Lead Guidelines for Primary Care Providers Caring for Migrant Children

Background

Lead poisoning is the most common disease of toxic environmental origin among children in the United States today.[1] The Centers for Disease Control and Prevention (CDC) estimates that 250,000 children aged 1 to 5 years currently have blood lead levels of 10 µg/dL or greater.[2]

Blood lead levels in the United States have declined dramatically over the past 3 decades. From 1999-2004 the prevalence of blood lead levels greater than 10 µg/dL was at an all time low of 1.6%.[6] This decline principally is due to removal of lead from gasoline and, additionally, to bans on the use of lead in household paint, food and drink cans, and plumbing systems.[1,18] Despite this decline in blood lead levels greater than 10 µg/dL between 1999–2002, an estimated 1.4 million children in the United States (almost 14%) had blood lead levels between 5–9 µg/dL.[5]

Moreover, the risk of lead exposure remains disproportionately high among children who are poor, African American, and/or Hispanic.[6] Among those least studied, are mobile Hispanic children.[7] Migratory farmworkers have been shown to live in crowded conditions, in inadequate housing lacking basic facilities such as vacuum cleaners.[8] Because of mobility, migratory farmworkers and their families face unique conditions that can potentially exacerbate health disparities including inconsistent health care and exposure to a constantly changing environment. A recent study found that children living in rental property and belonging to a family of migrant farmworkers were more likely to have elevated blood lead levels.[9] Moving from place to place into different substandard housing units as well as nutritional deficiencies caused by an inconsistent diet were likely factors for both children and adults. Migrant farmworker children must, therefore, be considered a high-risk population for lead poisoning. Several older studies have documented increased lead exposure in migrant farmworker children, attributed to poor housing and soil contamination.[10,11]

Sources of Lead

Because of their normal oral exploratory behavior, children are most likely to acquire lead through ingestion.[18]

- **Lead-based paint** continues to be the principal source of high-dose lead exposure for children. An estimated 57 million housing units in the United States contain lead-based paint. Children are at especially high risk of exposure to lead from paint in housing built before 1978; these conditions exist in an estimated 3.8 million US homes with young children.[12] Children may directly absorb lead from paint by ingesting paint chips (pica) or, more commonly, by ingestion and inhalation of lead-contaminated house dust.
- **Contaminated dust and soil** are pervasive sources of lead exposure.[12] Concentrations of lead in dust and soil range from near zero to many thousands of parts per million (ppm). Lead in dust and soil appears to produce elevated children's blood lead levels when the concentration exceeds 300 to 500 ppm.
- **Drinking water** is a common source of low-level lead exposure.[12] Although high concentrations of lead in drinking water occur only in unusual circumstances (such as storage of water in lead-lined tanks), lead in water contributes widely to background exposure. At its source, drinking water is almost always lead-free. Water can, however, become contaminated as it passes through lead pipes or comes into contact with lead solder or brass faucets. Soft water of lower pH poses the greatest hazard because it has the greatest capacity to dissolve lead from pipes and solder.
- **Home remedies, folk medicines, ethnic foods** can be a source of lead poisoning. Numerous case reports have documented this hazard,[13] and it appears to be especially common among ethnically isolated groups, including migrant children. Many ethnic products enjoyed by Hispanic families may be contaminated by lead. Seasonings may be contaminated due to the environments where they are processed and candies contaminated by the lead-ink wrappers they are packaged in. Other sources, such as grasshopper ingestion, have been linked to large "outbreaks" of lead poisoning in California Hispanic children.[14] It is unclear why the grasshoppers contained lead.
- **Imported lead- glazed ceramics and pottery** may contribute to lead exposure. The hazard becomes especially severe when lead-glazed pottery is used to store acidic foods such as fruit juices or salsa.

- **Toys, jewelry, and crafts** may also contain lead. The CDC website regularly posts recalled products. Examples include animal masks, pendants, plastic play sets, shoes, and fishing poles. The possibilities are numerous, so it is wise to check the CDC site periodically. Surface paints and coatings are the typical culprits.

Effects of Lead Poisoning

Lead is now recognized to produce a wide range of toxicity. These toxic effects extend from acute, clinically obvious poisoning to subclinical effects.[1]

- **Acute poisoning** can be caused by intense exposure to lead, characterized by abdominal colic, constipation, fatigue, anemia, peripheral neuropathy, and alteration of central nervous system function.[1] In severe cases, a full-blown acute encephalopathy with coma, convulsions, and papilledema may occur. In milder cases, only headache or personality changes are evident.[1] Children who have recovered from acute lead encephalopathy often are left with permanent neurologic and behavioral sequelae.[12,13]
- **Lower-dose exposures** to lead produce toxic effects, which are typically asymptomatic and become evident only on special testing. These effects are evident principally in the following three organ systems: the developing red blood cells, the kidneys, and the nervous system. Hypochromic microcytic anemia, often associated with iron deficiency, is the classic hematologic manifestation of lead poisoning. High lead levels also can produce basophilic stippling in red blood cells. In the kidneys, acute lead poisoning can produce a full-blown, but reversible, Fanconi syndrome. Chronic, low-dose exposure can produce renal fibrosis and hypertension.
- **Asymptomatic impairment to the nervous system** has been shown by extensive research to be caused by lead at levels too low to produce obvious encephalopathy. Asymptomatic school-aged children with elevated lead levels have been found to have significant decrements in verbal IQ scores.[12] This finding was still strongly evident after adjusting for a wide range of socioeconomic, behavioral, and biologic factors. Long-term follow-up of asymptomatic school-aged children with elevated lead levels has shown that they are at increased risk during adolescence for dyslexia, failure to graduate from high school, and delinquency.[1]
- **Early developmental delays:** A series of prospective studies of newborns[4,15] has found associations between early developmental delays and umbilical cord blood lead levels as low as 10 to 20 µg/dL. These findings, which are highly credible, have been accepted by the CDC[4] and by the National Academy of Sciences,[15] and are the basis for the CDC recommendation that the blood lead level of concern in children is 10 µg/dL.[4]

Medical Evaluation

Two fundamental principles must guide assessment of lead exposure in migrant farmworker children.

1. All migrant children 0 to 6 years of age must be considered to be at high risk of lead poisoning. Their high-risk status reflects their poverty and especially their residence in substandard housing that may contain lead paint. In addition, many migrant farmworker children come from cultures with unique risk factors for lead exposure. Mobility across borders escalates opportunities for exposures.
2. Because most pediatric lead poisoning today is asymptomatic, the only reliable means for establishing or excluding a diagnosis of lead poisoning is through determination of the blood lead level. Neither the medical history nor the physical examination can establish or exclude a diagnosis of lead poisoning. Blood for lead analysis may be obtained either by a finger prick or venipuncture. If a blood lead level greater than or equal to 10 µg/dL is found by a finger prick, it must be confirmed by venipuncture. The erythrocyte protoporphyrin (EP) test is no longer considered a reliable diagnostic tool for lead poisoning.

