EDTA, and oral DMSA chelation. Because the mother's landlord has not responded to requests to perform immediate lead abatement, the child is discharged to the lead-free home of a relative. After two months, during which the landlord remains unresponsive, the landlord is threatened with legal action by the city and, at last, complies. The residence is certified lead-free and the child returns home three months after discharge.

Chelation will fail if the child returns to a lead-rich environment. Therapeutic intervention must therefore go beyond prescribing medications and enter realms unfamiliar to many health-care providers.

Determining ownership of a problematic property, referring owners for government-supported abatement, and helping a family find temporary lead-free housing often require considerable skill in advocacy. Arranging for a home inspection (perhaps of several sites), let alone convincing homeowners or landlords to carry out sometimes expensive improvements, requires a high degree of tenacity and networking; simple medical requests often go unheeded.

Being an effective advocate for a child's environmental safety may require you to intervene directly with property owners, communicate with health department staff, and recruit social workers, social service agency assistance, and legal help. It may mean understanding that federally approved, low-cost, Section 8 housing is not necessarily lead-safe housing, and learning how to help a family extricate itself from lease obligations for a lead-contaminated rental property.

Knowledgeable and motivated medical and social work staff can sometimes impress upon homeowners and landlords the importance of timely and safe abatement and can work with local health departments to obtain expedited home inspections and follow-ups. Families can be directed to, for example, tenant organizations that will hold rent money in escrow until abatement is completed□at times, the only way to persuade a reluctant landlord to complete the lead abatement.

These activities are specialized and time consuming. A medical practice that sees children with lead poisoning might, therefore, be well advised to evaluate how best to accomplish the necessary components of care. We have found that having both a pediatric nurse practitioner and a pediatrician assigned part-time to coordinate lead poisoning management has enabled our entire practice to better provide services for patients. Having pediatric staff assigned to this role has improved patient follow-up, consistency of care, and coordination with community agencies, while simplifying the work of other providers and lowering our institution's liability. We had previously made several other quality improvement efforts, but creating a lead-management team has proved to be the most successful change.

Where efforts should be focused

The theoretical issues pertaining to the prevention and treatment of lead poisoning are far from simple or clear-cut. Reducing an elevated lead level alone seems unlikely to improve neurodevelopmental scores.[12] Even more troubling is the finding that, although IQ declines as blood lead rises, the greatest IQ decrement attributable to lead (7.4 points) has been found in children with levels in the supposedly safe range of 1 to 10 µg/dL.[35]

These theoretical issues notwithstanding, certain practical aspects of the management of lead poisoning should be emphasized:

- The CDC has clearly enunciated which children should be screened, and when.[41] It comes as an unwelcome surprise to parents when they discover that an early lead test was never performed, that they were never informed about an abnormal result, or that no action was ever taken to arrange for home inspection, cleaning or abatement, or possible chelation therapy. For pediatric providers, these scenarios represent realistic possibilities and challenges.

- Identifying and treating lead poisoning requires more than the usual level of attentiveness, coordination, and persistence, and a degree of family compliance that may be lacking.

- Clinical staff should be aware of lead screening recommendations and interventions as they apply to local circumstances.

There are reasons to be concerned about the efficacy of other currently recommended interventions for children who have lead poisoning. Sometimes, even intensive house cleaning efforts by the family do not lower a blood lead level.[21] Vitamin, mineral, and iron preparations in the form of a daily chewable vitamin (Centrum Jr., Flintstones Complete Chewable Vitamins) are commonly prescribed to children who are lead-poisoned, based on research with laboratory animals. This approach is effective in laboratory animals[44] but, to date, there is no evidence in humans that treatment with these nutritional supplements either prevents lead absorption or accelerates recovery once a child has been poisoned.

In the final analysis, efforts must focus on the prevention of lead poisoning, not its treatment.[14,45] Prevention will likely hinge on identifying and abating lead-contaminated residential housing, especially houses where serial generations of children have been poisoned with lead. A few communities have begun aggressive programs to do so.[46]

For practices in areas where the incidence of lead poisoning is high, we encourage adopting the model of a lead-management team to achieve needed medical follow-up, offer consistent support and guidance to families over a protracted time, pursue public health and other referrals until they are accomplished, and interface with landlords and the legal system. Members of a lead management team can also be instruments for social change critical to effective intervention and prevention, such as promoting applications for housing lead abatement grants; becoming a spokesperson for community lead-reduction efforts; and helping to implement community prevention efforts.[15]

