

Making the Environment Healthier for Our Kids

*An overview of environmental challenges
to the health of North America's children*



**Commission for
Environmental Cooperation
of North America**

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For more information:

Commission for Environmental Cooperation
393, rue Saint-Jacques Ouest, bureau 200
Montréal (Québec) Canada H2Y 1N9
Tel.: (514) 350-4300 Fax: (514) 350-4314

<http://www.cec.org>

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Foreword

As parents, and as adults in a caring society, we do everything we can to protect children from harm. We vaccinate them against disease, teach them to be wary of strangers, restrict their freedom to work or drink alcohol. But what can we do when the danger lurks in the grass of a public park or in the air that they breathe?

Almost every day we learn more about the hazards of environmental contaminants. We know that lead from chipping paint or pottery can depress IQ and create disturbances in the central nervous system. We know that PCBs and dioxins from municipal incinerators can promote cancer and cause developmental, reproductive, and metabolic damage. Just recently we learned that second-hand tobacco smoke plays a major role in SIDS. And for every association that we have been able to prove, there are dozens more that we strongly suspect.

Children are especially vulnerable to environmental assault. Their bodies are changing rapidly, which opens many windows of opportunity for chemicals to subvert the process. They take in more air—pollutants and all—and absorb more pesticide residue and other contaminants in their food than adults do, relative to size. Impoverished children are at even higher risk. With limited access to health care and proper nutrition, and with a greater likelihood of living in polluted, industrial areas, they are less able to withstand attack. In all three North American countries, children make up the largest age group living in poverty.

We have a problem that transcends borders. And this report is the first step toward addressing it in a collective manner, capitalizing on our varied perspectives and experiences. Before we can begin to propose solutions, we need to understand the challenges we each face within the context of our different countries.

One challenge is already clear: Environmentally induced disorders are typically chronic, difficult to treat, and harder to reverse. Prevention is key. The CEC's children's environmental health initiative gives us the chance to take preventive action to improve the health of future generations of parents and decision makers.

While there is abundant literature on the acute toxicity of many chemicals, we have scant information on the effects of chronic, low-dose exposures or on how various chemicals act in combination. We need to promote scientific and clinical research to help regulators make evidence-based decisions. But we also need to find the courage to take precautionary action while awaiting further data. In this we have a strong precedent. Consider the warnings we give pregnant women about drinking, even though we understand little about how alcohol affects the developing fetus. Precautionary approaches of this nature are what we need to be working on.

Children are our most precious resource in North America. They are our adult population of tomorrow who will create the children of the next generation. Protecting them by protecting our environment is a double investment in the future.

A handwritten signature in black ink, appearing to read "S. Boka". The signature is written in a cursive, flowing style.

Irena Buka, M.B. Ch.B. F.R.C.P. (C)
Chair, Expert Advisory Board on Children's Health and the Environment in North America

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I. Introduction

Over the past several years it has become increasingly clear that environmental hazards pose a particular threat to children. At the same time, we have deepened our understanding of how pollutants like mercury, lead, DDT, dioxins and other persistent organic pollutants are transported vast distances by wind, water or commerce. Given that children are increasingly being exposed to environmental contaminants of foreign origin through long-range transport of contaminants such as persistent organic pollutants (POPs), coupled with the knowledge that children are a more susceptible population to the effects of these and other environmental contaminants, it is clear that there is a strong need for global cooperation and a well-coordinated regional effort in order to truly protect our children.

Conscious of the need for greater cooperation, the Commission for Environmental Cooperation (CEC) Council, comprising the federal environmental ministers (or their delegates) from Canada, Mexico and the United States, announced a special CEC initiative in this important area. Already, the CEC is actively helping to eliminate or reduce persistent organic pollutants and other substances, is tracking data on toxic releases to the environment, and is involved in other initiatives relevant to the children's health agenda.

The CEC Symposium on North American Children's Health and the Environment, held in Toronto in May 2000, was an important first step towards identifying a common agenda for the three countries. The symposium brought together scientists, policymakers, and environmental and children's health advocates to discuss recent scientific findings, emerging issues, gaps in our understanding, and new directions in policymaking. Participants were able to identify areas of common interest and to exchange ideas for a regional plan.

The outcomes of the symposium provided important groundwork for Council Resolution 00-10 on Children's Health and the Environment, which was adopted by the CEC Council during its session in Dallas, Texas, in June 2000. The Resolution commits the three governments to work together as partners to develop a cooperative agenda to protect children from environmental threats, with an initial focus on asthma and other respiratory diseases, the effects of lead, including lead poisoning, and the effects of exposure to other toxic substances. The Resolution also called for the formation of an Expert Advisory Board to provide advice to Council on matters of children's health and the environment. This board was convened in October 2001.

This paper is intended to paint a broad picture of children's environmental health issues, with a specific focus on the situation in North America. The main elements of its structure are as follows: Section II is a general introduction to the subject. Sections III and IV present an overview of child development and examine how pollutants affect children at various stages of their lives—something that is critical not only for assessing risk but for crafting targeted solutions. Sections V and VI provide an overview of environmental hazards and their consequences to children. Finally, Section VII outlines some policy considerations and possible opportunities for trilateral action, with a view to stimulating dialogue among interested individuals and groups throughout civil society about what can be done to better protect children from environmental threats in North America.

II. Why a Healthy Environment is Important for Healthy Children

Environmental concerns affecting children's health is a relatively new field incorporating the child, the environment and health—three interrelated and dynamic components that involve many disciplines and sectors. However, a basic tenet of this new field is that the child, and his/her health and development, is at the center of the paradigm. Children constitute 30% of the world's population but they are 100% of our future (United Nations 1998). Their growth and development is therefore of primary concern.

The connection between the external environment and human health is acknowledged by institutions such as the World Health Organization (WHO), which has stated "...human health ultimately depends on society's capacity to manage the interactions between human activities and the physical and biological environment" (WHO 1992). More recently, WHO has concluded that about one quarter of the global disease burden is attributable to environmental factors (WHO 1997), and many environmental threats to health are preventable. One example of this is lead poisoning. In the United States, the Centers for Disease Control and Prevention (CDC) helped to initiate federal activities to reduce lead in gasoline, which brought about declines in average blood lead levels in the US population. Data from the most recent National Health and Nutrition Examination Survey (NHANES) show that the percentage of US children with elevated blood lead levels has dropped from 88.2% in the late 1970s to 4.4% in the early 1990s (Brody et al. 1994).

Our world has seen sweeping changes over the past 50 years. Technological innovations in life sciences, communications, medicine and other areas have revolutionized the way we live. Part of that revolution has led to the discovery and manufacture of thousands of chemicals previously unknown to the world. These substances are now virtually everywhere, because they are transported by natural forces and the growing commerce among nations. While we have reaped many positive benefits from our use of minerals and chemicals, new and old, we are just beginning to explore and understand some of the other impacts that these substances may have on human health and on the health of our children. In light of our increased scientific understanding of child development, environmental toxicants, and human health, there is a need to assess our protective strategies to ensure that they protect children's health.

There are several unique aspects to environmental impacts on children's health:

- Most children have a longer life expectancy than adults do, so that impacts from environmental exposures early in life have a longer time to manifest in adverse health consequences later on.
- Effects from environmental exposures can **permanently** alter or damage developing systems in a child, whereas an adult experiencing the same exposures might not experience any ill health effects (the reverse can also be true).

To insure that children live in a healthy environment is an issue that lies at the very heart of sustainable development. In general, healthy children grow into healthy, capable adults. Investing in environmental conditions that protect and enhance children's health today will provide North American society with long-term dividends in terms of reduced demands on health and social services and increased productivity in the future.

If we create an environment that is safe and healthful for children, possibly the most vulnerable and sensitive among us, we create an environment safe and healthful for all.

Children's Health and the Environment—Definitions of Terms

Children

Children are "dynamic organisms," growing and changing with great rapidity. For the purposes of this paper, a child is defined as 18 years of age and under, after which most biological systems are fully developed, with the recognition that parental reproductive health has an enormous impact on the future healthy development of both fetus and child.

Environment

Many environmental factors influence children's health, including the quality of water, air, food housing and the safety of the places in which children live, learn and play. Each of these factors is important in its own right, but they also interact with each other, and with the additional determinants of health, which include social and economic factors, health practices, genetic factors and access to health services (Federal/Provincial/Territorial Advisory Committee on Population Health 1994).

Health

Over the last 50 years, the World Health Organization has revised and expanded its definition of health from "a complete state of physical, mental and social well-being and not merely the absence of disease" to "a positive concept emphasizing social and personal resources, as well as physical capacity."

III. Why Children Are at Greater Risk

A. Overview

Children are not little adults. From conception on, the fetus, infant, child, and adolescent are in dynamic states of growth. These involve the brain, skin, kidneys, and liver, and the respiratory, immune, endocrine, reproductive, gastrointestinal, skeletal, and nervous systems. The elegance and complexity of this development allows the body to mature. But it also opens windows of vulnerability that can divert, alter or permanently damage these developing systems.

We therefore need to consider *when* during a child's development an exposure takes place—not just the toxicants involved, sources and routes of exposures, and the dose of a contaminant. The fetus, for example, is perhaps the most vulnerable to environmental insults. We now know that a variety of toxic substances can cross the placenta, including polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), carbon monoxide (CO), lead (Pb), and ethanol (Bearer 1995; Etzel and Balk 1999). These toxicants can cause serious health problems in exposed children (Jacobson et al. 1990). We also know that the blood-brain barrier is not fully matured in the fetus or newborn, allowing some toxic substances to pass freely, for example, alcohol.

Adults and children differ in behavior, physiology, metabolism, and diet. Kilogram for kilogram of body weight, children breathe more air, drink more fluids, and consume more food than adults, proportionately increasing their exposure to whatever contaminants may be present. Generally, children are more active than adults and engage in a range of behaviors that can place them at higher risk of exposure.

