



Children's Health and the Environment in North America

A First Report on Available Indicators and Measures

Country Report: Canada

Prepared by the Government of Canada

Library and Archives Canada Cataloguing in Publication

Children's Health and the Environment in North America: A First Report on Available Indicators and Measures. Country Report: Canada

Also issued in French under title: La santé des enfants et l'environnement en Amérique du Nord : Premier rapport sur les indicateurs et les mesures disponibles. Rapport national : Canada.

Includes bibliographical references: p. 59

ISBN 0-662-42422-0

Cat. no. En4-60/2005E

1. Environmentally induced diseases in children--Canada.
2. Children--Health risk assessment--Canada.
3. Children--Health and hygiene--Canada.
4. Environmental health--Canada.
5. Pollution--Canada.
6. Environmental monitoring--Canada.
7. Environmental policy--Canada.
8. Children and the environment.
9. Health status indicators. I. Canada. Environment Canada

RA407.5.C3C54 2005

614.4'271'083

C2005-980344-4

For more information and to obtain copies of this document, free of charge:

Enquiry Centre

Environment Canada

Gatineau, Quebec

K1A 0H3

Telephone: 1-800-668-6767

Fax: (819) 994-1412

Email: enviroinfo@ec.gc.ca

Web site: www.ec.gc.ca/publications/index.cfm?lang=e

This report is also available on the internet: www.cec.org

This publication may be reproduced without permission provided that its use falls within the scope of fair dealings under the Copyright Act, and is solely for the purposes of study, research, criticism, review or newspaper summary. The source must be fully acknowledged. However, reproduction of this publication in whole or in part for purposes of resale or redistribution requires the prior written permission from the Minister of Public Works and Government Services Canada, Ottawa, Ontario K1A 0S5 or copyright.droitdauteur@communication.gc.ca.

© Her Majesty the Queen in Right of Canada 2006

Table of Contents

Executive Summary	iv
1 Introduction.....	1
1.1 Context Indicators.....	3
2 Asthma and Respiratory Disease.....	6
2.1 Outdoor Air Pollution	6
2.2 Indoor Air Pollution	14
2.3 Asthma	17
3 Lead and Other Chemicals, Including Pesticides.....	20
3.1 Blood Lead Levels	20
3.2 Lead in the Home	23
3.3 Industrial Releases of Lead and Selected Chemicals	26
3.4 Pesticides	41
4 Waterborne Diseases.....	44
4.1 Drinking Water.....	44
4.2 Sanitation.....	48
4.3 Waterborne Diseases	51
5 Recommendations and Conclusions.....	54
5.1 Recommendations for Improving Reporting on Indicators of Children’s Health and the Environment in North America	54
5.2 Conclusions	58
References	59
Acknowledgements.....	65
Appendix 1 List of Acronyms and Abbreviations	66
Appendix 2 Healthy Environments for Children—What You Can Do!	67
Appendix 3 Indicator Templates	77
Appendix 4 Indicators Steering Group—Canada	110

Executive Summary

There are nearly 8 million children 19 years of age and under in Canada—representing approximately 25% of our population. Overall, indicators of Canadian children's health are quite positive. Over the past 20 years, life expectancy at birth has increased, perinatal, neonatal and infant mortality rates have all decreased, the immunization rate for Canadian children has become one of the best in the world and the number of children born to teenage mothers has declined. Despite this generally favourable picture, there are some indications that Canadian children are facing risks to their health from the environment in which they live.

The single leading cause of infant death in Canada is birth defects. After the first year of life, unintentional injuries are the leading cause of death for both boys and girls. Childhood cancer is one of the top three causes of death in children from 1 to 4 years of age. The incidence rates for several types of cancer have increased among young adults in Canada, which may be related to childhood exposures to environmental hazards. The leading causes of infant hospitalization are respiratory diseases, followed by perinatal conditions and digestive diseases. Children from 1 to 4 years of age are most likely to be hospitalized due to illnesses of the respiratory system, digestive system and injuries.

It is widely recognized that poverty is a major determinant of disproportionate exposure to multiple environmental hazards. Children living in poor families are more likely to live in areas of heavy traffic, to live in substandard housing and to be exposed to second-hand smoke in their homes. In 2001, 15.6% of children in Canada lived in families with income levels below the low income cut-off.

The prevalence of asthma in Canada has increased fourfold over the past 20 years, to the point where more than 1 in 10 Canadian children have been diagnosed with asthma (indicator 3). Two factors related to the exacerbation of asthma are indoor and outdoor air quality. In terms of outdoor air quality, extensive epidemiological research has demonstrated that children are especially sensitive to air pollution. Exposure to air pollutants at various ambient levels has been associated with increased coughing and wheezing, increased use of airway medications, increased hospital visits by asthmatic children as well as harmful effects on lung growth, development and function. However, developing and portraying meaningful national measures of children's exposure to air pollution remain a challenge in Canada.

Existing information on ambient air quality shows that levels of several important air pollutants have dropped over the last 10 years in Canadian urban areas. Meanwhile, levels of ground-level ozone and fine particulate matter (PM_{2.5}) are still of concern. In fact, levels of ground-level ozone in Canada are not decreasing. Southern Ontario experienced the highest numbers of days on which ground-level ozone and PM_{2.5} levels exceeded the Canadian standards. However, the population of Canadian children exposed to harmful levels of air pollutants cannot be accurately measured at this time (indicator 1). In contrast, we do know that many Canadian children continue to be exposed to second-hand smoke and other indoor air contaminants at home and in public buildings. In Canada, in 2002, 19% of children aged 0–17 were regularly exposed to second-hand smoke in the home (indicator 2). Generally, the proportion of children exposed to second-hand smoke in Canadian homes has been decreasing.

Information on the extent of exposure of Canadian children to lead and other toxic chemicals is limited. Low-level or moderate lead exposure during early childhood can cause persistent adverse neurobehavioural effects, including cognitive deficits. There is no recent nationally representative sample of blood lead levels in Canadian children (indicator 4). Ingestion of lead in house dust is currently the major source of intake of lead for children. Older homes are more likely to contain lead in house dust from paint, and the risk of exposure is higher during renovations. Most indoor and outdoor paints produced before 1960 in Canada contained substantial amounts of lead. Thus, children living in housing stock built before 1960 may be at a

potential risk of exposure to lead. In 2001, 24% of Canadian children under 5 years of age lived in housing built prior to 1960 (indicator 5). Overall, total industrial releases of lead to the environment by reporting facilities decreased 46% between 1995 and 2000 in Canada (indicator 6).

There are many possible sources of children's exposure to other chemicals. An indicator using pollutant release and transfer register (PRTR) data is provided as an "action" indicator to describe the effectiveness of preventive or remedial action in reducing emissions of toxic substances to the environment (indicator 7). Data for Canada are provided for 153 "matched" chemicals—those chemicals reported in the Canadian National Pollutant Release Inventory (NPRI) that are also required to be reported in the United States. The indicator shows that, overall, the number of facilities reporting to the NPRI increased from 1998 to 2002, while total pollutant releases decreased during this period. Of the four industrial sectors with the largest total releases, the primary metals and chemical manufacturing sectors reported reductions in releases between 1998 and 2002, while the paper products and electric utilities sectors both reported increases in releases over the same period.

Canada is also reporting separately on trends in emissions of seven pollutants selected because they are of specific concern to children's health. The selected pollutants are arsenic, benzene, cadmium, chromium, dioxins and furans, hexachlorobenzene and mercury.

Canada is reporting the yearly number of organophosphate pesticides detected on domestic and imported fruits and vegetables, expressed as a percentage of sample size (indicator 8). This indicator is a weak surrogate of children's exposure to pesticides in foods because of the uncertainty inherent in the scope of the monitoring program. Over a several-year period, the percentage of fruits and vegetables with detectable organophosphate pesticide residues has decreased, suggesting reduced exposure from this source.

This report contains case studies of research on subpopulations of children that may be disproportionately affected by environmental contaminants. We know that some segments of our population are exposed to unacceptably high levels of environmental pollutants. For example, the Northern Contaminants Program has found that some Inuit women from the North who eat traditional/country foods have levels of certain persistent organic pollutants and mercury in their bodies that are above Health Canada's guidelines. Their infants may experience subtle neurodevelopmental effects as a result of exposures to these toxic substances *in utero*. Canada is working with the international community to decrease the levels of persistent organic pollutants and mercury in the environment. Although the consumption of traditional/country foods containing contaminants may be associated with greater exposures and health risks, it is important to recognize that diets containing these foods confer substantial nutritional benefits and are the foundation of the social, cultural and spiritual way of life for Canada's Aboriginal peoples.

As in many parts of the world, waterborne diseases continue to be of concern for children's health in Canada. Numerous past outbreaks, together with recent studies, suggest that drinking water may be a substantial contributor to endemic (non-outbreak-related) gastroenteritis. In Canada, children aged 1–4 are more likely to be infected with the parasite *Giardia* than the rest of the population (indicator 12). Giardiasis, sometimes called "beaver fever," is an intestinal parasitic infection characterized by chronic diarrhea and other symptoms.

Approximately 78% of Canadians are served by central water distribution systems (indicator 9), although the percentage of children living in areas served by public systems in violation of local standards (indicator 10) is currently not available in Canada. Recent outbreaks in Walkerton, Ontario, and North Battleford, Saskatchewan—two communities on public distribution systems—are reminding Canadians that vigilant management of drinking water and effective protection of sources continue to be of critical importance. An estimated 6.8 million Canadians rely on private water supplies, primarily groundwater wells. Some surveys indicate that between 20% and 40% of wells, particularly in rural areas, may be contaminated by nitrates or bacteria.

Sanitary sewage, especially when it is not disinfected, can be an important source of pathogens to receiving water bodies. This presents a potential risk for children engaged in aquatic recreational activities, consuming contaminated shellfish or drinking untreated water in the area of influence of an outfall. Seventy-four percent of Canadians, living mostly in urban areas, are serviced by municipal sewer systems, with three-quarters of these Canadians being served by a high level of treatment (i.e., secondary or tertiary) (indicator 11). The remaining 26% of Canadians are assumed to be serviced by on-site septic systems.

1 Introduction

The physical environment, where children live, learn and play, is an important determinant of their health and well-being. Children are affected by environmental threats in all regions of the world, including Canada. When children suffer ill health because of a poor physical environment, hopes for improved quality of life and future development are stifled.

Protecting Canadian children from environmental threats requires research, legislation and programs to reduce environmental hazards, outreach and education of parents and caregivers, and better information to track the environmental threats to children's health. This report is concerned with the latter only—developing indicators to provide better information to track trends over time and measure the effectiveness of our interventions to protect the quality of the Canadian environment upon which children's health and well-being depend.

In June 2002, the environment ministers of Canada, Mexico and the United States, members of the Council of the North American Commission for Environmental Cooperation (CEC), agreed to a Cooperative Agenda to protect children from environmental risks. The Cooperative Agenda committed the three countries to selecting and publishing a core set of indicators of children's health and the environment for North America. This commitment was reaffirmed in the CEC Council Session in June 2003, with the adoption of Council Resolution 03-10. A Steering Group was established, which applied the following criteria (CEC, 2003) in selecting indicators for the first North American report:

- **Useful and relevant.** Each indicator must be related to a specific question or condition of interest that highlights a trend or caution regarding children's health and the environment.
- **Scientifically sound and credible.** Each indicator must be unbiased, reliable, valid and based upon high-quality data. The methodology for collecting the data should be robust and repeatable. There must be a credible link between the environmental condition that the indicator addresses and the health outcome (e.g., air quality and asthma rates).
- **Available.** It is agreed that because not all countries will be able to report on all indicators, countries will choose indicators from this list that are most appropriate and available from their national perspective (e.g., whether or not nationally representative) and based on information that already exists, since governments may be unable to commit resources for collecting new data.
- **Applicable and understandable.** The indicator must be useful for policymakers and a non-specialist audience.

The Steering Group recommended that the three countries report on the following initial 12 indicators of children's health and the environment:

- Indicator 1: Percentage of children living in urban areas where air pollution levels exceed relevant air quality standards
- Indicator 2: Prevalence of asthma
- Indicator 3: Measure of children exposed to second-hand smoke
- Indicator 4: Blood lead levels
- Indicator 5: Children living in homes with a potential source of lead
- Indicator 6: Pesticides
- Indicator 7: Pollutant release and transfer register (PRTR) data
- Indicator 8: Percentage of children served with treated water
- Indicator 9: Percentage of children served by drinking water systems in violation of local standards
- Indicator 10: Percentage of children served with centralized sewage treatment
- Indicator 11: Morbidity related to waterborne diseases
- Indicator 12: Mortality related to waterborne diseases

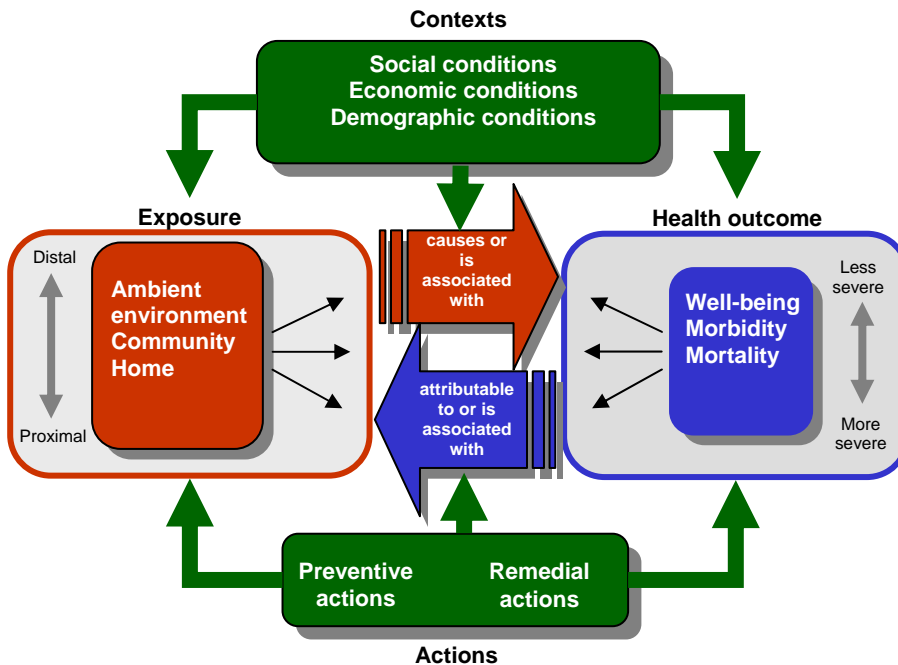
An additional indicator of industrial emissions of lead was later added to the list.

The Steering Group recommended the use of the World Health Organization's Multiple Exposure – Multiple Effect (MEME) model (see Figure 1.1) to capture the complex interactions between the environment and children's health. The MEME model highlights the fact that environmental exposures and health outcomes are based on many links between the environment and health and are rarely based on simple, direct relationships. The model illustrates that environmental exposures and health outcomes are influenced by social, economic and demographic factors (context). These are among a number of factors that are known to influence health outcomes and are frequently referred to as determinants of health. In this report, indicators in each of the four categories are presented—context, exposure, health outcome and action indicators.

This is Canada's contribution to the first report on indicators of children's health and the environment in North America. Canada is reporting on the indicators recommended by the CEC Steering Group, based on available data at the national level. Canada was not able to provide information to populate some of the indicators recommended, while for other indicators, Canada is reporting additional information. In accordance with CEC Council Resolution 03-10, Canada resolves to continuously improve the quality and comparability of indicators and data across North America in subsequent reports. The list of Canadian Steering Group members that produced this report can be found in Appendix 4.

For tips on what you can do to protect children's health and the environment, please consult the tip sheet included in Appendix 2, also available at:
http://www.hc-sc.gc.ca/hl-vs/pubs/child-enfant/child_safe-enfant_sain_e.html

Figure 1.1: Multiple Exposure – Multiple Effect (MEME) framework



Source: Briggs (2003)

1.1 Context Indicators

1.1.1 Overview of Population Demographics

There are nearly 8 million children 19 years of age and under in Canada. Children below 4 years of age represent 5.4% of the Canadian population, while children below 20 years of age represent approximately 25% of the population (Statistics Canada, 2001a). A greater proportion of children live in urban areas, as 79.7% of the Canadian population lived in urban areas in 2001 (Statistics Canada, 2003).

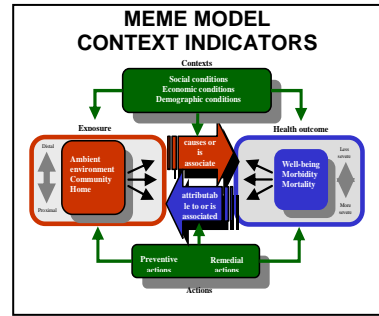
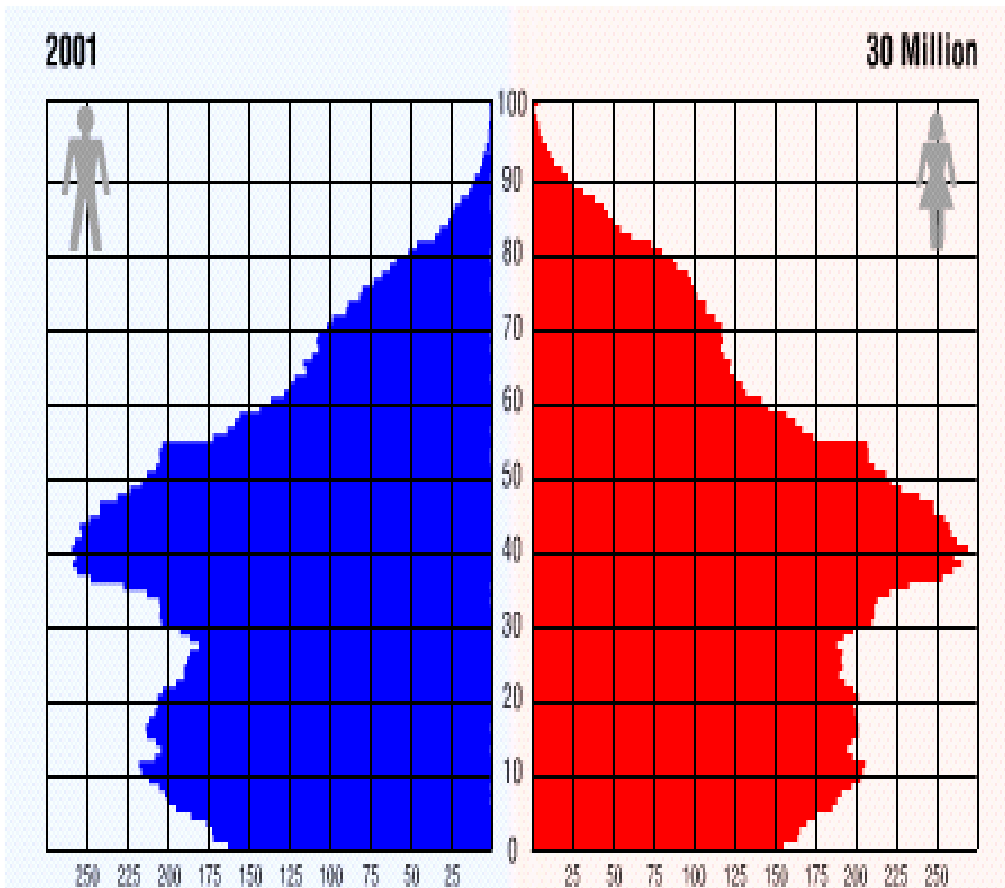


Figure 1.2: Age pyramid of population of Canada, 2001 (shown in 000s)



Source: Statistics Canada (2001b)

In 1990, the crude birth rate in Canada was 15 live births per 1000 population; by 1995, it was 13 live births per 1000 population, and by 2000, it was 10.7 live births per 1000 population. From 1990 to 2000, births to teenagers, particularly young teenagers, decreased. The proportion of women who are delaying childbearing to later in life has increased markedly in Canada in recent years¹ (Health Canada, 2003a). The implication for environmental health is that older women

¹ The age-specific live births among older mothers is defined as the number of live births to women 30–34, 35–39, 40–44 or 45 years and older per 1000 females of the same age group (in a given place and time). A related indicator is the proportion of live births to older mothers, which refers to the number of live births to

have had a longer period of time to accumulate persistent environmental chemicals in their bodies from occupational and other exposures. Their infants potentially have greater exposures to contaminants *in utero* as a result of increased maternal body burdens (Hu et al., 1996; Rhoads et al., 1999; Hertz-Picciotto et al., 2000).

1.1.2 Child Mortality and Morbidity

The infant mortality rate decreased from 6.5 per 1000 live births in 1990 to 5.1 per 1000 live births in 2001. In 1999, the single leading cause of infant death in Canada was birth defects, accounting for 26.5% of all infant deaths, followed by immaturity and sudden infant death syndrome (SIDS). The total incidence of birth defects has been stable over recent years. The incidence of neural tube defects has declined over the past decade—due in part to increased intake of folic acid from fortified foods and use of vitamin supplements—but the number is still a concern (Health Canada, 2003a). There is limited evidence linking environmental exposures to major birth defects (Wigle, 2003).

The mortality rate for children from 1 to 4 years of age was 0.4 per 1000 in 1990 and 0.2 per 1000 in 2001 (CICH, 2000: 75). After the first year of life, unintentional injuries are the leading cause of death for both boys and girls (CICH, 2000: 74, 106, 107). This means that many deaths during this period may have resulted from predictable, preventable events. Childhood cancer is one of the top three causes of death in children from 1 to 4 years of age (CICH, 2000: 74). Apart from ionizing radiation, no definite links have been established between childhood cancers and environmental exposures; there is limited and non-conclusive evidence for links to parental prenatal and childhood exposures to pesticides. The incidence rates for several types of cancer have increased among young adults in Canada, which may be related to childhood exposures to environmental hazards. For example, melanoma rates (sun exposure early in life is a contributor to melanoma later in life), thyroid cancer (medical x-rays), testicular cancer (unexplained) and non-Hodgkin's lymphoma (several possible environmental links) have all increased significantly (Wigle, 2003). The third leading cause of death in Canadian children from 1 to 4 years of age is birth defects.

For children from 5 to 9 years of age, unintentional injury and childhood cancer remain leading causes of death, with the third being diseases of the nervous system (CICH, 2000: 106). Leading causes of death for children from 10 to 14 years of age include injuries (52%), cancer (13%) and diseases of the nervous system (7%) (CICH, 2000: 107). Among male youth from 15 to 19 years of age, leading causes of death include injuries (75%), cancer (6%), nervous disorders and birth defects (3%). Among females in this age group, leading causes of death include injuries (66%), cancer (10%) and circulatory diseases (10%) (CICH, 2000: 113).

The leading causes of infant hospitalization have not changed in over a decade. The main cause of hospitalization in children less than 1 year of age is respiratory diseases (34%), followed by perinatal conditions (19%) and digestive diseases (8%) (CICH, 2000: 47). Children from 1 to 4 years of age are most likely to be hospitalized due to illnesses of the respiratory system (41%), digestive system (10%) and injuries (9%) (CICH, 2000: 74). The main causes of hospitalization for children from 5 to 9 years of age are respiratory diseases (29%), injuries (17%) and digestive diseases (11%). Children from 10 to 14 years of age are hospitalized for injuries (21%), respiratory diseases (17%) and digestive diseases (14%) (CICH, 2000: 102). Finally, male youth from 15 to 19 years of age are hospitalized for injuries (29%), digestive diseases (14%) and mental disorders (13%). Their female counterparts are hospitalized due to mental disorders (16%) and injuries, respiratory diseases and digestive diseases (all 14%) (CICH, 2000: 136).

mothers aged 30–34, 35–39, 40–44 or 45 years and older expressed as a percentage of all live births (in a given place and time) (Health Canada, 2003a: 22).

1.1.3 Socioeconomic Information and Other Determinants of Health

Maternal Education

It is generally accepted that the educational level of the mother has a significant impact on child development. Recent research has demonstrated a strong link between maternal education and levels of vocabulary development. The more language a child hears, the more the child is likely to use. Mothers with higher levels of education are more likely to talk with their children and use a broader range of vocabulary (Government of Canada, 2003a). Studies looking at preschool vocabulary in relation to reading and math skills 4 years later have suggested that the mother's education level has both a short-term and a long-term impact on the child's development (Government of Canada, 2003a). The effects of maternal education are not confined solely to academic skills. They also have an impact on a child's social skills. Data show that mothers who complete more than a secondary school education are less likely to have toddlers with problematic personal and social behaviours (Government of Canada, 2003a).

Maternal education has an impact on children's exposures to alcohol and tobacco *in utero* and second-hand smoke throughout childhood. There are strong inverse associations between maternal education and both smoking and alcohol consumption—i.e., women with lower education levels have higher rates of alcohol and tobacco use. Breastfeeding initiation and duration rates are also associated with maternal educational levels. Women with fewer years of education were less likely to breastfeed than those with higher educational attainment, and, if they did breastfeed, they did so for a shorter period of time (Health Canada, 2003a). In 1994–95, 17.2% of children under the age of 2 years had a mother who had not completed high school, compared with 13.4% in 1998–99 (Health Canada, 2003a).

Proportion of Children Living in Low-Income Families

Family income is acknowledged as a consistent, significant contributor to child outcomes. For example, children who live in low-income families at 4 and 5 years of age are more likely to have lower vocabulary skills than their counterparts living in middle- and upper-income families (Government of Canada, 2003a). Children living in families with lower incomes are also less likely than children in higher-income families to participate in recreational activities, which help build the foundation for core skills and success in school (Government of Canada, 2003a). In fact, children living in families with lower incomes are more likely to be exposed to multiple environmental hazards (Evans and Kantrowitz, 2002). Children living in poor families are more likely to live in areas of heavy traffic, to live in substandard housing and to be exposed to second-hand smoke in their homes.

Child poverty rates reflect parental poverty rates and tend to rise or fall as economic conditions deteriorate or improve (National Council of Welfare, 2002). Low income cut-offs are used to distinguish "low-income" family units from "other" family units. A family unit is considered low income when its income is below the cut-off for the size of the family and the community in which it lives. Low income cut-offs are set according to the proportion of annual family income spent on food, shelter and clothing (Statistics Canada, 1998). In 2001, 15.6% of children in Canada lived in families with an income level below the low income cut-off. The percentage of children living in low-income family units has been decreasing in Canada in recent years (Statistics Canada, 2001c).

Immunization Rate

Measles immunization rates were selected as an indicator of the availability of public health services for children. In Canada, implementation of the two-dose measles immunization program in 1996–97 led to a sevenfold decrease in the incidence of reported measles by 1998 (Health Canada, 1997). By 2002, 94.5% of 2-year-old children had been immunized against measles (Health Canada, 1997).

2 Asthma and Respiratory Disease

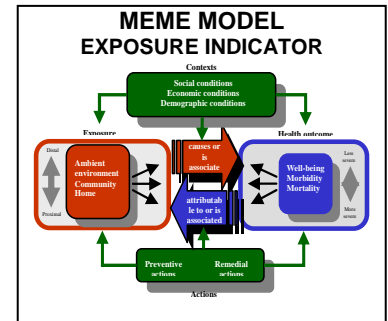
2.1 Outdoor Air Pollution

Indicator 1: Percentage of children living in areas where air pollution levels exceed relevant air quality standards

This specific indicator is currently not available in Canada.

Rather, Canada is reporting the following information:

- Average levels of several air pollutants in Canada, 1984–2002
- Peak levels of ground-level ozone for selected regions of Canada, 1989–2002
- Number of days in 2002 on which ozone levels exceeded the Canada-wide Standard
- Peak levels of fine particulate matter (PM_{2.5}) for selected cities in Canada, 1984–2002
- Number of days in 2002 on which PM_{2.5} levels exceeded the Canada-wide Standard



Issue, Context and Relevance of the Indicator:

Air pollution, or “smog,” refers to a noxious mixture of air pollutants consisting of ozone, particulate matter (PM) and other pollutants referred to as “precursor air pollutants.” Smog can often be seen as a haze in the air. Ground-level ozone is not directly emitted into the air, but it is formed when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in sunlight. Some PM is released directly to the atmosphere from industrial smokestacks and automobile tailpipes, but a large percentage is actually formed in the atmosphere from other pollutants, such as sulphur dioxide (SO₂), NO_x and VOCs. Fossil fuel combustion in motor vehicles, power plants and large industries, as well as household activities such as use of wood stoves and fossil fuel-powered lawnmowers, are all sources of air pollution (Environment Canada, 2002a).

Short-term exposures to ambient levels of air pollution have repeatedly been shown to be significantly associated with adverse health outcomes in adults, including premature mortality and emergency room visits and hospitalizations for cardiorespiratory conditions (Burnett et al., 1994, 1995, 1997, 1998, 1999; Schouten et al., 1996; Stieb et al., 2002).

Children are especially sensitive to air pollution because of their rapid growth, developing body systems, unique pathways of exposure and higher intakes of air. Air pollution has long been considered as a source of exacerbation of asthma and other respiratory conditions; however, recent studies suggest that air pollution is associated with infant mortality and the development of asthma. Furthermore, PM has been associated with acute bronchitis and pneumonia in children. Research has shown that rates of bronchitis and chronic cough are reduced when particulate levels decline. There is new evidence that air pollution may also play a role in adverse birth outcomes such as early fetal loss, preterm delivery and lower birth weight associated with prenatal exposures (Schwartz, 2004). A recent study conducted in Vancouver has found an association between relatively low concentrations of gaseous air pollutants and adverse effects on birth outcomes, such as low birth weight, preterm birth and intrauterine growth retardation (Liu et al., 2003).

Studies that have investigated the impact of outdoor air pollution on children have noted increased coughing and wheezing (Pope, 1991; Segala et al., 1998), increased use of airway medications (Roemer et al., 1993; Peters et al., 1997; Van der Zee et al., 1999), increased hospital visits for respiratory conditions (Delfino et al., 1997; Burnett et al., 2001) and a permanent reduction of lung capacity (Raizenne et al., 1998). The health effects of exposure to acidic air pollution were investigated among children 8–12 years of age living in 24 communities in the United States and Canada. Results of this study indicated that long-term exposure to acidic

particles may have harmful effects on lung growth, development and function, with the length of exposure being a potential determining factor (Raizenne et al., 1996). Although there have been no Canadian studies evaluating the effect of ambient air pollution on mortality in children, a study conducted using infant mortality data from selected metropolitan areas in the United States did find an association between exposure to particulate matter less than or equal to 10 micrometres in diameter (PM₁₀) and several causes of postneonatal mortality, including SIDS (Woodruff et al., 1997).

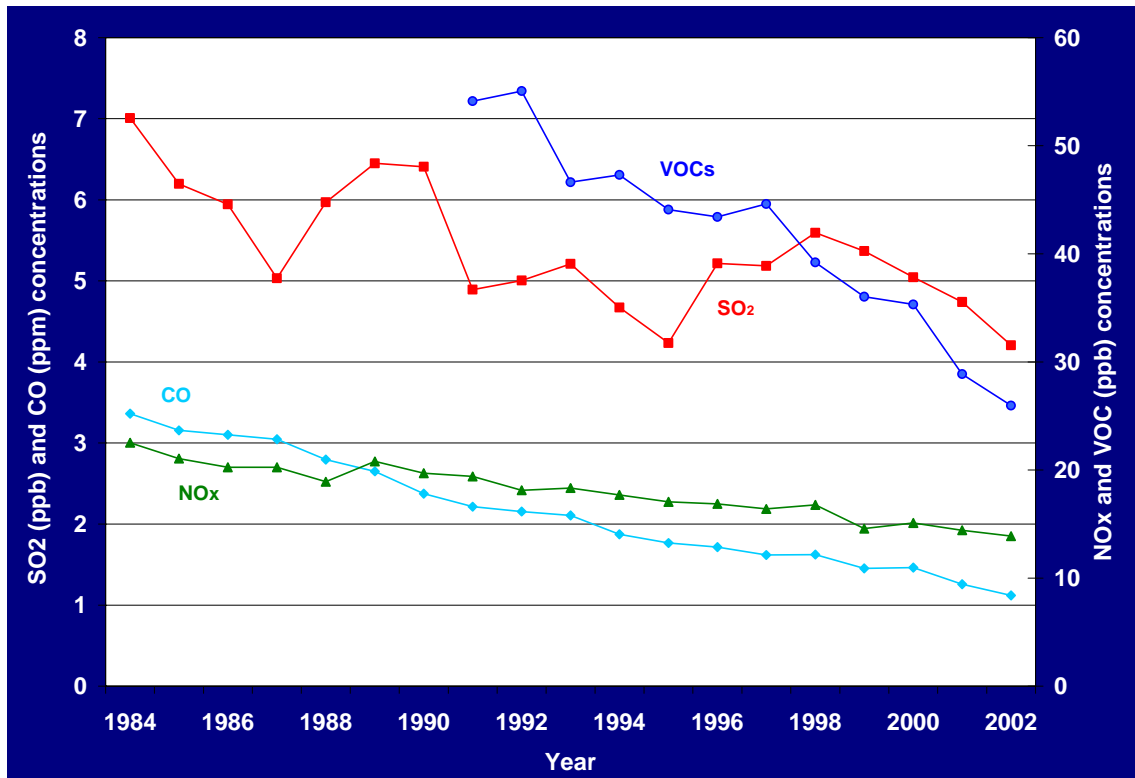
Indicator—Status and Trends:

Canada was not able to generate this specific indicator. Air quality varies locally as a result of local emissions, topography, weather, long-range transport and chemical behaviour of the different pollutants; thus, insufficient information was available, on a national scale, to determine the spatial dispersion of the various pollutants and link these areas to matching populations. Additionally, the suitability of ambient monitoring networks for reporting a population-based indicator is currently under review.

In the interim, Canada is reporting trends in ambient levels of several air pollutants (carbon monoxide [CO], VOCs, SO₂ and NO_x) (see Figure 2.1). It is important to note that national average levels of ambient air pollutants are not ideal indicators for communicating the substantial variation in air quality across the country and throughout the year. These indicators do not reflect the yearly number of poor air quality episodes that are critical for triggering asthma and other respiratory disease episodes in children. Canada is reporting peak levels of PM_{2.5} and ground-level ozone as well as the number of days in 2002 on which PM_{2.5} and ground-level ozone levels were above the respective Canada-wide Standards (see Figures 2.2–2.5).

Air quality data are reported as “annual averages” of levels measured in ambient air, which are derived by averaging the mean concentrations of air pollutants measured at each monitoring station for each year. “Peak levels,” on the other hand, are obtained by averaging the highest concentrations measured at each monitoring station for each year. For example, in Canada, ground-level ozone levels tend to peak in summer, during mid-afternoon in the city and during late afternoon to early evening in rural areas downwind of cities. Both long-term exposure to average levels of air pollutants and short-term exposure to peak levels of air pollutants are critical for triggering respiratory problems in children.

Figure 2.1: Average levels of several air pollutants in Canada, 1984–2002



Source: National Air Pollution Surveillance Network, Environment Canada

Notes:

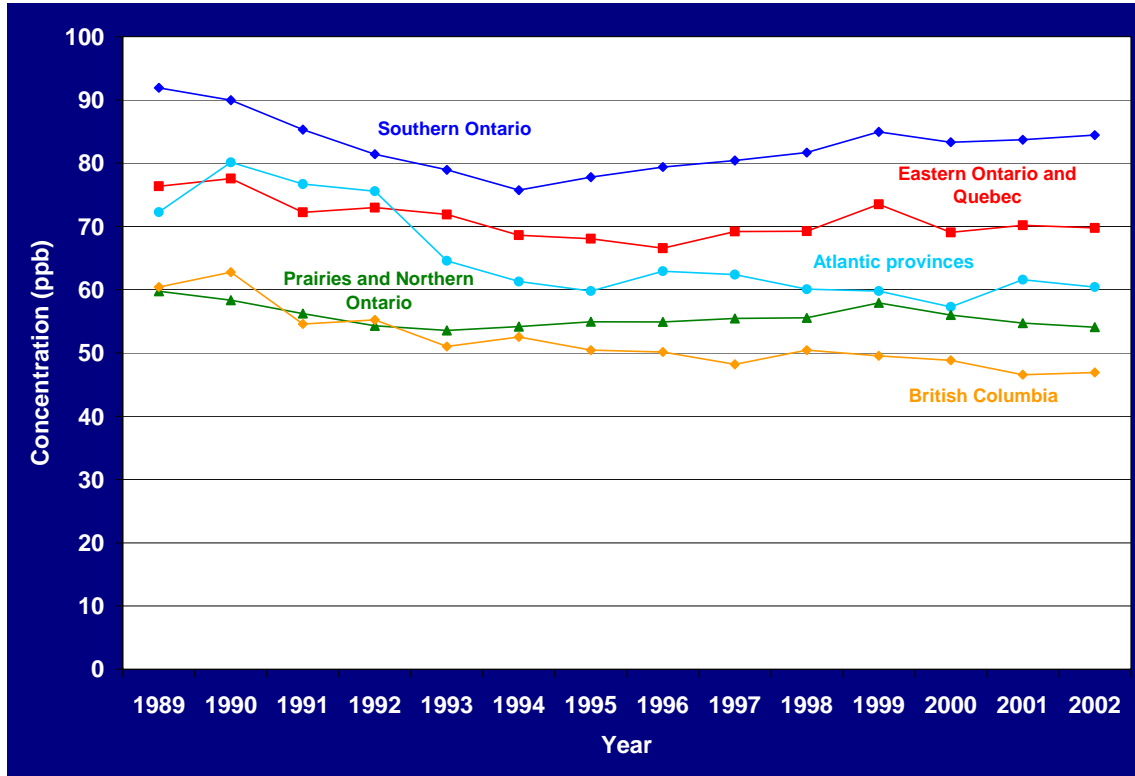
- Some of these air pollutants are precursor air pollutants that contribute to smog: NO_x, SO₂ and VOCs.
- Levels of VOCs, NO_x and SO₂ are annual averages, whereas CO levels are the 98th percentile of the 8-hour means for all monitoring stations meeting data completeness requirements.
- “ppb” are parts per billion and “ppm” are parts per million.

Key Observations:

- Ambient levels of several important air pollutants have dropped over the last 20 years.
- The national trends for these pollutants are generally favourable. It should be noted, however, that the trends and fluctuations in the levels of these pollutants in local areas are masked when national annual averages are presented.

For more information, see the indicator template in Appendix 3.