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KEY POINTS

Lead poisoning and children

- Children at risk of lead poisoning continue to have routine blood screening performed at an unacceptably low rate
- An elevated lead level found on a capillary blood test should be confirmed by taking a

more accurate venous sample
- Inpatient chelation therapy has minimal benefit if it is followed by a return to lead exposure, and oral chelation during continued lead ingestion might actually facilitate lead absorption
- Long-term patient follow-up is needed because lead levels often rise again as a result of continued exposure
- Being an effective advocate for a child's environmental safety may require pediatricians to intervene directly with property owners, communicate with health department staff, and recruit social workers, social service agency assistance, or legal help
- For practices in areas where the incidence of lead poisoning is high, the authors recommend establishing a lead-management team
- Nationwide, prevention of lead poisoning in children will likely hinge on identifying and abating lead-contaminated residential housing

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Helping families of children with an elevated blood lead level find sources of lead

Health providers can help families of children with elevated blood lead levels (10 mg/dL or higher) find possible sources of lead. A footnote guides the clinician to specific advice for the potential lead source identified in each question that follows. More information is available from the local or state health department.

Date of interview:_____			
Child's name	**Guardian□s name**	**Phone**	
Child's name	**Guardian□s name**	**Phone**	
Home address	**City**	**State**	**Zip code**
1. About your home: a. Year home built? Don't know[1] before 1950[1] 1950-1978[1]		after 1978	→ Go to #2
b. Peeling or flaking paint inside home?		Yes[2]	No
c. Porches used as play areas?		Yes[3]	No
d. Peeling or flaking paint on the outside?		Yes[4]	No
e. Paint removal, renovation, or remodeling in the last six months?		Yes[5]	No
2. Does your child regularly spend time at another home (babysitter, grandparent, etc.) which was built before 1978?		Yes[1] → repeat #1b-e	No → Go to #3
Name of occupant		Relationship	
Address City	State	Zip code	
3. Can your child put mouth on windowsills or reach into window wells (space between inner and outer windowsills) at home?		Yes[6]	No
4. Do your child□s main outdoor play areas include areas of bare soil near		Yes[4]	No

painted buildings or porches, or near roads with heavy traffic?		
5. In the last six months, have any buildings near your home had exterior painting or renovations?	Yes[4]	No
6. Is anyone in your home exposed to lead at work (such as smelter, brass foundry, radiator repair, motor vehicle batteries, paints or pigments, ammunition/firing range,demolition, home/building remodeling or repair, paint removal, soldering, glass products, or other lead-related trades)? Anyone with hobbies involving ceramic glazes, oil paints, furniture refinishing, fishing weights, ammunition, metal toy soldiers, stained glass, or other lead sources? If YES, specify_____	Yes[7]	No
7. Does your family use tap water for drinking or cooking?	Yes[8]	No
8. Does your family use pottery, pewter, or crystal for cooking or eating?	Yes[9]	No
9. Does your child mouth/chew on almost anything?	Yes[10]	No
10. Does your family eat imported canned foods (like tomatoes, fruit)?	Yes[11]	No
11. Are imported vinyl mini-blinds in your home?	Yes[12]	No
12. Is your child underweight or anemic (iron-poor blood), or is your child□s diet low in calcium (milk or dairy products) or iron (iron-fortified formula/cereals or red meat)?	Yes[13]	No
13. Does anyone in your home use home remedies like greta, azarcon, pay-loo-ah, or others? Health store products like dolomite? Traditional cosmetics like surma or kohl? If YES, specify_____	Yes[14]	No
14. Is painted wood burned in or near your home?	Yes[15]	No
15. Does your family live near an industry that uses lead? (See Question 6)	Yes[16]	No
16. Has your child lived or traveled outside the US?	Yes[17]	No

Patient education footnotes (explain all that apply)

Remember: (a) all children with high lead levels should eat healthy meals and snacks at regular intervals; (b) diets should be rich in calcium (milk, dairy products) and iron (formula with iron, cereals, dark green vegetables, meats), with the right amount of fat for the child□s age; (c) avoid giving lots of high-fat foods.

1. Older homes have house paints made before 1950, which often contain much lead; house paints from 1950 to 1978 have less lead. Due to subsequent laws, all house paints made after 1978 are lead-free. Chips, flakes, and dusts from lead-containing paints can poison children when swallowed. **Suggest:** a) wash children□s hands often, and before eating, b) carefully clean up paint chips, c) reduce lead dust levels in the home by wet-mopping and damp-dusting often with detergent, then rinsing with plain water, d) never remove intact paint without the help of an expert unless you know it does not contain lead.

