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The New York City Department of Health and Mental Hygiene

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LEAD POISONING: PREVENTION, IDENTIFICATION, AND MANAGEMENT

For Pediatric Patients

- Educate parents on how to prevent lead exposure.
- Test all children at ages 1 and 2, and other children at risk of lead exposure.
- Assess children up to 6 years of age annually for risk of lead exposure.

For Obstetric Patients

- Educate pregnant women on how to prevent lead exposure.
- Test pregnant women at risk for lead exposure.
- Assess pregnant women for risk of lead exposure at the first prenatal visit.

Lead poisoning remains a significant health problem in New York City (NYC). In young children, exposure to lead can result in long-lasting neurological damage, including learning and behavioral problems and lowered intelligence. Health effects of lead poisoning may persist long after a child's blood lead level (BLL) has declined and may go undetected until the child enters school.

Most people with lead poisoning show no clinical symptoms. Thus, blood lead tests are routinely required for diagnosis. New York State (NYS) law requires blood lead testing for every child at both 1 and 2 years of age and for other children found to be at risk. However, in 2009, only 83% of 1-year-olds and 70% of 2-year-olds in NYC were tested, and only 50% of children had been tested at both ages.¹

Fetal exposure to lead may also adversely affect neurodevelopment.² A pregnant woman with an elevated BLL can pass the lead to her developing fetus; children born with elevated BLLs may suffer cognitive and developmental problems as a result of prenatal exposure.

Recent research shows that adverse health effects may occur at BLLs $<10 \mu\text{g}/\text{dL}$ ³⁻⁵ and that more people may be affected than previously recognized (Table 1). Health care providers can help by educating families on ways to prevent lead exposure, and by identifying lead poisoning early through blood lead testing.



PART 1: PREVENTING, IDENTIFYING, AND MANAGING CHILDREN WITH BLLs ≥ 5 $\mu\text{g}/\text{dL}$

Profile of NYC lead-poisoned children

Lead poisoning can affect children of all ages, races, and income groups, but certain populations are at greater risk. These groups include children younger than 3 years of age, low-income children living in older, deteriorated housing, and children of color. In addition, children born outside the United States (US) are overrepresented among lead-poisoned children in NYC. In 2009, among NYC children newly identified with venous BLLs ≥ 15 $\mu\text{g}/\text{dL}$:¹

- 86% were black, Asian, or Hispanic;
- 86% lived in homes built before 1950;
- 76% had lead-based paint hazards found on inspection of their addresses;
- 64% were younger than 3 years of age;
- 19% were foreign-born.

Annually educate parents of children 6 months to 6 years of age by providing anticipatory guidance as required by NYS law⁶

Helping parents minimize their children's exposure to lead is the best way to prevent the developmental and cognitive deficits associated with lead poisoning. Provide parents with the following educational messages:

- Keep your child away from peeling paint and home repairs that disturb lead paint.
- Report peeling paint to your landlord. If your landlord does not make repairs, call 311.
- Frequently wash hands, toys, pacifiers, bottles, and other items your child puts in his or her mouth.
- Clean floors, windowsills, and dusty places often with wet mops and wet cloths.
- Avoid using health remedies and eye cosmetics (such as

kohl, kajal, surma) from other countries. Some of these products have been found to contain high levels of lead.

- Use caution when using candies, spices, snack foods, and children's toys and jewelry made in other countries. These items may contain lead.
- Use only cold tap water for making baby formula, drinking, and cooking. Let the water run for a few minutes before use.
- Keep your child away from the work clothes and tools of household members who do construction work or other work and hobbies that may expose them to lead. Wash work clothes separately from other laundry. Remove shoes and work clothes before entering your home.
- Use safe work methods when doing home repair that disturbs paint. For information on lead-safe work methods, call 311.

Test all children at ages 1 and 2, and test other children found to be at risk. Annually assess children from 6 months to 6 years of age for lead exposure risk⁶

Children between 9 months and 36 months of age are at risk of lead exposure due to normal hand-to-mouth toddler behavior. Rapid growth and development at these ages also makes them more vulnerable to lead's toxic effects.