Figure 2.2: Peak levels of ground-level ozone for selected regions of Canada, 1989–2002



Source: National Air Pollution Surveillance Network, Environment Canada

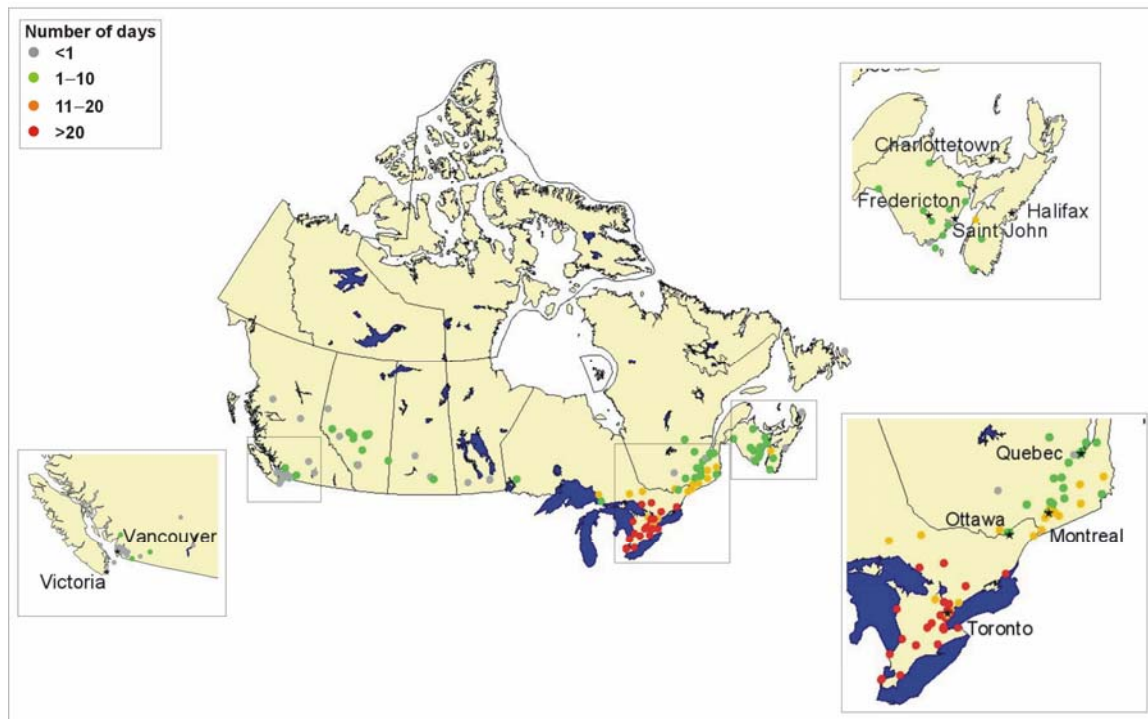
Notes: The yearly values for each station were calculated by averaging the peaks (i.e., 4th highest measurements of the year for 8-hour periods) for the current year and the 2 previous years, resulting in a 3-year rolling average. The yearly rolling averages for each station were then averaged for each region.

Key Observations:

- Although ground-level ozone levels fluctuate from year to year, they did not improve significantly in the Prairies, Ontario and Quebec over the period 1989–2002.
- Ground-level ozone levels have shown improvements in British Columbia and the Atlantic provinces.
- Levels are heavily dependent on the weather, with the highest levels occurring in the warmer months.

For more information, see the indicator template in Appendix 3.

Figure 2.3: Number of days in 2002 on which ozone levels exceeded the Canada-wide Standard



Source: National Air Pollution Surveillance Network Database, Environment Canada (consulted March 2004)

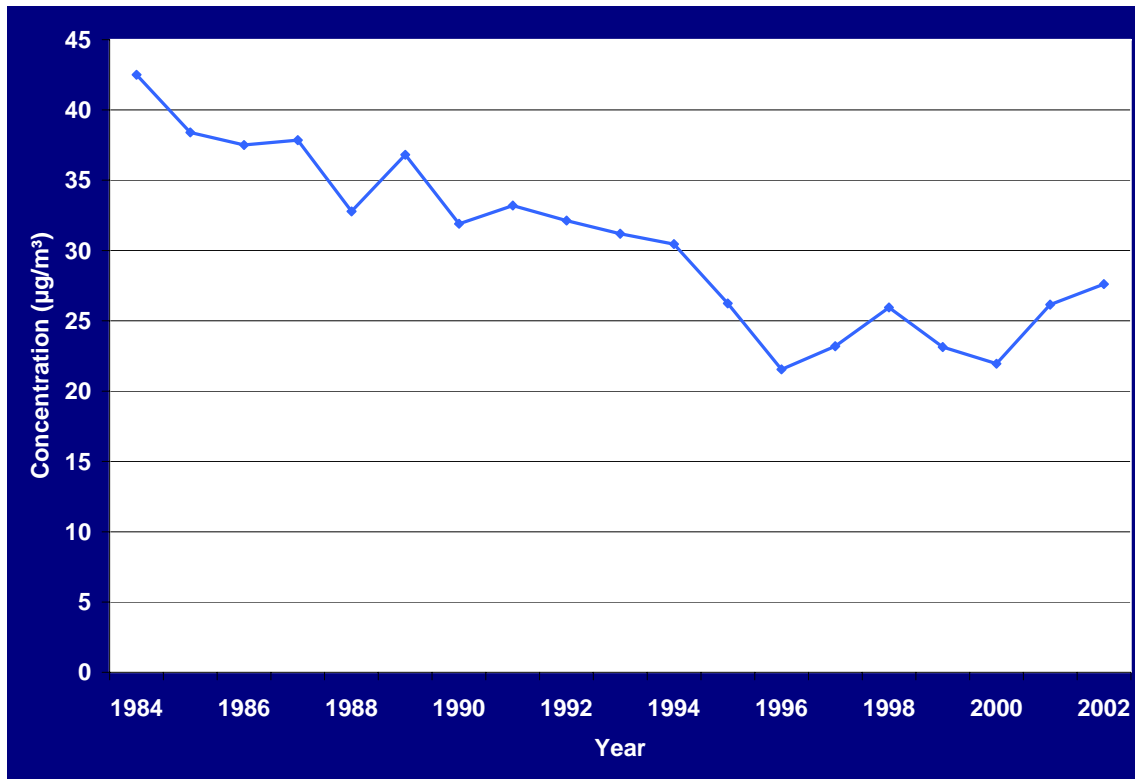
Notes: The points represent the number of days on which 8-hour ground-level ozone measurements exceeded the Canada-wide Standard of 65 ppb. The standard comes into force in 2010, and achievement will be measured using 3 years of data.

Key Observations:

- In 2002, southern Ontario experienced the highest numbers of days on which ground-level ozone levels exceeded the Canada-wide Standard.
- The number of high-ozone days in Canada will fluctuate from year to year. They are influenced by topography, local emissions, transported air pollutants and the occurrence of hot, stagnant weather conditions.
- In Canada, ground-level ozone levels tend to peak in summer, during mid-afternoon in the city and during late afternoon to early evening in rural areas downwind of cities.

For more information, see the indicator template in Appendix 3.

Figure 2.4: Peak levels of fine particulate matter (PM_{2.5}) for selected cities in Canada, 1984–2002



Source: National Air Pollution Surveillance Network, Environment Canada

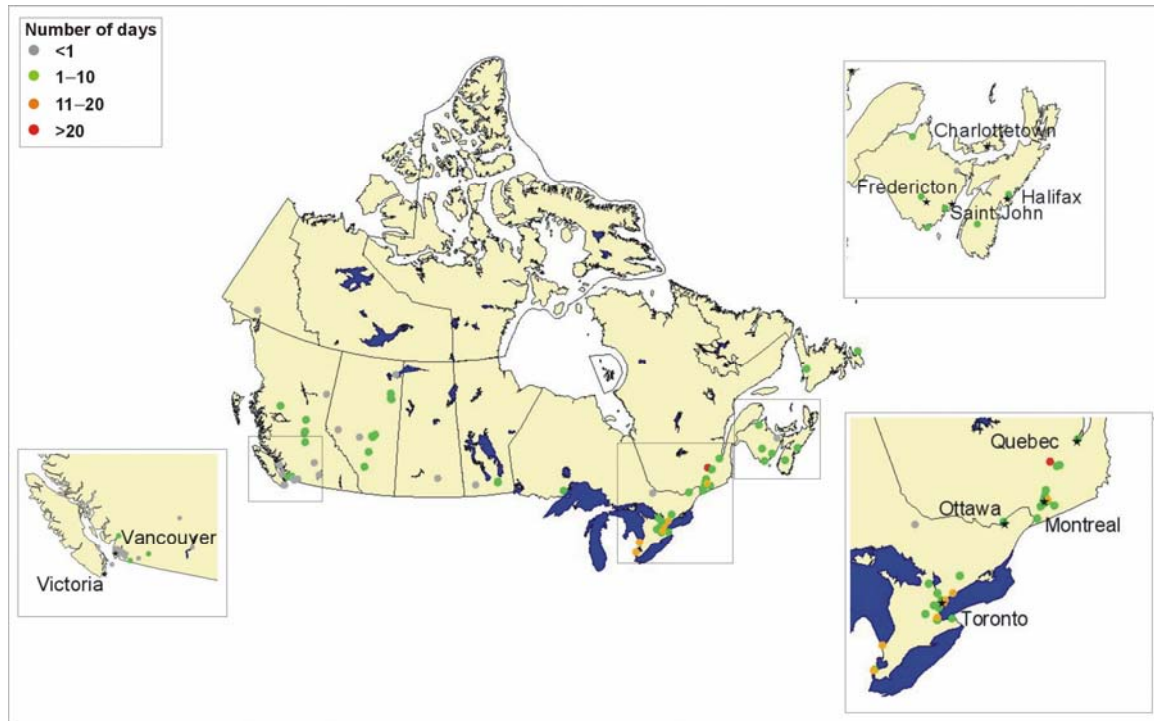
Notes: Peak values are the 98th highest values measured over 24-hour periods at each monitoring station. Data in the above graph are collected at 10–15 urban sites across Canada.

Key Observations:

- Historical monitoring of fine particulates (PM_{2.5}) in Canada has been limited, and data are collected in major urban centres; thus, it has been difficult to determine meaningful national trends.
- The data available from 10–15 sites show a decrease in the peak levels of PM_{2.5} over the first 10 years shown on the figure. However, the last 7 or 8 years did not see improvements.

For more information, see the indicator template in Appendix 3.

Figure 2.5: Number of days in 2002 on which PM_{2.5} levels exceeded the Canada-wide Standard



Source: National Air Pollution Surveillance Network Database, Environment Canada (consulted March 2004)

Notes: The points represent the number of days on which 24-hour PM_{2.5} measurements exceeded the Canada-wide Standard of 30 µg/m³. The standard comes into force in 2010, and achievement will be measured using 3 years of data.

Key Observations:

- Significant increases in real-time monitoring over the last 4 years are improving the coverage for PM_{2.5} monitoring in Canada.
- Southern Ontario experiences the highest number of days with elevated PM_{2.5}, followed by the eastern Ontario/southern Quebec region.

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

PM₁₀ and its precursors as well as ozone and its precursors have all been declared toxic under Schedule 1 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999). In June 2000, the federal, provincial and territorial governments (except Quebec) signed the Canada-wide Standards for Particulate Matter (PM) and Ozone. These standards commit governments to significantly reduce PM and ground-level ozone by 2010. The Canada-wide Standard for PM_{2.5} is 30 µg/m³ averaged over 24 hours using 3 years of data, to be achieved by 2010. The Canada-wide Standard for ozone is 65 ppb averaged over 8 hours using 3 years of data, to be achieved by 2010. A wide range of actions to reduce emissions from vehicles, products and industry will have to be implemented to meet the standards. Some of these, such as vehicle and fuel emission standards, will be carried out by the Government of Canada. Other actions, such as emission

reductions from certain existing industrial sources, will be undertaken by provinces and territories (Environment Canada, 2002a, 2002b).

In 2000, Canada signed the Ozone Annex under the 1991 Canada–U.S. Air Quality Agreement to reduce the flow of air pollutants across the Canada–U.S. border. Consequently, the Government of Canada announced a commitment of \$120 million over 4 years as part of a 10-year program to invest in new measures to accelerate action on clean air by focusing on cleaner vehicles and fuels, initial measures to reduce smog-causing emissions from industrial sectors, improvements to the cross-country network of air pollution monitoring stations and expansion of the public reporting on pollutant releases by industry (Environment Canada, 2003a).

Research and its translation into policy are critical components of health protection measures for air pollution. Health and air quality research contributes to a better understanding of the relative risks of vulnerable subpopulations to enable policymakers to develop more equitable policy outcomes for Canadians. Health Canada conducts specialized, multidisciplinary research to assess the health impacts of exposure to air pollution. This ongoing research supports and improves the health-based risk assessments and subsequent management activities, such as development of air quality objectives and standards. Health Canada's epidemiological research on PM and ozone has contributed to a host of federal regulatory and standards-based activities.

Currently, under the Canada–U.S. Border Air Quality Strategy, Health Canada is preparing to undertake a cross-sectional study using a questionnaire survey and objective measures of lung function. This will identify any associations between respiratory symptoms and air pollution in elementary school children living in Windsor. These children may be followed up next fiscal year to investigate any changes in their respiratory health (symptoms and lung function) (Health Canada, 2004a).

What You Can Do

For more information on outdoor air quality, visit *Clean Air—What You Can Do* at:
http://www2.ec.gc.ca/cleanair-airpur/Individuals-WSFC107749-1_En.htm

Opportunities for Improvement:

A review of ambient air pollution monitoring networks to assess their suitability in estimating population exposure, in addition to further research in determining spatial dispersion of the various air pollutants across Canada, will help Canada report this indicator in the future. In addition, it would be useful to develop reference levels that would consider children's vulnerabilities to air pollutants. Current ambient levels of air pollutants could then be reported against those health-based reference levels.

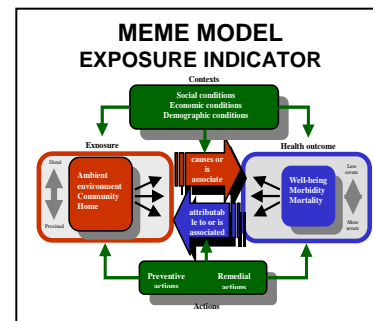
Indicators could also be developed to reflect the health effects associated with short-term exposure to high levels of certain air pollutants—for example, the peak level of ground-level ozone within a day. The Government of Canada has committed to building on the 2003 recommendations of the Environment and Sustainable Development Indicators Initiative of the National Round Table on the Environment and the Economy by developing and reporting annually on new air quality indicators.

2.2 Indoor Air Pollution

Indicator 2: Measure of children exposed to second-hand smoke

Issue, Context and Relevance of the Indicator:

In terms of population health, much emphasis has been placed on the health impacts of exposures to ambient air pollution. Given that the Canadian Human Activities Pattern Survey indicates that persons in Canada spend about 90% of their time indoors (in built environments such as homes, offices, factories and schools), the implications of indoor air quality for public health are demonstrable (Leech et al., 1996). The importance of indoor air quality to human health is highlighted in reports such as *Respiratory Disease in Canada 2001* (Canadian Institute for Health Information et al., 2001) and *The Prevention and Management of Asthma in Canada* (Health Canada, 2000). Both reports indicate the rising rate of respiratory health problems and the possible involvement of indoor air pollutants.



Indoor air quality is influenced by outdoor air pollution, combustion appliances, personal sources (second-hand smoke, pets), consumer products and the building fabric. The current course of improved residential energy efficiency may be having direct adverse effects on the quality of indoor air. Airtight buildings, combined with reduced ventilation, can result in the concentration of many of these contaminants in the built environment and can increase the health risks. In addition, as multiple concomitant exposures may heighten sensitivities, a combination effect is important to consider.

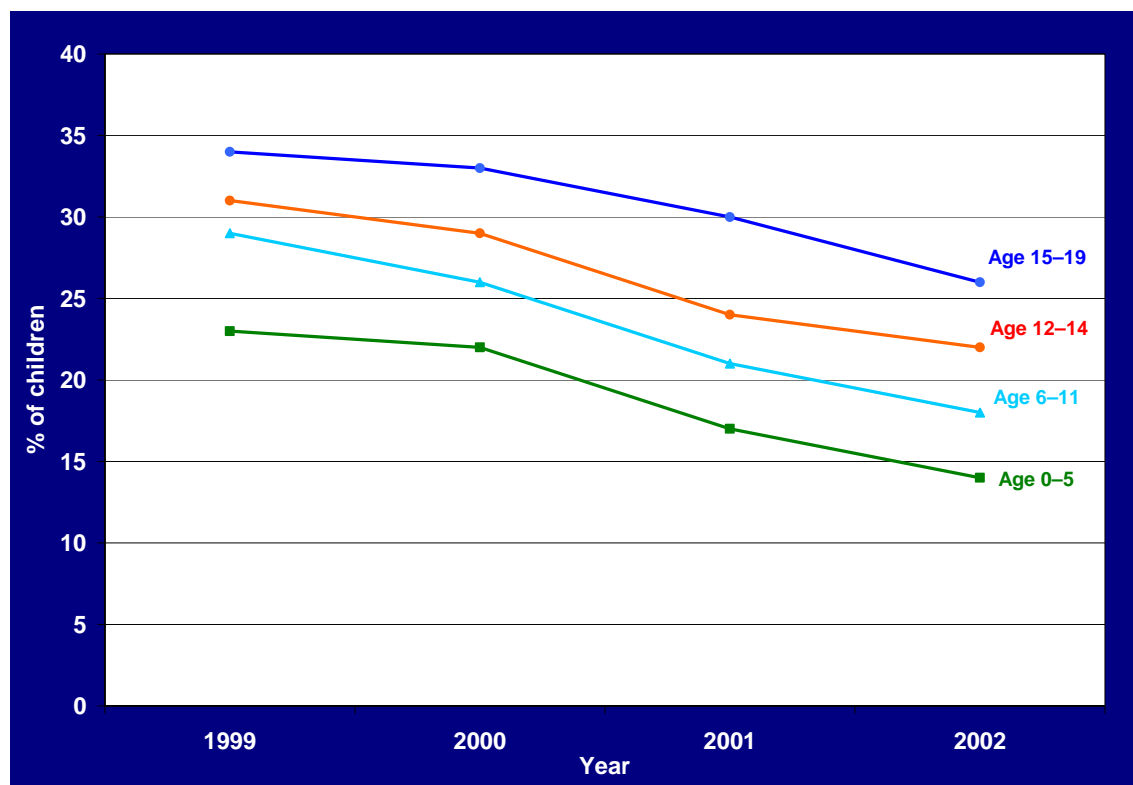
Children are especially sensitive to their environments, because of rapid growth, developing body systems, unique pathways of exposure and higher daily intakes of air, water and food per unit body weight. The National Academy of Sciences in the United States recently reviewed the evidence for the development of asthma in children and concluded that there is substantial evidence of a causal relationship between exposure to house dust mites and asthma (National Academy of Sciences, 2000). Exposures to second-hand smoke (preschool children), cat and dog allergens, cockroaches, dust mites, nitrogen dioxide (NO₂) or NO_x (high-level exposures), fungi and rhinoviruses have been shown to be related to the development and exacerbation of asthma. Indoor air quality may also influence other respiratory diseases, such as chronic obstructive pulmonary disease (COPD). Much less research has been done on these diseases in comparison with asthma.

Children who are exposed to second-hand smoke are at increased risk of serious adverse health effects, including bronchitis, pneumonia, lower respiratory tract infections, chronic/repeated ear infections and SIDS (Health Canada, 2002). Second-hand smoke is one of the irritants known to trigger asthma attacks. Several recent reviews concluded that there is sufficient evidence of a causal association between childhood incident asthma (the development of asthma) and postnatal second-hand smoke exposure (World Health Organization, 1999; Jaakkola and Jaakkola, 2002; DiFranza et al., 2004; California Environmental Protection Agency, 2004).

Indicator—Status and Trends:

The data for this indicator, the percentage of children exposed to second-hand smoke in Canadian homes (Figure 2.6), were obtained from the Canadian Tobacco Use Monitoring Survey (CTUMS) Report and the National Population Health Survey (NPHS).

Figure 2.6: Percentage of children exposed to second-hand smoke in Canadian homes, by age group, 1999–2002



Source: Canadian Tobacco Use Monitoring Survey, Household Component

Key Observations:

- Generally, the percentages of children (in all four age categories 0–5, 6–11, 12–14 and 15–19) exposed to second-hand smoke in Canadian homes are decreasing.
- It is also evident that for all 4 years (1999–2002), exposure to second-hand smoke is highest among children aged 15–19 and lowest among those aged 0–5.
- Overall, in 2002, 19% of children aged 0–17 were regularly exposed to second-hand smoke in the home.

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

One of the primary goals of the Tobacco Control Program, under the federal Tobacco Control Strategy, is to reduce involuntary exposure of all Canadians, including children, to second-hand smoke. To achieve this goal, a comprehensive approach is employed, which includes resource development that encourages and supports the development of municipal by-laws for smoke-free public areas; mass media campaigns directed at youth and adults to raise awareness of the dangers of exposure to second-hand smoke; research on attitudes and behaviours relating to second-hand smoke; and surveillance on exposure to second-hand smoke in the home and workplace.

The Indoor Environments Division of the Safe Environments Programme of Health Canada, whose mission is to provide leadership in the development of national collaborative strategies to promote and enhance healthy indoor environments in Canada, has developed a “Tools for

Schools” Action Kit. The purpose of the kit is to provide basic information and easy-to-follow actions to address indoor air quality in schools.

What You Can Do

For more information on second-hand smoke, consult *Second-hand Smoke: The Facts* at:
http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/second/do-faire/ribbon-ruban/index_e.html

Opportunities for Improvement:

Children may be exposed to second-hand smoke in their homes and other public places as well. Biomonitoring, or biological monitoring, is the measurement of the concentration of a chemical in human specimens such as blood, urine, saliva or adipose tissue. Measures of cotinine, a metabolite of nicotine, in urine would provide a more accurate measure of all sources of exposure to second-hand smoke.

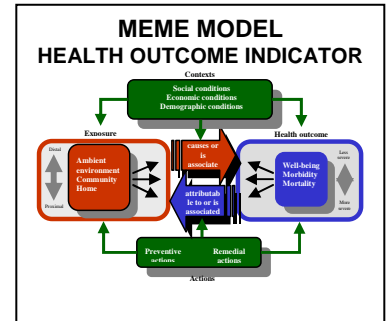
2.3 Asthma

Indicator 3: Prevalence of asthma in children

Issue, Context and Relevance of the Indicator:

Asthma is one of the most prevalent chronic conditions in Canadian children and is also a serious problem in adults. According to the NPHS, it affects 2.5 million people—8% of adults and 12% of children (Statistics Canada, 2000). Asthma reduces the quality of life for individuals with asthma and their families and imposes a heavy burden on the nation's health care expenditures. The exact cause of asthma is unknown, but it appears to be the result of a complex interaction of three factors:

- 1) predisposing factors (e.g., atopy—a tendency to have an allergic reaction to foreign substances);
- 2) environmental causal factors (especially second-hand smoke, house dust mite antigen, outdoor air pollution); and
- 3) aggravating factors that increase the frequency and/or severity of asthma episodes, including second-hand smoke, certain indoor air allergens, outdoor air pollutants including PM and ozone, and respiratory infections (Health Canada, 2004a).

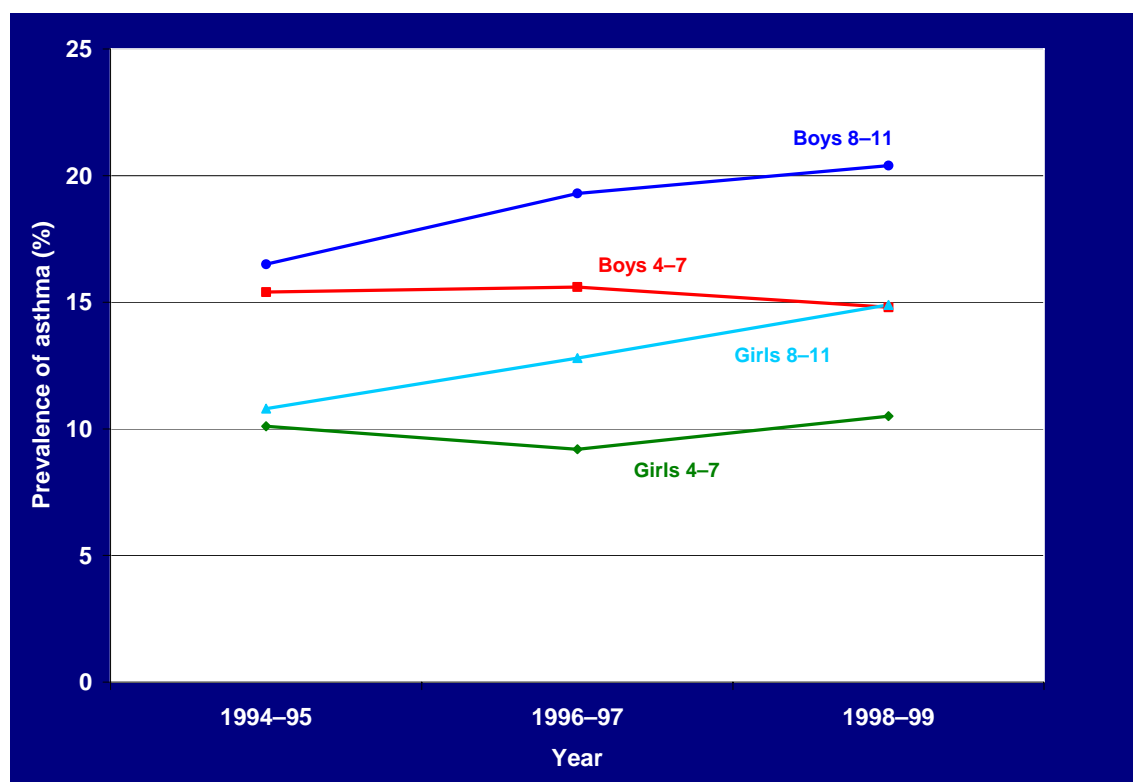


While asthma is often considered a “children’s disease,” it is common among all age groups of Canadians. Children and youth do have the highest prevalence of asthma and the highest hospitalization rates. The prevalence of asthma among adults is increasing and is cause for concern. Further research is needed to identify the potential factors responsible for increased prevalence rates, as well as to study the primary prevention of asthma in at-risk individuals. Reducing exposure to airborne school and workplace contaminants, second-hand smoke, house dust mites, animal dander and moulds may decrease the risk of the development of asthma among sensitive individuals and should decrease symptoms and attacks among those with asthma. While individuals can take personal responsibility for some preventive measures, other solutions require the collaborative efforts of government, industry and business sectors. Legislation, policies and voluntary cooperation need to be part of a concerted effort to decrease school and workplace contaminants and improve air quality (Health Canada, 2000).

Indicator—Status and Trends:

Three Canadian population-based surveys asked parents if their child(ren) had ever been diagnosed with asthma by a physician. These surveys constitute the source of information on asthma prevalence in Canada. The surveys provide data on the percentage of children who have reported a diagnosis of asthma. Since it is difficult to differentiate in the surveys those with other respiratory conditions (such as wheezing) from those with asthma, children under the age of 4 were excluded from the analyses. “Prevalence” is the number of people in the population who have a condition at a specific point in time. “Incidence” is the number of new people who develop the condition during a specific time period. Each measure provides valuable information on the population. Canada does not currently have incidence data on asthma, so we must rely on prevalence data (Figure 2.7).

Figure 2.7: Prevalence of physician-diagnosed asthma (ever) among children, by sex and age group, Canada, 1994–95, 1996–97 and 1998–99



Source: Centre for Chronic Disease Prevention and Control, Health Canada, using data adapted from the National Longitudinal Survey of Children and Youth (cross-sectional component), Statistics Canada, 1994–95, 1996–97 and 1998–99

Key Observations:

- Since 1994, asthma prevalence has been increasing among children (except for boys aged 4–7 years).
- Boys of all ages have a higher prevalence of asthma than girls.
- Currently, approximately 20% of boys aged 8–11 have been diagnosed with asthma, the highest prevalence group among children.

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

Canada is currently reviewing and developing national guidelines for the prevention and management of asthma among children. They are being developed by the Canadian Network on Asthma Care and will be national. The organizations involved are the Canadian Paediatric Society, the Canadian Thoracic Society, the College of Family Physicians, the Canadian Respiratory Therapy Society, Asthma Educators, the Asthma Society of Canada and the Canadian Lung Association. The new pediatric clinical practice guidelines will include recommendations on how to diagnose asthma. They will include the need to take a history of symptoms as well as a family history and a history of allergy or atopy, as this predisposes the wheezing child to actually have persistent wheezing and asthma.

Opportunities for Improvement:

Data collected in these population health surveys are self-reported; thus, validity and reliability of data could be questionable. Information on patient encounters with the health care system may provide a more accurate method of assessing asthma prevalence.

3 Lead and Other Chemicals, Including Pesticides

3.1 Blood Lead Levels

Indicator 4: Blood lead levels in children

This information is currently not available in Canada.

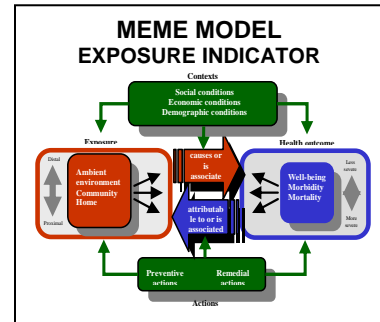
Blood lead levels provide a measure of a child’s current body burden of lead. There is no recent, nationally representative survey of blood lead levels in children in Canada. For this indicator, Canada is presenting a case study on blood lead levels in children in Ontario.

Issue, Context and Relevance of the Indicator:

It is generally well recognized that low-level or moderate lead exposure during early childhood can cause persistent adverse neurobehavioural effects, including cognitive deficits. The child and developing fetus are at greater risk for higher blood lead levels than adults, for a number of reasons. Because children are developing rapidly, they have a higher metabolic rate. As a result, they take in more air, food and water per unit body weight per day. They are also more efficient than adults at absorbing certain substances such as lead. It has been estimated that adults absorb 10–15% of lead ingested with meals, but children and pregnant women can absorb up to 50% (Wigle, 2003: 75). In addition, their hand-to-mouth behaviour places young children at risk of increased exposure to lead-contaminated soil and house dust. Compounding this, the developmental organs and systems of children are immature, making them less able to inactivate and/or eliminate certain toxicants.

There is no known “safe” blood lead level for children, but risks of adverse health impact decline as exposure to lead declines. Studies suggest that children are most susceptible to the neurological effects of lead in the first 3 years of life because of the brain development that takes place during this time (Wigle, 2003).

Sources of environmental lead exposure include lead-based paint; soil and dust from paint, gasoline and industrial sources; drinking water; certain occupations and hobbies; airborne lead from point sources such as lead smelters; and lead-contaminated food (from sources such as lead-soldered cans, the rain and soil in which food plants are grown, storage and serving vessels), dust in the home and consumer products (Health Canada, 2004d). The case study presented illustrates the fact that lead in gasoline was an important contributor to children’s exposure to lead. Lead exposure in Canada has decreased substantially, mainly because leaded gasoline and lead-based paint were phased out and the use of lead solder in food cans was virtually eliminated (Health Canada, 2004d).



Umbilical cord blood lead levels and source assessment among the Inuit in northern Quebec

A study on Inuit newborns from northern Quebec showed that about 7% of 475 Inuit newborns had a cord blood lead concentration equal to or greater than 0.48 micromoles per litre, an intervention level adopted by many governmental agencies. A comparison between the cord blood lead isotope ratios of Inuit and southern Quebec newborns showed that lead sources for these populations were different. The study suggests that lead shot used for game hunting was an important source of lead exposure in the Inuit population. A cohort study conducted in three Inuit communities shows a significant decrease of cord blood lead concentrations after a public health intervention to reduce the use of lead shot. Lead shot ammunition can be a major and preventable source of human exposure to lead.

Source: Lévesque et al. (2003)

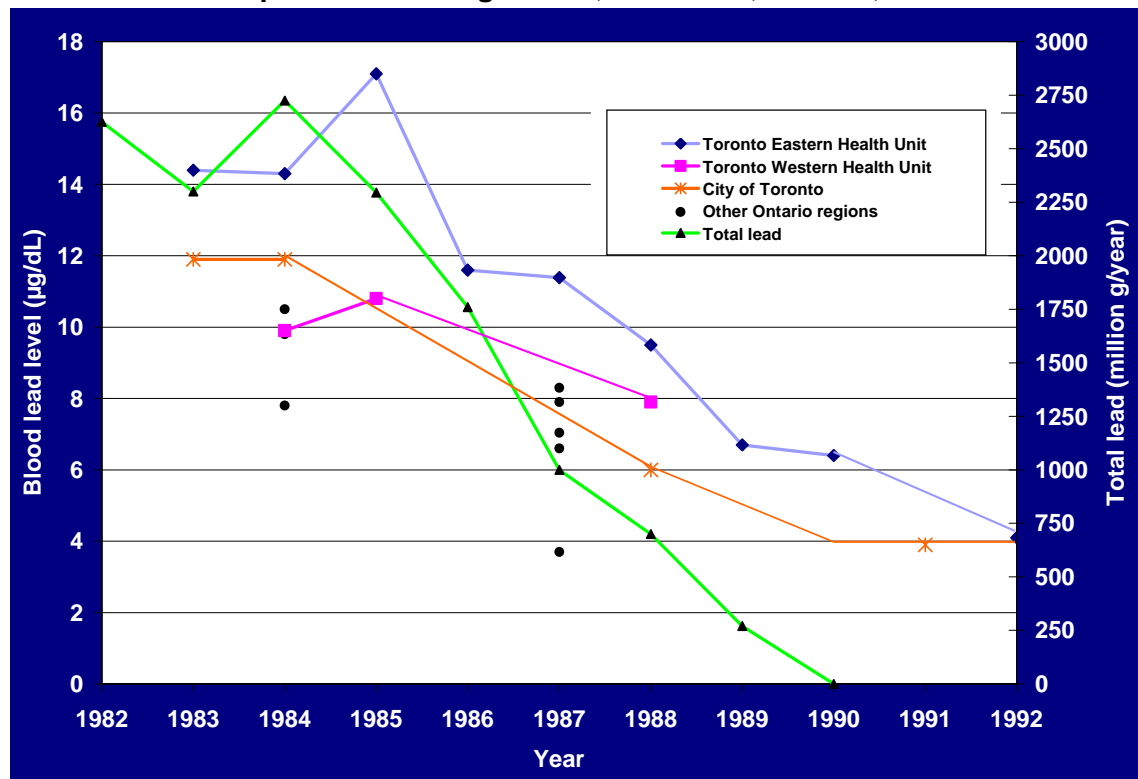
CASE STUDY

Blood lead levels in children in Ontario

There has been some sampling of blood lead levels in certain regions of Canada. Since 1980, health departments in Ontario have conducted several blood lead screening surveys in children living in several cities and regions of the province. The same collection procedure (capillary finger-prick blood samples) and method for blood lead analysis (Zeeman graphite furnace atomic absorption spectrophotometry) were used in all the blood lead analyses in this study.

As illustrated in Figure 3.1, the findings from this analysis indicate that as lead levels in gasoline declined, so did children's blood lead levels in Ontario. These findings have been confirmed by evidence from the United States, where a biomonitoring system for measuring blood lead levels has been in place since the 1970s, through the U.S. National Health and Nutrition Examination Survey.

Figure 3.1: Decline in the geometric mean blood lead concentrations related to a decline in consumption of leaded gasoline, in Ontario, Canada, 1983–1992



Source: Adapted from Wang et al. (1997)

Legislative and Policy Framework:

The use and release of lead and its compounds fall under various laws, regulations, agreements and voluntary initiatives designed to protect the environment and human health. Control measures range from maximal government intervention (e.g., prohibition of lead in gasoline) through restrictions (e.g., permitted levels in consumer products) and voluntary measures (e.g., industry agreement to eliminate lead-soldered cans) to consumer awareness and education programs.

Environment Canada is working with other countries to reduce emissions of heavy metals, including lead, that are subject to long-range atmospheric transport.

Health Canada has promoted awareness of issues concerning lead and health by educating the public, health professionals and industry. Health Canada, in partnership with various groups, has released many publications on topics such as lead and home renovations and lead risk associated with arts and crafts. Other non-regulatory initiatives include the Guidelines for Canadian Drinking Water Quality and standards under the national Plumbing Code for plumbing fixtures that come into contact with potable water.

What You Can Do

For more information on lead and human health, consult:

http://www.hc-sc.gc.ca/ewh-semt/contaminants/lead-plomb/asked_questions-questions_posees_e.html

Opportunities for Improvement:

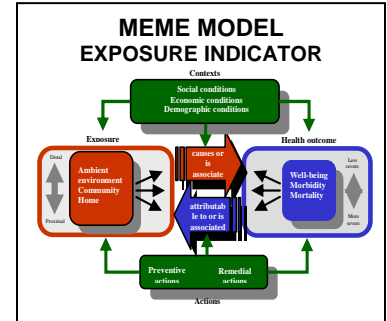
The collection of nationally representative data on blood lead levels in children would assist in identifying the scope of this issue in Canada. Blood lead level sampling is usually reported by percentiles, identifying the distribution of blood lead levels in the population selected (see, for example, the indicator on blood lead levels provided in the United States indicators report; U.S. EPA, 2005). As such, national data on blood lead levels would allow the identification of subpopulations of children in Canada that may be at risk from high exposure to lead (higher percentiles in the population).

3.2 Lead in the Home

Indicator 5: Children living in homes with a potential source of lead

Issue, Context and Relevance of the Indicator:

Dust in the home and soil can be significant sources of lead exposure, especially for young children. Lead dust can be generated within the home, especially older homes (pre-1960) that used lead-based paints; such homes may also have lead pipes that can leach lead into drinking water. Lead dust is especially dangerous for babies and young children who crawl on the floor, because their breathing zone is closer to floor level, which increases their exposure to lead dust. The key pathway of childhood exposure to lead in residential environments is ingestion of house dust by toddlers and preschoolers through normal hand-to-mouth activities.