2. Highest lead levels are often found on woodwork, windows, and doors. **Suggest:** a) block children□s access to peeling paint, b) carefully remove chips by wet-wiping with a detergent, c) throw away chips in plastic bags out of the reach of children, and wet-mop any dust, d) contact paper and duct tape can be used temporarily to cover chipping surfaces. Do not try to remove intact paint without the help of an expert.

3. Exterior house paint may contain large amounts of lead, which weathers into chips and dust. Many older porches may have lead-containing paint. **Suggest:** a) avoid letting children play on or under painted porches or balconies, b) clean as suggested in #1 and #2, above.

4. Soil and playthings may contain lead dust from paint, industry, or past auto exhaust. **Suggest:** a) avoid play on bare soil, b) plant grass or shrubs over bare soil or permanently cover with stone or cement, c) wash and rinse equipment, d) place doormats at all entrances to the home and remove shoes at entry.

5. Removing paint can create lead dust in the home. **Suggest:** dust control as in #1 and #4, above.

6. Older windows were often painted with lead paint. **Suggest:** a) block children□s access to window wells by shutting windows or blocking with furniture, b) do not allow child to chew on sill, c) wet-clean window sills and wells often with a detergent, then rinse with water.

7. Lead can enter the home on worker□s clothing. Some hobbies use lead. **Suggest:** a) workers exposed to lead should shower and change away from home, b) keep any lead-containing materials out of children□s reach; dust control as in #1.

8. Lead can enter drinking water from lead pipes, solder, or storage tanks. **Suggest:** a) allow cold taps to run until water is cold before drinking or using in cooking, b) never drink hot or warm tap water or use in cooking.

9. Imported or older pottery and porcelain may contain lead. Pewter and crystal also may contain lead. Lead can leach out of these dishes into food. **Suggest:** Avoid using as holder for food unless you are sure it is lead-free.

10. The child is more likely to swallow lead. **Suggest:** a) frequently clean pacifiers, toys, and surfaces the child may mouth, b) wash child□s hands often, c) keep fingernails clean and trimmed.

11. Lead can leach from can solder, especially with acid foods like tomatoes. U.S. cans are usually safe. **Suggest:** a) never store foods in opened cans, b) avoid imported canned foods for young children unless you are sure the can is lead-free.

12. Imported vinyl mini-blinds may contain lead and produce lead dust as they age. **Suggest:** Remove imported vinyl mini-blinds from the home, unless they are labeled as "non-leaded" or "no lead added."

13. Lead more easily enters the bodies of children who don□t eat regularly, don□t get enough food, or consume too little calcium or iron. **Suggest:** a) regular meals and snacks, b) recommended amounts of calcium and iron (see top of this page).

14. Some home remedies and traditional cosmetics have a very high lead content. Such remedies include: alkohl, bala goli, coral, ghasard, liga, and rueda. Some mineral supplements contain lead. **Suggest:** Keep out of reach of children and only use products shown to be essentially lead-free.

15. Fumes from lead paint may be hazardous. **Suggest:** Never burn painted wood.

16. Lead-containing dusts could drift into home or outdoor play areas. **Suggest**: dust and soil control as in #1 and #4.

17. Control of lead in air, water, soil, gasoline, and consumer products is lacking in many developing and Eastern European countries. **Suggest:** Review all footnotes and test blood lead levels when appropriate.

Source: *Help families find lead. Clinician□s guide to lead source assessment and patient advice*, by Seth Foldy, MD, and the Cleveland Lead Hazard Abatement Project. Revised by Dr. Foldy (City of Milwaukee Health Department) and Helen Binns, MD, MPH (Children□s Memorial Hospital, Chicago) in 1998, with review by Chicago-Area Health Care Providers□ Lead Consortium.