Household lead exposure, in either the child's home or homes they regularly visit, remains a concern. Although lead-based paint for residential use in NYC was banned in 1960, about 67% of NYC housing was built before 1960.

Use the "Recommended Lead Risk Assessment Questions for Parents" (see **Box**) to assess potential lead exposure in a child. If the parent answers "yes" to any of these questions, the child should have a blood lead test (preferably venous, see **Table 2**). All fingerstick blood level results ≥ 10 $\mu\text{g}/\text{dL}$ must be confirmed with venous specimens within the time frames specified in **Table 3**.

TABLE 1. NEW REPORTS OF BLOOD LEAD LEVELS ≥ 5 $\mu\text{g}/\text{dL}$ AMONG CHILDREN AND WOMEN OF REPRODUCTIVE AGE TESTED FOR LEAD, NYC, 2009

| BLL ($\mu\text{g}/\text{dL}$) | GROUP | | | |
|---------------------------------|---|----------------------------------|---|-------------------------------|
| | Children 6 months-5 years (n=11,674) | Children 6-17 years (n=1,867) | Women of Reproductive Age, 18-49 years (n=1,497) | Infants 0-5 months (n=141) |
| 5-9 | 10,287 | 1,655 | 1,239 | 97 |
| 10-14 | 884 | 145 | 152 | 33 |
| ≥ 15 | 503 | 67 | 106 | 11 |

New York City Department of Health and Mental Hygiene, Lead Poisoning Prevention Program. Unpublished 2009 data.

TABLE 2. RECOMMENDED MANAGEMENT OF CHILDREN BASED ON BLOOD LEAD LEVELS⁷**BLL (µg/dL) Recommendations:**

| | |
|--------------|--|
| 5-9 | <ul style="list-style-type: none"> Recognize that a BLL of 5-9 µg/dL may indicate lead exposure. Provide educational messages (see page 42). Evaluate for adequate intake of calcium, iron, and vitamin C.^a If a fingerstick specimen, confirm with venous specimen within time frame specified in Table 3. Venous specimens are more accurate than fingerstick specimens. Monitor BLLs by retesting as per follow-up schedule in Table 3. The NYC Health Department will provide educational information to the family and health care provider. Report BLLs <10 µg/dL within 5 days when using a point-of-care device (LeadCare[®]) to analyze blood lead specimens.⁸ |
| 10-14 | <p>All actions for BLLs 5-9 µg/dL, and:</p> <ul style="list-style-type: none"> Report BLL to NYC Health Department within 24 hours by fax to (212) 676-6326.⁹ Laboratory requisition forms must include: <ul style="list-style-type: none"> Patient's name, date of birth, address (including apartment number), and phone number. Health care provider name and phone number. Type of sample (venous or fingerstick) and date of collection. The NYC Health Department will inspect the homes of children <3 years of age with venous specimens. |
| 15-44 | <p>All actions for BLLs 5-14 µg/dL, and:</p> <ul style="list-style-type: none"> Provide a complete medical evaluation, including a detailed environmental history, thorough developmental and nutritional assessment, and physical exam. Evaluate for iron deficiency anemia, often associated with lead poisoning. Consider abdominal x-ray if paint chip or other lead solid ingestion is suspected. If radio-opaque particles are found or recent ingestion is witnessed, use a cathartic. Consider monitoring erythrocyte protoporphyrin levels (EP) for BLL ≥25 µg/dL to help assess timing of exposure.^b Monitor development even after BLLs decrease. Consider this child at higher risk for developmental delays and behavior problems. The NYC Health Department will: <ul style="list-style-type: none"> Inspect the child's home to identify potential lead sources. Order the landlord to repair any lead paint hazards identified. Refer children <36 months of age to the NYC Health Department Early Intervention Program. |
| ≥45 | <p>All actions for BLLs 5-44 µg/dL, and:</p> <ul style="list-style-type: none"> Arrange hospitalization and chelation according to "Recommended Chelation Protocol for Children with BLLs ≥45 µg/dL," at www.nyc.gov/health/lead/chelation. Perform complete neurological exam. Confirm BLL with venous specimen processed as an emergency test before providing chelation therapy, unless symptoms of encephalopathy are present. Obtain abdominal x-ray to look for paint chips or other lead solid ingestion; if radio-opaque particles are found or recent ingestion is witnessed, use a cathartic. Child must receive chelation therapy in, and be discharged to, a lead-safe environment. Do not discharge the child until the NYC Health Department inspects the home. Inform the NYC Health Department of hospital admission by calling (212) 676-6100. The NYC Health Department can provide: <ul style="list-style-type: none"> Same-day BLL processing. Referrals to facilities and providers with expertise in treating lead poisoning. For treatment consultations on evenings or weekends, call the Poison Control Center at 311. Referrals to temporary lead-safe housing. |

