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SAFEGUARDING OUR CHILDREN AT HOME:

Reducing Exposures to Toxic Chemicals and Heavy Metals

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As parents we do everything we know to ensure that our children are safe: We install gates at stairways; we put child locks on cabinet doors; we use car seats; and we do much more. We may not think, however, to guard against toxic chemicals in our environment that are invisible to the eye, but no less dangerous for our children. These can include lead in our drinking water, pesticides on our food, insecticide residues in the air, brominated flame retardants in the dust in our carpets, and many other culprits in the everyday products we use.

What makes these exposures so concerning is that children are not just "little adults." Pound for pound, children are exposed to greater amounts of toxic chemicals because they eat, drink, and breathe more for their size than adults do (Landrigan & Carlson, 1995). For example, the effect of a glass of apple juice on a 2-year-old will be 20 times stronger than on an adult. If that apple juice contains pesticides—and nonorganic apple juice can contain as many as 80 different pesticides—the 2-year-old who drinks it receives an exposure to these chemicals 20 times as powerful as her mother does (Wargo, 1998).

Children also generally live closer to the ground. When they play on floors, for example, they can come in contact with dust that may carry toxic chemicals from insecticides, household cleaners, paint, plastic, and some fabrics. Children may also be exposed to chemicals tracked in from outdoors, such as pesticides. In addition, children frequently put their

abstract

Emerging research suggests that exposure to environmental pollutants, prenatally and in early childhood, may contribute significantly to diseases and disabilities. For example, exposures to mercury or lead early in life can impact the nervous system and brain, potentially contributing to learning, behavioral, and developmental disabilities. The author suggests that parents and caregivers can better protect children in utero and at home by making better consumer choices and minimizing contact with contaminants. The article includes suggestions for reducing children's risk of exposure to lead, mercury, pesticides, flame retardant chemicals, PBDEs, solvents, and chemicals in plastics.

hands and other objects in their mouths—this means any toxic residue on those hands and objects may further increase their exposure (Landrigan, Needleman, & Landrigan, 2001).

Another reason children are at higher risk is that their bodies are growing rapidly. Biological systems—including the neurological, immune, reproductive, and endocrine—develop in a beautifully choreographed sequence of events, starting in the womb and on through adolescence. Even tiny amounts of toxic exposures during critical developmental periods can disrupt this process and harm children's health, sometimes for life (Schettler, Stein, Reich, Valenti, & Wallinga, 2000).

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Unfortunately, most of the 80,000 chemicals that have been produced since the 1940s have never been thoroughly tested in the United States for possible toxicity for adults, much less for children. And even though we are all exposed to hundreds of chemicals every day, these chemicals have not been tested as mixtures for synergistic health effects.

Concurrent with environmental science's increased understanding of how these synthetic chemicals and heavy metals may harm our children, health care providers are seeing increased prevalence of asthma, learning and developmental disabilities, and certain childhood cancers such as leukemia and brain cancer. Also some reproductive disorders, such as testicular cancer and endometriosis that may begin in utero but become evident in young adulthood, are on the rise. Emerging research suggests that environmental pollutants may contribute significantly to these diseases and disabilities. For example, exposures to mercury or lead early in life can impact the nervous system and brain, potentially contributing to learning, behavioral, and developmental disabilities (National Academy of Sciences, 1993). That is the bad news.

The good news is that a number of environmental health and justice organizations, researchers, health professionals, health-affected groups, policymakers, and industries—nationally and internationally—are advocating for more precautionary and protective measures and developing safer alternatives. The other good news is that we can better protect children at home by making better consumer choices and minimizing contact with contaminants.

Though this one article cannot comprehensively cover all toxics potentially found in the home, the following summary covers key concerns as well as steps that we—parents, grandparents, health professionals, educators, caretakers, and anyone who spends time with children—can take to reduce their exposure to these hazards and ensure they reach their fullest potential. Taking these steps also protects babies in utero, when they are highly sensitive to exposures (see Sattler, this issue, p. 20.) Cumulatively, taking these precautions will make a difference.