Note: All migrant farmworker children 0 to 6 years of age should receive a minimum of two lead tests – one at approximately 1 year of age and the second at age 2. If never previously tested, consider testing even in later childhood. If the blood lead level is greater than or equal to 10 µg/dL in either of these evaluations, if a household member has elevated blood lead levels, or if the healthcare professional suspects that a child is exposed to lead, then additional and more frequent blood lead determinations are indicated.

Diagnosis and Plan

A confirmed venous blood lead level in a child of 10 µg/dL or greater establishes a diagnosis of lead poisoning. The management of a child with an elevated blood lead level depends upon the magnitude of the elevation. Table 1 offers recommendations for children with confirmed elevated blood lead levels ≥10 µg/dL. These recommendations are excerpted from the CDC guidelines,[16] and endorsed by the American Academy of Pediatrics.[15] Table 2 offers the CDC schedule for follow-up blood lead testing.

CDC also recognizes that a blood lead level of 10 µg/dL does not define a threshold for the harmful effects of lead.[18] Recent studies offer strong evidence that physical and mental development of children can be affected at blood lead levels of less than 10 µg/dL. The CDC Advisory Committee on Childhood Lead Poisoning Prevention recommends providing anticipatory guidance to parents of all young children regarding sources of lead and helping them identify sources of lead in their child's environment.[17,19]

In addition to lead poisoning prevention education, MCN recommends considering retesting migrant children within 3 months with blood lead levels between 5 and 9 µg/dL.

Table 1. Summary of Recommendations for Children with Confirmed (Venous) Elevated Blood Lead Levels

Blood Lead Level (µg/dL)

10 - 14	15 - 19	20 - 44	45 - 69	>70
Lead education – Dietary – Environmental Follow-up blood lead monitoring	Lead education – Dietary – Environmental Follow-up blood lead monitoring Proceed according to actions for 20-44 µg/dL if: – A follow-up BLL is in this range at least 3 months after initial venous test **or** – BLLs increase	Lead education – Dietary – Environmental Follow-up blood lead monitoring Complete history and physical exam Lab work: – Hemoglobin or – hematocrit – Iron status Environmental investigation Lead hazard reduction Neurodevelopmental monitoring Abdominal X-ray (if particulate lead ingestion is suspected) with bowel decontamination if indicated	Lead education – Dietary – Environmental Follow-up blood lead monitoring Complete history and physical exam Lab work: – Hemoglobin or – hematocrit – Iron status – FEP or ZPP Environmental investigation Lead hazard reduction Neurodevelopmental monitoring Abdominal X-ray with bowel decontamination if indicated Chelation therapy	Hospitalize and commence chelation therapy Proceed according to actions for 45-69 µg/dL

The following actions are NOT recommended at any blood lead level:

- Searching for gingival lead lines
- Testing of neurophysiologic function
- Evaluation of renal function (except during chelation with EDTA)
- Testing of hair, teeth, or fingernails for lead
- Radiographic imaging of long bones
- X-ray fluorescence of long bones

Source: Centers for Disease Control and Prevention. Managing Elevated Blood Levels Among Young Children: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta: CDC; 2002.

Table 2 Schedule for Follow-Up Blood Lead Testing[a]

Venous blood lead level (µg/dL)	Early follow-up (first 2-4 tests after identification)	Late follow-up (after BLL begins to decline)
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] Seasonal variation of BLLs exists and may be more apparent in colder climate areas. Greater exposure in the summer months may necessitate more frequent follow ups.

[b] Some case managers or PCPs may choose to repeat blood lead tests on all new patients within a month to ensure that their BLL level is not rising more quickly than anticipated.

Source: Centers for Disease Control and Prevention. Managing Elevated Blood Levels Among Young Children: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta: CDC; 2002.

The long-term goal of management is to prevent recurrence of lead poisoning in the affected child and also to prevent poisoning in siblings and in playmates. The worst tragedy is to discharge a child home after treatment only to have lead poisoning recur because the child is re-exposed.

Resources for Referral and Consultation

- Pediatric Environmental Health Specialty Units (PEHSU) offer medical information and advice on environmental conditions that influence children's health. PEHSUs are academically based, typically at university medical centers, and are located across the United States, Canada and Mexico. These PEHSU form a network that is capable of responding to requests for information throughout North America and offering advice on prevention, diagnosis, management, and treatment of environmentally-related health effects in children. To find your regional PEHSU, contact the Association of Occupational and Environmental Clinics at www.aoec.org or (888) 347- 2632.
- The CDC offers a listing of state and local lead programs and appropriate health department contacts at http://www.cdc.gov/nceh/lead/programs.htm

Resources for Education and Prevention

- Centers for Disease Control
  (800-232-4636)
  24 Hours/Every Day
  cdcinfo@cdc.gov
  http://www.cdc.gov/nceh/lead/
- The Migrant Clinicians Network website has numerous lead resources — downloadable Spanish language patient education materials, clinical resources targeting primary care providers, and links to other organizations on its lead web page: http://www.migrantclinician.org/clinical_topics/lead.html

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Lead Guidelines for the Pregnant Migrant Woman

Background

Migrant women may not be recognized as being particularly at risk for lead exposure. Yet they possess a host of risk factors: frequent mobility with residential stays in substandard housing; intermittent work in hazardous occupations; avoidance of reporting illness; environmental exposures related to country of origin; self-importation of products that contain lead; and linguistic, cultural, and access barriers to health education and prevention efforts related to lead.

Routine screening of pregnant women is not currently recommended by any national organizations. Neither is there significant research on the value of such screening. The US Preventive Services Task Force (USPSTF) cites declining levels of blood lead levels in children and a lack of evidence related to the safety of treatment for lead poisoning in pregnancy to support the conclusion that the benefits of screening and treatment do not outweigh the potential harms.[1] Because the migrant population possesses a variety of risk factors for lead exposure,[2] however, the Migrant Clinicians Network recommends that perinatal providers maintain a high level of suspicion for lead exposure and consider routine screening.

With chronic current or past exposure lead is deposited in bone. During pregnancy, as calcium is mobilized from the bone, lead is also released and transfers to the fetus via the placenta. Lead poisoning in turn is the most common disease of toxic environmental origin among children in the United States today.[3] The Centers for Disease Control and Prevention (CDC) estimates that 250,000 children aged 1 to 5 years currently have blood lead levels of 10 µg/dL or greater.[4] Exposure to lead can result in neurological sequelae for the infant and may represent a risk to the mother also.

Guidelines for appropriate screening and treatment of pregnant migrant women are outlined in the sections that follow.

Sources of Lead

Pathways of lead absorption include ingestion, inhalation and maternal fetal transfer via the placenta. Some common sources of exposure for the migrant population are listed here.