Resources about lead poisoning

For clinicians

Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials, by the Centers for Disease Control and Prevention, November 1997

"Lead poisoning," by Morri Markowitz, MD, *Pediatrics in Review*, October 2000 (Vol. 21, No. 10, pages 327□335)

Treatment Guidelines for Lead Exposure in Children (RE9529), by the American Academy of Pediatrics □ Policy Statement, July 1995

For parents

The National Lead Information Center

800-424-LEAD

Environmental Protection Agency (EPA) Safe Drinking Water Hotline

800-426-4791

Web sites

www.afhh.org
Alliance for Healthy Homes
202-543-1147

www.leadsafe.org
Coalition to End Childhood Lead Poisoning
800-370-5323

www.epa.gov/lead
EPA Lead Awareness Program

www.cdc.gov/nceh/lead/lead.htm
Centers for Disease Control and Prevention Childhood Lead Poisoning Prevention Program

www.hud.gov/offices/lead
Department of Housing and Urban Development Office of Healthy Homes and Lead Hazard Control

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GUIDE FOR PARENTS

Preventing lead poisoning

Until the 1970s, lead was commonly used in paint, water pipes, gasoline, and pottery. Although not used as much today, lead does not decompose. That means it must be removed or covered to render it harmless. Lead paint that is in good condition (not flaking or peeling) is not an immediate problem, but it may be a hazard if it begins to peel.

Less common sources of lead are imported foods, toys made outside the United States, and some jewelry. People who work with lead or have hobbies that involve the use of lead (such as making stained glass) may bring the substance home on their clothing.

Exposure to too much lead can be dangerous. In a child, lead poisoning can result in learning disabilities, a lower IQ (intelligence quotient), a slower growth rate, and behavioral problems that are lifelong.

How can lead poison a child?

Small bits of paint can come off windowsills, doors, and walls, and a child may put these pieces in his mouth during normal hand-to-mouth activity. Other children are exposed to lead by sucking their thumbs or fingers after they have touched dust from lead paint. Also, many old porches are painted with lead paint. By walking across the porch, lead paint dust is picked up on shoes and tracked into the house. Lead dust can also be inhaled.

Why should your child be tested for lead?

A level of lead circulating in the blood that is equal to or higher than a measurement of 10 micrograms is considered elevated. The only way to tell if your child's lead level is too high is by having his blood tested. In the early stages of lead poisoning, most young children do not have any symptoms. Once in the body, though, lead begins to replace calcium in the bones, interfere with the manufacture of red blood cells, and attack parts of the nervous system and brain.

If the blood test determines that your child's level of lead is high, the pediatrician will speak with you about the treatments and other measures that are available to lower that level. And don't hesitate to ask questions of the pediatrician about this serious problem so that you can take an active part in keeping your child safe and healthy!

Does your home have lead?

If your home was built before 1950, it is very likely that it has lead paint. In 1978, lead was removed from paint sold for use in homes. Homes built between 1950 and 1978 were sometimes contaminated by the use of older, lead-based paints. And, homes built before the 1920s may still have lead water pipes.

How can you protect your child from lead?

 Wash your child's hands and face often with soap and water, especially before eating. Wash toys weekly.

 Remove shoes before entering your home.

 Minimize the amount of lead dust in your home by using a wet mop and by wet dusting all your furniture, windows, and floors at least once a week. You can use cleaners with phosphates such as automatic dishwasher detergent (Cascade, Electrasol, etc.). Carpets can be vacuumed with a HEPA (high efficiency particulate air) vacuum; these vacuums are designed to pick up fine particles.

 Do not do remodeling work on your home while children and pregnant mothers are there. Remodeling older homes can cause lead paint to contaminate your home. Sanding woodwork, sandblasting, and torching paint can cause high amounts of lead in your home. Contact your local Health Department for advice on the safest way to remove lead paint.

 Do not allow your child to play in the soil. Soil closest to your home can contain lead paint chips and dust if the outside of your home has lead paint. If your home is near a highway, the soil may have lead from car exhaust from the days when gasoline contained lead. Provide a

sandbox outside or plant grass for your child to play in. Mulch can cover the soil closest to your home.

 Allow cold water to run 20 seconds in the morning to flush the pipes before using the water to drink or prepare food. This is necessary because water pipes may be made with lead or joined with lead solder; water that flows through them (especially hot water) may contain lead.

 Feed your child a healthy diet. A child who does not get an adequate amount of calcium and iron in his diet is more likely to absorb lead when exposed to it. Making sure your child gets enough of these nutrients and giving him a daily chewable vitamin can lower how much lead his body takes in. Recommended vitamins include Flintstones Complete and Centrum Kids chewable vitamins. Foods high in iron include red meats, beans, iron-enriched cereals, and green leafy vegetables. Young children should have four daily servings of foods containing calcium such as milk, yogurt, and cheese.

Mark Feingold, Roberta Anderson. Lessons and tactics to lead the charge against lead poisoning. *Contemporary Pediatrics* April 2004;21:49.