B. Physical Vulnerabilities

1. Development

The brain and nervous system develop through adolescence and into the mid-twenties, and are extremely sensitive to exposures at critical times in development (Rodier 1995). We have learned through experience in Canada, the United States and Mexico that lead and methylmercury can profoundly affect intelligence and central nervous system development. Subtle effects, including impaired language skills, attentiveness and memory, as well as motor and visual-spatial functions, can be measured in children exposed to even low doses, when exposure occurs during specific stages of development. The effects of lead on IQ have been well documented (McKeown-Eyssen et al. 1983b; Needleman et al. 1990; WHO 1990; Grandjean et al. 1999). In Canada and the United States, subtler effects and developmental disabilities such as attention deficit hyperactivity disorder (ADHD) are being observed, and have been linked with various environmental toxicants such as environmental tobacco smoke, alcohol, lead, mercury and PCBs (Chen et al. 1992). There is also research that shows a possible link between environmental exposures (for example, to lead) and juvenile delinquency (Needleman 1996).

At times, an infant's developing systems (such as the nervous, immune, reproductive, gastrointestinal and respiratory systems) can protect against exposure to toxicants, since his or her body is not able to break these toxic compounds into harmful metabolites. Such is the case with acetaminophen (Etzel and Balk 1999). But more often, infants and children are at greater risk because they cannot metabolize, detoxify and excrete toxins as efficiently as adults (Echobichon and Stevens 1973; Landrigan et al. 1998).

Infants grow and develop rapidly and are more prone to adverse effects from low-dose exposures, as growing and dividing cells are at greater risk of influence by chemicals (McBride 1998). Typically, they double their birth weight within the first 4–6 months, and triple it by their first birthday. Although the newborn weighs only one-twentieth of an average adult male, the infant's surface area is one-eighth as great, creating a much larger dermal surface per mass ratio. As a result, infants and children could be at greater risk from dermal contact with environmental contaminants—a risk which in turn is increased by the behavior of infants and children (see Section IIIC, Behavioral Vulnerabilities).

Children absorb and metabolize nutrients at different rates from adults. For example, children require more calcium than adults for bone growth and thus absorb more through the gastrointestinal tract. Children who are deficient in calcium, iron and protein can absorb lead faster than a child who is well nourished. It is estimated that while an adult will absorb 10% of ingested lead, a one- or two-year-old will absorb 50% (Royce 1992; Bearer 1995). Manganese and iron are other examples. Children need iron and manganese for oxygenation, and they absorb it through the intestinal wall. Lead and other metals can interfere and replace needed nutrients in the absorption process (Peraza et al. 1998).

The health risks from air pollutants are also greater in children. Young children breathe more rapidly, with newborns taking 60 breaths per minute—versus 12 for adults—and therefore they take in a larger volume of air per minute of breathing time (Bearer 1995). Consequently, children are likely to take in greater quantities of air pollutants. And, because their lungs continue developing alveoli through adolescence (Etzel and Balk 1999), they may be more susceptible to permanent damage.

Puberty and adolescence is another time of rapid growth and change. Aside from tobacco, there has been little research on the risks of environmental toxins at this stage of development. Some scientists believe it is ripe for study.

2. Diet

For many infants in North America, breast milk is their primary food. It is an ideal source of nutrition, providing them with high protein, fat, and natural immunities. Unfortunately, it may also be providing them with heavy metals (such as lead, cadmium and mercury), chlorinated pesticides (such as hexachlorobenzene, DDT and its metabolites and trans-nonachlor), and industrial organic chemicals (such as PCBs and dioxins) (Jensen and Slorach 1991; Newsome et al. 1992; Bearer 1995; Sonawane 1995; Lopez-Carrillo et al. 1996; Polder et al. 1998; CEC 1999; Nashashibi 1999; Waliszewski et al. 1999). Many of these chemicals are transported through the

atmosphere and deposited in distant regions, by a process known as the “Grasshopper Effect” (CEC 1997), and eventually accumulate in the fatty tissue of animals and humans. It is partly because of this and other transport processes that persistent and bioaccumulative chemicals have been found in the breast milk and fatty tissues of humans and animals residing far from the point of initial chemical use. The presence of contaminants in mothers’ milk is of concern because it is typically the only source of food for infants during the first few months of life. Nevertheless, analyses conclude that the benefits of breastfeeding outweigh the risks associated with the presence of contaminants.

The average infant consumes 5 ounces (148 mls) of formula per kilogram of body weight, which is the equivalent of an average male adult drinking 30 twelve-ounce (355 mls) glasses of milk per day (Etzel and Balk 1999). Infants and children drink 2.5 times more water daily than adults, by percentage of their body weight (Plunkett et al. 1992). Children between ages 1 and 5 eat three to four times more than adults, per unit of body weight. And children tend to eat diets higher in fruits and vegetables, which may increase their relative exposures to any pesticide residues that may be present. Proportionate to body weight, the average one-year-old in the United States eats two to seven times more grapes, bananas, pears, carrots, and broccoli than an adult (National Research Council 1993).

C. Behavioral Vulnerabilities

It is part of the natural course of development for children to explore their surroundings. Infants instinctively bring objects from their hands to their mouths as part of this discovery process. Later, as they begin to crawl, whatever is near floor level becomes a candidate for ingestion and experience. From dirt to dust, and anything in between.

Even though children may live in the same home as their family, they experience different environments within the home. For example, infants are often indoors in cribs or on the floor. Toddlers are crawling, and small children also occupy space close to ground level. By contrast, an adult’s breathing zone is 4–6 feet above the ground. Heavier chemicals, such as lead, as well as particulates, radon, mercury vapors, and pesticide vapors settle close to the floor—increasing the possibility of children’s exposure (Bearer 1995; Mott 1997; Etzel and Balk 1999; Fenske et al. 1990). It has also been noted that up to 3% of the displaceable residues of some pesticides applied on lawns are introduced into the home on the shoes of residents and accumulate in carpets (Nishioka et al. 1996). According to one study (Whitmore et al. 1994), these residues can persist for as long as four years, which increases the exposure of children to these toxic substances since they tend to live closer to the floor than adults.

Children frequently eat soil as part of their explorations, and they ingest along with it whatever toxicants are present. In at least one risk assessment, the Centers for Disease Control and Prevention (CDC) in the United States used the following estimates of soil ingestion: 0–9 months, 0 mg/d; 9–18 months, 1,000 mg/d; 1.5–3.5 years, 10,000 mg/d; 3.5–5 years, 1,000 mg/d; and 5–70 years, 100 mg/d (Paustenbach, undated).

As children get older, their environments may include daycare, school, recreational spaces and work. Some children help their parents do craft jobs at home (Olaiz et al. 1995) and many others in North America join their parents in the fields as agricultural workers. Children in both urban and rural settings may live in homes that are part of the family business, where chemicals, solvents, paints, and pesticides are used or stored (Stansfield and Shepard 1993; Riojas et al. 1998). As children reach adolescence, many take part- or full-time jobs that may further expose them to occupational hazards (Pollack et al. 1990). In all of these situations, exposure to chemicals and other environmental pollutants may occur.

D. Factors for Additional Susceptibility

All children are exposed to a variety of toxicants at different developmental stages of their lives. Some children, however, are disproportionately exposed to environmental health threats due to poverty, and in some cases, to their ethnicity.

1. Poverty

The poverty rates in Canada and the United States are higher for children than for all other age groups. Today, there are approximately 1.3 million children living in poverty in Canada (Statistics Canada 1999). In the United States, the figure is 13.5 million, with African-Americans and Hispanics accounting for 26.1 and 25.6 percent respectively (US Census Bureau 1999).

A recent UNICEF report entitled *The Progress of Nations 2000* indicates that Mexico and the United States now top the list of OECD countries where children live in 'relative' poverty. It states that more than one in four children in Mexico (26.2%) and more than one in five in the United States (22.4%) are poor. The report defines relative poverty as living in a household where income is less than half of the national median.

Impoverished children often have limited access to clean water and health care, and live in sub-standard housing. Their parents or other adult family members may work in the dirtiest, most hazardous jobs, increasing the likelihood of "take home" exposures (Chaudhuri 1998). And poor children are more likely to live in areas where there is pollution and environmental degradation.

Poverty is also associated with poor nutritional status, which affects proper growth and development as well as the body's ability to withstand environmental insults. A child's nutritional status can help determine whether certain toxicants are readily absorbed or whether they will interfere with the absorption of needed nutrients. For example, low dietary levels of calcium, potassium, zinc, copper and iron have been associated with increased lead absorption (Skerving 1988; Mahaffey 1995).

The combination of poverty, nutritional status, and exposure to environmental toxicants places great stress on developing children, putting them at much greater risk of illness and chronic health problems (Bleyl, 1990; Chaudhuri, 1998). These interactions may be of particular importance in Mexico, where poverty is more widespread and severe malnutrition has not been eradicated. In

one sampling of a semi-rural population of about 11 million, there were 79,217 registered cases of malnutrition—99 percent of whom were children ages 14 and under (IMSS SOLIDARIDAD 2000). Malnutrition rates for 1999 are presented in Table 1 (IMSS SOLIDARIDAD 2000).

Table 1. Malnutrition Rates for Mexican Children, 1999

Age (years old)	Severe		Moderate		Low	
	cases	rate	cases	rate	cases	rate
Total *	2,432	22.76	16,217	151.74	60,568	566.73
Under 1 **	406	150.85	1,910	709.67	7,608	2,826.79
1-4 **	1,755	144.83	12,395	1,022.91	45,085	3,720.70
5-14 **	228	7.59	1,786	59.45	7,286	242.54
15-24 **	14	0.66	74	3.46	401	18.77

*Rate per 100,000 inhabitants in the Program IMSS SOLIDARIDAD, June 1999

**Rate per 100,000 inhabitants in the Program IMSS SOLIDARIDAD, June 1999, according to age group (estimation with base on the percentage of Work Units)

2. Ethnicity

In Canada, children (0–14 years of age) who belong to a visible minority (defined there as non-Caucasians or non-whites, other than Aboriginal peoples) account for 13 percent of the population—a significant proportion. Breaking that down further, children of Asian and Middle-Eastern origin account for 8.9 percent of the population, and Black and Latin American children account for 2.8 and 0.7%, respectively. Aboriginal people account for approximately 2.8% (Statistics Canada 1996). Aboriginal children and youth represent 50% of the total Aboriginal population (Statistics Canada 1996).

