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

Country Reports

Prepared by:
Government Representatives from Canada, Mexico and the United States

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Executive Summary

This volume of *Indicators of Children's Health and the Environment in North America: A First Report on Available Measures* is provided as a technical compendium to the main report. It consists of the country reports prepared by the governments of Canada, Mexico and the United States. The country reports provide an introduction to each country and offer a more detailed description of the various issues that the indicators are addressing as well as actions being undertaken by the countries to address the issue. Each country report also includes data templates for each indicator. These templates were based on data templates created by the World Health Organization Global Initiative on Children's Environmental Health Indicators, but were modified slightly for use in this initiative.

There are many factors that influence environmental conditions and the health of a country's population. The country reports offer additional context for each country that will assist readers with the interpretation of the information presented in the main report. In some cases this includes additional illustrations and information that were not included. In some cases, the countries have elected to present additional indicators on related topics.

Technical details for each indicator are found in the country report appendix. The indicator templates provide important reference information such as definitions, source data, and calculations. This technical information is available as a resource for those interested in how the indicators were constructed or those who are wishing to develop indicators themselves.

COUNTRY REPORT: CANADA

Prepared by the Government of Canada

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 point in 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 have decreased 41% 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 2001, 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 2001, 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 (OP) pesticides detected on domestic and imported fruits and vegetables, expressed as 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 OP 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, water-borne 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 served with treated water (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 6.7 million Canadians rely on private water supplies, primarily groundwater wells. Some surveys indicate that between 20–40% 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. 74% 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 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, and applied the following criteria in selecting indicators for the first North American report.

Criteria for Selection of Indicators:

1. **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.
2. **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 (for example air quality and asthma rates).
3. **Availability.** 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.
4. **Applicable and understandable.** The indicator must be useful for policy-makers and a non-specialist audience.[1]

[1] Commission for Environmental Cooperation (CEC) Steering Group on Children's Health and the Environment Indicators, CEC Secretariat (2 June 2003), p 2-3

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

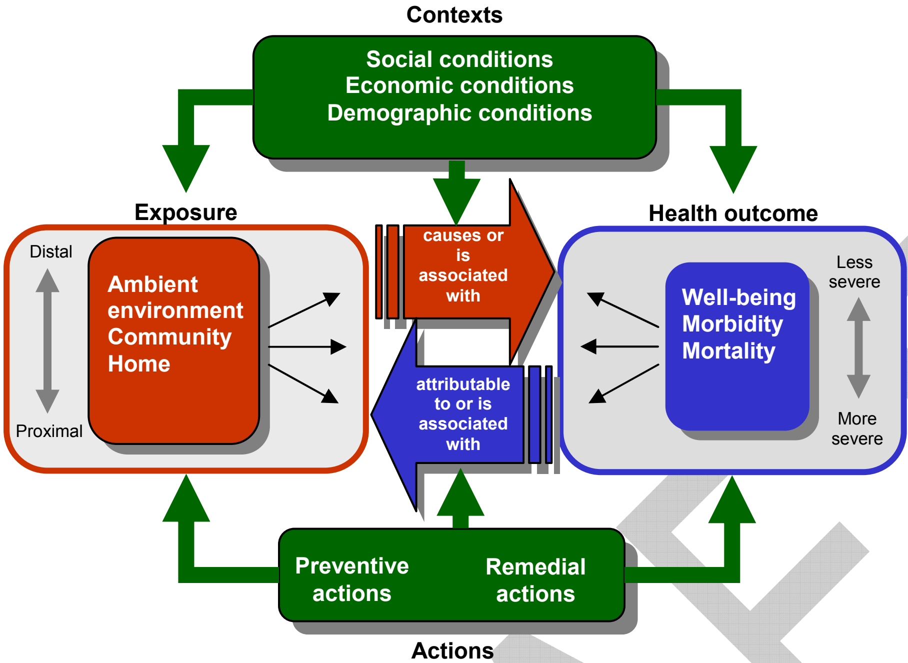
Indicator 1: Percent of children living in urban areas where air pollution levels exceed relevant air quality standards
Indicator 2: Prevalence of asthma
Indictaor 3: Measure of children exposed to second-hand smoke
Indicator 4: Blood lead levels
Indicator 5: Children living in homes with a potential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

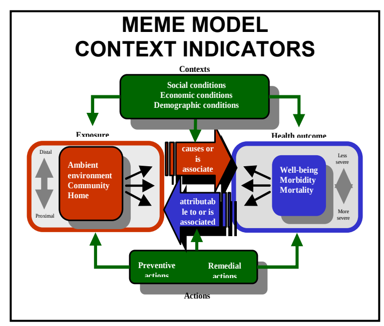
Figure 1.1: Multiple Exposure – Multiple Effect (MEME) framework



Source: Briggs (2003)

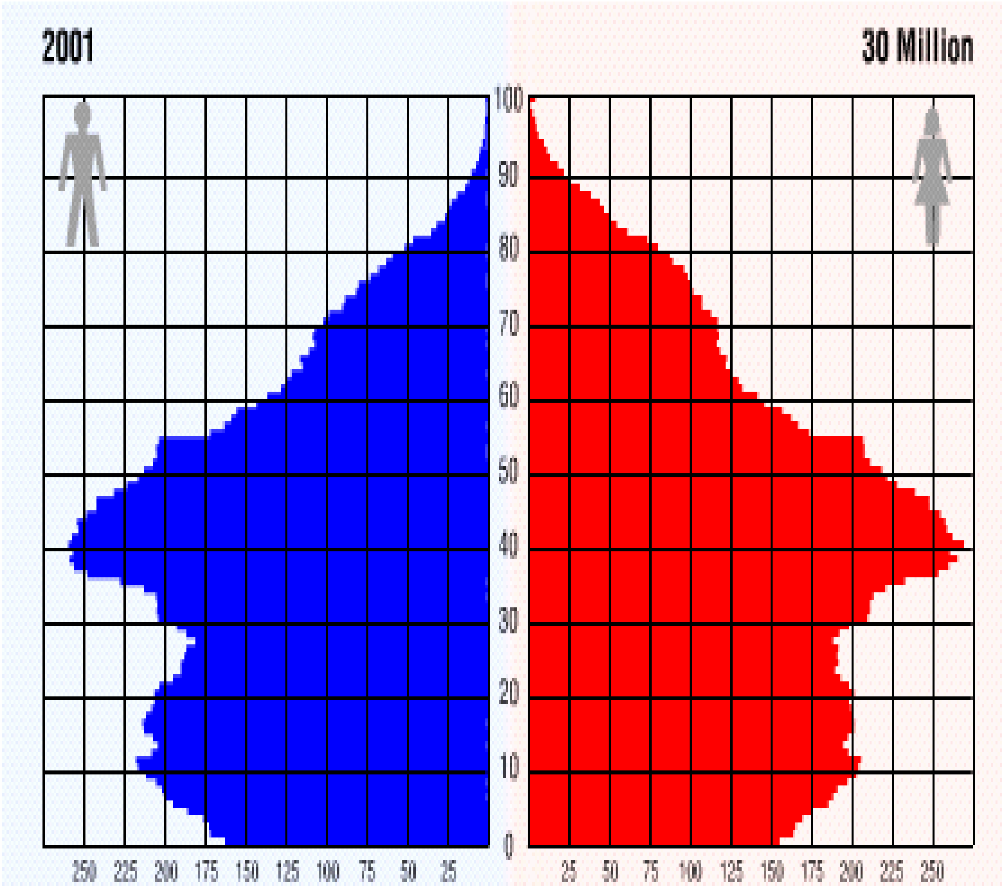
1.1 Context Indicators

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 19 years of 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, 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 years[2] (Health Canada, 2003a). The implication for environmental health is that older women 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. (Hertz-Picciotto et al., 2000; Hu et al., 1996; Rhainds et al., 1999)

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

[2] 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 1,000 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 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). Source: Health Canada, 2003a p. 22.

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 due 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).

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. Participation in these types of early childhood activities helps build the foundation for core skills and success in school (Government of Canada, 2003a). In fact, such children 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 on Welfare, 2002). Low income cut-offs (LICOs) 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. LICOs 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 LICO. The percentage of children living in low income family units has been decreasing in Canada in recent years (Statistics Canada, 2001c).

Immunization Rate

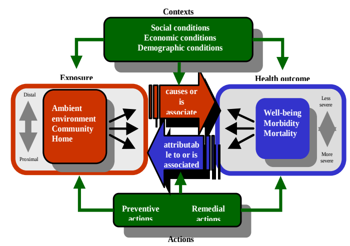
Measles immunization rates were selected as an indicator of the availability of public health services for children. In Canada, implementation of the two-dose measles immunization program in 1996–97 led to a sevenfold decrease in the incidence of reported measles by 1998 (Health Canada, 1997). By 2002,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

MEME MODEL
EXPOSURE INDICATOR



This specific indicator is not yet available in Canada

Rather, Canada is reporting the following information:

- Average levels of several air pollutants in Canada
- Peak levels of ground-level ozone for selected regions of Canada
- Number of days on which ozone levels in 2002 exceeded the Canada-wide Standard
- Peak levels of fine particulate matter ($PM_{2.5}$) for selected cities in Canada
- Number of days on which $PM_{2.5}$ levels in 2002 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 (SO_2), NO_x and VOCs. Fossil fuel combustion in motor vehicles, power plants and large industries, as well as household activities such as woodstoves 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 for asthma and other respiratory conditions, however, recent studies suggest that air pollution is associated with infant mortality and the development of asthma. Furthermore, particulate matter 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).

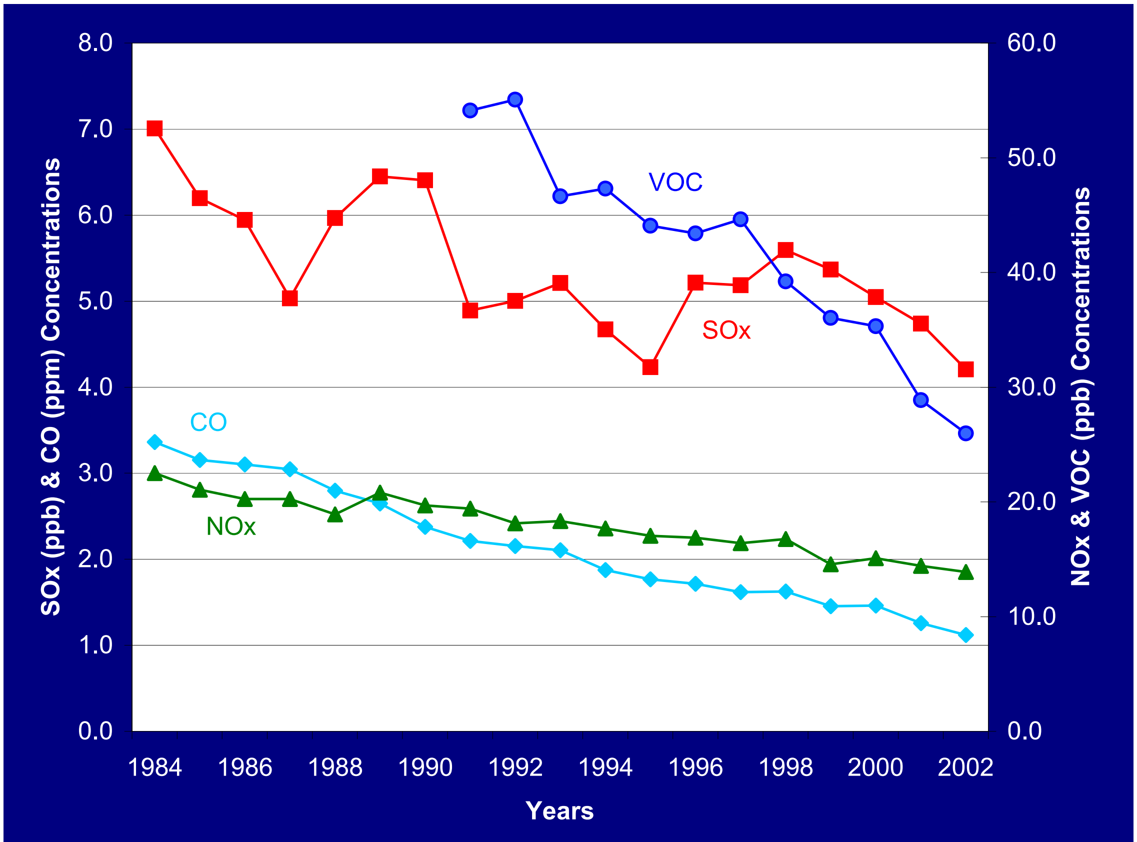
Studies that have investigated the impact of outdoor air pollution on children have noted increased coughing and wheezing (Pope, 1991; Segala et al., 1998), increased use of airway medications (Roemer et al., 1993; Peters et al., 1997; Van der Zee et al., 1999), increased hospital visits for respiratory 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 (PM_{10}) and several causes of postneonatal mortality, including sudden infant death syndrome (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, SO_2 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:

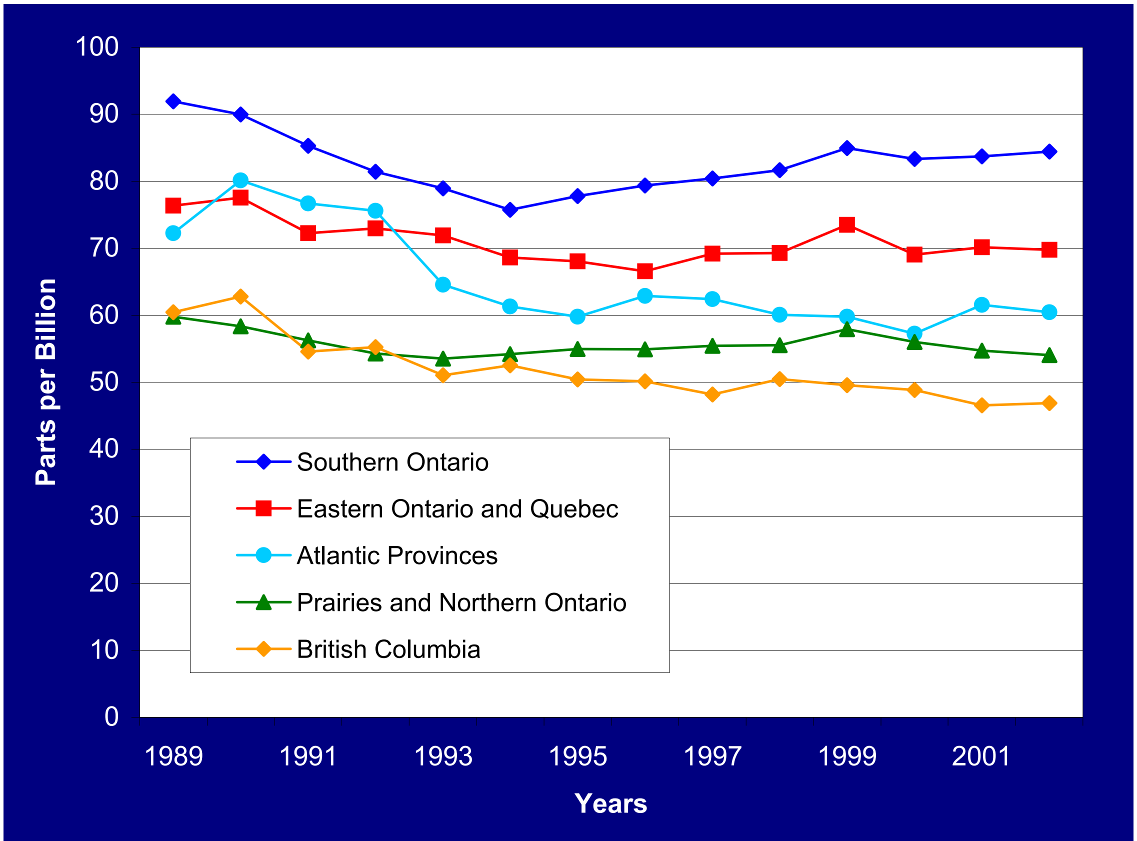
- Some of these air pollutants are precursor air pollutants that contribute to smog; nitrogen oxides (NO_x), sulphur dioxide (SO_2) and volatile organic compounds (VOCs).
- Levels of VOCs, NO_x and SO_2 are annual averages, whereas carbon monoxide (CO) levels are the 98th percentile of the 8h means for 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 presenting national annual averages.

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

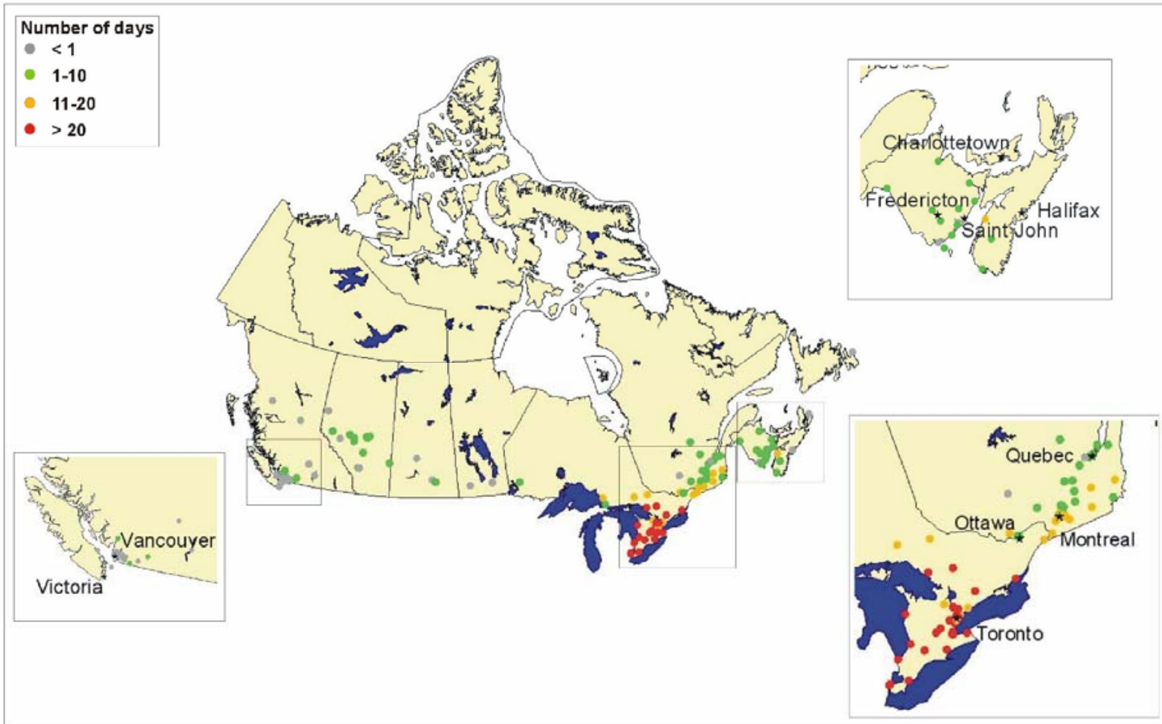
Notes: The yearly values for each station were calculated by averaging the peaks (i.e., 4th highest measurements of the year for 8 hours periods) for the current year and the two previous years resulting in a three year rolling average. The yearly rolling averages for each station were then averaged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

Key Observations:

- Although ground-level ozone levels fluctuate from year to year, they have not improved significantly in the Prairies, Ontario and Quebec over the last 13 years.
- 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 Ground-level Ozone Levels Exceeded the Canada-wide Standard



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

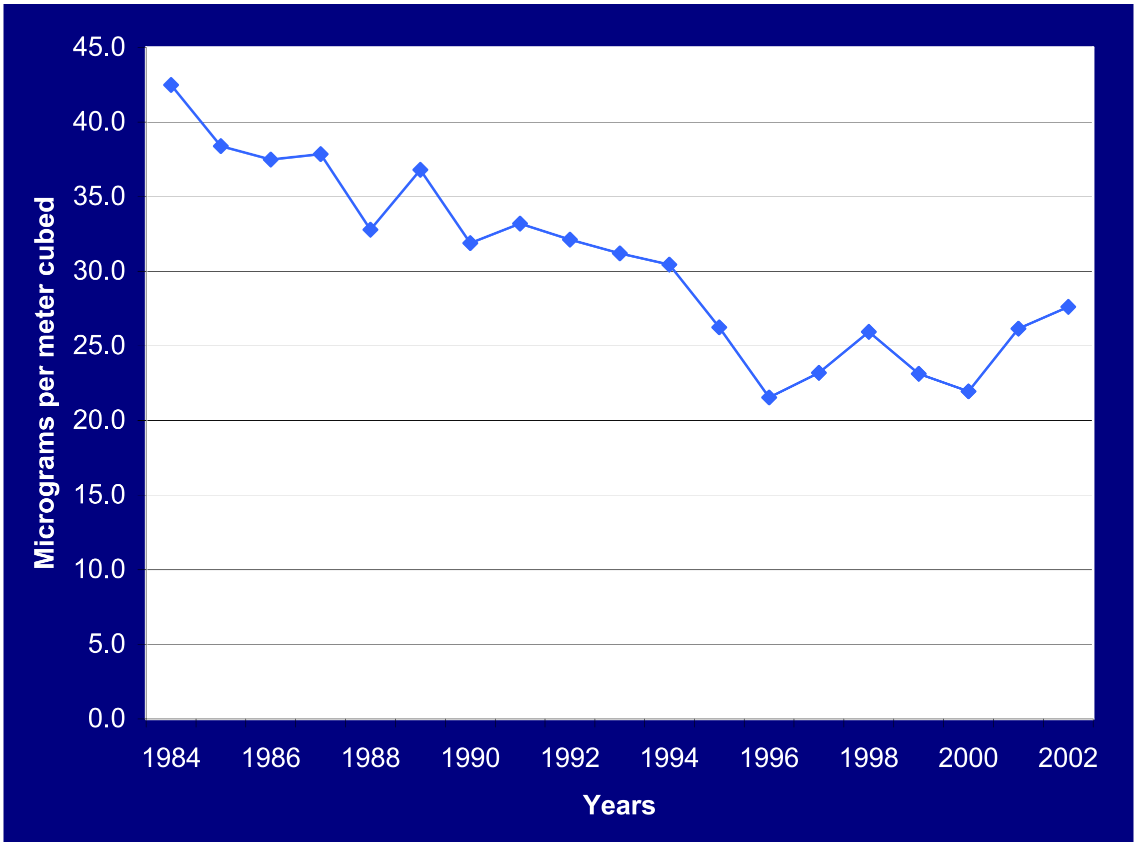
Notes: The points represent the number of days on which 8-hour ground-level ozone measurements exceeded the Canada-wide Standard of 65 ppb. The standard comes into force in 2010 and achievement will be measured using three years of data.

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

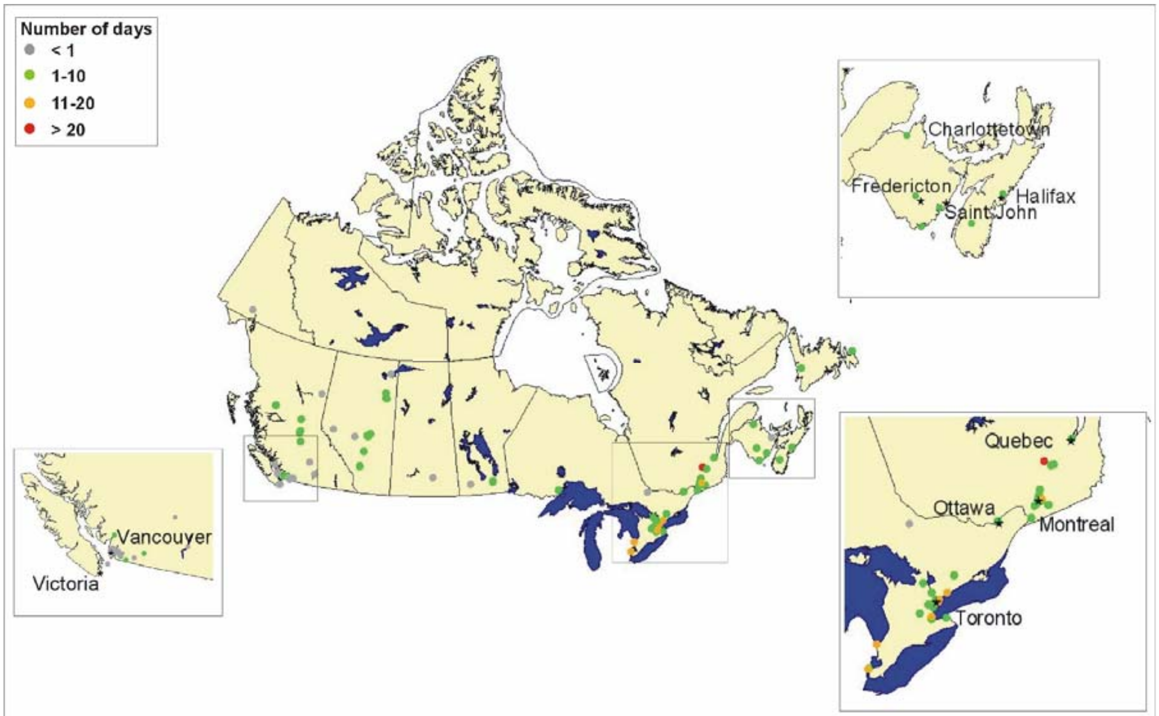
Notes: Peak values are the 98th highest values measured over 24-hour periods at each monitoring station. Data in the above graph are collected at 10–15 urban sites across Canada.

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. However, the last 7 or 8 years have not seen 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 ppb. The standard comes into force in 2010 and achievement will be measured using three 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:
PM_{10} 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 Standard for $PM_{2.5}$ is 30 $\mu g/m^3$ averaged over 24 hours using three years of data, to be achieved by 2010. The Standard for Ozone is 65 ppb averaged over 8 hours using three 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 emissions 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,b).

In 2000, Canada signed the Ozone Annex under the 1991 Canada–US Air Quality Agreement to reduce the flow of air pollutants across the Canada–US 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 particulate matter and ozone has contributed to a host of federal regulatory and standards-based activities.

Currently, under the Canada–US 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://www.ec.gc.ca/air/you-can-do_e.html

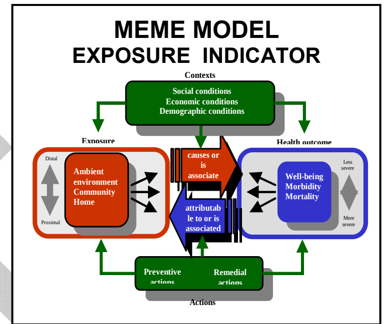
Opportunities for improvement:
A review of ambient air pollution monitoring networks to assess their suitability in estimating population exposure, in addition to further research in determining spatial dispersion of the various air pollutants across Canada, will help Canada report this indicator in 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 National Round Table for Environment and Economy Environment and Sustainable Development Indicators Initiative 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 (CHAPS) 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.



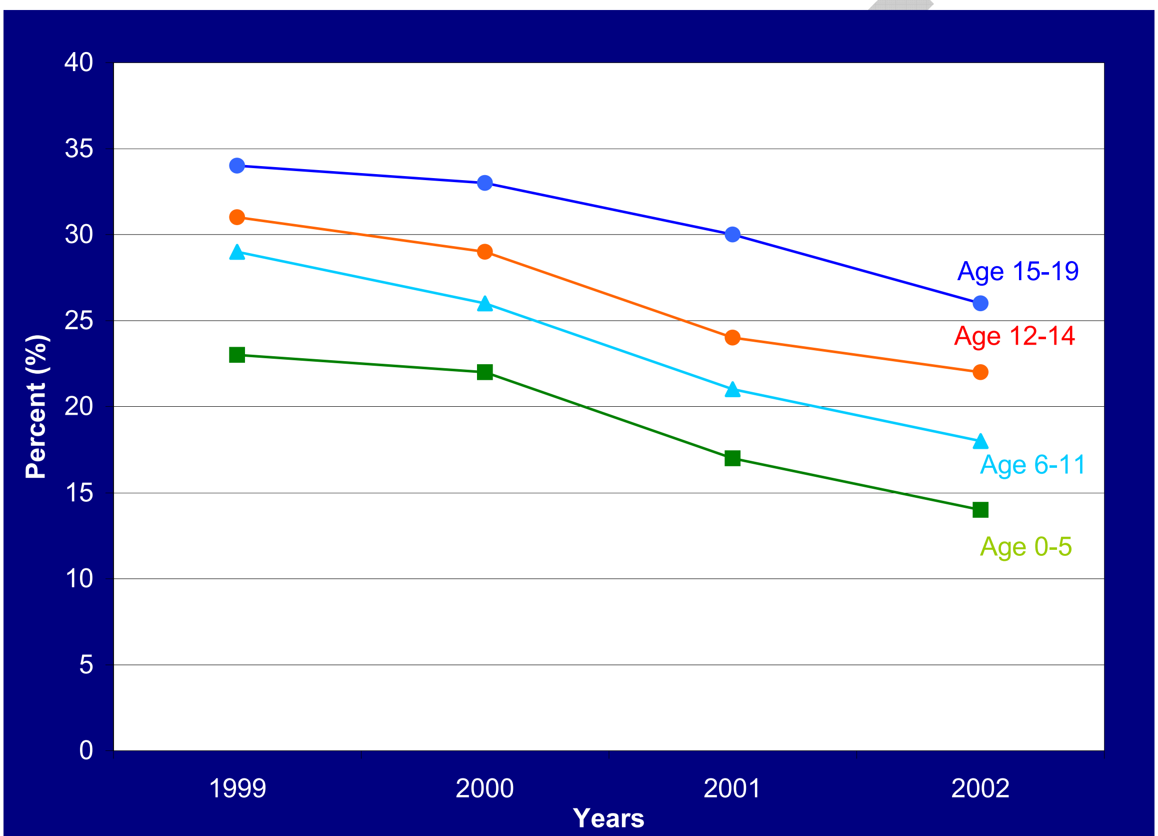
Indoor air quality is influenced by outdoor air pollution, combustion appliances, personal sources (second-hand smoke, pets), consumer products and the building fabric. The current course of improved residential energy efficiency may be having direct adverse effects on the quality of indoor air. Airtight 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. Exposure to second-hand smoke (preschool children), cat and dog allergens, cockroaches, dust mites, NO_2 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. Much less research has been done for these diseases in comparison to asthma.

Children who are exposed to secondhand smoke are at increased risk of serious adverse health effects including bronchitis, pneumonia, lower respiratory tract infections, chronic/repeated ear infections and sudden infant death syndrome (SDS) (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, 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 smoke-free municipal by-laws; 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/hecs-sesc/tobacco/facts/blueribbon/second-hand.html

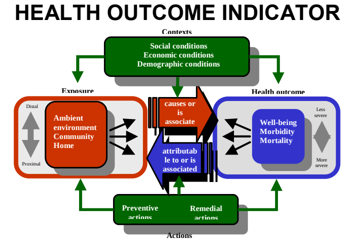
Opportunities for Improvement:
Children may be exposed to second-hand smoke in their homes and other public places as well. Biomonitoring, or biological monitoring, is the measurement of the concentration of a chemical in human specimens such as blood, urine, saliva or adipose tissue. Measures of cotinine, 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 National Population Health Survey (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:

MEME MODEL
HEALTH OUTCOME INDICATOR

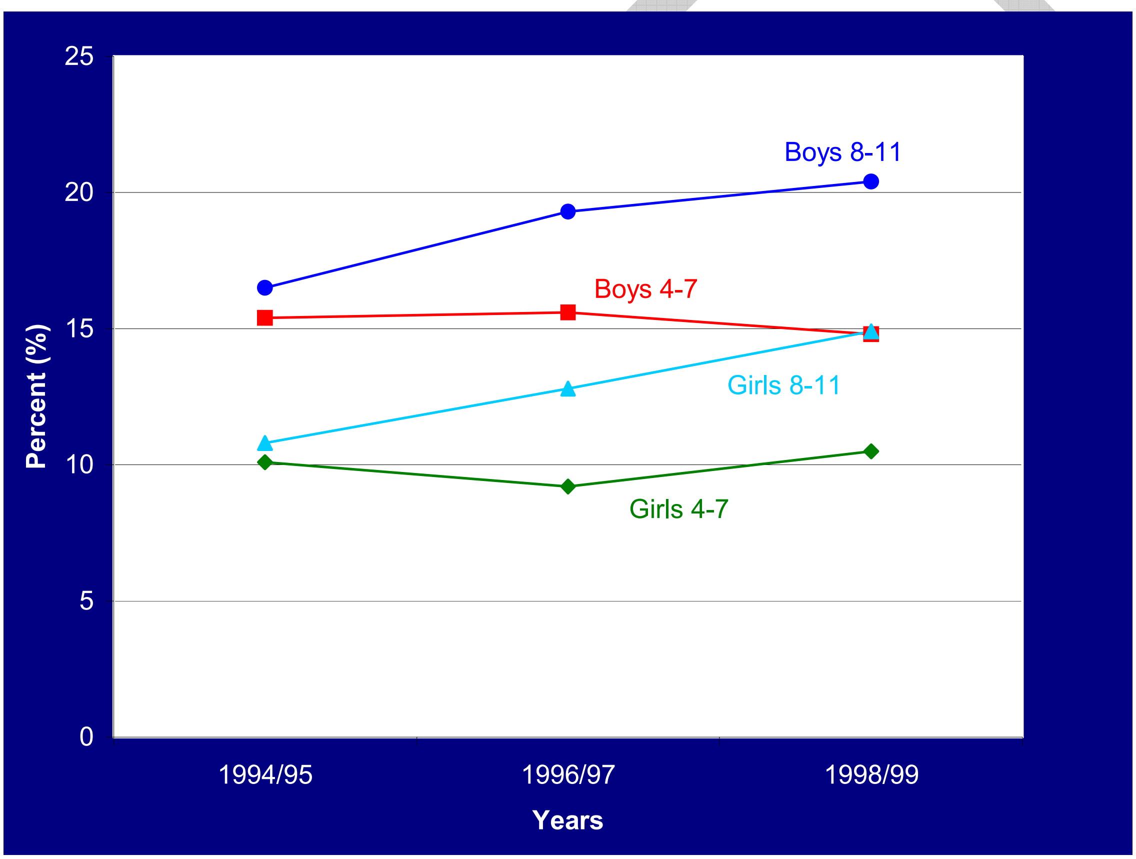


1. predisposing factors (e.g., atopy—a tendency to have an allergic reaction to foreign substances);
2. environmental causal factors (e.g., especially second-hand smoke, house dust mite antigen, outdoor air pollution); and
3. aggravating factors that increase the frequency and/or severity of asthma episodes and include 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 survey provides data on the percentage of children who have reported a diagnosis of asthma. Since it is difficult to differentiate in the survey those with other respiratory conditions (such as wheezing) from those with asthma, children under the age of four 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: Prevalence of Physician-diagnosed Asthma (ever) among Children by Age Group, Canada, 1994/1995, 1996/1997 and 1998/1999



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, 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 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.