- **Lead-based paint** continues to be the principal source of high-dose lead exposure for children and can be a factor for adults also. An estimated 57 million housing units in the United States contain lead-based paint. Risk of exposure to lead from paint in housing built before 1978 is especially high; these conditions exist in an estimated 3.8 million US homes with young children.[5] Lead may be directly absorbed from paint by ingesting paint chips (pica) or, more commonly, by ingestion and inhalation of lead-contaminated house dust.
- **Contaminated dust and soil** are pervasive sources of lead exposure.[6] Concentrations of lead in dust and soil range from near zero to many thousands of parts per million (ppm). Pica practices can result in lead exposure through ingestion of soil or clay.[6]
- **Drinking water** is a common source of low-level lead exposure.[7] Although high concentrations of lead in drinking water occur only in unusual circumstances (such as storage of water in lead-lined tanks), lead in water contributes widely to background exposure. At its source, drinking water is almost always lead-free. Water can, however, become contaminated as it passes through lead pipes or comes into contact with lead solder or brass faucets. Soft water of lower pH poses the greatest hazard because it has the greatest capacity to dissolve lead from pipes and solder.
- **Home remedies, folk medicines, ethnic foods** can be a source of lead poisoning. Numerous case reports have documented this hazard[8] and it appears to be especially common among ethnically isolated groups, including migrant children. Many ethnic products enjoyed by Hispanic families may be contaminated by lead. Seasonings may be contaminated due to the environments where they are processed and candies contaminated by the lead-ink wrappers they are packaged in. Other sources, such as grasshopper ingestion has been linked to large "outbreaks" of lead poisoning in California.[9]

- **Imported lead- glazed ceramics and pottery** may contribute to lead exposure. The hazard becomes especially severe when lead-glazed pottery is used to store acidic foods such as fruit juices or salsa.
- **Toys, jewelry, and crafts** may also contain lead. The CDC website regularly posts recalled products. Examples include animal masks, pendants, plastic play sets, shoes, and fishing poles. The possibilities are numerous, so it is wise to check the CDC site periodically. Surface paints and coatings are the typical culprits.

[See Tables 1 and 2 for additional information about high-risk occupations and other sources of lead exposure.]

Effects of Lead Poisoning

High maternal blood lead levels (BLL) (> 10 µg/dL) can lead to fetal lead exposure resulting in behavioral problems and learning difficulties in the child, and place the mother at risk for pregnancy complications such as miscarriage and low birth weight.[10] Studies in children suggest that the risk of neurological sequelae exists at a lower BLL (5 µg/dL), previously thought to be safe. There is limited research on perinatal lead exposure, but theoretical risk suggests that interventions should be initiated at these lower BLLs.

A range of effects of lead poisoning can occur in the pregnant woman and her newborn, including:

- **Acute poisoning** can be caused by intense exposure to lead, characterized by abdominal colic, constipation, fatigue, anemia, peripheral neuropathy, and alteration of central nervous system function.[3] In severe cases, a full-blown acute encephalopathy with coma, convulsions, and papilledema may occur. In milder cases, only headache or personality changes are evident.[3]
- **Lower-dose exposures** to lead produce toxic effects, which are typically asymptomatic and become evident only on special testing. These effects are evident principally in the following three organ systems: the developing red blood cells, the kidneys, and the nervous system. Hypochromic microcytic anemia, often associated with iron deficiency, is the classic hematologic manifestation of lead poisoning. High lead levels also can produce basophilic stippling in red blood cells. In the kidneys, acute lead poisoning can produce a full-blown, but reversible, Fanconi syndrome. Chronic, low-dose exposure can produce renal fibrosis and hypertension.
- **Asymptomatic impairment to the nervous system** has been shown by extensive research to be caused by lead at levels too low to produce obvious encephalopathy. Asymptomatic school-aged children with elevated lead levels have been found to have significant decrements in verbal IQ scores.[7] This finding was still strongly evident after adjusting for a wide range of socioeconomic, behavioral, and biologic factors. Long-term follow-up of asymptomatic school-aged children with elevated lead levels has shown that they are at increased risk during adolescence for dyslexia, failure to graduate from high school, and delinquency.[11]
- **Early developmental delays**: Most recently, a series of prospective studies of newboms[12,13] has found associations between early developmental delays and umbilical cord blood lead levels as low as 10 to 20 µg/dL.

Medical Evaluation

[**Note:** The following screening and treatment guidelines are adapted from the New York State Department of Health *Lead Poisoning Prevention Guidelines for Prenatal Care Providers*[14] and *Protocol: Lead Screening and Lead Poisoning Management in Pregnancy* by Susanna Cohen, CNM, MS.[15]]

Summary:

- All pregnant women should receive anticipatory guidance on preventing lead poisoning during pregnancy. They should be informed about the major sources of lead in the environment and the means of preventing exposure.
- At the initial prenatal visit, health care providers should assess a woman's risk for current high dose lead exposure. For perinatal providers working with a patient population that consists of large numbers of women who are migrant farmworkers, foreign-born immigrants, and/or Hispanic, routine screening is recommended. The questions below are suggested screening questions appropriate for a Hispanic migrant/immigrant population.

- Those women found to be at risk for current high dose exposure should be tested for blood lead levels and counseled on how to reduce or eliminate current exposure.
- Women found to have a blood lead level of 10 micrograms per deciliter (µg/dL) or greater, should receive additional risk reduction counseling based on their responses to the risk assessment. There is currently no medical treatment recommended for women with elevated lead levels during pregnancy. Women who may be occupationally exposed should be referred to an Occupational Health Clinic for individual guidance.
- At the postpartum visit, providers should advise all women about the major causes of lead poisoning in infants and the means of preventing exposure.

1. Screening

The following questions are suggested to determine if a pregnant woman is at risk for current high dose exposure to lead. They are adapted from other risk assessment questionnaires and are appropriate for migrant or immigrant women. Translations are provided for those who are Spanish speakers. [See Tables 1 and 2 for additional information about high-risk occupations and other sources of lead exposure.]

A. Were you born, or have you spent any time, outside of the United States?
¿Usted nació o estuvo algun tiempo fuera de los Estados Unidos?

B. During the past 12 months, did you use any imported health remedies, spices, foods, ceramics, or cosmetics?
¿En los últimos 12 meses, ha usado cosas importadas como ollas o platos hechas de cerámica, remedios caseros, cosméticos, comidas?

C. At any time during your pregnancy, did you eat, chew on, or mouth non-food items such as clay, crushed pottery, soil, or paint chips?
¿Durante este embarazo, ha comido o masticado algunas cosas como barro, cerámica, tierra o pedazos de pintura?

D. In the last 12 months, has there been any renovation or repair work in your home or apartment building?
¿Durante los últimos 12 meses habia trabajo de reparaciones en su casa o apartamento?

E. Have you or anyone in your family ever had a job or hobby that involved possible lead exposure, such as home renovation or working with glass, ceramics, or jewelry?
¿Ha tenido un trabajo que incluye el plomo como trabajo de reparaciones caseras, trabajo con vidrio, cerámica, o joyeria, o alguien de su familia?

2. Testing

Testing is not recommended for women who are not at risk. If the woman answers "yes" to any of the screening questions, she is at risk for lead exposure, and should have a blood lead test. Given the relatively low incidence of elevated lead levels in pregnancy, it is suggested that unless a woman responds "yes" to a risk assessment question, she not be tested unless there is other reason to suspect potential ongoing exposure to lead. A blood lead test during pregnancy is not indicated for a previous history of childhood lead exposure.