^a Adequate stores of calcium and iron may decrease gastrointestinal absorption of lead. Vitamin C may increase renal excretion.

^b The BLL reflects more recent exposure to lead, while the EP level reflects more chronic exposure. Once elevated, the EP remains elevated for several months even after the exposure has ceased and the BLL has fallen.

If potential exposures are noted during the risk assessment, emphasize the educational messages on page 42 that address those exposures.

Foreign-born children up to 16 years of age, particularly children who are refugees or internationally adopted, should have their BLLs tested when they arrive in the United States and again 3 to 6 months after they receive permanent placement.¹⁰ Blood lead tests should also be considered for older children with a history of an elevated BLL, foreign residency, or developmental delay.

Management of children with BLLs ≥ 5 $\mu\text{g}/\text{dL}$

Children with BLLs ≥ 5 $\mu\text{g}/\text{dL}$ require follow-up management (Table 3). The actions recommended are based upon the BLL and should always include providing educational messages (see page 42) and BLL monitoring (Table 3). Children with venous BLLs ≥ 45 $\mu\text{g}/\text{dL}$ typically require hospitalization and chelation therapy in consultation with a lead expert. For more information on chelation therapy, see “Recommended Chelation Protocol for Children with BLLs ≥ 45 $\mu\text{g}/\text{dL}$ ” on the NYC Health Department Web site (Resources).

REPORTING REQUIREMENTS

When to report

- All providers are required to report BLLs ≥ 10 $\mu\text{g}/\text{dL}$ to the NYC Health Department within 24 hours.⁹
- Providers using a point-of-care device (LeadCare[®]) to analyze blood lead specimens in their offices must report BLLs < 10 $\mu\text{g}/\text{dL}$ within 5 days.⁸

How to report

- **New Online Registry:** The Registry is accessible at www.nyc.gov/health/cir. Call (212) 676-2323 to obtain a user ID and password.
- Fax or phone:
 - For children younger than 18 years of age: fax (212) 676-6326 or phone (212) 676-6158.
 - For pregnant women: fax (212) 676-6386 or phone (212) 676-6379.

What to include

Laboratory requisition forms must include:

- Patient’s name, date of birth, address (including apartment number), and phone number
- Health care provider name and phone number
- Type of sample (venous or fingerstick) and date of collection

After business hours, call the Poison Control Center at 311.

RECOMMENDED LEAD RISK ASSESSMENT QUESTIONS FOR PARENTS

1. Is your child between 9 and 36 months of age?
2. Have any of your children or their playmates ever had a high blood lead level?
3. Does your child live in, or regularly visit, an older home or other place with peeling or damaged paint?
4. Does your child live in, or regularly visit, an older home or other place that is being or was renovated within the last 12 months?
5. Does your child have any developmental delays, have hand-to-mouth behavior, or put nonfood items, such as paint chips or soil, in their mouth?
6. Has your child moved to the United States from or traveled to a foreign country where lead poisoning may be common?^a
7. Does your family use products from other countries such as health remedies, spices, food, or pottery?
8. Does your child play near a heavily traveled highway, bridge, or elevated train where there is peeling paint?
9. Does your child come into contact with an adult whose job or hobby involves exposure to lead (eg, bridge painting and repair, building demolition, home renovation and repair, automotive and electronics repair, furniture refinishing, working with firearms, and arts/crafts work involving ceramics, metals, and color pigments)?
10. Is your child enrolled in or are you planning to enroll him or her in Medicaid or the NYC Early Intervention Program?^b