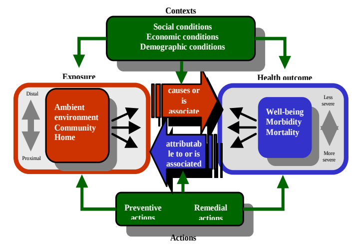
3 Lead and Other Chemicals, Including Pesticides

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.

MEME MODEL
EXPOSURE INDICATOR



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).

CASE STUDY
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)

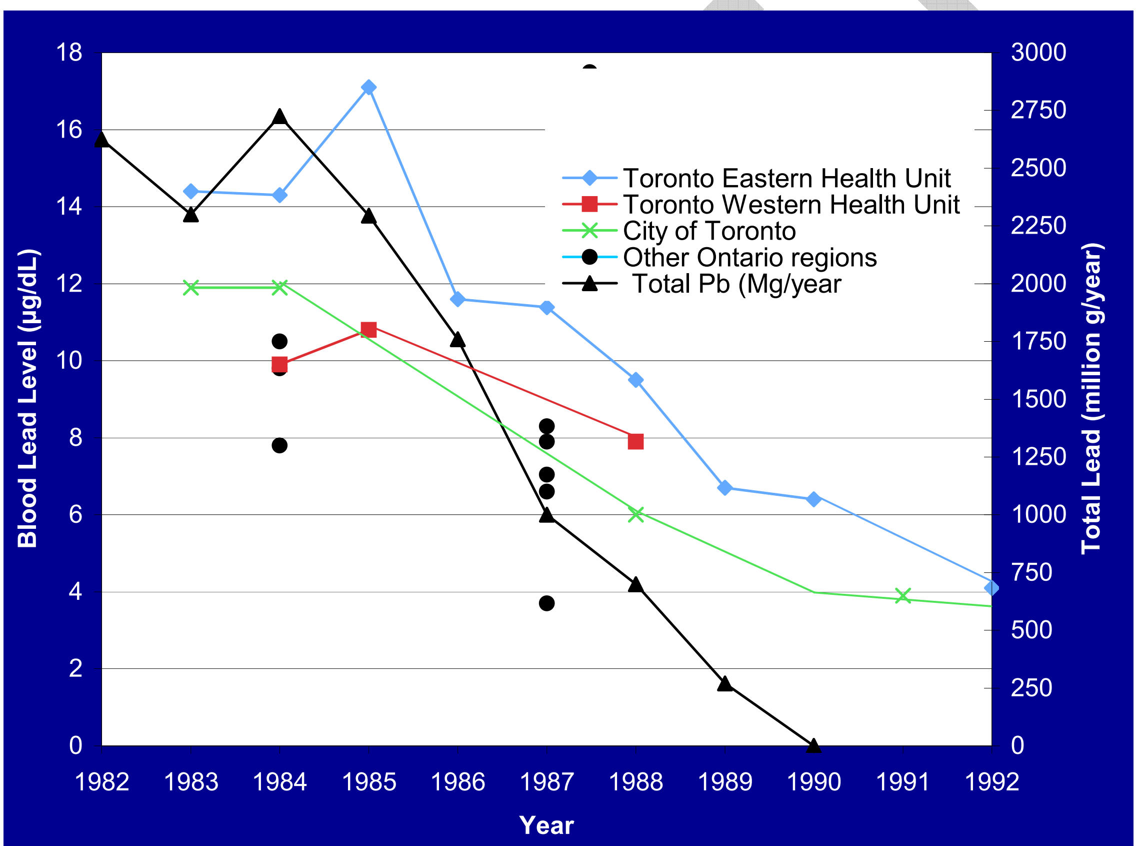
Sources of environmental lead exposure include: lead-based paint; soil and dust from paint, gasoline, and industrial sources; drinking water; certain occupations and hobbies; airborne lead from point sources such as lead smelters; and lead-contaminated food (from sources such as lead-soldered cans, the rain and soil in which food plants were 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)

CASE STUDY
Blood lead levels in children in Ontario, Canada

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 US National Health and Nutrition Examination Survey.

Figure 3.1: Decline in the Geometric Mean of the Blood Lead Concentrations related to a Decline in Consumption of Leaded Gasoline, in Ontario, Canada, 1983–1992



Source: Adapted from Wang, S.T., S. Pizzolato, H.P. Demshar, and L. Smith. 1997. Decline in blood lead in Ontario children correlated to decreasing consumption of leaded gasoline, 1983–1992. *Clinical Chemistry* 43: 1251–1252. <http://www.clinchem.org/cgi/content/full/43/7/1251>.

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.

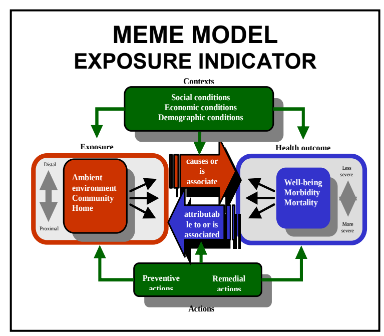
What You Can Do
For more information on lead and human health, consult:
http://www.hc-sc.gc.ca/hecs-sesc/toxics_management/publications/leadQandA/toc.htm.

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. 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

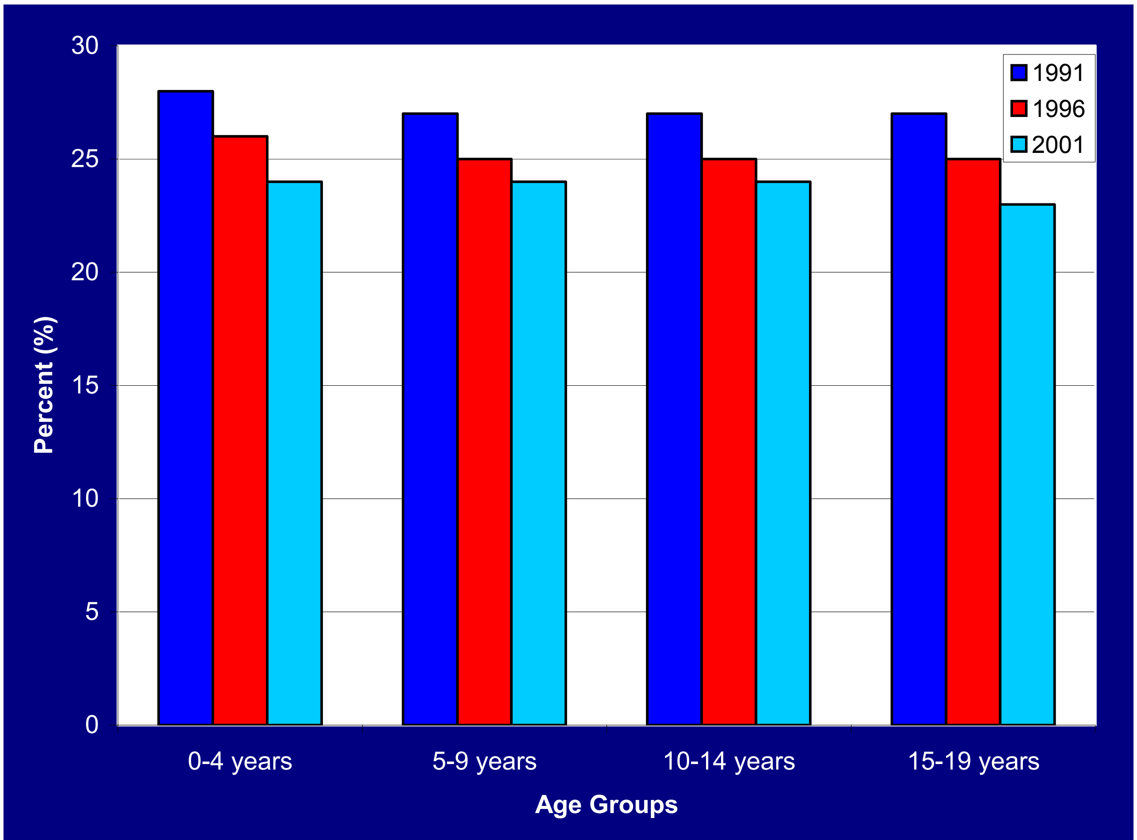
Issue, Context and Relevance of the Indicator:
Dust in the home and soil can be significant sources of lead exposure, especially for young children. Lead dust can be generated within the home, especially older homes (pre-1960) that used lead-based paints; such homes may also have lead pipes that can 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 pre-schoolers 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 has 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 (US 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, in Canada, 1991, 1996, 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 has 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.

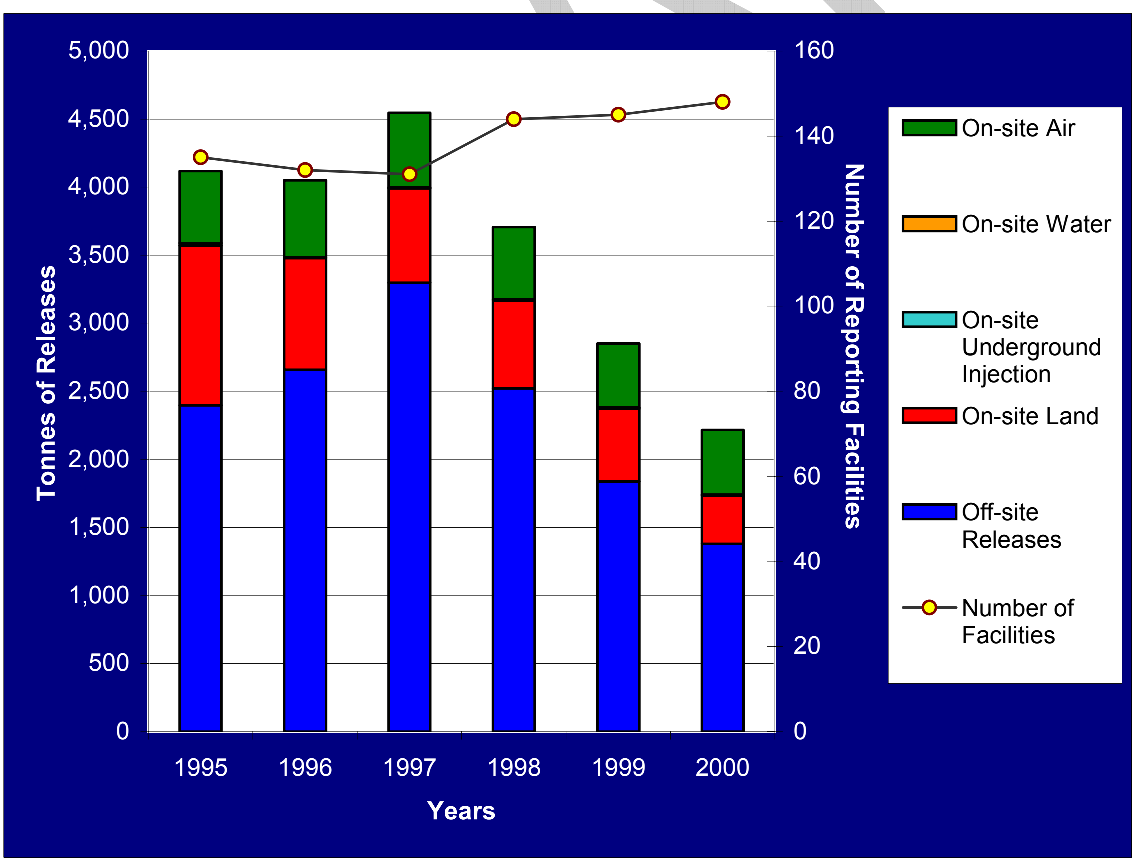
What You Can Do
The Canadian Mortgage and Housing Corporation provides guidelines on issues to examine when considering a renovation on an older home, how to test for leaded paints and precautions to take when dealing with leaded paint.
For more information, see *Lead Precautionary Measures* at:
http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/92-206.pdf

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

Indicator 6 PRTR data on industrial releases of lead

Figure 3.3: On- and Off-site Releases of Lead (and its compounds), in Canada, 1995–2000



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

Notes:

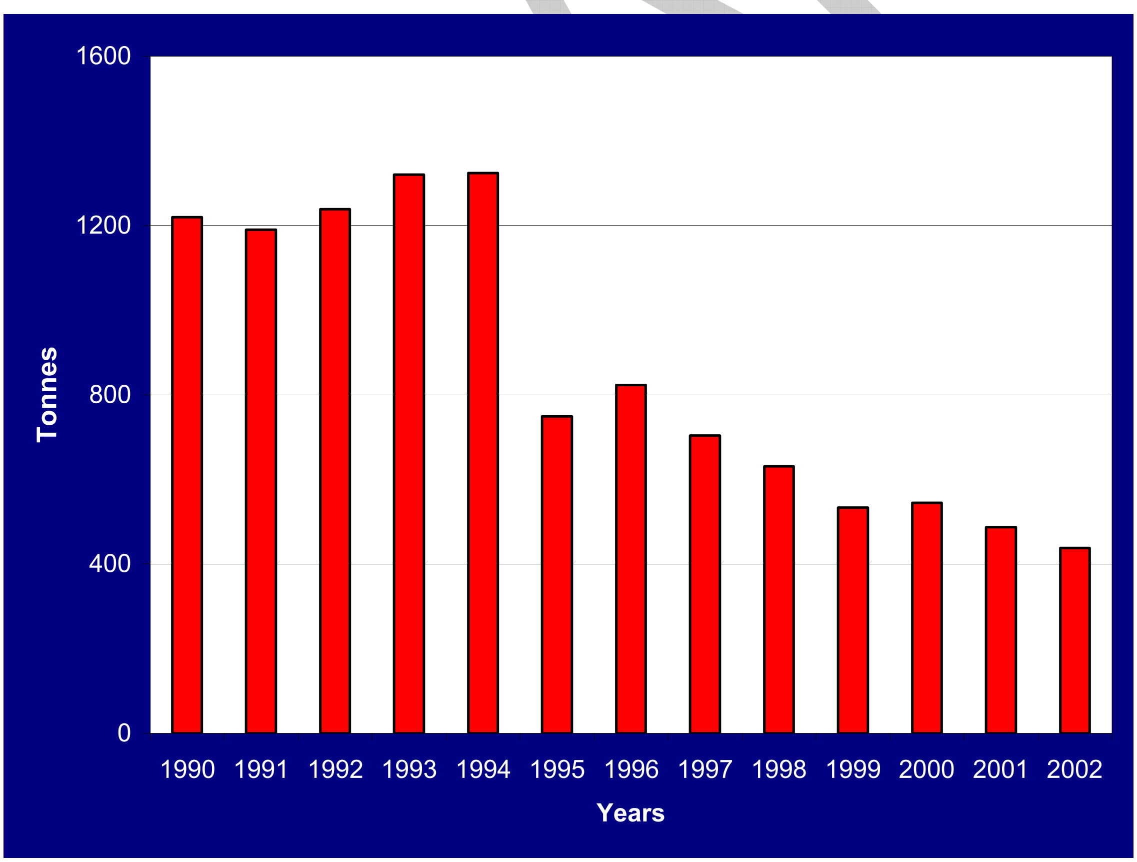
- On-site air emissions include stack or point releases, storage or handling releases, fugitive releases, spills and other non-point releases;
- On-site water discharges include direct discharges, spills, and leaks; on-site releases to land include landfill, land treatment, spills, leaks and other; and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

Key Observations:

- Overall, while the number of reporting facilities increased by 10 percent, total releases of lead and its compounds decreased 46 percent between 1995 and 2000. 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 percent from 1995 to 2000.
- On-site releases to the air decreased from 1996 to 1999 but showed an increase (of 0.6 percent) from 1999 to 2000.

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

Figure 3.4: Total Estimated Emissions of Lead to Air (tonnes), in 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 NPRI) have decreased by 67% between 1994 and 2002.

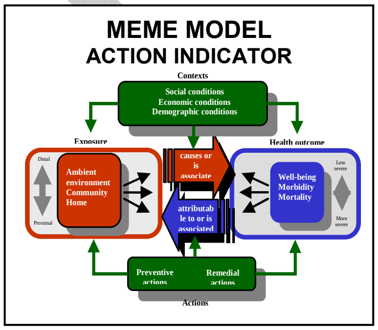
For more information, see the indicator template in Appendix 3.

3.4 Industrial Releases of Selected Chemicals

Indicator 7 PRTR data on industrial releases of 153 chemicals

Issue, Context and Relevance of the Indicator:

The indicator uses PRTR data as an "action" indicator. 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 indicator is 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 of 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.

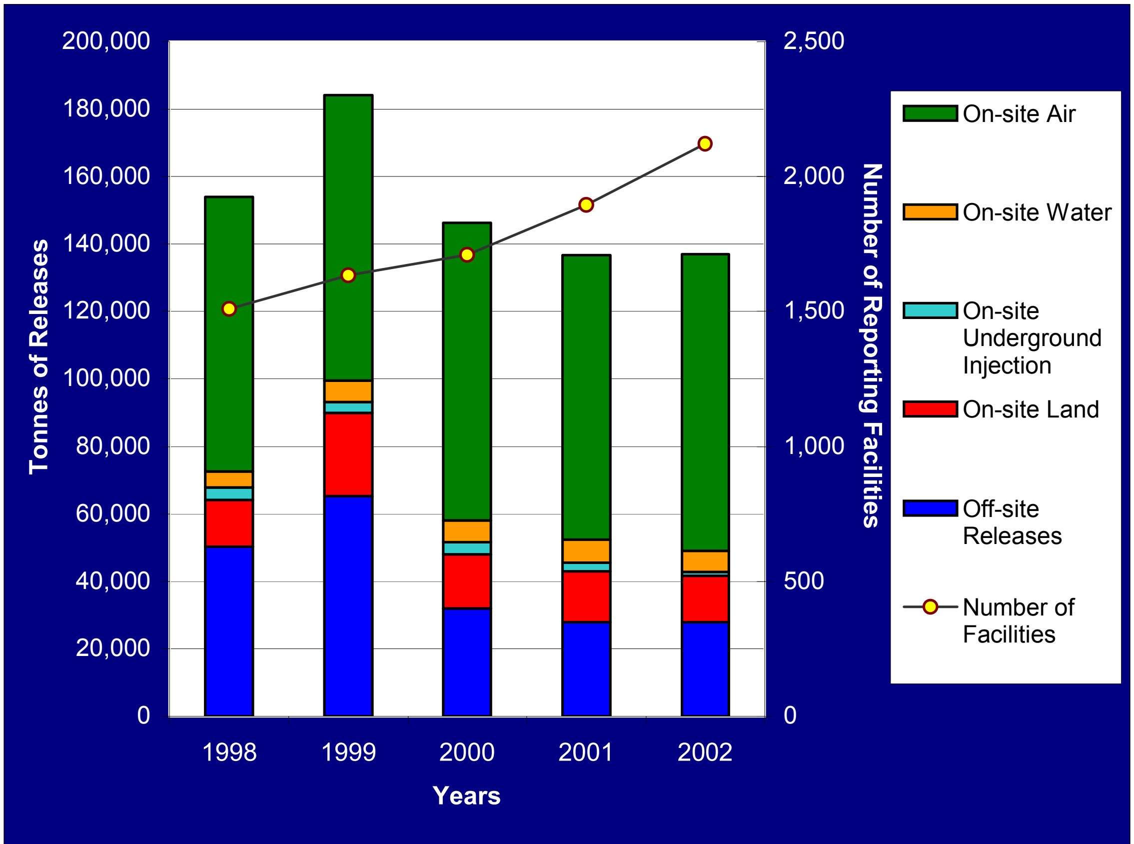
From a children's health perspective, the rationale for providing an action indicator of PRTR data is that industrial emissions of these chemicals may contribute to the contamination of the food children eat, the water they drink, the air they breathe and the soil with which they come in contact. In addition, certain subpopulations of children may be exposed to pollutant releases to air, water and soil 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. Factors determining a child's exposure to a pollutant 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 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.

Indicator–Status and Trends:
Canada is reporting pollutant releases for 153 "matched" chemicals—those chemicals reported in the NPRI that are also required to be reported in the United States. Figure 3.5 presents on-site and off-site releases of 153 matched chemicals, in tonnes, for the period of 1998–2001. The figure also describes where in the environment the chemicals were released and provides 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 1998–2001.

Figure 3.5: On- and Off-site Releases of Matched Chemicals, in Canada, 1998–2002



Source: National Pollutant Release Inventory, Environment Canada

Notes:

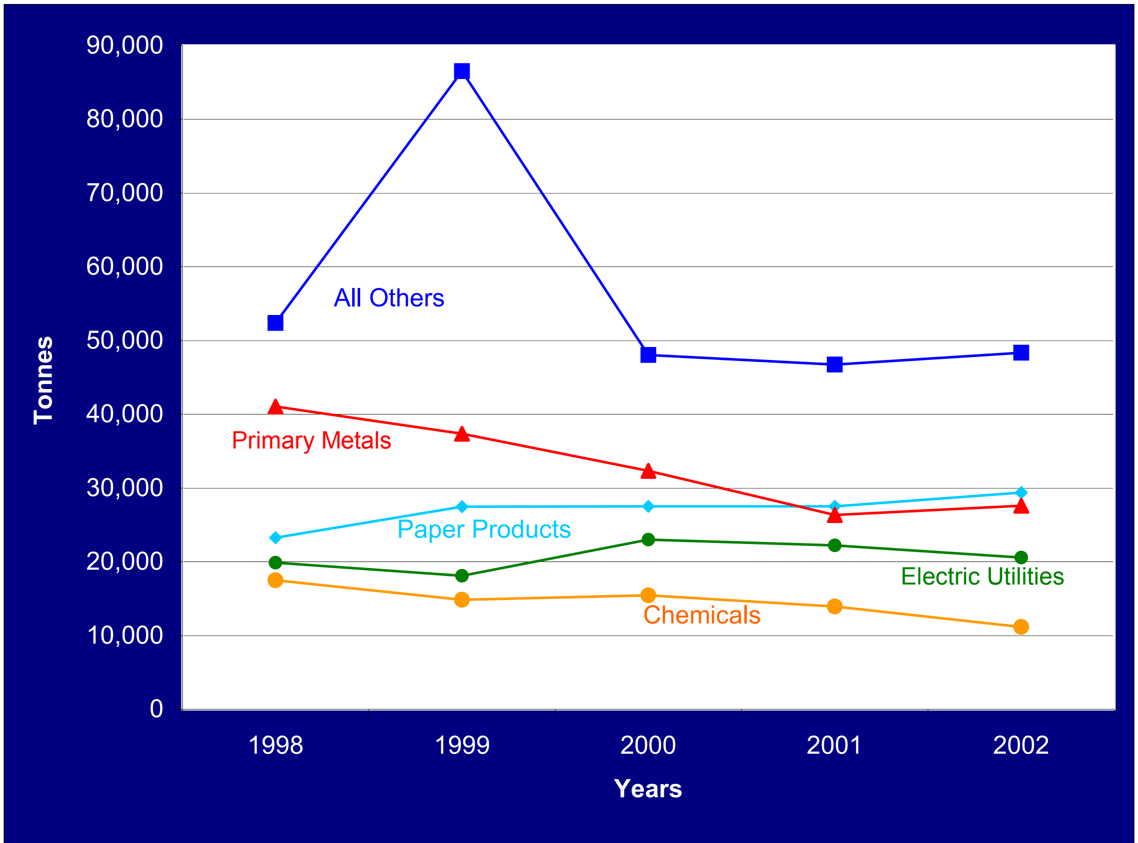
- On-site air emissions include stack or point releases, storage or handling releases, fugitive releases, spills and other non-point releases;
- On-site water discharges include direct discharges, spills, and leaks; on-site releases to land include landfill, land treatment, spills, leaks and other; and
- 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 US Toxics Release Inventory.
- Not all industry sectors are included to ensure consistent reporting between Canada and the US

Key Observations:

- The number of facilities reporting to the NPRI for the matched chemicals set increased by 41 percent between 1998 and 2002, while total releases decreased by 11 percent during this period. Releases to on-site air and water increased, 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, in 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 US Toxics Release Inventory.
- Not all industry sectors are included to ensure consistent reporting between Canada and the US

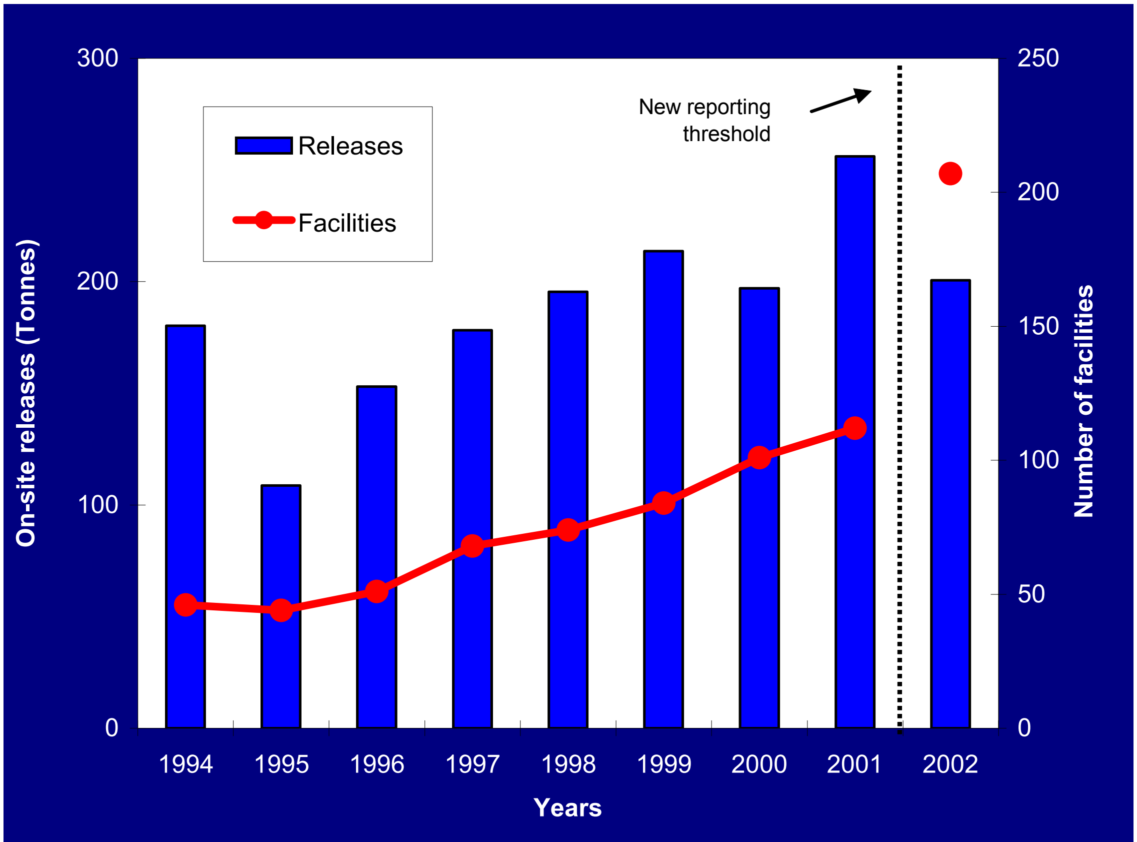
Key Observations:

- 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 percent and 36 percent, respectively between 1998 and 2002 while the paper products and electric utilities sectors both reported increases, of 26 percent and 4 percent respectively, over the same period

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

In addition to reporting the total releases for the matched 153 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, benzene, cadmium, chromium, dioxins and furans, hexachlorobenzene and mercury. 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 National Pollutant Release Inventory for Canada, 1994–2002



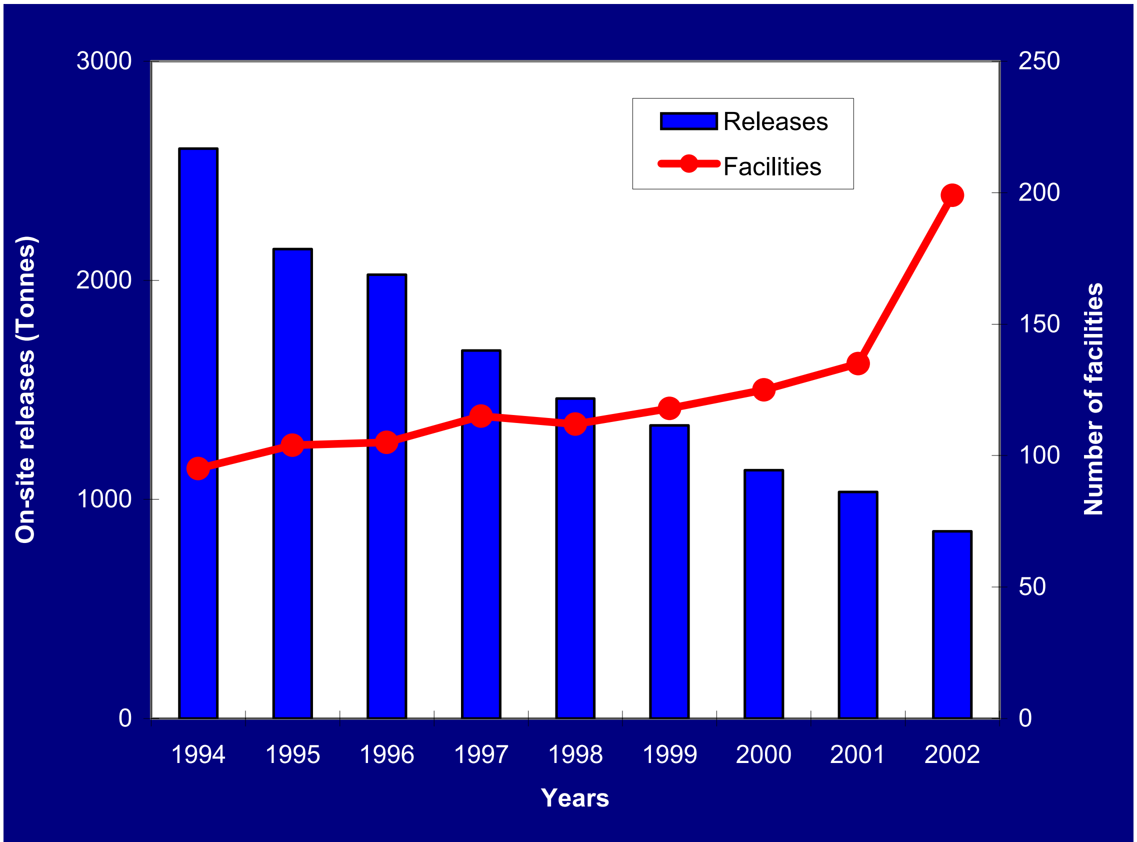
Source: National Pollutant Release Inventory, Environment Canada.

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 from 180 tonnes in 1994 to 201 tonnes in 2002, representing an 11.4% increase in releases.
- Some important changes to NPRI reporting guidelines with respect to arsenic releases occurred in 2000 and 2002. In the year 2000 the 20 000 hr 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 5-fold increase in the number of reporting facilities.