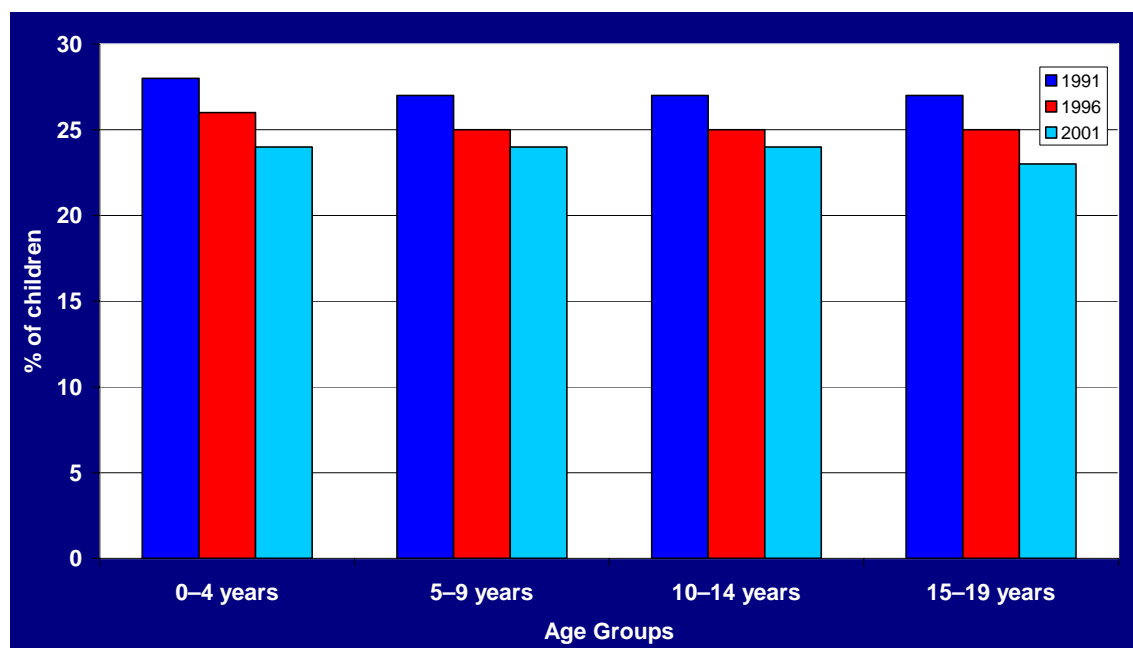


It has been estimated that 97% of children's total daily lead intake is from ingestion of house dust, food and water, and only a small proportion (<3%) is through inhalation (Davies et al., 1990). Another study concluded that 50% of the daily lead intake of 2-year-old urban children occurs by ingestion of house dust through normal hand-to-mouth activities (Thornton et al., 1994). Older homes are more likely to contain lead in house dust from paint. Most indoor and outdoor paints produced before 1960 contained substantial amounts of lead. Although older homes are more likely to contain lead in house dust from paint, lead-based paint that is in good condition is believed not to pose a risk to residents living in the home. The highest risk of exposure to lead may be to children living in an older home during a renovation where paint is sanded, burned with a propane torch or scraped off, as these activities increase the amount of lead in house dust (Laxen et al., 1988; Davies et al., 1990; Rasmussen et al., 2001; Rasmussen, 2004). Children may also be at risk if they chew on surfaces painted with lead-based paint. Biomonitoring surveys in the United States have revealed that children living in older homes are more likely to experience elevated blood lead levels. Children living in low-income families are particularly at risk (U.S. Centers for Disease Control and Prevention, 1997).

Indicator—Status and Trends:

This indicator represents the proportion of children 19 years of age or younger living in housing stock built before 1960 in the Census years 1991, 1996 and 2001 (Figure 3.2).

Figure 3.2: Percentage of children living in pre-1960 homes, by age group, Canada, 1991, 1996 and 2001



Source: Statistics Canada, Census of Population, 1991, 1996, 2001

Key Observations:

- In 2001, 24% of Canadian children under 5 years of age lived in housing built prior to 1960.
- The number of children in the four age categories (<5, 5-9, 10-14 and 15-19) living in homes built prior to 1960 declined slightly between 1991 and 2001.
- This indicator measures only the potential for exposure to lead in home. The slow retirement of old housing stock may contribute to the decline observed.

For more information, see the indicator template in Appendix 3.

Legislation and Policy Framework:

In Canada, the Liquid Coating Materials Regulations were enacted under the *Hazardous Products Act* in 1976 to restrict the lead content in paints and other liquid coatings on furniture, household products, children’s products, and exterior and interior surfaces of any building frequented by children to 0.5% by weight. By the end of 2002, the amount of lead in paint was restricted to 0.06% by weight. Although the lead content of exterior paint is not regulated, Canadian paint manufacturers have voluntarily ensured that no lead is intentionally added. Exterior paint with lead carries a warning label not to use it inside. Homes built before 1960 were likely painted with lead-based paint. Some paint made in the 1940s contained up to 50% lead by dry weight. During the 1950s, the use of lead in exterior paint was more common, but lead paint was still used in the interior of homes.

What You Can Do

The Canadian Mortgage and Housing Corporation provides guidelines on issues to examine when considering a renovation on an older home, how to test for leaded paints and precautions to take when dealing with leaded paint.

For more information, see *Lead Precautionary Measures* at:

Opportunities for Improvement:

Information on the effectiveness of measures to reduce the release of lead into house dust during a renovation would assist in reducing children's risks of exposure to elevated levels of lead. Measures of blood lead levels of children living in older homes, particularly children of low-income families, would assist in determining if the American pattern of elevated blood lead levels associated with older housing units occurs in Canadian children.

3.3 Industrial Releases of Lead and Selected Chemicals

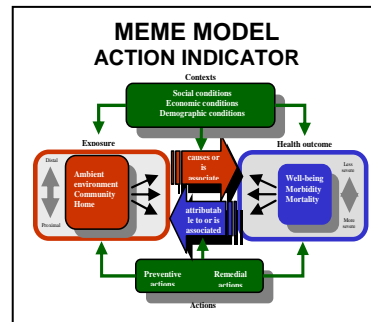
Indicator 6: PRTR data on industrial releases of lead

Indicator 7: PRTR data on industrial releases of 153 chemicals

Issue, Context and Relevance of the Indicators:

The indicators use pollutant release and transfer register (PRTR) data as “action” indicators. An action indicator under the MEME model is intended to describe preventive or remedial action taken by governments to address a specific environmental threat to children’s health. The PRTR data indicators are intended to measure effectiveness at reducing emissions of toxic substances to the environment.

The PRTR data are annual estimates of emissions to the environment. For chemicals that persist a long time in the environment, bioaccumulate and travel far from their points of origin, these ongoing annual releases are of particular concern, because they add to the cumulative load of chemicals to the environment.



PRTR data are just one source of information on toxic chemicals in the environment. Other sources include measurements of concentrations of chemicals in the air, land and water in our communities, specialized chemical and air pollutant inventories, hazardous waste databases, modelling estimates, body burdens in plants, fish and people, and industrial emission rates for chemicals. Canada is also reporting total atmospheric releases of mercury in Canada (see Figure 3.14).

In making good use of PRTR data, it is important to know their limitations. PRTR data do not include:

- all potentially harmful chemicals—just those on the lists of chemicals to be reported;
- chemicals released from mobile sources, such as cars and trucks;
- chemicals released from natural sources, such as forest fires and erosion;
- chemicals released from small sources, such as dry cleaners and gas stations;
- chemicals released from small manufacturing facilities with fewer than 10 employees;
- chemicals released from consumer products;
- information on the toxicity or potential health effects of chemicals;
- information on risks from chemicals released or transferred; or
- information on exposures of humans or the environment to chemicals released or transferred.

From a children’s health perspective, the rationale for providing action indicators of PRTR data is that industrial emissions of these chemicals may contribute to the contamination of the food children eat, the water they drink, the air they breathe and the soil with which they come in contact. In addition, certain subpopulations of children may be exposed to pollutants released to air, water and soil in their community. PRTR data represent estimated releases of pollutants to the environment and do not represent estimates of human exposure to these substances. The degree of human exposure is not necessarily proportional to the number of tonnes of pollutants released. There are many factors to consider in determining human exposure to each chemical and the risks associated with that exposure. These include:

- the routes of exposure (ingestion, inhalation, dermal);
- the duration and frequency of the exposure;
- the rate of uptake of the substance;
- the individual age and gender; and

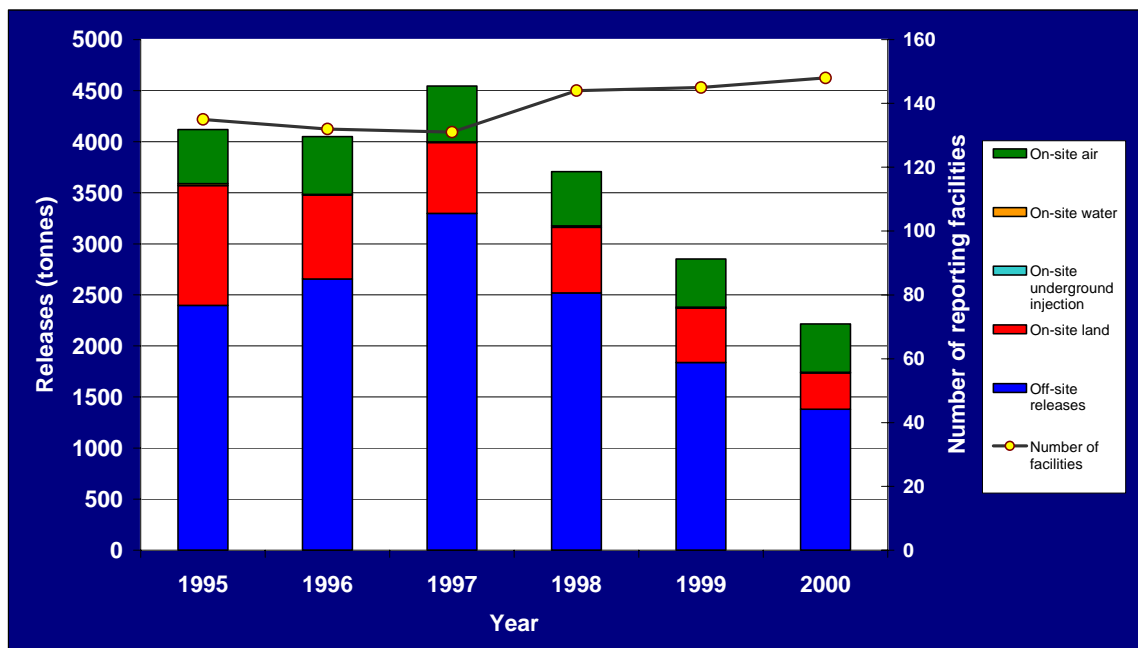
- the disease, overall health and nutritional status of the individual (including pregnancy status, in the case of prenatal exposure).

PRTR data for Canada are provided by the National Pollutant Release Inventory (NPRI), which is a legislated, nationwide, publicly accessible inventory of pollutants released to the environment. It was created in 1992 to provide Canadians with information on pollutant releases to air, water and land from facilities located in their communities and the quantities sent to other facilities for disposal, treatment or recycling. For the 2001 reporting year, there were 274 substances listed in the NPRI.

Indicators—Status and Trends:

Canada is reporting pollutant releases for lead and its compounds, based on matched industrial sectors with the United States (Figure 3.3), and total estimated emissions of lead to air (Figure 3.4). Canada is also reporting pollutant releases for 153 “matched” chemicals—those chemicals reported in the NPRI that are also required to be reported in the United States. Figures 3.3 and 3.5 present on-site and off-site releases, in tonnes, describe where in the environment the chemicals were released and provide the number of facilities reporting releases for each year. Figure 3.6 presents total on-site and off-site releases for 153 matched chemicals, in tonnes, by sector, for the period 1998–2002.

Figure 3.3: On- and off-site releases of lead (and its compounds), Canada, 1995–2000



Source: National Pollution Release Inventory (NPRI), Environment Canada

Notes:

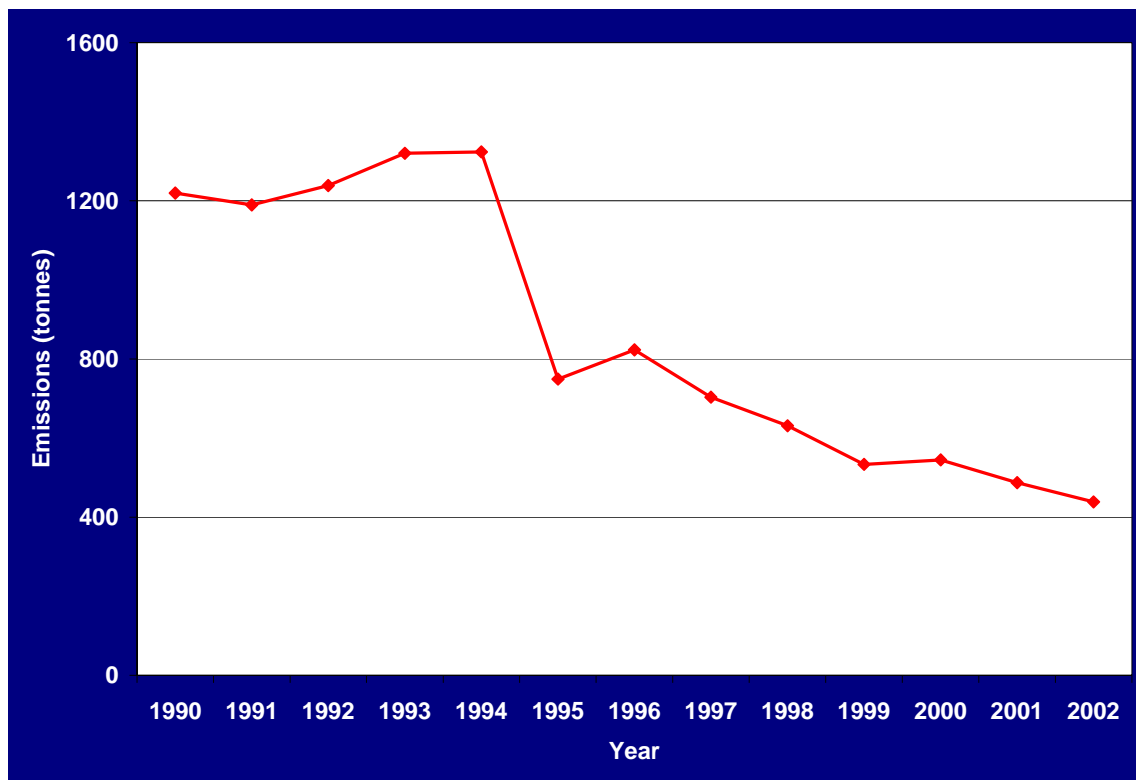
- On-site air emissions include stack or point releases, storage or handling releases, fugitive releases, spills and other non-point releases.
- On-site water discharges include direct discharges, spills and leaks; on-site releases to land include landfill, land treatment, spills, leaks and other.
- Off-site transfers include transfers for disposal and treatment, but not recycling.
- Only certain manufacturing industries were selected, not including electric utilities, hazardous waste facilities or mining facilities.

Key Observations:

- Overall, while the number of reporting facilities increased by 10% between 1995 and 2000, total releases of lead and its compounds decreased by 46%. Releases increased moderately from 1995 to 1997, followed by a decrease in total releases from 1998 to 2000.
- Off-site releases (primarily transfers to landfills) accounted for the largest portion of releases and variation over this time period.
- On-site land releases decreased by 70% from 1995 to 2000.
- On-site releases to the air decreased from 1996 to 1999 but showed an increase (of 0.6%) from 1999 to 2000.

For more information, see the indicator template in Appendix 3.

Figure 3.4: Total estimated emissions of lead to air, Canada, 1990–2002



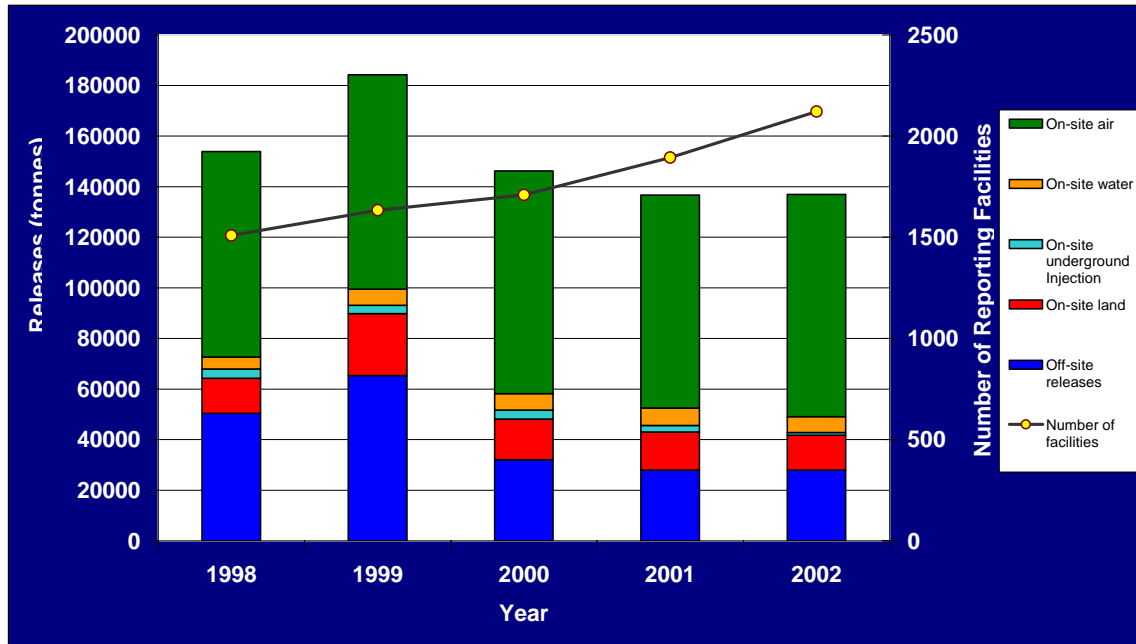
Source: Lead emissions inventory, Criteria Air Contaminants Office, Environment Canada

Key Observations:

- With the introduction of unleaded gasoline in Canada in 1975, lead concentrations in the air have declined significantly. Leaded gasoline in cars was banned in Canada in 1990 (Health Canada, 2004b).
- Total estimated lead emissions to air (including those reported to the NPRI) decreased by 67% between 1994 and 2002.

For more information, see the indicator template in Appendix 3.

Figure 3.5: Total on- and off-site releases of matched chemicals, Canada, 1998–2002



Source: National Pollutant Release Inventory, Environment Canada

Notes:

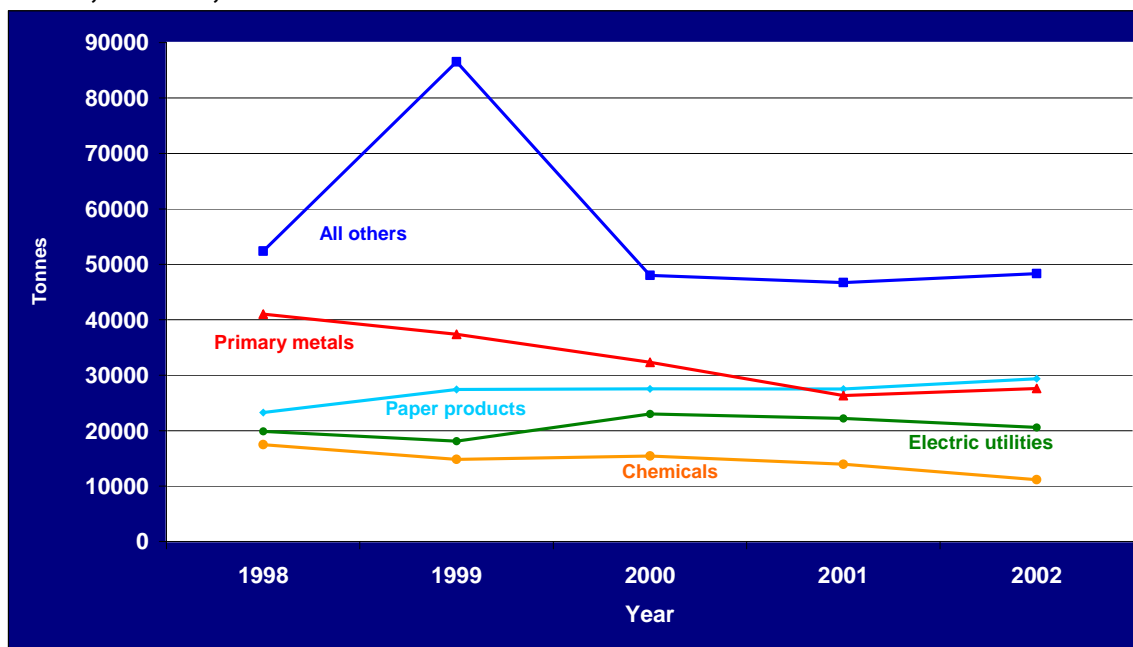
- On-site air emissions include stack or point releases, storage or handling releases, fugitive releases, spills and other non-point releases.
- On-site water discharges include direct discharges, spills and leaks; on-site releases to land include landfill, land treatment, spills, leaks and other.
- Off-site transfers include transfers for disposal and treatment, but not recycling.
- The 153 matched chemicals are the chemicals reported in both the Canadian NPRI and the U.S. Toxics Release Inventory.
- Not all industry sectors are included to ensure consistent reporting between Canada and the United States.

Key Observations:

- The number of facilities reporting to the NPRI for the matched chemicals set increased by 41% between 1998 and 2002, while total releases decreased by 11% during this period. Releases to on-site air and water increased between 1998 and 2002, while releases to on-site underground injection and off-site transfers (primarily transfers to landfills) decreased, and on-site land releases were about the same in 1998 and 2002.

For more information, see the indicator template in Appendix 3.

Figure 3.6: Total on- and off-site releases of matched chemicals, by industry sector, Canada, 1998–2002



Source: National Pollutant Release Inventory, Environment Canada

Notes:

- Total on- and off-site releases include on-site air emissions, on-site water discharges, on-site releases to land and off-site transfers.
- The 153 matched chemicals are the chemicals reported in both the Canadian NPRI and the U.S. Toxics Release Inventory.
- Not all industry sectors are included to ensure consistent reporting between Canada and the United States.

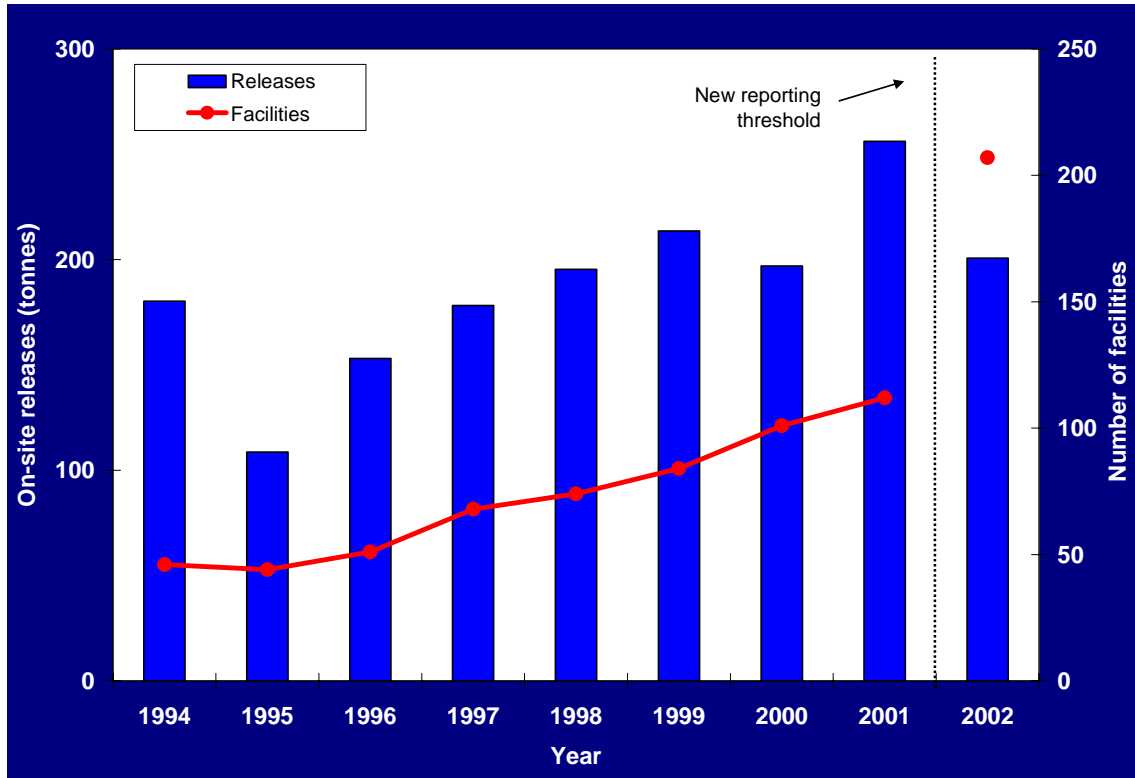
Key Observations:

- Of the four industry sectors with the largest total releases in 1998, the primary metals and chemical manufacturing sectors reported reductions in releases of the matched set of chemicals of 33% and 36%, respectively, between 1998 and 2002, while the paper products and electric utilities sectors both reported increases, of 26% and 4%, respectively, over the same period

For more information, see the indicator template in Appendix 3.

In addition to reporting the total releases for lead and the 153 matched chemicals, Canada is reporting separately emissions of a few substances selected because they are known to have adverse effects on children’s health. The seven substances selected are not intended to be a comprehensive list of substances that are of specific concern to children’s health. Rather, they are a few substances for which there are known adverse health effects in childhood or adulthood associated with prenatal or childhood exposure. The selected substances are arsenic (Figure 3.7), benzene (Figure 3.8), cadmium (Figure 3.9), chromium (Figure 3.10), dioxins and furans (Figure 3.11), hexachlorobenzene (HCB) (Figure 3.12) and mercury (Figures 3.13 and 3.14). This is Canada’s first attempt at prioritizing a vast amount of data from a children’s health perspective.

Figure 3.7: On-site releases to air, water and soil of arsenic and its compounds reported in the NPRI for Canada, 1994–2002



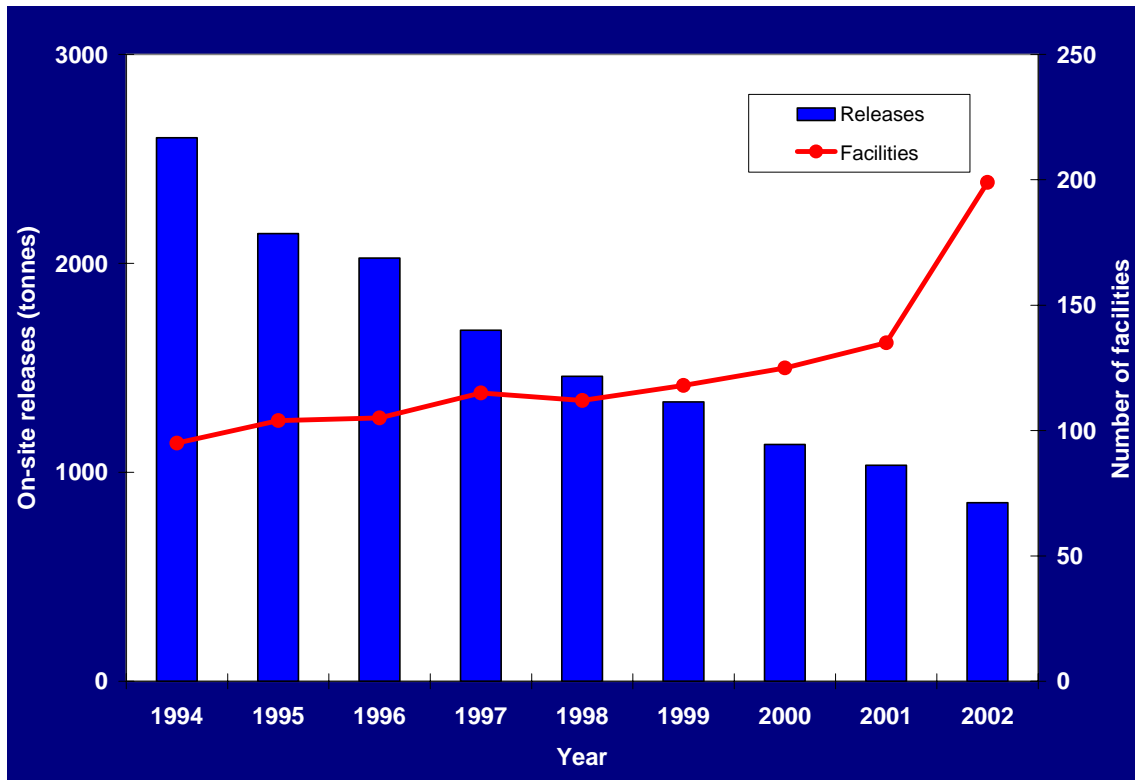
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal.

Key Observations:

- Since 1994, on-site releases of arsenic to air, water and soil have increased slightly, by 11.4%, from 180 tonnes in 1994 to 201 tonnes in 2002.
- Some important changes to NPRI reporting guidelines with respect to arsenic releases occurred in 2000 and 2002. In the year 2000, the 20 000-hour employee threshold was removed for certain industries, including wood preservation, a source of arsenic releases. In 2002, the reporting threshold for arsenic was decreased from 10 tonnes to 50 kg at 0.1% concentration.
- Much of the increase in on-site releases of arsenic, which include emissions to air and releases to land and water, can be accounted for by the almost fivefold increase in the number of reporting facilities.

Figure 3.8: On-site releases to air, water and soil of benzene reported in the NPRI for Canada, 1994–2002



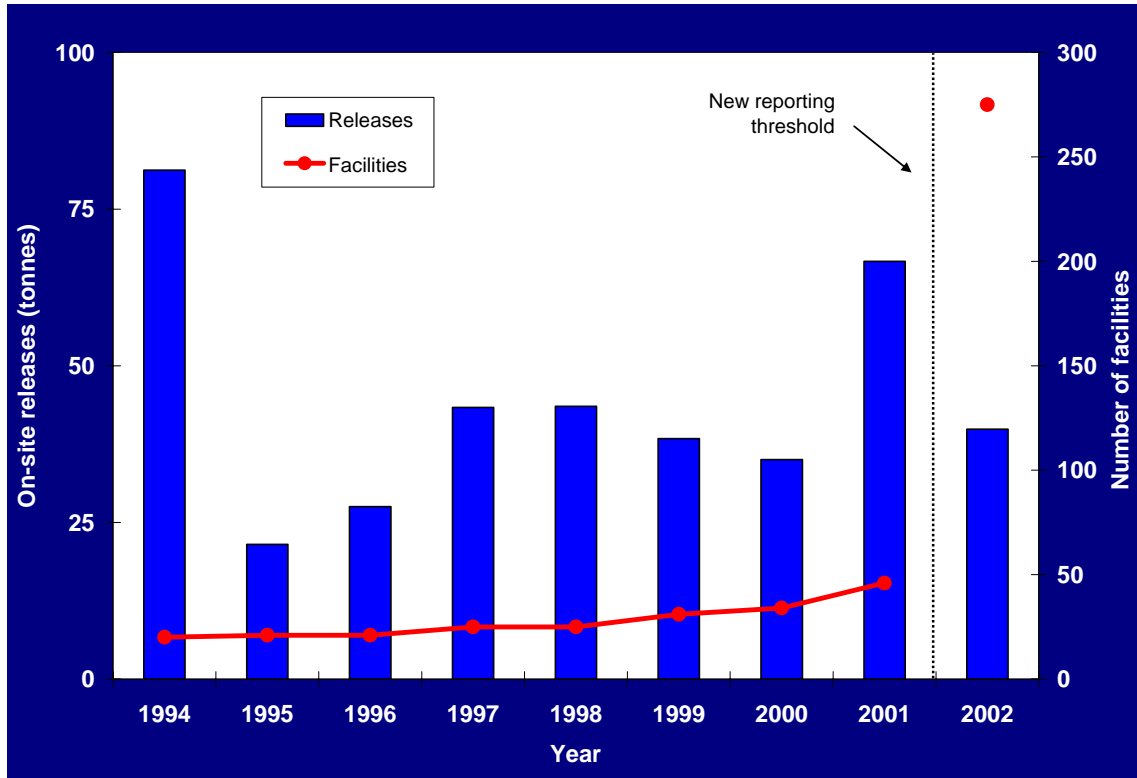
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal.

Key Observations:

- In 1994, 2608 tonnes of benzene were released, while in 2002, 863 tonnes were released—representing a 67% decrease in benzene releases.
- These have been significant decreases in on-site releases since 1994, while the number of reporting facilities has been steadily increasing.

Figure 3.9: On-site releases to air, water and soil of cadmium and its compounds reported in the NPRI for Canada, 1994–2002



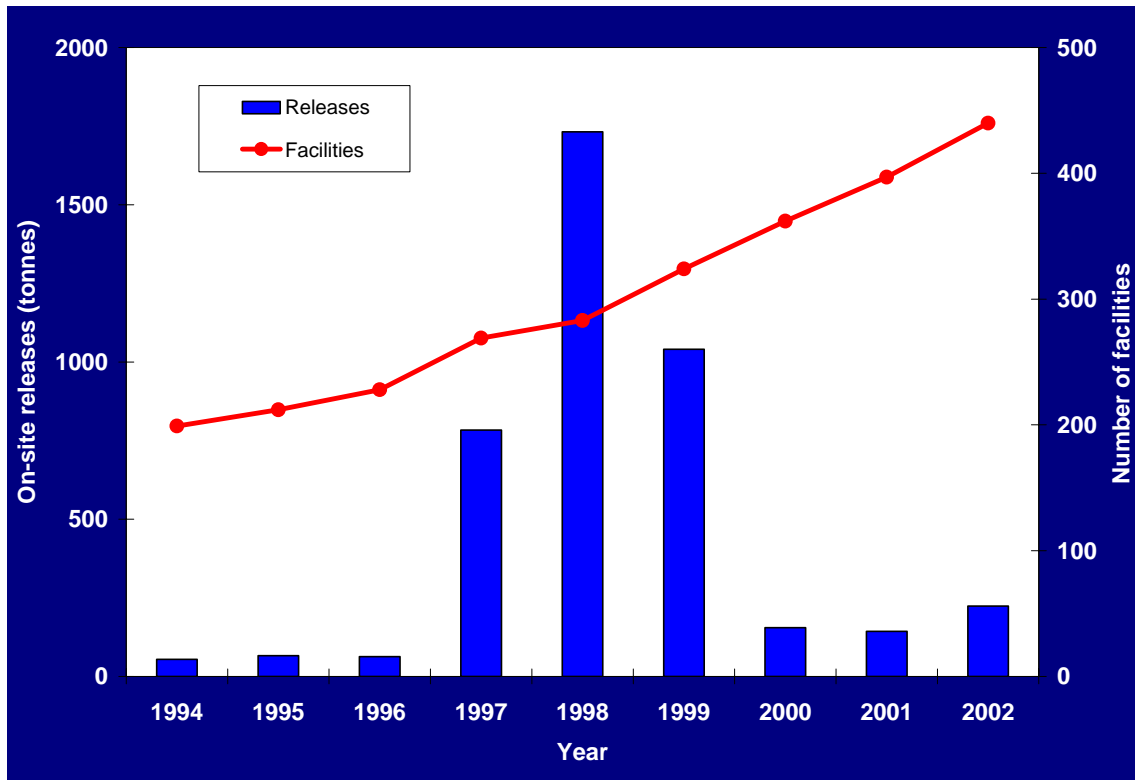
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal.

Key Observations:

- In 1994, cadmium releases were 82 tonnes, while in 2002, releases were down to 40 tonnes.
- The number of reporting facilities increased steadily from 20 reporting facilities in 1994 to 46 in 2001.
- In 2002, the reporting threshold for cadmium was reduced from 10 tonnes to 5 kg with a 0.1% concentration criterion, increasing the number of reporting facilities to 281.

Figure 3.10: On-site releases to air, water and soil of chromium and its compounds reported in the NPRI for Canada, 1994–2002



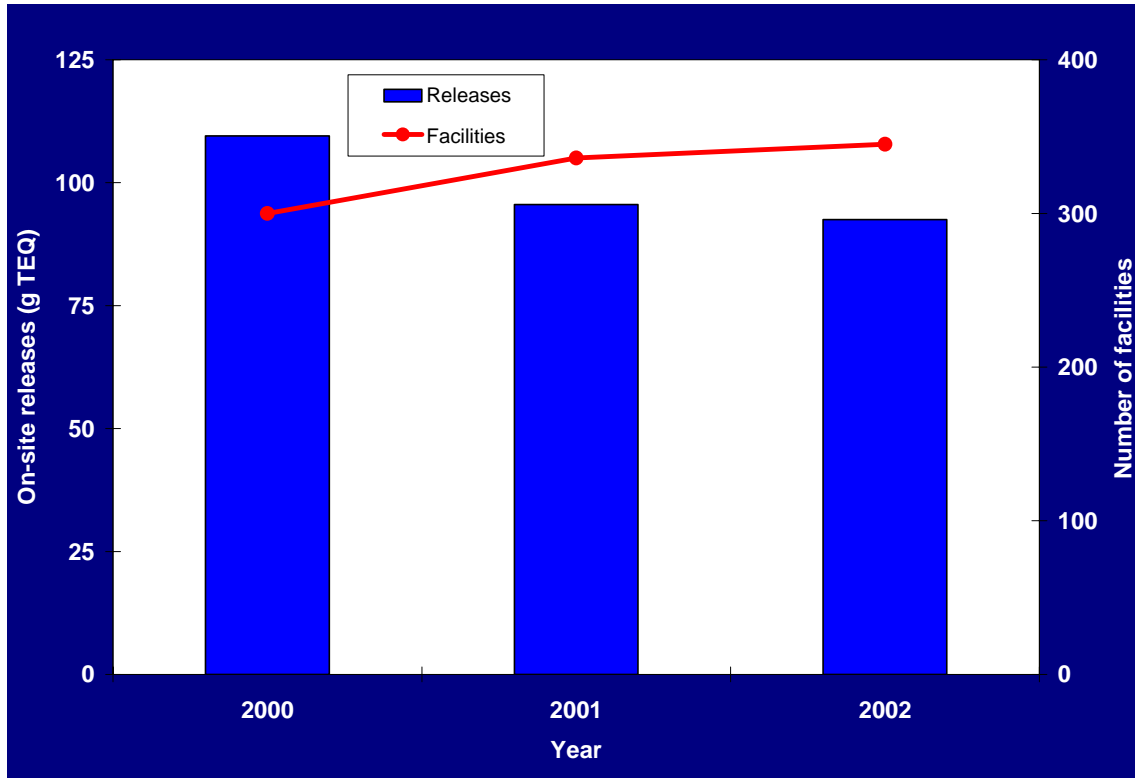
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal.

Key Observations:

- On-site chromium releases remained at a steady level between the years 1994 and 1996 (65 tonnes and 69 tonnes, respectively) and then exhibited a drastic increase beginning in 1997 and ending in 1999 (790 tonnes and 1048 tonnes, respectively).
- Emissions of chromium hit a peak of 1740 tonnes in 1998, only to drop again to 161 tonnes in 2000. The peak in 1998 was caused by a single nickel, copper and ore mining facility with a one-time release of 1545 tonnes (approximately 89% of total on-site releases) to land.
- Beginning in 2002, the reporting of hexavalent chromium, the most toxic of chromium compounds, was done separately.