Compared to the general population, Inuit in northern Canada are at higher risk of exposure to persistent organic pollutants due to a diet rich in traditional country foods including marine mammals—animals whose fat provides ideal storage for the various toxins and chemicals. Arctic regions, such as Nunavut and Nunavik, are at the highest risk, as contaminants deposited by air and water currents accumulate in the cold climate and break down at a much slower rate. In fact, high levels of PCBs and DDT have been found in the breast milk of Inuit women in the remote Arctic regions of Canada (Dewailly et al. 1993). Although the health risk to Inuit children has not yet been established, some scientists have concluded that they show compromised immune systems and higher rates of illness (Repetto 1996).

In the United States, the ethnic breakdown of the under-18 population is 14% Hispanic, 15% African-American, 4% Asian/Pacific Islander, 1% Native American, and 66% white/non-Hispanic as of 1996 (US Census Bureau 1999). Several studies have demonstrated that proportionately more landfills, power plants, toxic waste sites, bus depots, railyards, sewage treatment plants, and industrial facilities are in non-white, impoverished communities (Bullard 1994; Brynant 1995). Similarly, it has been documented that children living in ethnic communities in the United States are

more exposed to air pollution and lead than their white counterparts (Wernette and Nieves 1992; Centers for Disease Control, undated).

In Mexico, it has been estimated that 10% of the total population is composed of indigenous people (Valdés 1996), and a relationship between ethnic background and life expectancy seems to exist. Counties with an indigenous population of more than 70%, for instance, have mortality rates that are 13% higher than the national average (Bronfman et al. 1994). Contributing factors are unclear, however.

IV. The North American Context

Children make up a large part of the population throughout North America, and particularly in Mexico. Children, birth through 18 years of age, make up 28% of the national population in Canada for the year 1996, 28.8% of the national population in the United States for the year 1997, and 45.6% of the national population in Mexico as of 1997 (Statistics Canada 1997; US Census Bureau 1999; INEGI, 1999).

A. Urban and Rural Populations

An overwhelming majority of North Americans live in urban areas. The United States is the most heavily urbanized, with 80% of its population living in or near cities as of 1993 (United Nations 1996). In Canada, 78% live in urban areas, but here too there is a sizable rural population of 22% (Statistics Canada 1997). Mexico is urbanizing the fastest of the three countries. While 73% of the population lived in or near cities in 1993, that percentage has been growing at the rate of 2% a year—versus 1% for Canada and 1.2% for the United States (Latin American Center for Demography 1997).

B. Births

In 2000, the birth rate (per 1,000 population) in Canada, the United States and Mexico was 11.3, 13.5 and 23.4, respectively (PAHO 2000). As reported in UNICEF's *State of the World's Children 2000*, the crude birth rate is declining in all three countries (UNICEF 2000) and is expected to decline further.

C. Mortality and Morbidity

Clean water, sanitation, vaccines, antibiotics, education, the quality and accessibility of health care services, and a heightened public awareness in Canada and the United States have led to a steady decline in infant and child mortality from infectious diseases, as well as in child mortality from injuries. Currently, there is increasing attention being paid to chronic illnesses in infants and young children because exposures during infancy and childhood may be associated with adult onset diseases.

In Mexico, patterns of sickness vary throughout the country, with poorer communities more susceptible to infectious diseases. Although the number of deaths from respiratory illness continues to grow (Riojas and Santos-Burgoa 1998), mortality from infectious intestinal diseases has declined, due to efforts by the Health and Environment Ministries to chlorinate water, lower reservoirs, and improve health education.

Leading mortality rates in Canada, the United States and Mexico are shown in Table 2 (SSA 1999; WHO 2001). In 1997, the top two causes of death for infants under 1 were congenital anomalies and conditions that originated during the perinatal period. For age groups 1–4 and 5–

14, accidents (other than traffic accidents) and adverse effects were the main cause of death in the three countries. In Canada and the United States, traffic accidents were second on the list; in Mexico, it was pneumonia and influenza, with infectious intestinal diseases ranked third for these age groups.

Table 2. Leading Mortality Rates in Canada, United States and Mexico (1997)

Country	Age Group			
	<1*	1-4**	5-14**	15-24**
Canada	Conditions originated in the perinatal period 254.4	Accidents and adverse effects 8.0	Accidents and adverse effects 6.5	Accidents and adverse effects 27.1
	Congenital anomalies 147.7	Signs and symptoms and other ill-defined conditions 4.3	Motor vehicle traffic accidents 3.1	Motor vehicle traffic accidents 18.6
	Signs and symptoms and other ill-defined conditions 77.5	Malignant neoplasms 3.2	Malignant neoplasms 2.7	Suicides and self-inflicted injuries 13.7
United States	Conditions originated in the perinatal period 333.3	Accidents and adverse effects 13.1	Accidents and adverse effects 8.7	Accidents and adverse effects 36.5
	Congenital anomalies 159.2	Motor vehicle traffic accidents 4.3	Motor vehicle traffic accidents 4.8	Motor vehicle traffic accidents 27.4
	Sign and Symptoms and other ill-defined conditions 97.2	Accidental drowning and submersion 3.0	Malignant neoplasms 2.7	Homicide and injuries purposely inflicted by other persons 16.6
Mexico	Conditions originating in the perinatal period 734.5	Accidents 21.9	Accidents 12.2	Accidents 34
	Congenital anomalies 267.7	Pneumonia and influenza 12.5	Malignant neoplasms 4.7	Homicide and injuries purposely inflicted by other persons 18.4
	Pneumonia and influenza 199.2	Intestinal infectious diseases 12.0	Congenital anomalies 2.0	Malignant neoplasms 6.7

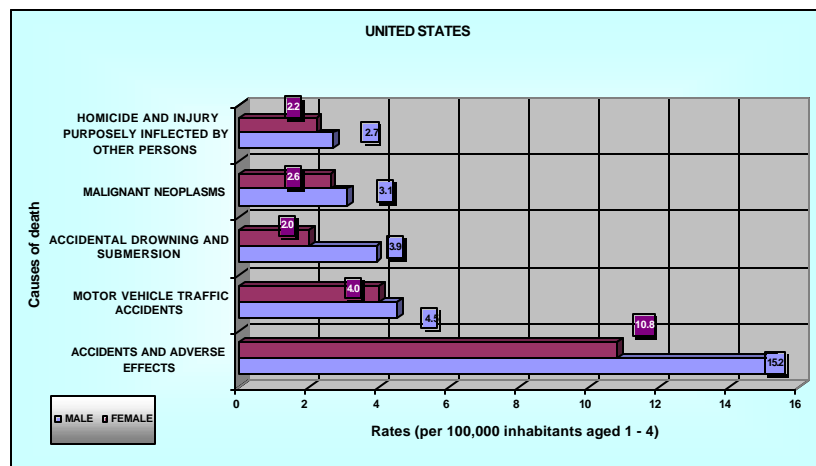
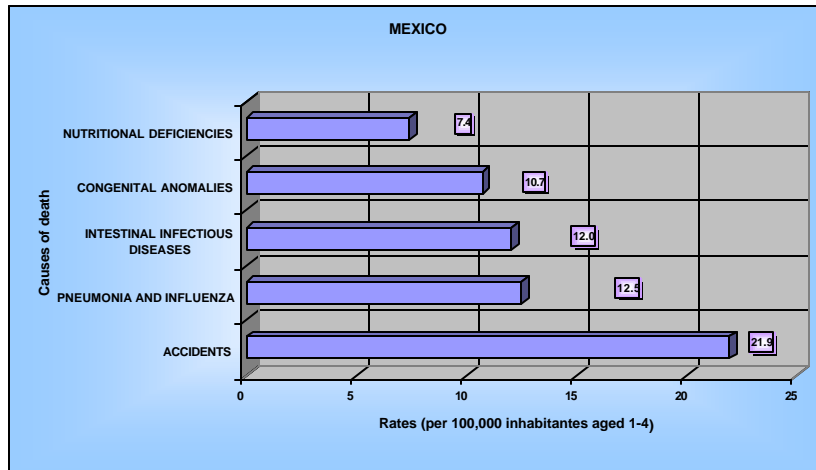
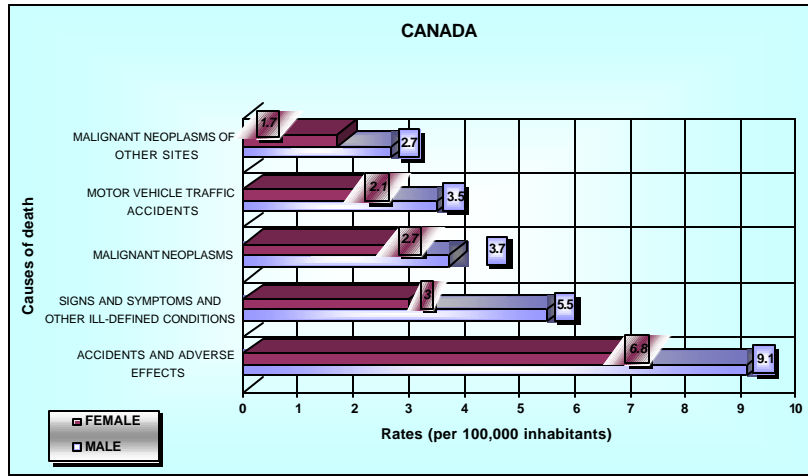
*Infant death rates per 100,000 live births

**Death rates per 100,000 inhabitants per age group

Sources: World Health Organization (WHO). 2001. *Mortality Data*; Secretaría de Salud (SSA). 1999. *Estadísticas Vitales, Mortalidad*.

Leading Mortality Rates for Children Aged 1- 4, 1997

Source: WHO, 2001; SSA, 1999



V. Environmental Threats to Children's Health

A. Sources of Exposure—Types of Hazards

1. Chemical Pollutants

Children are exposed to a number of different hazards from a variety of sources, ranging from naturally occurring hazards such as UV radiation and microbiological agents, to human-made hazards such as pesticides. The following is a brief overview of some of the hazards children in North America encounter through their food, as a result of air and water contamination, and in the places where they live, learn and play.

2. Chemical Pollutants

A new chemical is discovered about every nine seconds of the working day (McGinn 2000). On 15 June 1998, chemists identified the 18-millionth synthetic chemical substance known to science (McGinn 2000). Yet, only 2000 new chemicals are taken to US EPA for review each year, implying that the capacity to produce new chemicals has far surpassed our ability to monitor them (Landrigan 1998). It is likely, then, that many chemicals of common use have not been examined for their health consequences—particularly to children (Roe et al. 1997; Schaefer 1994).