Figure 3.8: On-site Releases to Air, Water and Soil of Benzene Reported in the National Pollutant Release Inventory for Canada, 1994–2002



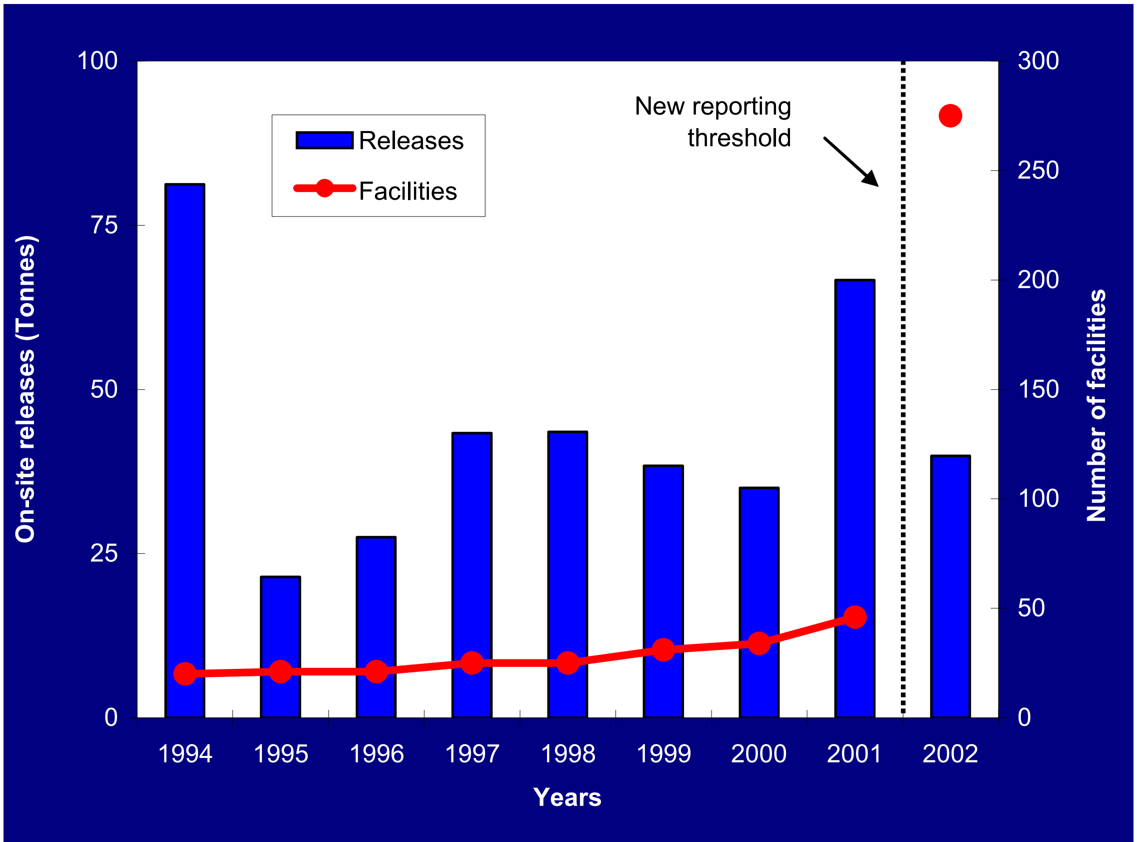
Source: National Pollutant Release Inventory, Environment Canada.

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, 2,608 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 while the number of reporting facilities has been steadily increasing since 1994.

Figure 3.9: On-site Releases to Air, Water and Soil of Cadmium and its Compounds Reported in the National Pollutant Release Inventory for Canada, 1994–2002



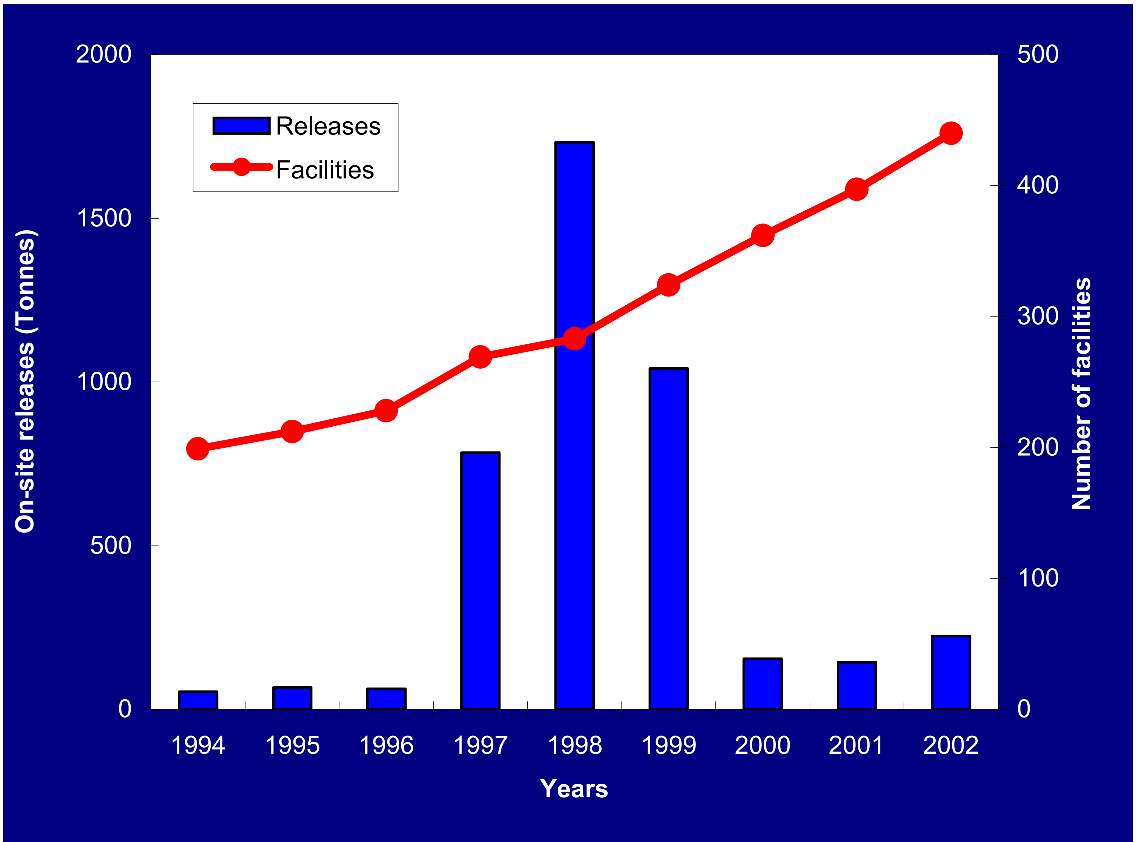
Source: National Pollutant Release Inventory, Environment Canada.

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 5kg with 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 National Pollutant Release Inventory for Canada, 1994–2002



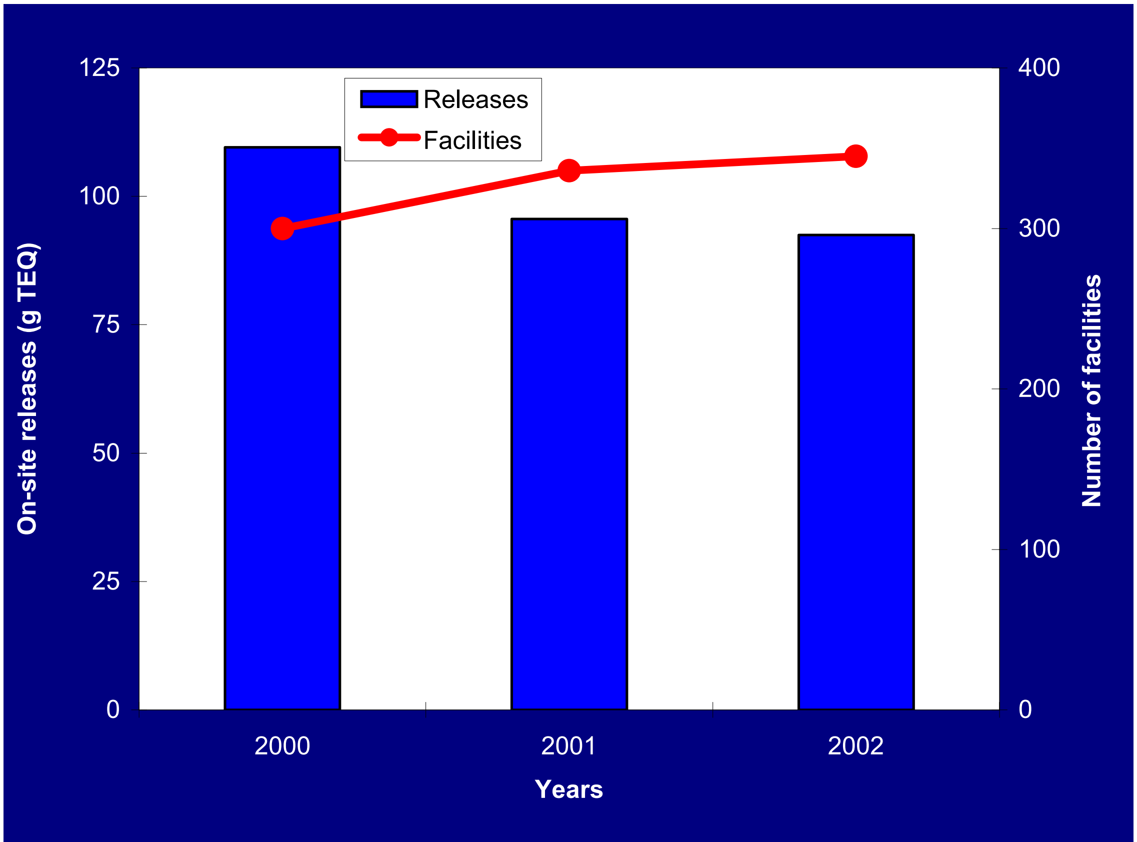
Source: National Pollutant Release Inventory, Environment Canada.

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 in on-site releases beginning in 1997 and ending in 1999 (790 tonnes and 1,048 tonnes respectively).
- Emissions of chromium hit a peak of 1,740 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 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 National Pollutant Release Inventory for Canada, 1994–2002



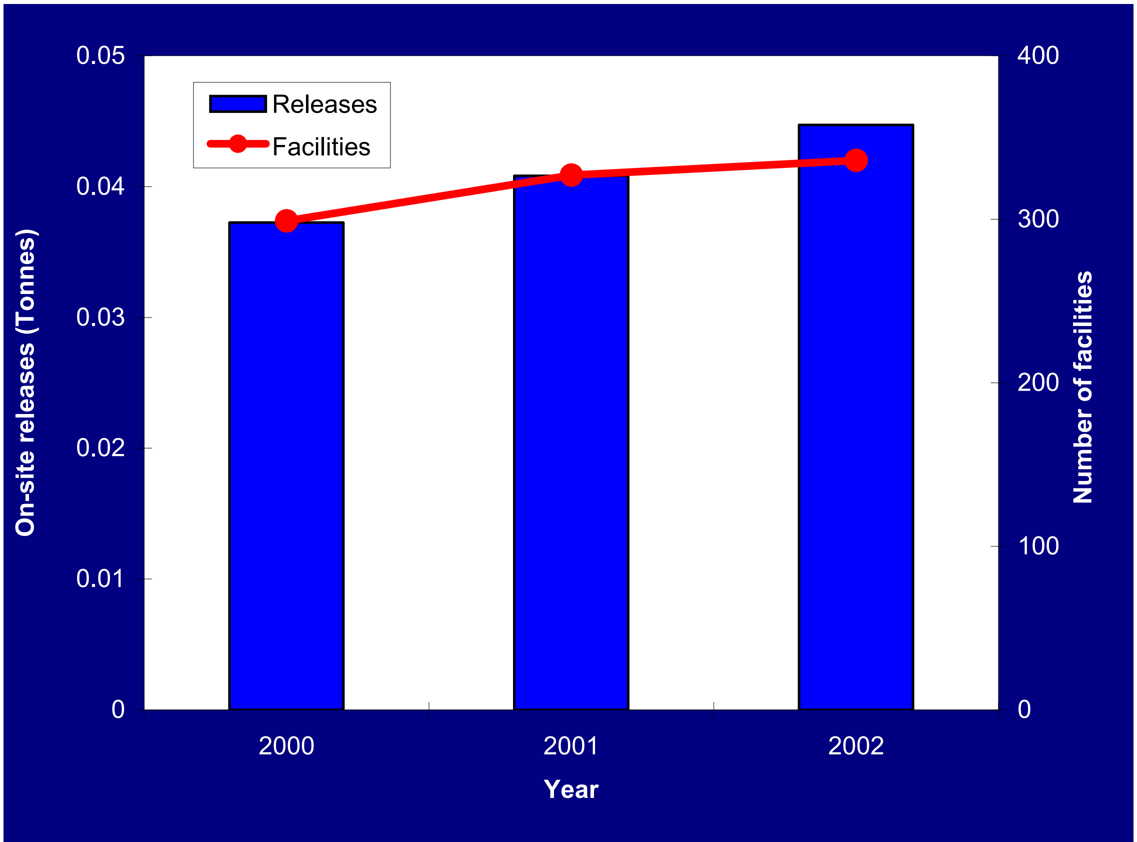
Source: National Pollutant Release Inventory, Environment Canada.

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.
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 100.5 g TEQ to 92.5 g TEQ while reporting facilities have 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 quantity of dioxins and furans were primary metal manufacturing, electricity generation and waste management sectors.

Figure 3.12: On-site Releases to Air, Water and Soil of Hexachlorobenzene Reported in the National Pollutant Release Inventory for Canada, 1994–2002



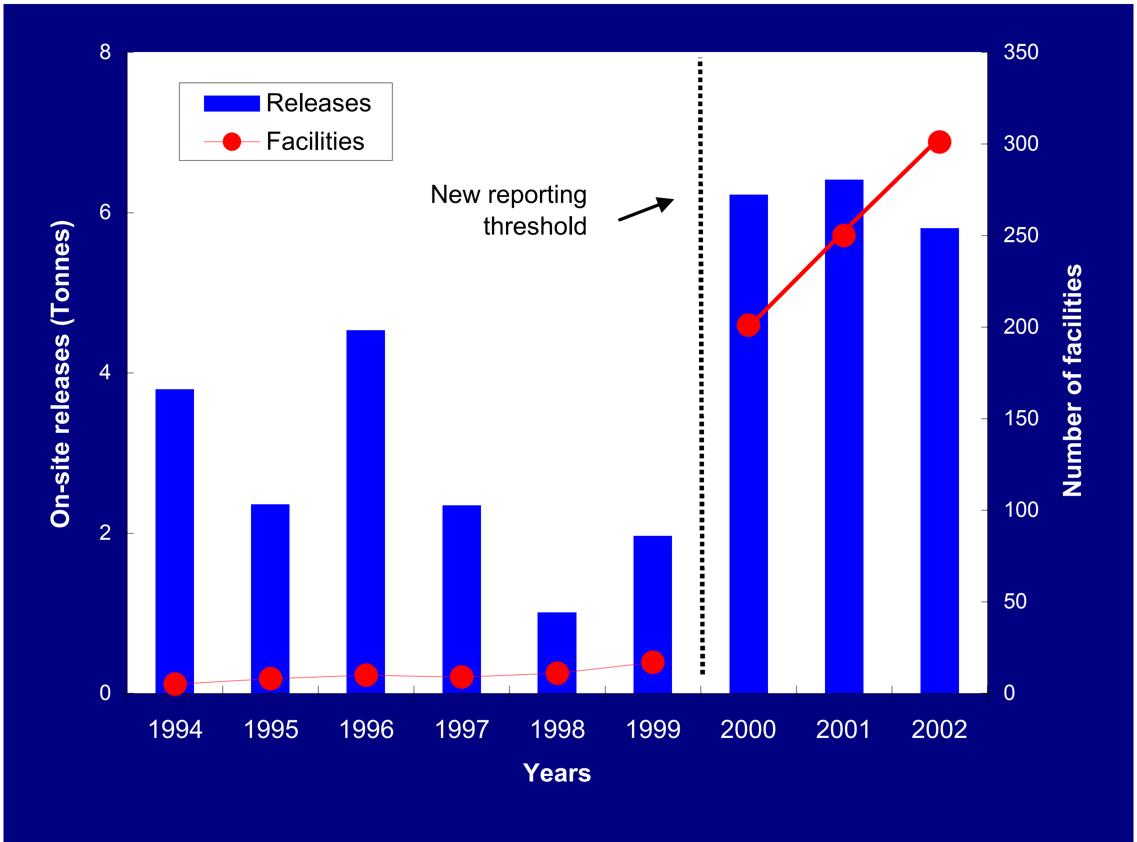
Source: National Pollutant Release Inventory, Environment Canada.

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:

- Between 2000 and 2002 total releases of hexachlorobenzene (HCB) increased to 0.045 tonnes and 341 reporting facilities, representing a 20% increase in total on-site releases and 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 the electric power generation, metal manufacturing, mining and smelting sectors. Typically, HCB is a byproduct 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 National Pollutant Release Inventory for Canada, 1994–2002



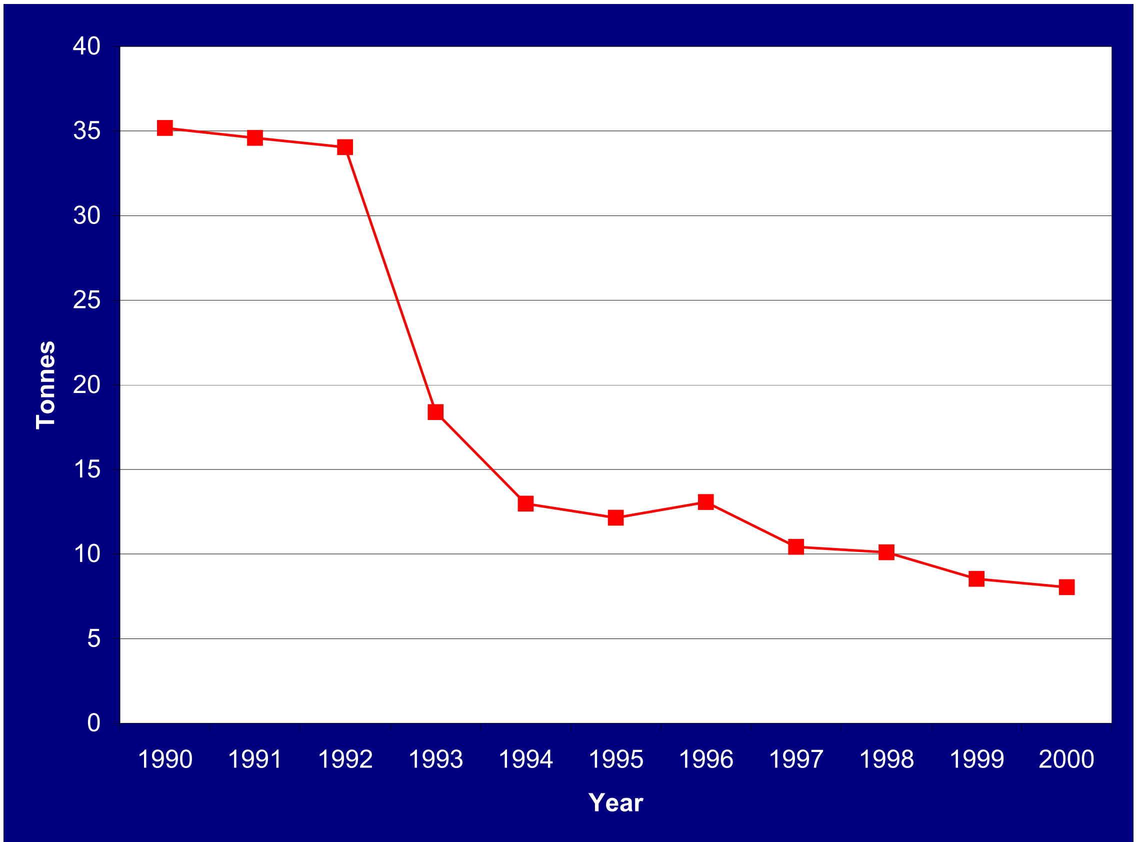
Source: National Pollutant Release Inventory, Environment Canada.

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 in 2002 with 5.8 tonnes. 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 thresholds, 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 the electrical power generation and base metal smelting sectors.

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.

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

> **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.

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 a contaminant. Toxic substances come from many industrial and household sources. The *Canadian Environment Protection Act*, *1999* (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 health, the environment or its biological diversity, or to the environment that supports life. 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 seven substances reported in this indicator 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 that 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, 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 provides a measure of the current body burden of a chemical in an individual.

CASE STUDY
Northern Aboriginal people in Canada
The Northern Contaminants Program (NCP) 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 NCP found that Inuit mothers had oxychlordane and trans-nonachlor levels that are 6–12 times higher than those in Caucasians, Dene and Métis, or other mothers. Similar patterns were observed for PCBs, hexachlorobenzene, mirex and toxaphene. Recent research has also revealed significantly higher levels of mercury in maternal blood of Inuit women, when compared to 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 NCP is to study prenatal exposure 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).

3.5 Pesticides

Indicator 8: Pesticides

Issue, Context and Relevance of the Indicator:
Recent advances in scientific understanding reaffirm that children are not "little adults" and 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 than adults do, 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, 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)

This indicator is a measure of children's exposure to pesticides in food. *It is not a health outcome indicator.*

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.

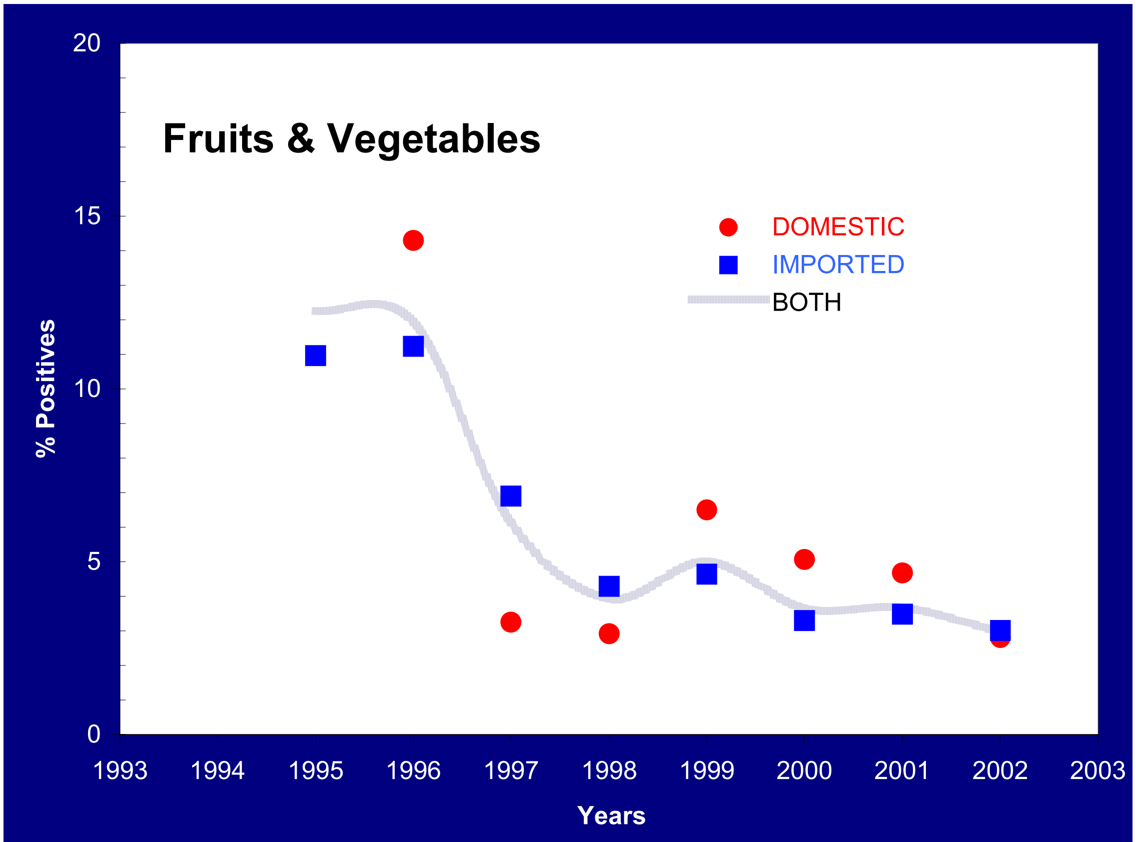
The Canadian Food Inspection Agency (CFIA) is responsible for monitoring domestic and imported foods and carrying out enforcement actions to prevent the sale of food containing excessive residues.

Indicator–Status and Trends:
This indicator reports the yearly number of organophosphate (OP) pesticides detected on domestic and imported fruits and vegetables, expressed as percentage of sample size. 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 optimised for enforcement purpose, not specifically for children exposure.
- The number of OP pesticides entering the market and the time and size of samples is not uniform over the years.

This indicator is also a weak indicator of children's health outcomes, as 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, in Canada, 1995–2002



Source: Canadian Food Inspection Agency, Food Safety Directorate, Food Microbiology and Chemical Evaluation, Chemical Residue Annual Reports 1995–2002.

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

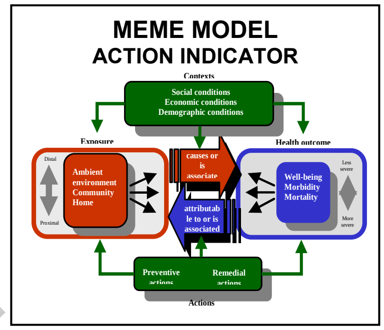
Opportunities for Improvement:
Biomonitoring data, measuring the levels of pesticides and their metabolites in urine, is the best indicator of children's exposure to pesticides. In order for biomonitoring results to be meaningful it is critical that they be collected using appropriate study design and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

The PMRA will soon implement a database of adverse effects. Adverse effects are effects that relate to the health or environmental risks, or the value of a pest control product. Adverse effects can include impairment of health or reproduction, pesticide residues in excess of established limits, etc. With the future introduction of this mandatory adverse effect reporting system for pesticides, Canada 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 the Pest Management Regulatory Agency 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

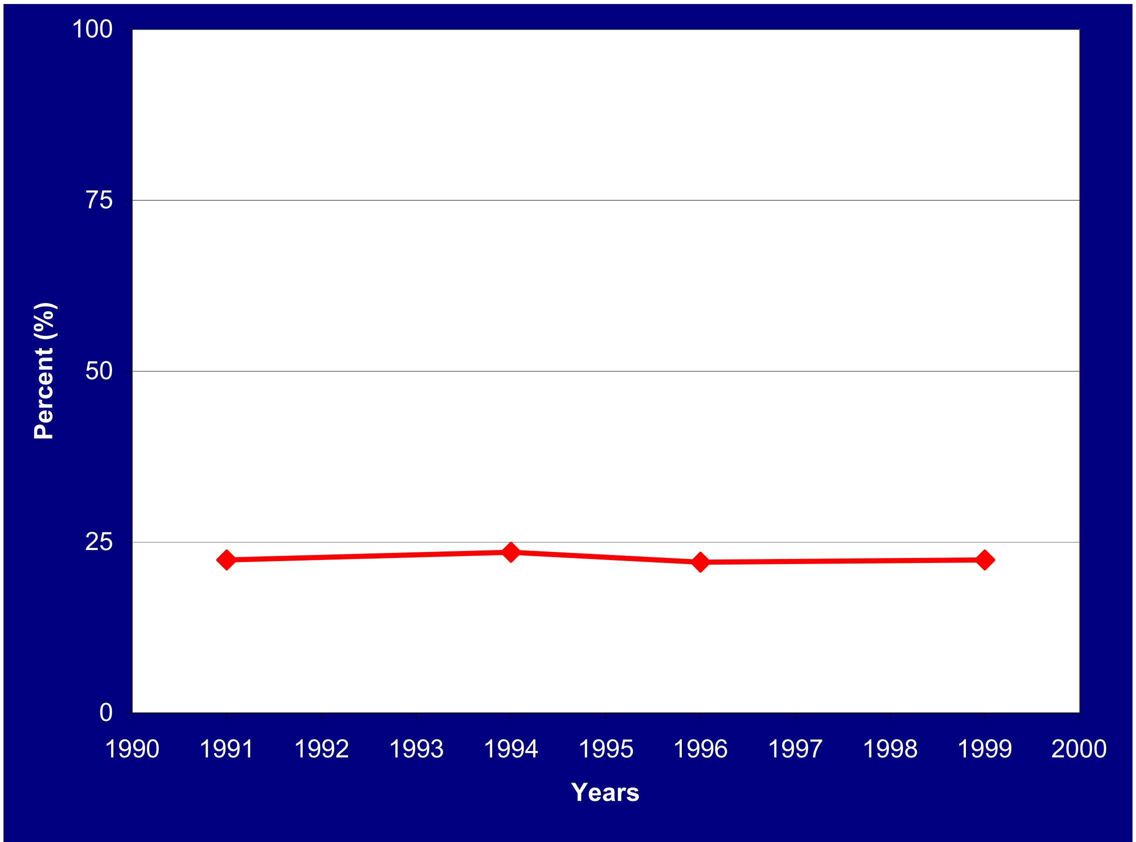
This information is currently not available in Canada.
The percentage of children served with treated water is not available in Canada. Canada is reporting the percentage of Canadians not connected to public water distribution systems

Issue, Context and Relevance of the Indicator:
Access to clean water is critical for reducing the risk of exposure to water-borne 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). 92% 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 1,000, which covered about 25.4 million Canadians or 83% of the total population in 1999. Canadians not covered by the survey, 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 water-borne 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, 2002 (for total population).

Notes: It is assumed that most Canadians not surveyed by the Municipal Water Use Database (MUD) survey, living in municipalities with a population below 1,000, 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 multi-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 to the multi-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

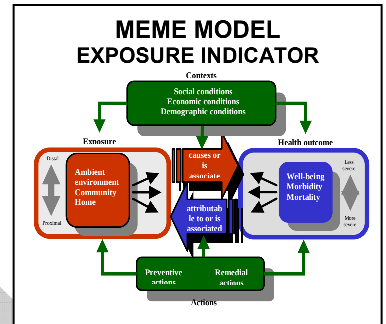
Opportunities for Improvement:
An improvement to this indicator would be to reflect the population of children with access to public water distribution systems, as opposed to the overall Canadian population.

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 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

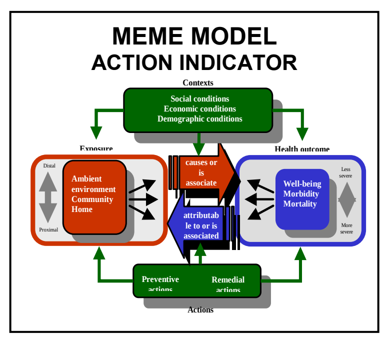
Indicator 11 Percentages of children (households) that are not served with sanitary sewers

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.

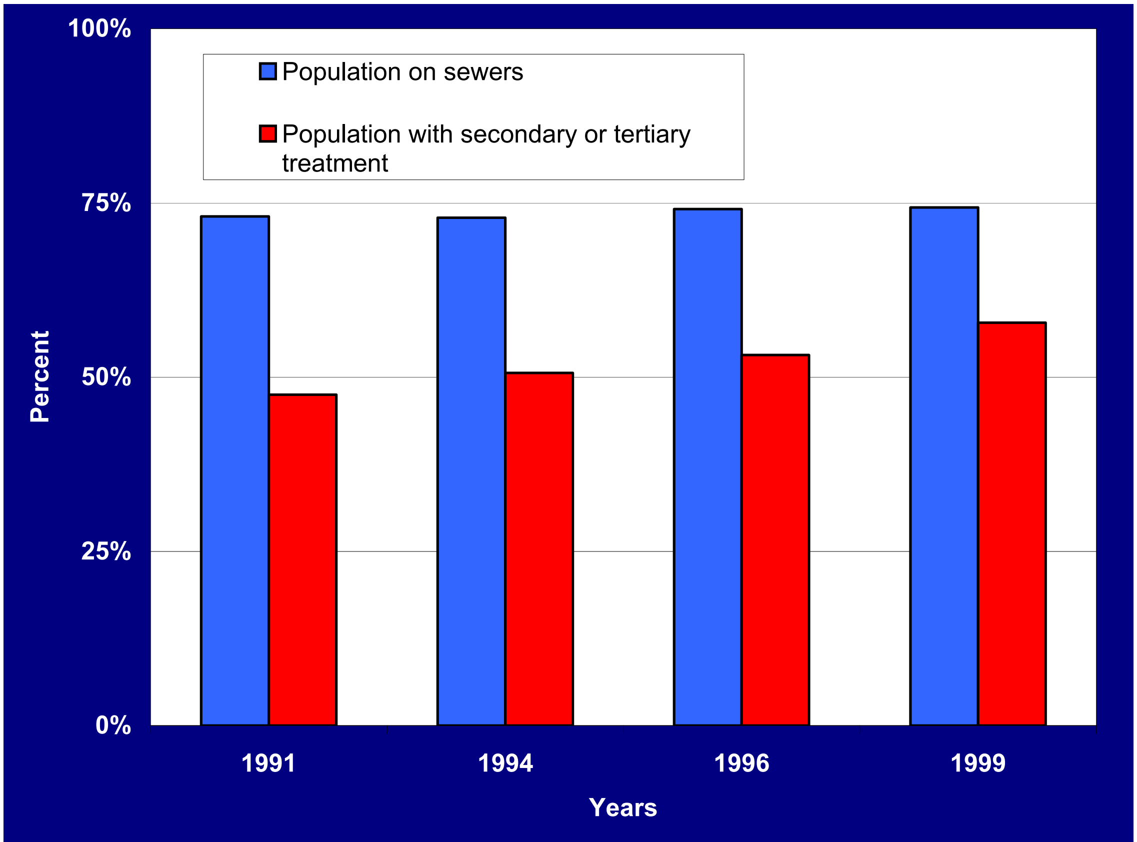
In Canada, municipalities and provincial departments conduct routine monitoring of bacterial counts at most beaches and shellfish harvesting areas throughout the applicable parts of the year and following events that may result in water contamination (e.g., rainfall). Fecal coliform or *E. coli* counts 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 square kilometres 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 1,000, 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, 1999



Source: The Municipal Water Use Database, Environment Canada

Notes: It is assumed that most Canadians not surveyed by the Municipal Water Use Database (MUD) survey, living in municipalities with a population below 1,000, 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.

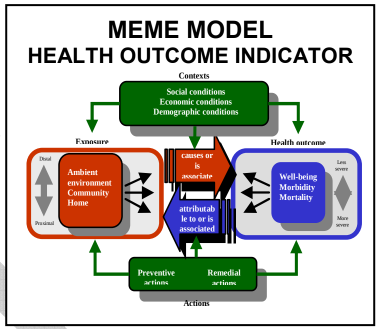
Private industry, research and educational institutions, conservation authorities and individual Canadians also have an important influence on decisions concerning wastewater management. Actions by all of these groups have ensured that the standard of wastewater management in Canada compares well with 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 water-borne 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 water-borne 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 the need for additional water treatment (Lim et al., 2002).