Lead

Lead is a soft, bluish-gray metal that occurs naturally in small amounts in the earth's crust. Human activities, including burning fossil fuels, mining, manufacturing, and the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays, are the source of most lead exposures (Agency for Toxic Substances and Disease Registry, 1999).

Low-level lead exposure had been shown conclusively to be associated with deficits in neurobehavioral–cognitive performance in childhood through adolescence (Finkelstein, Markowitz, & Rosen (1998). Outcomes include damage to the brain and nervous system, behavior and learning problems, slowed growth, hearing problems, and headaches (U.S. Environmental Protection Agency [EPA], 2004b). In fact, as scientists have become more sophisticated in evaluating lead exposure effects, the definition of a "safe" level of exposure has dropped significantly. Currently the EPA uses the standard of 10 micrograms/decilitre as the acceptable level of exposure, but many epidemiologists suggest that no level of lead exposure is truly safe (Schettler et al., 2000).

Though lead was removed from gasoline and paint in the US in the late 1970s, many children still have elevated blood lead levels. According to the U.S. Environmental Protection Agency (1993), the primary sources of lead exposure for children are deteriorating lead-based paint, lead-contaminated dust, lead in plumbing (pipes, solders, and faucets), and lead-contaminated residential soil. Because families living in older homes with higher lead contamination are often people of color and/or low income, lead exposure has become a significant environmental justice issue. (See Prakash & Jordan, this issue, p. 38.) These families often cannot afford to move or remediate their apartments or homes and often feel unable to press their landlords to clean up these buildings (Needleman, 2004).

Exposure can also result from using some health-care products or folk remedies that contain lead, from hobbies involving lead products (Agency for Toxic Substance and Disease Registry, 1999), from toys (National Institute of Environmental Health Sciences, 2005) from burning lead-wicked candles (Wasson, Guo, & McBrian, 2002), and from some cosmetics, and imported candy and pottery (Centers for Disease Control and Prevention, 2005).

Mercury

Mercury is a naturally occurring metal that is a persistent, bioaccumulative, and toxic (PBT) pollutant. It does not degrade through natural processes and accumulates in soil, water, and living organisms, such as fish. A prevalent

form of mercury, methylmercury, is produced mainly by bacteria in water and soil.

The developing nervous system and brain of babies in the womb and young children are highly sensitive to mercury in any form, particularly to methylmercury and mercury vapors (Physicians for Social Responsibility, 2004). Children exposed to relatively high doses of mercury before birth may develop mental retardation, cerebral palsy, deafness, blindness, speech difficulties (Commission on Life Sciences, 2000), or seizures (Gilbertson, 2004). Chronic low-dose exposure before birth from the mother's consumption of fish can lead to poor performance on neurobehavioral tests, particularly on tests of attention, fine-motor function, language, visual-spatial abilities such as drawing, and verbal memory (Commission on Life Sciences, 2000). Because the brain continues to develop after birth, exposure to mercury during childhood can also affect brain functions (Harvard School of Public Health, 2004).

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Research indicates that there are differences, perhaps genetic, in how easily some children eliminate mercury from their bodies (Holmes, Blaxill, &, Haley, 2003). The failure to shed mercury allows it to build up in body tissues so that even very small exposures over a period can be harmful to these children.

Children are exposed to mercury most often through eating fish. Mercury pollution from power plant smokestacks, mining, and other industrial activities ends up in bodies of water, where bacteria convert it to methylmercury (Physicians for Social Responsibility, 2004). As progressively larger organisms feed on each other, "moving up the food chain," mercury becomes concentrated in large fish, such as tuna. Other exposure routes include: dental amalgam used to fill cavities (Khordi-Mood, Sarraf-Shirazi, & Balali-Mood, 2001); drugs and related products, including topical mercury-based skin creams, infant teething powders, contact solutions, nasal sprays, and some vaccines (U.S. Food and Drug Administration, 2004); and broken household items that contain mercury, such as thermometers or fluorescent light bulbs.

Pesticides (also Herbicides and Fungicides)

Pesticides are used to kill pests such as rodents and insects; herbicides and fungicides kill weeds and fungi. Many common pesticides contain potent neurotoxins that can impact the nervous systems and brains not only of pests, but of humans as well. Exposures to pesticides have been linked to learning, behavioral, and developmental disabilities (Schettler et al., 2000).