Some of these chemicals are known as persistent organic pollutants (POPs), because they remain in the environment for long periods of time, accumulate in the tissues of living species, and often are transported far from their sources. As discussed earlier, they can be detected in human beings worldwide and may be passed from one generation to the next through breast milk. POPs include industrial chemicals such as PCBs, pesticides such as DDT and chlordane, and unintentional by-products of industrial processes such as dioxins and furans. Some POPs are known endocrine disruptors and neurotoxins. The Stockholm Convention on POPs, signed by over 100 countries worldwide since May 2001, seeks the elimination or phase-out of POPs, with an initial focus on twelve substances: aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, PCBs, DDT, dioxins and furans.

3. Consumer Products

A variety of seemingly innocuous household products can expose children to toxic or hazardous substances. Possible sources include: chemically treated building materials (e.g., particle board and insulation); upholstery and furnishings (e.g., carpets, curtains, and wall decorations); appliances (e.g., gas and wood stoves, and kerosene heaters); cleaning products; and materials used for hobbies (Metropolitan Toronto Teaching Health Units and the South Riverdale Community Health Centre 1995). Even toys and other items made specifically for children can be hazardous. A recent example is soft-vinyl toys that use phthalate esters as plasticisers. While

scientists are still debating the health risks, some companies are removing the chemical from their products and some countries are acting to ban its use.

4. Pesticides

North America continues to be the world's leading consumer of pesticides. Under NAFTA, pesticides can be traded tax-free among the three partners. Over the past three decades, sales have jumped by 50% (US EPA 1997) and have been growing at a rate of about 6% a year since 1990, particularly for so-called cosmetic use—that is, to make lawns and gardens weed-free and attractive (Agrow 1997). In the United States alone, this translates to 4.6 billion pounds of active ingredients in a typical year (US EPA 1999b), including wood preservatives and disinfectants.

Mexico also has registered a steady increase in sales of pesticides. In 1960, 14,000 tons were sold within the country; by 1986, sales had climbed to 60,000 tons (Ortega-Ceseña J. et al. 1994). From 1999 to 2000, pesticide imports grew by 28.2% from 1999 to 2000 (Subcomité de Comercio y Fomento Industrial 2001).

Canada is one of the only OECD nations that does not require reporting of pesticide sales (Boyd 2001). Nevertheless, according to OECD data, pesticide use in Canada appears to be declining, by 26% since 1985 (OECD 1999), whereas Statistics Canada recently published figures indicating that pesticide use in Canada rose over 400% between 1970 and 1995 (Statistics Canada 2000). This discrepancy may be due to the fact that Canada's survey coverage has varied greatly (different active ingredients, registrants and products); therefore, survey trends may not reflect actual trends but simply changes in the survey coverage (OECD 1999, as cited in Boyd 2001).

Pesticides have the potential to contaminate food and ground and surface waters and can bioaccumulate in the food chain. Also, the dangers of acute pesticide poisoning are well documented, with up to 5 million people being poisoned annually, worldwide (WHO 1990). There is now growing concern about chronic, low-level exposure to persistent residues, which may interfere with immune, thyroid, respiratory and neurological processes in children (NRC 1993; IPCS 1998) and may be linked to childhood cancers, endocrine disruption, and developmental neurotoxicity.

Children, like other members in the general population, are exposed to pesticide residues in their diets; however, children eat more fruit and vegetable products per kilogram of body weight than adults do. A report entitled *Pesticides in the Diets of Infants and Children* (National Research Council 1993) concluded that the differences in diet and, thus, in dietary exposure to pesticide residues, account for most of the differences in pesticide-related health risks that have been found to exist between children and adults.

Foods commonly consumed by children, such as apples, tomatoes, grapes and peas, among other food crops, are likely to carry more than one pesticide. One US study analyzed twenty-two fruits and vegetables for pesticide residues. The results showed 108 different pesticides; forty-two different pesticides were detected on tomatoes, thirty-eight were detected on strawberries, and

thirty-four were detected on apples (Wiles et al. 1999). The study also indicated that twenty million children aged five and under eat an average of eight pesticides a day; a total of more than 2,900 pesticide exposures per child each year from food alone. These numbers may be higher, particularly in agricultural areas where children may be exposed to pesticides in the air from aerial spraying, as well as from clothing of parents who work with pesticides (Health Canada 1996).

Each year, more than 100,000 children in the United States accidentally ingest pesticides (US EPA 1998b), either directly or by putting contaminated objects into their mouth. In Mexico, where acute poisonings dropped by 27% from 1997 to 1999 (IMSS SOLIDARIDAD 2000), one rural area of 11 million people reported 592 pesticide poisonings in 1999, 141 of which occurred in children 14 and under (IMSS SOLIDARIDAD 2000). According to data for Canada, accidental pesticide exposure accounts for about 4% of all reported childhood poisonings (Health Canada 1995a).

Far more often, though, children are exposed less acutely through inhalation or absorption through their skin. Parents or landlords may spray their home and their lawn, and their pets may wear flea collars. Schools and daycare facilities may use pesticides in classrooms and food preparation areas, as well as to maintain playgrounds and sports fields. Public buildings and parks also are frequently sprayed. In rural areas, some children may be directly involved in the application of pesticides, or they may be exposed by playing in treated fields or by family members who bring it home on their clothing.

5. Toxic Metals

Lead

Lead is a potent neurotoxin that can cause significant health problems in children. It has no known function in the human body and as a systemic toxin exerts its effects in a variety of ways, for example, by forming bonds with negatively charged groups of enzymes and proteins. It is absorbed into the bloodstream and can accumulate in tissues, particularly in the bones and teeth. Children and the fetus are particularly at risk because they absorb lead more efficiently than adults, and because immature organs and tissues are thought to be more susceptible to lead. Lead can damage a child's developing brain, kidneys and reproductive system; even low levels are associated with learning disabilities, hyperactivity, behavioral problems, impaired growth, and hearing loss (Needleman and Bellinger 1991).

Much of the debate over low-level exposure centers around the effect it may have on childhood intelligence. Although studies consistently suggest a negative impact on IQ, it is a challenge in epidemiological studies to control for the many social factors that have a strong influence on children's intelligence (Wasserman et al. 1997). Currently, researchers have not been able to determine a threshold of exposure below which lead does not have an effect on human health (Federal/Provincial Committee on Environmental and Occupational Health 1994).

Although historical uses of lead have been shown to result in widespread distribution (for example, through analysis of ice cores from remote areas), the most extensive example of its pervasiveness

in the environment was through the introduction of lead in gasoline and industrial products. Other sources of exposure can include: (1) lead-based paint, which children may i) directly ingest, ii) indirectly ingest through the hand-to-mouth route via contact with contaminated dust in the home, or iii) encounter in soil contaminated with flaking paint; (2) hazardous waste sites including lead which may originate from many different industrial or commercial processes; (3) drinking water from lead pipes, or copper pipes with lead solder, used in older homes, or faucets with lead-containing alloys; or corrosive water leaching lead from bedrock; (4) low-temperature-glazed pottery inappropriately used for food preparation or storage; (5) home environments associated with a parent who works in a lead-related industry or cottage industry, has artisan applications, or has a hobby involving lead use; and, (6) industrial emissions from a host of different processes. In the US, the EPA has published guidelines to determine if any of these source areas represent a hazard.

For children in the United States, sources identified as important are paint chips and lead in dust (US EPA 1996b). In Mexico, among the priorities are food prepared in leaded pottery and contamination of the environment around mining industries and waste treatment facilities (Rojas et al, 1994). Both countries saw a 90% drop in the levels of lead in the air after banning leaded gasoline (US EPA 1996b; Rothenberg, et al. 2000). This is anticipated to have a considerable impact on children's health: for example, blood lead levels dropped a corresponding 75% in the United States after the ban (US EPA 1996b). Nevertheless, historical evidence of ancient bone and teeth samples collected from past civilizations suggest modern day exposures may still be several orders of magnitude higher than background values (US EPA 1984; Patterson 1983). Consequently, efforts which result in the reduction of exposure further still are likely to result in reduced risk of health effects in susceptible individuals.

Mercury

The most toxic form of mercury is methylmercury (WHO 1990), which has been found to be a strong teratogen (a substance able to cause birth defects) and to affect the central nervous system (Etzel and Balk 1999). Most mercury released to the environment is in the inorganic form, as a result of mining, smelting, and other industrial discharges, or of coal-fired power plants, which in the United States are responsible for 34% of mercury arising from human activities (Grant et al. 1999). Bacteria then convert inorganic mercury to organic methylmercury, making it available for uptake into the food chain, where it bioaccumulates and biomagnifies (Lindberg et al. 1987). Food, such as tuna and other types of predatory fish, is considered to be the primary route of exposure for children and adults, while marine mammals remain the main source of exposure for Inuit. This is of particular concern because methylmercury in food is almost totally absorbed into the bloodstream by the gastrointestinal tract (WHO 1990).

Health Canada has established a guideline level of 0.5 parts per million (ppm) for mercury in most commercial fish, whereas the current guideline for methyl mercury in the United States is 1.0 ppm. Certain fish species sold in Canada and the United States, namely, shark, swordfish, and fresh and frozen tuna, contain mercury at levels which are known to exceed the guidelines. Based on current

data available, average mercury levels in these species are at or near 1.0 ppm with a typical range of 0.5–1.5 ppm (Health Canada 1999).

All fish are an excellent source of high-quality protein and are low in saturated fat, which makes them a healthy food choice. Health Canada advises pregnant women, women of childbearing age and young children to limit the consumption of shark, swordfish and fresh and frozen tuna to no more than one meal per month; whereas, the US Food and Drug Administration's Center for Food Safety and Applied Nutrition advises that pregnant women and women of childbearing age do not consume shark, swordfish, King mackerel, or tilefish (US FDA 2001). They also advise that it is prudent for nursing mothers and young children not to eat these fish as well.

