Children at Risk from Parental or Caretaker Occupations and Hobbies

Workers can carry harmful residues home on their clothes, bodies, and tools. Storage of work chemicals at home, such as industrial cleaning products, can also expose children and other family members to toxicants. Physicians can protect their pediatric patients by taking environmental/occupational histories of parents and caregivers, and offering appropriate recommendations.

"Take-home" toxic exposures can be prevented by the following:

- Changing clothes at work;
- Showering before leaving work;
- Laundering work clothes separately;
- Removing shoes before entering the home, etc.

If hazardous substances are used by individuals working at home, care should be taken to keep the work and living areas separate – and hazardous materials must be stored and disposed of properly. Similarly, hobbies such as painting, model building, furniture refinishing, and auto repair often involve using toxic solvents. Pregnant and breastfeeding women, and children should avoid these exposures.

Unique Vulnerabilities of Teens

Although a teenager's ability to detoxify chemicals is similar to that of an adult, s/he continues to be more vulnerable to chemical exposure and its potential health effects for a number of reasons. Teens are still growing and developing, especially their reproductive, nervous, and immune systems. Teens are also less likely to understand the nature of chemical threats and may underestimate the dangers of certain situations. Adults should educate teens about possible environmental health hazards, and help them negotiate work or school-related issues regarding possible exposure. To that end, it is important that teens understand and have access to the Material Safety Data Sheets (MSDS) information provided for each of the chemicals they may be exposed to while at work. In the event of possible exposure, they should be fitted with appropriate protective gear or, preferably, be assigned to a less dangerous task or tasks.

The Right-to-Know

A number of laws and regulations provide families with a legal "right-to-know" about potential health dangers of toxic substances. Unfortunately, the right-to-know about these dangers is not comprehensive. Even where laws such as the Occupational Safety & Health Act and the Emergency Planning and Community Right to Know Act govern access to information in the workplace and community, critical information may be lacking. For example, although employees have the right by law to be informed about hazardous materials on the job primarily via Material Safety Data Sheets (MSDS), critical information on health effects may be incorrect or missing. In addition, MSDS labels often do not list all inert ingredients, which may be the reason for a substance's toxicity. Also, data collection on hazards at the community level often is incomplete or incorrect.

Although there are some state and local laws that require certain product labeling, or school notification of pesticide use, most consumers and families do not have access to information on the environmental hazards that may impact the health of their children. Complete consumer product labeling which includes both active and inert ingredients, comprehensive and accessible information regarding toxic chemical releases, and nationwide notification of pesticide use in schools and other public sites are some of the important initiatives that will help families take the necessary steps to reduce or eliminate exposure to environmental toxicants.

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Pediatric Environmental Health Toolkit

Key Concepts in Pediatric Environmental Health

Unique Vulnerability of Children

- **Exposure:** Child physiology, diet and behavior contribute to unique vulnerability to environmental toxicants. From birth, children breathe more air, drink more water, and eat more food per kilogram of body weight than adults. An infant's respiratory rate is more than twice an adult's. In the first six months of life children drink seven times as much water, and from one to five years consume three to four times more food than adults.

  A young child's typically restricted diet may lead to greater exposures to contaminants unique to certain foods, e.g. pesticides used specifically on grapes. Normal play and hand-to-mouth behavior, which increase a child's exposure to dust and dirt (carpet, lawns, playing fields), can also increase toxicant exposure. A young child's higher surface area to body mass ratio increases exposure to toxicants that are absorbed through the skin.
- **Toxicokinetics:** Nearly 75% of commercial chemicals produced at greater than a million pounds per year have undergone little or no toxicity testing. What little toxicity testing has been done is primarily from studies in mature, adult animals. These are necessarily limited as a basis for surmising risks or safety to young, developing organisms, in part because they fail to account for different exposures and toxicokinetics in the young. Children's exposures and their ability to metabolize and excrete chemicals will vary greatly depending on where they are in terms of growth and development. For example, while an adult will absorb 10% of ingested lead, a toddler absorbs 50%.
- **Differential Susceptibility:** As a child progresses from fetus to adult, s/he passes through critical windows of development that mark periods of vulnerability where toxicant exposure can be particularly harmful. This is especially true for neurotoxicants such as lead, mercury, PCBs, alcohol and other solvents in which the timing of exposure, perhaps more than the actual toxic dose, can be critical in determining overall neurologic impact. Many toxicants can cross the placenta, thereby resulting in exposures during a very vulnerable period of early development. Toxicity testing in adult animals also fails to account for differential susceptibility due to age and stage of development.
- **Longer Life Span:** Children have a long "shelf life." Many toxicants have long latency periods before adverse effects may manifest, making early life exposure particularly concerning. This is especially true for carcinogens like arsenic and asbestos and substances like radon. It is also true for some neurotoxicants where early exposures may lead to behavioral and developmental problems not appreciated until problems arise in school or later in life. Early exposure to carcinogens may increase the risk of adulthood cancer and may cause certain cancers to appear sooner in life.