Figure 3.11: On-site releases to air, water and soil of dioxins and furans reported in the NPRI for Canada, 2000–2002



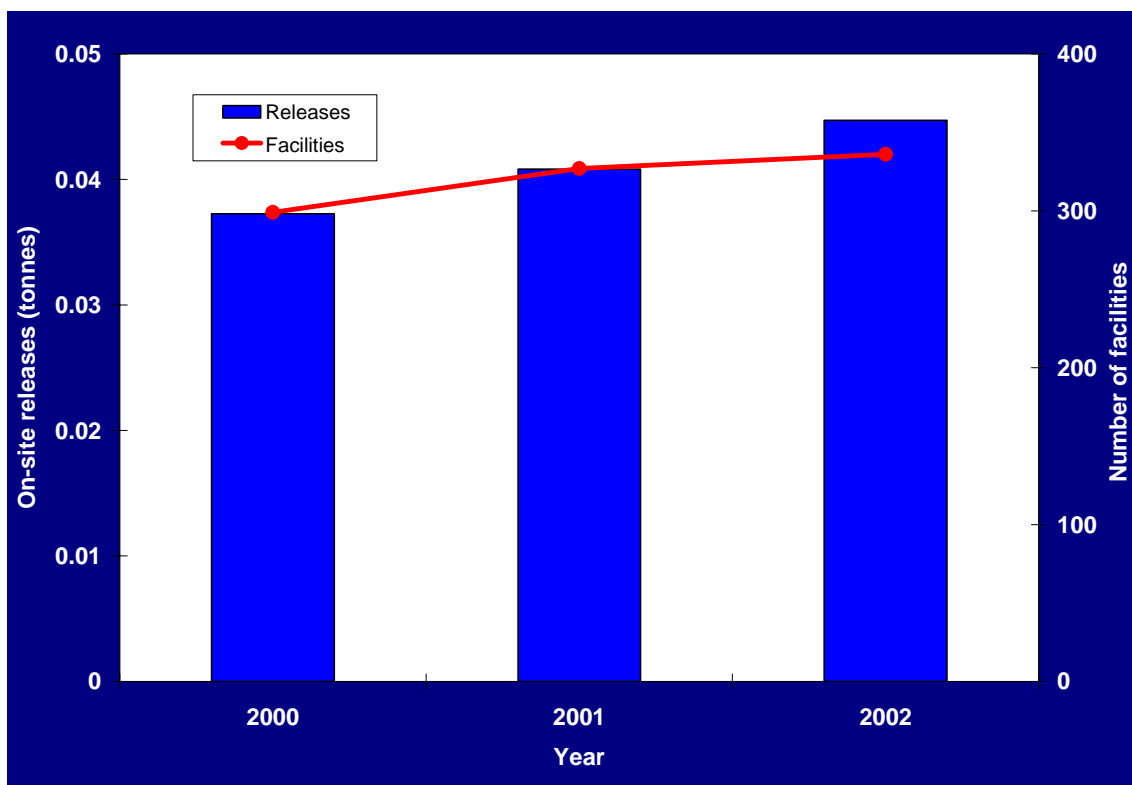
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal. TEQ = Toxic equivalency. The TEQ is obtained by multiplying the concentration of each congener by its relative toxicity factor.

Key Observations:

- Between 2000 and 2002, releases decreased from 109.5 g TEQ to 92.5 g TEQ, while the number of reporting facilities increased from 300 to 345, respectively.
- Metal producers do not have a quantitative threshold for reporting—all facilities that use or engage in activities that have the potential to incidentally manufacture dioxins and furans must submit an NPRI report.
- In 2002, the sectors emitting the greatest quantities of dioxins and furans were primary metal manufacturing, electricity generation and waste management.

Figure 3.12: On-site releases to air, water and soil of hexachlorobenzene reported in the NPRI for Canada, 2000–2002



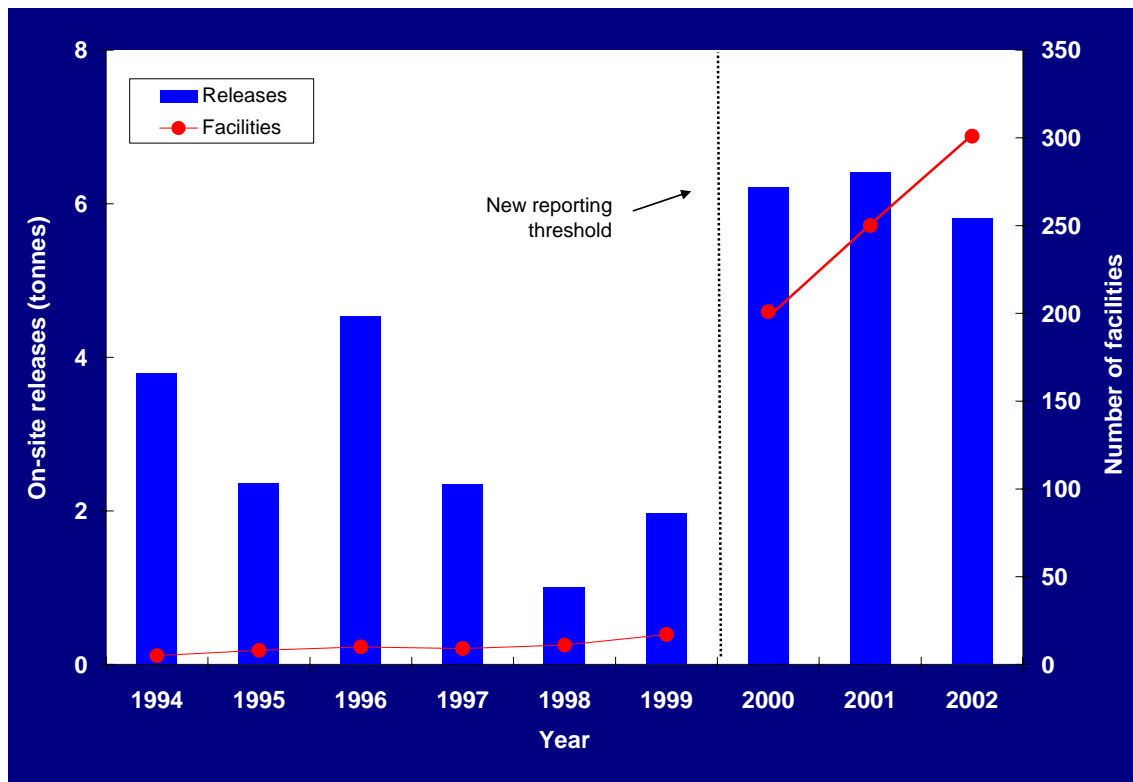
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal.

Key Observations:

- Between 2000 and 2002, total releases of HCB increased from 0.037 tonnes to 0.045 tonnes and the number of reporting facilities increased from 299 to 336, representing a 20% increase in total on-site releases and a 14% increase in reporting facilities.
- The reporting of HCB releases does not have a quantitative threshold, but is based on specific activities. Any facility that uses or engages in specified fuel combustion, metal smelting, production and waste incineration-based activities that have the potential to incidentally manufacture HCB must submit an NPRI report.
- In 2002, the sectors that reported the largest amount of HCB releases were electric power generation, metal manufacturing, and mining and smelting. Typically, HCB is a by-product of chemical manufacturing, wood preservation plants and waste combustion.

Figure 3.13: On-site releases to air, water and soil of mercury and its compounds reported in the NPRI for Canada, 1994–2002



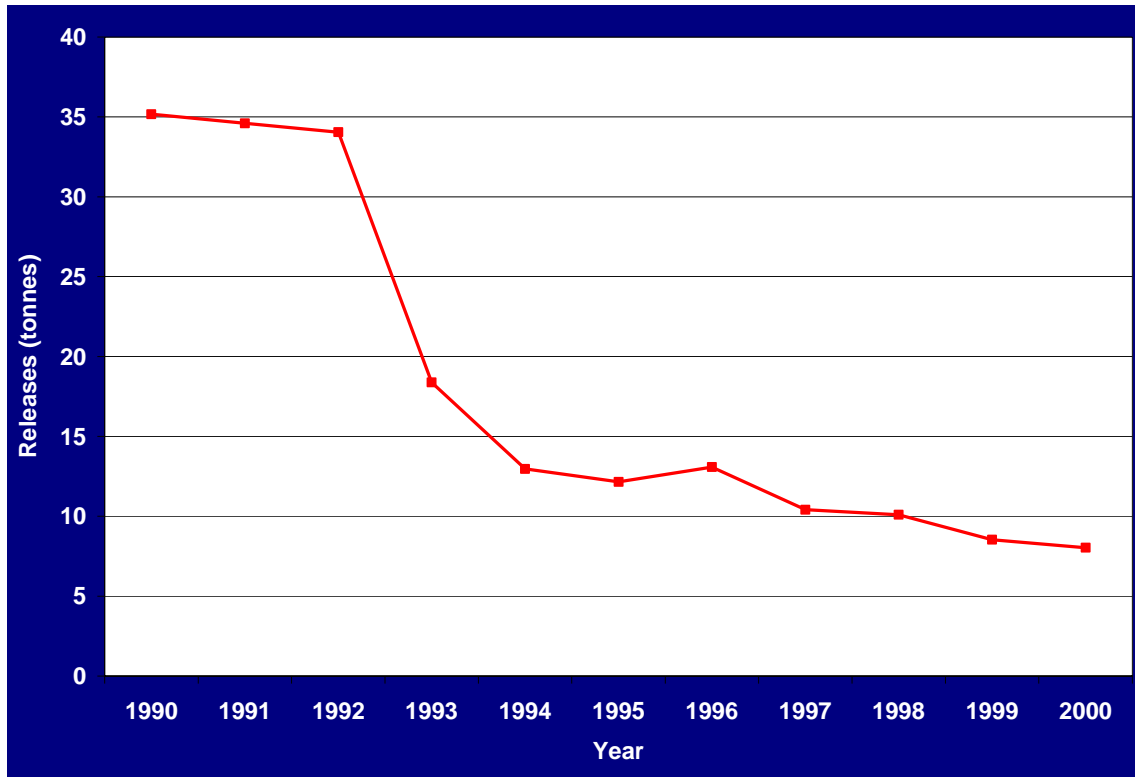
Source: National Pollutant Release Inventory, Environment Canada

Notes: On-site releases to air include stack and point emissions; releases to water include water discharges; and releases to land include fill and treatment. These numbers do not include spills, leaks and fugitive emissions, nor do they include underground injection or off-site transfers for recycling or disposal.

Key Observations:

- In 2000, mercury releases increased dramatically to 6.2 tonnes, decreasing slightly to 5.8 tonnes in 2002. This overall increase is due to a reduction in reporting threshold, from 10 tonnes to 5 kg.
- As a result of the change in reporting threshold, the number of reporting facilities increased from 5 in 1994 to 308 in 2002. In 2002, 5.4 tonnes (93% of total on-site releases) were air releases.
- The sectors that emitted the greatest quantity of mercury were electrical power generation and base metal smelting.

Figure 3.14: Total atmospheric releases of mercury in Canada, 1990–2000



Source: Environment Canada (2003b)

Key Observations:

- Mercury emissions to air saw an overall decrease of 77% from 1990 to 2000.
- Emissions were reduced primarily from incineration operations, as well as the steel and primary base metal sectors. However, emissions from electric power generators increased over this time period.

Mercury levels in fish

Fish consumption is an important source of mercury exposure. Consumption of shark, swordfish and fresh and frozen tuna should be restricted to one meal per week. For young children, pregnant women and women of child-bearing age, consumption should be limited to one meal per month.

For more information on fish consumption and mercury, consult:

<http://www.inspection.gc.ca/english/corpaffr/foodfacts/mercurye.shtml>

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

New substances, which include chemicals, polymers and products of biotechnology, are assessed before their release into the marketplace. However, all the substances monitored by Canada's NPRI are existing substances rather than new substances. An existing substance is one that has been or is currently used in Canada as a commercial substance or product or is released into the Canadian environment on its own or as an effluent, mixture or contaminant. Toxic substances come from many industrial and household sources. CEPA 1999 provides for the assessment and management of substances that can enter into the Canadian environment. Under Section 64 of CEPA 1999, a substance is defined as "toxic" if it enters or may enter the environment in amounts or under conditions that may pose a risk to human life or health, to the environment or its biological diversity or to the environment on which life depends. Sixty-eight

substances are defined as “toxic” by CEPA 1999. These substances can be harmful to the environment, aquatic life, endangered species and human health (Environment Canada, 2004).

All eight substances reported in these two indicators have been listed as “toxic” under CEPA 1999. These substances are subject to various risk management measures, thereby reducing or eliminating risks to human health and the environment posed by their use and/or release. The Toxics Management Process is the consultative approach taken to develop management tools for substances determined to be toxic under CEPA 1999. Under this process, Environment Canada and Health Canada prepare a risk management strategy, which outlines the proposed approach for reducing risks to human health or the environment posed by a substance found toxic under the Act. For more information on risk management measures for each substance, see the indicator template in Appendix 3.

Opportunities for Improvement:

PRTR indicators could be improved by providing a more complete picture of total emissions to the environment. Comprehensive inventories, as were done for atmospheric releases of mercury and lead, are also extremely useful for estimating the total releases to the environment, by including sources not covered under the NPRI—which may constitute the main sources of emissions for some substances (e.g., motor vehicle emissions for benzene).

Similarly, only facilities meeting the reporting requirements are required to report to the NPRI. Recent changes to reporting thresholds do, however, increase the number of facilities reporting annual releases. For many substances, scientific evidence shows that adverse health effects are associated with very low levels of exposure (especially *in utero*). Furthermore, many of the substances of concern to children’s health are non-threshold toxicants—in other words, there are no “safe” levels of exposure (e.g., lead). Reporting thresholds should be lowered to reflect the risk associated with low levels of exposure.

Additional indicators that could be appropriate to use in this area are actual levels of these chemicals in ambient air, water, soil and food, which would give a better indication of the fate of those chemicals in the environment and sources of human exposure. They would also indicate whether the chemical load to the environment is increasing or decreasing over time. Another approach to presenting the data would be to report geographically (i.e., using geographic information systems) by representing communities that may be more at risk than others, based on the type and amount of substances emitted locally.

The best indicator of children’s exposure to specific chemicals would be biomonitoring data (e.g., levels of chemicals in urine, blood, etc.). Biomonitoring data provide a measure of the current body burden of a chemical in an individual.

CASE STUDY

Northern Aboriginal people in Canada

The Northern Contaminants Program was established in Canada in 1991 in response to concerns about human exposure to elevated levels of contaminants in fish and wildlife species that are important to the traditional diets of northern Aboriginal people in Canada. The primary contaminants of concern in the context of traditional/country food consumption in Arctic Canada are the persistent organic pollutants (POPs), including polychlorinated biphenyls (PCBs), chlordane and toxaphene, the toxic metal mercury and naturally occurring radionuclides.

The Northern Contaminants Program found that Inuit mothers had oxychlordane and trans-nonachlor levels in maternal/cord blood that are 6–12 times higher than levels in Caucasians, Dene and Métis, or other mothers. Similar patterns were observed for PCBs, HCB, mirex and toxaphene. Recent research has also revealed significantly higher levels of mercury in maternal blood of Inuit women, when compared with other mothers.

Most health risk uncertainty related to the presence of contaminants in the Arctic food chain is due to methylmercury and POPs. One of the research priorities of the Northern Contaminants Program is to study prenatal exposure to environmental chemicals and adverse developmental effects on immune system and nervous system function early in life. Neurobehavioural and immune function effects of prenatal exposure to environmental chemicals are being studied in prospective longitudinal cohort studies starting during pregnancy (Van Oostdam et al., 2003).

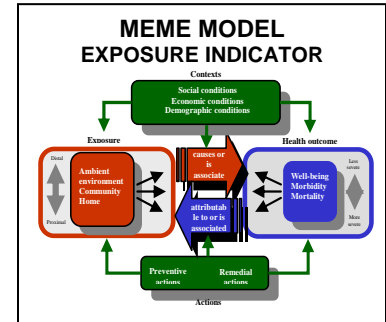
3.4 Pesticides

Indicator 8: Pesticides

Issue, Context and Relevance of the Indicator:

Recent advances in scientific understanding reaffirm that children are not “little adults” and that they have unique vulnerabilities to the potential health effects of pesticides. Two elements distinguish infants and children from the adult population:

- 1) Biological considerations. The developing fetus, infants and children are in a state of rapid growth, with cells dividing and organ systems developing. Some organ systems mature in early childhood, and others are not fully developed until adulthood. Children have a higher ratio of skin surface area to body weight than adults, and, on a weight for weight basis, children eat more food, drink more water and breathe more air than adults. As a result of these biological differences, children may absorb, metabolize and excrete chemicals differently from adults, potentially resulting in differing levels of susceptibility to chemical hazards.
- 2) Unique exposures. In addition to exposure through minute residues that may remain on some food, such as fruits and vegetables, children may be exposed to pesticide residues in breast milk, in formula, through skin contact with treated surfaces while crawling and playing and through incidental ingestion from behaviours such as hand-to-mouth transfer (PMRA, 2002).



Estimates of exposure from food are derived from two distinct pieces of information: the amount of a pesticide residue that is present in and on food (i.e., the residue level) and the types and amounts of foods that people eat (i.e., food consumption) (PMRA, 2003).

Pesticide residues can occur in or on food. Residue levels are determined based on a number of sources of information, including crop field trials and monitoring programs, use information, and commercial and consumer practice information, such as washing, cooking, processing and peeling practices.

The Canadian Food Inspection Agency (CFIA) is responsible for monitoring domestic and imported foods and carrying out enforcement actions to prevent the sale of food containing excessive residues.

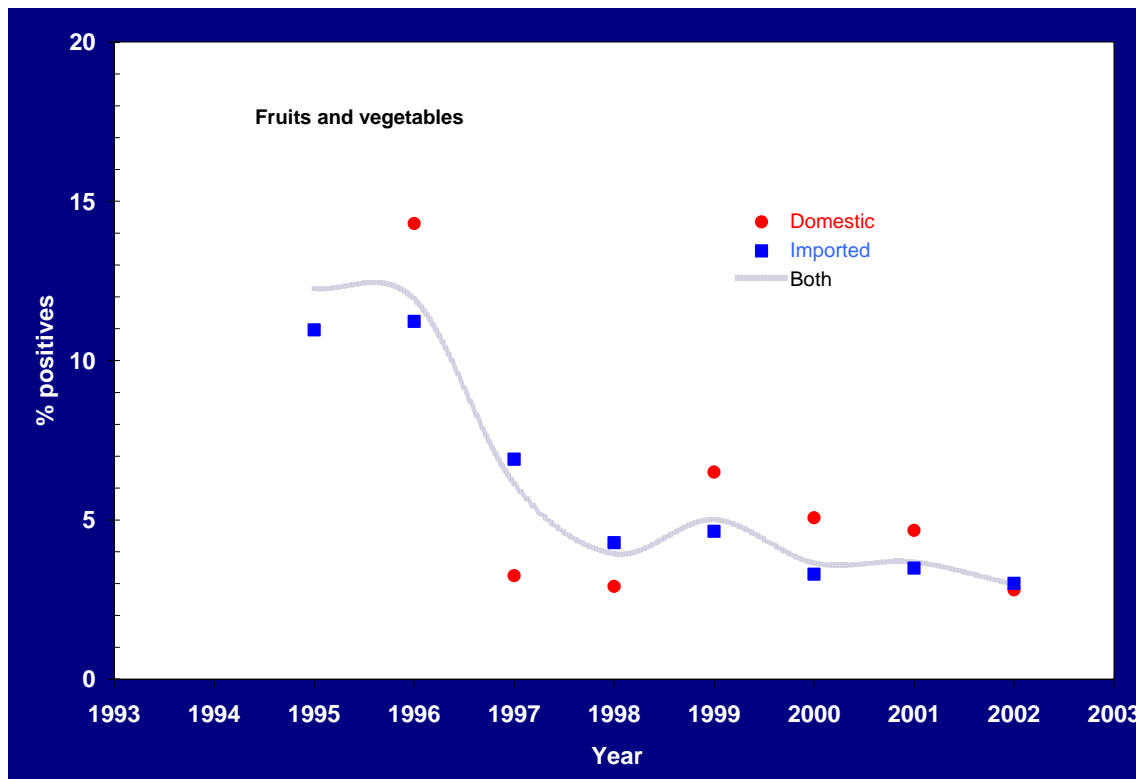
Indicator—Status and Trends:

This indicator reports the yearly number of organophosphate (OP) pesticides detected on domestic and imported fruits and vegetables, expressed as a percentage of sample size (Figure 3.15). This indicator is a weak surrogate of children’s exposure to pesticides in foods because of the uncertainty inherent in the scope of the monitoring program:

- The CFIA residue monitoring program is optimized for enforcement purposes, not specifically for children’s exposure.
- The number of OP pesticides entering the market and the time and size of samples are not uniform over the years.

Detection of low levels of residues does not necessarily represent a risk. Risk is assessed by comparing total exposure to a pesticide or group of pesticides with the toxicity profile of the pesticide(s) involved.

Figure 3.15: Percentage of sampled fresh fruits and vegetables with detectable organophosphate pesticide residues, Canada, 1995–2002



Source: Canadian Food Inspection Agency, Chemical Residue Annual Reports 1994–1998 and 2001–2002

Key Observations:

- Over a several-year period, the percentage of fresh fruits and vegetables with detectable OP pesticide residues has decreased, suggesting reduced exposure from this source.

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

Health Canada’s Pest Management Regulatory Agency (PMRA) is the federal agency responsible for the regulation of pest control products in Canada. The PMRA also develops pest management policies and guidelines, promotes sustainable pest management, looks to improve the regulatory process to increase efficiency, enforces compliance with the legislation and distributes pest management information to the general public and key stakeholders.

Health Canada has codified special considerations of children and vulnerable populations in the new *Pest Control Products Act*. Child-protective health risk assessments are conducted for children, based on foods that children consume and anticipated residues. The unique food consumption patterns of infants and children, including breast milk, formula and fruit juice, are used in the risk assessment. It is important to recognize that many factors influence risk to children, and detection of residues on foods does not necessarily represent a risk.

When assessing risks from pesticide residues in food, additional safety factors for infants and children are applied where warranted. This is to ensure protection of vulnerable subpopulations. Available information on aggregate exposure from a single pesticide is considered. This includes exposure through dietary and drinking water sources and other non-occupational exposures such

as arise from use of pesticides in and around homes. Available information on cumulative effects of pesticides with a common mechanism of toxicity is considered. The CFIA is responsible for monitoring the food supply and enforcing the specific maximum residue limits for all Canadian foods, whether domestic or imported products.

Opportunities for Improvement:

Biomonitoring data, measuring the levels of pesticides and their metabolites in urine, are the best indicators of children's exposure to pesticides. In order for biomonitoring results to be meaningful, it is critical that they be collected using appropriate study design and sampling methodology.

The PMRA will soon implement a mandatory adverse effect reporting system for pesticides for Canada and anticipates that age-related information may be available by 2008.

What You Can Do

For more information on the consideration of children in the regulation of pesticides, visit Children's Health Priorities within PMRA at:
<http://www.pmra-arla.gc.ca/english/pdf/spn/spn2002-01-e.pdf>

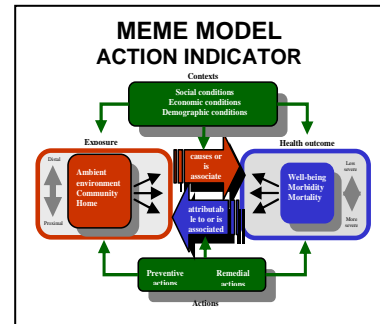
4 Waterborne Diseases

4.1 Drinking Water

Indicator 9: Percentage of children (households) without access to treated water

This information is currently not available in Canada.

The percentage of children served with treated water is not available in Canada. Canada is reporting the percentage of Canadians not connected to public water distribution systems. This information is not meant to indicate that the risks associated with private water supplies are necessarily higher—they are less well known on a national basis. As such, the information provided below is intended to highlight an important information gap.



Issue, Context and Relevance of the Indicator:

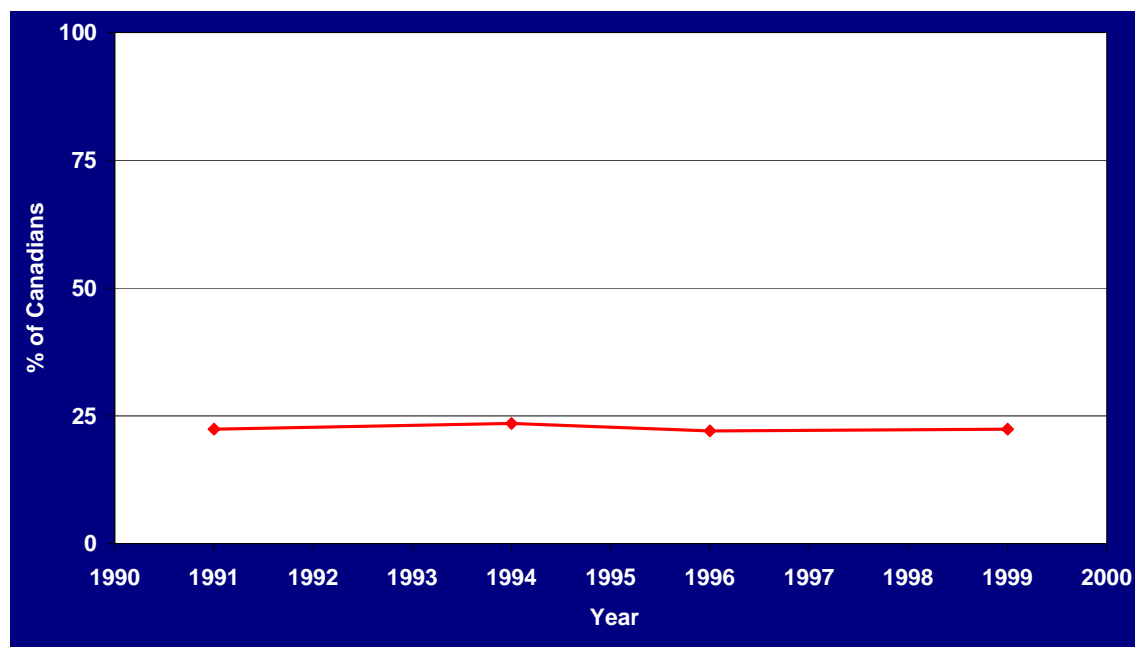
Access to clean water is critical for reducing the risk of exposure to waterborne pathogens to a minimum. Most centralized water distribution systems in Canada are equipped with filtration and disinfection processes (e.g., chlorination, ozonation) designed to kill bacteria and other pathogens that may be present in source water (either surface water or groundwater). Most of these distribution systems are also equipped with water treatment processes that may improve the taste and odour of the water and reduce the concentration of various chemicals in the water.

In 1999, it is estimated that 23.7 million Canadians were on public distribution systems, while 6.8 million depended on private supplies, mostly groundwater wells (Municipal Water Use Database survey, Environment Canada). There is no national program for tracking how many private wells have water treatment or disinfection systems and how many are subject to contamination. However, according to various surveys, nitrates and bacteria represent by far the most common well water contaminants in Canada. It is estimated that 20–40% of all rural wells have nitrate concentrations or coliform bacteria occurrences in excess of drinking water guidelines (Van der Kamp and Grove, 2001). Specifically, studies in Saskatchewan and Ontario have found that roughly 30–35% of surveyed wells exceeded drinking water guidelines for bacteria, while approximately 8% of wells in Alberta exceeded those guidelines (Rudolph and Goss, 1993; Fitzgerald et al., 1997; Sketchell and Shaheen, 2001). Ninety-two percent of private wells in Alberta and 99% in Saskatchewan exceeded Canadian guidelines for one or more health and aesthetic parameters (i.e., those that affect taste and/or odour, stain clothes and encrust or damage plumbing) (Corkal, 2003). Groundwater contamination may come from a variety of sources, including manure storage and application, septic systems, accidental spills and pesticide application.

Indicator—Status and Trends:

This indicator presents the percentage of Canadians not connected to public water distribution systems in their homes (Figure 4.1). The percentage of children without access to treated water could not be derived for Canada at this time. The indicator is based on surveys conducted every 2–3 years (Municipal Water Use Database survey, Environment Canada). These surveys include municipalities with populations of over 1000, which covered about 25.4 million Canadians or 83% of the total population in 1999. Canadians not covered by the survey, those living in small rural municipalities, are expected to be mostly served by private individual water supplies, such as groundwater wells. It is assumed that Canadians on public distribution systems have a very low risk of being exposed to waterborne diseases unless there is a failure in technology or management of the water distribution system, which, despite best efforts, occasionally occurs. Of the Canadians served by public water distribution systems, only 1.8% were without centralized disinfection in 1999 and relied almost entirely on groundwater for their drinking water supplies.

Figure 4.1: Percentage of Canadians not connected to public water distribution systems, 1991, 1994, 1996 and 1999



Source: Municipal Water Use Database, Environment Canada (consulted December 2003); and Statistics Canada (consulted December 2003) (for total population)

Note: It is assumed that most Canadians not surveyed by the Municipal Water Use Database survey, living in municipalities with a population below 1000, are served by private water systems, mostly groundwater wells.

Key Observations:

- The percentage of Canadians with access, in their home, to water obtained from a private individual source has remained constant at about 22–23% between 1991 and 1999. This represented about 6.8 million Canadians in 1999.
- Canadians not connected to public water distribution systems live mostly in rural areas. Nationally, it is not known how many people have wells that are subject to contamination or how many treat or disinfect their water before consumption

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

The division of responsibilities for managing water in Canada is complex, and responsibilities are often shared among federal, territorial and provincial governments. Overall, provincial governments are responsible for long-term as well as day-to-day management of water resources. Recently, Canada's territorial governments have been acquiring more and more provincial-like responsibilities for water.

Provincial governments have developed a substantial range of policies, regulations, strategies and frameworks to enhance the safety of drinking water supplies. The priorities and specific approaches may vary according to the management needs and specific circumstances of individual jurisdictions.

There are many issues shared by all jurisdictions in Canada that benefit from collaborative approaches. For example, federal, provincial and territorial health and environment departments

have developed a comprehensive source-to-tap approach to protecting water quality, which includes watershed management.

The multiple-barrier approach to protecting drinking water looks at all components of a drinking water system and identifies safeguards needed to provide safe drinking water. The components include source water protection, drinking water treatment and distribution systems. The safeguards include management, monitoring, research, science and technology development, guidelines, standards and objectives, legislative and policy frameworks, and public involvement and awareness. The elements of a successful drinking water program can include state-of-the-art facilities, operation certification, an effective compliance assurance program with emergency response protocols and measures to ensure public confidence.

The protection of source water is the critical first barrier in the multiple-barrier approach to protecting drinking water. This extends beyond controlling individual sources of contamination to address problems and solutions on a regional or watershed basis. Many provincial and territorial jurisdictions, as well as local governments, are already managing water quality programs with a watershed approach (adapted from Government of Canada, 2003b).

What You Can Do

For more information on water quality and health, see:
<http://www.hc-sc.gc.ca/waterquality>

Opportunities for Improvement:

An improvement to this indicator would be to reflect the population of children with access to public water distribution systems, as opposed to the overall Canadian population.

This indicator is not a direct measure of water quality, nor does it reflect improvements or failure in drinking water management and technology. More detailed surveys in future are expected to allow the reporting of population serviced by technology type (disinfection, filtration type) and general plant performance. This indicator does not provide information on a relatively large segment of the total population (around 17%), mostly in rural areas, which may be more at risk from untreated groundwater sources. Nationally collected data on the extent and type of well water contamination would improve our ability to track the extent to which Canadians may be exposed to pathogens and harmful chemicals.

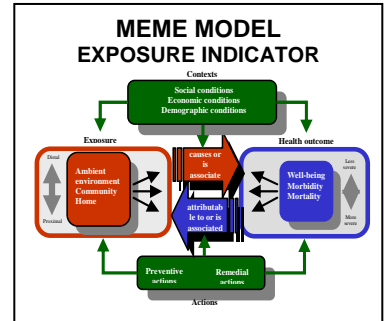
Indicator 10: Percentage of children living in areas served by public water systems in violation of local standards

This information is currently not available in Canada.

One method of tracking whether drinking water poses a potential risk to health is to report on the percentage of children served by drinking water systems in violation of local standards. In Canada, a violation of drinking water standards does not necessarily mean that drinking water from a system is unsafe—it indicates that on at least one occasion, a water quality standard has been exceeded. These range from aesthetic measures, such as taste and odour, to the measurement of the presence of health-related contaminants.

In Canada, drinking water quality data and adverse water quality incidences are requested from municipal systems and collected by the provinces. This information is not available from a national perspective. In all provinces, a number of safeguards are in place to deal with these violations, such as boil water advisories when the equipment fails or when *Escherichia coli* or other fecal coliforms are detected. Canada has no comprehensive national data on boil water advisories.

In order to report on this indicator in the future, detailed analysis of water quality data in each province would be required to generate comparable data on a national level. Such analysis could begin with a selected number of specific water quality standards that are of particular concern to children’s health (e.g., certain bacteriological standards, chlorinated disinfection by-products, nitrates, etc.).



4.2 Sanitation

Indicator 11: Percentage of children (households) that are not served with sanitary sewers

This information is currently not available in Canada.

The percentage of children that are not serviced by centralized sewage treatment is not available in Canada. Canada is reporting the percentage of Canadians on sewers with or without treatment and the percentage on sewers with secondary or tertiary sewage treatment.

Issue, Context and Relevance of the Indicator:

Sanitary sewage, especially when it is not disinfected, can be an important source of pathogens to receiving water bodies. This presents a potential risk for children engaged in aquatic recreational activities or drinking untreated water in the area of influence of an outfall. A further threat includes the contamination of shellfish harvesting areas. A number of toxic substances can also be released with municipal sewage, posing an additional threat to children's health. Poorly managed municipal sewage remains one of the biggest threats to water quality (Environment Canada, 2001).

The quality of municipal sewage effluents is dependent on what goes into the collection system and the specific equipment and processes used for treatment. Secondary treatment using biological or physicochemical processes generally exhibits better performance than primary treatment (using screening and settling only) for reducing the loadings of a number of substances found in sewage. Tertiary or advanced treatment can be used to further reduce specific substances, such as phosphorus or nitrogen. All forms of treatment can be equipped with disinfection processes (e.g., chlorination/dechlorination, ozonation and ultraviolet radiation) to reduce or eliminate the presence of pathogens in the effluent.

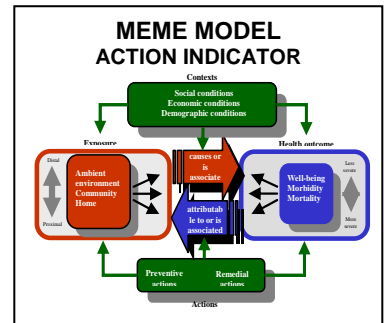
In Canada, municipalities and Government departments conduct routine monitoring of bacterial counts at most beaches and shellfish harvesting areas throughout the applicable parts of the year and following events that may result in water contamination (e.g., rainfall). Fecal coliform or *E. coli* counts are typically used as indicators of the presence of pathogens (e.g., viruses and protozoan parasites) in the water. Shellfish harvesting and beach closures can occur temporarily when bacterial counts exceed the established guidelines. In 1999, 3115 km² of shellfish growing areas in British Columbia and the Atlantic provinces were closed due to bacterial contamination from municipal wastewaters and a number of other sources (Environment Canada, 1999a; Menon, 2000). In Quebec, of the 196 shellfish zones evaluated in 1999, 58% were permanently closed and 11% were closed between June 1 and September 30 (Environment Canada, 1999b). Beach closure data are not collected nationally; however, beach closures can occur frequently in some areas.

It should be noted that bacterial counts are not a perfect measure of the presence of pathogens in the water but are much more cost-effective than directly trying to identify pathogens. Furthermore, results from bacterial counts typically take a day or two to be known, resulting in potential exposure before action is taken.

As most Canadians are serviced by either municipal sewer systems or private septic systems, direct contact with or exposure to human wastes around households is not thought to be a major problem in Canada.

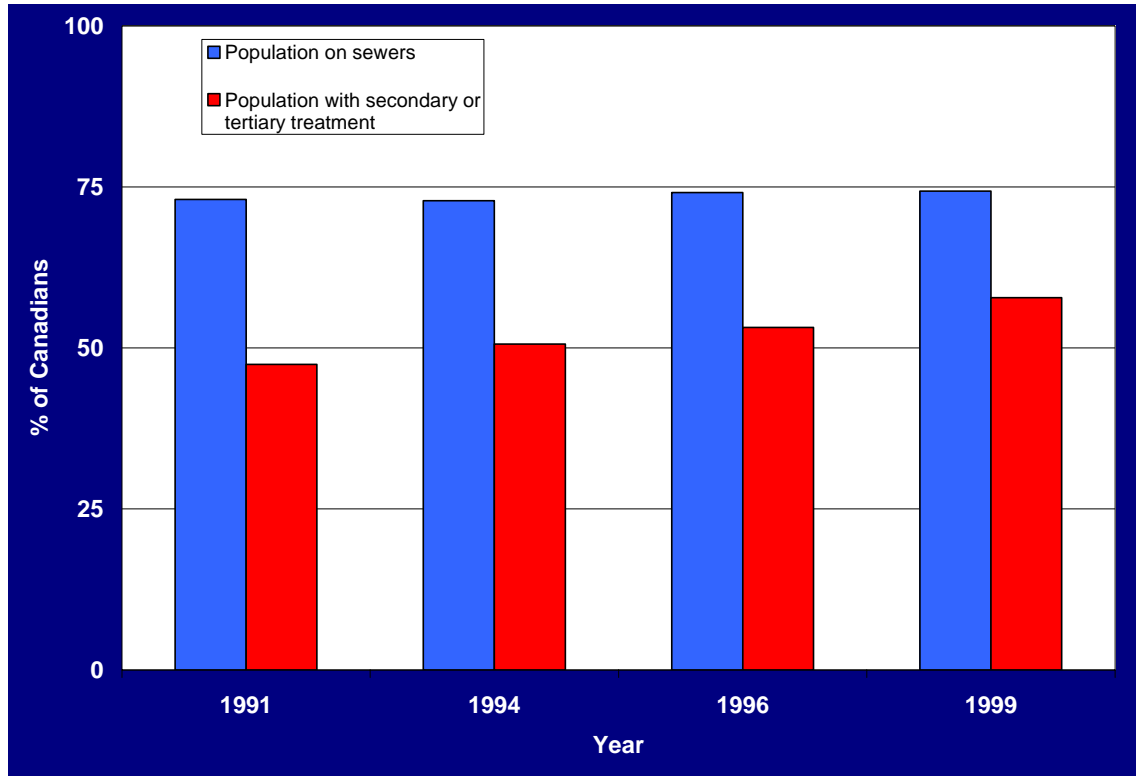
Indicator—Status and Trends:

This indicator presents the percentage of Canadians on sewers with or without treatment and the percentage on sewers with secondary or tertiary sewage treatment (Figure 4.2). The indicator is based on surveys conducted every 2–3 years (Municipal Water Use Database survey,



Environment Canada). These surveys include municipalities with populations of over 1000, which covered about 25.4 million Canadians or 83% of the total population in 1999.