Cadmium

Cadmium has been designated a 'probable human carcinogen' by the International Agency for Research on Cancer, and chronic exposure to it has been associated with anemia, softening of the bones, cardiovascular disease, and kidney damage. Food is a principal route of non-occupational exposure for children and adults, though adults are exposed through tobacco as well (Buchet et al. 1990). Due to its toxicity, cadmium may pose significant risks to the respiratory system even at low ambient air concentrations (Wadge and Zelikoff 1999).

Arsenic

Arsenic is a known human carcinogen and is highly acutely toxic (ASTDR 2000). It is also a chemical element and a natural constituent of the Earth's crust. It occurs naturally in rocks and soil, water, air, and plants and animals. When in the natural environment, arsenic usually binds to other molecules, such as those found in soils, and does not tend to travel very far. Arsenic can be released into the environment through natural occurrences such as volcanic activity, erosion of rocks, and forest fires, or through human actions. Agricultural practices, mining, and smelting also contribute to arsenic releases in the environment. Approximately 90 percent of industrial arsenic in the United States is currently used as a wood preservative, but it is also used in paints, dyes, metals, drugs, soaps, and semiconductors (ASTDR 2000).

6. Asbestos

Asbestos is a group of minerals that is found naturally as a bundle of strong and flexible fibers. Due to their insulating, fireproofing, and sound absorption properties, asbestos fibers have been used extensively since the late 1800s in the clothing, shipbuilding, and construction industries (NCI 2001). Many schools, homes, public buildings, and offices—especially those constructed between the 1950s and the 1970s—contain asbestos. Widespread public concern over its health implications led to a decline in its use starting in the late 1970s.

Asbestos is known to cause mesothelioma (a rare cancer of the lining of the chest or abdominal cavity), asbestosis (scarring of the lung which makes breathing difficult), and lung and other

cancers. The risk of developing these diseases depends on the level and duration of exposure to asbestos dust, on fiber size, and the mineralogical type of the fiber. Asbestos fibers may be released, for example, especially if the material is damaged, exposed and flaking. There is a very long latency period associated with mesothelioma—up to 30 years or more.

Some evidence points to elevated risks for children and other family members of workers who are heavily exposed to asbestos. Asbestos dust may be brought into the home on clothing, shoes, and the body or hair of workers (NCI 2001).

7. Ozone

Since children spend more time outdoors than adults, they are the group most at risk to ozone at levels measured in the air of many cities. Ozone can cause breathing difficulty, inflammation of the airways, susceptibility to respiratory infection, impaired pulmonary function (Castillejos et al. 1992; Gold et al. 1999), and a variety of respiratory symptoms (e.g., cough, chest pain, nose and throat irritation, shortness of breath).

8. Particulate Matter

Particulate matter is one of the most pervasive air pollutants, posing a threat to all age groups. Toxicity is most likely related to its physical or chemical properties, including particle size, number, shape, composition, and reactivity. Particles are classified by size, based on their sources and on their ability to penetrate and deposit on the lungs. The PM₁₀ fraction (particles of less than ten microns in diameter), also called thoracic or inhalable particles, can penetrate and deposit in the respiratory tract (Lippmann 1989) and includes both fine (PM_{2.5}) and coarse (PM_{2.5-10}) particles.

Fine particles are formed during high-temperature processes and by chemical reactions in the atmosphere, and include nitrates, sulfates, ammonium, organic compounds, and trace metals (Hinds 1982; Koutrakis and Sioutas 1996; US EPA 1996a). Coarse particles, by contrast, are typically produced mechanically and through erosion and soil resuspension, and include elements such as calcium, potassium, sodium and silicon, as well as pollen, mold, and plant spores (Spengler and Thurston 1983; Chatigny et al. 1989; US EPA 1996a; Spengler and Wilson 1996).

Studies conducted in the United States, Mexico and the Czech Republic have all found a link between particulate exposure (measured as fine or total suspended particles) and child mortality (total infant mortality or deaths due to respiratory causes) (Woodruff et al. 1997; Bobak and Leon 1999; Loomis et al. 1999). A host of respiratory ailments have been associated with fine particulate matter in particular. These include symptoms such as cough, shortness of breath, and throat and nose irritation; labored breathing; asthma; and vulnerability to lung infections. In addition, several studies have associated fine particles with higher mortality rates in the elderly (Dockery and Schwartz 1995; Pope et al. 1995; Schwartz et al. 1996; Laden et al. 2000).

9. Second-hand Tobacco Smoke

Exposure to environmental tobacco smoke (ETS), commonly referred to as “second-hand smoke,” has been linked to a variety of respiratory symptoms, including asthma. Children who live with at least one smoking parent have a higher incidence of bronchitis, pneumonia, otitis media (middle ear infection), and viral respiratory infections than unexposed children (Landrigan et al. 1998). Also, maternal smoking during pregnancy has been associated with low-birth-weight infants, and a greater risk of pulmonary hypertension and lower respiratory tract infections in the newborn (Erlich et al. 1996; Landrigan et al. 1998).

Smoking is still permitted in many restaurants, shops and other public places throughout North America. Many states in the United States have banned smoking in public places. In Canada, it is banned in many public buildings, and municipal by-laws in some cities require non-smoking sections in restaurants. Mexico enacted in a federal law in 1992 that prohibits smoking in federal buildings. Still, all three countries allow children in smoking areas, where they may be subjected to acute ETS exposure associated with bronchial hyperreactivity (Etzel and Balk 1999).

10. Hazardous Air Pollutants

Commonly referred to as air toxics, hazardous air pollutants (HAPs) include substances that are known to cause or suspected of causing cancer or other serious health problems, such as reproductive impacts and neurological damage. Examples of air toxics include heavy metals like mercury, lead and chromium; and organic chemicals like benzene, 1,3-butadiene, formaldehyde, perchloroethylene, and dioxins. Benzene, for example, is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs (ATSDR 1997).

Dangerous exposures to HAPs can occur from nearby facilities, from distant sources whose emissions are carried through the atmosphere, or from a mixture of pollutants in urban settings. The great number of HAPs and the scarcity of evidence about their toxicity under non-occupational conditions limit a fuller evaluation of their health risks.

11. Airborne Agents

These include pollen, bacteria, and fungal spores—all of which affect children’s health and can be particularly harmful in closed, indoor environments. Exposures have been associated with reduced lung function and higher incidence of respiratory illness.

12. Microbiological Agents

Food and water are the main sources of microbiological contamination in children. For food-borne illnesses, the major causes are bacteria, protozoa and parasites, as well as shellfish-borne toxins produced by algae. Improper food handling, storage, and cooking practices may lead to the growth and multiplication of bacteria like *Salmonella*, *Campylobacter*, *E. coli*, *Listeria*, and

Clostridium, which can cause diarrhea, dehydration, abdominal pain, mild fever, nausea, and vomiting. The most commonly contaminated foods include vegetables, meat and poultry (see Water section, under *Routes of Children's Exposure*, for water-borne illnesses.)

Food poisoning statistics for children are not available in Canada, Mexico or the United States in a concentrated and valid manner, although some data are available at a population level. Canada records about 10,000 cases of bacterial food poisoning in adults and children every year, but there may be up to 100 unreported cases for each reported one (Health and Welfare Canada 1992a; Health and Welfare Canada 1992b; Health Canada 1994). In fact, *Salmonella* poisoning alone is thought to be responsible for about 600,000 cases of illness a year in Canada (Health Canada 1997).

One report from the United States estimated that food-borne diseases cause 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths every year, among all age groups. Known pathogens account for only 14 million of those illnesses, 60,000 hospitalizations, and 1,800 deaths (CDC 1999). *Escherichia coli* alone is thought to cause 73,000 cases of infection and 61 deaths per year (CDC 1999).

B. Routes of Children's Exposure

1. Food

Food provides the nutrients for children to grow. It is also an effective conduit for microbiological agents, persistent organic pollutants, pesticides, food additives, and metals, including mercury, lead and cadmium.

Some of the most toxic pollutants enter the food chain through farmland—after being either deposited by air currents, applied through sewage sludge and untreated water, or sprayed on crops directly. These include persistent organic pollutants (POPs), such as PCBs, chlorinated dioxins, furans, and organochlorine pesticides; and polycyclic aromatic hydrocarbons (PAHs). In Canada, it has been estimated that food accounts for 80–95% of our daily intake of persistent organic pollutants (Health Canada 1995b).

Food additives, including nitrates/nitrites and sulfites, are another concern for children's health. Nitrates and nitrites are used as anti-microbial preservatives in cured meats like sausage, but most human exposure is through vegetables (Health Canada 1995b). Sulfites are used as preservatives in a wide variety of foods that appeal to children, including fruit juices, snack foods, ketchup, candy, and jams and jellies. Some children, especially those with asthma, are highly sensitive to sulfites. Allergic symptoms include hives, nausea, and even fatal shock (Health Canada 1995b).

2. Water

Children are vulnerable to a range of hazards from water, such as microbial contaminants, disinfection by-products, metals, and chemical contaminants. Exposure can occur in seemingly

innocuous ways—from drinking to hand-washing or by inhalation of contaminants in steam while showering. Swimming in contaminated surface waters can put children at particular risk of exposure to harmful microbes. Those risks may include pathogens like *Entamoeba*, *Giardia*, and *Cryptosporidium* (protozoans), as well as *Escherichia coli*, *Salmonella*, *Shigella* spp., *Vibrio cholerae* (bacteria), Hepatitis A (virus), and Enteroviruses.

One likely source of microbial contamination is human fecal waste that has leaked from septic systems. The disinfection of drinking water is a critical safeguard, particularly in rural areas where it can be the sole affordable treatment. As discussed earlier, children are especially vulnerable to contaminated water, because they consume more for their body weight than adults. In Canada, where about 87% of the population receives treated municipal drinking water, the incidence of serious waterborne diseases has been among the lowest in the world (Health Canada 1997). Recently, however, *Escherichia coli* contamination of municipal water in Walkerton, Ontario, led to seven deaths in the small rural community. Similarly, in the United States, a 1993 outbreak of cryptosporidiosis in Milwaukee, Wisconsin, caused over 400,000 persons to be affected. More than 4,000 people were hospitalized, and over 50 deaths (some counts are as high as 100) were attributed to exposure to the bacteria through drinking water. Both of these cases have helped put the issue of drinking water quality on the public agenda in Canada and the United States.