Many regulations geared towards protecting the population from the impacts of toxic substances are based on results from adult studies, which fail to account for the different toxicokinetics in the young.

"Built Environment" and "Food Environment" Influence Health

Both the "Built Environment" – how we design and build our homes, communities, and roadways, and the "Food Environment," the types and quantity of foods made available to children and their families, influence health.

Fifteen percent of children and teens (triple that of 1980) and over 10% of preschool children ages 2-5 years old are overweight. Lack of sidewalks and bicycle paths, inadequate lighting and poorly designed public spaces that make them unsafe for walking, contribute to lack of exercise. High-caloric, nutritionally-depleted foods are readily available to children either through school vending machines or nearby fast food restaurants, and make it difficult for families to make healthy choices.

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The "Built Environment" is also linked with asthma. This includes the indoor environment, as well as the outdoor. Over reliance on the automobile and its resultant increase in ozone and fine particulate pollution contributes to the severity and frequency of attacks. The percentage of children with asthma has doubled over the past two decades, and is now the number one cause of school absenteeism attributed to chronic conditions.

Dust in homes is a pathway for exposures to allergens and toxic chemicals, including lead, arsenic, mercury, pesticides, and PCBs. Crawling and hand to mouth behavior of infants makes them uniquely susceptible to exposure to contaminants in dust that may have long-term health effects. Parents can reduce exposures through low cost measures such as vacuuming weekly, a commercial quality door mat, and removing shoes indoors. Damp-wiping surfaces (skip chemical cleaners) is effective in removing dust from household surfaces. These simple steps can help create a healthier home environment for children and ensure that they reach their full potential.

Health care providers can help educate parents and community leaders about the important links between the "built" and "food" environments and health and begin a dialogue on the public policy and personal choices that promote health.

Human Milk

Human milk is considered the optimal nutrition for infants. Parents should be reassured that breastfeeding is the healthiest way to provide nutrition, for both mother and infant, even when potential contamination of human milk is taken into account. Research has shown that many human milk samples contain small amounts of toxicants. Contaminants in human milk are usually reflective of maternal body burden of these chemicals (the amount in people's bodies is sometimes called "body burden"), and are an important reminder that we are all exposed to small amounts of these chemicals throughout our lives, beginning *in utero*. Most of these chemicals are widely dispersed in our environment and the breastfeeding alternative, formula and the water used to prepare formula, may contain similar contaminants.

Outside of the unique exposures some women may experience in the occupational setting, where an environmental health specialist or toxicologist should be consulted, mothers should be encouraged to breastfeed. (Note: By choosing a diet low in animal fat, and continuing to do so throughout their teen years and into adulthood, young girls have an opportunity to decrease their body burden of persistent chemicals such as dioxins and PCBs.)

Countries such as the United States and Sweden are using human milk surveillance as a way to monitor more general human exposures to chemicals and to enact precautionary measures to prevent exposures. Sweden has taken a precautionary approach in their regulation of poly-brominated diphenyl ethers (PBDEs), a group of compounds used widely as flame retardants and added to plastics, foams, televisions, computers, and textiles in

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furniture, mattresses, and pillows. Chemically, PBDEs are structurally similar to PCBs. While no human neuro-toxicity data are available, animal data suggests that impacts of PBDEs on the developing brain are similar to those of PCBs. Analyses of breast milk contamination in Sweden during the 1990s showed that PBDE levels had been rising at a rapid rate. In the late 1990's, based on these observations, Sweden enacted precautionary regulatory controls on PBDEs, including manufacturing restrictions, despite scientific uncertainty as to their health impact. This regulatory action probably explains the decline in breast milk levels of PBDEs that have been observed in Sweden since the restrictions began.