3. Patient Education/Anticipatory Guidance

The Migrant Clinicians Network offers resources and educational materials particularly suited to those who serve migrant workers and the mobile poor: www.migrantclinician.org

Methods to Reduce Lead Exposure in Pregnant Women – Do's and Don'ts

- Do discuss with your employer ways to reduce possible lead exposure on the job.
- Do damp mop and damp dust rather than sweep and dry dust.
- Do avoid drinking acidic liquids from imported ceramic cups, mugs or from leaded crystal.
- Do avoid the use of traditional folk remedies or cosmetics which might contain lead.
- Do avoid lead-related crafts to avoid exposure to lead.
- Do wash hands thoroughly before meal preparation.
- Do run water from the faucet for at least a minute until it runs cold before collecting for drinking and cooking.
- Don't be in the home when renovations that may involve lead-based paint are taking place.
- Don't clean up after renovations involving lead-based paint.
- Don't strip paint from antique furniture, such as cribs and rocking chairs.
- Don't store food in open imported cans.

Nutrition

Poor nutrition associated with migrant populations makes the recommendations below especially important to consider.

- Eat frequent and regular meals. Environmental lead is more easily absorbed on an empty stomach.
- Iron or calcium deficits promote lead absorption. A diet rich in iron and calcium reduces the absorption of lead. Calcium supplements made from bone should be avoided as they may contain lead.
- Breastfeeding is generally safe even if a woman has an elevated blood lead level. However, if a mother with an elevated blood lead level is breastfeeding, the infant's blood lead level should be carefully and frequently monitored. (See **Diagnosis and Management** for details.)

Postpartum Education to Prevent Lead Poisoning In Infants

- Breast milk usually is best for babies, even if your blood lead level is elevated.
- If baby formula is used, take care when preparing it. Use cold tap water – not hot – to make infant formula. Let the cold water run for at least a minute, to flush any lead picked up from the pipes. Purchase bottled water if the home's drinking water exceeds the U.S. Environmental Protection Agency's action level of 15 ppb (µg/L).
- Feed your baby foods that get ahead of lead. Iron fortified formula and cereals can lower your baby's lead risk. Serving foods that are high in iron and calcium can help lower the family's lead risk.
- If your baby uses a pacifier, obtain one that can be attached to your baby's shirt so it won't fall on the floor. Wash the pacifier often. This will help remove any lead dust.
- Wash your baby's hands and toys often. Babies suck their fingers and put things in their mouths - things that might have lead dust on them. Washing helps lower the lead risk.
- Take your baby for regular health care visits and follow the health provider's lead test advice. All children should be tested by their first birthday, and again when they are two years of age.

4. Diagnosis and Management

The following chart represents management recommendations for pregnant women, adapted for the migrant population.

Medical Management of Pregnant Women Based on Blood Lead Levels

BLL (µg/dL)	Interventions	Time Frame for Interventions	Frequency of BLL Follow-up Testing
5 – 9	• Assess for risk factors in greater detail. • Provide risk reduction education and handouts. • Evaluate for adequate intake of calcium, iron, and vitamin C.* • CBC, TIBC, Serum Ferritin, Serum Iron to r/o concomitant Iron deficiency • Monitor BLL. • Coordinate with Pediatrics for follow-up of newborn • Anticipatory guidance regarding infant care	Within 30 days	• Repeat after interval of at least 1 month to assess trend. • If not increasing, repeat in 3rd trimester
10 – 19	**Above actions, plus:** • Consider occupational exposure or other sources • Refer to an occupational health clinic if potential occupational exposure is found (see www.aoec.org for clinic). • Provide Iron, Vitamin C and Calcium (non-bone) supplementation PRN.	Within 30 days	Repeat after interval of at least 1 month to assess trend. If BLL 10-19, repeat in third trimester. If repeat test >20, see actions below. Obtain a maternal BLL or umbilical cord lead level (UCLL) at birth if maternal BLL > 10 at anytime during the pregnancy.
20 – 44	**Above actions, plus:** • Evaluate for other symptoms.† • Refer woman to the local health agency for environmental investigation and abatement if occupational exposure, hobbies and folk remedies have been ruled out as a source of lead exposure. • For advice about patient counseling concerning teratogenic effects, consult a Teratogen Information Service (see www.otispregnancy.org).	Within 2 weeks	Within 2 weeks and then monthly to assess efficacy of case management Obtain a maternal BLL or umbilical cord lead level (UCLL) at birth if maternal BLL > 10 at anytime during the pregnancy. Rescreen for maternal BLL at 1 month PP if BLL > 10 anytime during the pregnancy
>45	**Above actions, plus:** • Consult with lead poisoning specialist to consider hospitalization and chelation with CaNa2EDTA if pregnancy is in late 2nd or 3rd trimester • Immediate removal from the contaminated environment may be indicated.	Within 24 hours	Within 24 hours and then at frequent intervals depending on clinical management and BLL trend Obtain a maternal BLL or umbilical cord lead level UCLL at birth if maternal BLL > 10 at anytime during the pregnancy. Rescreen for maternal BLL at 1 month PP if BLL > 10 anytime during the pregnancy
Postpartum/ Newborn	• Provide postpartum education to mother. • Coordinate care with pediatric provider. • Breastfeeding is generally safe for women with elevated BLL. • If the infant's blood lead level is 10 g/dL or greater and rising, and no remediable environmental source of lead can be detected, breastfeeding should be discouraged.		If maternal BLL > 10 at anytime during the pregnancy, test infant's BLL within 2 weeks of baseline and at least monthly.

Adapted from New York State Department of Health Guidelines (14)and New City Department of Health and Mental Hygiene Guidelines.[16]

*Adequate 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 lead excretion.

† The majority of adults have no symptoms of lead poisoning. Symptoms including headaches, crampy abdominal pain, anorexia, constipation, fatigue, malaise, myalgias, and arthralgias typically occur at BLLs ≥60 µg/dL, but can occur at BLLs ≥25µg/dL.

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TABLE 1. Jobs and Industries with Potential Lead Exposure

Note that agriculture often contains these aspects of work.

GENERAL

Lead production or smelting
Brass, bronze, copper, or lead foundries
Ammunition/explosives production
Scrap metal handling
Firing ranges
Machining or grinding lead alloys
Manufacture of radiation shielding
Repair/replacement of refractory material in furnaces
Ship building/repairing/breaking
Mining

INDUSTRY

Battery manufacturing or recycling
Automotive radiator repair
Lead soldering
Ceramic manufacturing
Cable/wire stripping, splicing or production
Rubber manufacturing
Plastics manufacturing
Leaded glass manufacturing
Paint/pigment manufacturing

CONSTRUCTION

Renovation, repair or demolition of structures with lead paint
Welding or torch-cutting painted metal
Sandblasting, sanding, scraping, burning, or disturbing lead paint
Use or disturbance of lead solder, sheeting, flashing, or old electrical conduit
Plumbing, particularly in older buildings

TABLE 2. Some Common Non-occupational and Environmental Sources of Lead Exposure

Immigration should be recognized as an environmental risk: Asia, Mexico and Central America have particularly high levels of lead still available in everyday products. Industrial pollution in Asia is a well-known source.