^a From 2002 to 2009, in descending order of frequency, lead poisoning has been found in at least 2 NYC children emigrating from Haiti, Bangladesh, Pakistan, Mexico, Dominican Republic, India, China, Guinea, Guyana, Liberia, Georgia, Ecuador, Jamaica, Nigeria, Guatemala, Sierra Leone, Senegal, Albania, Egypt, Togo, Yemen, Ghana, Ivory Coast, Mali, Nepal, United Kingdom, Burma, Canada, Israel, Suriname, Trinidad and Tobago, Uzbekistan, Yugoslavia, Afghanistan, Morocco, Thailand, Burkina Faso, Republic of the Congo, Cuba, El Salvador, Gambia, Honduras, Mauritania, and Peru.

^b Medicaid requires a blood lead test for children up to age 6 who have not been previously tested.¹¹ Enrollment in preschool/daycare¹² and the Early Intervention Program¹³ both require BLL documentation.

TABLE 3. FOLLOW-UP BLOOD LEAD TEST SCHEDULES FOR CHILDREN¹²**For Fingertick BLLs ≥ 5 $\mu\text{g}/\text{dL}$**

| Capillary Test Result ($\mu\text{g}/\text{dL}$) | Time Frame for Confirmatory Venous Test |
|---|---|
| 5-9 | 3-6 months ^a |
| 10-14 | 3 months ^b |
| 15-44 | 1 week-1 month ^c |
| ≥ 45 | Immediately |

For Venous BLLs ≥ 5 $\mu\text{g}/\text{dL}$

| Venous BLL ($\mu\text{g}/\text{dL}$) | Early Follow-up Test (first 2-4 tests after identification) | Late Follow-up Test (after BLL begins to decline) |
|--|---|---|
| 5-9 | 3-6 months ^a | 6-12 months |
| 10-14 | 3 months ^b | 6-9 months |
| 15-19 | 1-3 months ^b | 3-6 months |
| 20-24 | 1-3 months ^b | 1-3 months |
| 25-44 | 2 weeks-1 month | 1 month |
| ≥ 45 | As soon as possible | Chelation with subsequent follow-up |

^a Recognize that a BLL of 5-9 $\mu\text{g}/\text{dL}$ may indicate lead exposure. If the risk assessment indicates exposure is likely, consider retesting within 3 months to confirm that the BLL is not rising rapidly.

^b Health care providers may choose to repeat BLL test within 1 month for patients newly identified with an elevated BLL to confirm that BLL is not rising rapidly.

^c The higher the BLL, the sooner confirmatory venous testing should occur.

PART 2: PREVENTING, IDENTIFYING, AND MANAGING PREGNANT WOMEN WITH BLOOD LEAD LEVELS ≥ 5 $\mu\text{g}/\text{dL}$

Research suggests that lead poisoning during pregnancy is associated with spontaneous abortion, premature birth, maternal hypertension, and decreased fetal growth. Elevated maternal BLLs may reflect recent exposure to exogenous lead sources and/or mobilization of endogenous bone stores. During pregnancy, when maternal bone stores of calcium are released into the bloodstream to support development of the fetal bone structure, bone stores of lead from past exposure may also be released.