Figure 4.2: Percentage of Canadians on sewers and those with secondary or tertiary sewage treatment, 1991, 1994, 1996 and 1999



Source: The Municipal Water Use Database, Environment Canada

Note: It is assumed that most Canadians not surveyed by the Municipal Water Use Database survey, living in municipalities with a population below 1000, are serviced by on-site treatment, such as septic tanks.

Key Observations:

- In 1999, 22.7 million Canadians (or 74% of the total population), living mostly in urban areas, were serviced by municipal sewer systems. This level has remained relatively constant throughout the 1990s.
- The remaining Canadians not serviced by sewage collection systems, about 7.8 million people, were generally served by private septic tanks, which are routinely pumped out and trucked to communal treatment facilities. When not properly installed and maintained, septic systems have the potential to contaminate nearby water bodies and groundwater sources.
- The percentage of urban Canadians served by secondary sewage treatment or better increased from 48% to 58% between 1991 and 1999. This increase largely reflects infrastructure upgrades. A higher proportion of Canadians living in coastal areas were served by lower levels of treatment (primary or none).
- About 70% of Canadians served by sewage collection systems in 1999 had effluent disinfection.

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

In Canada, responsibility for the collection and treatment of municipal wastewater, the administration and performance of wastewater facilities and the control of environmental and health impacts of municipal wastewater is shared across all levels of government.

Municipal governments have the most direct responsibility for wastewater, by having the statutory mandate to provide sewage treatment. Municipalities also have the power, usually through a provincial/territorial municipal act, to control discharges into the sewer systems. Many municipalities have taken advantage of these powers to pass sewer use by-laws that are meant to reduce the toxicity of the effluents and establish source control. For example, the Regional Municipality of Ottawa-Carleton is active in reducing or eliminating toxic inputs to its treatment systems through the Industrial Waste Sewer Use Control Program. All industrial, institutional and commercial facilities that discharge non-domestic wastewater or have their liquid waste hauled to the wastewater treatment plant are required to comply with the Sewer Use By-law, which sets limits for various pollutants being discharged into sewers.

The provincial/territorial governments are primarily responsible for the regulation of municipal sewage treatment operations, and most provinces/territories maintain legislative control through waste control statutes that apply directly to sewage effluent. Operators of wastewater systems are required to seek approval from their provincial/territorial governments, and these provincial/territorial permits or licences may specify maintenance and treatment requirements on top of what is already stipulated in regulations. The approvals may also contain specific limits on the discharge of effluents. For example, British Columbia's *Waste Management Act* requires all municipalities to have a provincially approved Liquid Waste Management Plan. Discharges without such a plan are illegal in this province. The provinces/territories also generally have cost-sharing agreements with the municipalities for sewage-related infrastructure projects.

Currently, there is no federal legislation directly governing the deposit of harmful substances by municipalities into their wastewater. There are two acts, however, that do have the potential to apply to municipal wastewater. The *Fisheries Act* is enforced federally by both Fisheries and Oceans Canada and Environment Canada and addresses a general prohibition against the release of a "deleterious substance" into waters frequented by fish. CEPA 1999 governs the release of toxic substances to the environment and allows the federal government to create regulations to control or eliminate the use of such substances.

Private industry, research and educational institutions, conservation authorities and individual Canadians also have an important influence on decisions concerning wastewater management. Actions by all of these groups have ensured that the standard of wastewater management in Canada compares well with that of any other country. However, municipal wastewater is still a major contributor to the degradation of aquatic habitat, the fouling of recreational waters, the contamination of shellfish growing areas and other environmental and health concerns (Environment Canada, 2001).

Opportunities for Improvement:

New surveys being conducted will help better determine the treatment and disinfection technologies used by municipalities and provide better measures of their performance for removing wastes. Current data collection at a national level does not permit us to evaluate how many people have private septic systems that pose a risk for drinking water sources, shellfish harvesting or recreational waters. Information on the number and extent of sewage bypasses at treatment plants, as well as the number of plants violating provincial discharge regulations, would also improve existing survey information and provide an indication of how well treatment plants are managed.

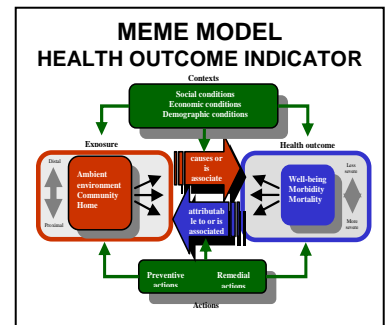
4.3 Waterborne Diseases

Indicator 12: Morbidity: number of cases of childhood illnesses attributed to waterborne diseases

Issue, Context and Relevance of the Indicator:

Recent outbreaks of waterborne diseases in Walkerton, Ontario, and North Battleford, Saskatchewan, have heightened Canadian awareness of the fact that threats to water quality and quantity can have a profound impact on their health, the environment and the economy.

The risk of microbial disease associated with drinking water is a concern among North American water jurisdictions. Numerous past outbreaks, together with recent studies suggesting that drinking water may be a substantial contributor to endemic (non-outbreak-related) gastroenteritis, demonstrate the vulnerability of many North American cities to waterborne diseases. These findings have fuelled debates in Canada and the United States and highlight the need for stricter water quality guidelines, changes in watershed management policies and additional water treatment (Lim et al., 2002).



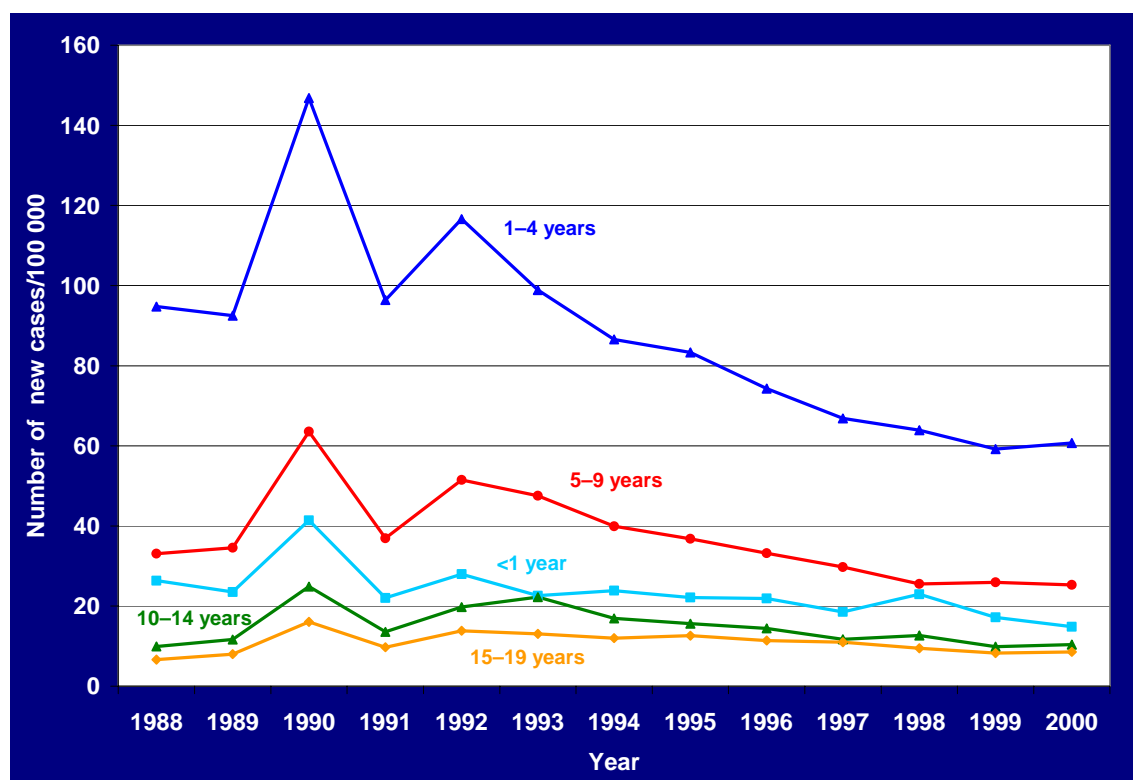
Enteric, foodborne and waterborne diseases are caused by a variety of microorganisms. Infections usually result when the microorganism enters the body through the mouth, either by the consumption of contaminated food (foodborne) or water (waterborne) or via contaminated fingers or objects. Waterborne diseases are those infections due to contaminated water. Given multiple causes of enteric diseases and common symptoms, it is difficult to determine the source of the pathogen (foodborne, waterborne). Giardiasis, sometimes called “beaver fever,” is an intestinal parasitic infection characterized by chronic diarrhea and other symptoms. Giardiasis may be foodborne, but transmission is common where personal hygiene may be poor. Community outbreaks may occur by ingesting *Giardia* cysts from fecally contaminated food or unfiltered water. Persons with acquired immunodeficiency syndrome (AIDS) may have more severe and prolonged illness.

Cases are not reported to the Notifiable Diseases Registry until the individual seeks assistance in the primary care system and the primary care provider reports information to the provincial/territorial health unit. Public health scientists acknowledge that these illnesses are far more common than the reported numbers suggest. Estimates from studies in North America and Europe indicate that as few as 1–10% of cases are reported. This may, in part, reflect the mild nature of many infections, which are managed at home, or the fact that only a small proportion of patients have specimens taken for laboratory tests (Government of Canada, 1999). Limitations of the registry include underreporting, timeliness of reporting, disease case definitions and passive surveillance.

Indicator—Status and Trends:

In Canada, morbidity related to waterborne diseases is tracked in the national Notifiable Diseases Registry. Data are available for giardiasis from 1983 to 2000, which are the years in which this disease was reportable. The indicator is the incidence of giardiasis (number of new cases per 100 000 population) in the Canadian population aged 19 and under from 1988 to 2000 (Figure 4.3).

Figure 4.3: Incidence of giardiasis among children, by age group, Canada, 1988–2000



Source: Notifiable Diseases Registry, Health Canada

Key Observations:

- The number of new cases of giardiasis in Canada has been declining since 1988 (with the exception of the age groups 10–14 and 15–19, which showed a slight increase).
- Children aged 1–4 are most likely to be infected with *Giardia* compared with the rest of the population. In 2000, the incidence of giardiasis among children aged 1–4 years was 60 cases per 100 000. This may be because they are more likely to be brought to a primary care provider, less likely to be breastfed, more vulnerable to infection than older children and also more likely to ingest contaminated recreational water while playing in warm weather.

For more information, see the indicator template in Appendix 3.

Legislative and Policy Framework:

While no program specifically targets children, the Federal–Provincial–Territorial Committee on Drinking Water—which represents government departments with interests in drinking water quality (usually health and environment) at the federal, provincial and territorial levels—has developed a guidance document for managing drinking water supplies in Canada (Health Canada, 1996).

Opportunities for Improvement:

Further studies would have to be done to link cases with their etiology in order to determine the proportion of reported cases of giardiasis caused by waterborne infection. Other methodologies, such as household surveys and physician reporting, could be used to collect information on cases of giardiasis in Canada, in order to address underreporting in the national Notifiable Diseases Registry.

Indicator 13: Mortality: number of child deaths attributed to waterborne diseases

This indicator was recommended for inclusion in the indicators report by the CEC Steering Group. However, in subsequent work, Canada and the United States decided not to report on this indicator. Mortality rates attributed to waterborne diseases in Canada and the United States are very low and do not provide meaningful information on drinking water quality. Mexico, however, will be reporting on an indicator of cholera mortality rates and mortality rates for diarrheic diseases.

5 Recommendations and Conclusions

5.1 Recommendations for Improving Reporting on Indicators of Children's Health and the Environment in North America

There is an increasing body of epidemiological research linking exposures to environmental contaminants to child health outcomes. However, measuring the extent of those environmental exposures and the associated burden of disease in Canadian children requires appropriate environmental monitoring and health surveillance data. Furthermore, indicators need to be developed to adequately report and communicate this information.

Reporting on a limited number of indicators (13) selected by the CEC has proven to be a challenge for Canada—the most significant challenge being data availability at the national level. The approach taken for Canada's contribution to the first report on indicators of children's health and the environment in North America has been to collect existing data at the national level. In doing so, it became clear that opportunities exist for collecting data from provincial, territorial and municipal governments, as well as other organizations. This would provide for more comprehensive reporting in future reports. In keeping with Council Resolution 03-10, Canada is committed to the continuous improvement of indicators of children's health and the environment.

This section highlights lessons learned and puts forward some recommendations for generating informative and relevant indicators on the state of the Canadian environment as it influences children's health. Recommendations for improvement of specific indicators as well as, more generally, indicators in each of the MEME model indicator categories have been identified.

5.1.1 Recommendations by Indicator—Canada

Outdoor Air Quality (Indicator 1)

Many factors affect the levels of air pollutants across Canada, such as weather, topography, long-range transport of air pollutants and sources of emissions. Therefore, national averages of ambient levels of air pollutants may not provide the most accurate measure of air quality across Canada. Efforts need to continue in Canada in order to generate indicators of outdoor air quality that better incorporate children's population and their potential level of risk. In addition, future efforts could focus on generating indicators of local air quality to identify potential subpopulations of children, or geographic areas, that may be at increased risk of exposure to poor air quality—for example, children in certain high-industry regions or children living along major transportation corridors. In the future, generating indicators to measure both the long-term exposure of children to average levels of air pollutants as well as their exposure to peak air pollution events would provide better tools to track this important issue.

Indoor Air Quality and Second-hand Smoke (Indicator 2)

The Canadian Tobacco Use Monitoring Survey provides a good estimate of children's exposures to second-hand smoke at home. However, this survey is conducted in French and English and may miss families that are not able to speak either language. Given that new immigrants and refugees to Canada are arriving from countries where smoking may be endemic, a study on the exposure of children of newcomers to Canada to second-hand smoke would provide a broader understanding of the issue. Biomonitoring surveys of cotinine levels in Canadian children (levels in blood, urine or saliva) would also provide a more complete picture of children's exposure to second-hand smoke, including all sources of exposure—not just the home environment, but other

public places in which children live, learn and play. In addition, indicators for other parameters of indoor air quality could be developed—for example, mould in housing, VOCs from building materials and consumer products.

Prevalence of Asthma (Indicator 3)

The main issue is reliance on parents' reports of physician-diagnosed asthma and the concern over the reliability of this diagnosis. Canada is currently reviewing and developing national guidelines for the prevention and management of asthma among children. The new pediatric clinical practice guidelines will include recommendations on how to diagnose asthma. Use of these guidelines will increase the accuracy of physicians' diagnosis of asthma and hence parental reports of this diagnosis. Better indicators could be generated in the future by linking outdoor air quality indicators, especially episodes of poor air quality, with specific information on the associated health outcomes in children—for example, timing and occurrences of asthma attacks.

Exposure to Lead (Indicators 4 and 5)

Although Canadian health departments have conducted blood lead screenings on pregnant women and children for many years, there has been no national blood lead survey in Canada since 1978. There is a volume of blood lead data from children that has been collected in specific areas throughout Canada, generally by provincial health departments, municipalities or other groups in response to a potential exposure. It has been proposed that a compendium of these findings be developed to provide an overview of children's blood lead levels in Canada.

Biomonitoring surveys (i.e., measurement of blood lead levels) of pregnant women, infants and young children would provide a more complete understanding of children's exposures to lead at crucial points in their development. Biomonitoring surveys would allow the identification of subpopulations of children with potentially high blood lead levels and inform necessary health interventions. In addition, biomonitoring data would provide the information required to report on those subpopulations of children at higher risk. For example, blood lead levels could be linked to information on housing stock, hence improving the relevance of an indicator of "children living in homes with a potential source of lead."

Exposure of children to lead, as with many other toxic substances, is associated with persistent neurobehavioural effects, including cognitive deficits. Limited information exists in Canada on the prevalence of neurobehavioural disorders and learning disabilities. Better information on the health outcomes associated with lead exposure would allow better reporting on indicators on the effects of lead in children in Canada.

Pollutant Release and Transfer Register (PRTR) Data (Indicators 6 and 7)

In Canada, 274 substances are currently required to be reported to the NPRI. This inventory provides a wealth of information to citizens on which specific pollutants are released to air, water and land from facilities located in their communities, as well as the quantities sent to other facilities for disposal, treatment or recycling. This was Canada's first attempt at prioritizing a vast amount of pollutant release data from a children's health perspective. Future efforts could focus on selecting specific substances that are associated with adverse health effects in children and refining the reporting of PRTR data for those substances.

The use of PRTR data to generate informative indicators is only beginning. Trends in pollutant release can provide "action" indicators measuring the effectiveness of government and industry interventions to reduce pollutant releases to the environment. Analysis of PRTR data needs to be refined if it is to provide meaningful indicators of children's potential exposure to these substances. It is necessary to take into account the fact that the degree of human exposure is not necessarily proportional to the number of tonnes of pollutant released but depends on the environmental media (where the pollutant is released), its chemical behaviour and the routes of

exposure. Hence, the contribution of specific pollutant releases to ambient levels in outdoor air, concentrations in water and food contamination needs to be assessed. Another approach to presenting pollutant release data would be to report geographically by representing communities (and subpopulations of children) that may be more at risk than others, based on the type and amount of pollutants emitted locally.

The best indicator of exposure to specific chemicals would be the collection of biomonitoring data of children in Canada.

Pesticides (Indicator 8)

The best measure of the exposure of pregnant women, fetuses and children to pesticides would be biomonitoring data (i.e., levels of pesticides or their metabolites in blood, urine and breast milk).

The PMRA will soon commence a database of adverse effects from exposure to pesticides. In addition, measurement of multiple exposures and resulting body burdens would greatly enhance our understanding and reporting in this area. Health effects surveillance could provide additional information on the adverse health effects in children associated with pesticide exposure. Consolidating data from poison control centres across Canada for pesticide poisonings should be examined for potential use in the future.

Drinking Water Quality (Indicators 9 and 10)

A national picture of drinking water quality in Canada would require integration, streamlining and analysis of provincial data on boil water advisories and water treatment plant violations of water quality standards. In Canada, all of the drinking water quality data for public systems are collected and categorized differently across the provinces and territories, which means that they are not readily available from a national perspective. As a matter of priority, these data could be analyzed for specific parameters of water quality that are critical to children's health. In addition, there is no national system or program in Canada for reporting on the quality of water in private wells. This is an important area for improvement for future indicators, as bacteriological contamination of well water and high nitrate levels may be common in Canada and are of particular concern for children's health.

Sanitation (Indicator 11)

As most Canadians are serviced by either municipal sewer systems or private septic systems, direct contact with or exposure to human wastes around households is not thought to be a major problem in Canada. However, better reporting on the level of sanitary sewage treatment, on both public and private systems, is important, since protection of source water is the critical first barrier to protecting drinking water. In addition, poor sewage treatment presents a potential risk for children engaged in aquatic recreational activities (e.g., beach closures) and contributes to the contamination of shellfish harvesting areas. An indicator of sewage treatment level as it may impact children's health is an area for future development.

Waterborne Diseases (Indicators 12 and 13)

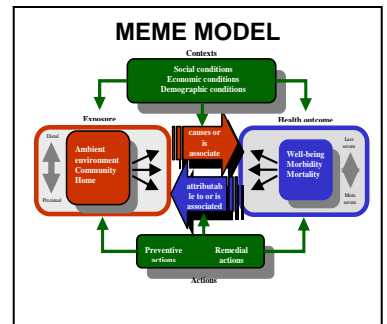
The Notifiable Diseases Registry captures outbreaks of waterborne diseases and diseases caused by identified organisms when infected individuals consult their primary care providers. Identifying the cause of each case of enteric disease in children would be a more effective way to identify the number of infections caused by contaminated water (as opposed to foodborne or fecal-oral route). Moreover, some people may not seek assistance from a primary care provider in response to their symptoms. Using data from the Notifiable Diseases Registry, therefore, underestimates the prevalence of waterborne diseases in Canada. Other methodologies, such as

household surveys, could be used to collect information on morbidity associated with waterborne diseases.

5.1.2 Recommendations by MEME Model Indicator Category

Improving “Exposure” Indicators

It is clear that there are many other known environmental threats to children's health that are not reported through this initial set of 13 indicators. Opportunities for improvements exist in developing additional indicators of exposure of children and pregnant women. Such indicators could address issues such as other parameters of indoor air quality, exposure to toxic substances through consumer products and exposure to chemical and bacteriological contaminants through food or water that are associated with adverse health effects in children. Occupational exposure of pregnant women to contaminants as well as the contribution of parental occupational exposure are also areas that deserve reporting.



Improving “Health Outcome” Indicators

Due to the inherent difficulty of linking an individual's exposure to a subsequent disorder or disease, especially with low-dose, long-term exposures to environmental contaminants and the contribution of various other determinants of health (genetic, lifestyle, socioeconomic factors), developing sound “health outcome” indicators presents health experts and other practitioners with enormous challenges. As such, public health surveillance systems need to continue to refine the tracking of waterborne diseases, pesticide poisonings, hospital admissions or cardiorespiratory illness related to air quality, learning and behavioural disabilities, childhood cancers, reproductive health outcomes, etc. This information is important for a better overall reporting of the environmental burden of disease in children and the health care costs associated with environmental exposures.

Improving “Action” Indicators

As governments and other stakeholders develop interventions to address threats to children's health in Canada, it becomes necessary to track the effectiveness of those interventions. Action indicators can be developed in each of the priority areas—outdoor and indoor air quality, exposure to lead and other toxic substances and water quality. A good set of “action” indicators would provide us with the signposts telling us whether we are on the right track for reducing the exposure of children to environmental contaminants and improving their health and well-being.

Improving “Context” Indicators

It is important to understand the socioeconomic context that affects children's exposure to environmental contaminants. Factors such as family income level, maternal education and geographic location (urban versus rural population) have already been identified and require further exploration.

In keeping with the state of the science on the influences of the environment on children's health, it is necessary to develop indicators on emerging issues—for example, endocrine disruptors and the impacts of climate change on children's health. In Canada, the climate is a very real part of our physical environment. Climate change, which leads to changing weather patterns and increased numbers of extreme weather events, is expected to have a negative impact on the health of vulnerable populations, particularly children. This negative impact includes health effects associated with increased smog episodes, heat and cold waves, waterborne and foodborne contamination, diseases transmitted by insects, stratospheric ozone depletion and extreme weather events (Health Canada, 2003b).

In addition, we know that some segments of our population are exposed to unacceptably high levels of environmental pollutants. This report contains case studies of research on subpopulations of children, such as First Nations and northern Aboriginal populations, that may be disproportionately affected by environmental contaminants. There is no such thing as a "national" child in Canada. In the future, indicators will be needed to better understand the unique local environmental conditions and diverse realities facing children across Canada.

5.2 Conclusions

Canada is committed to improving the reporting of indicators of children's health and the environment. A good set of indicators would allow us to translate large amounts of complex scientific information into understandable measures. The first North American report lays the foundation for such work and has allowed Canada to identify opportunities for improved data gathering and for indicator development. This lays a path forward to future comprehensive reporting on the state of the Canadian environment as it influences children's health and well-being.

For tips on what you can do to protect children's health and the environment, please consult the tip sheet included in Appendix 2, also available at:
http://www.hc-sc.gc.ca/hl-vs/pubs/child-enfant/child_safe-enfant_sain_e.html

References

- Briggs, D. (2003) *Making a Difference: Indicators to Improve Children's Environmental Health*. World Health Organization, Geneva. Available online at: <http://www.who.int/phe/children/childrenindicators/en/>
- Burnett, R.T., Dales, R.E., Raizenne, M.E., Krewski, D., Summer, P.W., Roberts, G.R., Raad-Young, M., Dann, T. and Brook, J. (1994) Effects of low ambient levels of ozone and sulfates on the frequency of respiratory admissions to Ontario hospitals. *Environ. Res.*, 65: 172–194.
- Burnett, R.T., Dales, R.E., Krewski, D., Vincent, R., Dann, T. and Brook, J.R. (1995) Associations between ambient air particulate sulfate and admissions to Ontario hospitals for cardiac and respiratory diseases. *Am. J. Epidemiol.*, 142(1): 15–22.
- Burnett, R.T., Brook, J.R., Cakmak, S. and Krewski, D. (1997) The role of particulate size and chemistry in the association between summertime ambient air pollution and hospitalization for cardiorespiratory diseases. *Environ. Health Perspect.*, 105: 614–620.
- Burnett, R.T., Cakmak, S. and Brook, J. (1998) The effect of the urban ambient air pollution mix on daily mortality rates in 11 Canadian cities. *Can. J. Public Health*, 89(3): 152–156.
- Burnett, R.T., Smith-Doiron, M. and Stieb, D. (1999) Effects of particulate and gaseous air pollution on cardiorespiratory hospitalizations. *Arch. Environ. Health*, 54(2): 130–139.
- Burnett, R.T., Smith-Doiron, M., Stieb, D., Raizenne, M., Brook, J., Dales, R.E., Leech, J.A. and Krewski, D. (2001) The association between ozone and hospitalization for acute respiratory diseases in children under the age of two years. *Am. J. Epidemiol.*, 153(5): 444–452.
- California Environmental Protection Agency (2004) *Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant. Part B—Health Assessment* (Scientific Review Panel review draft). Office of Environmental Health Hazard Assessment.
- Canadian Food Inspection Agency. *Chemical Residue Annual Reports 1994–1998 and 2001–2002*. Food Microbiology and Chemical Evaluation, Food Safety Directorate. Available online at: <http://www.inspection.gc.ca/english/fssa/microchem/resid/reside.shtml#resid>
- Canadian Institute for Health Information, Canadian Lung Association, Health Canada and Statistics Canada (2001) *Respiratory Disease in Canada*. Available online at: <http://www.phac-aspc.gc.ca/publicat/rdc-mrc01/index.html>
- CEC (2003) *Recommendations for the Development of Children's Health and the Environment Indicators in North America*. North American Commission for Environmental Cooperation Steering Group on Children's Health and Environment Indicators, CEC Secretariat, June 2, 2003. Available online at: http://www.cec.org/files/pdf/POLLUTANTS/CHE-Recommendations_en.pdf
- CICH (2000) *The Health of Canada's Children: A CICH Profile*. 3rd Edition. Canadian Institute of Child Health, Ottawa.
- Corkal, D. (2003) *Ensuring the Safety of Small Rural Water Systems*. Prairie Farm Rehabilitation Administration, Agriculture and Agri-Food Canada, Saskatoon.

- Davies, D.J.A., Thornton, I., Watt, J.M., Culbard, E.B., Darvey, P.G., Delves, H.T., Sherlock, J.C., Smart, G.A., Thomas, J.F.A. and Quinn, M.J. (1990) Lead intake and blood lead in two-year-old U.K. urban children. *Sci. Total Environ.*, 90: 13–29.
- Delfino, R.J., Murphy-Moulton, A.M., Becklake, M.R., Burnett, R.T. and Brook, J.R. (1997) Effects of ozone and particulate air pollution on emergency room visits for respiratory illnesses in Montreal. *Am. J. Respir. Crit. Care Med.*, 155: 568–576.
- DiFranza, J.R., Aligne, C.A. and Weitzman, M. (2004) Prenatal and postnatal environmental tobacco smoke exposure and children's health. *Pediatrics*, 113: 1007–1015.
- Environment Canada (1999a) *Shellfish Water Quality Protection Program on the West Coast of Canada*. Environment Canada, Pacific and Yukon Region. 5 pp.
- Environment Canada (1999b) *Recommandation de classification*. Shellfish Water Quality Protection Program, Environment Canada, Quebec Region.
- Environment Canada (1999c) *Mercury and the Environment*. Available online at: <http://www.ec.gc.ca/MERCURY/images/mercenv.pdf>
- Environment Canada (2001) *The State of Municipal Wastewater Effluents in Canada*. National Indicators and Assessment Office. 67 pp. Available online at: <http://www.ec.gc.ca/soer-ree/english/SOER/MWWE.cfm>
- Environment Canada (2002a) *Clean Air—What Is Smog?* Available online at: http://www.ec.gc.ca/cleanair-airpur/Smog-WS13D0EDAA-1_En.htm
- Environment Canada (2002b) *Clean Air—Particulate Matter (PM_{≤10})*. Available online at: http://www.ec.gc.ca/cleanair-airpur/PM-2.5,10-WS2C68B45C-1_En.htm
- Environment Canada (2003a) *Clear Air—Government of Canada Action on Clean Air*. Available online at: <http://www.ec.gc.ca/cleanair-airpur/>
- Environment Canada (2003b) *Environmental Signals, Canada's National Environmental Indicators Series 2003*. Available online at: http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm#pic
- Environment Canada (2004) *Overview of Existing Substances Program in Environment Canada*. Available online at: <http://www.ec.gc.ca/substances/ese/eng/overview.cfm>
- Etzel, R.A. (ed.) (2003) *Pediatric Environmental Health*. 2nd Edition. Committee on Environmental Health, American Academy of Pediatrics, Elk Grove Village, Illinois.
- Evans, G.W. and Kantrowitz, E. (2002) Socioeconomic status and health: the potential role of environmental risk exposure. *Annu. Rev. Public Health*, 23: 303–331.
- Fitzgerald, D.A., Kiely, D.A., Neilson, R.D., Shaw, S., Audette, R.J., Prior, M., Ashton, E. and Allison, E. (1997) *Alberta Farmstead Water Quality Survey*. Alberta Agriculture, Food and Rural Development, Edmonton. Technical report submitted to the Canada–Alberta Environmentally Sustainable Agriculture Agreement. 50 pp. plus appendices.
- Government of Canada (1993a) *Arsenic and Its Compounds, Priority Substances List Assessment Report, Canadian Environmental Protection Act*. Environment Canada and Health Canada, Ottawa. Catalogue No. EN40-215/14E.

- Government of Canada (1993b) *Benzene, Priority Substances List Assessment Report, Canadian Environmental Protection Act*. Environment Canada and Health Canada, Ottawa. Catalogue No. En40-215/11-E.
- Government of Canada (1993c) *Hexachlorobenzene, Priority Substances List Assessment Report, Canadian Environmental Protection Act*. Environment Canada and Health Canada, Ottawa. Catalogue No. En40-215/7E.
- Government of Canada (1999) *Statistical Report on the Health of Canadians*. Statistics Canada, Ottawa. Available online at: <http://www.statcan.ca/english/freepub/82-570-XIE/82-570-XIE.pdf>
- Government of Canada (2003a) *The Well-Being of Canada's Young Children: Government of Canada Report*. Federal/Provincial/Territorial Early Childhood Development Agreement. Catalogue No. RH64-20/2003.
- Government of Canada (2003b) *Water and Canada: Preserving a Legacy for People and the Environment*. Catalogue No. En4-28/2003E. Available online at: http://www.ec.gc.ca/water/en/info/pubs/wwf/e_contnt.htm
- Health Canada (1996) *Guidelines for Canadian Drinking Water Quality*. Sixth Edition. Catalogue No. H48-10/1996E. Available online at: http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index_e.html
- Health Canada (1997) Canadian National Report on Immunization—1996: Measles elimination in Canada. *Can. Commun. Dis. Rep.*, 23S4. Available online at: <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/97vol23/23s4>
- Health Canada (2000) *The Prevention and Management of Asthma in Canada: A Report of the National Asthma Control Task Force*. p. 43.
- Health Canada (2002) *The Facts about Tobacco*. Available online at: http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/fact-fait/fs-if/index_e.html
- Health Canada (2003a) *Canadian Perinatal Health Report 2003*. Minister of Public Works and Government Services Canada, Ottawa. Available online at: <http://www.phac-aspc.gc.ca/publicat/cphr-rspc03/>
- Health Canada (2003b) *Canada's Health Concerns from Climate Change and Variability*. Climate Change and Health Office. Available online at: http://www.hc-sc.gc.ca/ewh-semt/climat/health_table-tableau_sante_e.html
- Health Canada (2004a) *Health Topics: Chronic Respiratory Diseases—Asthma*. Centre for Chronic Disease Prevention and Control. Available online at: http://www.phac-aspc.gc.ca/ccdpc-cpcmc/topics/crd-asthma_e.html
- Health Canada (2004b) *Lead Information Package: Some Commonly Asked Questions about Lead and Human Health*. Healthy Environments and Consumer Safety Branch. Available online at: http://www.hc-sc.gc.ca/ewh-semt/contaminants/lead-plomb/asked_questions-questions_posees_e.html
- Health Canada (2004c) *It's Your Health: Dioxins and Furans*. Catalogue No. 0-662-35893-7. Available online at: <http://www.hc-sc.gc.ca/english/iyh/environment/dioxins.html>
- Health Canada (2004d) *It's Your Health: Effects of Lead on Human Health*. Available online at: <http://www.hc-sc.gc.ca/english/iyh/environment/lead.html>

- Hertz-Picciotto, I., Schramm, M., Watt-Morse, M., Chantala, K., Anderson, J. and Osterloh, J. (2000) Patterns and determinants of blood lead during pregnancy. *Am. J. Epidemiol.*, 152(9): 829–837.
- Hu, H., Hashimoto, D. and Besser, M. (1996) Levels of lead in blood and bone of women giving birth in a Boston hospital. *Arch. Environ. Health*, 51(1): 52–58.
- Jaakkola, J.J. and Jaakkola, M.S. (2002) Effects of environmental tobacco smoke on the respiratory health of children. *Scand. J. Work Environ. Health*, 28(Suppl. 2): 71–83.
- Laxen, D.P.H., Lindsay, F., Raab, G.M., Hunter, R., Fell, G.S. and Fulton, M. (1988) The variability of lead in dusts within the homes of young children. *Environ. Geochem. Health*, 10: 3–9.
- Leech, J.A., Wilby, K., McMullen, E. and Laporte, K. (1996) The Canadian Human Activity Pattern Survey. *Chron. Dis. Can.*, 17(3).
- Lévesque, B., Duchesne, J.F., Gariépy, C., Rhainds, M., Dumas, P., Scheuhammer, A.M., Proulx, J.F., Dery, S., Muckle, G., Dallaire, F. and Dewailly, E. (2003) Monitoring of umbilical cord blood lead levels and sources assessment among the Inuit. *Occup. Environ. Med.*, 60(9): 693–695.
- Lim, G., Aramini, J., Fleury, M., Ibarra, R. and Meyers, R. (2002) *Investigating the Relationship between Drinking Water and Gastroenteritis in Edmonton: 1993–1998*. Health Canada, Ottawa.
- Liu, S., Krewski, D., Shi, Y., Chen, Y. and Burnett, R.T. (2003) Association between gaseous ambient air pollutants and adverse pregnancy outcomes in Vancouver, Canada. *Environ. Health Perspect.*, 111: 1773–1778. Available online at: http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/relation_gastro_edmonton/index_e.html
- Menon, A.S. (2000) Personal communication. Environment Canada, Atlantic Region.
- National Academy of Sciences (2000) *Clearing the Air: Asthma and Indoor Air Exposures*. National Academy Press, Washington, D.C.
- National Council of Welfare (2002) *Poverty Profile 1999*. Available online at: http://www.ncwcnbes.net/htmldocument/reportpovertypro99/Introduction_e.htm#_Toc500047770
- Peters, A., Witchmann, H.E., Tuch, T., Heinrich, J. and Heyder, J. (1997) Respiratory effects are associated with the number of ultrafine particles. *Am. J. Respir. Crit. Care Med.*, 155: 1376–1383.
- PMRA (2002) *Children's Health Priorities within the Pest Management Regulatory Agency*. Science Policy Notice SPN2002-01, Pest Management Regulatory Agency, January 3, 2002.
- PMRA (2003) *Assessing Exposure from Pesticides in Food: A User's Guide*. Science Policy Notice SPN2003-03, Pest Management Regulatory Agency, July 28, 2003.
- Pope, C.A. (1991) Respiratory hospital admissions associated with PM₁₀ pollution in Utah, Salt Lake, and Cache valleys. *Arch. Environ. Health*, 46(2): 90–97.
- Raizenne, M., Neas, L.M., Damokosh, A.I., Dockery, D.W., Spengler, J.D., Koutrakis, P., Ware,

- J.H. and Speizer, F.E. (1996) Health effects of acid aerosols on North American children: Pulmonary function. *Environ. Health Perspect.*, 104(5): 492–499.
- Raizenne, M., Dales, R. and Burnett, R. (1998) Air pollution exposures and children's health. *Can. J. Public Health*, 89: 542–548.
- Rasmussen, P.E. (2004) Elements and their compounds in indoor environments. In: E. Merian, M. Anke, M. Ihnat and M. Stoepler (eds.), *Elements and their Compounds in the Environment. Vol. 1*. Wiley-VCH, Weinheim. pp. 215–234.
- Rasmussen, P.E., Subramanian, K.S. and Jessiman, B.J. (2001) A multi-element profile of house dust in relation to exterior dust and soils in the city of Ottawa, Canada. *Sci. Total Environ.*, 267: 125–140.
- Rhainds, M., Levallois, P., Dewailly, E. and Ayotte, P. (1999) Lead, mercury and organochlorine compounds levels in cord blood in Quebec, Canada. *Arch. Environ. Health*, 54(1): 40–47.
- Roemer, W., Hoek, G. and Brunekreef, B. (1993) Effect of ambient winter air pollution on respiratory health of children with chronic respiratory symptoms. *Am. Rev. Respir. Dis.*, 147: 118–124.
- Rudolph, D. and Goss, M. (eds.) (1993) *Ontario Farm Groundwater Quality Survey. Summer 1992*. Report prepared for Agriculture Canada. Available online at: http://res2.agr.ca/initiatives/manurenet/env_prog/gp/download/ofgqs_93.pdf
- Schouten, J.P., Vonk, J.M. and de Graff, A. (1996) Short term effects of air pollution on emergency hospital admissions for respiratory disease, results of the APHEA project in two major cities in The Netherlands, 1977–89. *J. Epidemiol. Commun. Health*, 50(Suppl. 1): S22–S29.
- Schwartz, J. (2004) Air pollution and children's health. *Pediatrics*, 113: 1037–1043.
- Segala, C., Fauroux, B., Just, J., Pascual, L., Grimfeld, A. and Neukirch, F. (1998) Short-term effect of winter air pollution on respiratory health of asthmatic children in Paris. *Eur. Respir. J.*, 11: 677–685.
- Sketchell, J. and Shaheen, N. (2001) Ground water quality in rural Saskatchewan—Emerging issues for drinking water. In: W. Robertson (ed.), *Maintaining Drinking Water Quality—Lessons from the Prairies and Beyond*. Proceedings of the 9th National Conference on Drinking Water, Regina, May 16–18, 2000. Canadian Water and Wastewater Association, Ottawa. pp. 242–258.
- Statistics Canada (1998) *Measuring Low Income and Poverty in Canada: An Update*. Income and Labour Dynamics Working Paper Series. Product No. 75G0002M.
- Statistics Canada (2000) *National Population Health Survey 1998–1999*.
- Statistics Canada (2001a) *Age (122) and Sex (3) for Population, for Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2001 Census—100% Data*. Table No. 95F0300XCB01004. Available online at: http://www.library.mcgill.ca/edrs/data/dli/statcan/census/census2001/geog/cma_cd/ab.html
- Statistics Canada (2001b) *Age Pyramid of Population of Canada July 1, 1901–2001*. Available online at: <http://www12.statcan.ca/english/census01/products/analytic/companion/age/cda01pymd.cfm>

- Statistics Canada (2001c) *Income Trends in Canada, 2001*. Product No. 13F0022XCB.
- Statistics Canada (2003) *Human Activity and the Environment—Annual Statistics 2002*. Catalogue No. 16-201-XIE.
- Stieb, D.M., Smith-Doiron, M., Brook, J.R., Burnett, R.T., Mamedov, A., Dann, T. and Chen, Y. (2002) Air pollution and disability days in Toronto: Results from the National Population Health Survey. *Environ. Res.*, 89: 210–219.
- Thornton, I., Watt, J.M., Davies, D.J.A., Hunt, A., Cotter-Howells, J. and Johnson, D.L. (1994) Lead contamination of U.K. dusts and soils and implications for childhood exposure: an overview of the work of the Environmental Geochemistry Research Group, Imperial College, London, England, 1981–1992. *Environ. Geochem. Health*, 16: 113–122.
- U.S. Centers for Disease Control and Prevention (1997) Update: Blood lead levels—United States, 1991–1994. *Morbid. Mortal. Wkly. Rep.*, 46(7): 143.
- U.S. EPA (2005) *Children's Health and the Environment in North America—A First Report on Available Indicators and Measures. Country Report: United States*. United States Environmental Protection Agency, Washington, D.C. Available online at: http://www.cec.org/programs_projects/pollutants_health/project/index.cfm?projectID=28&Varlan=english
- Van der Kamp, G. and Grove, G. (2001) Well water quality in Canada: An overview. In: M. Mahmoud and R. van Everdingen (eds.), *An Earth Odyssey*. Proceedings of the 54th Canadian Geotechnical Conference, Calgary, September 16–19, 2001. Bitech Publishers Ltd., Richmond, B.C. pp. 45–49.
- Van der Zee, S., Hoek, G., Boezen, H.M., Schouten, J.P., Van Wijnen, J.H. and Brunekreef, B. (1999) Acute effects of urban air pollution on respiratory health of children with and without chronic respiratory symptoms. *Occup. Environ. Med.*, 56: 802–812.
- Van Oostdam, J., Donaldson, S., Feeley, M. and Tremblay, N. (2003) *Canadian Arctic Contaminants Assessment Report II: Human Health*. Northern Contaminants Program. Available online at: http://www.ainc-inac.gc.ca/NCP/pub/pub_e.html
- Wang, S.T., Pizzolato, S., Demshar, H.P. and Smith, L.F. (1997) Decline in blood lead in Ontario children correlated to decreasing consumption of leaded gasoline, 1983–1992. *Clin. Chem.*, 43: 1251–1252. Available online at: <http://www.clinchem.org/cgi/content/full/43/7/1251>
- Wigle, D.T. (2003) *Child Health and the Environment*. Oxford University Press, Oxford.
- Woodruff, T.J., Grillo, J. and Schoendorf, K.C. (1997) The relationship between selected causes of postneonatal infant mortality and particulate air pollution in the United States. *Environ. Health Perspect.*, 105(6): 606–613.
- World Health Organization (1999) *International Consultation on Environmental Tobacco Smoke (ETS) and Child Health*. Geneva (WHO/NCD/TFI/99.10). Available online at: http://www.who.int/tobacco/health_impact/youth/ets/en/

Acknowledgements

This publication was prepared by Environment Canada (EC) and Health Canada (HC), with assistance from the North American Commission for Environmental Cooperation (CEC). Annie Bérubé, working for both EC and HC, provided a major contribution to this project by overseeing a substantive portion of the development of the report, researching information, writing sections, editing, providing direction and coordination among and within the two Canadian departments and representing Canada on the Steering Group for the Development of Indicators of Children's Health and the Environment in North America. Amber McCool (EC), Vincent Mercier (EC), Andrea Ecclestone (HC), Dr. Anthony Myres (HC), Susan Ecclestone (HC) and Nicki Sims-Jones (HC) also provided advice, research, writing, reviews and consultation with partners and reviewers and participated as members of the Steering Group. Andrea Ecclestone (HC), Emma Wong (HC) and Daniel Panko (HC) provided significant support in many aspects of the preparation of this report, including research, data integration and analysis, consultation with experts, writing and project management. Initial development of the project was also provided by Julie Charbonneau (EC), Risa Smith (EC) and Kerri Henry (EC).