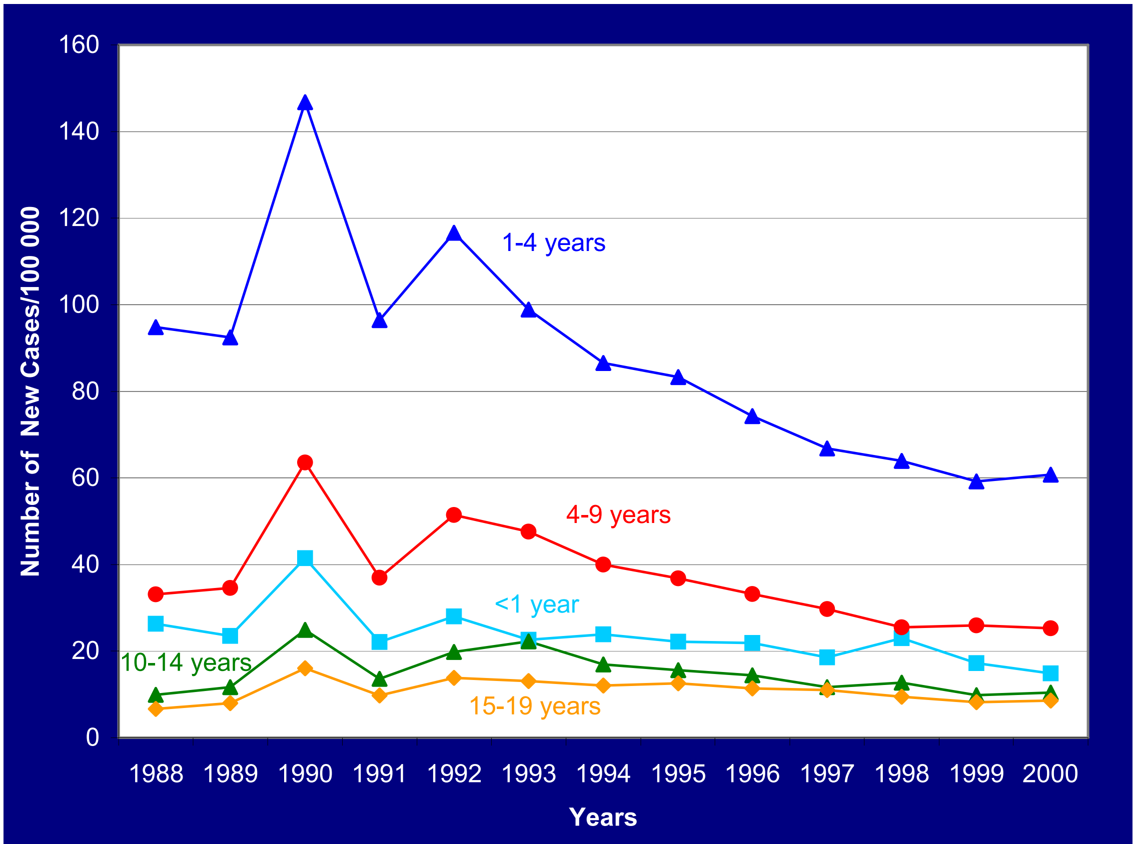
Enteric, food-borne and water-borne, diseases are caused by a variety of microorganisms. Infections usually result when the microorganism enters the body though the mouth, either by the consumption of contaminated food (food-borne) or water (water-borne) or via contaminated fingers or objects. Water-borne 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 (food-borne, water-borne). Giardiasis, sometimes called “beaver fever,” is an intestinal parasitic infection characterized by chronic diarrhea and other symptoms. Giardiasis may be food-borne, 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 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 under-reporting, timeliness of reporting, disease case definitions and passive surveillance.

Indicator–Status and Trends:

In Canada, morbidity related to water-borne 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 became 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, in 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* than the rest of the population. In 2000, the incidence of giardiasis amongst 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 to be able to determine the proportion of reported cases of giardiasis caused by water-borne infection. Other methodologies, such as household surveys and physicians reporting, could be used to collect information on cases of giardiasis in Canada, in order to address under-reporting 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 water-borne 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 Commission for Environmental Cooperation 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 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.

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 population-weighted indicators of outdoor air quality. 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 (measures 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, volatile organic compounds 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 (Indicator 6 and 7)—In Canada, 274 substances are currently required to be reported to the National Pollutant Release Inventory. This inventory provides a wealth of information to citizens on which specific pollutant 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 pollutants 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).

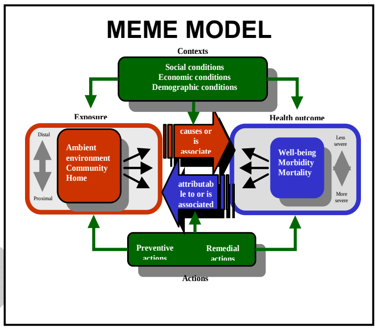
The PMRA will soon commence a database of adverse effects. Adverse effects are effects that relate to the health or environmental risks, or the value of a pest control product. Adverse effects can include death, impairment of health or reproduction, pesticide residues in excess of established limits, etc. 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 centers 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, both on public systems 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 (for example beach closures) or as it contributes to the contamination of shellfish harvesting areas. Development of indicators of sewage treatment level as it may impact children's health is an area for future development.

Water-borne Diseases (Indicators 12 and 13)—The Notifiable Diseases Registry captures outbreaks of water-borne 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 food-borne 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 water-borne diseases in Canada. Other methodologies, such as household surveys, could be used to collect information on morbidity associated with water-borne diseases.

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 and refine the tracking of water-borne diseases, pesticide poisonings, hospital admissions or cardio-respiratory 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, water- and food-borne 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/hecs-sesc/oceh/pdf/healthy_environments_children_what_you_can_do.pdf

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Appendix 1 Canada's List of Acronyms and Abbreviations

µg/m^3	micrograms per cubic metre
AIDS	acquired immunodeficiency syndrome
CEC	North American Commission for Environmental Cooperation
CEPA 1999	*Canadian Environmental Protection Act, 1999*
CO	carbon monoxide
CTUMS	Canadian Tobacco Use Monitoring Survey
HCB	hexachlorobenzene
LICO	low income cut-off
MEME	Multiple exposure–multiple effect framework (World Health Organization)
mg/m^3	milligrams per cubic metre
NAPS	National Air Pollution Surveillance
NCP	Northern Contaminants Program
NOx	nitrogen oxides
NPHS	National Population Health Survey
NPRI	National Pollutant Release Inventory
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-*p*-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
POP	persistent organic pollutant
ppb	part per billion
ppm	part per million
PRTR	pollutant release and transfer register
SHS	secondhand smoke
SIDS	sudden infant death syndrome
SO_2	sulphur dioxide
SO_x	sulphur oxides
TCDD	tetrachlorodibenzo-*p*-dioxin
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). Below, is 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, mold 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 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 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 one 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 two 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
www.hc-sc.gc.ca/hecs-sesc/ccrpb/protection.htm

A Parent's Guide to Sun Protection: Sun Fiction and Fact
www.hc-sc.gc.ca/hecs-sesc/ccrpb/fiction_fact.htm

Ultraviolet Radiation from the Sun
www.hc-sc.gc.ca/english/iyh/environment/ultraviolet.html

Sunglasses
www.hc-sc.gc.ca/english/iyh/products/sunglasses.html

Sunscreens
www.hc-sc.gc.ca/english/iyh/lifestyles/sunscreen.html

Information about Products Containing Sunscreen and DEET:
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 www.cmhc-schl.gc.ca/en/burema/gesein/abhose/abhose_ce25.cfm or call the Canadian Housing Information Centre at (613) 748-2367.

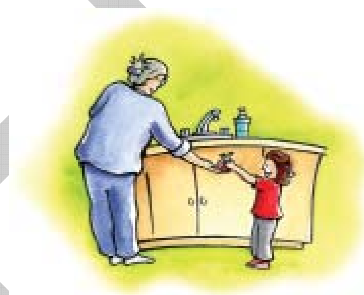
Keep Pesticides Away from Children

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 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 two 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 exist. 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 exist.

- 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 www.hc-sc.gc.ca/english/westnile/insect_repellents.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 www.westnilevirus.gc.ca or call the National West Nile Virus Info-line at 1-800-816-7292.

Keep Mold Levels Down in Your Home

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

To reduce the risk of exposure to mold:
- Make sure that there 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. Molds 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 mold growth.
- Wash or change shower curtains monthly and keep bathtub and shower areas free from mold build-up.

- Get rid of mold on surfaces by removing the source of moisture. Scrub the moldy 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 mold can be complex, for steps on cleaning up mold consult Canada Mortgage and Housing Corporation's Fighting Mold – The Homeowners' Guide at 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 www.cmhcschl.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 www.inspection.gc.ca/english/related/provincese.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: 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/hecs-sesc/water/factsheets/treatment_guide.htm 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 two or three 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 which 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:
www.hc-sc.gc.ca/english/iyh/products/leadpaint.html

Lead Crystalware and Your Health:
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/hecs-sesc/toxics_management/publications/leadQandA/toc.htm

Effects of Lead on Human Health:
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, polishers, 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 www.hc-sc.gc.ca/hecs-sesc/cps/publications/hazard.htm, 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 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 nontoxic, 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 Indicators 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. ***This information is currently not available in Canada.***	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Figure 2.2. Average levels of several air pollutants in Canada Figure 2.3. Peak levels of ground-level ozone for selected regions of Canada Figure 2.4. Number of days where ozone exceeded the standard for 2002, in Canada Figure 2.5. Peak level of Fine Particulate Matter (PM2.5) for Selected Cities in Canada Figure 2.6. Number of days where PM2.5 exceeded the standard for 2002, in Canada
Rationale and role	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.
Data Range	1. For volatile organic compounds, nitrogen oxides, sulphur dioxide, and carbon monoxide: 1985–2002 2. For ozone: 1989 to 2002 3. For fine particulate matter ($PM_{2.5}$): 1985–2002.
Terms and concepts	“Annual averages” of air pollutants levels measured in ambient air are derived by averaging the mean concentrations of air pollutants measured at each monitoring station for each year. Canada-Wide Standards: In 1998, the Canadian Environment Ministers signed the Canada Wide Accord on Environmental Harmonization and its sub-agreement on Canada Wide Standards (CWSs). CWSs typically contain a numeric limit, a timeframe 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: Ground-level ozone: 65 ppb (8hr averaging time, averaged over 3 years, to be attained by 2010). Particulate matter less than 2.5 microns ($PM_{2.5}$): 30 $\mu g/m^3$ (24hr averaging time, averaged over 3 years, to be attained by 2010) Ground-level ozone (O_3) is formed when nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Particulate matter (PM) is one of the major components of smog. PM are microscopic particles in the air, capable of being inhaled by humans and are divided into two size ranges: $PM_{2.5}$ and $PM_{\leq 10}$. “Peak levels” of air pollutants are obtained by averaging the highest concentrations measured at each monitoring station for each year. Precursor air pollutants are carbon monoxide [CO], volatile organic compounds (VOCs), sulphur dioxide (SO_2) and nitrogen oxides (NO_x). Precursor air pollutants contribute to the formation of smog. Smog: Smog has become a common term for urban air pollution. It contains two key

	elements: fine airborne particles and ground-level ozone.
Data sources, availability and quality	Data is 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 QA program: site selection; sampling system requirements; site and analyzer operation; instrument calibration and reference standards; inter-laboratory testing and performance audit program; data validation and reporting; documentation; training and technical support. Contact: Paul Brunet Environmental Technology Centre Environment Canada (613) 991-9460
Units of measurement	⇒ Parts per billion (ppb) for ground-level ozone, sulphur dioxide, nitrogen dioxide, and volatile organic compounds. ⇒ Parts per million (ppm) for carbon monoxide. ⇒ Micrograms per meter cube for $PM_{2.5}$.
Computation	<u>For levels of several air pollutants:</u> Volatile organic compounds (VOC), nitrogen oxides (NOx) and sulphur oxides (SOx) are annual averages, while carbon monoxide (CO) is the 98th percentile of the eight-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. <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 8h ozone values for each station were averaged over three consecutive years. The 3 year running average value for each station was then averaged for the region. <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 for which the maximum 8-hour measurements exceeded 65 ppb were then summed for each station and plotted on the map of Canada. Values used as is for sites meeting completeness criteria <u>For peak level 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. <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 for which the 24-hour measurements exceeded 30 μg/m^3 were then summed for each station and plotted on the map of Canada.
Sources of further	The National Air Pollution Surveillance Network website (and annual reports):

information	http://www.etc-cte.ec.gc.ca/NAPS/index_e.html
Geographic scale	Data is 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.
Useful references	*Environmental Signals 2003: Canada's National Environmental Indicators Series*, urban air quality indicators: http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm Environment Canada's Air Quality Services Website: http://www.msc-smc.ec.gc.ca/aq_smog/index_e.cfm Environment Canada's Criteria Air Contaminant Emissions summaries: http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm Canadian Council of Ministers of the Environment: http://www.ccme.ca
INDICATOR presentation and observations	
Data Table(s) and Chart(s)	See graphs in section 2.1 of the Canada Country Report
Key observations	See text in section 2.1 of the Canada Country Report
Strengths of the Indicator	⇒ The indicators provide a clear national and regional overview of key trends in ambient levels of pollutants for Canada for the last 13 to 17 years. ⇒ Although only reflecting 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)
Limitations	⇒ The $PM_{2.5}$ peak indicator only represents 10 to 15 urban stations and is not considered to be representative of Canada. This will be addressed in the future as more monitoring data becomes available. ⇒ Ambient air quality levels measured at a sampling station do not necessarily represent the exact levels the population is exposed to 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 multiple pollutants simultaneously.
Additional Indicators	Criteria Air Contaminant Emissions Inventory: This inventory provides yearly estimates of total Canadian emissions for several air pollutants and their precursors (e.g. volatile organic compounds and ammonia). 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.
Opportunities for Improvement	⇒ 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. ⇒ Indicators integrating health outcomes (e.g. hospital admissions, mortality) and ambient levels are under development and could provide more informative trends.
Related	Many programs are in place at all levels of government to address problems related

Programs/Activities	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 web site for more details and links to sources of information: http://www.ec.gc.ca/air/being_done_e.html.

Indicator 2 - Indoor air quality: Measure of children exposed to second-hand smoke	**Type of Indicator: Exposure**
INDICATOR Description	
Definition	Percentage of children exposed to second-hand smoke in Canadian homes
Rationale and role	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/hecs-sesc/tobacco/facts/health_facts/second_hand.html
Data Range	Age groups: 0–5, 6–11, 12–14, 15–19 Years: 1999, 2000, 2001, 2002
Terms and concepts	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 side stream smoke, the smoke released directly from the end of a burning cigarette. Second-hand smoke contains over 4,000 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 to 20 minutes causes physical reactions linked to heart and stroke disease: the heart rate increases; the heart's oxygen supply decreases; 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, 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/hecs-sesc/tobacco/facts/health_facts/second_hand.html
Data sources, availability and quality	Canadian Tobacco Use Monitoring Surveys (CTUMS) 1999, 2000, 2001, 2002 Household Component E-mail: TCP-PLT-questions@hc-sc.gc.ca
Units of measurement	Percentage of children who are exposed at home to second hand smoke by province and age group.
Computation	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 (SHS) 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 SHS, 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.
Sources of further	Microdata: A microdata set containing the results of the survey is available for

information	purchase from Statistics Canada.
Geographic scale	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.
Useful references	http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/ctums/index.html
INDICATOR presentation and observations	
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.
Strengths of the Indicator	The indicator is nationally and regionally relevant.
Limitations	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.
Additional Indicators	Exposure of fetuses. Number of children who smoke.
Opportunities for Improvement	Bio-monitoring of the levels of contaminants in the blood of children who live in homes with smokers.
Related Programs/Activities	Health Canada's website includes information for youth related to smoking entitled "You and Me Smoke Free" http://www.hc-sc.gc.ca/hecs-sesc/tobacco/youth/index.html

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Table 11. Exposure of children at home to Environmental Tobacco Smoke (ETS), by province and age group, Canada 2002

Province	% Children Age 0-11 regularly exposed	% Children Age 12-17 regularly exposed	% 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 percent due to rounding. Source: Canadian Tobacco Use Monitoring Survey, Household component, February - December 2002, available at: http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/ctums/2002/annual_table11.html

Indicator 3 - Prevalence of asthma in children	**Type of Indicator: Health Outcome**
INDICATOR Description	
Definition	Prevalence of physician-diagnosed asthma
Rationale and role	Exposures to indoor and outdoor sources of biological and chemical environmental contaminants have been shown to cause asthma or exacerbate existing asthma.
Data Range	Children in two age groups: 4-7, 8-11. For the years 1994-5, 1996-7 and 1998-9.
Terms and concepts	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.
Data sources, availability and quality	National Longitudinal Survey of Children and Youth (NLSCY), Statistics Canada http://www.statcan.ca/english/sdds/4450.htm
Units of measurement	Percentage of children whose parents indicated that their child(ren) had ever been diagnosed with asthma by a physician.
Computation	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 into adult with data collection occurring at two year intervals beginning in the winter and spring of 1994-5. 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. House holds with children in the target population (ages 0-11) were selected from the old-design Labour Force Survey (LFS), and from the new-design LFS, from the National population Health Survey both outside and inside Quebec. A total of 22,831 responding children made up the longitudinal sample in 1994–1995. The sample size was 16,903 in 1994–1997 and 16,718 in 1998–1999.
Sources of further information	Statistics Canada, Social Development Canada.
Geographic scale	The indicator is intended to be nationally relevant. The objective of the NLSCY is to produce reliable provincial estimates by age group.
Useful references	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	
Key observations	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.
Strengths of the Indicator	It is nationally and regionally significant.
Limitations	It is difficult to quantify the link between the environment and the prevalence of asthma. There are contributing factors to asthma prevalence other then 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 duirng 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.
Additional Indicators	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
Opportunities for Improvement	More children could be included and assessed at greater frequency. Efforts could be made to distinguish environmental contributors to asthma from others.
Related Programs/Activities	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: Surveillance: Coordination of national surveillance on chronic respiratory disease; report on "Respiratory Disease in Canada" every three years; Web site with up to date data. Population-based research using national databases: Research using: National Population Health Survey, Canadian Community Health Survey (Statistics Canada); Hospitalization Database (Canadian Institute for Health Information); Mortality Database (Statistics Canada); Special Surveys. • Prevention and Control of Asthma: 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. • Prevention and Control of COPD: 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. • Information dissemination: Respond to internal and external requests for data and information More information is provided by Health Canada's Centre for Chronic 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

Indicator 5 - Children living in homes with a potential source of lead	**Type of indicator: Exposure surrogate**
INDICATOR Description	
Definition	Children aged 0–19, living in housing stock built before 1960, are aggregated for the Census years 1991, 1996 and 2001.
Rationale and role	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).
Data Range	For the Census years 1991, 1996 & 2001. Four age groups were selected for children aged 0–4, 5–9, 10–14, 15–19.
Data sources, availability and quality	The data are from Statistics Canada, Census of Population, 1991, 1996, 2001.
Units of measurement	The number of children 0–4, 5–9, 10–14, 15–19, living in houses built before 1960
Computation	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 data bases using CAPS. The data were then processed in EXCEL to develop the final indicator. Rationale for the selection of the 1960 threshold Homes built before 1960 were likely painted with lead based paint. Paints before 1950 contained large amount of lead. Some paint made in the 1940s contained up to 50% lead by dry weight. During the 1950s, the use of lead was more common in exterior paint but was still used in the interior of homes. In Canada, the Liquid Coating Materials Regulations were enacted under the Hazardous Products Act in 1976 to restrict the amount of 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.
Sources of further information	Data providers: Statistics Canada, Canadian Mortgage and Housing Corporation Indicator Developers: Health Canada/Environment Canada.
Scale of application	The data has been compiled nationally for the indicators report.
Useful references	Please see Table 1 and Figure 1. Wigle, Don. 2003. Child Health and the Environment. Oxford: Oxford University Press.
Key observations	In 2001, 24% of Canadian children under five 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 has 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. 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 increase use of unleaded gasoline. Since 1990, the use of leaded gasoline in on-road motor vehicles has been prohibited in Canada, under the Canadian Environmental Protection Act (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.
Strengths of the Indicator	Nationally relevant. Focuses on the major source of exposure for children in Canada.
Limitations	Because children are believed not to be at 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.

Additional Indicators	Blood lead measures would be ideal. Currently, they are not available on a nationally representative sample of Canadian children.
Opportunities for Improvement	Include health exposure data from lead found in the soil, dust, drinking water, food and various consumer products. Measure blood lead levels in children/
Related Programs/Activities	Health Canada is mandated, under the Government of Canada's Hazardous Products Act 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 Food and Drug Act controls the lead content in food and food packaging materials such as tin cans.

Indicator 6 and 7 - PRTR data on industrial releases of lead/ PRTR data on industrial releases of 153 chemicals	**Type of Indicator:** **Action**
INDICATOR Description	
Definition	The indicator uses data from 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.
Rationale and role	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 US and Canada) 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. 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. 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 of chemicals. 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; • 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 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. Factors determining a child's exposure to a pollutant include: • 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). PRTR data for Canada are provided by the 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. Using NPRI data, Canada is reporting: • Under Lead Indicators -Indicator 4 Blood lead levels: 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 (tonnes), Canada • Under Other Toxic Substances – Indicator 7 Pollutant Release and Transfer Register data Figure 3.5: Total On- and Off-site Releases of Matched Chemicals in Canada, 1998–2001 Figure 3.6: Total On- and Off-site Releases of Matched Chemicals, by Sector, Canada, 1998–2001 Figure 3.7-3.13: On-site releases of selected toxic substances reported in the National Pollutant Release Inventory for Canada Figure 3.14: Total atmospheric releases of mercury in Canada In order to increase comparibility of data, the 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) In addition, emissions data are presented separately for 8 of the 274 chemicals reported to the NPRI (Figure 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, lead and mercury. Exposure can take place through inhalation of the chemical in the air (indoor or outdoor), 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. 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.
Data range	Emissions are reported from 1994–2002 except for dioxins and furans (2000–2001) and hexachlorobenzene (2000–2001), because those substances have been required to be reported to the NPRI since the year 2000 only. In addition, an inventory of total atmospheric releases of mercury is presented for 1990–2000.
Terms and concepts	The "153 matched-chemicals" are those chemicals reported in the Canadian NPRI as well as the US Toxics Release Inventory. *On-site releases*: An on-site release is a discharge of an NPRI-listed pollutant to the environment, within the physical boundaries of the facility. This includes: - 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, 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). *Off-site transfers for treatment prior to final disposal*: 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: - 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. *Off-site transfers for recycling and energy recovery*: 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: - 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. *Reporting thresholds*: 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. 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. 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. Reporting thresholds for each chemical reported for this indicator are as follows: 1. Arsenic: From 1994–2001: 10 tonnes, for year 2002: 50 kg with a 0.1% concentration threshold In the year 2000 the 20 000 hr 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. 2. Benzene: 10 tonnes with a 1% concentration threshold 3. Cadmium: From 1994–2001: 10 tonnes with a 1% concentration threshold, for year 2002 reporting threshold changed to 5 kg with a 0.1% concentration. 4. Chromium (and its compounds): 10 tonnes with a 1% concentration threshold, beginning in 2002 the reporting of hexavalent chromium (most toxic form of chromium compounds) is reported separately in the NPRI. 5. Hexachlorobenzene (HCB) and 6. Dioxins and furans: Reported on an "activity-based" threshold. 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. 7. Lead: 50 kg with a 0.1% concentration threshold 8. Mercury: From 1994–2000 reporting threshold at 10 tonnes, from 2000–2002 reporting threshold at 5 kg at with no concentration limit.
Data sources, availability and quality	*Data source:* 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 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 on-line database (http://www.ec.gc.ca/pdb/npri/). *Data quality*: Amounts reported to 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.
Units of measurement	The units of measurement are tonnes, grams (for hexachlorobenzene) and g TEQ – grams of international toxicity equivalent (TEQ), (for dioxins and furans).
Computation	Figure 3.3: On- and Off-site Releases of Lead (and its compounds), Canada, 1995–2000 Only manufacturing industries were selected, which does not include electric utilities, hazardous waste facilities, or mining facilities. Manufacturing Industry Sectors (US SIC Codes 20-39) includes 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, (US SIC Codes 20-39). **Figure 3.4. Total estimated emissions of lead to air (tonnes), Canada:** 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/EMEP Task Force on Emissions Inventories and Projections. **Figure 3.5 and 3.6**: 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/). **Only certain industry sectors are covered in the matched data set:** Manufacturing Industry Sectors (US 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, Other sectors (US SIC Codes 20-39): Coal Mining (except US SIC code 1241), Electric Utilities (limited to those that combust coal and/or oil, US SIC codes 4911, 4931 and 4939), Hazardous Waste Treatment and Disposal/Solvent Recovery (US SIC codes 4953 and 7389),Chemical Wholesalers. * US SIC codes are used because NPRI facillities report both the Canadian SIC code and the equivalent US SIC code and TRI facilities report only the US Sic codes. 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. **Figure 3.7-3.13: On-site releases of selected toxic substances reported in the National Pollutant Release Inventory for Canada** On-site releases on selected substances as reported in the NPRI, all sectors. **Figure 3.14: Total atmospheric releases of mercury in Canada** 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. Databases such as the Canadian Residual Discharge Information System II, which contains facility-specific information, were used in conjunction with emission factors from the US 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. 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. The comprehensive mercury inventory includes emissions to air only. (Environment Canada, 2003b).
Sources of further information	*Data providers:* Environment Canada National Pollutant Release Inventory Environment Canada 9th Floor, Place Vincent Massey 351 St. Joseph Blvd. Hull, Quebec K1A 0H3 Tel: (819) 953-1656 Fax: (819) 994-3266 email: 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) *Indicator developers*: National Indicators and Reporting Office Environment Canada

	Environmental Signals (http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm) North American Commission for Environmental Cooperation, Taking Stock reports, (http://www.cec.org) NPRI Office Environment Canada National Pollutant Release Inventory (http://www.ec.gc.ca/pdb/npri) *Data users*: Non-governmental organizations (e.g., PollutionWatch, http://www.pollutionwatch.org/home.jsp; North American Commission for Environmental Cooperation, Taking Stock reports, http://www.cec.org)
Geographic scale	National (all of Canada). The data are collected for individual facilities and can be expressed at different scales (e.g., by province).
Useful references	- NRPI website, which includes downloadable databases and annual reports: http://www.ec.gc.ca/pdb/npri - On-line data search: http://www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm - General inquiries: npri@ec.gc.ca - Environment Canada's *Environmental Signals, Canada's National Environmental Indicator Series 2003*: http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm
INDICATOR presentation and observations	
Key observations	*NPRI "on-site" releases and transfers*: **1. Arsenic** Health effects 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 US 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). Trends in emissions Arsenic is a naturally occurring element found commonly in wood preservation industries, mining as well as the combustion of fossil fuels. Since the year 1994, total on-site releases of arsenic have increased slightly from 180 tonnes in 1994 to 201 tonnes in 2002, representing an 11.4% increase in releases. 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 5-fold increase in reporting facilities. In the year 2002 there were 211 facilities reporting to the NPRI for arsenic compared to only 46 in 1994. Arsenic releases were at their lowest in 1995 with 108.8 tonnes and at their highest in 2002 with 256.3 tonnes. The year 1995 saw the least amount of reporting facilities (44 reporting facilities) while 2002 had the highest number of reporting facilities (211 reporting facilities). It is important to note, however, that the inherent increase in arsenic releases is a result of an increase in the number of reporting facilities. Some important changes to NPRI reporting guidelines with respect to arsenic releases occurred in 2000 and 2002. In the year 2000 the 20 000 hr 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. Legislative and policy framework

	Arsenic and its compounds were on the first Priority Substances List under the *Canadian Environmental Protection Act* (CEPA). 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. Currently, there are a number of regulations in place regarding arsenic releases on a federal level to reduce exposure. CEPA regulates the dumping at sea of any materials containing specified concentrations of arsenic. The federal government is also developing controls to reduce environmental exposure. In addition to CEPA, section 36 of the Federal Fisheries Act prohibits the depositing of harmful substances, including arsenic into waters used by fish. Metal Mining Liquid Effluent Regulations under the Fisheries Act also placed limits on arsenic and other metals found in mining effluents. The shipping or transport of arsenic under the federal Transportation of Dangerous Goods Act is controlled by the Hazardous Product Act, the Food and Drug Act and the Pest Control Products Act. 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: ▪ 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 **2. Benzene** <u>Health effects</u> Vehicle emissions are the major source of benzene release 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 in 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). <u>Trends in emissions</u> Total on-site releases of benzene have been decreasing steadily since 1994 while the number of reporting facilities has increased. In 1994, 2,608 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 reporting facilities has been steadily increasing since 1994. In 1994 there were 95 reporting facilities compared to 204 reporting facilities in 2002, over a two-fold increase. Benzene is currently one of 60 volatile organic compounds (VOC) with additional reporting criteria in which the reporting of benzene releases is only required if the 10 tonne air release threshold for VOC has been met. Some major sources of benzene and other VOC, 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. <u>Legislative and policy framework</u> Benzene is listed as toxic under Schedule 1 of CEPA. A major contributor to the decrease in releases thus far has been the federal government's Benzene in Gasoline Regulations that 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 regulations have shown that

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.

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 or 38L/min.

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 (Phase One and Two) called for a 30% reduction in air emissions by the year 2000.

3. Cadmium

Health effects

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).

Trends in emissions

Cadmium is a substance that is present in the Canadian environment both from 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 5kg with 0.1% concentration criterion.

Legislative and policy framework

Inorganic cadmium compounds are listed as toxic under CEPA. Some tools developed in reducing cadmium emissions include:

- New Sources Emission Guidelines for Thermal Electricity Generation
- Environmental Code of Practice for Integrated and Non-Integrated Steel Mills
- Contaminated Fuel Regulations
- United Nations Economic Commission for Europe's Aarhus Protocol on Heavy Metals (ratified by Canada in 1998)

4. Chromium

Health effects

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).

Trends in emissions

Chromium is a naturally occurring metal that mostly exists in the trivalent or hexavalent forms 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 in on-site releases 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 1,545 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 two-fold 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.

Legislative and policy framework

Hexavalent chromium compounds are listed as toxic under CEPA. 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 nonferrous base metals also contributes to chromium releases. Human exposure to chromium in Canada is most likely from contaminated food sources.

Guidelines and codes of practice regarding chromium include: the New Source of Emission Guidelines for Thermal Electricity Generation and Recommendations for the Design and Operation of Wood Preservation Facilities.

5. Hexachlorobenzene

Health effects

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).

Trends in emissions

Hexachlorobenze (HCB) was added to the NPRI substance list in 2000. Between 2000 and 2002 total releases of hexachlorobenzene (HCB) increased to 0.045 tonnes and 341 reporting facilities, representing a 20% increase in total on-site releases and 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 the electric power generation, metal manufacturing, mining and smelting sectors. Typically, HCB is a by product of chemical manufacturing, wood preservation plants, and waste combustion.

Legislative and policy framework

	Hexachlorobenzene is listed as toxic under CEPA 1999. The CEPA 1999 that HCB is considered a toxic, persistent and bioaccumulative substance slated for virtual elimination (VE) under the Toxics Substances Management Policy (TSMP). In addition, it is considered on the United Nations Economic Commission for Europe (UN/ECE) Persistent Organic Pollutant (POP) protocol as a toxic substance with the potential for long-range transport through the atmosphere. Some regulatory and non-regulatory tools used to manage this substance determined to be toxic under CEPA 1999 include the following: • Prohibition of Certain Toxic Substances Regulations, 2003 • Inter-provincial Movement of Hazardous Waste and Hazardous Recyclable Material 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 • North American Commission for Environmental Cooperation-Draft Phase One North American Regional Action Plan on Dioxins and Furans, and Hexachlorobenzene **6. Dioxins and Furans** <u>Health effects</u> Dioxins and furans are toxic chlorinated chemicals that are found in very small amounts in the environment, including in the air, water and soil. They are also present in some foods. 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-*p*-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). <u>Trends in emissions</u> 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 reporting facilities have 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 sectors. <u>Legislative and policy framework</u> Dioxins and Furans are released as byproducts of combustion and many industrial processes. They occur also 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 lifespan 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 for effluent waste. After the implementation of dioxin and furan effluent regulations in the 1990’s, this

sector achieved virtual elimination of its effluent with a reduction of over 99%.

Under the Toxics Substances Management Policy (CEPA), polychlorinated dibenzo-p-dioxins (PCDD or dioxins) and polychlorinated dibenzofurans (PCDF or furans) are slated for virtual elimination as they were determined to be toxic under the CEPA, and are persistent and bioaccumulative. Dioxins and Furans are also listed on the United Nations Economic Commission for Europe Persistent Organic Pollutant Protocol as toxic with the potential for long-range transport through the atmosphere.
In addition to the CEPA and UN regulations, the federal government has imposed several Canada-wide Standards regarding the release of dioxins and furans:

- Pulp and Paper Mill Effluent Chlorinated Dioxin and Furan 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

7. Mercury
<u>Health effects</u>
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 methyl mercury, 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 neurotoxin—it can cause damage to the brain and central nervous system. It also affects the kidneys and lungs. Methyl mercury is known to affect learning ability and development in children (Environment Canada, 1999c).