Recent scientific studies also link pesticides to immune system problems (World Resources Institute, 1996) and to reproductive disorders (Tremain, 2004). Acute pesticide poisoning can also create many health problems (U.S. Environmental Protection Agency, 2004c).

In 2001, more than 1.2 billion pounds of the active ingredients in pesticides, herbicides, and fungicides were used in the United States (U.S. Environmental Protection Agency, 2004d). These chemicals were applied on land (agricultural fields, golf courses, sports fields, playgrounds, roadsides, gardens, and lawns), in homes (professional exterminations and carpet treatments, flea sprays and dips for dogs and cats), inside schools and community buildings (professional exterminations and carpet treatments, pressure-treated or CCA lumber), on bodies (head lice treatments, insect and tick repellants), and on food (during cultivation on farms as well as after harvesting to deter fungal growth during shipping.

PBDEs

Polybrominated diphenyl ethers, known as PBDEs, are synthetic, flame-retardant chemicals that are added to some fabrics and plastics during the manufacturing process. The different kinds of PBDEs have various uses: PentaBDEs are added to mattresses and foam cushioning in upholstery, while octaBDEs are used in business equipment, automobile trim, telephones, and kitchen appliance casings. DecaBDEs are used in electronic enclosures, such as wire insulation, televisions, and computers (Agency for Toxic Substances and Disease Registry, 2004). DecaBDEs are also used as a fabric treatment and coating on carpets and draperies, although they are not used on clothing (Washington State Deparment of Ecology, no date).

Although we don't have clear evidence about the health effects of PBDEs in humans, a number of harmful effects have been shown in animal studies.

- PBDE exposure before and after birth caused problems with brain development in mice. Studies have observed problems with learning, memory, and behavior (Gill, Chu, Ryan, & Feeley, 2004).
- Exposure to PBDEs during development can decrease thyroid hormone levels in mice (Gill et al., 2004). Appropriate levels of thyroid hormone is essential for healthy brain development, and decreases in thyroid hormone may contribute to problems with brain and nervous system development (Mazdai, Dodder, Abernathy, Hites, & Bigsby, 2003).
- PBDEs also harm reproductive systems, immune system performance, and the liver in mice and rats (Gill et al., 2004; Kuriyama, Talsness, Grote, & Chahoud, 2005).

PBDEs are very similar in molecular structure to polychlorinated biphenyls (PCBs), which were banned in the 1970s because of their health effects, particularly on the

Reducing Children's Risk of Exposure to Environmental Toxins

Lead

- Use only cold water from the tap for drinking, cooking, and for making baby formula. Hot water is more likely to contain higher levels of lead. Flush water pipes (run the water until it becomes as cold as it will get) before using water for drinking and cooking.
- If you suspect lead dust is present in the home, frequently wash a child's hands, pacifiers, and toys. Guard against children's eating food that has been placed on dusty surfaces.
- Prevent peeling and erosion of surfaces where lead-based paints have been used. Do not try to remove lead-contaminated paint; this needs to be done by qualified professionals. Check with your local government about lead removal assistance programs.
- If lead dust is a possibility, have soil tested before planting vegetables or fruit trees.
- Advocate that children be tested for blood lead levels, especially where housing was built before 1978. No level of lead is considered safe (Needleman, 2004).
- Avoid consumer products that contain lead: toy metal jewelry, lead-wicked candles, candy from Mexico, and imported ceramics.

Mercury

- Children and women of childbearing age should avoid eating fish known to accumulate mercury, such as tuna or swordfish. Follow local and state fish advisories posted at www.egp.gov/ostwater/fish. Safe fish and seafood guides are available in many groceries and restaurants.
- Advocate with dentists to use alternatives to mercury-based amalgam for filling cavities and to dispose of amalgam properly if used.
- Ask your physician whether the vaccinations your child is to receive contain the mercury preservative thimerosal; there is a possible link between thimerosal exposure and developmental disabilities such as autism. Until this link is definitively proven or disproven, the safest course is to request thimerosal-free vaccines.
- Dispose of mercury thermometers, burned-out fluorescent light bulbs, spent alkaline batteries, and other mercury-contaminated waste at an appropriate hazardous waste collections or disposal sites.
- Advocate for your local hospital or health department to offer a trade-in program for mercury thermometers. A national nonprofit organization, Hospitals for a Healthy Environment, provides help with this: www.h2e-onliine.org
- Urge policymakers and government officials to act to reduce the amount of mercury being released into the environment.