Advice, information and feedback on various sections and aspects of the report were provided by the following people: Bruce Dudley and Samantha Baulch (Delphi Group); Erica Phipps (consultant with the CEC); François Lavallée, David Niemi and Arun Chatterjee (National Pollutant Release Inventory Office, EC); Catherine Miller (Hampshire Research); Phil Blagden and Carrie Lillyman (Meteorological Service of Canada, EC); Domenic Mignacca (Air Pollution Prevention Directorate, EC); Liz LeFrançois (Sustainable Water Use, EC); Doug Trant, Giuseppe Filoso and Peter Morrison (Statistics Canada); Christine Norman, Mary Mitchell and Pierre Brassard (Pest Management Regulatory Agency, HC), Wendy Enright (Air Health Effects Division, HC) and Elaine Easson (Management of Toxic Substances Division, HC).

A special thanks goes to Dr. Donald Wigle (Affiliate Scientist, Institute of Population Health, University of Ottawa), Dr. Theresa To (Senior Scientist, Hospital for Sick Children, Toronto) and Pumulo Rody (Project Manager, International Institute for Sustainable Development) for spending a significant amount of time in providing expert advice, direction and content review, on several occasions.

Editing was provided by Marla Sheffer, translation by Les Entreprises Hélène Bruyère, formatting by the Delphi Group and conversion for the Internet by the CEC.

Appendix 1 List of Acronyms and Abbreviations

µg	microgram
AIDS	acquired immunodeficiency syndrome
CEC	North American Commission for Environmental Cooperation
CEPA	1988 <i>Canadian Environmental Protection Act</i>
CEPA 1999	<i>Canadian Environmental Protection Act, 1999</i>
CFIA	Canadian Food Inspection Agency
CMHC	Canada Mortgage and Housing Corporation
CO	carbon monoxide
COPD	chronic obstructive pulmonary disease
CTUMS	Canadian Tobacco Use Monitoring Survey
dL	decilitre
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe
g	gram
HCB	hexachlorobenzene
km ²	square kilometre
L	litre
LFS	Labour Force Survey
m ³	cubic metre
MEME	Multiple Exposure – Multiple Effect
mg	milligram
min	minute
MUD	Municipal Water Use Database
NAPS	National Air Pollution Surveillance
NCP	Northern Contaminants Program
NLSCY	National Longitudinal Survey of Children and Youth
NO ₂	nitrogen dioxide
NO _x	nitrogen oxides
NPHS	National Population Health Survey
NPRI	National Pollutant Release Inventory
OP	organophosphate
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo- <i>p</i> -dioxin
PCDF	polychlorinated dibenzofuran
PM	particulate matter
PM _{2.5}	particulate matter less than or equal to 2.5 micrometres in diameter
PM ₁₀	particulate matter less than or equal to 10 micrometres in diameter
PMRA	Pest Management Regulatory Agency
POP	persistent organic pollutant
ppb	part per billion
ppm	part per million
PRTR	pollutant release and transfer register
SIC	Standard Industrial Classification
SIDS	sudden infant death syndrome
SO ₂	sulphur dioxide
SO _x	sulphur oxides
SPF	sun protection factor
TCDD	tetrachlorodibenzo- <i>p</i> -dioxin
TEQ	toxic equivalency
TRI	Toxics Release Inventory
UNECE	United Nations Economic Commission for Europe
UV	ultraviolet
VOC	volatile organic compound

Appendix 2 Healthy Environments for Children—What You Can Do!

Children come into closer contact with their environment than adults.

They crawl on the floor and the ground, put their fingers in their mouths and because of their curious nature touch and taste things without knowing if they are harmful. They may also be more sensitive to some harmful substances because of their stage of development. As a parent or caregiver you have an important role to play in providing a healthy environment for your child(ren). This appendix has information on what you can do and gives Internet links and telephone numbers for more information. Your local Public Health Department may have information on providing healthy environments for children.



Washing Hands

Hand-washing with warm water and soap after going to the bathroom, touching animals, and before every meal helps to prevent infection and reduce exposure to harmful substances your child may have touched.

Tips for hand-washing include:

- Use warm water.
- Lather with soap for 10 to 15 seconds. Any soap will do.
- Have your child(ren) sing a favourite song while hand-washing to help them wash for a longer time.
- Rinse hands and dry well with a clean towel.



Taking Shoes Off When You Come Inside

The soil outside your home can contain a number of substances you do not want inside. Taking your shoes off when you come inside is one way to reduce the amount of these substances in your home.



Preventing Breathing Problems

The quality of indoor and outdoor air affects children's ability to breathe easily.

To help your child(ren) breathe more easily:

Outdoor Air

- Listen to the radio or watch television reports for information about air quality and smog advisories. Plan your day based on this information.
- Consider limiting or rescheduling physical outdoor activities on smog advisory days when air pollution is more harmful than usual.
- Reduce exposure to motor vehicle exhaust by limiting physical activity near heavy traffic areas, particularly at rush hour.
- Stop unnecessary vehicle idling. This is an easy way to help improve the air quality in your community.



Indoor Air

- Prevent anyone from smoking in your car or home. Infants and children exposed to second-hand smoke are more likely to suffer from respiratory disease, ear infections, allergies and Sudden Infant Death Syndrome (SIDS).
- Keep your home as clean as possible. Dust and vacuum rugs and upholstery regularly. For children with asthma, dust, mould and pet dander can trigger asthma attacks and allergies.
- Reduce your use of aerosol sprays indoors.

For more information on second-hand smoke, consult *The Facts About Tobacco: What is Second-Hand Smoke?* at <http://www.gosmokefree.ca> or call the Tobacco Control Programme at 1-866-318-1116.

For information on air quality and health, visit Health Canada's Air Quality website at <http://www.healthcanada.ca/air> or call the Air Health Effects Division at (613) 957-1876.

Protect Children from Too Much Sun

Too much sun can be harmful. The sun's ultraviolet (UV) rays can cause painful sunburn and lead to skin cancer. This is especially true for babies and children because their skin burns easily.

To protect your child(ren) from the sun:

- Keep babies under 1 year of age out of direct sunlight. They should be in the shade, under a tree, umbrella or stroller canopy.
- Do not use sunscreen on babies less than 6 months old. Keep them in the shade.
- Dress children in protective clothing (light colours with long sleeves and pants), including a broad brim hat, AND use sunscreen with a Sun Protection Factor (SPF) of at least 15 whenever they are in direct sunlight.
- Be sure to use lots of sunscreen lotion and reapply every 2 hours as well as after swimming.
- Keep children out of the sun between 11 a.m. and 4 p.m. when the sun's rays are strongest, unless they are well-protected by clothing and sunscreen.
- Take extra care on days when the UV level is high.
- Don't think that children are safe just because it's cloudy. The sun's harmful rays can get through fog, haze, and light cloud cover.
- Bring water or some juice for your child(ren).



For more information on sun protection, please call the Consumer and Clinical Radiation Protection Bureau at (613) 954-6699 or visit the following websites:

A Parent's Guide to Sun Protection: Protecting Your Family

http://www.hc-sc.gc.ca/hl-vs/securit/sports/sun-sol/protecting-proteger_e.html

A Parent's Guide to Sun Protection: Sun Fiction and Fact

http://www.hc-sc.gc.ca/hl-vs/securit/sports/sun-sol/facts-realites_e.html

Ultraviolet Radiation from the Sun

<http://www.hc-sc.gc.ca/english/iyh/environment/ultraviolet.html>

Sunglasses

<http://www.hc-sc.gc.ca/english/iyh/products/sunglasses.html>

Sunscreens

<http://www.hc-sc.gc.ca/english/iyh/lifestyles/sunscreen.html>

Information about Products Containing Sunscreen and DEET

<http://www.hc-sc.gc.ca/pmra-arla/english/pdf/pnotes/deet-e.pdf>

Protect Children from Carbon Monoxide Poisoning

Carbon monoxide (CO) is a harmful gas that has no colour, odour or taste. Even at low levels of exposure, carbon monoxide can cause serious health problems. CO is harmful because it will rapidly accumulate in the blood, reducing the ability of blood to carry oxygen.

To reduce the risk of exposure to CO:

- Open your garage door before starting your car.
- If you have a natural gas or propane clothes dryer, clean its ductwork and outside vent cover regularly to make sure they are not blocked.
- Have a qualified professional check your furnace and chimney every year.
- Check your fireplace to make sure the flues are open before lighting a fire. If the chimney does not draw, call a fireplace professional.
- Do not use propane, natural gas or charcoal barbeque grills indoors, in an attached garage, or in any other enclosed area.
- Never run gasoline-powered tools such as lawnmowers, snowblowers, or grass trimmers inside a garage.



More tips to reduce the risk of exposure to CO

- Avoid the use of all kerosene heaters indoors or in a garage. They produce CO and other pollutants. If you must use a kerosene heater indoors, be sure it is meant to be used inside. Review and follow the instructions before every use.
- Put at least one CO detector in your home as a good safety precaution—in some cities it is the law. It is best to have one CO detector on each floor of your home. CO detectors should be replaced every 3 to 5 years.

For more information on eliminating sources of CO in your home and CO detectors, visit http://www.cmhc-schl.gc.ca/en/burema/gesein/abhose/abhose_ce25.cfm or call the Canadian Housing Information Centre at (613) 748-2367.

Keep Pesticides Away from Children

A pesticide is any substance used to control pests such as insects, mice and weeds. Pesticides are poisonous. Poison Control (Information) Centres across Canada often receive calls about children who have swallowed a pesticide that was not stored properly.

To protect your children from coming in contact with pesticides:

- Wash fruits and vegetables under running water before eating them.
- Avoid the use of pesticides in and around your home. Check for alternatives such as sealing cracks to prevent pests from entering your home.

If you do need to use a pesticide product:

- Review the pesticide product label or safety sheet carefully before every use.
- Keep children, pets and toys away when pesticides are applied either inside or outside your home. If a pesticide comes into contact with toys, wash them with water before using.
- Read the label or information sheet to find out when children can return to the treated area. If you are unsure of the recommended time, keep them away from the area for at least 24 hours.
- Put up signs to notify neighbours where a pesticide has been used so their children may also be kept away from the treated area.
- Store pesticides in their original containers. Children may mistake other containers for food or drink.
- Store pesticides in a locked area out of the sight and reach of children.



If your child has swallowed a pesticide:

- Call a Poison Control (Information) Centre immediately and seek medical attention if you suspect your child has swallowed a pesticide.
- Keep the phone number of the Poison Control (Information) Centre by the phone. Phone numbers of Poison Control (Information) Centres can be found at the front of your local telephone directory.
- When you call the Poison Control (Information) Centre, you need to know the name of the product, amount taken, and the time of the incident.
- Follow the first aid statement on the pesticide label and take the pesticide container or label with you to the emergency facility or physician.

For more information on pesticide use, visit *Pesticide Use In and Around the Home* at <http://www.pmra-arla.gc.ca/english/pdf/pnotes/homeuse-e.pdf> or call the Pest Management Information Service at 1-800-267-6315.

For more information about maintaining a healthy lawn, consult *Healthy Lawns* at <http://www.healthylawns.net/english/index-e.html> or call the Pest Management Information Service at 1-800-267-6315.

For more information on pressure-treated wood, consult Health Canada's *Fact Sheet on Chromated Copper Arsenate (CCA) Treated Wood* found at http://www.pmra-arla.gc.ca/english/pdf/fact/fs_cca-e.pdf or call the Pest Management Information Service at 1-800-267-6315.

Using Personal Insect Repellents Safely

Parents and caregivers have always tried to protect their children from mosquito bites. Now that mosquitoes can carry the West Nile virus, there is even more concern about their bites. For most Canadians, the risk of illness from West Nile virus is low, and the risk of serious health effects is even lower. To help prevent mosquito bites, the use of a personal insect repellent should be considered. Never use personal insect repellents on children under 6 months of age, and for children under 2 years of age it is advisable to use mosquito netting around their carriages rather than personal insect repellents, unless a high risk of complications from insect bites exists. Repellents containing soybean oil, P-menthane 3,8-diol, Citronella, Lavender and DEET are currently registered for use in Canada. Mosquitoes are most active between dusk and dawn. To help prevent mosquito bites during this time, avoid mosquito areas and dress your child(ren) in long-sleeved, light-coloured clothing with a tight weave.

For all types of personal insect repellents:

- Read the label carefully before using. Pay special attention to the maximum number of applications allowed per day, the age restrictions for use, and the protection times.
- Do not put repellent on children's faces and hands. This will reduce their chances of getting it in their eyes and mouths. If it does get into their eyes, rinse immediately with water.
- Do not apply repellent on sunburns, open wounds or skin irritations.
- Apply as little of the repellent as possible to exposed skin surfaces or on top of clothing. Never use it under clothing.
- Put on insect repellent only in well-ventilated areas. Never use it near food.
- If using a sunscreen product that contains insect repellent, use the product as a repellent and apply sparingly.
- If using a separate sunscreen and repellent together, apply the sunscreen first, wait 20 minutes, and then apply the insect repellent.
- Wash treated skin with soap and water when you return indoors or when protection is no longer needed.



Guidelines for using personal insect repellents containing DEET include:

For children under 6 months of age:

- NEVER use personal insect repellents containing DEET. Instead consider alternative methods of protection such as protective clothing and mosquito netting.

For children aged 6 months to 2 years:

- Apply once a day only in situations where a high risk of complications from insect bites exists.
- Use products labelled 10% DEET or less.
- Avoid using over a prolonged period.

For children between 2 and 12 years of age:

- Apply no more than 3 times per day.
- Use products labelled 10% DEET or less.
- Avoid using for a prolonged period.

For children of 12 years of age or older:

- Use products labelled 30% DEET or less.

For more information, please consult *Safety Tips on Using Personal Insect Repellents* at http://www.phac-aspc.gc.ca/wn-no/repellents-insectifuge_e.html for more tips or call the Pest Management Information Service at 1-800-267-6315.

For more information on the West Nile virus, please see <http://www.westnilevirus.gc.ca> or call the National West Nile Virus Info-line at 1-800-816-7292.

Keep Mould Levels Down in Your Home

Mould inside your home can be a health concern. Mould grows when there is too much humidity and condensation from building leaks, cooking, washing, flooding, etc. Mould can lead to allergic reactions and respiratory diseases. Reducing mould levels in your home is one way to help your child(ren) breathe more easily.

To reduce the risk of exposure to mould:

- Make sure that there are no wet spots in your house such as damp basements, leaking bathroom sinks, cold closets on exterior walls, etc.
- Check for and fix water leaks. Repair leaky roofs, walls, and basements.
- Ensure that your home is adequately ventilated.
- Circulate air and prevent moisture build-up by installing and using exhaust fans vented to the outdoors in kitchens and bathrooms.
- Check that your clothes dryer exhausts to the outdoors. Remove lint before every use.
- Discard clutter and excess stored materials in basements. Moulds grow on fabrics, cardboard, paper, wood, and anything that collects dust and holds moisture.
- Discard or clean water-damaged materials such as carpets quickly to avoid mould growth.
- Wash or change shower curtains monthly and keep bathtub and shower areas free from mould build-up.
- Get rid of mould on surfaces by removing the source of moisture. Scrub the mouldy area with a mild cleaning detergent. Rinse by sponging with a clean, wet rag. Repeat. Dry the area quickly and completely. Make sure that there is good air circulation when cleaning.
- Cleaning up mould can be complex; for steps on cleaning up mould, consult Canada Mortgage and Housing Corporation's *Fighting Mold—The Homeowners' Guide* at http://www.schl.ca/en/burema/gesein/abhose/abhose_ce08.cfm



For more information on measuring humidity in your home, consult the Canada Mortgage and Housing Corporation's (CMHC) publication, *Measuring Humidity in Your Home: Do You Have a Humidity Problem?* at http://www.cmhc-schl.gc.ca/en/burema/gesein/abhose/abhose_ce01.cfm

For more information on bathroom and kitchen fans, consult CMHC's *The Importance of Bathroom and Kitchen Fans* at http://www.cmhc-schl.gc.ca/en/burema/gesein/abhose/abhose_ce17.cfm. For copies of these publications, call CMHC's national office at 1-800-668-2642.

Protect Children from Mercury in Fish

Eating high amounts of mercury can cause damage to the nervous system. Pregnant women and young children are particularly vulnerable to the harmful effects of mercury. Of the different kinds of foods we eat, fish is usually the largest source of mercury. This is because mercury in lakes, streams and oceans can build up in the bodies of some fish. Fish are an excellent source of high-quality protein and are low in saturated fat, which makes them a healthy food choice.

To reduce the risk of exposure to fish contaminated by mercury:

When eating fish bought from the store:

- Limit eating swordfish, shark, or fresh and frozen tuna to one meal per month for young children, pregnant women, and women of child-bearing age. This restriction does not apply to canned tuna.



When sport fishing:

- Watch for local fish advisories that may indicate high levels of mercury and other contaminants in fish.
- Contact your provincial authority for information about eating recreationally caught freshwater fish.
- A list of provincial authorities is given at <http://www.inspection.gc.ca/english/related/province.se.shtml>, or check your phone book for a provincial government contact related to food, agriculture or fisheries.

For more information, visit *Information on Mercury Levels in Fish* at http://www.hc-sc.gc.ca/english/protection/warnings/2002/2002_41e.htm or call the Canadian Food Inspection Agency at 1-800-442-2342.

Protect Children from Polluted Water

Good quality water is a high priority for everyone's health, especially that of children. There are many potential sources of contamination, including agricultural runoff, faulty septic systems, and storm sewers. To reduce children's exposure to polluted water, be alert for beach closings that result from bacterial contamination.



For more information on well water, consult *What's In Your Well?—A Guide to Well Water Treatment and Maintenance* at http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/well_water-eau_de_puits_e.html or call your local Public Health Department.

Providing Safe Drinking Water

If your drinking water comes from a well, make sure it is safe by having it tested 2 or 3 times a year.

Protecting Children from Exposure to Lead

Lead is an inexpensive metal with many uses. However, it can cause many harmful health effects, especially to the nervous system and kidneys. Exposure to even very low levels of lead can cause learning disabilities and other harmful effects on children's development.

To reduce your family's risk of lead exposure:

- If your home was built before 1960, you should assume that lead was used in the original exterior and interior paint. Leaded paint that is chipping or peeling is a serious health hazard, especially to children who might eat it. In such cases the paint should be contained or removed following the guidelines in the booklet *Lead in Your Home*. Call the Canada Mortgage and Housing Corporation at 1-800-668-2642 to obtain a printed copy.
- It is important to review this booklet before starting any renovation project in an older home. Renovations that are improperly carried out can greatly increase the risk of lead exposure from leaded paint.
- Plumbing systems may have solder or other parts that contain lead. Because lead will leach into water sitting in pipes, always let the water run until it is cold before using it for drinking, cooking, and especially for making baby formula. Do not use water from the hot water tap for cooking or drinking. If you are concerned about elevated lead levels in your home's drinking water, contact your local Public Health Department.
- Costume jewellery containing lead is a health hazard for children who chew or suck on it. Ask when you purchase children's jewellery to make sure it does not contain lead.
- Discourage children from putting non-food items in their mouths.
- When drinks are stored in leaded crystal containers some lead may dissolve into the liquid. Do not store liquids in lead crystal containers or serve pregnant women or children drinks in crystal glasses.



For more information on the health effects of lead, please call Health Canada's Information and Education Health Unit at (613) 952-1014 or consult the following websites:

Lead-based Paint:

<http://www.hc-sc.gc.ca/english/iyh/products/leadpaint.html>

Lead Crystalware and Your Health:

http://www.hc-sc.gc.ca/english/iyh/products/crystal_lead.html

Lead Information Package – Some Commonly Asked Questions About Lead and Human Health:

http://www.hc-sc.gc.ca/ewh-semt/contaminants/lead-plomb/asked_questions-questions_posees_e.html

Effects of Lead on Human Health:

<http://www.hc-sc.gc.ca/english/iyh/environment/lead.html>

Reducing Unintentional Exposure to Household Chemicals

Household chemicals are safe if used and stored as recommended. Chemical products commonly found throughout the home include cleaning liquids and powders, polishes, drain cleaners, paint thinners and windshield washers.

Use the following tips to keep your child safe from household chemicals:

- Learn what the symbols and safety warnings on the labels of household chemicals mean.
- Teach children that the symbols on product labels mean: DANGER! DO NOT TOUCH.
- Read the label. If there is anything in the label instructions that you don't understand, ask for help.
- Make sure the labels on containers are not removed or covered up.
- Lock all chemical products out of the sight and reach of children. Household chemical containers, even if sealed or empty, are not toys. Never let children play with them.
- Close the cap on the container tightly, even if you set it down for just a moment. Make sure that child-resistant containers are working. Child-resistant does not mean childproof!
- Keep household chemicals in their original containers. Never store chemicals in pop bottles or other food containers.
- Never mix chemicals together. Some mixtures can produce harmful gases. Consider using non-toxic alternatives such as baking soda instead of commercial cleaning products.
- Buy the smallest quantity of chemical products needed for the job. Unwanted portions should be disposed of at a hazardous waste depot. Contact your local municipal or county office for locations nearest you.

If you suspect your child has swallowed a household chemical:

- Call a Poison Control (Information) Centre immediately and seek medical attention.
- Keep the phone number of the Poison Control (Information) Centre by the phone.
- Phone numbers of Poison Control (Information) Centres can be found at the front of your local telephone directory.
- When you call the Poison Control (Information) Centre, you need to know the name of the product, amount taken, and the time of the incident.



For more information on product labels and symbols, consult *Do You Know What These Symbols Mean?* at http://www.hc-sc.gc.ca/cps-spc/pubs/cons/symbol_e.html or call Health Canada's Information and Education Health Unit at (613) 952-1014.

Using Arts and Crafts Materials Safely

The most common health hazards from working with arts and crafts materials are cuts from knives or scissors. However, there can be risks from a few of the materials themselves, such as some colourings and solvents.

To help your child(ren) stay safe when doing arts and crafts:

- Supervise children with arts and crafts materials.
- Choose non-toxic products.
- Always follow safety instructions given on the label.
- Keep materials in their original containers so that you can refer to the label instructions every time they are used.
- Store all arts and crafts materials that should be used under supervision out of the reach and sight of children.



- Do not allow children to eat or drink when using arts and crafts materials.
- Do arts and crafts in a well-ventilated area.

Some arts and crafts materials are never safe for children to use:

- Paint that is not identified as non-toxic, ceramic glaze, copper enamel and solder for stained glass may contain lead or cadmium.
- Shellac, paint strippers and craft dyes may contain solvents with toluene or methyl alcohol, which may cause blindness or other serious health effects if swallowed. Check the label for the ingredients of the product.

For pregnant or breastfeeding women:

- Do not work with solvents, lead compounds or dust-producing materials. If you are contemplating pregnancy or are pregnant consult your physician with respect to the effects of toxic arts materials.

For further information, consult Arts and Crafts at <http://www.hc-sc.gc.ca/english/iyh/products/arts.html> or call Health Canada at (613) 957-2991.

Appendix 3 Indicator Templates

Note: No indicator templates are provided for indicators 4, 10 and 13.

Indicator 1 - Percentage of children living in areas where air pollution levels exceed relevant air quality standards <i>This specific indicator is currently not available in Canada.</i>		Type of indicator: Exposure
INDICATOR description		
<i>Definition</i>	<p>Figure 2.1. Average levels of several air pollutants in Canada, 1984–2002</p> <p>Figure 2.2. Peak levels of ground-level ozone for selected regions of Canada, 1989–2002</p> <p>Figure 2.3. Number of days in 2002 on which ozone levels exceeded the Canada-wide Standard</p> <p>Figure 2.4. Peak levels of fine particulate matter (PM_{2.5}) for selected cities in Canada, 1984–2002</p> <p>Figure 2.5. Number of days in 2002 on which PM_{2.5} levels exceeded the Canada-wide Standard</p>	
<i>Rationale and role</i>	<p>Ground-level ozone and airborne particles combine with other air pollutants to produce smog. Smog can affect our health by irritating the eyes, nose and throat, reducing lung capacity and aggravating respiratory or cardiac diseases. It has also been implicated in premature deaths. Especially vulnerable are the elderly, children and those with heart or lung disease. Recent studies suggest that there are no safe levels of human exposure to fine airborne particles and ground-level ozone.</p>	
<i>Data range</i>	<ul style="list-style-type: none"> • For volatile organic compounds (VOCs): 1991–2002 • For nitrogen oxides (NO_x), sulphur dioxide (SO₂) and carbon monoxide (CO): 1984–2002 • For ozone: 1989–2002 • For PM_{2.5}: 1984–2002 	
<i>Terms and concepts</i>	<p>“Annual averages” of air pollutant levels measured in ambient air are derived by averaging the mean concentrations of air pollutants measured at each monitoring station for each year.</p> <p>Canada-wide Standards: In 1998, the Canadian Environment Ministers signed the Canada-wide Accord on Environmental Harmonization and its subagreement on Canada-wide Standards. Canada-wide Standards typically contain a numeric limit, a time frame for achievement and a framework for monitoring progress and reporting to the public. Air-related Canada-wide Standards exist for benzene, dioxins and furans, mercury, particulate matter (PM) and ground-level ozone. The Canada-wide Standards are:</p> <ul style="list-style-type: none"> • Ground-level ozone: 65 ppb (8-hour averaging time, averaged over 3 years, to be attained by 2010) • PM_{2.5}: 30 µg/m³ (24-hour averaging time, averaged over 3 years, to be attained by 2010) <p>Ground-level ozone is formed when NO_x and VOCs react in sunlight.</p> <p>PM is one of the major components of smog. PM consists of microscopic particles in the air that are capable of being inhaled by humans and is divided into two size ranges: PM_{2.5} and PM₁₀.</p> <p>“Peak levels” of air pollutants are obtained by averaging the highest concentrations measured at each monitoring station for each year.</p> <p>Precursor air pollutants are CO, VOCs, SO₂ and NO_x. Precursor air pollutants contribute to the formation of smog.</p> <p>“Smog” has become a common term for urban air pollution. It contains two key</p>	

Indicator 1 - Percentage of children living in areas where air pollution levels exceed relevant air quality standards <i>This specific indicator is currently not available in Canada.</i>	Type of indicator: Exposure
	elements: fine airborne particles and ground-level ozone.
<i>Data sources, availability and quality</i>	Data are collected by the Federal/Provincial/Territorial National Air Pollution Surveillance (NAPS) network. NAPS air quality monitors collect real-time data and samples throughout Canada, particularly in urban areas. The number of monitors varies by pollutant type. NAPS network agencies' quality assurance and quality control programs are supplemented by a federal quality assurance program. These programs ensure that the ambient air monitoring data collected from NAPS stations are valid, complete, comparable, representative and accurate. Elements of the network quality assurance program are site selection; sampling system requirements; site and analyzer operation; instrument calibration and reference standards; interlaboratory testing and performance audit program; data validation and reporting; documentation; and training and technical support. Contact: Paul Brunet Environmental Technology Centre Environment Canada (613) 991-9460
<i>Units of measurement</i>	<ul style="list-style-type: none"> • Parts per billion (ppb) for ground-level ozone, SO₂, NO_x and VOCs. • Parts per million (ppm) for CO. • Micrograms per cubic metre (µg/m³) for PM_{2.5}.
<i>Computation</i>	<p><u>For levels of several air pollutants:</u> VOCs, NO_x and SO_x are annual averages, while CO is the 98th percentile of the 8-hour averages, for all selected monitoring stations. Stations were included in the analysis if 70% of the years in the period had valid annual statistics.</p> <p><u>For peak levels of ground-level ozone:</u> The selected stations were the ones having data for 70% of the years in the period. Valid annual statistics are based on the methodology outlined in the Guidance Document on Achievement Determination: Canada-wide Standards for Particulate Matter and Ozone. The yearly 4th highest daily maximum 8-hour ozone values for each station were averaged over 3 consecutive years. The 3-year running average value for each station was then averaged for the region.</p> <p><u>For ozone exceedance days in 2002:</u> Stations meeting the minimum data requirement based on the methodology outlined in the Guidance Document on Achievement Determination: Canada-wide Standards for Particulate Matter and Ozone were selected. The number of days on which the maximum 8-hour measurements exceeded 65 ppb were then summed for each station and plotted on the map of Canada. Values were used as is for sites meeting completeness criteria.</p> <p><u>For peak levels of PM_{2.5}:</u> Yearly PM_{2.5} values are the averages of the 98th percentile of 24-hour measurements for all available stations. Measurements were made by manual samplers (i.e., dichotomous samplers), which operate on a 1-in-6-day schedule. A site was considered to have a valid year of data if at least 40 measurements were available for the year and measurements were available in each quarter. Sites were also required to have 70% valid years of data in the period. For each year there were between 10 and 15 stations, located in commercial and residential areas of 10 cities, meeting these requirements.</p> <p><u>For PM_{2.5} exceedance days in 2002:</u> Continuous samplers meeting the minimum data requirement based on the methodology outlined in the Guidance Document on Achievement Determination: Canada-wide Standards for Particulate Matter and Ozone were selected. The number of days on which the 24-hour measurements exceeded 30 µg/m³ were then summed for each station and plotted on the map of Canada.</p>
<i>Sources of further</i>	The NAPS Network website (and annual reports): http://www.etc-

Indicator 1 - Percentage of children living in areas where air pollution levels exceed relevant air quality standards <i>This specific indicator is currently not available in Canada.</i>	Type of indicator: Exposure
<i>information</i>	cte.ec.gc.ca/NAPS/index_e.html
<i>Geographic scale</i>	Data are presented by individual monitoring stations for exceedance days, regionally for peak ground-level ozone and nationally for peak PM _{2.5} and for all precursor pollutants.
<i>Useful references</i>	<p><i>Environmental Signals 2003: Canada's National Environmental Indicators Series</i>, urban air quality indicators: http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm</p> <p>Environment Canada's Air Quality Services website: http://www.msc-smc.ec.gc.ca/aq_smog/index_e.cfm</p> <p>Environment Canada's Criteria Air Contaminant Emissions summaries: http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm</p> <p>Canadian Council of Ministers of the Environment: http://www.ccme.ca</p>
INDICATOR presentation and observations	
<i>Data table(s) and chart(s)</i>	See graphs in section 2.1 of the Canada Country Report
<i>Key observations</i>	See text in section 2.1 of the Canada Country Report
<i>Strengths of the indicator</i>	<ul style="list-style-type: none"> • The indicators provide a clear national and regional overview of key trends in ambient levels of pollutants for Canada for the last 13–17 years. • Although reflecting only a single year, the exceedance maps show the spatial variability in PM and ozone and the number of days of high pollution levels. • The indicator covers most urban areas in Canada (except for peak PM_{2.5} average trend).
<i>Limitations of the indicator</i>	<ul style="list-style-type: none"> • The PM_{2.5} peak indicator represents only 10–15 urban stations and is not considered to be representative of Canada. This will be addressed in the future as more monitoring data become available. • Ambient air quality levels measured at a sampling station do not necessarily represent the exact levels to which the population is exposed in the surrounding areas. • The indicator does not link measured air quality levels with population numbers, to give an indication of how many children may be more at risk from poor air quality. • The indicators do not provide a measure of the potential combined health effects of exposure to multiple pollutants simultaneously.
<i>Additional indicators</i>	<p><u>Criteria Air Contaminant Emissions Inventory:</u> This inventory provides yearly estimates of total Canadian emissions for several air pollutants and their precursors (e.g., VOCs and ammonia).</p> <p>The NAPS network also monitors the ambient levels of several other substances, including toxic metals (such as arsenic, lead and mercury), 14 inorganic and organic anions and 11 inorganic cations.</p>
<i>Opportunities for improvement</i>	<ul style="list-style-type: none"> • Methods could be developed to convert point NAPS data to areas of influence for a number of pollutants to estimate potential exposure on a geographic scale. • Methods could be developed for estimating the percentage of children living or commuting in these areas of potential concern: specifically, breaking down the population of children to small geographic units for inter-census years. • Health research on the effects of multiple pollutants could provide the basis for developing an index that would incorporate several pollutants simultaneously, while considering the possible cumulative, additive or synergistic effects.