<u>Trends in emissions</u>
Total on-site releases of mercury varied between 3.8 tonnes in 1994 to 2.0 tonnes in 1999, showing no apparent tendency. In 2000, mercury releases increased dramatically to 6.2 tonnes, decreasing slightly in 2002 with 5.8 tonnes. This overall increase is due to a reduction in reporting thresholds to a 5 kg with no concentration limit. As a result of the change in reporting thresholds, 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 the electrical power generation and base metal smelting sectors. 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.

<u>Legislative and policy framework</u>
Mercury has been determined to be toxic under CEPA, and has been added to Schedule 1, the List of Toxic Substances. It is also included on the CEC's North American Regional Action Plan on Mercury. Mercury has been an NPRI substance since its inception. In addition to CEPA, the federal government also participates in a number of international activities to reduce mercury releases such as:

- United Nations Economic Commission for Europe Aarhus Protocol on Heavy Metals
- North American Commission for Environmental Cooperation (CEC) North American Regional Action Plan on Mercury
- The Great Lakes Bi-National Toxics Strategy
- The Arctic Council Action Plan Mercury Project
- The New England Governors/Eastern Canadian Premiers Mercury Action Plan

Federal and provincial mercury initiatives are also being initiated including:

- Chlor-Alkali Mercury Release Regulations
- Canada-Ontario Agreement Respecting the Great Lakes
- Harmful Pollutants Annex to the Canada-Ontario Agreement Respecting the

Great Lakes Basin Ecosystem

Canada-wide Standards for mercury-reducing initiatives include:

- Mercury in Dental Amalgams
- Mercury-containing Lamps
- Base Metal Smelting and Waste Incineration

8. Lead

Health effects

Lead occurs naturally in the environment and has many industrial uses. However, even small amounts of lead can be hazardous to human health.

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, 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).

Trends in emissions

Total on-site releases from lead have been decreasing steadily from 1994 to 2001, with a significant decrease in releases in 1995. In 1994, lead releases were 1256.0 tonnes with 165 reporting facilities falling to 931.1 tonnes with 172 reporting facilities in 1995. The following year in 1996 both releases and reporting facilities increased slightly (1018.6 tonnes and 178 reporting facilities), but releases were still lower than in 1994. This decreasing trend continued until 2001 with on-site releases of 602.2 tonnes and 206 reporting facilities. In 2002 emissions increased to 735.6 tonnes a result of an increased number of reporting facilities due to a reduction in reporting thresholds from 10 tonnes to 50 kg at 0.1% concentration criterion. Currently, lead mining, smelting, refining, metal manufacturing and industrial operations are the major sources of lead releases to the atmosphere. Process improvements, changes in the base metal sector and the phase-out of many older incinerators have contributed to the decline in lead levels in recent years. Historically, lead emissions were decreasing over time because of regulations prohibiting leaded gasoline – once the primary source of lead emissions to the environment.

Legislative and policy framework

Lead was one of the first substances named to CEPA 1999's Toxic Substance List. 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 the Act.

In addition to CEPA 1999, the federal Fisheries Act 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 Metal Mining Liquid Effluent Regulations and Metal Finishing Liquid Effluent Guidelines under the Fisheries Act. Compounds containing lead are controlled by the Hazardous Products Act, the Food and Drug Act, and the Pest Control Products Act, while the shipping or transport of substances containing lead are regulated under the federal Transportation of Dangerous Goods Act.

	In combination with federal regulations are a number of risk management tools that aim to reduce levels of lead emissions which include: • Secondary Lead Smelter Release Regulations • Regulations Amending the Gasoline Regulations • Gasoline Regulations • Fuels Information Regulations • Gasoline and Gasoline Blend Dispensing Flow Rate Regulations
Strengths of the indicator	- 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.
Limitations of the indicator	- NPRI data do not encompass all substances emitted to the environment. - Reported NPRI emissions generally underestimate the actual chemical load to the 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 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. - 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.
Additional indicators	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). For many substances, scientific evidence shows that adverse health effects are associated with very low levels of exposure (especially *in utero*). While reporting thresholds should be lowered to reflect the risk of 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. The best indicator of human exposure to specific chemicals would be biomonitoring data.
Opportunities for improvement	- 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.
Related	Substances in the NPRI that are determined to be toxic under the CEPA are managed

programs/activities	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, persistent and result primarily from human activity. 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. Environment Canada's Management of Toxic Substances website: http://www.ec.gc.ca/Toxics/

Indicator 8 – Pesticide residues on foods	Type of indicator: *Exposure surrogate*
INDICATOR Description	
Definition	*Percentage of fresh fruits and vegetables with detectable organophosphate pesticide residues reported by the Canadian Food Inspection Agency Program from 1992–2003.*
Rationale and role	Children's consumption of fruits and vegetables is relatively high. This can be a major dietary source of exposure to pesticides.
Data sources, availability and quality	Canadian Food Inspection Agency (CFIA) residue monitoring database, 1995 to 2003. Data from the CFIA is optimised for enforcement of MRLs for Canadian food. Number of detections is established according to detection limits by standardized multiresidue methods, subject to strict quality control.
Units of measurement	Percent fraction
Computation	Yearly enumeration of residues above 0.017 ppm for all OP pesticides on fruits and vegetables, expressed as percent of sample size.
Sources of further information	
Geographic scale	National
Useful references	Canadian Food Inspection Agency, Food Safety Directorate, Food Microbiology and Chemical Evaluation, Chemical Residue Annual Reports 1995–2002.
INDICATOR presentation and observations	
Key observations	Percentage of fresh fruits and vegetables with OP pesticide residues has decreased over the years suggesting reduced exposure from this source.
Strengths of the Indicator	The indicator is a weak estimator of overall children expoure because it only captures part of the overall diet and does not capture other sources of exposure.
Limitations	The indicator cannot estimate children's risk or health outcome
Additional indicators	Biomonitoring of pesticides and their metabolites in urine
Opportunities for Improvement	Implement a reporting system for adverse effects expected to be available by 2007.
Related Programs/Activities	

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

SAMPLE SIZE	10446	9235	8289	6803	8085	8582	14124	15530
% DETECTED	12.3	11.9	6.1	3.9	5.0	3.6	3.7	3.0
YEAR	1995	1996	1997	1998	1999	2000	2001	2002

Indicator 9 - Percentage of children (households) without access to treated water	**Type of indicator: Action**
INDICATOR Description	
Definition	Percentage of urban Canadians not connected to public water distribution systems in their homes
Rationale and role	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 water-borne 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.
Data range	1991, 1994, 1996 and 1999
Terms and concepts	*Municipal population:* 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. *Municipal population served water*: 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.)
Data sources, availability and quality	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. 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. 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 Census of Canada: Canadian Population (1991, 1996 and 2001). Data available at: http://www12.statcan.ca/english/census01/home/index.cfm
Units of measurement	Percentage of Canadians (based on the MUD survey population, not the total Canadian population)
Computation	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. 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 *Municipal Water Use indicators for Canada*, below, for details).
Sources of further information	Environment Canada's Municipal Water Use Database (MUD) survey background information: http://www.ec.gc.ca/water/en/manage/e_manag.htm
Geographic scale	National. Data are collected at the municipal level.
Useful references	Environment Canada's *Environmental Signals, Canada's National Environmental Indicator Series 2003*, municipal water use indicators for Canada: http://www.ec.gc.ca/soer-ree/English/Indicator_series/ Environment Canada, *Municipal Water Pricing, 1991–1999*: http://www.ec.gc.ca/water/en/info/pubs/sss/e_price99.htm

	Health Canada, *Water Quality and Health*: http://www.hc-sc.gc.ca/hecs-sesc/water/index.htm
INDICATOR presentation and observations	
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
Strengths of the indicator	National in scope and easy to understand.
Limitations of the indicator	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. Current data collection, at the national level, also does not provide information on pathogen occurrence or chemical contamination in private wells. 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).
Additional indicators	See other indicators under theme "Waterborne diseases" of this report.
Opportunities for improvement	Future improvements would include deriving the population of children served by various levels of water treatment. 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., CCME Source to Tap Water Protection Strategy). 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.

<table>
<tr><th colspan="2">Indicator 11 - Percentages of children (households) that are not served with sanitary sewers.</th><th>Type of indicator: Action</th></tr>
<tr><td colspan="3">INDICATOR Description</td></tr>
<tr><td>Definition</td><td colspan="2">Percentage of urban Canadians that have access to secondary-level sewage treatment or better, through a centralized collection system.</td></tr>
<tr><td>Rationale and role</td><td colspan="2">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.</td></tr>
<tr><td>Data range</td><td colspan="2">1991, 1994, 1996, 1999</td></tr>
<tr><td>Terms and concepts</td><td colspan="2">Municipal population serviced by sewers: 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.

Primary treatment: All population served by collection systems having any form of mechanical sewage treatment (in some cases can include screens and meshes).

Waste stabilization ponds: 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.

Secondary treatment: 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.

Tertiary treatment: 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.</td></tr>
<tr><td>Data sources, availability and quality</td><td colspan="2">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.

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.

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</td></tr>
<tr><td>Units of measurement</td><td colspan="2">Percentage of Canadians (based on the MUD survey population, not the total Canadian population)</td></tr>
<tr><td>Computation</td><td colspan="2">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.</td></tr>
<tr><td>Sources of further information</td><td colspan="2">Environment Canada's Municipal Water Use Database (MUD) survey background information:
http://www.ec.gc.ca/water/en/manage/e_manag.htm</td></tr>
<tr><td>Geographic scale</td><td colspan="2">National. Data are collected at the municipal level.</td></tr>
<tr><td>Useful references</td><td colspan="2">Environment Canada's Environmental Signals, Canada's National Environmental Indicator Series 2003, municipal water use indicators for Canada:
http://www.ec.gc.ca/soer-ree/English/Indicator_series/

Environment Canada's The State of Municipal Wastewater Effluents in Canada:
http://www.ec.gc.ca/soer-ree/english/SOER/MWWE.cfm</td></tr>
</table>

	Health Canada's *Water Quality and Health*: http://www.hc-sc.gc.ca/hecs-sesc/water/index.htm
INDICATOR presentation and observations	
Key observations	The percentage of urban[1] Canadians served by secondary sewage treatment or better increased from 65% to 78% between 1991 and 1999. This increase largely reflects infrastructure upgrades. A higher proportion of Canadians living in coastal areas are served by lower levels of treatment (primary or none). About 70% of urban Canadians serviced by sewage collection systems had effluent disinfection. Further analysis and research are required on a case-by-case basis to assess whether areas without disinfection pose a particular risk to children's health. Canadians not serviced by sewage collection systems are generally served by private septic tanks, which are routinely pumped out and trucked to communal treatment facilities.
Strengths of the indicator	Covers a large portion (83%) of the total Canadian population as part of ongoing survey and is relatively simple to calculate and update. Municipalities' responses to secondary levels of treatment or better are generally more reliable than responses to primary treatment, due in part to the ambiguity of the MUD definitions.
Limitations of the indicator	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. 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.
Additional indicators	See other indicators under theme "Waterborne diseases" of this report.
Opportunities for improvement	An improvement ot this indicator would be to derive the population of children serviced by centralized sewage treatment. Collecting detailed data from provincial sewage treatment plant performance and compliance would also be an improvement.

[1] Refers to Canadians living in municipalities having a population of over 1000. In 1999, this comprised about 83% of the total population.

Indicator 12 – Morbidity: number of cases of childhood illnesses attributed to waterborne diseases	**Type of indicator: Health Outcome**
INDICATOR Description	
Definition	Notifiable Diseases Registry: Number of cases of infection, by age, reported to provincial/territorial authorities and collected by Health Canada. Cause of infection is not identified.
Rationale and role	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.
Data Range	Notifiable Diseases Registry 1988 to 2000 – 0-1, 1–4, 5–9, 10–14, 15–19.
Terms and concepts	Notifiable Diseases Registry *Giardiasis*, sometimes called 'beaver fever', is an intestinal parasitic infection characterized by chronic diarrhoea 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 AIDS may have more severe and prolonged illness.
Data sources, availability and quality	Notifiable Diseases Registry The list of national Notifiable Diseases Registry is agreed upon by consensus among provincial and federal health authorities through the Advisory Committee on Epidemiology (ACE). ACE meets approximately twice annually at which times, proposed additions and/or deletions to the list are debated. Data is available for campylobacter from 1986 to 1999 and for Giardia from 1983 to 1999. These are the years in which these diseases became reportable. Available online at: http://dsol-smed.phac-aspc.gc.ca/dsol-smed/ndis/c_time_e.html
Units of measurement	Notifiable Diseases Registry Number of cases reported to provincial/territorial health authorities per 100,000 population and number of reported cases both available on line.
Computation	Notifiable Diseases Registry – information collected by provincial/territorial health departments based on where the patient resides and then passed to Health Canada. HC computes both the number of cases and the rate per 100,000.
Sources of further information	Notifiable Diseases Registry is available on line through the PPHB database.
Geographic scale	National.
Useful references	Article by Lim et al, 2002. http://www.hc-sc.gc.ca/pphb-dgspsp/publicat/ccdr-rmtc/03pdf/29s1e.pdf Gillian Lim, Jeff Aramini, Manon Fleury, Rita Ibarra, Rob Meyers (2002) Investigating the relationship between drinking water and gastroenteritis in Edmonton: 1993–98, Ottawa: Health Canada. Government of Canada (1999) Statistical Report on the Health of Canadians, Ottawa: Statistics Canada.
INDICATOR presentation and observations	
Key observations	Children aged 1–4 are more likely to be infected with both Giardia and Campylobacter. 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.
Strengths of the Indicator	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 aetiology.

Limitations	Notifiable Disease Registry Cases are not reported to the 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 recorded. 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 under reporting, timeliness of reporting, disease case definitions, and passive surveillance.
Additional Indicators	Proportion of population with access to adequate sanitary and water treatment facilities.
Opportunities for Improvement	Within the present system. None.
Related Programs/Activities	While no program specifically targets children, the Federal-Provincial-Territorial Subcommittee on Drinking Water (DWS) – 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

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COUNTRY REPORT: MEXICO

Prepared by Mexico's Ministry of Health

Executive Summary

More than 40 percent of Mexico's total population in the year 2002 (nearly 44 million people) were under the age of 19. The birth rate per 1,000 inhabitants declined from 45 in 1960 to 17 in 2000. Today, the general mortality rate is five per 1,000 inhabitants. Mexico's life expectancy increased progressively, jumping 25 years between 1950 and 2000.

The primary causes of death have changed radically as well, especially per age group. Transmissible diseases and reproduction-related problems, which had been the leading causes of death, were replaced by non-transmissible diseases and injury.

Common infections and reproductive illnesses continue to cause significant harm to health in highly marginalized groups. There are states in southern Mexico whose mortality rates from such causes are ten times higher than those in the more developed northern states. The same occurs with deaths from acute respiratory infections (ARIs).

Recent studies have looked at the health effects of exposure to air pollution. Some studies conducted in Mexico City show a close correlation between air pollution and lung disease, pulmonary aging processes and respiratory infections. Ground-level ozone and PM_{10} are among the most worrisome air pollutants due to their potential health effects and the frequency with which they exceed the air quality standards established to protect human health.

ARIs and asthma are most closely related with air pollution in rural and urban areas alike. Over the last ten years, ARI deaths among children younger than five decreased by 60 percent, while morbidity from ARIs and asthma increased.

Indoor air pollution caused by wood or coal burning for cooking or heating represents a public health problem for children under five and women of reproductive age, especially in the country's marginalized areas. In the year 2000, 18 percent of Mexico's total population continued to heat their homes using such methods.

Involuntary tobacco exposure is the cause of several illnesses, such as lung cancer and other respiratory diseases. Children exposed to tobacco smoke face a greater risk of disease, particularly in their early years, due to the immaturity of their immune systems. In 2002, there was a 36 percent national prevalence of passive smokers of 12 to 65 years of age, with the majority in urban areas. Mexico does not have the corresponding information on younger groups.

The primary source for environmental exposure to lead in Mexico is the manufacture of glazed ceramic pottery and its use in food preparation and storage. Several studies conducted among rural populations, especially with school-age children and women of reproductive age, point to a significant link between high concentrations of lead in blood and the use of glazed pottery for cooking and serving food and beverages.

Given the lack of a representative value of blood lead levels in the general population, but rather only isolated studies in industrial zones and certain pottery-making regions, two Mexican case studies are presented. The first study refers to metallurgical activities in the northern region, while the second shows the impact of specific actions to reduce atmospheric lead emissions in Mexico City. Mexico's pollutant release and transfer register is in the process of being developed, and therefore the respective information is not currently available.

Mexico does not adequately record poisonings. The Unique Automated Epidemiological Oversight System (*Sistema Único Automatizado de Vigilancia Epidemiológica*) of the Secretariat of Health (*Secretaría de Salud*) records pesticide poisonings caused by household accidents or suicide attempts. As these are unequivocally urban data, significant under-recording is possible. Notwithstanding the above, cases of pesticide poisoning showed a decrease from 1998 to 2002.

Although national sewer system coverage and access to drinking water increased notably over the last 20 years, in 2000 one of every four inhabitants lacked sewer system access and one of ten lacked household drinking water. In rural areas, the lack of access to both services continues to be a major problem.

Diarrheic illnesses persist as a serious problem among the child population. These diseases are often transmitted by drinking water. Data from 2003 indicate that 95 percent of drinking water is disinfected, although in that year 17 percent of the population did not have water of appropriate bacteriological quality.

Due to specific health service actions and educational and basic sanitation activities, cases of giardiasis and cholera have decreased in the various age groups. For example, there have been no cholera deaths since 1998.

Mexico shifted from [using for tracking population statistics] a broad population pyramid whose area corresponded to the child population (0–14 years old) to an enlarged pyramid [encompassing] both the child population and the population between 20 and 30 years of age. The infant mortality rate in the first year of life, per 1,000 inhabitants, [thus] decreased from 19.1 in 1998 to 16.78 in 2002.

In 2002, the leading causes of death in the population under 19 were distributed as follows: in the first years of life, conditions originating in the perinatal stage, congenital malformations, influenza and pneumonia; and in adolescence, accidents, intestinal infections, intentional injuries and cancer. The main causes of morbidity for the same age groups in that year were ARIs, undefined intestinal infections, intestinal amebiasis, and urinary tract infections.

Women's levels of education have increased over the last 40 years. The total female population with primary education increased from 11.7 to 43.9 percent. In the same period, the [percent of the] female population at all education levels increased, with the greatest increase seen in post-secondary and higher education. Data show that birth rates among women of reproductive age (from 15 to 44 years of age) decrease as education levels and age increase.

Households with per capita income below that required to satisfy basic food needs represented 18.6 percent in the year 2000. For nearly half of all households (45.9 percent), per capita income was below that required to satisfy basic food needs plus basic health, education, clothing, footwear, housing and public transportation needs.

From 2000, national coverage with the triple viral vaccine (measles, mumps and rubella) has remained above 95 percent. Progress in the National Vaccination Program (*Programa Nacional de Vacunación*) since 1992, as well as its sustained increase, is reflected in the decreased rates of morbidity and mortality from diseases preventable by vaccination.

6 Introduction

General health conditions in Mexico have improved considerably over the last 50 years. This is clearly seen in life expectancy at birth. Between 1950 and 2000, the country added 25 years to this indicator. However, the respective differences among the states show the inequality prevailing in the country.

The differences found per region are an important fact to consider in understanding the Mexican situation. In the modern and industrialized northern region, the population is concentrated mostly in urban zones. The southern region is clearly traditional, unindustrialized and with a high indigenous population living in small, dispersed rural communities. This explains why the health indicators for the northern region are similar to those of developed countries, while the same indicators for the southern region are similar to those of developing countries with social and economic problems.

In 2002, there were 43,719,756 persons under 19 years of age in Mexico, representing just over 40 percent of the total population. The birth rate per 1,000 inhabitants has decreased from 45 in 1960 to 17 in 2000, while the child mortality rate in the first year of life decreased from 19.1 per 1,000 inhabitants in 1998 to 16.78 per 1,000 inhabitants in 2002. The leading causes of death also changed radically over the past 50 years. Transmissible diseases and congenital illnesses, which were the primary causes of death, were displaced by non-transmissible diseases and injuries. In the same period, the percentage of deaths due to intestinal infections decreased by a factor of 14 (from 14.3 percent to 1 percent), while deaths from heart disease quadrupled (from 4 percent to 16 percent).

Another fact pointing to a clear epidemiological transition in the country is the changing pattern of causes of death among children under 1 year of age. Previously, infant deaths were concentrated at the postnatal period (between one month and one year of age), mostly caused by acute respiratory infections and diarrhea. Presently, infant deaths are concentrated in the first 28 days of life, due to perinatal causes and congenital anomalies requiring high-technology intervention.

Common infections and congenital events continue to cause major harm to health in highly marginalized groups. Over the last 10 years, deaths from diarrhea in children under five years of age have decreased by 85 percent. However, there are southern states with mortality rates from diarrhea above 40 per 100,000 inhabitants under five years of age, *i.e.*, five times higher than the rates found in the more developed northern states. The same is found with deaths from acute respiratory infections, another clear example of the persistently lower quality of life.

Despite the major progress in health systems, the problems of poverty, social inequality, marginalization, the lack of services, and environmental air, water and soil pollution constitute important factors associated with a poor quality of life for a high percentage of the child population, primarily in the country's rural areas.

Air pollution is a generalized problem in Mexico's major metropolitan areas. However, current demographic growth, industrial concentration, greater numbers of vehicles, increased fuel consumption and inadequate urban mobility patterns have caused the problem to increase in other areas, such as medium-size cities.

Ground-level ozone and PM_{10} [airborne particles less than 10 microns in diameter] are air pollutants of concern given their potential health effects and the frequency with which they exceed the air quality standards for health protection. In the Mexico City Metropolitan Area, the ground-level ozone standard is exceeded during 80 percent of the year, while the air quality standard for PM_{10} is exceeded during 30 percent of the year in certain metropolitan areas.

Indoor air pollution caused by the burning of wood or coal used for cooking of heating constitutes a public health problem with repercussions for the population under five years of age and women of reproductive age, especially in the country's marginalized areas. In 1990, one of every three Mexican (91 percent of rural inhabitants and 11 percent of urban inhabitants) used wood for cooking. In 1993, 25.6 million persons were estimated to use wood as household fuel, decreasing to 17.2 million inhabitants in 2000.

Since 1988, with the first National Addictions Survey (*Encuesta Nacional de Adicciones*, applied throughout the country for persons in urban areas between 12 and 65 years of age, Mexico has begun to have an epidemiological oversight of tobacco addiction. This national survey has been conducted every five years (with the last such survey in 2002), which has enabled a detailed observation of the epidemic's trends, which include stable use figures, a lower average starting age, increased use by minors, and increased use by women.

As regards passive smokers, Mexico does not have specific information for child groups. However, the national index of passive smokers in the urban population is 36.1 percent, while the index for the rural population is 26.2 percent. The greatest [regional] involuntary exposure to tobacco smoke is found in the northern region, with 31.9 percent.

In 2002, the prevalence of asthma in Mexican children under one year of age was 35 per 10,000 inhabitants, while the rate for children between one and four years of age was 63 and the rate for children between 5 and 14 years of age was 35. Inhabitants of the coastal states were found to have a higher number of cases, probably due to the relative environmental humidity or perhaps because these regions have greater usage of air conditioning systems. These systems are known to keep a considerable amount of dust and fungus, which can set off asthma attacks.

The main cause of environmental exposure to lead in Mexico derives from the manufacture of glazed pottery with lead oxide and the use thereof in food preparation. This artisan craft is carried on in 20 Mexican states, by approximately five million potters, many of whom are members of indigenous groups.

Pottery workshops are family businesses, employing all family members between 7 and 70 years of age. Each person participates in some part of the pottery production process, using techniques inherited over the generations and employing no personal protection whatsoever. This activity constitutes the main source of exposure for the child population.

Mexico does not have a representative value of blood lead levels in the general population. It only has data from isolated studies undertaken in industrial areas and in certain pottery-making regions, lacking national basic information on blood lead levels. Considering this fact, it presents the case study on lead poisoning in the child population of a community in northern Mexico, caused by a metals business.

As regards pesticide poisoning, only partial information is available: solely acute cases are reported, without identifying the type of pesticide involved. Cases of poisoning among children under 15 years of age dropped from 1,335 in 1999 to 672 cases in 2002. However, 1:5 underreporting is estimated, *i.e.*, for every reported case there are five cases not reported.

At present, Mexico does not have information on a pollutant release and transfer register because the information requested of businesses for such purpose was voluntary. However, there is current legislation that requires businesses to report their pollutant releases.

The leading environmental and public health problems faced by Mexico include those relating to deficient basic sanitation and poor water quality (not to mention the insufficient availability of water for a numerous and growing human population).

In countries such as Mexico, diarrheic illnesses persist as a serious problem among to the child population. These diseases, caused by bacteria, viruses and protozoan pathogens dispersed through the fecal-oral route, may originate in water used in various household activities, including personal hygiene, and from contact with contaminated recreational water.

The principal component in reducing mortality among children under five years of age has been, in recent years, the component corresponding to death from diarrheic illness. The rate per 100,000 inhabitants under five years of age decreased from 125.6 in 1990 to 20 in 2002.

Water disinfection oversight is undertaken with the periodic and ongoing monitoring of free residual chlorine in the distribution network. Despite the increased volume of chlorinated water in the country, the rate of sewer system coverage is below the average for Latin America, the Caribbean or North America. National sewer system coverage shows a 27 percent increase (from 49 percent to 76 percent, in accordance with the 1980 and 2000 censuses, respectively). The lack of access to such service is particularly notable in rural areas, especially in southeastern Mexico. Drinking water coverage is 95 percent in urban areas and 68 percent in rural zones.

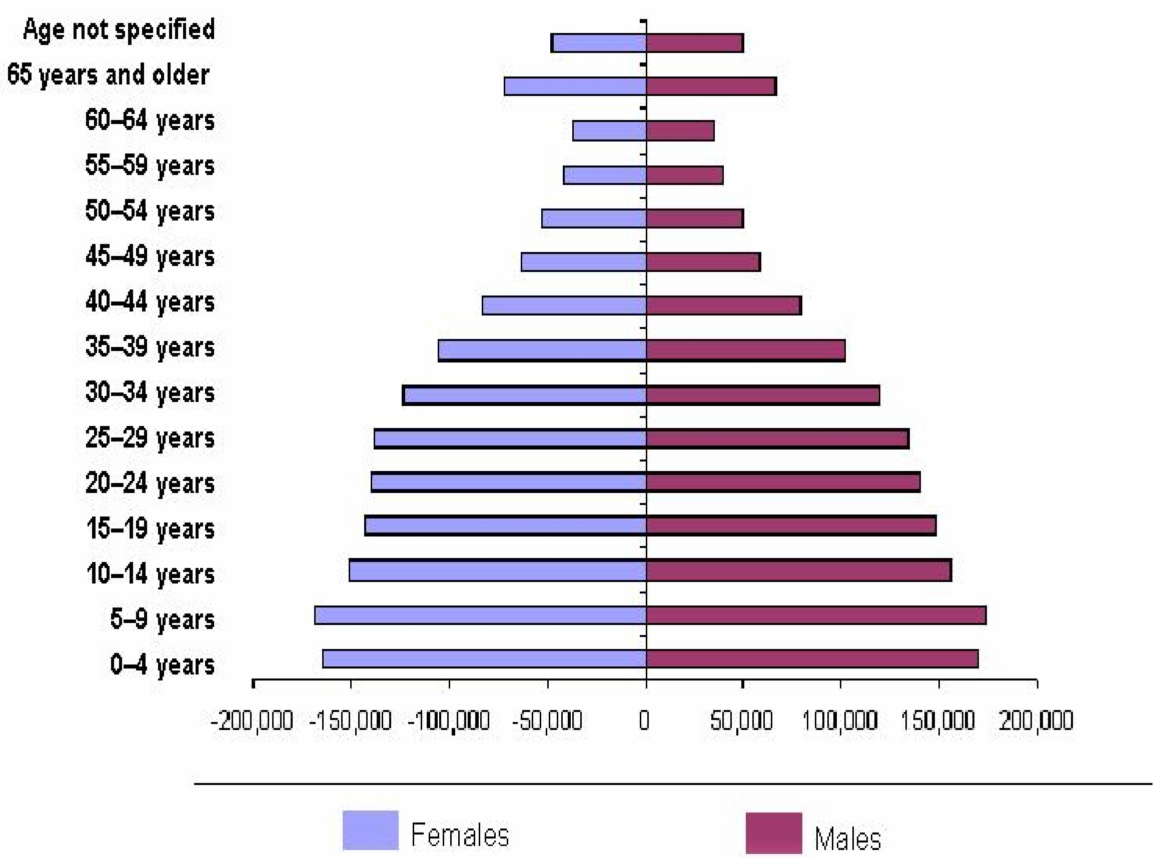
The presence of giardiasis has decreased in the different age groups, as have cases of cholera (from which no deaths have been reported since 1998). This is fundamentally due to specific actions in healthcare and other sectors, particularly education and basic sanitation.

6.1 Indicators of Children's Health in Mexico

6.1.1 Overview of Population Demographics

Mexico's total population in 2002 numbered 103,039,964, of whom 43.7 million were children of 19 years of age or less, representing 42.4 percent. Ten percent were children at or below 4 years of age, according to the 2000–2050 Mexican Population Projection (*Proyección de la población de México*) of the National Population Council (*Consejo Nacional de Población*—Conapo), released in 2002. Furthermore, from 1970, when it had an enlarged population pyramid in the area corresponding to the child population (0 to 14 years old), in 2000 Mexico became a nation with an enlarged population pyramid for both the child population and the population between 20 and 30 years of age (see Figure 6.1).

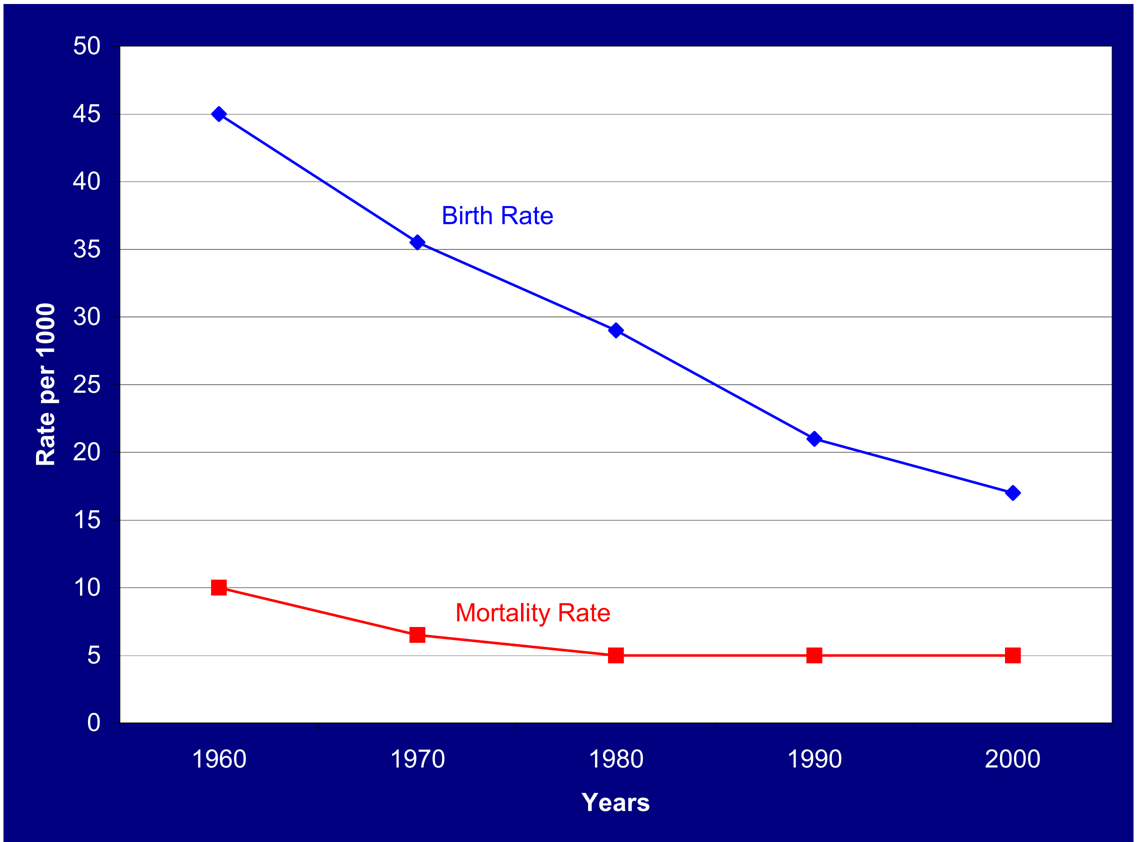
Figure 6.1: Population Pyramid of Mexico, 2000



Source: CIES, based on 2000 Population and Housing Census.

In Mexico, the birth rate in 1960 was 45 per 1,000 inhabitants, decreasing to 17 in 2000. The greatest decrease occurred in the decade from 1960 to 1970. The overall mortality rate decreased from 10 per 1,000 inhabitants to 5 in 2000 (see Figure 6.2).

Figure 6.2: Evolution of Birth and Mortality Rates in Mexico, 1960–2000



Source: Conapo.

In 2002, Mexico's life expectancy at birth was 74.62 years. The average life expectancy for women was 77.1, while men's' life expectancy was 72.1 years of age. Between 1950 and 2000, the country added 25 years to this indicator.