Remodeling or painting pre-1978 housing
Peeling paint
Ethnic medicines or folk remedies (e.g., azarcón, greta, pay-loo-ah, kandu, some Ayurvedics)
Ethnic Foods such as fried grasshoppers, self-imported spices, and candies. The wrappers of these foods may also contain lead, as has been shown with candies.
Pica (ingestion of lead-containing nonfood items, e.g., soil or ceramics, plaster, or paint chips)
Retained lead bullet or fragments
Melting lead for fishing weights, bullets, or toys
Lead solder in stained-glass artwork
Lead-soldered cans
Lead-contaminated candies
Backyard scrap metal recycling
Moonshine (liquor from a homemade still)
Antique pewter plates, mugs, utensils, toys
Imported brass or bronze kettles, cookware, lead-glazed tableware or cooking vessels
Leaded crystal tableware
Mine tailings
Beauty products such as kohl eye make-up, certain hair dyes
Imported toys

Screening Tool for Lead Exposure in Pregnant Migrant Women

The following questions are suggested to determine if a pregnant woman is at risk for current high dose exposure to lead. They are adapted from other risk assessment questionnaires and are appropriate for migrant or immigrant women. Translations are provided for those who are Spanish speakers. [See MCN Lead Guidelines for Pregnant Women for additional information]

Were you born, or have you spent any time, outside of the United States?	☐ Yes	☐ No
¿Usted nació o estuvo algun tiempo fuera de los Estados Unidos?	☐ Sí	☐ No
During the past 12 months, did you use any imported health remedies, spices, foods, ceramics, or cosmetics?	☐ Yes	☐ No
¿En los últimos 12 meses, ha usado cosas importadas como ollas o platos hechas de cerámica, remedios caseros, cosméticos, comidas?	☐ Sí	☐ No
At any time during your pregnancy, did you eat, chew on, or mouth non-food items such as clay, crushed pottery, soil, or paint chips?	☐ Yes	☐ No
¿Durante este embarazo, ha comido o masticado algunas cosas como barro, cerámica, tierra o pedazos de pintura?	☐ Sí	☐ No
In the last 12 months, has there been any renovation or repair work in your home or apartment building?	☐ Yes	☐ No
¿Durante los últimos 12 meses habia trabajo de reparaciones en su casa o apartamento?	☐ Sí	☐ No
Have you or anyone in your family ever had a job or hobby that involved possible lead exposure, such as home renovation or working with glass, ceramics, or jewelry?	☐ Yes	☐ No
¿Ha tenido un trabajo que incluye el plomo como trabajo de reparaciones caseras, trabajo con vidrio, cerámica, o joyeria, o alguien de su familia?	☐ Sí	☐ No

If the woman answers "yes" to any of the screening questions, she is at risk for lead exposure, and should have a blood lead test.

Testing is not recommended for women who are not at risk.

MIGRANT CLINICIANS NETWORK
www.migrantclinician.org

10/09

Lead Guidelines for Primary Care Providers Caring for the Adult Migrant Worker

Introduction

This guideline is intended to provide useful advice to primary care clinicians caring for adult migrant patients who have been exposed to lead, whether at work, at home, in their country of origin, through hobbies, in the community, or through consumer products, retained bullets, or other sources. These guidelines have been adapted to the migrant population from the **California Department of Public Health Occupational Lead Poisoning Prevention Program Medical Guidelines for the Lead-Exposed Worker, updated April 2009**, and are intended to provide management guidelines appropriate for the primary care setting. For additional treatment information appropriate to the occupational health setting, consult the guidelines at http://www.cdph.ca.gov/programs/olppp/Documents/medgdln.pdf or other resources cited in this guideline. In attending a migrant patient with possible lead exposure or toxicity, consider the following points:

- Clinicians who evaluate patients with potential lead exposure should have appropriate public health and occupational health referral mechanisms in place for medical management and evaluation of the workplace. Although a primary goal of health care is to remove the patient from exposure, the social consequences of potential disruption of housing or of income are particularly relevant to farmworkers and must be considered by the clinician.
- Although the federal Occupational Safety and Health Administration's (OSHA) lead standards have provided guidance that has been beneficial for lead-exposed workers, these regulations have not been substantially changed since the late 1970s, and thus are primarily based on health effects studies that are well over three decades old. Nor do they adequately address long-term effects. There is an urgent need to revise them.
- The clinical guidelines presented here are appropriate for adults. They are not targeted to younger adults. Many "adult" farmworkers are adolescents who may be at greater neurodevelopmental risk than their older counterparts. See the MCN publication "Lead Guidelines for Primary Care Providers Caring for Migrant Children".
- Adult workers may include pregnant women and reproductive health risks and effects are addressed in this guideline. More detailed information relevant to the management of lead exposure in pregnant women, however, is treated as a separate problem because the guidelines differ from those for the general adult population. See the MCN publication "Lead Guidelines for the Pregnant Migrant Woman".

Background

Lead exposure may occur in more than 100 industries in the United States (Table 1). Although the toxic effects of lead have been known for centuries, harmful lead exposures are still widespread. Adults are primarily exposed in the workplace. Lead affects multiple body systems and can cause permanent damage. Lead exposure, if undetected, often results in misdiagnosis and costly care. Many workers with lead toxicity do not receive medical attention and, for those who do, follow-up may not be adequate to prevent future lead poisoning.[1] Studies have shown that only a small percentage of employers in some lead industries provide routine blood lead testing for lead-exposed employees in spite of regulatory requirements.[2,3]

Adult migrant workers are generally not recognized as particularly at risk for lead exposure. Yet they experience a host of risk factors: frequent mobility with residential stays in substandard housing; intermittent work in hazardous occupations such as construction; work within the farm that includes lead exposure; dependence on day labor and avoidance of reporting illness; environmental exposures related to country of origin; self-importation of ethnic products that contain lead; and linguistic, cultural, and access barriers to health education and prevention efforts related to lead.

Lead is not an essential element and serves no useful purpose in the body. Acute, high-dose lead poisoning with findings such as headache, malaise, and crampy abdominal pain is now relatively uncommon. However, low exposures that in the past were without recognized harm are now considered hazardous as new information continues to emerge about the toxicity of low dose and cumulative lead exposures. Efforts to reduce lead in the environment have resulted in a decline

TABLE 1. JOBS AND INDUSTRIES WITH POTENTIAL LEAD EXPOSURE

Industry Type	Work Activities
General Industry	Lead production or smelting Battery manufacturing or recycling Brass, bronze, or lead foundries Metal radiator repair Scrap metal handling Recycling of lead-sheathed cables Lead soldering Firing ranges Ceramics manufacturing Machining or grinding metal alloys containing lead Plastics manufacturing
Construction Industry	Sanding, scraping, burning, or disturbing lead paint Demolition of old structures Welding or torch cutting lead painted metal Abrasive blasting Construction or repair of bridges, water towers, tanks, roofing Lead abatement Painting—residential or commercial Renovation or remodeling structures built before 1978 Welding on metal structures

in the geometric mean blood lead level (BLL) for adults in the United States from more than 12 micrograms of lead per deciliter of blood (mcg or µg/dL) in 1980 to less than 2 µg/dL in 2002.[4] However, even though the average BLL in the general population has markedly declined, many workers with high-risk jobs are still overexposed to lead. Exposures in the U.S. are primarily to the inorganic form of lead.