RECOMMENDED LEAD RISK ASSESSMENT QUESTIONS FOR PREGNANT WOMEN

1. Have you ever had a high blood lead level?
2. Were you born, or have you spent any time, outside of the United States?^a
3. During the past 12 months, did you use any products from other countries, such as health remedies, spices, foods, ceramics, or cosmetics?
4. At any time during your pregnancy, did you eat, chew on, or put in your mouth any nonfood items such as clay, crushed pottery, soil, or paint chips?
5. In the last 12 months, has there been any renovation or repair work in your home?
6. Do you now have, or have you ever had, a job or hobby that could expose you to lead, such as construction work, home renovation/repair, furniture refinishing, working with firearms, or arts/crafts work involving ceramics, stained glass, metals, or color pigments?

^a From 2002 to 2009, in descending order of frequency, lead poisoning has been found in at least 2 NYC pregnant women emigrating from Mexico, Bangladesh, India, Ecuador, Pakistan, Guatemala, China, Russia, Dominican Republic, Jamaica, Georgia, Morocco, Afghanistan, Haiti, and Nepal.

In NYC, approximately 94% of the pregnant women found to have elevated BLLs are foreign-born.¹ Therefore, prenatal medical practices that predominantly serve foreign-born women may elect to routinely test all pregnant women at their first prenatal visit.

Educate all pregnant women about how to prevent lead poisoning during pregnancy by providing anticipatory guidance as required by NYS law¹⁴

Provide the following educational messages to all pregnant women. Women of childbearing age could benefit from these messages as well:

- Avoid using health remedies and eye cosmetics (such as kohl, kajal, surma) from other countries. Some of these products have been found to contain high levels of lead.
- Use caution when using candies, spices, and snack foods made in other countries. These items may contain lead and it is best to avoid them during your pregnancy.
- Avoid using imported clay pots and dishes to cook, serve, or store food, and do not use pottery that is chipped or cracked.

TABLE 4. RECOMMENDED MANAGEMENT OF PREGNANT WOMEN BASED ON BLOOD LEAD LEVELS

| BLL (µg/dL) | Time Frame for Action | Recommendations | Frequency of Follow-up Venous Blood Testing |
|-------------|-----------------------|---|---|
| 5-9 | Within 30 days | <ul style="list-style-type: none"> Assess for risk factors. Provide educational messages (see pages 45 and 47). Evaluate for adequate intake of calcium, iron, and vitamin C.^a Monitor BLL. | <ul style="list-style-type: none"> Repeat after interval of at least 1 month to assess trend. Repeat each trimester. |
| 10-14 | Within 30 days | <p>All actions for BLLs 5-9 µg/dL, and:</p> <ul style="list-style-type: none"> Report BLL to the NYC Health Department within 24 hours by fax: (212) 676-6386. Refer to occupational health clinic if occupational exposure is suspected. The NYC Health Department will interview the woman to identify potential lead sources and recommend strategies to reduce exposure. | <ul style="list-style-type: none"> Repeat after interval of at least 1 month to assess trend. Repeat each trimester. |
| 15-44 | Within 2 weeks | <p>All actions for BLLs 5-14 µg/dL, and:</p> <ul style="list-style-type: none"> Evaluate for other symptoms.^b Consider monitoring erythrocyte protoporphyrin levels (EP) when BLL ≥25 µg/dL to help assess timing of exposure.^c The NYC Department of Health will conduct home visits to identify potential exposure sources and recommend strategies to reduce exposure. | <ul style="list-style-type: none"> Within 2 weeks and then monthly to assess efficacy of management. |
| ≥45 | Within 24 hours | <p>All actions for BLLs 5-44 µg/dL, and:</p> <ul style="list-style-type: none"> Confirm BLL with venous sample. Consult with the NYC Health Department and a lead poisoning specialist to consider hospitalization and chelation therapy with CaNa₂EDTA if pregnancy is in the late 2nd or 3rd trimester.^d Monitor EP levels to help assess timing of exposure.^c | <ul style="list-style-type: none"> Within 24 hours and then at frequent intervals, depending on clinical management and BLL trend. |

^aAdequate stores of calcium and iron may decrease gastrointestinal absorption of lead. Adequate stores of calcium may decrease mobilization of lead from maternal bone. Vitamin C may increase renal excretion.