6.1.2 Child Mortality and Morbidity

The child mortality rate in the first year of life, per 1,000 inhabitants, decreased from 19.1 in 1998 to 16.78 in 2002. In 2002, the three main causes of death in children under one year of age were conditions originating in the perinatal stage; congenital malformations, deformities and chromosomal anomalies; and influenza and pneumonia. For the population between 1 and 4 years of age, the main causes of death were accidents; congenital malformations, deformities and chromosomal anomalies; and intestinal infectious diseases. In the case of the 5–9 and 10–14 age groups, the three main causes of death were accidents; cancer; and congenital malformations, deformities and chromosomal anomalies. Lastly, in the 15 to 19-year-old age group, the leading causes of death were accidents; intentional injuries; and cancer, in that order.

In 2002, the two main causes of morbidity in all population groups between 1 and 19 years of age were acute respiratory infections and undefined intestinal infections. The third cause of illness was intestinal amebiasis for the population under four years of age, and urinary viral intestinal for the other age groups.

6.1.3 Socioeconomic Information and Other Determinants of Health

Maternal Education

Women's levels of education have increased over the last 40 years. In 1960, women without education represented 43.9 percent of the overall female population; this percentage decreased consistently, to 11.7 percent by the year 2000. During the same period, the female population having completed primary education[3] increased from 11.8 percent to 20.1 percent. With respect to completed secondary education,[4] the increase was from only 2.3 percent to 18.4 percent in 2000, while the population with postrsecondary[5] and higher education[6] increased from 2.4 percent to 26.7 percent in the period.

According to the 1996 Mexican Fertility Survey (*Encuesta Mexicana de Fecundidad*), specific fertility rates per 1,000 women of reproductive age between 15 and 44 years old decreased as women's education rates and ages increased. The highest fertility rate among all age groups was found at the lowest education levels.

Poverty

As regards the food/poverty threshold (homes with per capita income below the requirements to satisfy basic food needs, equivalent to 15.4 and 20.9 pesos per day in rural and urban areas): in 2000 18.6 percent of Mexican households and 24.2 percent of the total population had incomes below this point of reference[7]. The proportion of children in food poverty, with respect to the total number of children under 18 years of age, decreased from 32.7 percent in 2000 to 27.4 percent in 2003.

Lastly, the economic poverty threshold for 2000 (households with per capita income below the requirements to satisfy basic food needs and basic health, education, clothing, footwear, housing and public transportation needs) was calculated at 28.1 and 41.8 pesos per day per person in rural and urban areas, respectively. In the year 2000, 45.9 percent of Mexican households and 53.7 percent of the total population had income below this point of reference. In the same year, the proportion of children in economic poverty with respect to all children under 18 years of age was 63.9 percent, with a minimal decrease to 62.7 percent for 2002.

Vaccination coverage

The performance of state health systems with regard to vaccination is measured by the immunization coverage among children of less than one year of age. The most important component in the basic vaccination plan for these children is the coverage attained with the triple viral vaccine (measles, mumps and rubella). From 2000, national coverage with the triple viral vaccine has remained steady above 95 percent.

Progress in the National Vaccination Program (*Programa Nacional de Vacunación*) since 1992, as well as the sustained increase thereof, is reflected in the decreased rates of morbidity and mortality from diseases preventable by vaccination.

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[3] Primary: first official level of education, lasting six years
[4] Secondary: second official level of education, lasting three years
[5] Postsecondary: from the tenth through the thirteenth grades
[6] Higher education: from the fourteenth grade and higher
[7] With respect to the capability/poverty threshold (referring to households with per capita income below the requirements necessary to satisfy food needs in addition to the income required to assume education and health expenses), this level was calculated at 18.9 and 24.7 pesos per day per person in rural and urban areas, respectively, for 2000. In that year, 25.3% of households and 31.9% of the total Mexican population had incomes below these amounts. In that same year, the proportion of children under 18 years of age in capability poverty, with respect to the total number of children in the same age group, was 41.6%. By 2002, the proportion had decreased to 35.1%.

7 Asthma and Respiratory Disease

Air pollution is a widespread problem in the large metropolitan areas of Mexico. Due to ongoing demographic growth, industrial concentration, increasing numbers of motor vehicles, high fuel consumption, and inadequate urban mobility patterns, this problem is beginning to be felt in other areas, such as mid-sized cities.

In our country, standards exist for the following air pollutants: sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O3), total suspended particles (TSP), particles smaller than 10 microns in diameter (PM_{10}), and lead (Pb). These pollutants are called “criterion pollutants” and there is an air quality standard for each of them. The air quality standards establish the ambient pollutant concentrations that may not be exceeded more than once a year in the interests of guaranteeing adequate protection of public health.

In Mexico as in other countries, easy-to-understand pollution indicators have been developed. Mexico uses the Metropolitan Air Quality Indicator (*Indice Metropolitano de la Calidad del Aire*—Imeca), according to which the concentration set out in the air quality standard for each pollutant corresponds to an Imeca value of 100. The applicable air quality standards were published by the Ministry of Health and are developed by it in coordination with the Ministry of the Environment and Natural Resources (*Secretaría del Medio Ambiente y Recursos Naturales*—Semarnat), with the participation of academics, environmentalists, and industry representatives.

In general, air pollution in Mexico has declined considerably in urban areas in the last ten years, including in Mexico City. This is undoubtedly due to the implementation and monitoring of a series of measures to improve the environment by decreasing pollutant emissions, including:

- Switching from fuel oil to natural gas for a proportion of electricity production; the share of natural gas in the total primary energy supply rose to 21 percent, while the share of petroleum dropped to 62 percent.
- Seven large metropolitan areas have adopted local air quality management programs aiming to counter pollution from industry, the service and transportation sectors, as well as environmental recovery.
- Fuel quality improvement has been the cornerstone of these programs. The reduction of lead and sulfur content in motor vehicle fuels has helped to reduce certain mobile source emissions.
- A regional surcharge has been applied to gasoline with the objective of financing measures to improve the environment of the Mexico City Metropolitan Zone (MCMZ, *Zona Metropolitana del Valle de México*—ZMVM) and internalize environmental externalities.
- In addition, Mexican Official Standards have been established for CO, NO_x and motor vehicle hydrocarbon emissions.
- Vehicles with catalytic converters replaced after five years of operation, clean industrial facilities, and facilities using natural gas were exempted from the air quality contingency plans by recent regulations.
- The number of companies voluntarily carrying out environmental audits has grown constantly. Significant progress has been achieved on the implementation of the OECD recommendations concerning the Pollutant Release and Transfer Register.

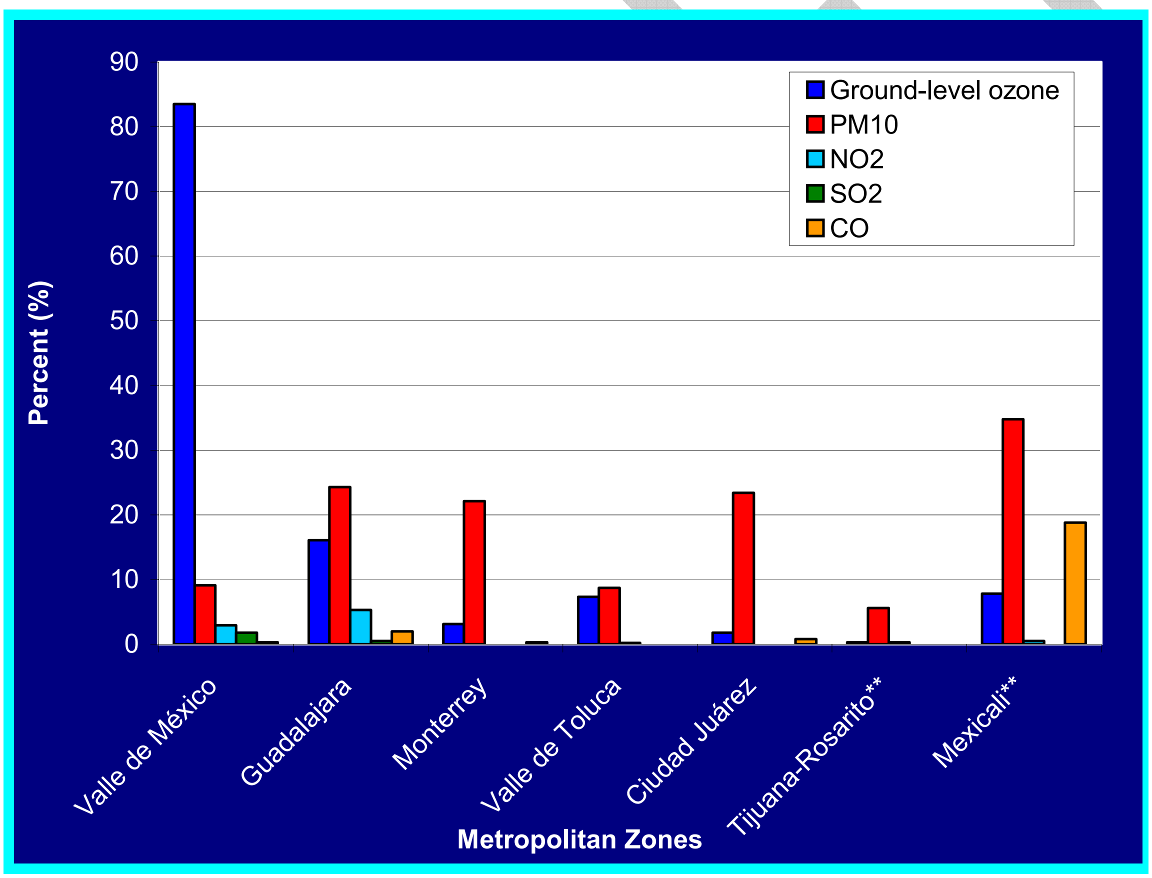
7.1 Outdoor Air Pollution

Despite air quality improvement measures, exposure to air pollution continues to be a severe threat to public health.

Figure 7.1 shows that suspended particles are a significant concern, with 30 percent exceedance days per year for the PM_{10} standard in certain metropolitan areas; the other pollutant of particular concern is ground-level ozone, for which exceedance is 80 percent in the MCMZ.

Given the number and percentage of air quality exceedance days indicated in national monitoring systems' monthly reports, air pollution continues to be a serious problem in both the MCMZ and the Guadalajara Metropolitan Area (*Zona Metropolitana de Guadalajara*—ZMG), while in the Toluca Valley Metropolitan Area (*Zona Metropolitana del Valle de Toluca*—ZMVT) and the Monterrey Metropolitan Area (*Zona Metropolitana de Monterrey*—ZMM) the problem is less severe. The situation in Mexicali is also worrisome as regards PM_{10} and CO levels.

Figure 7.1: Percentage of Days on which the Air Quality Index (Imeca) was exceeded in Key Mexican Metropolitan Areas, 1999–2002*



Source: *Instituto Nacional de Ecología* (INE)

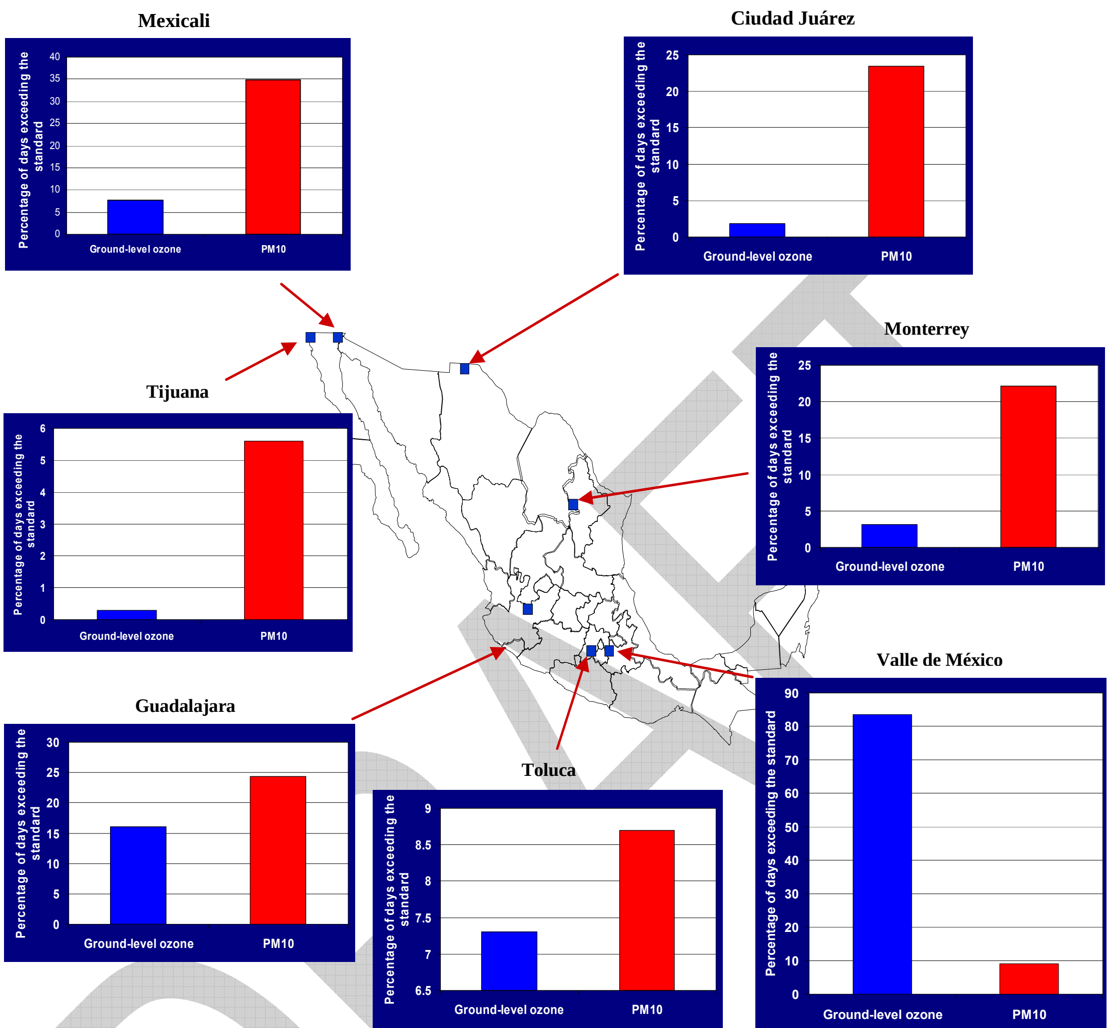
Notes: * four-year arithmetic mean
**three-year arithmetic mean 1997–1999

Key Observations

- Suspended particles are a significant concern in a number of metropolitan zones, with greater than 30 percent of days in exceedance for the PM_{10} in Mexicali and greater than 20 percent in Guadalajara, Ciudad Juarez and Monterrey.
- The other pollutant of concern is ground-level ozone, for which exceedance is over 80 percent in the Mexico Valley Metropolitan Area.
- Given the number and percentage of air quality exceedance days indicated in the national monitoring systems' monthly reports, air pollution continues to be a serious problem in both the Mexico Valley Metropolitan Area and the Guadalajara Metropolitan Area.
- The situation in Mexicali is also worrisome in regards to PM_{10} and carbon monoxide levels.

A National Air Quality Information System (*Sistema Nacional de Información de Calidad del Aire*—Sinaica), seen in Figure 7.2, was established in the second half of 2002, based upon various antecedent air monitoring programs in Mexican metropolitan areas. Presently 23 cities have permanent air monitoring systems, including the major cities (Mexico City, Guadalajara, Monterrey, Toluca) and some cities along the northern border (Ciudad Juárez, Tijuana, Mexicali).

Figure 7.2: Metropolitan Areas in Mexico with Air Quality Programs Including Air Monitoring, 1999–2002*



Source: *Instituto Nacional de Ecología* (INE), graphic: COFEPRIS 2004

Notes: *4-year arithmetic mean, for Mexicali and Tijuana, 3-year arithmetic mean 1997–1999

Key Observations

- Regional map illustrating the metropolitan zones that offer air quality monitoring data, as well as the Imeca information for ground-level ozone and PM_{10}

7.2 Indoor Air Pollution

Use of Biomass

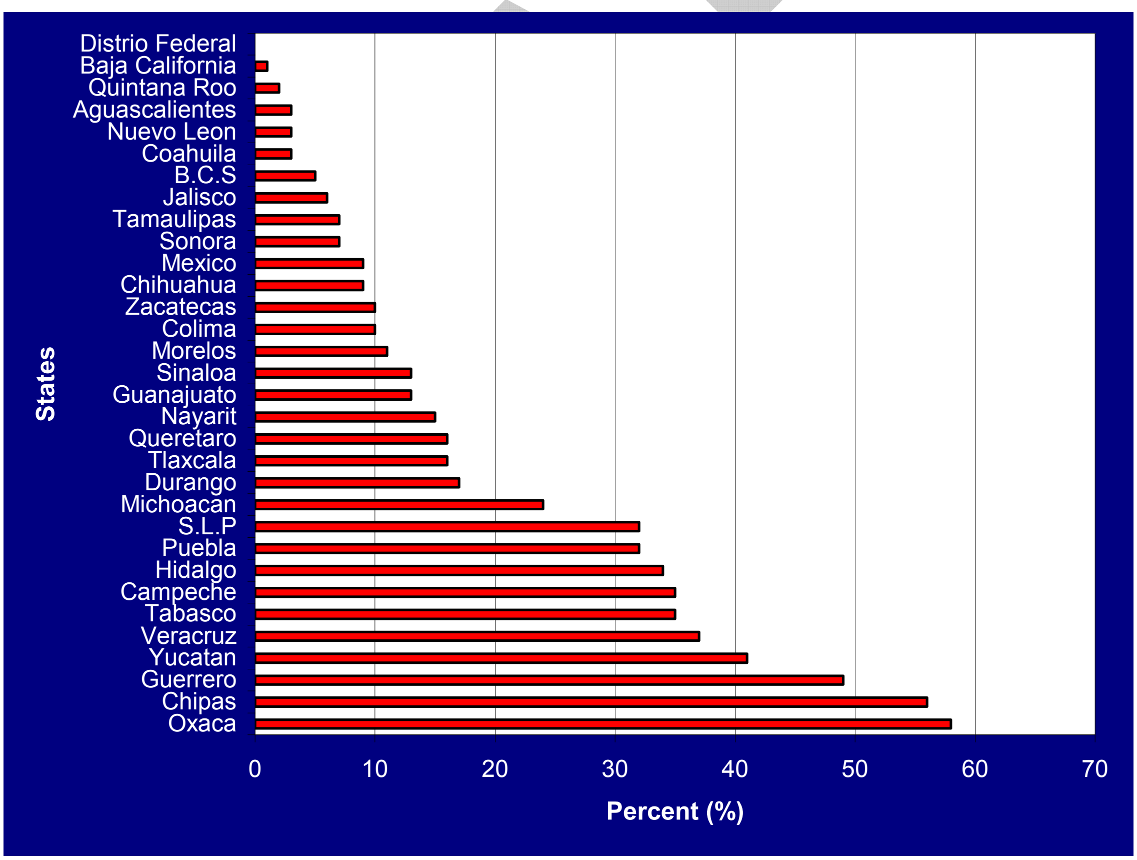
Indoor air pollution in homes caused by the burning of firewood or coal for cooking is a public health problem with impacts on children under five and reproductive-age women. The number of annual deaths in developing countries associated with domestic biomass combustion is estimated at 1,849,000.

In 1990, one in three Mexicans used firewood for cooking, including 91 percent of rural residents and 11 percent of urban residents. It is estimated that 25.6 million people used this fuel in their homes in 1993 and that by 2000 this number had declined to 17,256,471.

Because of this, the Federal Commission for Protection Against Sanitary Risks (*Comisión Federal Para la Protection Contra Riesgos Sanitarios*—COFEPRIS) will initiate a project in 2004 to decrease indoor exposure to biomass smoke. This will be accomplished through the promotion of technological improvements in indoor emission control, reinforcement of community participation, promotion of inter-institutional and cross-sector participation, and risk communication to the population.

Figures 7.3 to 7.5, below, illustrate exposure to biomass smoke.

Figure 7.3: Percentage of Mexico's General Population Exposed to Biomass Smoke, by Region, 2000

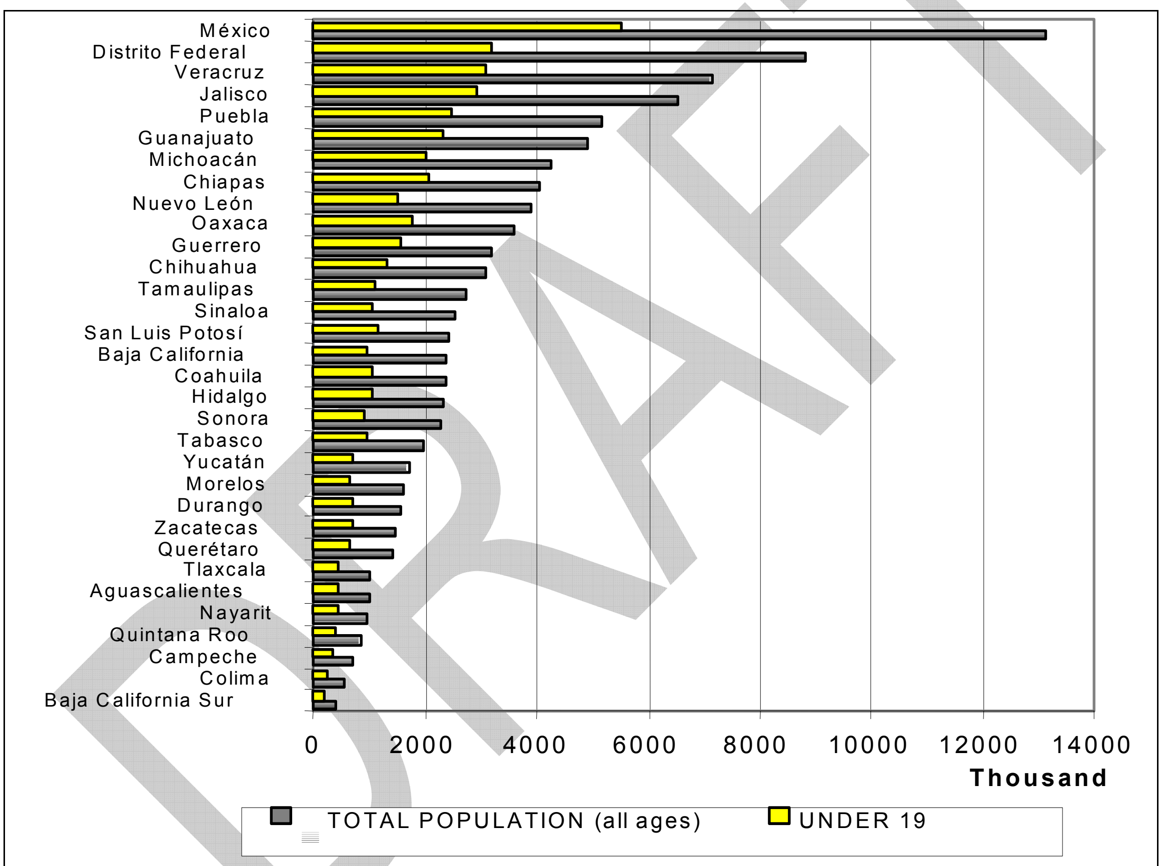


Source: *Diagnóstico Nacional de Salud Ambiental y Ocupacional 2002. Dirección General de Salud Ambiental*

Key Observations

- In 1990, one in three Mexicans used firewood/charcoal for cooking, including 91 percent of rural population and 11 percent of those living in urban areas. In 1993 25.6 million people used this fuel in their homes and by 2000 this number had declined to 17.3 million.
- Among the states with the highest use of firewood are Oaxaca and Chiapas, where it is estimated that 50–60 percent of the population uses this type of fuel. The general pattern is that a higher proportion of people are exposed to firewood and charcoal in the southern part of the country. These are largely rural states with some of the poorest populations; thus, exposure to firewood-related pollutants is more prevalent here.

Figure 7.4: Population Under the Age of 19 Exposed to Biomass Smoke, by State, Mexico, 2000

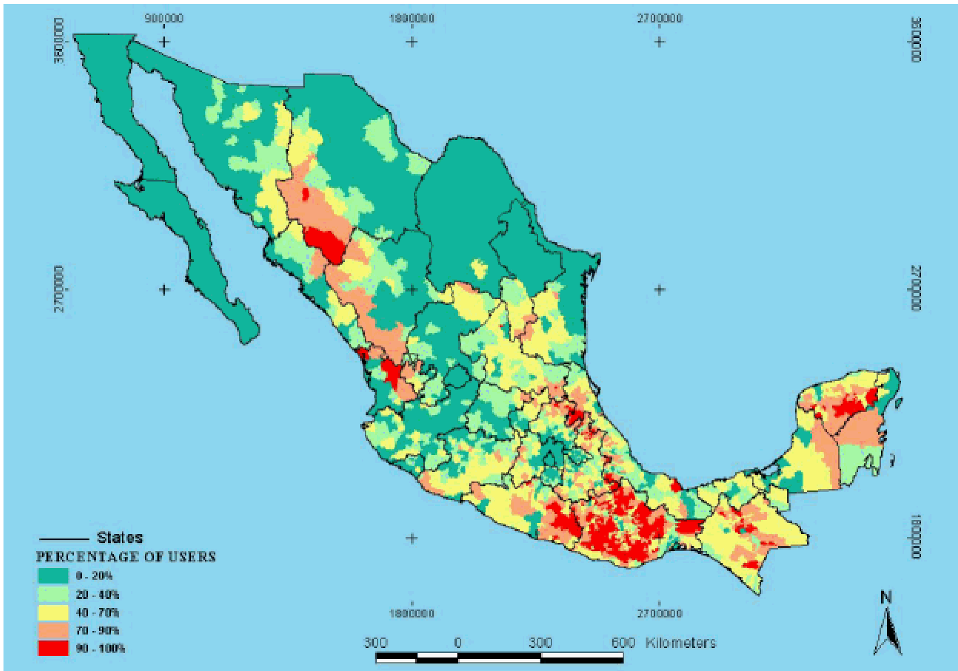


Source: XII General Census of Population and Housing (*Censo General de Población y Vivienda XII, 2000)* INEGI 2000

Key Observations

- The graph shows the percentage of the population under 19 may potentially be exposed to pollutants from biomass usage. This age group corresponds to 43 percent of the Mexican population, with the highest proportion in the country's southern region.

Figure 7.5: Percentage of Fuel Wood Users, at the Municipal Level, in Mexico, 2000



Source: Food and Agriculture Organization of the United Nations, 2003

Key Observations

- The heaviest biomass usage is in southern Mexico and North Central Mexico where areas of 90 to 100 percent utilization may be found in some locales. These are largely rural states with some of the poorest populations

Smoking Rates

Mexico does not have specific information on passive smoker statistics in the population under 12, where “passive smoker” or “involuntary smoker” is defined as any person not classified as an active smoker who is exposed to tobacco smoke (smokers in a given environment) at home, in the classroom and/or at the workplace. However, the National Addictions Survey (*Encuesta Nacional de Adicciones*—ENA-2002) finds that there are around 48 million Mexicans in this situation.

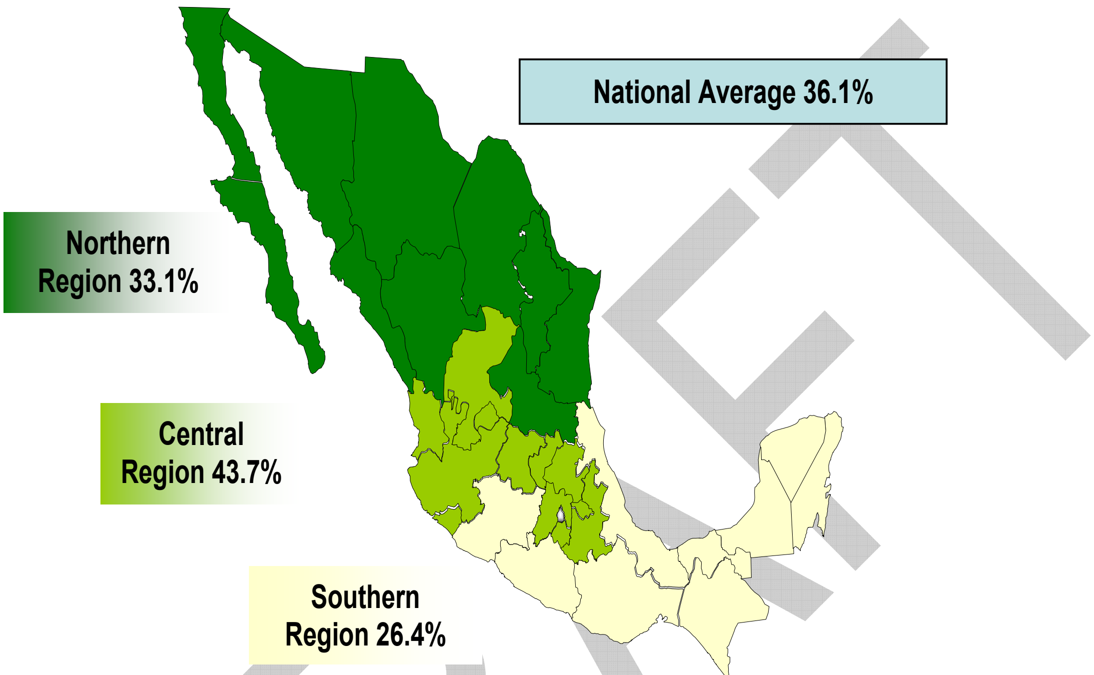
Since 1998, the Secretariat of Health has been conducting the same survey every five years, representing a major repository of information on the subject. The National Addictions Survey (ENA-2002) is the first survey conducted by the National Institute of Statistics, Geography and Information (*Instituto Nacional de Estadística, Geografía e Informática*—INEGI), although it does have an earlier background in the study entitled “Drugs and Users,” published in 1976.

According to data in the Anti-Tobacco Program prepared by the National Council Against Addictions, (*Consejo Nacional contra las Adicciones*), there are around 13 million smokers in Mexico, of whom 24.6 percent are women and 75.4 percent are men.

As regards passive smokers, 36.1 percent of the urban population is included in this category, with the highest percentage in the central region (43.7 percent) (Fig. 7.7 shows only information on urban areas).

The highest involuntary exposure to tobacco smoke among the rural population was found in interviewees' homes in the northern region (31.9 percent).

Figure 7.6: Prevalence of Passive Smoking in Urban Populations (Ages 12 to 65) in Mexico, 2002

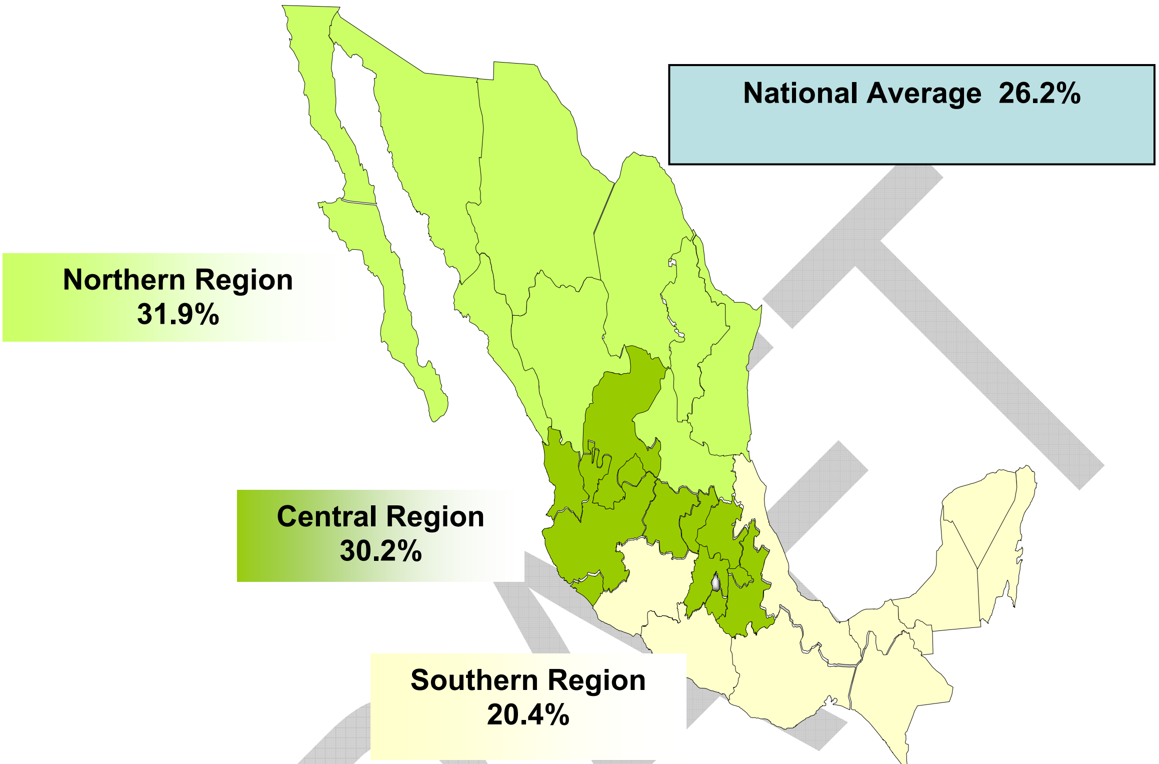


Source: ENA 2002, National Council Against Addictions (*Consejo Nacional Contra las Adicciones*—Conadic), National Institute of Pediatrics (*Instituto Nacional de Pediatría*—INP), General Bureau of Epidemiology (*Dirección General de Epidemiología*—DGE), National Institute of Statistics, Geography and Information (*Instituto Nacional de Estadística, Geografía e Informática*—INEGI)

Key Observations

- With regards to age, young persons (12 to 17 years old) represented 19 percent of the total sample smoking population (urban and rural) and the rest of the sample smoking population was distributed among groups ranging from 18 to 65 years of age. The distribution of the rural population was similar, with 46 percent corresponding to men and 54 percent to women, and with 22 percent being adolescents and the rest the adult population.
- With regards to passive smokers, Mexico does not have specific information on children. There is a 36.1 percent national prevalence of passive smokers in the urban population, with the highest percentage in the central region (43.7 percent).