Sources of Lead

Routes of exposure for inorganic lead are inhalation and ingestion. Lead fumes and soluble lead dust are nearly completely (~80%) absorbed by inhalation. In general, adults absorb about 10-15% of an ingested dose through the gastrointestinal tract, in contrast to 50% absorption for children. Once absorbed, lead is found in all tissues but eventually 90% or more of the body burden is accumulated (or redistributed) into bone. Lead does not remain in the bone permanently; rather, it is slowly released back into the blood with a half-life of years to decades. Lead is excreted primarily through the urine with smaller amounts in feces, sweat, hair, and nails.

Job activities known to involve the use or disturbance of lead include: handling of lead-containing powders, liquids, or pastes; production of dust or fumes by melting, burning, cutting, drilling, machining, sanding, scraping, grinding, polishing, etching, blasting, torching, or welding lead-containing solids; and dry sweeping of lead-containing dust and debris. Adults also encounter lead in environmental settings and through activities such as home remodeling, particularly in homes built before 1978 that contain lead-based paint, lead-contaminated consumer products, traditional remedies, moonshine whiskey, hobbies, such as melting lead sinkers or use of target ranges, from retained bullets, and through other sources.

Agricultural work may involve machinery repair, construction, blasting, welding, renovation, and cleaning of lead-based materials. Farmworker housing is typically substandard and even if freshly painted, may contain lead dust in the dirt surrounding the dwelling. Cooking materials, from spices to pottery to pots and pans, may contain lead if they were not manufactured in the US. Many migrant workers are not responsible for their own cooking, so the source of the crew's food preparation must be noted.

TABLE 2. SOME COMMON NON-OCCUPATIONAL AND ENVIRONMENTAL SOURCES OF LEAD EXPOSURE

Immigration should be recognized as an environmental risk: Asia, Mexico and Central America have particularly high levels of lead still present in everyday products. Industrial pollution in Asia is a well-known source.

- Remodeling or painting pre-1978 housing
- Peeling paint
- Ethnic medicines or folk remedies (e.g. azarcón, greta, pay-loo-ah, kandu, some Ayuverdics)
- Ethnic foods such as fried grasshoppers, self-imported spices, and candies. The wrappers of these foods may also contain lead, as has been shown with candies.
- Pica (ingestion of lead-containing nonfood items, e.g., soil or ceramics, plaster, or paint chips)
- Retained lead bullet or fragments
- Melting lead for fishing weights, bullets or toys
- Lead solder in stained-glass artwork
- Lead-soldered cans
- Lead-contaminated candies
- Backyard scrap metal recycling
- Moonshine (liquor from a homemade still)
- Antique pewter plates, mugs, utensils, toys
- Imported brass or bronze kettles, cookware
- Lead-glazed tableware or cooking vessels
- Leaded crystal tableware
- Mine tailings
- Beauty products such as kohl eye make-up, certain hair dyes
- Imported toys
- Imported vinyl miniblinds
- Recreational target shooting
- Lead-contaminated drinking water supply
- Using lead glazes for ceramics, food dishes, and cookware. Acidic foods like salsa can leach even more lead from these containers.
- Painting/stripping cars, boats, bicycles

TABLE 3. SYMPTOMS ASSOCIATED WITH LEAD TOXICITY

Mild Toxicity:	Mild fatigue or exhaustion; emotional irritability or lability; difficulty concentrating; sleep disturbances
Moderate Toxicity:	Headache; general fatigue or somnolence; myalgia, arthralgia, tremor; nausea; decreased appetite; abdominal cramps, constipation or diarrhea; decreased libido
Severe Toxicity:	Colic (intermittent, severe abdominal cramps); peripheral neuropathy; encephalopathy

There are some well documented exposures related to ethnic foods and treats. Grasshoppers are considered a delicacy by people from the area of Oaxaca, Mexico. Both the grasshoppers, and the spices they are cooked in, have been found to have very high lead levels. Public health campaigns have tried to remove these items from local tiendas, but the practice continues and is not regulated. Some candies brought from Central America and Mexico have been found to contain lead, as have the wrappers. Many medicines are sent to migrants from family members in their home countries, and it is unclear how many of these traditional and prescription medicines contain lead. Recently, large levels of lead were found in vitamins imported from India. Environmental exposures that occurred in immigrants' countries of origin can result in long-term bone storage with ongoing release into the bloodstream.

See Tables 1 and 2 for additional information about high-risk occupations and other sources of lead exposure.

Effects of Lead Poisoning

Lead adversely affects multiple organ systems and can cause permanent damage. In addition to the symptoms associated with acute, high-dose exposures, there is increasing concern with regard to the sometimes subclinical health effects linked to chronic, lower-dose exposures including hypertension, effects on renal function, cognitive dysfunction, and adverse female reproductive outcomes. Current concern over the adverse health risks associated with lead exposure in adults starts at a BLL of 5 µg/dL for adverse female reproductive outcomes and at 10 µg/dL for the other health effects listed above.[5]

In general, the number and severity of overt symptoms worsen with increasing BLL (Table 3). Early symptoms are often subtle and nonspecific, involving the nervous system (fatigue, irritability, sleep disturbance, headache, difficulty concentrating, decreased libido), the gastrointestinal system (abdominal cramps, anorexia, nausea, constipation, diarrhea), or the musculoskeletal system (arthralgia, myalgia). A high level of intoxication can result in delirium, seizures, and coma associated with lead encephalopathy, a life-threatening condition. Symptoms may lag physiological changes. Some individuals may be unaware of any symptoms even though they are experiencing lead toxicity.

Research shows multiple health effects at BLLs once thought to be without recognized harm (Table 4).[5] A recent review concluded that evidence is now sufficient to infer a causal relationship of lead exposure with hypertension.[6] Since hypertension is a significant risk factor for heart disease, stroke, and renal insufficiency, lead exposure may exert an important influence on cardiovascular, cerebrovascular, and renovascular mortality.

Early kidney damage is difficult to detect. However, a 10 µg/dL increase in BLL has been associated with a 10.4 mL/minute decrease in creatinine clearance.[7] In a population of older men with a mean BLL of 8.6 µg/dL (range 0.2-54.1), a 10-fold increase in BLL predicted an increase of 0.08 mg/dL in serum creatinine concentration, roughly equivalent to 20 years of aging.[8] Another recent review concluded that there is an association between BLLs and decrements in cognitive function in adults.[9] A study of currently exposed lead workers (mean age 40.4 years) showed that a 5 µg/dL increase in BLL had the same negative influence on cognitive function as an increase of 1.05 years of age.[10] Subclinical slowing of nerve conduction velocity has been seen at BLLs as low as 30 µg/dL.[11] Because of the blood-brain barrier, lead and other heavy metals are slow to enter and leave the brain tissue. Central nervous system effects may sometimes persist well after the BLL has dropped. These effects may negatively impact job performance and safety.