^bThe majority of people with lead poisoning have no symptoms. Symptoms including headaches, crampy abdominal pain, anorexia, constipation, fatigue, malaise, myalgia, and arthralgias typically occur at BLLs ≥60 µg/dL, but can occur at BLLs ≥25 µg/dL.

^cThe BLL reflects more recent exposure to lead, while the EP level reflects more chronic exposure. Once elevated, the EP remains elevated for several months, even after exposure has ceased and the BLL has fallen.

^dWhen BLLs ≥45 µg/dL are noted in the first half of pregnancy, chelation therapy is NOT recommended. Management consists of limiting further lead exposure by identifying potential exposure sources, recommending strategies to reduce exposure, and promoting adequate intake of calcium, iron, and vitamin C.

- Never eat nonfood items, such as clay, soil, pottery, or paint chips.
- Stay away from any repair work being done in the home.
- Avoid jobs or hobbies that may involve contact with lead, such as construction work, home renovation/repair, furniture refinishing, working with firearms, and arts/crafts work involving ceramics, stained glass, metals, or color pigments.

Test pregnant women at risk of lead exposure after assessing risk during first prenatal visit¹⁴

Use the “Recommended Lead Risk Assessment Questions for Pregnant Women” (Box) to assess potential lead exposure. If a pregnant woman answers “yes” to any of these questions, she should have a blood lead test. If potential exposures are noted during the risk assessment, the health care provider should emphasize the educational messages (page 45 and above) that address those exposures.

Management of pregnant women with BLLs $\geq 5 \mu\text{g}/\text{dL}$

Guidelines for managing pregnant women with elevated BLLs are summarized in Table 4. In addition, postpartum care should include a maternal BLL and umbilical cord BLL drawn at delivery and another maternal BLL drawn one month after delivery. The many benefits of breastfeeding must be weighed against the potential risks of lead exposure on a case-by-case basis. When advising your patient about breastfeeding, consultation with a lead poisoning specialist is recommended. In addition, care of the newborn should be coordinated with

TABLE 5. RECOMMENDED BLOOD TEST SCHEDULE FOR LEAD-EXPOSED INFANTS (0-5 MONTHS OF AGE)

| Umbilical Cord BLL at Delivery ($\mu\text{g}/\text{dL}$) | Initial Infant Venous Test | Follow-up Infant Venous Tests |
|--|----------------------------|---|
| 0-4 | None | Based on infant's risk of current exposure |
| 5-14 | Within 1 month | Every 3 months |
| 15-24 | Within 1 month | Every 1-3 months |
| 25-44 | Within 2 weeks | Every 2 weeks - 1 month |
| ≥ 45 | As soon as possible | Depends on clinical management ^a |

^aCollaborate with NYC Health Department and an experienced lead poisoning specialist.

the pediatric health care provider. The NYC Health Department recommends that the BLL of newborns prenatally exposed to lead be monitored for the first 6 months of life as per Table 5. ♦

RESOURCES

- New York City Department of Health and Mental Hygiene Lead Poisoning Prevention Program www.nyc.gov/lead

Consultation with a NYC Health Department physician, call (212) 676-6100

Patient education materials for your office, www.nyc.gov/lead or call 311 and ask for BAN-LEAD

Recommended Chelation Protocol for Children with BLLs $\geq 45 \mu\text{g}/\text{dL}$ www.nyc.gov/health/lead/chelation

Kohl, Kajal, and Surma Products Containing Lead www.nyc.gov/html/doh/html/lead/lead-import-eyecos.shtml

Contaminated Herbal Medicine Products (HMPs) and Remedies www.nyc.gov/html/doh/html/lead/lead-herbalmed.shtml

Online Registry www.nyc.gov/health/cir/

- Centers for Disease Control Capillary Blood Lead Sampling Protocol www.cdc.gov/nceh/lead/guide/1997/pdf/c2.pdf.



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NOTICE TO READERS: The NYC DOHMH no longer offers continuing education credits (CME/CNE). We are exploring options for offering the credits in the future. We apologize for any inconvenience.

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