Figure 7.7: Prevalence of Passive Smoking in Rural Populations (Ages 12 to 65) in Mexico, 2002

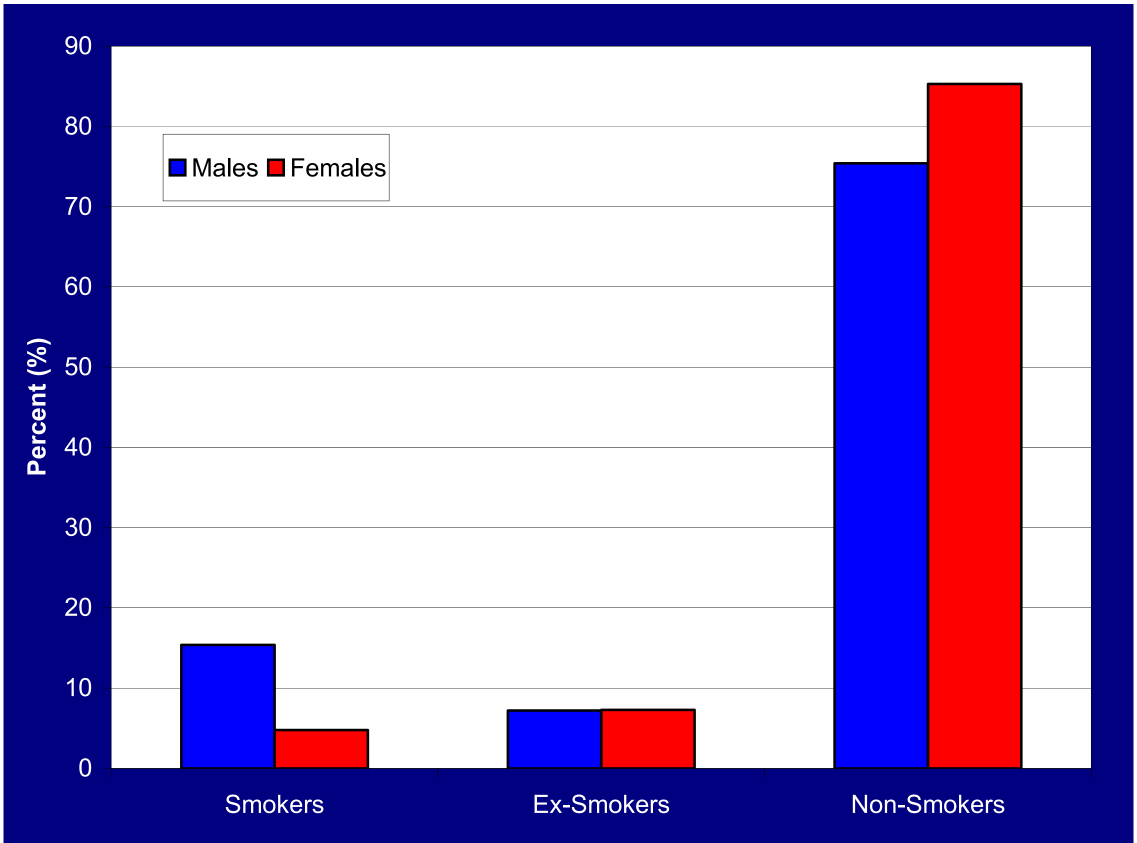


Source: ENA 2002, National Council Against Addictions (*Consejo Nacional Contra las Adicciones*—Conadic), National Institute of Pediatrics (*Instituto Nacional de Pediatría*—INP), General Bureau of Epidemiology (*Dirección General de Epidemiología*—DGE), National Institute of Statistics, Geography and Information (*Instituto Nacional de Estadística, Geografía e Informática*—INEGI)

Key Observations

- 26.2 percent of the rural population (between 12 and 65 years old) is exposed to passive smoke
- The highest percentage of the population exposed to passive smoke is in the northern region (31.9 percent) and the lowest percentage is in the southern region (20.4 percent)

Figure 7.8: Percentage of Smokers, Ex-smokers and Non-smokers among Adolescents (12–17 years old), by Gender, in Urban Locations in Mexico, 2002

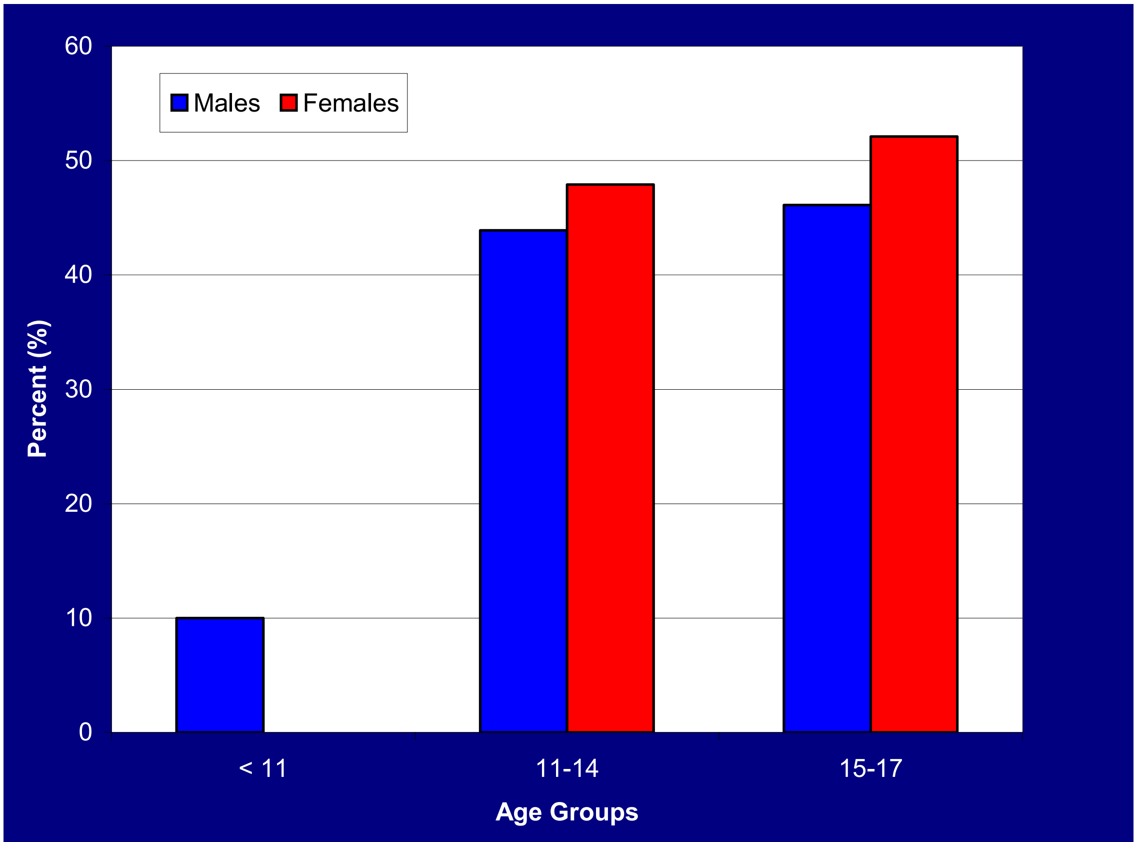


Source: National Survey of Addictions, 2002 (*Encuesta Nacional de Adicciones 2002*) *Secretaría de Salud*

Key Observations:

- A recent study (the Mexico-Monterrey Global Youth tobacco survey, an initiative of WHO) performed in the city of Monterrey found very high environmental exposure to tobacco in first-, second- and third-year middle school students, among whom four of every ten live in homes where others smoke. Six out of ten are exposed to smoke in public places, while nearly half have parents who smoke.

Figure 7.9: Percentage of Smokers among Adolescents, by Age Group and by Gender, in Urban Locations in Mexico, 2002



Source: National Survey of Addictions, 2002 (*Encuesta Nacional de Adicciones 2002*) *Secretaría de Salud*

Key Observations:

- With respect to the tobacco use starting age among urban youth, nearly half (47.6 percent) began to smoke between 15 and 17 years of age, with a variability among sexes (46.1 percent for males and 52.3 percent for females). Note that while one of every ten adolescent males began to smoke before the age of 11, no women mentioned such an early starting age.
- The smoking frequency of rural youth is 6.1 percent (231,677), of whom 11.3 percent are male and only 1 percent are female. The graph shows only urban population.

7.3 Asthma

The health impacts of exposure to air pollutants have begun to be studied in recent years. Some studies in Mexico City have revealed a close correlation between urban air pollution and lung diseases, lung aging processes, and respiratory infections.

An individual's risk level is determined by various factors, including genetic predisposition, age, nutritional status, presence and severity of heart and respiratory conditions, and use of prescription drugs, as well as type and place of work. In general, the highest-risk population consists of children under the age of 5, senior citizens (over the age of 65), persons with heart or respiratory diseases, and asthmatics.

Ozone and particles are the pollutants of greatest importance, both for their potential health effects and the frequency of exceedance of the corresponding air quality standards.

Acute respiratory infections (ARI), asthma, and chronic obstructive pulmonary disease (COPD) are considered to be the conditions most related to air pollution in both rural and urban areas.

In Mexico, statistical data on morbidity and mortality is compiled and analyzed as an official source through the National Epidemiological Surveillance System (*Sistema Nacional de Vigilancia Epidemiológica*—SINAVE), an action program made up of a set of strategies and activities to identify and detect harm and risks to health.

Its importance resides in its capacity to generate information useful in guiding programs, diseases control interventions, and risk situations that seriously and frequently affect the community.

Since the inception of SINAVE in 1995, the Unified Epidemiological Surveillance System (*Sistema Único de Information para la Vigilancia Epidemiológica*—SUIVE) was established. It systematizes morbidity and mortality information with the participation of the whole sector. With the creation of SUIVE, criteria, formats, and notification procedures were standardized across the institutions of the National Health System (*Sistema Nacional de Salud*—SNS).

SUIVE generates homogeneous information from the health services at their various technical/administrative levels. This information concerns the occurrence, distribution in time, place and person, risk factors, and consequences of diseases affecting public health. It is recorded in special formats for each level. From the local level it is sent to the jurisdictional level where it is compiled and sent to the state level and, in turn, to the national level. The information from the corresponding levels is compiled and analyzed to guide and support decision-making for the design and application of health plans and programs throughout the country.

The Automated Epidemiological Surveillance System (*Sistema Unico Automatizado para la Vigilancia Epidemiológica*—SUAVE) is a software package that compiles SINAVE information generated by the institutions making up the SNS. This program contains information on the 109 diseases subject to weekly reporting and the 30 subject to immediate reporting, of which 96 are reported on form SUIVE-1-2000. SUAVE is a self-installing, user-friendly program. The databases captured can be sent by electronic mail. This program offers graphic reporting and mapping capabilities; it also contains historical morbidity information and compiles information on new disease cases.

The "National Epidemiological Surveillance System" action plan has five components:

- Weekly notification of new disease cases (SUAVE).
- Hospital Epidemiological Surveillance Network (*Red Hospitalaria para la Vigilancia Epidemiológica*—RHOVE).
- Epidemiological and Statistical Death Reporting System (*Sistema Epidemiológico y Estadístico de las Defunciones*—SEED).
- Special systems.
- Unified Laboratory Information System (*Sistema Único de Information de Laboratorio*—SUILAB).

These components are described in further detail in Appendix 6.

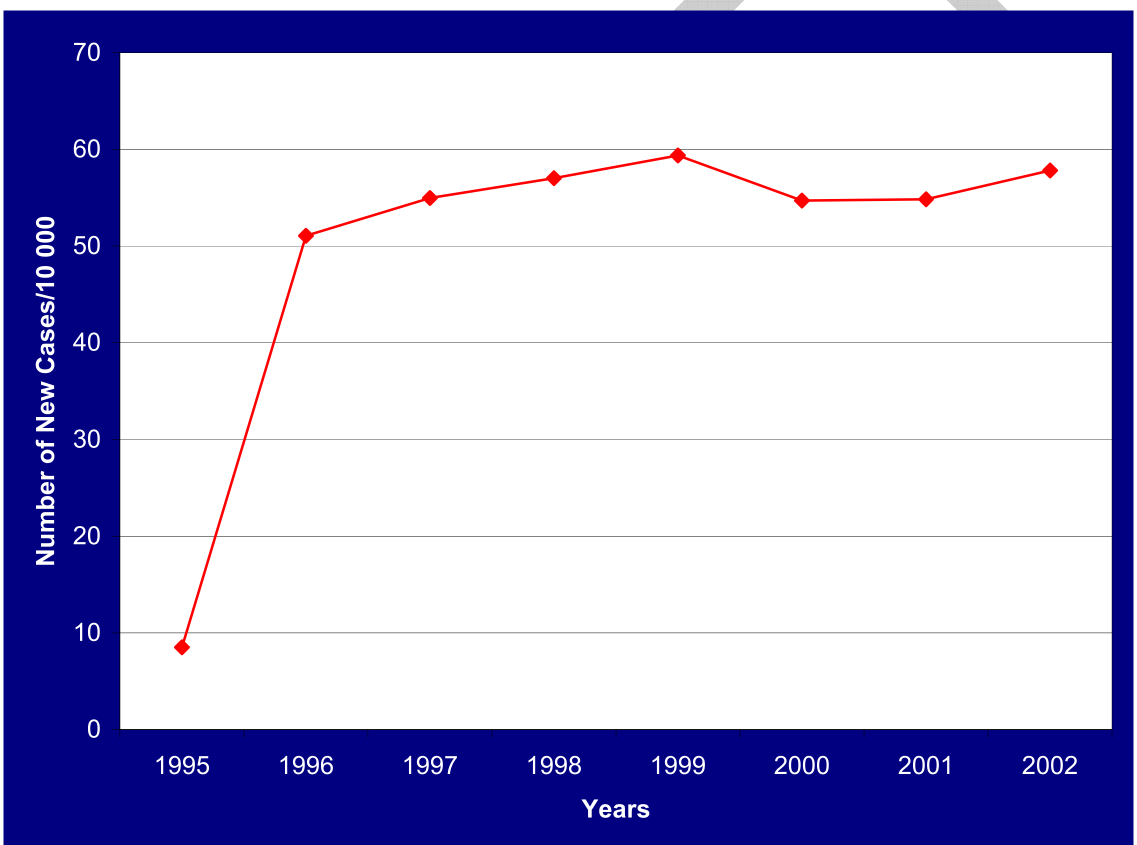
Prevalence of Asthma

Asthma is a genetically based disease that is accompanied by immunological alterations. It is the most common chronic illness in children, generally diagnosed in the first years of life due to its early clinical manifestation.

Exposure in open or closed spaces to sources of biological or chemical contamination has been shown to cause and/or exacerbate asthma. The greater the concentration of pollutants to which an asthmatic is exposed, including frequency and duration of exposure, the more severe the symptomatic and functional response. Particulate matter constitutes a group of pollutants that represent a significant public health risk due to their size and composition; the situation is particularly bad in metropolitan areas where the frequency of PM_{10} exceedance is approximately 30 percent.

In Mexico, it has been observed that the residents of coastal states are more likely to exhibit asthma, possibly due to the ambient humidity, where dust in homes has a high probability of entering the respiratory tract in the form of suspended particles. Its greater frequency in these regions has also been attributed to the use of air conditioning systems, which harbor a large quantity of dust and molds that can trigger asthmatic episodes. In a recent study, an inverse relationship was found between altitude and asthma incidence (Mario H. Vargas et al., 1999).

Figure 7.10: Incidence of Asthma in Children under Five Years Old, in Mexico 1995–2002



Source: Epidemiological Information Bulletin 1995–2000; Population projections 1990–2010/Conapo

Key Observations

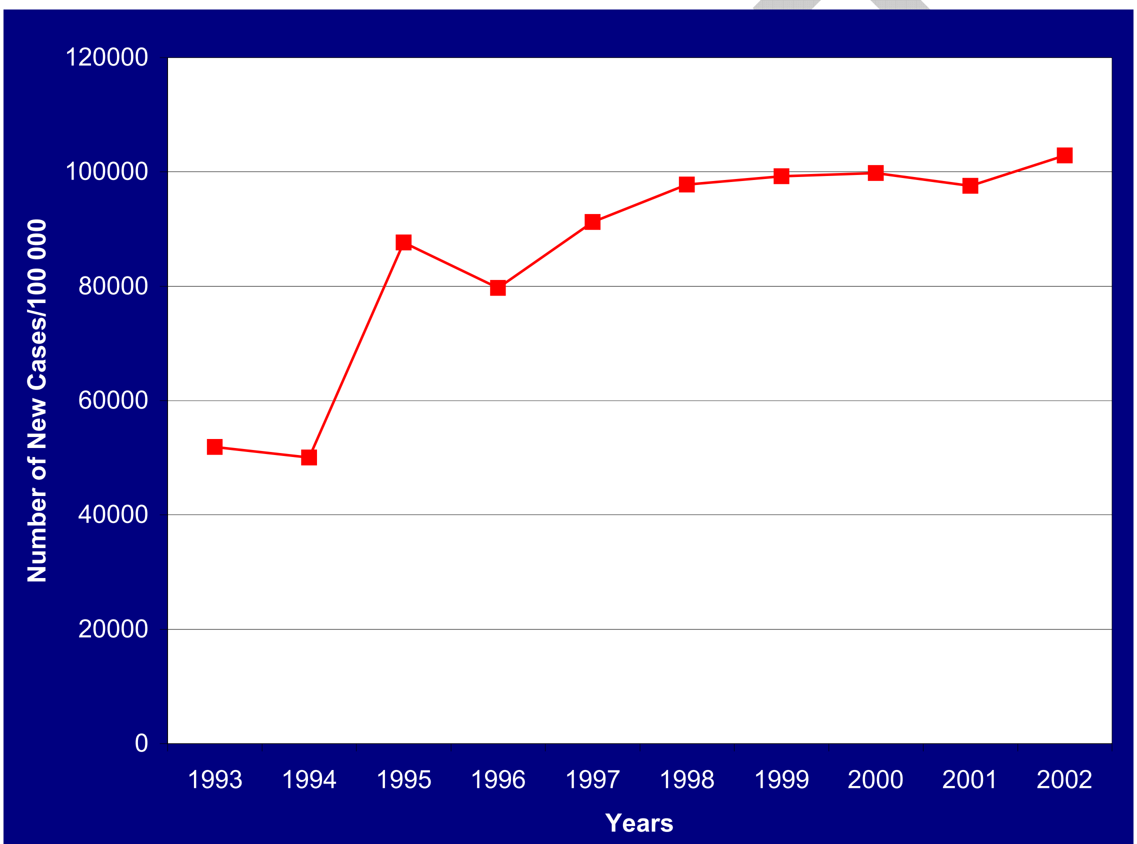
- The population of asthmatic children under the age of five is considered especially vulnerable to air pollutants.
- The incidence of asthma morbidity increased in this age group between 1995 and 1999, but a 10-point decrease was observed in 2000.

Prevalence of Acute Respiratory Infections

There is a group of viral, allergic, and bacterial illnesses classified as acute respiratory infections (ARI). They include upper respiratory tract infection, laryngitis, and acute bronchitis. They present clinically with similar symptoms and it can be difficult to identify the cause of the pathology. They are important because of the high morbidity they cause.

The ARI-related morbidity rates vary throughout the nation according to various mitigating or exacerbating factors, such as poverty; marginalization; malnutrition; lack of access to health services; physicochemical state of the pollutants and their concentration in the environment, mainly dependent on industrialization; and prevailing weather and geographical conditions.

Figure 7.11: Incidence of Acute Respiratory Infections (ARI) in Children under Five Years of Age, in Mexico, 1993–2002

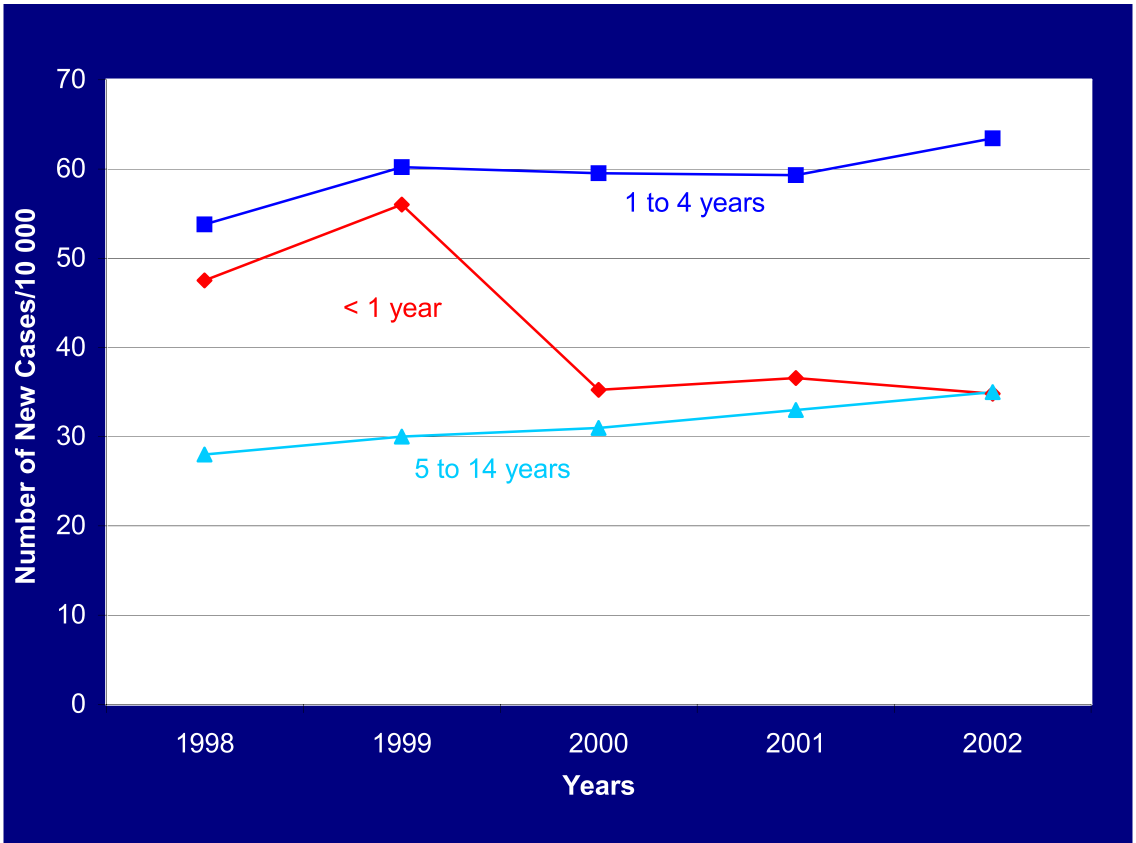


Source: Epidemiological Information Bulletin 1993–2000; Population projections 1990–2010/Conapo

Key Observations

- Figure 7.9 shows a nearly 100 percent increase in ARI-related morbidity between 1993 and 2000. Meanwhile, ARI-related mortality rates are on the decline. Hence these figures are a reflection of the epidemiological transition our country is undergoing, in which mortality due to infections has tailed off while mortality due to chronic degenerative diseases is on the rise.

Figure 7.12: Incidence of Asthma among Children, by Age Group, in Mexico, 1998–2002

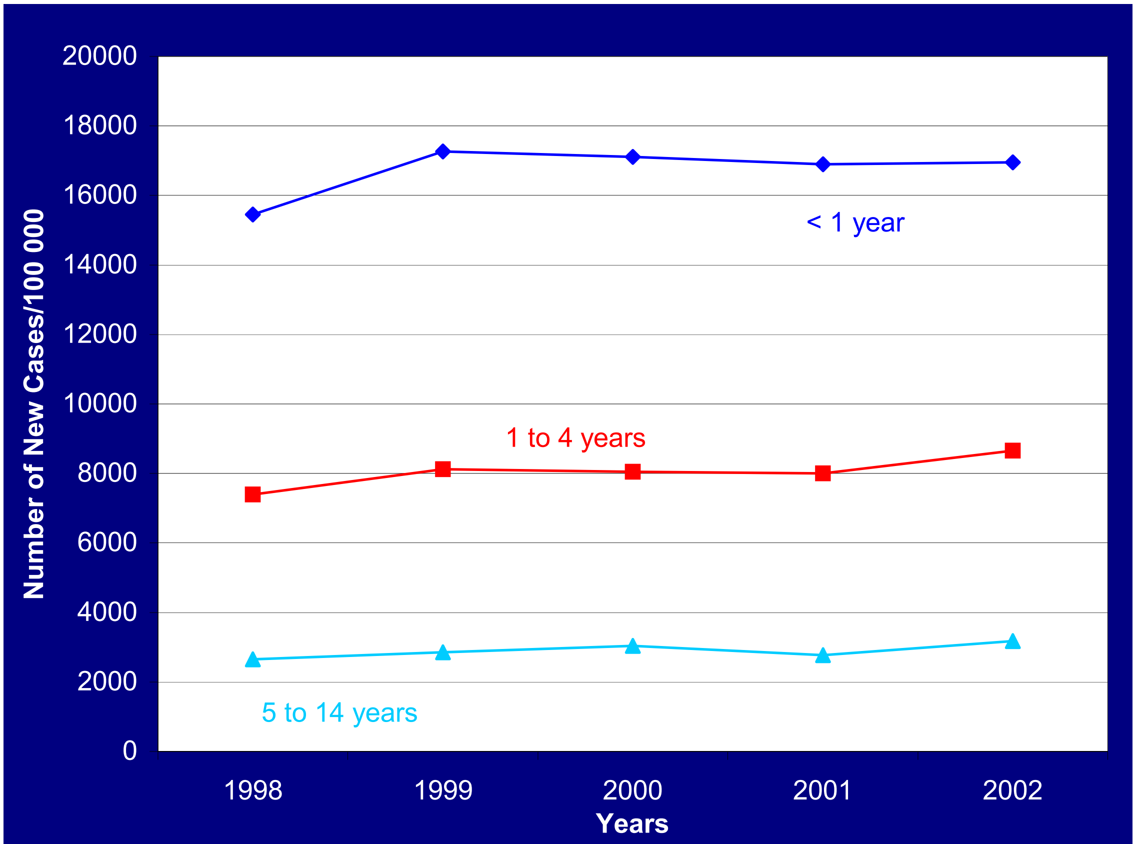


Source: Epidemiological Information Bulletin 1998–2002, Population projections 1990–2010/Conapo

Key Observations

- The highest rates of asthma consistently appear for the group of children aged 1 to 4 years, with an increasing trend from 54 cases per 10,000 in 1998 to 63 cases per 10,000 in 2002.
- The asthma prevalence rate in children less than one-year-old showed a decline since 2000, and currently remains at 33 cases per 10,000. As opposed to a true change in disease prevalence, this decline was directly attributable to a change in the immediate notice form (Epi-1 2000) for medical unit reporting. This occurred due to the difficulty in diagnosing asthma in this age group. In the 5 to 14 year-old age group, the rates have grown slightly from 28 to 32 cases per 10,000 over the sampling period.
- In Mexico, it has been observed that the residents of coastal states are more likely to exhibit asthma than populations elsewhere in the country.

Figure 7.13: Incidence of Acute Respiratory Infections (ARI) among Children in Mexico, by Age Group, 1998–2002

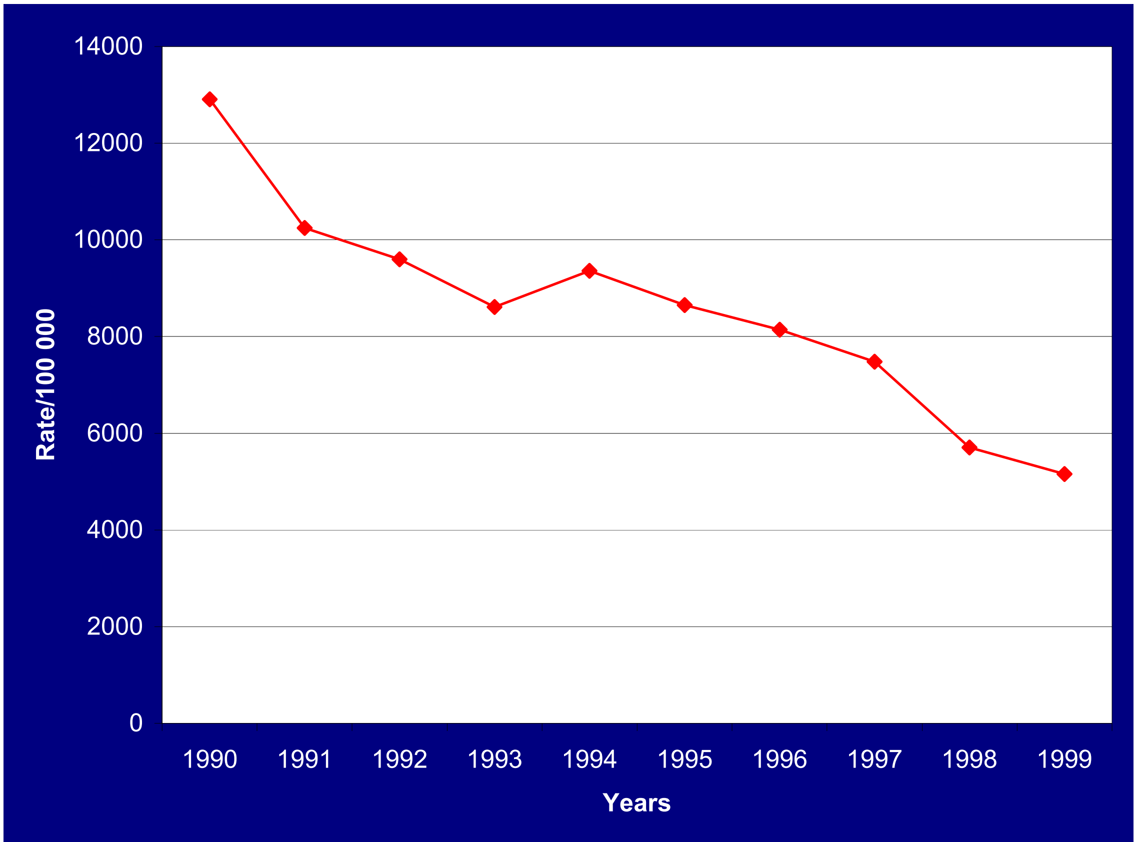


Source: Epidemiological Information Bulletin 1998–2002, Population projections 1990–2010/Conapo

Key Observations

- For acute respiratory infections (ARI), the most affected population is children below one year of age with annual rates averaging at 16,000 per 100,000 children. Only in 1998 were fewer cases reported during this period. The population of 1 to 4 years shows a slight increase in rates from 7500 in 1998 gradually arriving at 8100 per 100,000 children in this age group. The lowest rates are observed for children from 5 to 14 years old.
- ARI and asthma in children, and chronic obstructive pulmonary disease (COPD) in adults are considered to be the conditions most related to air pollution in both rural and urban areas.

Figure 7.14: Rate of Mortality by Acute Respiratory Infections (ARI) Infections of Five-year-old Children in Mexico, 1990–1999



Source: *Boletín de información epidemiológica 1990–1999/* Conapo national projections

Key Observations

- The number of five-year-old children dying from ARI infections has been decreasing, from 12 907 deaths per 100,000 in 1990 to 5,159 deaths per 100 000 in 1999. This reflects the epidemiological transition, where the mortality rate due to infectious diseases has been decreasing and the mortality rate due to degenerative chronic diseases has been increasing in the last decade.

8 Lead and Other Chemicals, Including Pesticides

In Mexico, the main source of environmental exposure to lead is the manufacture and use of glazed ceramics containing lead oxide. According to the National Crafts Fund (*Fondo Nacional de las Artesanías*—FONART), ceramics are produced in 20 states of the country and there are approximately 5 million potters, a significant proportion of them indigenous.

Various people and social groups of all ages participate in this activity. Workshops are family-run, with father, mother, children and perhaps other relatives such as cousins, uncles, godparents, etc., all participating. They use processes handed down across the generations.

Workshops are generally found in the yards of people's homes; they are rudimentary and inadequate to prevent exposure to lead, which occurs primarily while the pots are being glazed with lead oxide.

Pottery making has always been one of the primary sources of exposure to lead, and the glazing process represents the highest risk. In the 16th century, it was known that preparation and conservation of food and beverages in lead-glazed containers caused them to become contaminated, giving rise to increased blood lead levels which manifested themselves as acute or chronic lead intoxication.

Prior to 1521 when it was introduced by the Spanish, lead was not used in this process in Mexico. The use of lead became widespread and continues to this day.

When pots are manufactured at temperatures less than 990°C, the lead glazes can go into solution on contact with food, especially acidic foods such as vinegar, lemon, orange, and tomato.

In terms of health effects, starting in 1960 cases of acute lead intoxication due to the consumption of fruit drinks or juices from glazed containers were reported by health institutions in Mexico City. Studies have been conducted on urban populations, especially schoolchildren and reproductive age women, finding a significant association between high blood lead levels and the use of glazed ceramics to serve food and drinks. In potters themselves, a case of endemic lead intoxication was reported in a population of potters in the state of Oaxaca as early as 1878; subsequent epidemiological studies found high lead levels in potters in Oaxaca, Michoacán and Jalisco.

The groups most likely to become intoxicated by lead are children and reproductive-age women, although men and women of any age can be affected.