In Canada, drinking water guidelines are revised and updated on a continuing basis by the federal government in collaboration with the provinces and territories. The *Guidelines for Canadian Drinking Water Quality* outline maximum acceptable concentrations and/or aesthetic objectives for the physical, microbiological, chemical and radiological parameters of drinking water supplies, both public and private (Health Canada 1995b). Since supervision of drinking water is a provincial responsibility, the guidelines are not applied nationally except in those areas that fall under federal jurisdiction. Provinces and territories may develop enforceable standards based on the national guidelines, and many provincial and territorial governments have established their own measures of water quality based on the guidelines.

In the United States, the *Safe Drinking Water Act* gives the Environmental Protection Agency (EPA) the responsibility for setting national drinking water standards. While EPA and state governments set and enforce standards, local governments and private water suppliers have direct responsibility for the quality of drinking water. Water systems test and treat their water, maintain the distribution systems that deliver water to consumers, and report on their water quality to the state. States and EPA provide technical assistance to water suppliers and can take legal action against systems that fail to provide water that meets state and EPA standards (US EPA 2001b). EPA issues drinking water standards, or Maximum Contaminant Levels (MCLs), for more than 80 contaminants. The standards limit the amount of each substance allowed to be present in drinking water.

In the United States, about 95% of the population was served by filtered water systems as of 1995, and was, at least in principle, protected against microbiological contaminants (US EPA 1996b). Similarly, the Mexican government has implemented programs to improve the percentage of households served as well as the quality of drinking water. From 1991 to 1998, the percentage

of households with access to drinking water increased from 79% to 86.4%, and the percentage of water that is disinfected increased from 84.5% to 93.4% (CNA 1999). For that same period, the mortality rate for children under 5 from infectious intestinal diseases declined by 70.5% (SSA 1999), which may attest to the effectiveness of such programs.

It should be noted that while disinfectants are an effective weapon, they pose their own problems. Some can react with matter from plant and animal decay, forming disinfection by-products (DBPs). Epidemiological studies have found a possible association between certain DBPs and a slightly elevated risk of reproductive and developmental effects (US EPA 2001a). Toxicological studies have shown that several trihalomethanes found in drinking water can cause cancer, and other epidemiological studies have indicated that chlorinated drinking water may be associated with bladder cancer (King and Marret 1996).

A number of other water contaminants can cause health problems for children. Nitrates found in drinking water—a product of municipal wastes, urban and agricultural runoff, and the erosion of natural deposits—may lead to acute toxicity in bottle-fed infants, causing methaemoglobinaemia. This disease is life threatening in infants under six months unless they receive immediate medical attention (US EPA 2001a).

Arsenic, which is a human carcinogen in its inorganic form, may also be found in drinking water, introduced from industrial runoff, from the dissolution of mineral and ores, and from atmospheric deposition. Studies conducted in the United States have linked exposure to arsenic in drinking water to miscarriages (Aschengrau et al. 1989). In Mexico, chronic exposure to arsenic-contaminated water has been associated with skin cancer, cutaneous lesions, peripheral vascular diseases, abdominal pain, diarrhea, and nausea (Tseng 1977; Cebrian et al. 1983).

Another serious hazard sometimes found in drinking water is inorganic mercury compounds. Long-term exposure at levels above the maximum contaminant level (0.002 mg/L) can cause kidney damage (US EPA 2001a). But there is inadequate evidence to say whether a lifetime exposure to drinking water can cause cancer (US EPA 2001a).

Chemical contaminants, including pesticide runoff, chemical discharges from industrial facilities, and even consumer products and pharmaceuticals, can also be found in drinking water sources. While the main health effects associated with some of these chemicals are known, there are other potential effects, including more subtle, long-term effects such as endocrine disruption, that may be caused by some of these chemicals and which are not yet fully understood.

3. Air

Literally thousands of studies have documented the health effects of indoor and outdoor air pollutants, both in human and laboratory animal research. Conducted over the past three decades, these studies have shown that inhaled air pollutants modulate the lung immune system response (Thomas and Zelikoff 1999) and are associated with a variety of health problems in children. These range from relatively minor ailments, such as small changes in the ability to breathe normally

or nose and throat irritation, to asthma and cancer, resulting in hospitalizations or even death (Woodruff et al. 1997; Borja et al. 1999; Loomis et al. 1999).

Indoor air pollution is a very serious concern—one of the five biggest environmental hazards, according to the Science Advisory Board of the US EPA—because children are indoors so much of the day (Moeller 1997; US EPA 1998a). One Canadian study reported that young children spend almost 90% of their time indoors (Leech et al. 1996), a percentage that an earlier US study found applies for people of all ages, throughout the industrialized world (US EPA 1989). In Mexico, researchers concluded that children ages 9 to 12 are indoors 85% of the time (Rojas-Bracho 1994).

Levels of certain pollutants can also be much higher indoors. In some US cities, the EPA says, concentrations of nitrogen oxides, carbon monoxide, suspended particles, and volatile organic compounds can be two to five times higher indoors than outdoors. But even when levels are low, the longer duration of exposure could have a significant impact.

Pollutants that are thought to pose the greatest threat to children are carbon monoxide, pesticides, respirable particles, volatile organic compounds, microbiological agents (mites, fungal spores, etc.), cigarette smoke, and asbestos. Potential sources of contamination are diverse, including such things as kerosene heaters, cooking and heating stoves, tobacco, cleaning products, furniture-finishing materials, building insulation, humidity, poor hygiene, and the presence of pets. And exposure risks are virtually everywhere: home, school, day care, and any public place.

Indoor air problems in industrialized countries seem to differ from those in developing areas. In Canada or the United States, for example, indoor air pollution basically arises from low ventilation rates and emissions from a large variety of compounds. In developing countries, the principal problems may be related to the use of biomass fuels for cooking and heating in rural areas. A recent Mexican study showed that PM₁₀ levels inside the homes in two rural towns were on average five times higher than national standards (Riojas-Rodriguez et al. 2001). These unhealthy conditions are thought to contribute to the very high rates of infectious respiratory diseases found in children in rural Mexico (Riojas-Rodríguez et al. 2001). For instance, in one predominantly rural state, respiratory diseases are the third leading cause of death overall and the main cause of death among children (SSA 1995).

As for outdoor air, the chief sources of pollution are the burning of fossil fuels in power plants, industry and industrial operations (e.g., paper and pulp mills, smelters), agricultural practices, petroleum refineries, gasoline stations, dry cleaners, and motor vehicles (Moeller 1997). Contaminants include the six so-called criteria pollutants (carbon monoxide, lead, ozone, particulate matter, sulfur dioxide, and nitrogen dioxide), as well as a large number of chemicals.

VI. Health Consequences

C. Asthma

Asthma has been epidemic in large portions of North America for the past 15 to 30 years, affecting all ages, races, and ethnic groups—but none more than children (GPO 1999). Industrialized areas seem to have fared the worst: Reported incidences of asthma are higher in the United States and Canada (up to 17% of the population) than in Mexico (6%) (ISAAC 1998). Although the relationship between exposure to contaminants and onset of the disease is still unknown, the rising rates and concentration in industry-heavy areas point to an environmental trigger (Becklake and Ernst 1997).

As it is now understood, asthma is a disease of chronic airway inflammation and hyperresponsiveness to a variety of stimuli, resulting from a complex interplay between environmental exposures and genetic and other factors (GPO 1999). While the initial cause remains something of a mystery, the triggers of subsequent attacks in children are well characterized. Allergens such as house dust mites, cockroaches, fungal spores, and animal dander all can provoke asthma symptoms (National Asthma Education and Prevention Program 1997; Platts-Mills et al. 1997; Warner et al. 1996), whereas tobacco smoke can either trigger an episode or worsen the effects of allergens (US EPA 1992). Parental smoking during the first year of life has also been associated with an increased risk of childhood asthma (Strachan and Cook 1998). Upper respiratory viral infections are also recognized as important triggers for asthma episodes (Busse et al. 1997).

Children with asthma have long been recognized as particularly sensitive to outdoor air pollution. Many common pollutants, such as ozone, sulfur dioxide, nitrogen dioxide, and particulate matter, are respiratory irritants that may exacerbate the disease (Koren 1995; Romieu et al. 1995; Landrigan et al. 1998). Recent data further suggests that exposure to dense traffic is a risk factor for asthma as well as other respiratory symptoms in children (van Vliet et al. 1997; Brunkreef et al. 1997; English et al. 1999).

D. Childhood Cancer

Childhood cancers represent a range of diseases affecting different organ systems and tissues, all of which are characterized by chaotic cell growth and multiplication. About 10-20% of cancers are genetically determined, according to scientists. The remaining 80% have some environmental component. The environment here is broadly defined to include lifestyle choices, socio-economic status, and what we eat, drink, breathe, and are otherwise exposed to during the course of our lives (Needleman and Landrigan 1994; Carroquino et al. 1998). This includes exposure in utero, which may play a key role in childhood cancers (Herbst et al. 1971; Zahm and Devesa 1995; Perera et al. 1998).

Scientists believe that cancer involves a series of steps. Step one is a change or mutation in genetic material, possibly resulting in greater susceptibility and sensitivity to further mutations; next is the activation of oncogenes, causing cells to grow at a rapid rate; and finally the deactivation of tumor suppressor genes, which normally slow down the growth of cells. Critical factors in this scenario are the type of carcinogen (some are known to initiate cancer while others are known to promote it), the duration of exposure, routes and dose of exposure, and the stage of development when a child's exposure occurs.

In Canada, leukemia is the most common of the childhood cancers, followed by brain and spinal cord cancers (National Cancer Institute of Canada 1999). Similarly, in the United States, where cancer is the second most common cause of death after age 1, leukemia and brain cancers are the most prevalent in childhood (Landrigan et al. 1998). Mexico's cancer morbidity data suffers from under-reporting, making mortality statistics better indicators of health trends. According to 1996 data, cancer was the eighteenth cause of death in children age 5 and under, and the eighth cause of death in children 4 to 14 (SSA 1997). Of all childhood cancers, brain cancer was the most frequent cause of death.