<p>Indicator 1 - Percentage of children living in areas where air pollution levels exceed relevant air quality standards</p> <p><i>This specific indicator is currently not available in Canada.</i></p>	<p>Type of indicator: Exposure</p>
	<ul style="list-style-type: none"> Indicators integrating health outcomes (e.g., hospital admissions, mortality) and ambient levels are under development and could provide more informative trends.
<p><i>Related programs/activities</i></p>	<p>Many programs are in place at all levels of government to address problems related to air quality, including international agreements to reduce transboundary flow of emissions, air quality prediction programs, measures to make vehicles and fuel cleaner and regulations to reduce industrial emissions. See the Environment Canada Clean Air website for more details and links to sources of information: http://www.ec.gc.ca/air/being_done_e.html</p>

Indicator 2 - Measure of children exposed to second-hand smoke		Type of indicator: Exposure
INDICATOR description		
<i>Definition</i>	Percentage of children exposed to second-hand smoke in Canadian homes	
<i>Rationale and role</i>	The health effects on children exposed to second-hand smoke include sudden infant death syndrome (SIDS) and breathing problems in children as young as 18 months of age. Children exposed to second-hand smoke in their homes are more likely to suffer breathing problems such as asthma and damage to their lungs. Children are twice as likely to smoke if their parents are smokers. http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/second/fact-fait/index_e.html	
<i>Data range</i>	Age groups: 0–5, 6–11, 12–14, 15–19 Years: 1999, 2000, 2001, 2002	
<i>Terms and concepts</i>	Second-hand smoke is a combination of poisonous gases, liquids and breathable particles that are harmful to our health. It consists of mainstream smoke, the smoke inhaled and exhaled by the smoker, and sidestream smoke, the smoke released directly from the end of a burning cigarette. Second-hand smoke contains over 4000 chemical compounds, 50 of which are associated with or known to cause cancer. Two-thirds of the smoke from a burning cigarette is not inhaled by the smoker but enters into the surrounding environment. The contaminated air is inhaled by anyone in that area. Second-hand smoke has twice as much nicotine and tar as the smoke that smokers inhale. It also has five times the carbon monoxide, which decreases the amount of oxygen in our blood. Second-hand smoke causes disease and death in healthy non-smokers. Exposure for as little as 8–20 minutes causes physical reactions linked to heart and stroke disease: the heart rate increases; the heart's oxygen supply decreases; and blood vessels constrict, which increases blood pressure and makes the heart work harder. If you are a non-smoker, exposure to second-hand smoke increases your chance of lung cancer by 25%, heart disease by 10% and cancer of the sinuses, brain, breast, uterine cervix and thyroid, as well as leukemia and lymphoma. Although only 3 in 10 people report being exposed to second-hand smoke, 9 in 10 people have detectable levels in their bodies. The test measures exposure that has occurred over the last 3 days. Second-hand smoke is a major source of indoor air pollution and the greatest source of air particle pollution. http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/second/fact-fait/index_e.html	
<i>Data sources, availability and quality</i>	Canadian Tobacco Use Monitoring Surveys (CTUMS) 1999, 2000, 2001, 2002, Household Component E-mail: TCP-PLT-questions@hc-sc.gc.ca	
<i>Units of measurement</i>	Percentage of children who are exposed at home to second-hand smoke by province and age group	
<i>Computation</i>	Statistics Canada conducted computer-assisted interviews by telephone; only direct reports (i.e., not third-party) with selected persons were accepted. Information about household composition and second-hand smoke in the home was collected in 43 973 households. In about half of those households, one person aged 15 or older was selected to obtain information on smoking habits. This amounted to 21 788 individuals, about half of whom were aged 15–24. Further, to allow provincial comparisons of approximately equal reliability, the overall sample size for the survey was divided equally across all 10 Canadian provinces. Some topics were introduced in the questionnaire in July 2001, and the sample for these was 11 140. They include reasons for smoking light or mild cigarettes, views on public smoking, perceptions of the health effects of second-hand smoke, smoking restrictions at work and details about cessation. The overall response rate, which considers the participation of both households and individuals, was 77% for the 2001 CTUMS data collection. Every telephone number called by Statistics Canada was fully accounted for in order to calculate the survey's response rate accurately and to properly weight the data to represent the Canadian population.	
<i>Sources of further</i>	Microdata: A microdata set containing the results of the survey is available for	

Indicator 2 - Measure of children exposed to second-hand smoke		Type of indicator: Exposure
<i>information</i>	purchase from Statistics Canada.	
<i>Geographic scale</i>	Population coverage: The target population for CTUMS is all persons aged 15 and older living in Canada, excluding residents of Yukon, Nunavut and the Northwest Territories and full-time residents of institutions. In addition, because this was a telephone survey, the 3% of Canadians without telephones are not included.	
<i>Useful references</i>	http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/ctums/index.html	
INDICATOR presentation and observations		
<i>Key observations</i>	Generally, the percentages of children (in all four age categories 0–5, 6–11, 12–14 and 15–19) exposed to second-hand smoke in Canadian homes are decreasing. It is also evident that for all 4 years (1999–2002), exposure to second-hand smoke is highest among children aged 15–19 and lowest among those aged 0–5. Overall, in 2002, 19% of children aged 0–17 were regularly exposed to second-hand smoke in the home.	
<i>Strengths of the indicator</i>	The indicator is nationally and regionally relevant.	
<i>Limitations of the indicator</i>	It does not consider the degree to which those over 15 years of age smoke in the home and what protection measures (e.g., filters) may be in place. It does not consider exposure of the fetus.	
<i>Additional indicators</i>	Exposure of fetuses. Number of children who smoke.	
<i>Opportunities for improvement</i>	Biomonitoring of the levels of contaminants in the blood of children who live in homes with smokers.	
<i>Related programs/activities</i>	Health Canada's website includes information for youth related to smoking entitled "You and Me Smokefree": http://www.hc-sc.gc.ca/hecs-sesc/tobacco/youth/index.html	

Supplementary Tables, CTUMS Annual 2002

Table 11: Exposure of children at home to environmental tobacco smoke, by province and age group, Canada, 2002

Province	% of children age 0–11 regularly exposed	% of children age 12–17 regularly exposed	% of children age 0–17 regularly exposed
Canada	16	23	19
Newfoundland and Labrador	21	29	24
Prince Edward Island	17	24	20
Nova Scotia	21	24	22
New Brunswick	18	26	21
Quebec	26	36	29
Ontario	12	18	14
Manitoba	17	25	20
Saskatchewan	18	28	22
Alberta	15	21	17
British Columbia	6	14	9

Estimates may not sum to 100% due to rounding. Source: Canadian Tobacco Use Monitoring Survey, Household Component, February–December 2002, available at: http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/research-recherche/stat/ctums-esutc/index_e.html

Indicator 3 - Prevalence of asthma in children		Type of indicator: Health outcome
INDICATOR description		
<i>Definition</i>	Prevalence of physician-diagnosed asthma	
<i>Rationale and role</i>	Exposures to indoor and outdoor sources of biological and chemical environmental contaminants have been shown to cause asthma or exacerbate existing asthma.	
<i>Data range</i>	Children in two age groups: 4–7, 8–11. For the years 1994–95, 1996–97 and 1998–99.	
<i>Terms and concepts</i>	Asthma is characterized by cough, shortness of breath, chest tightness and wheeze. Asthma symptoms and attacks (episodes of more severe shortness of breath) usually occur after exposure to allergens, viral respiratory infections (“colds”), exercise or exposure to irritant fumes or gases. These exposures cause both an inflammation of the airway wall and abnormal narrowing of the airways, which lead to asthma symptoms. Avoiding triggers, environmental control and preventive treatment can reduce symptoms, and treatment medication can control symptoms once they occur. Asthma is one of the most prevalent chronic conditions in Canadian children and is also a serious problem in adults. Asthma imposes a heavy burden on the nation’s health care expenditures and reduces the quality of life for individuals with asthma and their families.	
<i>Data sources, availability and quality</i>	National Longitudinal Survey of Children and Youth (NLSCY), Statistics Canada: http://www.statcan.ca/english/sdds/4450.htm	
<i>Units of measurement</i>	Percentage of children whose parents indicated that their child(ren) had ever been diagnosed with asthma by a physician	
<i>Computation</i>	The NLSCY is a long-term study, the primary objective of which is to monitor the development and well-being of Canada’s children from infancy to adulthood. It follows a representative sample of Canadian children from birth to 11 years of age, with data collection occurring at 2-year intervals beginning in the winter and spring of 1994–95. Much of the information in the NLSCY, including the information relevant to asthma, is collected from parents on behalf of their children by means of a household interview. Several frames were used to select the initial sample. Households with children in the target population (ages 0–11) were selected from the old-design Labour Force Survey (LFS), from the new-design LFS and from the National Population Health Survey (NPHS) both outside and inside Quebec. A total of 22 831 responding children made up the longitudinal sample in 1994–95. The sample size was 16 903 in 1996–97 and 16 718 in 1998–99.	
<i>Sources of further information</i>	Statistics Canada, Social Development Canada	
<i>Geographic scale</i>	The indicator is intended to be nationally relevant. The objective of the NLSCY is to produce reliable provincial estimates by age group.	
<i>Useful references</i>	More information about this indicator is available on the following website, which includes additional facts and figures related to asthma: http://www.phac-aspc.gc.ca/ccdpc-cpcmc/crd-mrc/facts_asthma_e.html	
INDICATOR presentation and observations		
<i>Key observations</i>	Since 1994, asthma prevalence has been increasing among children (except boys aged 4–7 years). Boys of all ages have a higher prevalence of asthma than girls. Currently, approximately 20% of boys aged 8–11 have been diagnosed with asthma, the highest prevalence group among children. More research is required to better understand the causes of asthma, the reasons for the increased prevalence of asthma and the relationship between environmental factors and asthma.	
<i>Strengths of the indicator</i>	It is nationally and regionally significant.	
<i>Limitations of the indicator</i>	It is difficult to quantify the link between the environment and the prevalence of asthma. There are contributing factors to asthma prevalence other than	

Indicator 3 - Prevalence of asthma in children	Type of indicator: Health outcome
	environmental factors (e.g., predisposing factors). "Prevalence" is the number of people in the population who have a condition at a specific point in time. "Incidence" is the number of new people who develop the condition during a specific time period. Each measure provides valuable information on the population. Canada does not currently have incidence data, so we must rely on prevalence data.
<i>Additional indicators</i>	Additional indicators could include asthma hospitalization rates, asthma deaths and asthma mortality rates. See: http://www.phac-aspc.gc.ca/publicat/rdc-mrc01/index.html#figures or http://www.phac-aspc.gc.ca/publicat/pma-pca00/index.html
<i>Opportunities for improvement</i>	More children could be included and assessed at greater frequency. Efforts could be made to distinguish environmental contributors to asthma from others.
<i>Related programs/activities</i>	<p>The federal government, working with its partners through the Chronic Respiratory Diseases Program of the Centre for Chronic Disease Prevention and Control (Health Canada), has, as its mission, to bring about effective preventive and control measures to reduce suffering, disability and death due to chronic respiratory diseases in Canada. Strategies, programs and projects include:</p> <ul style="list-style-type: none"> • <u>Surveillance</u>: Coordination of national surveillance on chronic respiratory disease; report on "Respiratory Disease in Canada" every 3 years; website with up-to-date data. • <u>Population-based research using national databases</u>: Research using NPHS, Canadian Community Health Survey (Statistics Canada), Hospitalization Database (Canadian Institute for Health Information), Mortality Database (Statistics Canada), Special Surveys. • <u>Prevention and control of asthma</u>: National strategic plan; member of Canadian Network for Asthma Care; assistance with resource development; policy and guidelines development; interpretation of research literature reviews; building capacity for prevention and control initiatives. • <u>Prevention and control of chronic obstructive pulmonary disease (COPD)</u>: National strategic plan; member of Canadian COPD Alliance; assistance with resource development; policy and guidelines development; interpretation of research literature reviews; building capacity for prevention and control initiatives. • <u>Information dissemination</u>: Respond to internal and external requests for data and information. <p>More information is provided by Health Canada's Centre for Chronic Disease Prevention and Control: http://www.phac-aspc.gc.ca/ccdpc-cpcmc/crd-mrc/asthma_e.html and http://www.phac-aspc.gc.ca/ccdpc-cpcmc/topics/crd-asthma_e.html</p>

Indicator 5 - Children living in homes with a potential source of lead		Type of indicator: Exposure surrogate
INDICATOR description		
<i>Definition</i>	Children aged 0–19, living in housing stock built before 1960, are aggregated for the Census years 1991, 1996 and 2001.	
<i>Rationale and role</i>	Most indoor and outdoor paints produced before 1960 contained substantial amounts of lead. Children are believed not to be at risk from lead in paint unless it is disturbed (e.g., during renovations) or if they chew on surfaces painted with lead-based paint. Indoor lead levels tend to increase while houses are being renovated, particularly if the renovation involves electric sanding or burning with a blow lamp (Laxen et al., 1988; Davies et al., 1990).	
<i>Data range</i>	For the Census years 1991, 1996 and 2001. Four age groups were selected for children: 0–4, 5–9, 10–14, 15–19.	
<i>Data sources, availability and quality</i>	The data are from Statistics Canada, Census of Population, 1991, 1996, 2001.	
<i>Units of measurement</i>	The number of children 0–4, 5–9, 10–14 and 15–19 living in houses built before 1960	
<i>Computation</i>	<p>The charts are compiled from Census of Population counts cross-tabulated by age and period of construction. Data were extracted from the main Statistics Canada population databases. The data were then processed in Excel to develop the final indicator.</p> <p><u>Rationale for the selection of the 1960 threshold</u></p> <p>Homes built before 1960 were likely painted with lead-based paint. Paints before 1950 contained large amounts of lead. Some paint made in the 1940s contained up to 50% lead by dry weight. During the 1950s, lead was used more commonly in exterior paint but was still used in the interiors of homes. In Canada, the Liquid Coating Materials Regulations were enacted under the <i>Hazardous Products Act</i> in 1976 to restrict the amount of lead in paints and other liquid coatings on furniture, household products, children’s products and exterior and interior surfaces of any building frequented by children to 0.5% by weight. By the end of 2002, the amount of lead in paint was restricted to 0.06% by weight.</p>	
<i>Sources of further information</i>	Data providers: Statistics Canada, Canadian Mortgage and Housing Corporation Indicator developers: Health Canada/Environment Canada	
<i>Scale of application</i>	The data have been compiled nationally for the indicators report.	
<i>Useful references</i>	Please see Table 1 and Figure 1 of Wigle (2003).	
INDICATOR presentation and observations		
<i>Key observations</i>	<p>In 2001, 24% of Canadian children under 5 years of age lived in housing built prior to 1960. The number of children in the four age categories (<5, 5–9, 10–14 and 15–19) living in homes built prior to 1960 declined slightly between 1991 and 2001. This indicator measures only the potential for exposure to lead in the home.</p> <p>The slow retirement of old housing stock may have contributed to the decline observed.</p> <p>Concentrations of lead in the environment increased following the introduction of lead additives in automobile gasoline. Then, between 1973 and 1985, airborne lead concentrations fell considerably due to the increased use of unleaded gasoline. Since 1990, the use of leaded gasoline in on-road motor vehicles has been prohibited in Canada, under the <i>Canadian Environmental Protection Act</i> (CEPA). Although leaded gasoline is no longer used in such vehicles in Canada, lead particles from gasoline emissions are still a source of lead in our environment today. In addition, leaded gasoline is still being used in many countries, so contamination of the atmosphere continues.</p>	

Indicator 5 - Children living in homes with a potential source of lead		Type of indicator: Exposure surrogate
<i>Strengths of the indicator</i>	Nationally relevant. Focuses on the major source of exposure for children in Canada.	
<i>Limitations of the indicator</i>	Because children are believed not to be at risk from lead in paint until it is disturbed, the relationship between lead in paint in homes and actual exposure is not reflected in this indicator. There may also be other sources for lead in house dust posing risks to children's health that are not taken into account in this indicator.	
<i>Additional indicators</i>	Blood lead measures would be ideal. Currently, they are not available on a nationally representative sample of Canadian children.	
<i>Opportunities for improvement</i>	Include health exposure data from lead found in the soil, dust, drinking water, food and various consumer products. Measure blood lead levels in children.	
<i>Related programs/activities</i>	Health Canada is mandated, under the Government of Canada's <i>Hazardous Products Act</i> and Regulations, to protect Canadians from potential health hazards in consumer products. Health Canada has also developed a Lead Risk Reduction Strategy for Consumer Products to protect children from exposure to lead through consumer products. It proposes to regulate children from exposure to lead through consumer products. The <i>Food and Drugs Act</i> controls the lead content in food and food packaging materials such as tin cans.	

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
INDICATOR description	
<i>Definition</i>	<p>The indicator uses data from pollutant release and transfer registries (PRTRs) as an action indicator, to determine governments' and industry's effectiveness in reducing emissions of various chemicals released by facilities into all environmental media (air, water, land and injected underground). PRTRs are central national registries that are designed to provide detailed data on types, locations and amounts of chemicals that are released into air, water or land or that are transferred off-site for further management or disposal by industrial facilities. The data are collected by national governments each year and compiled into annual reports and electronic databases. PRTRs have been established both in Canada and the United States and voluntarily in Mexico.</p>
<i>Rationale and role</i>	<p>The role of this indicator is to serve as an action indicator by providing trends in release data from major industrial and commercial sources for selected chemicals. The selected chemicals are those that are required by governments to be reported to national (both U.S. and Canadian) registries. Those chemicals reported to national registries are a very small subset of all chemicals emitted to the environment every year. Trends in pollutant releases allow the determination of whether "actions" taken by governments and industry to reduce pollutant releases to the environment are effective.</p> <p>National registries of releases and disposal of chemicals provide information to the public on the sources, handling and quantities of hundreds of chemicals released into the environment. PRTRs are valuable tools that allow us to set better priorities and targets, manage releases and track progress.</p> <p>The PRTR data are annual estimates of emissions to the environment. For chemicals that persist a long time in the environment, bioaccumulate and travel far from their points of origin, these ongoing annual releases are of particular concern, because they add to the cumulative load of chemicals to the environment. PRTR data are just one source of information on toxic chemicals in the environment. Other sources include measurements of concentrations of chemicals in the air, land and water in our communities, specialized chemical and air pollutant inventories, hazardous waste databases, modelling estimates, body burdens in plants, fish and people, and industrial emission rates for chemicals.</p> <p>In making good use of PRTR data, it is important to know their limitations. PRTR data do not include:</p> <ul style="list-style-type: none"> • all potentially harmful chemicals—just those on the lists of chemicals to be reported; • chemicals released from mobile sources, such as cars and trucks; • chemicals released from natural sources, such as forest fires and erosion; • chemicals released from small sources, such as dry cleaners and gas stations; • chemicals released from small manufacturing facilities with fewer than 10 employees; • information on the toxicity or potential health effects of chemicals; • information on risks from chemicals released or transferred; or • information on exposures of humans or the environment to chemicals released or transferred. <p>From a children's health perspective, the rationale for providing an action indicator of PRTR data is that industrial emissions of these chemicals may contribute to the contamination of the food children eat, the water they drink, the air they breathe and the soil with which they come in contact. In addition, certain subpopulations of children may be exposed to pollutant releases to air, water and soil. PRTR data represent estimated releases of pollutants to the environment and do not represent human exposure to these substances. The degree of human exposure is not necessarily proportional to the number of tonnes of pollutants released. There are many factors to consider in determining human exposure to each chemical and the risks associated with that exposure. These include:</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<ul style="list-style-type: none"> • the route of exposure (ingestion, inhalation, dermal); • the duration and frequency of the exposure; • the rate of uptake of the substance; • the individual age, gender and ethnicity; and • the disease, overall health and nutritional status of the individual (including pregnancy status, in the case of prenatal exposure). <p>PRTR data for Canada are provided by the National Pollutant Release Inventory (NPRI), which is a legislated, nationwide, publicly accessible inventory of pollutants released to the environment. It was created in 1992 to provide Canadians with information on pollutant releases to air, water and land from facilities located in their communities and the quantities sent to other facilities for disposal, treatment or recycling. For the 2001 reporting year, there were 274 substances listed in the NPRI.</p> <p>Using NPRI data, Canada is reporting:</p> <ul style="list-style-type: none"> • Under Industrial Releases of Lead – Indicator 6 PRTR data on industrial releases of lead: <p>Figure 3.3: On- and off-site releases of lead (and its compounds), Canada, 1995–2000 Figure 3.4: Total estimated emissions of lead to air, Canada, 1990–2002</p> <ul style="list-style-type: none"> • Under Industrial Releases of Selected Chemicals – Indicator 7 PRTR data on industrial releases of 153 chemicals <p>Figure 3.5: Total on- and off-site releases of matched chemicals, Canada, 1998–2002 Figure 3.6: Total on- and off-site releases of matched chemicals, by industry sector, Canada, 1998–2002</p> <p>Figures 3.7–3.13: On-site releases of selected toxic substances reported in the NPRI for Canada Figure 3.14: Total atmospheric releases of mercury in Canada, 1990–2000</p> <p>In order to increase comparability of data, the Commission for Environmental Cooperation (CEC) Steering Group decided to report PRTR data for 153 matched chemicals—those chemicals reported in the NPRI that are also required to be reported in the United States (Figures 3.5 and 3.6).</p> <p>In addition, emissions data are presented separately for 7 of the 274 chemicals reported to the NPRI (Figures 3.7–3.13). Those chemicals were selected due to the health effects associated with potential children’s exposure to them. The chemicals selected are arsenic, benzene, cadmium, chromium, dioxins and furans, hexachlorobenzene (HCB) and mercury.</p> <p>Exposure can take place through inhalation of the chemical in the air (indoors or outdoors), dermal contact with contaminated soil and ingestion of contaminated food, water or small amounts of soil. Each substance is associated with specific health effects in children, including cancer, birth defects or disruption of reproductive, developmental, neurobehavioural, immune system, endocrine and metabolic processes.</p> <p>The eight substances selected are not intended to be a comprehensive list of substances that are of specific concern to children’s health. Rather, they are a few substances for which there are known adverse health effects in childhood or adulthood associated with prenatal or childhood exposure. This is Canada’s first attempt at prioritizing a vast amount of PRTR data from a children’s health perspective.</p>
<i>Data range</i>	<p>Emissions are reported from 1994 to 2002 except for dioxins and furans (2000–2002) and HCB (2000–2002), because those substances have been required to be reported to the NPRI since the year 2000 only.</p> <p>In addition, an inventory of total atmospheric releases of mercury is presented for 1990–2000.</p>
<i>Terms and concepts</i>	<p>The “153 matched chemicals” are those chemicals reported in the Canadian NPRI as well</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>as the U.S. Toxics Release Inventory (TRI).</p> <p><i>On-site releases:</i> An on-site release is a discharge of an NPRI-listed pollutant to the environment, within the physical boundaries of the facility. This includes:</p> <ul style="list-style-type: none"> • emissions to the air (discharges through a stack, vent or other point release, losses from storage and handling of materials, fugitive emissions, spills and accidental releases, and other non-point releases); • releases to surface waters (discharges, spills and leaks, but not including discharges to municipal wastewater treatment plants, which are reported under off-site transfers for treatment); and • releases to land (spills, leaks and others). <p><i>Off-site transfers for treatment prior to final disposal:</i> A shipment of an NPRI-listed substance may be transferred to an off-site location for treatment prior to final disposal. The treatment processes include:</p> <ul style="list-style-type: none"> • physical treatment (e.g., drying, evaporation, encapsulation or vitrification); • chemical treatment (e.g., precipitation, stabilization or neutralization); • biological treatment (e.g., bio-oxidation); • incineration or thermal treatment where energy is not recovered; and • treatment at a municipal sewage treatment plant. <p><i>Off-site transfers for recycling and energy recovery:</i> A shipment of an NPRI-listed substance may be transferred to an off-site location for recycling and energy recovery. "Recycling" refers to activities that keep a material or a component of the material from becoming a waste destined for final disposal. Nine types of recycling operations are identified:</p> <ul style="list-style-type: none"> • recovery of solvents; • recovery of organic substances (other than solvents); • recovery of metals and metal compounds; • recovery of inorganic materials (other than metals); • recovery of acids and bases; • recovery of catalysts; • recovery of pollution abatement residues; • refining or reuse of used oil; and • other recovery, reuse or recycling activities. <p><i>Reporting thresholds:</i> Only facilities that emit a chemical in a quantity above the reporting threshold are required to report the emission of that chemical to the NPRI. Prior to 2000, a facility was generally required to report releases and transfers of an NPRI-listed chemical if that chemical was manufactured, processed or otherwise used in a quantity exceeding 10 tonnes per year at a concentration equal to or greater than 1% by weight and by-products at any concentration.</p> <p>Reporting thresholds for some chemicals were lowered in 2002. Lowering of the reporting thresholds increases the number of facilities that are required to report and thus may result in increases in reported emissions. Such reported increases may not necessarily reflect an increase in emissions to the environment.</p> <p>In addition, even under a constant reporting threshold, the number of facilities reporting from year to year may still fluctuate, depending on whether their emissions were higher or lower than the reporting threshold for each particular year.</p> <p>Reporting thresholds for each chemical reported for these two indicators are as follows:</p> <p>1. Arsenic: From 1994 to 2001: 10 tonnes; for year 2002: 50 kg with a 0.1% concentration threshold.</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>In the year 2000, the 20 000-hour employee threshold was removed for certain industries, including wood preservation, a source of arsenic releases.</p> <p>2. Benzene: 10 tonnes with a 1% concentration threshold.</p> <p>3. Cadmium: From 1994 to 2001: 10 tonnes with a 1% concentration threshold; for year 2002, reporting threshold changed to 5 kg with a 0.1% concentration.</p> <p>4. Chromium (and its compounds): 10 tonnes with a 1% concentration threshold; beginning in 2002, the reporting of hexavalent chromium (the most toxic form of chromium compounds) is reported separately in the NPRI.</p> <p>5. Dioxins and furans and 6. HCB: Reported on an “activity-based” threshold basis. Facilities engaged in some identified activities (“activity-based threshold”) are required to submit a report on dioxins and furans and HCB to the NPRI. The identified activities were selected by Environment Canada to cover all main point sources of dioxins/furans and HCB releases being targeted by Canada-wide Standards initiatives for dioxins/furans and HCB. Reporting by limited sectors known to release these substances will capture all significant releases from such facilities, while minimizing reporting burden on other NPRI reporting facilities.</p> <p>7. Lead: 50 kg with a 0.1% concentration threshold.</p> <p>8. Mercury: From 1994 to 1999: reporting threshold at 10 tonnes; from 2000 to 2002: reporting threshold at 5 kg at with no concentration limit.</p>
<i>Data sources, availability and quality</i>	<p><i>Data source:</i> Data are provided by the NPRI. The NPRI is a legislated, nationwide, publicly accessible inventory of pollutants released to the environment. It was created in 1992 to provide Canadians with information on pollutant releases to air, water and land from facilities located in their communities and the quantities sent to other facilities for disposal, treatment or recycling. The NPRI program is delivered by Environment Canada under the authority of the <i>Canadian Environmental Protection Act, 1999</i> (CEPA 1999). Owners or operators of facilities that meet the criteria for reporting for one or more of the listed substances are required to submit an annual report to Environment Canada on the releases and transfers of those substances. The NPRI list of substances was developed through public consultation and includes substances of health or environmental concern. Environment Canada makes the information available to Canadians in an annual public report and maintains a detailed inventory that can be accessed and searched through an online database (http://www.ec.gc.ca/pdb/npri/).</p> <p><i>Data quality:</i> Amounts reported to the NPRI are estimates. These estimates may reflect monitoring, engineering calculations, emission factors (which identify the amounts of a chemical that can be expected to result from particular industrial processes or from use of specific equipment) or other estimation techniques. The NPRI requires reporting of the amounts of individual types of transfers. The data collected from the facilities are reviewed for inconsistencies by staff in the NPRI office, and then the data are posted on the NPRI website for public access.</p>
<i>Units of measurement</i>	The units of measurement are tonnes, grams (for HCB) and grams of international toxicity equivalent (TEQ) (for dioxins and furans).
<i>Computation</i>	<p>Figure 3.3: On- and off-site releases of lead (and its compounds), Canada, 1995–2000</p> <p>Only manufacturing industries were selected, which does not include electric utilities, hazardous waste facilities or mining facilities.</p> <p>Manufacturing Industry Sectors (U.S. SIC codes 20–39) include Food Products, Tobacco Products, Textile Mill Products, Apparel and Other Textile Products, Lumber and Wood Products, Furniture and Fixtures, Paper Products, Printing and Publishing, Chemicals, Petroleum and Coal Products, Rubber and Plastics Products, Leather Products, Stone/Clay/Glass Products, Primary Metals, Fabricated Metals Products, Industrial Machinery, Electronic/Electrical Equipment, Transportation Equipment, Measurement/Photographic Instruments, Misc. Manufacturing Industries.</p> <p>Figure 3.4: Total estimated emissions of lead to air, Canada, 1990–2002</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>Numerous data sources were used to compile Canada's comprehensive atmospheric lead emissions inventory, including the NPRI. Estimation methods are done according to the EMEP/CORINAIR Emission Inventory Guidebook (http://reports.eea.eu.int/EMEPCORINAIR3/en/tab_abstract_RLR) prepared by the United Nations Economic Commission for Europe (UNECE)/EMEP Task Force on Emissions Inventories and Projections.</p> <p>Figures 3.5 and 3.6</p> <p>See the CEC Taking Stock 2001 report for a complete list of the 153 matched substances included in these figures (http://www.cec.org/takingstock/).</p> <p>Only certain industry sectors are covered in the matched data set:</p> <p>Manufacturing Industry Sectors (U.S. SIC codes 20–39): Food Products, Tobacco Products, Textile Mill Products, Apparel and Other Textile Products, Lumber and Wood Products, Furniture and Fixtures, Paper Products, Printing and Publishing, Chemicals, Petroleum and Coal Products, Rubber and Plastics Products, Leather Products, Stone/Clay/Glass Products, Primary Metals, Fabricated Metals Products, Industrial Machinery, Electronic/Electrical Equipment, Transportation Equipment, Measurement/Photographic Instruments, Misc. Manufacturing Industries.</p> <p>Other Sectors: Coal Mining (except U.S. SIC code 1241), Electric Utilities (limited to those that combust coal and/or oil, U.S. SIC codes 4911, 4931 and 4939), Hazardous Waste Treatment and Disposal/Solvent Recovery (U.S. SIC codes 4953 and 7389), Chemical Wholesalers.</p> <p>* U.S. SIC codes are used because NPRI facilities report both the Canadian SIC code and the equivalent U.S. SIC code and TRI facilities report only the U.S. SIC codes.</p> <p>The data for this indicator were extracted from the NPRI database and then processed in Excel. The units for some of the substances have been converted to more appropriate units, such as kilograms or grams. The indicator is the sum of reported releases to air, water and land.</p> <p>Figures 3.7–3.13: On-site releases to air, water and soil of selected toxic substances reported in the NPRI for Canada</p> <p>On-site releases on selected substances as reported in the NPRI, all sectors.</p> <p>Figure 3.14: Total atmospheric releases of mercury in Canada, 1990–2000</p> <p>Numerous data sources were used to compile Canada's comprehensive atmospheric mercury emissions inventory. About 73% of the emissions were obtained from Canada's PRTR program, the NPRI. The NPRI-reported emissions are based on a variety of estimation methods, predominantly emission factors, and stack testing. To complete the inventory, a variety of statistics, databases, methodologies and submissions were used. Statistics from Statistics Canada, such as fuel use, were the major source of data for the area source calculations, but other information was obtained from various industrial sector associations (e.g., pulp and paper, electrical utilities), provincial authorities and government departments to estimate the emissions.</p> <p>Databases such as the Canadian Residual Discharge Information System II, which contains facility-specific information, were used in conjunction with emission factors from the U.S. Environmental Protection Agency emission factor database FIRE 6.23, AP-42 emission factor manuals, mercury locating and estimating documents, and numerous other documents. For some of the sectors, Environment Canada has performed surveys (e.g., residential firewood) or used consultants' reports to complete the emissions picture. Industrial/commercial sectors were analyzed to ensure comprehensiveness. Values for those facilities/sectors that did not report mercury emissions were estimated by Environment Canada.</p> <p>The mercury emissions inventory is for anthropogenic activities in that year. Emissions that are due to historical activities are not included, nor are natural mercury emissions sources such as soil evasion or geological releases.</p> <p>The comprehensive mercury inventory includes emissions to air only (Environment Canada, 2003b).</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
<i>Sources of further information</i>	<p><i>Data providers:</i> Environment Canada National Pollutant Release Inventory Environment Canada 9th Floor, Place Vincent Massey 351 St. Joseph Blvd. Gatineau, Quebec K1A 0H3 Tel.: (819) 953-1656 Fax: (819) 994-3266 E-mail: npri@ec.gc.ca http://www.ec.gc.ca/pdb/npri Air Pollutant Emission Inventories: http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm</p> <p><i>Indicator developers:</i> National Indicators and Reporting Office, Environment Canada <i>Environmental Signals:</i> http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm CEC, Taking Stock reports: http://www.cec.org NPRI Office, Environment Canada NPRI: http://www.ec.gc.ca/pdb/npri</p> <p><i>Data users:</i> Non-governmental organizations (e.g., PollutionWatch, http://www.pollutionwatch.org/home.jsp; CEC, Taking Stock reports, http://www.cec.org)</p>
<i>Geographic scale</i>	National (all of Canada). The data are collected for individual facilities and can be expressed at different scales (e.g., by province).
<i>Useful references</i>	<ul style="list-style-type: none"> • NPRI website, which includes downloadable databases and annual reports: http://www.ec.gc.ca/pdb/npri • Online data search: http://www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm • General inquiries: npri@ec.gc.ca • Environment Canada's <i>Environmental Signals, Canada's National Environmental Indicator Series 2003</i>: http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm
INDICATOR presentation and observations	
<i>Key observations</i>	<p><i>NPRI "on-site" releases and transfers:</i></p> <p>1. Arsenic</p> <p><u>Health effects</u></p> <p>Inorganic arsenic has been consistently demonstrated in numerous studies to cause cancer in humans exposed by both inhalation and ingestion (Government of Canada, 1993a). Food, drinking water and soil are the main potential sources of arsenic exposure for children. Inorganic arsenic crosses the human placenta, but there has been little research on adverse developmental outcomes. Ecological and case-control studies have shown elevated risks of spontaneous abortion, birth defects and/or stillbirths in areas with elevated drinking water or airborne arsenic levels. Prenatal exposure to high doses of inorganic arsenic caused neural tube defects, growth retardation and fetal death in hamsters, mice, rats and rabbits. The U.S. National Research Council and the Agency for Toxic Substances and Disease Registry concluded that there is insufficient evidence to judge if inorganic arsenic can affect reproduction or development in humans (Wigle, 2003: 118).</p> <p><u>Trends in emissions</u></p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>Arsenic is a naturally occurring element found commonly in wood preservation industries, mining and fossil fuel combustion. Total on-site releases of arsenic increased slightly, by 11.4%, from 180 tonnes in 1994 to 201 tonnes in 2002. Much of the increase in total on-site releases of arsenic, which include emissions to air and releases to land and water, can be accounted for by an almost fivefold increase in reporting facilities. In the year 2002, there were 207 facilities reporting to the NPRI for arsenic, compared with only 46 in 1994. Arsenic releases were at their lowest in 1995, with 108.8 tonnes, and at their highest in 2001, with 256.3 tonnes.</p> <p>Some important changes to NPRI reporting guidelines with respect to arsenic releases occurred in 2000 and 2002. In the year 2000, the 20 000-hour employee threshold was removed for certain industries, including wood preservation, a source of arsenic releases, while in 2002, arsenic thresholds were decreased from 10 tonnes to 50 kg at 0.1% concentration.</p> <p><u>Legislative and policy framework</u></p> <p>Arsenic and its compounds were on the first Priority Substances List under the <i>Canadian Environmental Protection Act (CEPA)</i>. The assessment concluded that current concentrations of inorganic arsenic in Canada may be harmful to the environment and may constitute a danger in Canada to human life and health. Inorganic arsenic compounds are listed as toxic in Schedule 1 of CEPA 1999.</p> <p>Currently, there are a number of regulations in place regarding arsenic releases on a federal level to reduce exposure. CEPA 1999 regulates the dumping at sea of any materials containing specified concentrations of arsenic. The federal government is also developing controls to reduce environmental exposure.</p> <p>In addition to CEPA 1999, section 36 of the federal <i>Fisheries Act</i> prohibits the depositing of harmful substances, including arsenic, into waters used by fish. The Metal Mining Liquid Effluent Regulations under the <i>Fisheries Act</i> also placed limits on arsenic and other metals found in mining effluents. The shipping or transport of arsenic under the federal <i>Transportation of Dangerous Goods Act</i> is controlled by the <i>Hazardous Products Act</i>, the <i>Food and Drugs Act</i> and the <i>Pest Control Products Act</i>.</p> <p>Environment Canada has also published technical guidelines for the safe design and operation of facilities that use arsenic. Guidelines and codes of practice that were developed to reduce the releases of arsenic include the following:</p> <ul style="list-style-type: none"> • New Source Emission Guidelines for Thermal Electricity Generation • Environmental Code of Practice for Integrated Steel Mills • Environmental Code of Practice for Non-Integrated Steel Mills • Recommendations for the Design and Operation of Wood Preservation Facilities <p>2. Benzene</p> <p><u>Health effects</u></p> <p>Vehicle emissions are the major source of benzene releases to the environment. Releases of benzene result in measurable concentrations in the various media to which humans and other organisms may be exposed. In Canada, the primary source of human exposure to benzene is ambient and indoor air; food and drinking water contribute only minor amounts to the daily intake of benzene. Benzene has been demonstrated to cause cancer in experimental animals and humans. Benzene is, therefore, considered to be a “non-threshold toxicant”—i.e., a substance for which there is believed to be some chance of adverse effects at any level of exposure (Government of Canada, 1993b). Exposure to benzene causes leukemia and probably causes multiple myeloma (Etzel, 2003: 283).</p> <p><u>Trends in emissions</u></p> <p>Total on-site releases of benzene have been decreasing steadily since 1994, while the number of reporting facilities has increased. In 1994, 2608 tonnes of benzene were released, while in 2002, 863 tonnes were released—representing a 67% decrease in benzene releases. These are significant decreases in on-site releases, as the number of</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>reporting facilities has been steadily increasing since 1994. There were 95 reporting facilities in 1994 compared with 204 reporting facilities in 2002, over a twofold increase. Benzene is currently one of 60 VOCs with additional reporting criteria in which the reporting of benzene releases is required only if the 10-tonne air release threshold for VOCs has been met. Some major sources of benzene and other VOCs, particularly in urban areas, include vehicle emissions, gasoline storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion and aircraft. On-site releases of benzene are decreasing in part due to the regulatory and non-regulatory tools that are used to reduce benzene releases in Canada.</p> <p><u>Legislative and policy framework</u></p> <p>Benzene is listed as toxic under Schedule 1 of CEPA 1999. A major contributor to the decrease in releases thus far has been the federal government's Benzene in Gasoline Regulations, which came into effect on July 1, 1999, by recommendation of the federal-provincial Task Force on Cleaner Vehicles and Fuels. This regulation prohibits the supply after July 1, 1999, of gasoline that contains benzene at a concentration exceeding 1.0% by volume. It also prohibits the sale or the offer of sale of gasoline that contains benzene at a concentration that exceeds 1.5% by volume. Benzene release levels have been significantly reduced from a pre-regulation average of 1.6% by volume to a current average of 0.7% by volume (over a 50% reduction), while ambient benzene levels have fallen by 45% in 2001.</p> <p>Other regulations regarding benzene releases include the On-Road Vehicle and Engine Emission Regulations and the Off-Road Small Spark-Ignition Engine Emission Regulations. The Gasoline and Gasoline Blend Dispensing Flow-Rate Regulations, which came into effect in 2001, also prohibit the dispensing of fuel beyond a maximum flow rate of 38 L/min.</p> <p>In addition to federal benzene regulations, best management practices were created, including the Control of Benzene Emissions from Natural Gas Dehydrators. The oil and gas industry has also committed to reductions from natural gas dehydrators, the second largest source of benzene releases to the Canadian environment. Environmental codes of practice have also been developed for both integrated and non-integrated steel mills to reduce benzene releases. Finally, the Canada-wide Standard for Benzene (Phases One and Two) called for a 30% reduction in air emissions by the year 2000.</p> <p>3. Cadmium</p> <p><u>Health effects</u></p> <p>Anthropogenic sources of cadmium include metal production (base metal smelting and refining), fuel combustion (power generation and heating), transportation, solid waste disposal and sewage sludge application. Except for tobacco smoke, food is likely the most significant source of human exposure in Canada. The International Agency for Research on Cancer classifies cadmium as a known carcinogen. In experimental animals, inhaled cadmium caused lung cancers, while ingested cadmium caused leukemia, testicular tumours and proliferative prostatic lesions. Delayed onset and progression of kidney damage reflect the accumulation and persistence of cadmium in tissues. The few epidemiological studies of cadmium and cognitive function in children have yielded inconclusive findings because of inadequate exposure assessment and lack of control for potential confounders. Prenatal exposure of rodents to relatively low cadmium levels caused adverse neurobehavioural effects (Wigle, 2003: 121–122).</p> <p><u>Trends in emissions</u></p> <p>Cadmium is a substance that is present in the Canadian environment from both natural processes and human activities, including base metal smelting and refining, stationary fuel combustion (power generation and heating), transportation, solid waste disposal and sewage sludge application. In 1994, cadmium releases were 82 tonnes, while in 2002, releases were down to 40 tonnes. The number of reporting facilities increased steadily, from 20 reporting facilities in 1994 to 46 in 2001, with a drastic jump to 281 in 2002 caused by a reduction in reporting thresholds from 10 tonnes to 5 kg with a 0.1%</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>concentration criterion.</p> <p><u>Legislative and policy framework</u></p> <p>Inorganic cadmium compounds are listed as toxic under CEPA 1999. Some tools developed in reducing cadmium emissions include:</p> <ul style="list-style-type: none"> • New Source Emission Guidelines for Thermal Electricity Generation • Environmental Code of Practice for Integrated Steel Mills • Environmental Code of Practice for Non-Integrated Steel Mills • Contaminated Fuel Regulations • UNECE's Aarhus Protocol on Heavy Metals (ratified by Canada in 1998) <p>4. Chromium</p> <p><u>Health effects</u></p> <p>The toxicity of chromium depends on its valence state. The three most common forms are metallic, trivalent and hexavalent chromium. Nutritional chromium is the trivalent form. Hexavalent chromium, the species used in industry, is extremely toxic. Chromium can be ingested, inhaled and absorbed through the skin. Hexavalent chromium crosses the placenta and passes into breast milk (Etzel, 2003: 185). Hexavalent chromium is a human carcinogen, and chronic inhalation of chromium is associated with an increased risk of lung cancers among adults. Hexavalent chromium has a number of other toxicities. Low birth weight, birth defects and other reproductive toxicities have been observed in experimental models of chronic hexavalent chromium exposure. Type IV hypersensitivity skin reactions with contact dermatitis or frank eczema are common consequences of long-term dermal exposure (Etzel, 2003: 286).</p> <p><u>Trends in emissions</u></p> <p>Chromium is a naturally occurring metal that exists mostly in the trivalent or hexavalent form throughout Canada. On-site chromium releases remained at a steady level between the years 1994 and 1996 (65 tonnes and 69 tonnes, respectively) and then exhibited a drastic increase beginning in 1997 and ending in 1999 (790 tonnes and 1048 tonnes, respectively). Emissions of chromium hit a peak of 1740 tonnes in 1998, only to drop again to 161 tonnes in 2000. The peak in 1998 was caused by a single nickel, copper and ore mining facility with a one-time release of 1545 tonnes (approximately 89% of total on-site releases) to land. During this period, the number of reporting facilities increased steadily, beginning with 199 facilities in 1994 and ending with 449 facilities in 2002, representing over a twofold increase. In 2002, reporting thresholds for chromium releases were lowered, such that the reporting of hexavalent chromium was no longer included, as a result capturing more facilities.</p> <p><u>Legislative and policy framework</u></p> <p>Hexavalent chromium compounds are listed as toxic under CEPA 1999. Sources of chromium are primarily from industrial applications, including the production of stainless and heat-resistant steels, brick and mortars, pigments, metal finishing, leather tanning and wood preservatives. The combustion of fossil fuels and the smelting and refining of non-ferrous base metals also contribute to chromium releases. Human exposure to chromium in Canada is most likely from contaminated food sources.</p> <p>Guidelines and codes of practice regarding chromium include the New Source Emission Guidelines for Thermal Electricity Generation and Recommendations for the Design and Operation of Wood Preservation Facilities.</p> <p>5. Dioxins and furans</p> <p><u>Health effects</u></p> <p>Dioxins and furans are toxic chlorinated chemicals that are found in very small amounts in the environment, including the air, water and soil. They are also present in some foods.</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>There are 210 different dioxins and furans. All dioxins have the same basic chemical "skeleton," and they all have chlorine atoms as part of their makeup. This is also the case with furans. These substances vary widely in toxicity. The one considered most toxic is referred to as 2,3,7,8-tetrachlorodibenzo-<i>p</i>-dioxin, or simply TCDD. Scientists have researched the effects of dioxins and furans on laboratory animals. While the impact varies from one type of animal to the next, the serious health effects that can occur include weight loss, skin disorders, liver problems, immune effects, impaired reproduction, birth defects and cancer. In people exposed to high levels of dioxins and furans through job-related activities or through chemical spills, the health effect seen most often is a skin condition called chloracne. There are also some reports of other effects on the skin, liver and thyroid and on reproduction and the immune system. There are also reports of an increase in cancer. While the evidence of these effects in humans is not conclusive, the findings generally support the results of animal studies. Scientists agree that exposure to dioxins and furans should be kept as low as possible (Health Canada, 2004c).</p> <p><u>Trends in emissions</u></p> <p>Dioxins and furans were added to the NPRI substance list in 2000. Between 2000 and 2002, releases decreased from 100.5 g TEQ to 92.5 g TEQ, while the number of reporting facilities increased from 300 to 345, respectively. Many factors contribute to the decrease in dioxins and furans, including improved accuracy in reporting through testing, facility closures or improvements to the facility. Metal producers do not have a quantitative threshold for reporting—all facilities that use or engage in activities that have the potential to incidentally manufacture dioxins and furans must submit an NPRI report. In 2002, the sectors emitting the greatest quantity of dioxins and furans were primary metal manufacturing, electricity generation and waste management.</p> <p><u>Legislative and policy framework</u></p> <p>Dioxins and furans are released as by-products of combustion and many industrial processes. They also occur as micro-contaminants in the manufacture of chlorinated organic chemicals, in the production of cement and in metal smelting operations. Once emitted, they can travel long distances from the source, with a long life span.</p> <p>Over the last decade, atmospheric releases have been reduced by approximately 60% due to facility closures or process technology changes. For example, the upgrade of the Quebec Levis Municipal Waste Incinerator resulted in bringing the largest single source of dioxins and furans to below the level of quantification, achieving virtual elimination from the source. Similarly, the pulp and paper industry was a major source of releases in effluent waste. After the implementation of dioxin and furan effluent regulations in the 1990s, this sector achieved virtual elimination of its effluent, with a reduction of over 99%.</p> <p>Under the Toxic Substances Management Policy (CEPA 1999), polychlorinated dibenzo-<i>p</i>-dioxins (PCDDs or dioxins) and polychlorinated dibenzofurans (PCDFs or furans) are slated for virtual elimination, as they were determined to be toxic under CEPA 1999 and are persistent and bioaccumulative. Dioxins and furans are also listed on the UNECE POPs Protocol as toxic, with the potential for long-range transport through the atmosphere.</p> <p>In addition to the CEPA 1999 and UNECE regulations, the federal government has imposed several regulations and Canada-wide Standards regarding the release of dioxins and furans:</p> <ul style="list-style-type: none"> • Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations • Canada-wide Standard for Incineration • Canada-wide Standard for Iron Sintering • Canada-wide Standard for Coastal Pulp and Paper Boilers • Canada-wide Standard for Steel Manufacturing Electric Arc Furnaces • Canada-wide Standard for Conical Waste Combustion for Municipal Waste <p>6. Hexachlorobenzene</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p><u>Health effects</u></p> <p>HCB is a persistent substance that has been distributed to all regions of Canada, primarily through long-range transport and deposition. As a result, HCB has frequently been detected in the various media to which humans and other organisms in Canada may be exposed, particularly in sediments and fatty tissues, where it tends to accumulate. Several studies in experimental animals have demonstrated reproductive toxicity following exposure to low doses of HCB. Similarly, HCB affects the immune system. HCB is classified in Group II (probably carcinogenic to humans) and is considered a non-threshold toxicant (i.e., a substance for which there is some probability of harm for the critical effect at any level of exposure). Virtually all (>98%) of the estimated intake of HCB by members of the general population of Canada is via food, primarily through dairy products such as milk, butter and ice cream and to a lesser extent through fresh meat and eggs and peanuts/peanut butter. HCB accumulates in breast milk, and the estimated intake for breast-fed infants is greater than in other age groups of the general population (Government of Canada, 1993c).</p> <p><u>Trends in emissions</u></p> <p>HCB was added to the NPRI substance list in 2000. Between 2000 and 2002, total releases of HCB increased from 0.037 to 0.045 tonnes and the number of reporting facilities increased from 299 to 336, representing a 20% increase in total on-site releases and a 14% increase in number of reporting facilities. The reporting of HCB releases does not have a quantitative threshold, but is based on specific activities. Any facility that uses or engages in specified fuel combustion, metal smelting, production and waste incineration-based activities that have the potential to incidentally manufacture HCB must submit an NPRI report. In 2002, the sectors that reported the largest HCB releases were electric power generation, metal manufacturing, and mining and smelting. Typically, HCB is a by-product of chemical manufacturing, wood preservation plants and waste combustion.</p> <p><u>Legislative and policy framework</u></p> <p>Under CEPA 1999, HCB is considered to be a toxic, persistent and bioaccumulative substance slated for virtual elimination under the Toxic Substances Management Policy. In addition, it is considered on the UNECE Persistent Organic Pollutants (POPs) Protocol as a toxic substance with the potential for long-range transport through the atmosphere.</p> <p>Some regulatory and non-regulatory tools used to manage this substance determined to be toxic under CEPA 1999 include the following:</p> <ul style="list-style-type: none"> • Prohibition of Certain Toxic Substances Regulations, 2005 • Interprovincial Movement of Hazardous Waste Regulations • Recommendations for the Design and Operation of Wood Preservation Facilities • Level of Quantification (LoQ) for HCB in Releases to Soil • Level of Quantification (LoQ) for HCB in Air Emissions • CEC's Draft Phase One North American Regional Action Plan on Dioxins and Furans, and Hexachlorobenzene <p>7. Mercury</p> <p><u>Health effects</u></p> <p>Mercury exists in three forms: in its elemental form, as inorganic salts and as organic mercury. Mercury compounds can be toxic at very low levels in the environment. Scientists cannot tell us what level of mercury in our environment would be considered "safe." Converted by bacterial action in lakes and waterways to the more toxic form known as methylmercury, the substance then bioaccumulates in fish and shellfish. The toxic form gets concentrated as it is transferred up the food chain to birds, animals, marine mammals and humans in a process known as biomagnification. High levels of exposure can cause severe health problems immediately, but it is the lifetime accumulation of mercury that is the greater risk to future mothers and their babies. Mercury is a</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>neurotoxin—it can cause damage to the brain and central nervous system. It also affects the kidneys and lungs. Methylmercury is known to affect learning ability and development in children (Environment Canada, 1999c).</p> <p><u>Trends in emissions</u></p> <p>Total on-site releases of mercury varied between 3.8 tonnes in 1994 and 2.0 tonnes in 1999, showing no apparent tendency. In 2000, mercury releases increased dramatically to 6.2 tonnes, decreasing slightly to 5.8 tonnes in 2002. This overall increase is due to a reduction in reporting threshold to 5 kg with no concentration limit. As a result of the change in reporting threshold, the number of reporting facilities increased from 5 in 1994 to 308 in 2002. In 2002, 5.4 tonnes (93% of total on-site releases) were air releases. The sectors that emitted the greatest quantity of mercury were electrical power generation and base metal smelting. Mercury may become airborne when coal is burned or when mercury-containing fuels are combusted. Fossil fuel (coal) combustion is a primary source of mercury.</p> <p><u>Legislative and policy framework</u></p> <p>Mercury has been determined to be toxic under CEPA 1999 and has been added to Schedule 1, the List of Toxic Substances. Mercury has been an NPRI substance since its inception. In addition to CEPA 1999, the federal government also participates in a number of international activities to reduce mercury releases, such as:</p> <ul style="list-style-type: none"> • UNECE's Aarhus Protocol on Heavy Metals • CEC's North American Regional Action Plan on Mercury • The Great Lakes Binational Toxics Strategy • The Arctic Council Action Plan Mercury Project • The New England Governors/Eastern Canadian Premiers Mercury Action Plan <p>Federal and provincial mercury initiatives are also being initiated, including:</p> <ul style="list-style-type: none"> • Chlor-Alkali Mercury Release Regulations • Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem • Harmful Pollutants Annex to the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem <p>Canada-wide Standards for mercury-reducing initiatives include:</p> <ul style="list-style-type: none"> • Mercury in Dental Amalgams • Mercury-containing Lamps • Base Metal Smelting and Waste Incineration <p>8. Lead</p> <p><u>Health effects</u></p> <p>Lead occurs naturally in the environment and has many industrial uses. However, even small amounts of lead can be hazardous to human health.</p> <p>Everyone is exposed to trace amounts of lead through air, soil, household dust, food, drinking water and various consumer products. The amount of lead in the environment increased during the industrial revolution and again significantly in the 1920s with the introduction of leaded gasoline. However, since the early 1970s, lead exposure in Canada has decreased substantially, mainly because leaded gasoline and lead-based paint were phased out and the use of lead solder in food cans was virtually eliminated. Short-term exposure to high levels of lead can cause vomiting, diarrhea, convulsions, coma or even death. Severe cases of lead poisoning are rare in Canada. However, even small amounts of lead can be harmful, especially to infants, young children and pregnant women. Symptoms of long-term exposure to lower lead levels may be less noticeable but are still serious. Anemia is common, and damage to the nervous system may cause impaired mental function. Other symptoms are appetite loss, abdominal pain, constipation, fatigue,</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>sleeplessness, irritability and headache. Continued excessive exposure, as in an industrial setting, can affect the kidneys. Lead exposure is most serious for young children, because they absorb lead more easily than adults and are more susceptible to its harmful effects. Even low-level exposure may harm the intellectual development, behaviour, size and hearing of infants. During pregnancy, especially in the last trimester, lead can cross the placenta and affect the unborn child. Female workers exposed to high levels of lead have more miscarriages and stillbirths (Health Canada, 2004d).</p> <p><u>Trends in emissions</u></p> <p>Overall, while the number of reporting facilities increased by 10% between 1995 and 2000, total releases of lead and its compounds decreased by 46%. Releases increased moderately from 1995 to 1997, followed by a decrease in total releases from 1998 to 2000. Off-site releases (primarily transfers to landfills) accounted for the largest portion of releases and variation over this time period. On-site land releases decreased by 70% from 1995 to 2000. On-site releases to the air decreased from 1996 to 1999 but showed an increase (of 0.6%) from 1999 to 2000. With the introduction of unleaded gasoline in Canada in 1975, lead concentrations in the air have declined significantly. Leaded gasoline in cars was banned in Canada in 1990. Total estimated lead emissions to air (including those reported to the NPRI) decreased by 67% between 1994 and 2002.</p> <p><u>Legislative and policy framework</u></p> <p>Lead was one of the first substances named to CEPA 1999's List of Toxic Substances. As a result, the federal government is allowed to control the importation, manufacture, distribution and use of lead and lead compounds in Canada. Regulations under CEPA 1999 also restrict the use of lead in gasoline and control its release from secondary lead smelters. Disposal of materials containing certain concentrations of lead at sea is also regulated by CEPA 1999.</p> <p>In addition to CEPA 1999, the federal <i>Fisheries Act</i> prohibits the release of any substance that is harmful to fish or their habitat. Releases from metal mines and processing facilities are also regulated under the Metal Mining Liquid Effluent Regulations and Metal Finishing Liquid Effluent Guidelines under the <i>Fisheries Act</i>. Compounds containing lead are controlled by the <i>Hazardous Products Act</i>, the <i>Food and Drugs Act</i> and the <i>Pest Control Products Act</i>, while the shipping and transport of substances containing lead are regulated under the federal <i>Transportation of Dangerous Goods Act</i>.</p> <p>In combination with federal regulations are a number of risk management tools that aim to reduce levels of lead emissions, which include:</p> <ul style="list-style-type: none"> • Secondary Lead Smelter Release Regulations • Regulations Amending the Gasoline Regulations • Gasoline Regulations • Fuels Information Regulations • Gasoline and Gasoline Blend Dispensing Flow Rate Regulations
<i>Strengths of the indicator</i>	<ul style="list-style-type: none"> • The indicator provides direct information on releases from major industrial, commercial and public facilities in Canada and, if properly constructed, can reflect pollution prevention efforts. • This indicator highlights the NPRI program to the public. Public access to NPRI data can put pressure on industry to adopt best management practices and reduce pollutant releases and on governments to evaluate substances of concern and implement policy, legislation and risk management measures. • This indicator, in combination with other indicators of exposure or health effects, can be used as a starting point for evaluating whether pollution prevention measures have been effective.
<i>Limitations of the indicator</i>	<ul style="list-style-type: none"> • NPRI data do not encompass all substances emitted to the environment. • Reported NPRI emissions generally underestimate the actual chemical load to the