Pesticides

- Always wash fruits and vegetables and peel when possible. Serve organically grown produce when possible (no need to peel these.) Certain produce is most likely to contain chemical residues: nectarines, peaches, strawberries, raspberries, apples, pears, celery, spinach, bell peppers, potatoes, and imported grapes. Avoid these, or buy only if organically grown. Advocate that grocers purchase from organic farmers to help make organic food available for all.
- Wipe shoes on doormats and leave them at the door to avoid tracking pesticide residues into the home.
- Avoid using pesticides/herbicides on the lawn and garden and in the home. Integrated Pest Management (IPM) provides safer alternatives (see Prakash & Jordan, this issue, p. 38).
- Prevent household pest problems naturally by removing their sources of food, water, shelter, and closing off entrance routes. Fix leaky plumbing and prevent wet spots inside and outside the home; wipe up food residues on countertops; seal pet food containers; keep garbage sealed; rinse recyclable containers; remove woodpiles from around or inside the home; repair door and window screens; and remove diseased plants and fallen fruit that may attract pests to the garden.
- If pesticides are used, lock them away from children's reach. Follow all warning label directions.
- Avoid lindane head lice treatments for children; olive oil has been shown to be an effective alternative.
- Advocate with neighbors, schools, businesses, and government officials to reduce pesticide use on playgrounds, lawns, roadsides, and public areas.

PBDEs

- Avoid using or purchasing items that contain PBDEs, especially the more toxic pentaBDEs. For example, older mattresses may have high levels of pentaBDEs.
- Purchase mattresses, bedding, and other furnishings made with naturally flame-retardant materials, such as wool, that meet flammability standards without added chemicals.
- Advocate with policymakers and government officials to reduce levels of PBDEs in your community by supporting the manufacture and use of safer flame retardant chemicals such as aluminum trihydroxide, ammonium polyphosphate, and red phosphorus in furniture and electronic equipment.

Toxic Chemicals in Plastics

- Avoid plastic packaging.
- Use glass baby bottles with silicon nipples.
- Use glass, metal, paper or ceramic containers for food and water.

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Reducing Children's Risk of Exposure to Environmental Toxins *(continued)*

- When plastics are the only choice, look for options with recycling codes #1 PETE, #2 HDPE, #4 LDPE and #5 PP (on the bottom of containers). Of these, #1 and #2 are most commonly recycled.
- Use microwave-safe glass to microwave food. Do not use plastic containers or cover with plastic wrap.
- Choose children's toys that are not made with PVC.
- Avoid home products and furnishings that contain vinyl or PVC.

Solvents

- Use less toxic products like natural degreasers made with essential oils such as tea tree, citrus based cleaners, or baking soda and vinegar.
- Buy in quantities that you will use soon; follow manufacturer's directions; never mix household care products unless directed on the label
- Use products only in well-ventilated areas.
- Keep out of reach of children and pets; throw away unused or little-used containers safely.
- Use environmentally friendly dry cleaners; avoid cleaners using perchloroethylene.

Good Practices for a Safer, Healthier Home

Serve your family lower-fat protein sources such as bean–grain combinations, or smaller servings of meats, dairy, and fish; this will reduce exposures to PBDEs (polybrominated diphenyl ethers), PCBs (polychlorinated biphenyls), and mercury. Increase servings of fruits and vegetables, choosing organically grown or pesticide-free as often as possible.