While a decrease in hemoglobin was previously associated with BLLs above 50 µg/dL, a study using K-shell X-ray fluorescence measurement of lead in bone has found that bone lead levels were significantly correlated with a decrease in hemoglobin and hematocrit even though BLLs were low (mean 8.3 µg/dL); this may reflect a subclinical effect of bone lead stores on hematopoiesis.[12]

Abnormal sperm morphology and decreased sperm count have been observed at approximately 40 µg/dL.[13,14] In a cohort of 668 pregnant women seeking prenatal care in Mexico City, it was found that women whose BLLs were 5-9, 10-14, and > 15 µg/dL had elevated odds ratios for spontaneous abortion of 2.3, 5.4, and 12.2, respectively, as compared with the reference category of women with < 5 µg/dL of blood lead.[15] Lead readily crosses the placenta and is present in breast milk.[16] Lead exposure during pregnancy affects children's physical development measured during the neonatal period and in early childhood.[17,18,19] Elevated maternal BLLs have also been associated with poorer infant mental development and adverse impacts on postnatal neurobehavioral development.[20,21,22]

Household members of workers with lead exposure are at increased risk for lead poisoning if lead is carried home on the worker's body, clothes, shoes, or in the personal vehicle (called "take-home" exposure). Children under six years old and the fetus are especially sensitive to neurological damage. Available evidence suggests there is no BLL without risk of health effects in these populations.[23]

Medical Evaluation

Screening

Taking a detailed medical and environmental/occupational history is a fundamental step in both determining whether a patient should receive BLL testing and for the assessment of a person with lead exposure. It is important to ask about exposure to lead in current and previous jobs (Table I), protections used, biological and air monitoring data, hygiene practices, knowledge and training, hobbies, traditional medications and foods, imported, cookware and cosmetics, moonshine use and other non-occupational sources (Table 2). Immigration from Asia, Central America, or Mexico is an independent risk factor. A medical and reproductive history is essential in identifying individuals at increased risk of adverse health effects from lead exposure. Physical exam findings in lead poisoning are frequently lacking. Gingival lead lines and wrist or foot drop, manifestations of high lead exposures, are rarely seen.

TABLE 4. HEALTH-BASED MANAGEMENT RECOMMENDATIONS FOR LEAD-EXPOSED ADULTS

Blood Lead Level (BLL) µg/dL	Short Term Risks Lead exposure < 1 year	Long Term Risks Lead exposure ≥1 year	Management
< 5	None documented	None documented	
5 – 9	Possible spontaneous abortion Possible postnatal developmental delay	Possible spontaneous abortion Possible postnatal developmental delay Possible hypertension and kidney dysfunction	Discuss health risks Reduce lead exposure for women who are or may become pregnant
10 – 19	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight Hypertension and kidney dysfunction Possible subclinical neurocognitive deficits	As above for BLL 5-9 µg/dL, plus: Decrease lead exposure Increase biological monitoring Consider removal from lead exposure to avoid long-term risks if exposure control over an extended period does not decrease BLL below 10 µg/dL, or if medical condition present that increases risk with continued exposure*
20-29	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight Hypertension and kidney dysfunction Possible subclinical neurocognitive deficits	Remove from lead exposure if repeat BLL measured in 4 weeks remains ≥ 20 µg/dL
30-39	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Hypertension and kidney dysfunction Possible neurocognitive deficits Possible non-specific symptoms**	Remove from lead exposure
40-79	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Non-specific symptoms** Neurocognitive deficits Sperm abnormalities	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Non-specific symptoms** Hypertension Kidney dysfunction/nephropathy Subclinical peripheral neuropathy Neurocognitive deficits Sperm abnormalities Anemia Colic Possible gout	Remove from lead exposure Refer for prompt medical evaluation Consider chelation therapy for BLL over 50 µg/dL with significant symptoms or signs of lead toxicity
≥80	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Non-specific symptoms** Neurocognitive deficits Encephalopathy Sperm abnormalities Anemia Colic	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight Non-specific symptoms** Hypertension Nephropathy Peripheral neuropathy Neurocognitive deficits Sperm abnormalities Anemia Colic Gout	Remove from lead exposure Refer for immediate/urgent medical evaluation Probable chelation therapy

* Medical conditions that may increase the risk of continued exposure include chronic renal dysfunction (serum creatinine > 1.5 mg/dL for men, > 1.3 mg/dL for women, or proteinuria), hypertension, neurological disorders, and cognitive dysfunction.

** Headache, fatigue, sleep disturbance, anorexia, constipation, arthralgia, myalgia, decreased libido, etc.

See Figure 1 for a suggested set of environmental and occupational health screening questions for the primary care setting. This tool was developed by the Migrant Clinicians Network with guidance from the Environmental and Occupational Medicine Residency Directors Association and endorsed by the Association for Occupational and Environmental Clinics. As a first line of screening, it is likely to reveal individuals who are at risk for lead exposure.

Figure 1.
Environmental and Occupational Health Screening Questions for the Primary Care Setting.

1. (Occupation) Describe what you do for work.
2. (Activities and Cause) Are there any physical activities that you do – at work or away from work – that you feel are harmful to you?
3. (Substances/Physical Hazards and Cause) Are you exposed to chemicals, fumes, dusts, noise, and/or high heat at your work or away from work? Do you think these are harming you?

Figura 1.
Preguntas para sondear en los lugares de atención a la salud

1 (Ocupación) Describa lo que hace en su trabajo.
2. (Activitidades y causa) ¿Qué actividades físicas hace usted –en su trabajo o en otro lugar- que usted cree que le hacen daño?
3. (Substancias/peligros físicos y causa) ¿Usted está expuesto en su trabajo o en otro lugar a químicos, humos, polvos, ruido, o altas temperaturas? ¿Usted cree que esas actividades le estan haciendo daño?

Developed by MCN with guidance from the Occupational and Environmental Medical Residency Directors Association and endorsed by the Association for Occupational and Environmental Clinics, 2007.

Testing

The single best diagnostic test for lead exposure is the blood lead level. It reflects the amount of lead currently found in the blood and soft tissues (and hence key target organs). The BLL alone is not a reliable indicator of prior or current exposure, or total body burden. BLLs reflect the contributions of recent external exposure to lead as well as the release of internal bone lead stores into the blood. As such, BLLs represent a mixture of both external exposure and internal lead stores.[24] When interpreting a person's blood lead level, three key questions to keep in mind are whether the exposure history has been:

- acute or chronic?
- recent or remote?
- high or low?

Periodic testing of BLL is called biological monitoring. This provides valuable information to assess lead exposure for individuals as well as groups of workers. Note that a detailed exposure history is an essential part of evaluating and interpreting biological monitoring information.

While the Cal/OSHA lead standards require zinc protoporphyrin (ZPP) testing, this is an indirect and insensitive biomarker of lead absorption. An elevated ZPP may indicate that lead is affecting the heme synthesis pathway. This effect can begin at a BLL as low as 20 µg/dL in some adults but is not greater than 90% sensitive until the BLL exceeds 50 µg/dL. An increase in ZPP usually lags an increase in BLL by two to six weeks. Therefore, a normal EP or ZPP in the presence of an elevated BLL suggests recent exposure. OLPPP recommends that routine measurement of ZPP be undertaken only when necessary to comply with the Cal/OSHA lead standards. Other medical conditions can cause an elevated ZPP, the most common being iron deficiency anemia, porphyria, and inflammatory conditions.[25,26] The upper limit of normal for ZPP varies some between labs but is usually between 35 and 40 µg/dL.