In Canada, the incidence of childhood cancer has been relatively stable over the past 15 years (Health Canada 1999a), whereas in the United States it rose 10% from 1974 to 1991 (Carroquino et al. 1998; Landrigan et al. 1998). During the last time period, 1990–1995, there is an indication of a leveling off, or a slight decline in the overall incidence rates for each of the five-year age groups (Ries et al. 1996). Death rates, though, have declined in the US. By contrast, Mexico has seen rising mortality rates during the same period. From 1986 to 1990, the number of deaths from cancer grew from 2.25% to 5.8% for children ages 1 to 4, and from 7.6% to 14% for those ages 5 to 14 (SSA 1991; SSA 1999). These increases in the United States and Mexico have been the subject of debate, as some scientists question if they really are a reflection of better diagnostics (Smith et al. 1998; Landrigan et al. 1998; Lent et al. 1999). Still, changes in lifestyle, diet and environment may play an important role (Carroquino et al. 1998; Landrigan et al. 1998; Schmidt 1998).

Apart from exposure to ionizing radiation, the causes of childhood cancer remain unclear. The list of suspects includes, but is not limited to: genetic abnormalities, ultraviolet radiation, electromagnetic fields, viral infections, certain medications, tobacco, alcohol, and industrial and agricultural chemicals (Zahm and Devesa 1995; Schmidt 1998).

E. Neurodevelopmental Effects

With no known cause for an estimated 70% of the developmental defects seen in children, there has been growing concern about the impact of chemicals and drugs on the developing nervous system (Wilson 1977). Learning disabilities, attention deficit hyperactivity disorder, developmental delays, and emotional and behavioral problems are among childhood disabilities of increasing concern. For example, in the United States nearly 12 million children under 18 years of age (17%) suffer from deafness, blindness, epilepsy, speech deficits, cerebral palsy, delays in growth and development, emotional or behavioral problems, or learning disabilities (Schettler 2001). Learning

disabilities alone affect 5–10% of children in public schools (Schettler 2001). Attention deficit hyperactivity disorder (ADHD) conservatively affects 3–6% of all school children and perhaps as many as 17% (Schettler 2001).

Genetics clearly play a significant role in some developmental problems like attention deficit disorder, but there is mounting evidence that chemicals, nutrition and other environmental factors are primary causative factors. Such neurodevelopmental defects as delayed development, altered reactivity to the environment, and cognitive dysfunction have been reported in children exposed to any of a number of chemicals in utero or as newborn. These toxicants include methyl mercury, nicotine, PCBs, alcohol, toluene, phenytoin, and lead (Friedman 1998; Levin and Slotkin 1998; Rice 1998). In addition, children exposed to chronic, low-dose environmental neurotoxicants may show permanent and irreversible neuropsychiatric effects, including learning deficits and behavioral alterations (Landrigan et al. 1998).

Interacting genetic, environmental and social factors are important determinants of childhood brain development and function (Schettler 2001). Children of lower socio-economic status, for instance, may be at higher risk of mental retardation because of severe malnutrition, disease and proximity to environmental hazards, including known developmental neurotoxicants like mercury, cadmium, lead and PCBs. Still, even though exposure to chemicals, genetic background, and nutritional status are known to affect neurodevelopmental processes, we need to better understand how these three factors interact to produce neurodevelopmental deficits.

F. Birth Defects

Birth defects are the second leading cause of infant mortality in Canada, the US and Mexico (SSA 1999; WHO 2001), and are among the top five causes of premature death in people under 65 in the United States (CDC 1988).

In most cases, there is no known etiology. One study found that almost 57% of birth defects were unexplained and that only about 5% percent were associated with chemical exposures (Nelson and Holmes 1989). Others have estimated that up to 80% of birth defects are of unknown etiology. We expect to learn much more about the development of birth defects and the role played by environmental factors as information becomes available from the Human Genome Project, as well as from studies linking genes with particular birth defects (Khoury 2000). For instance, some studies have found an interaction between maternal cigarette smoking during pregnancy and an uncommon allele of transforming growth factor alpha (TGF), resulting in as much as a ten-fold increase in the risk of cleft lip, with or without cleft palate, or cleft palate alone (Hwang et al. 1995; Shaw et al. 1996; Shaw and Lammer 1997).

In the United States, there has been increased monitoring of birth defects over the past few years. The Centers for Disease Control and Prevention (CDC) has set up 10 regional tracking centers that will do some evaluation of contributing factors, including environmental exposures. Texas began its own extensive tracking program after several children living on the Mexican border were born with anencephaly—a condition where most or all of the brain is missing. The most likely

culprit in those cases was a vitamin B deficiency, which may easily be prevented with appropriate supplements including folic acid. Because of findings from several studies showing that folic acid can help prevent neural tube defects like anencephaly and spina bifida, the US Public Health Service raised its recommended dose of folic acid to 4 milligrams daily for prospective mothers (US Public Health Service 1995). Similarly, Health Canada suggests that a daily supplement containing 0.4 mg of folic acid together with the amount of folate found in a healthy diet is expected to reduce the risk for women who have not previously had a pregnancy affected by a neural tube defect (Health Canada 1998).

Better tracking of birth defects, exposures, and genetic factors will help us discover other preventive measures and reduce the incidence of birth defects in the population. There is also the need to include data from prenatal screening for abnormalities and elective abortions when measuring birth defect rates.

G. Immunological Effects

The immune system is the body's defense against infection from foreign agents. There is also some evidence that it may play a role in containing malignant cells, thus allowing the body to resist tumor formation and cancerous growths. However, there is little known about the immune system effects from exposure to environmental contaminants in humans.

Two main immune system effects may be associated with exposure to toxins: 1) immune sensitization or heightened function may allow for development of allergic reactions to antigens; and 2) immune suppression may render the individual more susceptible to infections and cancer (Vanderlinden and Abelsohn 1999). There is also some speculation that certain auto-immune disorders may be associated with environmental exposures (Pieters and Albers 1999; Sentzivanyi et al. 1995).

While the exact immunological effects from environmental contaminants are not well known, it is believed that some may be potentially immunotoxic to humans. For example, exposure to compounds that may result in immunological effects include: pesticides; air pollutants such as ozone, nitrogen dioxide, environmental tobacco smoke; and metals such as cadmium, lead and mercury (Vanderlinden and Abelsohn 1999).

H. Reproductive Conditions and Endocrine Disruption

A growing body of evidence suggests that a number of synthetic and naturally occurring organic chemicals such as phytoestrogens (Hughes 1998), dioxins, PCBs, phthalate esters, and DDT, may disrupt the endocrine systems of humans and wildlife. Children may be at a particularly high risk from even very low levels of endocrine-disrupting chemicals because of the importance the endocrine system plays in development (Longnecker et al. 1997). Research has indicated that

early exposure to endocrine-disrupting compounds can interfere with reproductive development (Schell 1997).

Human health effects believed to be linked to endocrine-disrupting contaminants include difficulties in fertilizing and conceiving, birth defects of the reproductive organs, lower sperm counts, cryptorchidism and hypospadias, testicular cancer in young men, breast cancer, and premature puberty in girls (Foster 1998). Early life exposures to endocrine-disrupting substances and other environmental toxins have been proposed as possible causes of these effects.

Pre-natal exposure to endocrine disruptors has been implicated in reproductive tract defects and certain types of cancer. In men, it has been postulated that pre-natal exposure to endocrine disruptors could be causing increased incidences of cryptorchidism (Giwercman et al. 1993), abnormal formation of the penis (hypospadias) (Giwercman et al. 1993), reduced sperm counts (Auger et al. 1995) and testicular cancer (Giwercman et al. 1993; Klotz 1999; DeVesa et al. 1995). For example, in the United States, rates of hypospadias have increased more than 50% over the past three decades (Paulozzi et al. 1997). However, in Canada, increasing trends appear to have leveled off after 1985 (Paulozzi 1999). Hypospadias is one of the most common congenital anomalies in the United States, occurring in approximately 1 in 250 newborns or roughly 1 in 125 live male births (Baskin et al. 2001). While the causes remain unknown, the relatively recent increase in this birth disorder suggests that some change in environmental factors may well be involved.

Early-onset puberty has been recorded in children exposed to both synthetic and naturally-occurring endocrine disruptors (Gee 1999). For example, one study suggested that some girls in the US are entering puberty much earlier than normal (Herman-Giddens et al. 1997). This and several other studies (Boyce 1997; Walters et al. 1993; Gellert 1978) propose that exposure to estrogen-mimicking chemicals such as PCBs, DDT and methoxychlor might be involved.

Endocrine-disrupting contaminants may also be associated with an altered human sex ratio. Several recent reports indicate that the ratio of males to females being born has declined in several industrialized countries, including Canada (Davis et al. 1998). In the last 20 years, the male proportion of births in Canada has declined, resulting in a decrease of approximately 8600 male births (Davis et al. 1998). It has been suggested that this decline may be linked to endocrine-disrupting chemicals interfering with critical stages of sex determination (Davis et al. 1998).

While some researchers have concluded that endocrine-disrupting compounds may produce adverse health effects in humans, the specific mechanisms of action are not well understood for most reported associations between various hormonally active agents and various biologic effects (National Research Council 1999). Thus, the biological significance of the findings for humans has yet to be established (Foster 1998).

VI. Policy Considerations

A. Overview

Several basic conclusions can be drawn that are relevant in any policy discussion about children's environmental health:

- Children cannot be regarded as little adults because their behavior, physiology, metabolism and diet are different.
- Children have very different exposure patterns from those of adults, and different susceptibilities.
- Timing of exposure within a child's development is a key determinant of toxicity for certain chemicals.
- Children can have very different health outcomes from those of adults exposed to the same toxicant.

The fact that children cannot be regarded as little adults has enormous implications for environmental health policy because it means that children must be considered as a sensitive sub-population. Environmental policy decisions that are based on the need to protect adults' health may not be protective of children's health.

We also now recognize that children cannot be protected through domestic policy alone. Environmental contaminants know no boundaries and move freely on air and in ocean currents, in freshwater systems, as well as through foreign trade. To effectively safeguard the children of North America, the three nations—Canada, the United States and Mexico—must work together.

The aim of this section is to outline some factors and opportunities for consideration as the three countries develop a cooperative agenda to reduce environmental threats to children's health.