- If possible, purchase a water filter for drinking water that removes heavy metals (especially lead), pesticides, PBDEs, PCBs, and chlorine. Use filter and change cartridges per manufacturer's directions. Alternatively, use only cold tap water for cooking, washing fruits and vegetables, and preparing baby formula to reduce possible lead exposure.
- To minimize house dust that may contain lead, pesticides, PBDEs, and phthaltes, frequently damp-mop floors, damp-wipe surfaces, and vacuum. Use non-toxic cleaners or simple solutions made of water + vinegar, lemon juice, or baking soda.
- Ventilate the home daily by opening windows that catch cross-breezes for about an hour.
- Do not smoke in the home; pregnant women should not smoke, period. Guard children and pregnant women from any exposure to second-hand smoke.
- Household members who are exposed at work to pesticides, herbicides, solvents, heavy metals, or other toxic substances ideally should shower and change to clean clothes before entering the home or as soon as possible thereafter.

Photo: Robert Maust

neurological system. PCBs continue to persist in our environment; the primary source of exposure for children is eating high-fat foods, particularly meat and dairy, some fish, and drinking water in some areas of the U.S. The European Union and some U.S. states are banning PBDEs as a precautionary measure and promoting materials that are natural flame retardants.

Plastics

Some chemicals used in plastics found in everyday products have been shown to adversely impact the reproductive and neurological systems. Two chemicals of particular concern are:

- Bisphenol A (BPA): BPA was invented in the 1930s and is used today as a plastic coating for children's teeth to prevent cavities; as a coating in metal cans to prevent the metal from contact with food contents; as the plastic in food containers; refrigerator shelving; baby bottles; water bottles; returnable containers for juice, milk, and water; micro-wave ovenware; and eating utensils (Colborn, Dumanoski, & Myers, 1996).

  Other exposures result from BPA's use in "films, sheets, and laminations; reinforced pipes; floorings; water main filters; enamels, varnish, and adhesives; artificial teeth; nail polish; compact discs; electric insulators; and as parts of automobiles, certain machines, tools, electrical appliances, and office automation instruments" (Takahashi & Oishi, 2000).

  Recent studies have linked BPA exposure to reproductive abnormalities, neurobehavioral problems, and prostrate and breast cancers. (vom Saal & Hughes, 2005)
- Phthalates: Phthalates are a class of widely used industrial compounds. About a billion pounds per year are produced worldwide. Primarily used to soften plastics, they are found in a wide range of products, including: polyvinyl chloride (PVC) flooring; newborn intensive care unit I.V. bags; children's toys; and car seats. That "new car smell" is in part the odor of phthalates; they become volatile when the car interior heats up. When the interior cools down, phthalates condense to form an oily film on the inside windshield.

  Research now suggests that exposures to phthalates may have particularly adverse impacts on the reproductive system, including male genital malformation (associated with testicular cancer and impaired fertility), reduced sperm count, and premature breast development in girls (Colón, Caro, Bourdony, & Rosario, 2000; Swan, et.al., 2005). Studies also link phthalates in household dust and eczema and asthma. (Bornehag, et al., 2004).

Solvents and Other Volatile Organic Compounds

Solvents are volatile liquids that are used to dissolve other materials. They are highly volatile, converting readily from liquid to gas at room temperature. Solvents occur in products we use or are exposed to everyday: alcohol, glues, paints, cleaning products, aerosols, air fresheners, moth repellents, dry cleaning fluids, varnishes, gasoline, thinners, and degreasers. Our bodies easily absorb them through direct skin contact or respiration: when inhaled, they pass quickly through mucous membranes and lungs into the bloodstream (U.S. Environmental Protection Agency, 2004a).

Many health risks are associated with solvent exposure: throat and lung irritation upon inhalation; dizziness; unconsciousness; and in some very rare cases, death. Solvents have also been linked to various cancers and neurological problems. Exposure in the womb may result in birth defects and sometimes miscarriage (U.S. Environmental Protection Agency, 2004a).

Specific solvents include:

- *Alcohol:* rubbing alcohol (a disinfectant); beer, wine, and cocktails.
- *Toluene:* in spray paints, glues, nail polish, carpet spot removers, varnish, and lacquers.
- *Butane:* in cigarette lighters and in fuel.
- *Benzene:* in gasoline and in cigarette smoke.
- *Perchloroethylene:* in dry cleaning.

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