It is important to check BLLs of household members, particularly children, of lead-exposed individuals. Lead workers may unwittingly expose their families to lead dust brought home on clothes, shoes and in cars. Farmworker housing that is situated at the worksite may increase possibilities for exposure.

Patient Education

Individuals at risk of lead exposure should receive education on the following points:

1. Wear protective clothing at work
2. Meals eaten at work should be eaten in a clean area
3. Wash hands before eating
4. Shower and change clothing before touching household members
5 Maintain as much separation of home from workplace as possible, i.e., wash work clothes separately, do not allow children to play in or near work areas.

The Migrant Clinicians Network offers resources and educational materials particularly suited to those who serve migrant workers and the mobile poor: www.migrantclinician.org

Diagnosis and Management

The primary therapy for lead poisoning is cessation of exposure.

For any BLL ≥10µg/dl, treatment should be initiated. Recent research findings, as noted above, have prompted revised health-based management recommendations for lead-exposed adults. These recommendations and the adverse health risks associated with short-term and long-term exposures at different BLLs are summarized in Table 4. The table presents recommendations for a broad range of BLLs.

Primary care providers should enlist the assistance of an environmental/occupational health specialist for management and ongoing surveillance of lead toxicity in adults. To locate an Environmental Occupational Health Clinic in your area, consult www.aoec.org.

The clinician, with the patient's permission, should contact the employer for further workplace exposure information, such as air level monitoring, biologic monitoring and Material Safety Data Sheets (MSDSs). Work-related exposure measurements should be readily available to the clinician. The federal OSHA standards are available at http://www.osha.gov/SLTC/lead/standards.html. Small businesses can obtain information at http://www.osha.gov/dcsp/smallbusiness/index.html.

Assistance, especially for non-occupational problems such as herbal remedies, candy, moonshine, etc. is available from local and/or state health departments

Chelation Therapy

In adults, the use of chelation therapy is generally reserved for those with symptoms or signs of severe toxicity and/or very high BLLs. While uncommon, adults may have a very high BLL (e.g., 80 - 99 µg/dL) and have no overt symptoms. These patients should be removed from exposure and followed carefully.

Patients with BLLs of 80-99 µg/dL, with or without symptoms, as well as some symptomatic individuals with BLLs of 50-79, can be considered for chelation. Levels above 100 µg/dL usually warrant chelation as they are often associated with significant symptoms and may be associated with an incipient risk of encephalopathy or seizures.[5]

Chelation therapy primarily reduces lead in the blood and soft tissues, such as liver and kidneys, and has a relatively smaller impact on the fraction of lead stored in bone. In patients with substantial bone lead stores who are chelated, re-equilibration of lead from bone back into blood and soft tissues may result in a rebound effect with a rise in the BLL after an initial drop. Symptoms associated with lead toxicity may recur.

Chelation guidelines are controversial and may change as new agents and information are introduced. Although chelation has been associated with improvement in symptoms and decreased mortality, controlled clinical trials demonstrating efficacy are lacking, and treatment recommendations have been largely empirical.[27]

Chelation therapy should not be initiated until after the individual has been removed from exposure and should not be continued if the individual returns to a lead exposure job. Chelation should be considered only on an individual case basis and in consultation with medical providers who are knowledgeable about treatment of adult lead poisoning.[28]

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Name:_____

PRE TRAINING ASSESSMENT

Grasshoppers, Dust and Salsa - An Old Toxin in a New Setting: A Fresh Look at Lead Poisoning in Migrant Populations

1. Lead exposure is less likely for rural migrant workers than urban workers in the United States.

   True False

2. Children and pregnant women have particular risks related to lead exposure due to neurodevelopment. Monitoring of lead exposure over time may be done by analysis of which of the following? Select as many as apply:

   a) Hair shaft analysis
   b) Urine metabolic screen
   c) Capillary blood level
   d) Serum blood lead level
   e) Cord blood lead level
   f) Bone marrow aspirate

3. Blood lead levels are considered toxic over a continuum of measurements. Chelation is appropriate when blood lead levels reach 40-60 mcg/dl in workers who labor in known lead toxic industries, such as ironwork or radiator repair.

   True False

4. What are the primary routes of lead exposure? Select all that apply:

   a) Inhalation
   b) Ingestion
   c) Dermal absorption
   d) Blood and body fluid absorption

5. A pregnant woman had known blood lead levels of 20 mcg/dl. She has given birth, and her baby has had cord blood lead levels taken. Is it safe for the mother to breastfeed?

   Yes No

6. In addition to farm work, it is important to ask workers about other possible exposures to lead, including: (Select all that apply)

   a) construction work
   b) auto work
   c) dishes and cookware
   d) herbal medicines
   e) insect consumption

7. How many consecutive and stable blood lead levels must be obtained before a non-pregnant worker with a 60 mcg/dl blood lead level may return to work?

   a) 1
   b) 2
   c) 3
   d) 4

8. At what ages should children of migrant farmworkers be tested for lead exposure? Select all that apply:

   a) 6 months
   b) 12 months
   c) 24 months
   d) Kindergarten
   e) All of the above

9. At what point in a pregnancy should an at-risk migrant woman be tested for blood lead levels? Select all that apply:

   a) first trimester or first visit
   b) second trimester
   c) as part of delivery labs
   d) immediately postpartum

10. Lead is stored long-term in the:

   a) liver
   b) brain and nervous system
   c) kidneys
   d) bones
   e) all of the above

Name:_____

Post TRAINING ASSESSMENT

Grasshoppers, Dust and Salsa - An Old Toxin in a New Setting: A Fresh Look at Lead Poisoning in Migrant Populations

1. Lead exposure is less likely for rural migrant workers than urban workers in the United States.

   True False

2. Children and pregnant women have particular risks related to lead exposure due to neurodevelopment. Monitoring of lead exposure over time may be done by analysis of which of the following? Select as many as apply:

   a) Hair shaft analysis
   b) Urine metabolic screen
   c) Capillary blood level
   d) Serum blood lead level
   e) Cord blood lead level
   f) Bone marrow aspirate

3. Blood lead levels are considered toxic over a continuum of measurements. Chelation is appropriate when blood lead levels reach 40-60 mcg/dl in workers who labor in known lead toxic industries, such as ironwork or radiator repair.

   True False

4. What are the primary routes of lead exposure? Select all that apply:

   a) Inhalation
   b) Ingestion
   c) Dermal absorption
   d) Blood and body fluid absorption

5. A pregnant woman had known blood lead levels of 20 mcg/dl. She has given birth, and her baby has had cord blood lead levels taken. Is it safe for the mother to breastfeed?

   Yes No

6. In addition to farm work, it is important to ask workers about other possible exposures to lead, including: (Select all that apply)

   a) construction work
   b) auto work
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8. At what ages should children of migrant farmworkers be tested for lead exposure? Select all that apply:

   a) 6 months
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   c) 24 months
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9. At what point in a pregnancy should an at-risk migrant woman be tested for blood lead levels? Select all that apply:

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10. Lead is stored long-term in the:

   a) liver
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