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	<p>environment. NPRI requires only those industrial, commercial and public facilities that meet the reporting requirement to submit their release estimates. This does not include other sources from which substances are emitted to the environment—for example, non-point source emitters (i.e., cars) or facilities that emit below the thresholds. Certain industry/activity sectors are exempted from reporting emissions to the NPRI, such as agricultural operations, mining (extraction) and oil and gas exploration. In aggregate, these sources could emit large quantities to the environment.</p> <ul style="list-style-type: none"> NPRI data do not supply a direct measure of the ultimate environmental fate and behaviour of chemical substances. Thus, they are not an estimate of risk to humans or ecological populations. Additional data on exposure levels and pathways and the toxicological or hazardous nature of the chemicals are needed to begin to assess the potential impacts on human health and the environment.
<i>Additional indicators</i>	<p>Additional indicators that could be appropriate to use in this area are actual levels of these chemicals in ambient air, water, soil and food, which would give a better indication of the fate of those chemicals in the environment and the sources of human exposure. They would also indicate whether the chemical load to the environment is increasing or decreasing over time. Many of the substances of concern to children's health are non-threshold toxicants—substances for which there are no "safe" levels of exposure (e.g., lead).</p> <p>For many substances, scientific evidence shows that adverse health effects are associated with very low levels of exposure (especially <i>in utero</i>). While reporting thresholds should be lowered to reflect the risk associated with low levels of exposure, monitoring of levels of those substances in ambient air, water and soil would be most appropriate to detect those low levels.</p> <p>The best indicator of human exposure to specific chemicals would be biomonitoring data.</p>
<i>Opportunities for improvement</i>	<ul style="list-style-type: none"> Since only facilities meeting the reporting requirements are included in the NPRI's work, combining data sources and estimating total anthropogenic releases to the environment, such as in the mercury inventory, would provide Canadians with a more comprehensive picture of the total releases into environmental media and remove the potential for misinterpreting the trends in the NPRI data. There are no targets or benchmarks against which to compare emission levels for many of the substances reported. Currently, there are many chemicals not reported to the NPRI that may be affecting children's health. Therefore, the number of chemicals being reported to the NPRI could be increased to reflect the risk of exposure of children to these chemicals. Another approach to presenting the data would be to report geographically (i.e., using geographic information systems) by representing communities that may be more at risk than others, based on the type and amount of substances emitted locally.
<i>Related programs/activities</i>	<p>Substances in the NPRI that are determined to be toxic under CEPA 1999 are managed through specific programs. The Government of Canada's Toxic Substances Management Policy puts forwards a precautionary and preventive approach to deal with substances that enter the environment and could harm the environment and/or human health. It provides a framework for making science-based decisions on the effective management of toxic substances. CEPA 1999 provides the federal government with new tools to protect the environment and human health, establishes strict timelines for managing toxic substances and requires the virtual elimination of releases to the environment from toxic substances that are bioaccumulative, are persistent and result primarily from human activity.</p> <p>The Toxics Management Process is the consultative approach taken to develop management tools for toxic substances under CEPA 1999. Under this process, Environment Canada and Health Canada prepare a risk management strategy, which outlines the proposed approach for reducing risks to human health or the environment posed by a substance found toxic under CEPA 1999.</p> <p>Environment Canada's Management of Toxic Substances website:</p>

Indicators 6 and 7 - PRTR data on industrial releases of lead / PRTR data on industrial releases of 153 chemicals	Type of indicator: Action
	http://www.ec.gc.ca/Toxics/

Indicator 8 – Pesticides		Type of indicator: Exposure surrogate
INDICATOR description		
<i>Definition</i>	Percentage of fresh fruits and vegetables with detectable organophosphate (OP) pesticide residues reported by the Canadian Food Inspection Agency (CFIA) program from 1995 to 2002	
<i>Rationale and role</i>	Children's consumption of fruits and vegetables is relatively high. This can be a major dietary source of exposure to pesticides.	
<i>Data sources, availability and quality</i>	CFIA residue monitoring database, 1995–2003. Data from the CFIA are optimized for enforcement of maximum residue levels for Canadian food. Number of detections is established according to detection limits by standardized multiresidue methods, subject to strict quality control.	
<i>Units of measurement</i>	Percent fraction	
<i>Computation</i>	Yearly enumeration of residues above 0.017 ppm for all OP pesticides on fruits and vegetables, expressed as a percentage of sample size	
<i>Sources of further information</i>	None	
<i>Geographic scale</i>	National	
<i>Useful references</i>	CFIA Chemical Residue Annual Reports 1995–2002	
INDICATOR presentation and observations		
<i>Key observations</i>	Percentage of fresh fruits and vegetables with OP pesticide residues has decreased over the years, suggesting reduced exposure from this source.	
<i>Strengths of the indicator</i>	The indicator is a weak estimator of overall children exposure because it captures only part of the overall diet and does not capture other sources of exposure.	
<i>Limitations of the indicator</i>	The indicator cannot estimate children's risk or health outcome.	
<i>Additional indicators</i>	Biomonitoring of pesticides and their metabolites in urine	
<i>Opportunities for improvement</i>	Implement a reporting system for adverse effects, expected to be available by 2007.	
<i>Related programs/activities</i>	None	

Table 1: Percentage of fresh fruit and vegetables (combined domestic and imported fruits and vegetables) with detectable OP residues

Year	Sample size	% detected
1995	10 446	12.3
1996	9 235	11.9
1997	8 289	6.1
1998	6 803	3.9
1999	8 085	5.0
2000	8 582	3.6
2001	14 124	3.7
2002	15 530	3.0

Indicator 9 - Percentage of children (households) without access to treated water	Type of indicator: Action
INDICATOR description	
<i>Definition</i>	Percentage of urban Canadians not connected to public water distribution systems in their homes
<i>Rationale and role</i>	Access to clean disinfected water greatly reduces the risk of exposure to waterborne pathogens for children. Water treatment also helps to reduce the levels of some contaminants found in water. It is assumed that Canadians on public distribution systems have a very low risk of being exposed to waterborne diseases unless there is a failure in technology or management of the water distribution system, which, despite best efforts, occasionally occurs. Nationally, it is not known how many people have wells that are subject to contamination or how many treat or disinfect their water before consumption.
<i>Data range</i>	1991, 1994, 1996 and 1999
<i>Terms and concepts</i>	<p><i>Municipal population:</i> Estimate of the population for each municipality. Self-reported by municipalities for those who responded to the survey, and taken from the most recent Statistics Canada data for non-respondent municipalities. The population cut-off is 1000.</p> <p><i>Municipal population served water:</i> Population in the municipality served by any central water distribution system. Does not include population external to the municipality. Does not include population on private individual groundwater supplies (wells).</p>
<i>Data sources, availability and quality</i>	<p>The Municipal Water Use Database (MUD) survey collects water use information from municipalities in Canada that have a population of over 1000. The survey years that are currently available are 1983, 1986, 1989, 1991, 1994, 1996 and 1999.</p> <p>The MUD survey is a self-reporting survey. Thus, the quality of the data for this indicator depends on the accuracy and timing of the respondents, the response rate of municipalities and the number of municipalities surveyed. The municipal response rates were 86% for 1991 and 1994 and 87% for 1996 and 1999.</p> <p>MUD data are available at: http://www.ec.gc.ca/water/en/manage/use/e_data.htm or from the Environmental Economics Branch, Policy and Communications, Environment Canada, 24th Floor, 10 Wellington St., Ottawa, Ontario K1A 0H3</p> <p>Census of Canada: Canadian Population (1991, 1996 and 2001). Data available at: http://www12.statcan.ca/english/census01/home/index.cfm</p>
<i>Units of measurement</i>	Percentage of Canadians
<i>Computation</i>	<p>For each survey year, the total population served by a central water distribution system (i.e., calculated as the total "population served water" reported for all the municipalities in MUD) was subtracted from the total Canadian population. This number was divided by the total Canadian population to obtain the percentage.</p> <p>A procedure was used to estimate "population served water" for non-respondent municipalities based on the known "municipal population" (from Census data) and the relatively constant ratio between the two (see <i>Environmental Signals</i>, below, for details).</p>
<i>Sources of further information</i>	Environment Canada's MUD survey background information: http://www.ec.gc.ca/water/en/manage/e_manag.htm
<i>Geographic scale</i>	National. Data are collected at the municipal level.
<i>Useful references</i>	<p>Environment Canada's <i>Environmental Signals, Canada's National Environmental Indicator Series 2003</i>, municipal water use indicators for Canada: http://www.ec.gc.ca/soer-ree/English/Indicator_series/</p> <p>Environment Canada, <i>Municipal Water Pricing, 1991–1999</i>: http://www.ec.gc.ca/water/en/info/pubs/sss/e_price99.htm</p>

Indicator 9 - Percentage of children (households) without access to treated water	Type of indicator: Action
	Health Canada, <i>Water Quality and Health</i> : http://www.hc-sc.gc.ca/ewh-semt/water-eau/index_e.html Canadian Council of Ministers of the Environment: http://www.ccme.ca/ourwork/water.html
INDICATOR presentation and observations	
<i>Key observations</i>	<ul style="list-style-type: none"> • The percentage of Canadians with access, in their home, to water obtained from a private individual source has remained constant at about 22–23% between 1991 and 1999. This represented about 6.8 million Canadians in 1999. • Canadians not connected to public water distribution systems live mostly in rural areas. Nationally, it is not known how many people have wells that are subject to contamination or how many treat or disinfect their water before consumption.
<i>Strengths of the indicator</i>	National in scope and easy to understand.
<i>Limitations of the indicator</i>	<p>At the present time, the data collected do not allow us to assess how many Canadians on public distribution systems were potentially exposed to pathogens during periods when disinfection processes were malfunctioning (i.e., during boil water advisories). Furthermore, the MUD survey does not provide compliance or performance reports for all treatment plants in Canada.</p> <p>Current data collection, at the national level, also does not provide information on pathogen occurrence or chemical contamination in private wells.</p> <p>This indicator is not expected to change very much, unless major infrastructure upgrades are put in place in many parts of Canada or the MUD survey becomes more inclusive. The indicator will not reflect changes to current water treatment practices (e.g., stricter standards for water quality and reporting problems) or efforts to protect drinking water sources (e.g., watershed management).</p>
<i>Additional indicators</i>	See other indicators under theme “Waterborne diseases” of this report.
<i>Opportunities for improvement</i>	<p>Future improvements would include deriving the population of children served by various levels of water treatment.</p> <p>The MUD survey has been improved for the next cycle of data (2001) and will likely provide more reliable and comparable data on boil water advisories and other treatment problems. However, detailed data collection on treatment plant performance and compliance according to standards or legislation is done at the provincial level and in a way that may not be available or consistent across the country. Efforts to streamline and centralize this type of information could be undertaken, especially in the context of a related program (e.g., Canadian Council of Ministers of the Environment Source to Tap Water Protection Strategy).</p> <p>A national survey of private well water quality would provide a more complete picture of the number of Canadians potentially at risk from waterborne diseases and other contaminants.</p>
<i>Related programs/activities</i>	<p>There are a number of programs and funds in Canada to support new development projects or improve existing infrastructure in Canadian communities, rural areas and First Nations communities, including water infrastructure (see http://www.infrastructure.gc.ca/index_e.shtml).</p> <p>The Government of Canada has allocated new funding over 5 years to ensure the safety of water supplies in First Nations communities. This will help to close the gap in life chances between Aboriginal and non-Aboriginal Canadians and build healthy communities (see information on the First Nation Water Management Strategy at: http://www.ainc-inac.gc.ca/H2O/bkg_e.html).</p>

Indicator 11 - Percentage of children (households) that are not served with sanitary sewers	Type of indicator: Action
INDICATOR description	
<i>Definition</i>	Percentage of urban Canadians that have access to secondary-level sewage treatment or better, through a centralized collection system
<i>Rationale and role</i>	Sanitary sewage, when not disinfected, can be a major source of pathogens for children engaged in aquatic recreational activities or drinking untreated water in the area of influence of an outfall. A number of toxic substances can also be released with municipal sewage, posing an additional threat to children's health.
<i>Data range</i>	1991, 1994, 1996, 1999
<i>Terms and concepts</i>	<p><i>Municipal population serviced by sewers:</i> Population in the municipality serviced by any sewer collection system. Does not include population external to the municipality. In Northern Canada, this includes pump-outs.</p> <p><i>Primary treatment:</i> All population served by collection systems having any form of mechanical sewage treatment (in some cases can include screens and meshes).</p> <p><i>Waste stabilization ponds:</i> All population in the municipality served only by waste stabilization ponds (also called "lagoons" or "ponds"). Considered to be equivalent to secondary level of treatment for this indicator.</p> <p><i>Secondary treatment:</i> All population in the municipality served by biological sewage treatment. If municipalities have both "primary" and "tertiary" sewage treatment, they are usually combined and counted as secondary. Municipal septic tanks are assumed to be operating correctly and providing a secondary level of service.</p> <p><i>Tertiary treatment:</i> All population in the municipality served only by some form of sewage treatment providing a higher level of treatment than secondary. Usually includes effluent polishing, phosphate removal and sometimes spray irrigation.</p>
<i>Data sources, availability and quality</i>	<p>The Municipal Water Use Database (MUD) survey collects wastewater information from municipalities in Canada that have a population of over 1000. The survey years that are currently available are 1983, 1986, 1989, 1991, 1994, 1996 and 1999.</p> <p>The MUD survey is a self-reporting survey. Thus, the quality of the data for this indicator depends on the accuracy of the respondents, the MUD definitions provided with the survey, the response rate of municipalities and the number of municipalities surveyed. The municipal response rates were 86% for 1991 and 1994 and 87% for 1996 and 1999.</p> <p>MUD data are available at: http://www.ec.gc.ca/water/en/manage/use/e_data.htm or from the Environmental Economics Branch, Policy and Communications, Environment Canada, 24th Floor, 10 Wellington St., Ottawa, Ontario K1A 0H3</p>
<i>Units of measurement</i>	Percentage of Canadians
<i>Computation</i>	This indicator was calculated by a simple summation of the municipal population serviced by sewers having primary, secondary or tertiary treatment or waste stabilization ponds across Canada, divided by the total population serviced by sewers.
<i>Sources of further information</i>	Environment Canada's MUD survey background information: http://www.ec.gc.ca/water/en/manage/e_manag.htm
<i>Geographic scale</i>	National. Data are collected at the municipal level.
<i>Useful references</i>	<p>Environment Canada's <i>Environmental Signals, Canada's National Environmental Indicator Series 2003</i>, municipal water use indicators for Canada: http://www.ec.gc.ca/soer-ree/English/Indicator_series/</p> <p>Environment Canada's <i>The State of Municipal Wastewater Effluents in Canada</i>: http://www.ec.gc.ca/soer-ree/english/SOER/MWWE.cfm</p> <p>Health Canada's <i>Water Quality</i>:</p>

Indicator 11 - Percentage of children (households) that are not served with sanitary sewers	Type of indicator: Action
	http://www.hc-sc.gc.ca/ewh-semt/water-eau/index_e.html
INDICATOR presentation and observations	
<i>Key observations</i>	<p>In 1999, 22.7 million Canadians (or 74% of the total population), living mostly in urban areas, were serviced by municipal sewer systems. This level has remained relatively constant throughout the 1990s. The remaining Canadians not serviced by sewage collection systems, about 7.8 million people, were generally served by private septic tanks, which are routinely pumped out and trucked to communal treatment facilities. When not properly installed and maintained, septic systems have the potential to contaminate nearby water bodies and groundwater sources.</p> <p>The percentage of urban Canadians served by secondary sewage treatment or better increased from 48% to 58% between 1991 and 1999. This increase largely reflects infrastructure upgrades. A higher proportion of Canadians living in coastal areas were served by lower levels of treatment (primary or none).</p> <p>About 70% of Canadians served by sewage collection systems in 1999 had effluent disinfection.</p>
<i>Strengths of the indicator</i>	Covers a large portion (83%) of the total Canadian population as part of an ongoing survey and is relatively simple to calculate and update.
<i>Limitations of the indicator</i>	<p>This indicator provides an indirect measure of sewage treatment plant performance for removing pathogens and other contaminants. The level of treatment does not provide a direct measure of plant removal efficiency. Furthermore, it does not reflect sewage bypasses (i.e., when effluents are diverted directly to receiving waters, without treatment) when influents exceed plant capacity or during periods of malfunction or servicing.</p> <p>The indicator is based on Canadians serviced with secondary or better treatment, because the original definition of primary treatment was, in some cases, interpreted differently by the respondents. In many municipalities, primary treatment does provide disinfection of effluent.</p>
<i>Additional indicators</i>	See other indicators under theme "Waterborne diseases" of this report.
<i>Opportunities for improvement</i>	<p>An improvement to this indicator would be to derive the population of children serviced by centralized sewage treatment.</p> <p>Collecting detailed data from provincial sewage treatment plant performance and compliance would also be an improvement.</p>
<i>Related programs/activities</i>	There are a number of programs and funds in Canada to support new development projects or improve existing infrastructure in Canadian communities, rural areas and First Nations communities, including wastewater infrastructure (see http://www.infrastructure.gc.ca/index_e.shtml).

Indicator 12 - Morbidity: number of cases of childhood illnesses attributed to waterborne diseases		Type of indicator: Health outcome
INDICATOR description		
<i>Definition</i>	<p><u>Notifiable Diseases Registry</u>: Number of cases of infection, by age, reported to provincial/territorial authorities and collected by Health Canada.</p> <p>Cause of infection is not identified.</p>	
<i>Rationale and role</i>	<p>The risk of microbial disease associated with drinking water is a concern among North American water jurisdictions. Numerous past outbreaks, together with recent studies suggesting that drinking water may be a substantial contributor to endemic (non-outbreak-related) gastroenteritis, demonstrate the vulnerability of many North American cities to waterborne diseases.</p>	
<i>Data range</i>	<p>Notifiable Diseases Registry 1988 to 2000: 0–1, 1–4, 5–9, 10–14, 15–19</p>	
<i>Terms and concepts</i>	<p><u>Notifiable Diseases Registry</u>: <i>Giardiasis</i>, sometimes called “beaver fever,” is an intestinal parasitic infection characterized by chronic diarrhea and other symptoms. Person-to-person transmission is common where personal hygiene may be poor. Community outbreaks may occur by ingesting cysts from fecally contaminated food or unfiltered water. Persons with acquired immunodeficiency syndrome (AIDS) may have more severe and prolonged illness.</p>	
<i>Data sources, availability and quality</i>	<p>The list of diseases on the national Notifiable Diseases Registry is agreed upon by consensus among provincial and federal health authorities through the Advisory Committee on Epidemiology. The Advisory Committee on Epidemiology meets approximately twice annually, at which times proposed additions and/or deletions to the list are debated. Data are available for <i>Campylobacter</i> from 1986 to 1999 and for <i>Giardia</i> from 1983 to 1999. These are the years in which these diseases became reportable.</p> <p>Available online at: http://dsol-smed.phac-aspc.gc.ca/dsol-smed/ndis/c_time_e.html</p>	
<i>Units of measurement</i>	<p><u>Notifiable Diseases Registry</u>: Number of cases reported to provincial/territorial health authorities per 100 000 population and number of reported cases, both available online.</p>	
<i>Computation</i>	<p><u>Notifiable Diseases Registry</u>: Information collected by provincial/territorial health departments based on where the patient resides and then passed to Health Canada. Health Canada computes both the number of cases and the rate per 100 000.</p>	
<i>Sources of further information</i>	<p>Notifiable Diseases Registry is available online through the Population and Public Health Branch database.</p>	
<i>Geographic scale</i>	<p>National.</p>	
<i>Useful references</i>	<p>Article by Lim et al. (2002): http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/relation_gastro_edmonton/index_e.html</p> <p>Government of Canada (1999) <i>Statistical Report on the Health of Canadians</i></p>	
INDICATOR presentation and observations		
<i>Key observations</i>	<p>Children aged 1–4 are more likely to be infected with both <i>Giardia</i> and <i>Campylobacter</i>. This may be because they are more likely to be brought to a primary care provider, less likely to be breastfeeding and more vulnerable to infection than older children.</p>	
<i>Strengths of the indicator</i>	<p>Analysis of trend data would provide an indication of increasing or decreasing incidence of disease. Further studies would have to be done to link cases with their etiology.</p>	
<i>Limitations of the indicator</i>	<p>Cases are not reported to the Notifiable Diseases Registry until the individual seeks assistance in the primary care system and the primary care provider reports</p>	

Indicator 12 - Morbidity: number of cases of childhood illnesses attributed to waterborne diseases	Type of indicator: Health outcome
	information to the provincial/territorial health unit. Public health scientists acknowledge that these illnesses are far more common than the reported numbers suggest. Estimates from studies in North America and Europe indicate that as few as 1–10% of cases are reported. This may, in part, reflect the mild nature of many infections, which are managed at home, or the fact that only a small proportion of patients have specimens taken for laboratory tests (Government of Canada, 1999). Limitations of the registry include underreporting, timeliness of reporting, disease case definitions and passive surveillance.
<i>Additional indicators</i>	Proportion of population with access to adequate sanitary and water treatment facilities
<i>Opportunities for improvement</i>	Within the present system, none
<i>Related programs/activities</i>	While no program specifically targets children, the Federal–Provincial–Territorial Committee on Drinking Water, which represents government departments with interests in drinking water quality (usually health and environment) at the federal, provincial and territorial levels, has developed a guidance document for managing drinking water supplies in Canada.

Appendix 4 Indicators Steering Group—Canada

Annie Bérubé
Office of Vulnerable Populations and Climate
Change
Health Canada
Sir Charles Tupper Building
2720 Riverside Drive
Ottawa, Ontario K1A 0K9
Tel: (613) 941-3610
Fax: (613) 952-8857
E-mail: Annie_A_Berube@hc-sc.gc.ca

Susan Ecclestone
Health Impacts Bureau
Health Canada
Sir Charles Tupper Building
2720 Riverside Drive
Ottawa, Ontario K1A 0K9
Tel.: (613) 948-2589
Fax: (613) 952-8857
E-mail: Susan_Ecclestone@hc-sc.gc.ca

Vincent Mercier (Country Lead)
Knowledge Integration Strategies Division
Environment Canada
Environmental Science Centre
Campus, Université de Moncton
Moncton, New Brunswick E1A 3E9
Tel.: (506) 851-6244
Fax : (506) 851-6608
E-mail: Vincent.Mercier@ec.gc.ca

Amber McCool
Strategic Policy Branch
Environment Canada
10 Wellington Street
Gatineau, Quebec K1A 0H3
Tel.: (819) 997-5087
Fax: (819) 953-4679
E-mail: Amber.McCool@ec.gc.ca