In Europe, and increasingly in the United States, initiatives are focused on substituting the most hazardous chemicals in products and production processes with Green Chemistry and safer substitutes. Biomonitoring programs will enable scientists, policy-makers and the public to track the success of these novel technological alternatives in reducing body burden of toxic chemicals.

The Chemical Environment: Exposures

There are approximately 80,000 chemicals in commercial use, and for many of these we have little information on potential health effects. Through the increased use of biomonitoring, or testing for the presence of chemicals in people's bodies, we have more information on actual exposures to toxic and potentially toxic substances.

One of the most important sources of information for this in the U.S. is the Centers for Disease Control's National Exposure Reports, which include the results of testing of 10,000 people nationwide. Released in 2005, the CDC's third report analyzed the levels of 149 potentially hazardous chemicals in a representative cross-section of the American population. The report gives health care providers a snapshot of the types and quantities of chemicals that people have ingested or absorbed, and raises concerns about children's potential exposure in at least four areas: methylmercury, phthalates, pesticides, and second hand smoke. For instance, about 1 in 18 women of child-bearing age have levels of methylmercury within a factor of 10 of the level linked with adverse fetal neurodevelopment. Chloropyrifos, an organophosphate pesticide banned for residential use in the U.S. in 2000, was found in more than 50% of human samples and was more highly concentrated in children ages 6 to 11 years. Lastly, while median cotinine (a nicotine metabolite) levels in nonsmokers have decreased significantly, children's levels are more than twice those of adults'.

Declining Threshold of Harm

As scientists' understanding of and ability to measure levels of toxicants improves over time, what constitutes a "safe" level of exposure to these compounds tends to fall, sometimes dramatically. For example, the toxic blood lead level was set at 60 mcg/dl in 1960. The current blood lead level of concern is 10 mcg/dl, but the most recent science is demonstrating measurable neurological impacts at still lower levels. Since the latter may lead to sequelae such as behavioral and learning problems, many experts now believe there probably is no safe blood lead level. A similar "down trending" of concentrations of concern has been seen for most chemicals and substances that have been studied including mercury, arsenic, dioxins and PCBs, and organophosphate pesticides.

Higher Risk Communities

Communities of color, cultural minorities, economically disadvantaged, and socially marginalized groups are often at greater risk from toxic exposures. For example, because of both economic necessity and cultural tradition, subsistence fishing among immigrant communities such as Vietnamese, Cambodian, and many other communities results in increased exposure to fish-borne neurotoxicants. Where you live can also confer a higher exposure risk, such as agricultural areas (pesticides), urban neighborhoods (diesel or other air pollutants), and proximity to hazardous wastes or industrial sites.

Inequities in health are particularly dramatic with regard to exposure from tobacco smoke. More than one third of children in the United States live in homes where residents or visitors regularly smoke. Rates of smoking in the home increase with decreasing adult educational levels and family income. While the national rate for tobacco use by adults is around 24%, the rate of tobacco use is roughly double in low-income populations, and significantly higher for some minority populations, especially Native Americans and Southeast Asian American men.

The following statistics illustrate some of the inequities experienced by higher risk communities:

- Air quality tracks closely with community racial composition: Approximately 61.3% of black children, 69.2% of Hispanic children and 67.7% of Asian-American children live in areas that exceed the ozone standard, as contrasted with 50.8% of white children.
- Thanks to coordinated, intensive efforts at the national, state, and local levels beginning with efforts to remove lead from gasoline, food cans, and residential paint products, the number of U.S. children aged 1-5 years with elevated blood lead levels (BLL >/= 10 ug/dl) has continued to decline from 4.4% in the early 1990s to 1.6% during the period 1999-2002. However, according to the CDC's third report, vulnerable subpopulations of children remain at higher risk for lead poisoning and include those who are non-Hispanic black and Mexican American, who live in urban settings, who are from lower socioeconomic groups, who are immigrants, or who reside in housing built before 1950.
- A study found that industrial-scale animal feeding operations ("factory farms") with air and water emissions of health concern are more than seven times more likely to be in the poorest areas and nearly five times more likely to be located in areas with the largest percentage of non-white residents. Communities that are both poor and non-white are nearly ten times more likely to contain one of these facilities.
- Asian Pacific and Native American women of childbearing age have three-times-higher blood mercury than the average population.

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