Some preliminary questions:

- What are the most important environmental factors affecting children's health in the three countries?
- What environmentally-related health impacts are of greatest concern in the three countries? Are there issues that all three countries share and that would benefit from joint actions that are not currently addressed by other trilateral initiatives?
- How are children's unique susceptibilities taken into account when assessing risk and developing policy and regulations?

- Are there emerging issues that would benefit from a greater sharing of expertise and experience among the three countries?
- What mechanisms exist in North America to foster ongoing communication and collaboration on children's environmental health? Are new mechanisms or approaches needed?

B. Scientific Gaps and Emerging Issues related to Children's Environmental Health

There are many gaps in scientific data and understanding and numerous emerging issues related to children's environmental health, some of which may provide opportunities for North America cooperation. These include:

1. **Child Development:** There is a need to improve understanding of children's vulnerability at different stages of development, from conception onwards, including pre-puberty through adolescence. It is becoming increasingly clear that the timing of an environmental exposure can be a critical factor in whether a health impact will occur, and the nature of that impact.
2. **Exposures:** There is very little comprehensive information on children's exposure to hazardous agents in the environment. Information is needed for different ages and stages of development, especially adolescence.
3. **Synergistic and Cumulative Effects:** There is a need for improved understanding of the effects of exposures to multiple environmental hazards via multiple exposure pathways, and for the development of methodologies to assess these complex connections.
4. **Nutritional Data:** Patterns of food consumption for children at different stages of development need to be characterized. Information on contaminants in food (e.g., pesticide residues) is also important for assessing children's exposure to hazardous agents.
5. **Surveillance and Monitoring:** There is a need for national and regional databases on children's health conditions that are associated with environmental factors, including asthma, childhood cancers, and birth defects, as well as for surveillance systems for neurodevelopmental outcomes. There is also a need for databases on environmental conditions that are associated with children's health, such as contaminant levels in different media (e.g., food, soil, water), as well as for biomonitoring data. In addition, the three member countries need to reach consensus on diagnostic definitions and valid and reliable measurement tools for exposures and health conditions.

6. **Indicators of Children’s Environmental Health:** Currently there are no continent-wide indicators of children’s environmental health. Indicators can play an important role of raising the profile of children’s health concerns and encouraging and tracking improvements.
7. **Risk Assessment/Risk Management:** Children are not necessarily included in risk assessment and management methodologies in all three countries, with the exception of pesticides, which means they may not be adequately protected from the hazards of many substances. Methodologies for special consideration of children during risk assessments—even in the absence of perfect or complete data—need to be developed and used in all risk assessments.
8. **Public Access to Information:** There is a need to expand and strengthen information channels to allow communities, families and other stakeholders to make informed decisions about environmental exposures and risks to their children.
9. **Environmental Justice:** There is a need to fully explore the relationship between poverty, ethnicity and environmental health threats, particularly exposures to toxic chemicals, in order to address the issue of disproportionate exposures to environmental threats among lower socio-economic strata and certain minority populations and disadvantaged groups.
10. **Electromagnetic Fields:** Studies conflict on the health consequences of exposure to electromagnetic fields. More research and prudent preventive action may be needed.
11. **Endocrine Disruptors:** There is strong evidence from wildlife populations, and some evidence from humans, that various contaminants can disrupt normal endocrine metabolism. There is a need for more study, as well as preventive strategies.
12. **Climate Change:** Climate change may affect children’s health through changes in disease vectors, environmental exposures, etc., and thus is another area requiring further research and preventive action.

C. Areas of Opportunity for North American Action

1. Persistent Organic Pollutants and other substances capable of transboundary movement

There is strong scientific evidence of the long-range migration of certain pollutants, including DDT, mercury, dioxins and furans, and other POPs (CEC 1999). Several international protocols, such as the UN ECE POPs and Heavy Metals Protocols under the Convention on Long-Range

Transboundary Air Pollution, and the recently signed Stockholm Convention on POPs, recognize the need to address such substances through international action.

The CEC is actively assisting the Parties to reduce or eliminate the use of these substances. To date, the Commission has developed Regional Action Plans committing the three countries to take concrete steps to reduce PCBs, chlordane, DDT, and mercury. Another regional plan for dioxins, furans and hexochlorobenzene is being developed by the Sound Management of Chemicals CEC Working Group. Work has also begun on a regional action plan on environmental monitoring and assessment. Work on a regional action plan for lindane is anticipated to commence in 2002.

2. Goods Traded in Commerce

Goods such as food, manufactured products, pesticides, and chemicals cross political borders as part of the flow of trade among the NAFTA countries. In some cases, goods that are banned or restricted for health and safety reasons in one country may be exported without restriction to another. More cooperative work is needed to ensure that exported goods are safe for children everywhere.

3. Environmental Hazards in Border Regions

Border areas are typically characterized by intense transboundary interaction. In addition to sharing airsheds, watersheds, coastal areas, and wildlife corridors, these areas are criss-crossed by shipments of hazardous products or waste for use or disposal. Degraded air quality in the vicinity of congested border crossings also poses a threat to public health, including the respiratory health of children.

4. Scientific Cooperation

Scientific cooperation is fundamental to, and often a precondition to, problem-solving in complex areas such as health and environment. The CEC strives to share knowledge and build consensus in a number of areas in its work program, including the Sound Management of Chemicals and the Conservation of Biodiversity. In the realm of children's environmental health, opportunities for enhanced scientific cooperation may include exposure assessment methodologies, bio-marker technologies and research, epidemiological studies, diagnostic tools and common diagnostic definitions, and/or other specific applied-research areas. Furthermore, collaboration with organizations currently involved in international efforts to protect the health of susceptible sub-populations of children, such as Aboriginal and indigenous peoples, migrant workers, and others, provides additional opportunities for scientific cooperation.

5. Policy and Standard Setting

Important policy tools such as risk assessment and the application of the precautionary approach may strengthen the continental protection of children. The CEC serves as a forum in which the

governments and civil society can engage in a dialogue to advance the protection of children by strengthening the application of selected policy tools and approaches.

6. Public Education and Outreach

Participation of the public in research, policy development and communications strategies can strengthen the basis for educated decision-making and problem-solving. As part of the CEC, the Joint Public Advisory Committee (JPAC) together with the National Advisory Committees work to ensure active public participation and transparency in the actions of the Commission.

VII. Appendix: International Initiatives

During the last decade, the relationship between the environment and human health, and particularly the health of children, has been recognized in several key international reports, conventions and agreements. Following are highlights of several of these initiatives.

1. The UN Convention on the Rights of the Child (1989)

Signed and ratified by almost every country in the world, including Canada and Mexico, the UN Convention of the Rights of the Child outlines basic principles that acknowledge the special needs of children and elevate their status within all societies.

Article 24 outlines specifically that:

1. States Parties recognize the right of the child to the enjoyment of the highest attainable standard of health . . .
2. States Parties shall pursue full implementation of this right, and in particular, shall take appropriate measures:
 - c) To combat disease and malnutrition, including within the framework of primary health care, through, inter alia, the application of readily available technology and through the provision of adequate nutritious foods and clean drinking water, taking into consideration the **dangers and risks of environmental pollution**; [author's bold]
 - e) To ensure that all segments of society, in particular parents and children, are informed, have access to education and are supported in the use of basic knowledge or child health and nutrition, the advantages of breastfeeding, hygiene and **environmental sanitation** and the prevention of accidents . . . [author's bold].

2. Agenda 21, Chapter 25 (1992)

The UN Conference on Environment and Development and the resulting Agenda 21 gives prominence to the protection of children from the effects of a deteriorating environment, and urges governments to develop programs to protect children from the effects of environmental and occupational toxic compounds.

Chapter 25 of Agenda 21 is on Children and Youth in Sustainable Development.

Among other areas, this program addresses the need to: reach child-related goals set in the areas of health, nutrition, education and literacy; seek the ratification and implementation of the Convention on the Rights of the Child; promote Primary Environmental Care that benefits children;

expand educational opportunities; mobilize communities through schools and local health centers; and establish procedures to incorporate children's concerns into environmental and development policies at the local, regional and national levels.

3. Declaration of the Environment Leaders of the Eight on Children's Environmental Health (G7 countries plus Russia, 1997)

This declaration provides the framework for domestic, bilateral and international efforts to improve the protection of children's health from environmental threats. It highlights lead, microbiologically safe drinking water, air quality, environmental tobacco smoke, endocrine-disrupting chemicals, and global warming. The declaration also commits the eight to specific actions under each of these topic areas as well as to the general process of incorporating characteristics of infants and children into environmental science, risk assessments, and protection protocols.

The problem and solution are eloquently stated in the first section of the Declaration:

We acknowledge that, throughout the world, children face significant threats to health from an array of environmental hazards. The protection of human health remains a fundamental objective of environmental policies to achieve sustainable development. We increasingly understand that the health and well-being of our families depend upon a clean and healthy environment. Nowhere is this more true than in the case of children, who are particularly vulnerable to pollution. Evidence is growing that pollution at levels or concentrations below existing alert thresholds can cause or contribute to human health problems and our countries' present levels of protection may not, in some cases, provide children with adequate protection . . .

We affirm that prevention of exposure is the single most effective means of protecting children against environmental threats . . .

4. Declaration of the Third European Ministerial Conference on Environment and Health (1999) (WHO European Region only)

The Declaration of the European Environment Ministers supports the principles in the Declaration of the Environment Leaders of the Eight, and focuses specific attention on injuries, environmental tobacco smoke, asthma and allergies, and emerging threats. The Declaration requests that: "... all Member States and the EC ... identify methods and mechanisms to promote the exchange of information and experience" concerning the above target health areas. Additionally, the request is also to:

d)promote and encourage public health measures in areas of emerging concern about environmental impacts on children's health, on the basis of the precautionary principle . . .

f)develop an effective mechanism for monitoring and reporting progress annually throughout the Region on the basis of key indicators of the state of children's health and the relevant environmental conditions.

The Ministers agreed to maintain this issue on their agenda for 2003.

The above agreements, conventions, and declarations all acknowledge the unique susceptibilities and vulnerabilities of children. Many identify specific health outcomes such as asthma, specific toxicants such as lead, or specific exposure pathways such as air pollution or unclean water. Some incorporate the precautionary principle. All acknowledge that children are at risk from exposure to environmental health threats, and all call for the protection of children through policy and action.

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