Lead has a wide range of toxic effects on multiple body systems. Acute exposure to high levels causes severe intoxication manifested by a highly lethal encephalopathy. Chronic exposure produces a range of symptoms and a heightened risk of neuropsychological disorders, neuropathy, peripheral neuropathy, anemia, and birth defects. Lead has toxic effects even at low levels of exposure, the most notorious being an insidious effect on cognitive development in children. There is no threshold indicating exactly when lead's effects on health begin; however, levels as low as 10 μg/dL are known to produce clinical manifestations, and harm may occur at even lower levels.

Actions to Address Lead Problems in Mexico

Lead exposure assessment and prevention program in mining and metallurgy areas

Mexico, with its mineral wealth, has become one of the world's foremost lead mining countries. The Ministry of Health has taken various actions to reduce the risk of exposure, chief among them the regulation of its various sources and the issuance of an emergency standard establishing criteria for the determination of blood lead levels and health protection actions. In 1999, with a view to generating exposure information useful in identifying the existence of health risks, the program was brought to the states in which the country's main mining areas are located. This program made it possible to identify various companies that represent a risk to the health of their workers and the neighboring population.

Program for the elimination of lead oxide exposure in Mexicans manufacturing and using glazed pottery to prepare, consume, or store food and beverages.

Legal Framework
Within the framework of the Federal Metrology and Standardization Law (*Ley Federal sobre Metrología y Normalization*), 11 Mexican Official Standards were developed to regulate the use of lead:

NOM-002-SSA1-1993	Environmental health, goods and services. Metal containers for food and beverages. Seam specifications. Sanitary requirements.
NOM-003-SSA1-1993	Environmental health. Sanitary requirements for labeling of paints, dyes, varnishes, lacquers, and glazes.
NOM-004-SSA1-1993	Environmental health. Sanitary limitations and requirements for the use of lead monoxide (litargirio), red lead oxide (minium) and basic lead carbonate (albayalde).
NOM-005-SSA1-1993	Lead chromate and lead chromate molybdate pigments. Extraction and determination of soluble lead. Test procedure.
NOM-006-SSA1-1993	Paints and varnishes. Preparation of acid extracts of dry paint layers for determination of soluble lead. Test procedures.
NOM-008-SSA1-1993	Environmental health. Paints and varnishes. Preparation of acid extracts of liquid or powdered paint for determination of soluble lead and other methods.
NOM-009-SSA1-1993	Environmental health. Glazed ceramics. Test procedure for determination of soluble lead and cadmium.
NOM-010-SSA1-1993	Environmental health. Glazed ceramic items. Limits for soluble lead and cadmium.
NOM-011-SSA1-1993	Environmental health. Limits for soluble lead and cadmium in glazed pottery.
NOM-015-1/SCFI/SSA-1994	Bioavailability of metals in toys and school items
NOM-199-SSA1-2000	Environmental health. Blood lead levels and actions as criteria for protection of the health of the non-occupationally exposed population.
NOM-231-SSA1-2002	Glazed pottery, glazed ceramics and porcelain. Soluble lead and cadmium limits

For around ten years there have been rules banning the use of lead-glazed pottery in food preparation, requiring that this type of pottery be used for decoration only and perforated to ensure it is not used for food preparation. As well, several initiatives may change the distribution of pottery-making activities, distinguishing between areas where there is still a significant production of pottery glazed with lead oxide at low temperatures and those areas where kilns have been changed to raise the glazing temperature and/or use of alternative glazing methods have been introduced so that lead oxide is not used. Despite these actions, Mexican potters continue to use lead oxide in traditional pottery and the general public continues to purchase these lead-containing products.

8.1 Blood Lead Levels

Mexico has blood lead level data only from isolated studies conducted in industrial areas, as well as several regions in which pottery making is common; however, we have no baseline national information on blood lead levels.

Because of this, COFEPRIS undertook a project titled “Lead in Ceramics Fired at Low Temperatures” in which strategies are developed for the elimination of this risk. These include a risk communication program, a blood lead level monitoring system, and actions to prevent and control exposure and harmful health effects caused by exposure to lead in ceramics fired at low temperatures.

The table below summarizes several studies conducted in Mexicans exposed to lead occupationally and non-occupationally.

Table 8.1: Blood Lead Levels of Children in Rural and Urban Populations, in Mexico

				Exposure to ceramic glazes		Blood Lead Levels µg/dL		
Author and Year	**Place**	**Community**	**Population**	**Gen. public**	**Occ.**	**N**	**Mean**	**SD**
Azcona-Cruz.M. et al., 2000[18]	Oaxaca	Rural	Children	No	Yes	220	10.50**	-
Olaiz G. et al., 1994[17]	Michoacán	Rural	Children	No	Yes	181	26.2**	-
Batriz L. et al., 1994[8]	San Luis Potosí	Rural	Children	Yes	No	37	16.5*	±1.3
Romieu I. et al., 1991[9]	Mexico City	Urban	Children	Yes	No	80 40	10.7* 15.3*	±4.7 ±8.5
Molina B.G. et al., 1982[15]	Tonala, Jalisco	Rural	Children	No	Yes	233 9 149	39.5* 81* 54.3*	-
Viniegra G. et al., 1960[13]	Mexico City	Urban	Children and Adults	Yes	No	48	Clinical data	-

Notes: *Arithmetic mean, **Geometric mean, N = Sample size, Occ. = Occupational, SD=Standard Deviation. Please see the glossary in Volume I for a definition of geometric mean and arithmetic mean

Key Observations

- Studies indicate that some populations of Mexican children have very elevated levels of blood lead, in some cases more than five times the action level of 10 µg/dL (Mexico, Cofepris Date unknown).

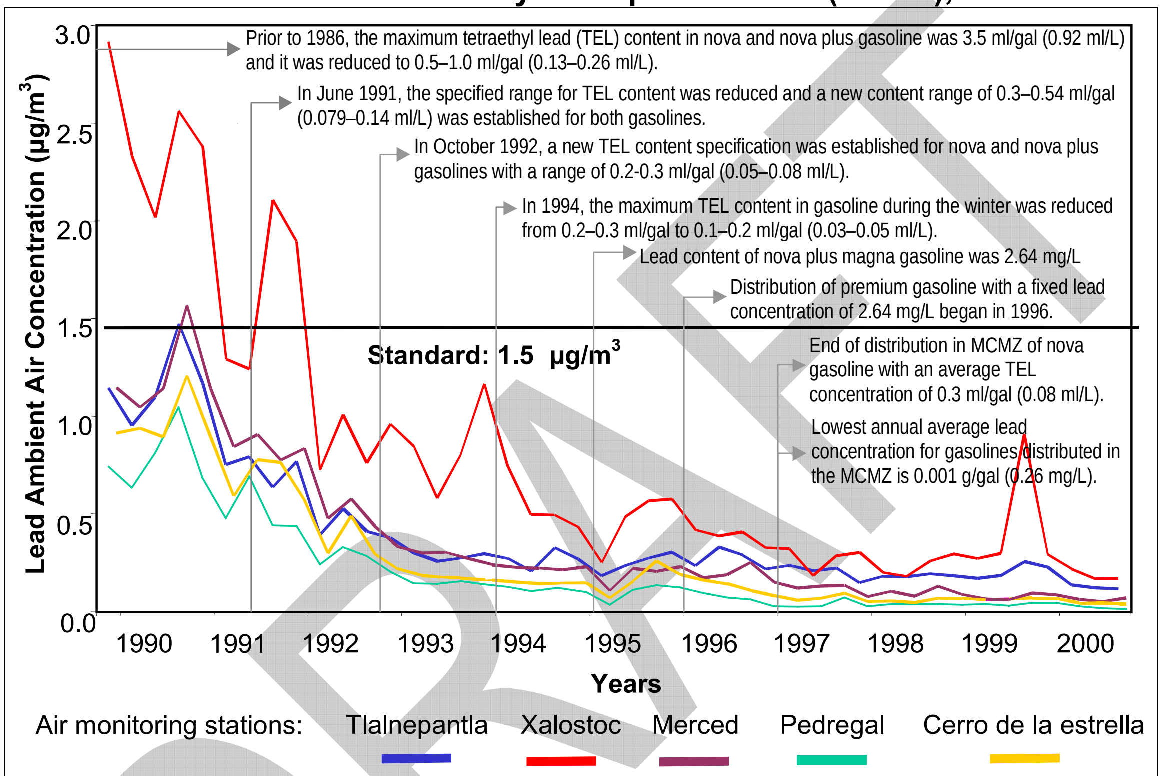
Case Study 1

Ambient lead levels and lead exposures were dramatically reduced through a series of initiatives to reduce lead in gasoline and consumer products in Mexico. These actions, which were supported with regulations and consumer education, have produced substantial reduction in childhood exposure to lead.

In October 1990, it was agreed to establish the Integrated Program for Air Pollution Control in the Mexico

City Basin (*Programa Integral Contra la Contaminación Atmosférica en el Valle de México*—PICCA. Lead levels in Mexican gasoline were reduced by 88 percent (average of 0.2 g/L) by 1992[8]. The transition to unleaded gasoline was assisted with a reduction of the price of lead-free gasoline to encourage its use. Over the course of the program a series of further reductions in the allowable levels of lead in gasoline were implemented across Mexico. These reductions resulted in an average annual and minimum recorded lead concentration in gasoline of 0.001g/gal in the Mexican City Metropolitan Zone.

Figure 8.1: Atmospheric Monitoring of Lead and Principal Activities to Reduce Lead Emissions in the Mexico City Metropolitan Zone (MCMZ), 1990–2000



Source: *Programa para Mejorar la Calidad del Aire de la Zona Metropolitana del Valle de México* 2002–2010 (Proaire).

Note: Tetraethyl lead (TEL) is a liquid. Nova, nova plus, and nova plus magna are grades of gasoline, ranked according to increasing octane levels.

Key Observations

- Actions to eliminate lead from gasoline substantially reduced airborne emissions of lead in the Mexico City Metropolitan Zone.

[8] http://www.hwwa.de/PersHome/Michaelowa_A/Lead.htm

Case Study 2

Levels of Lead in Blood in a Child Population in Northern Mexico due to Metallurgical Activities—A Local Case Study

The city of Torreón, Coahuila, located in northern Mexico, has a population of approximately 530,000 inhabitants. Latin America's largest, and the world's fourth-largest, mining-metallurgical company, Met-Mex Peñoles, is located in this town, producing lead, silver and gold. The presence of this industry has led to the chronic environmental exposure to lead in the non-occupational population, particularly in children.

The results of formal studies performed since 1997 have shown a high concentration of lead in the soil and air, thereby documenting prolonged, historic pollution. One of these studies (García, V.G. et al. 2001) corroborated the presence of lead in the blood of school children in a relationship directly proportional to their proximity to the metallurgical plant. This problem gave rise to an environmental emergency situation, as it represented both public health and social problems.

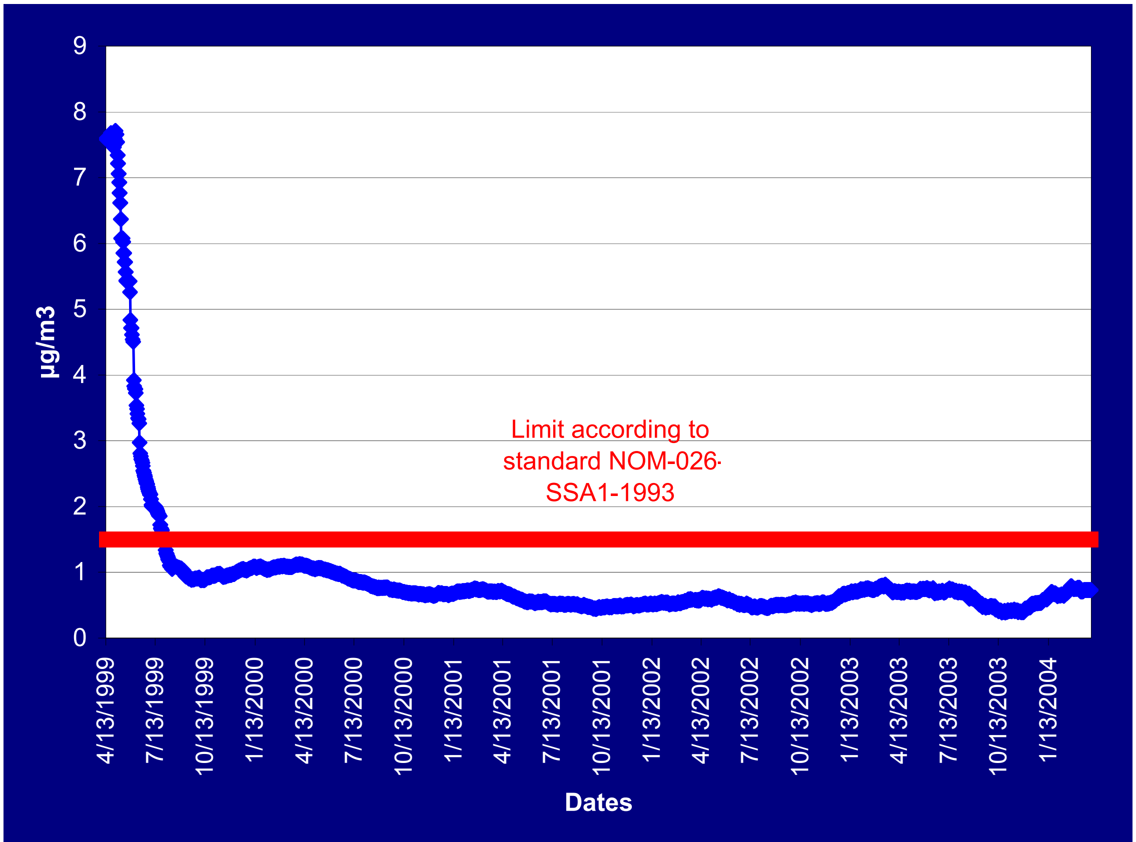
To handle this situation, the state Secretariat of Health (*Secretaría de Salud*), the Office of the Federal Attorney General for Environmental Protection (*Procuraduría Federal de Protección Ambiental*—Profepa) and the company Peñoles implemented a series of actions including, among others, emissions control and reductions and improved smelting processes in the facility, the oversight of the environmental authority by Profepa, and the oversight by the *Secretaría de Salud* of the medical care provided by the by the state secretariat of health for the environmentally exposed population.

A trust was set up with funding (60 million pesos) provided by the company in 1999, creating a Metals Program (*Programa de Metales*) to coordinate health-related actions (detection, treatment and rehabilitation) for the population with environmental lead exposure. To remediate the environment, teams with high-efficiency vacuums cleaned the streets, building roofs and house interiors within a radius of four kilometers of the facility to reduce the accumulated concentration of lead on surfaces and in the soil. Contaminated soil was removed, thorough cleaning of public and private living spaces was aggressively conducted, and streets and patios near the facility were paved.

On 31 May 2004, five years after its creation, the trust that originated the Metals Program ended, having accomplished its immediate goals of gradually reducing the risks and health effects of lead to the population. However, the success attained required vigilance and continuing efforts to assure the maintenance of good environmental quality and the health of the population, so the firm developed a new program for the protection and treatment of the population exposed to lead and other heavy metals in the ambient environment in Torreón, and funds it annually in the amount of 18 million pesos.

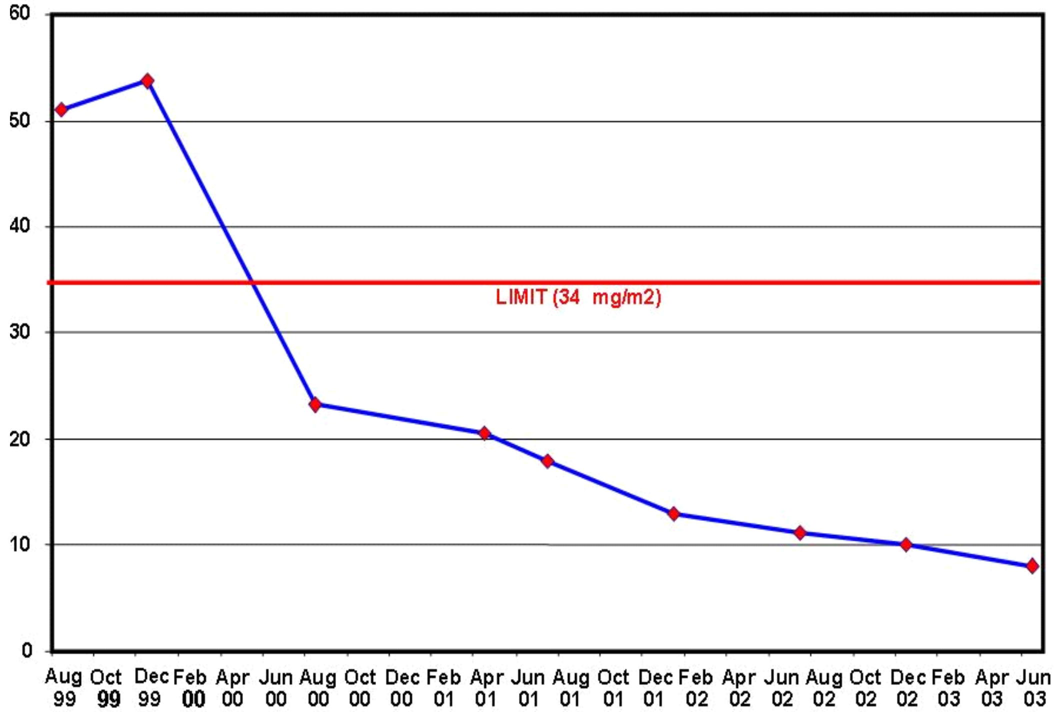
The following graphs show the results of the intervention of the health and environmental authorities to abate the concentrations of lead in blood, as well as the decreased concentrations of lead in soil and air.

Figure 8.2: Local Air Quality Data from Metallurgical Activities in Torreón, Mexico, 1999–2003



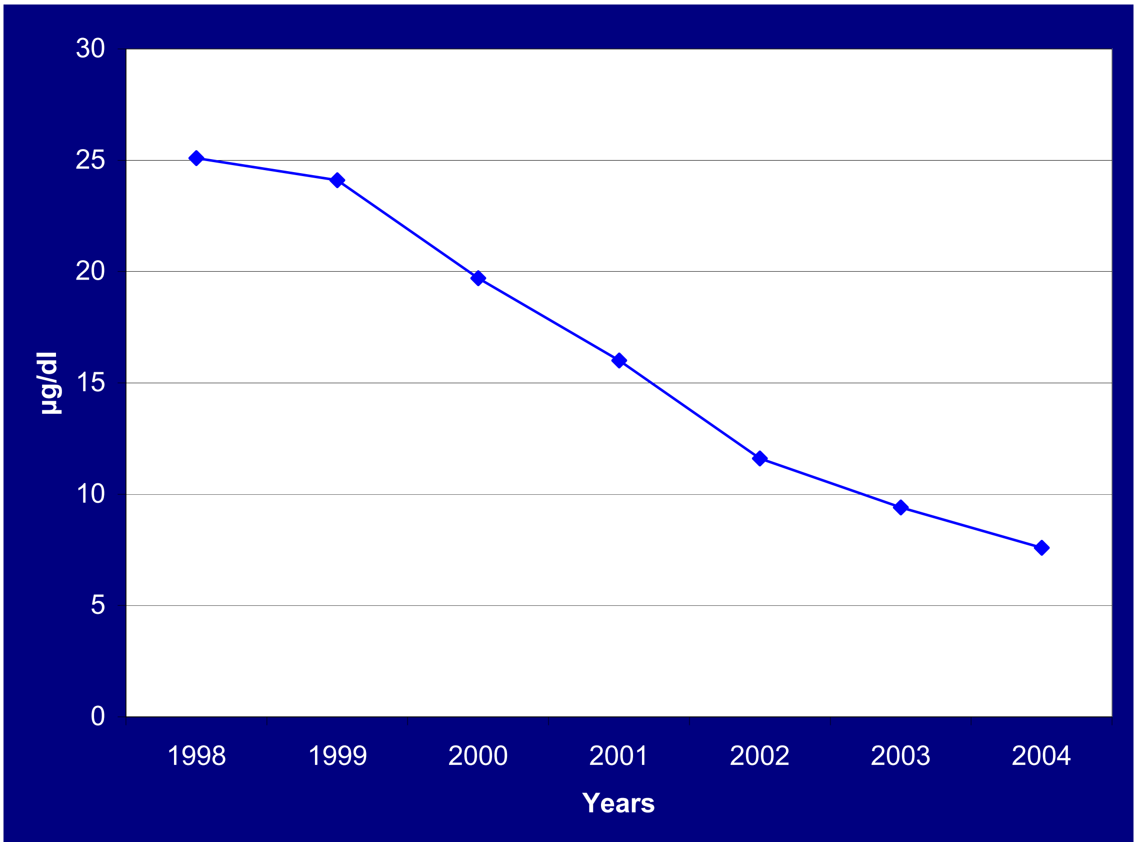
Source: *Secretaria de Salud* (SSA) Metals Program, 1999–2003

Figure 8.3: Lead Content in Local Soil Samples Taken Around MET-MEX PEÑOLES, in Mexico, 1999–2003



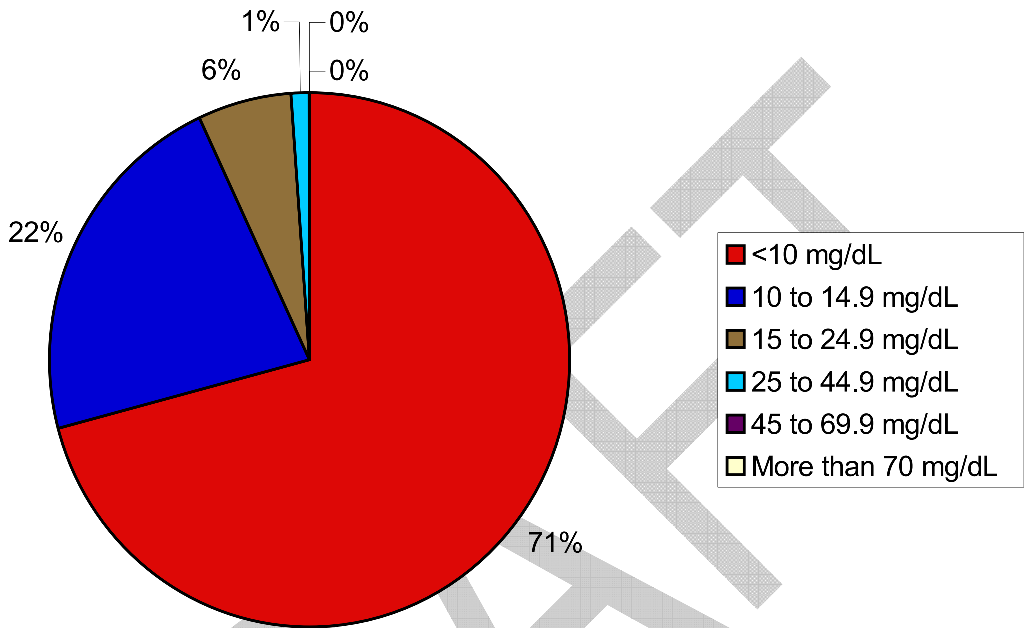
Source: *Secretaria de Salud* (SSA) Metals Program, 1999–2003

Figure 8.4: Annual Average Blood Lead Levels in Children 15 and Under Who Participated in the Metals Program in Torreón, Mexico, 1998–2004



Source: *Secretaria de Salud* (SSA) Metals Program, 1999–2003

Figure 8.5: Blood Lead Levels in Children, after Five Years' Participation in the Metals Program, in Torreón, Mexico



Source: *Secretaria de Salud* (SSA) Metals Program, 1999–2003

Key Observations

- The average concentration of lead in the air around the mine changed from nearly 8 µg/m^3 in April 1999 to less than 1 µg/m^3 in December 2003 (the limit under Mexican Official Standard (*Norma Oficial Mexicana*) NOM-026-SSA1-1993 is 1.5 µg/m^3). Starting in August 1999, lead concentrations remained below the official standard (Figure 8.2).
- The actions dictated by the environmental authorities enabled a decline in lead levels in both air and soil. Lead concentrations found in soil samples around the company Peñoles dropped from 50 mg/m^2 in 1999 to 9 mg/m^2 in 2003. Since 2000, lead concentrations have remained below the standard's limit of 34 mg/m^2 (Figure 8.3).
- In 1998 the annual average lead level in children's blood in the city of Torreón was 25 µg/dL the average five years later dropped to 10 µg/dL. These numbers are below the standard (NOM-199-SSA1-2000, Environmental health—levels of lead in blood and actions as health protection criteria for the non-occupationally exposed population) (Figure 8.4).
- After five years of operation of the Metals Program, the current situation may be deemed to no longer represent an environmental emergency, as the actions carried out have

significantly reduced the population's blood lead levels. (Figure 8.4).

- This chart demonstrates that 70 percent of the child population that has been attended to since the start of the Metals Program now have blood lead levels below 10µg/dL (Figure 8.5).
- Although the population's blood lead levels have declined, the risks of exposure persist. Children's exposure to lead continues to be a public health problem (Figure 8.5).

8.2 Lead in the Home

The main cause of environmental exposure to lead in Mexico derives from the manufacture of pottery with glaze containing lead oxide. This artisan craft is carried in 20 Mexican states, by approximately five million potters, many of whom are members of indigenous groups.

Pottery workshops are family businesses, employing all family members between 7 and 70 years of age. Each person participates in some part of the pottery production process, using techniques inherited over the generations and employing no personal protection whatsoever. This activity constitutes the main source of exposure for the child population.

Exposure to lead also comes from the use of lead glazed pottery. Studies have been conducted on urban populations, especially schoolchildren and reproductive age women, finding a significant association between high blood lead levels and the use of glazed ceramics to serve food and drinks.

Mexico does not have a representative value of blood lead levels in the general population. It therefore presents information on the number of pottery activities occurring in Mexico.

Figure 8.6: Communities with Pottery Activities by State, in Mexico, October 2001

Source: National Artisan Development Fund (*Fondo Nacional para el Fomento de las Artesanías*—FONART), Lead Program

Key Observations

- Pottery production occurs in the heavily indigenous populated state of Chiapas in the south.
- Epidemiological studies found high lead levels in potters in Oaxaca, Michoacán and Jalisco.

8.3 Industrial Releases of Lead

To date, Mexico has no information for this indicator, due to the fact that the contributions of information from Mexican companies to the Pollutant Release and Transfer Register are currently voluntary and there are a small percentage of companies reporting. Legislation was enacted in 2001 for a mandatory, publicly accessible PRTR, and in June 2004 the implementing regulations were passed, thus Mexico will likely be in a position to populate this indicator in future reports.

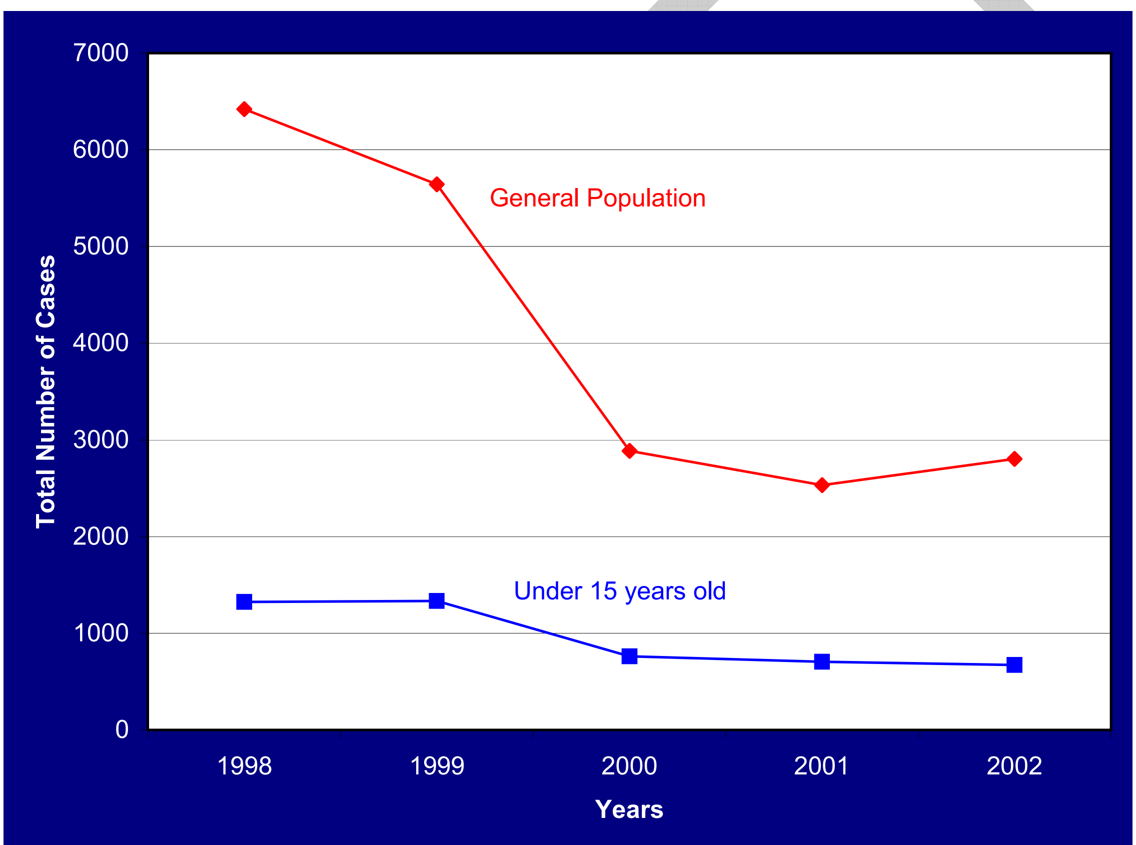
8.4 Industrial Releases of Selected Chemicals

To date, Mexico has no information for this indicator, due to the fact that the contributions of information from Mexican companies to the Pollutant Release and Transfer Register are currently voluntary and there are a small percentage of companies reporting. Legislation was enacted in 2001 for a mandatory, publicly accessible PRTR, and in June 2004 the implementing regulations were passed, thus Mexico will likely be in a position to populate this indicator in future reports.

8.5 Pesticides

Intoxication caused by toxic substances are not adequately recorded in Mexico. The only available information is on those cases caused by pesticides. As in the rest of Latin America, the most urgent problems of acute intoxication occurring in both workers and the general public are due to pesticide exposure. Publications are available on the chronic effects of organochlorine insecticide accumulation in human milk and adipose tissue, as well as the neurotoxic effects of certain organophosphorus insecticides and the pulmonary effects of certain dipyridil-like herbicides.

Figure 8.7: Cases of Pesticide Poisoning of Children (Under 15 Years Old) and the General Public in Mexico, 1998–2002



Source: *Sistema Único de Información de Vigilancia Epidemiológica*

Key Observations

- The above chart shows that 6422 pesticide poisonings were reported in 1998. A steady decline to 2802 in 2002 was observed.
- As regards cases recorded in children under the age of 15, the number decreased from a high of 1335 in 1999 to a low of 672 in 2002.

- It is believed that pesticide poisonings are under recorded in Mexico for various reasons, including the relative inaccessibility of health services, underreporting by physicians in private practice, lack of knowledge as to the real population at risk, inadequate diagnostic training for physicians visiting rural communities and lack of training in safe handling of toxic substances in the workplace.

9 Waterborne Diseases

Among the environmental and public health problems facing the country are those relating to inadequate basic sanitation and poor water quality. Furthermore, the availability of water for the growing human population is limited. The availability of reliable and safe water sources is fundamental to the protection of public health, since many diseases are caused by chemicals and pathogens found in contaminated water.

Water contamination is a health risk. Because of its social, economic, and political implications, water is one of the most fragile elements for the sustainable development of the social fabric.

The risks related to the degradation and scarcity of water may be classified as:

- those transmitted by water itself;
- those transmitted by waterborne vectors;
- those attributable to lack of water for personal and household hygiene;
- those transmissible by parasites or pathogens spending part of their life cycle in water;
- the presence of chemicals in water.

Mexico has made substantial progress toward the goals set in the National Water Plan (*Plan Nacional Hidráulico*—PNH) for 1995–2000. The goals of providing access to drinking water, sewerage, and wastewater treatment services were amply met in urban areas, although in rural areas efforts fell somewhat short. Today, more than 95 percent of the drinking water supply is disinfected. This has led to a dramatic decrease in the number of gastrointestinal disease cases, and cholera has been eradicated.

Mexico has developed a practical water quality indicator (ICA) to describe the quality of its surface water. The ICA ranges from 0 (toxic) to 100 (pristine). The indicator is a composite of up to 18 variables (e.g., BOD, oxygen, coliforms, nutrients, and suspended solids). An extensive national monitoring network with 535 stations has been set up. Measurement frequency varies according to the importance of each station. Not all 18 parameters are measured at all stations.

The results published by the National Water Commission (*Comisión Nacional del Agua*—CNA) show that 78 percent of monitoring stations recorded an ICA of 50 or better in 2001. The proportion of water bodies with ICA less than 50 rose from 17 percent in 1998 to 23 percent in 2001. These figures may reflect the fact that the number of sewer hook-ups has increased faster than the rate of wastewater treatment.

Table 9.1: Water Quality of Mexican Water Bodies for 1998 and 2001

ICA range[a]	Water quality	Use	% of water bodies[b] 1998	2001
100-85	Excellent	All uses	4	6
84-70	Acceptable	Potable with conventional treatment	21	20
69-50	Slightly contaminated	Potable with advanced treatment	58	51
49-30	Contaminated	Not fit for most direct uses	13	16
29-0	Highly contaminated	Not fit for most direct uses	2	6
Off the scale	Presence of toxic substances	Not fit for most direct uses	2	1

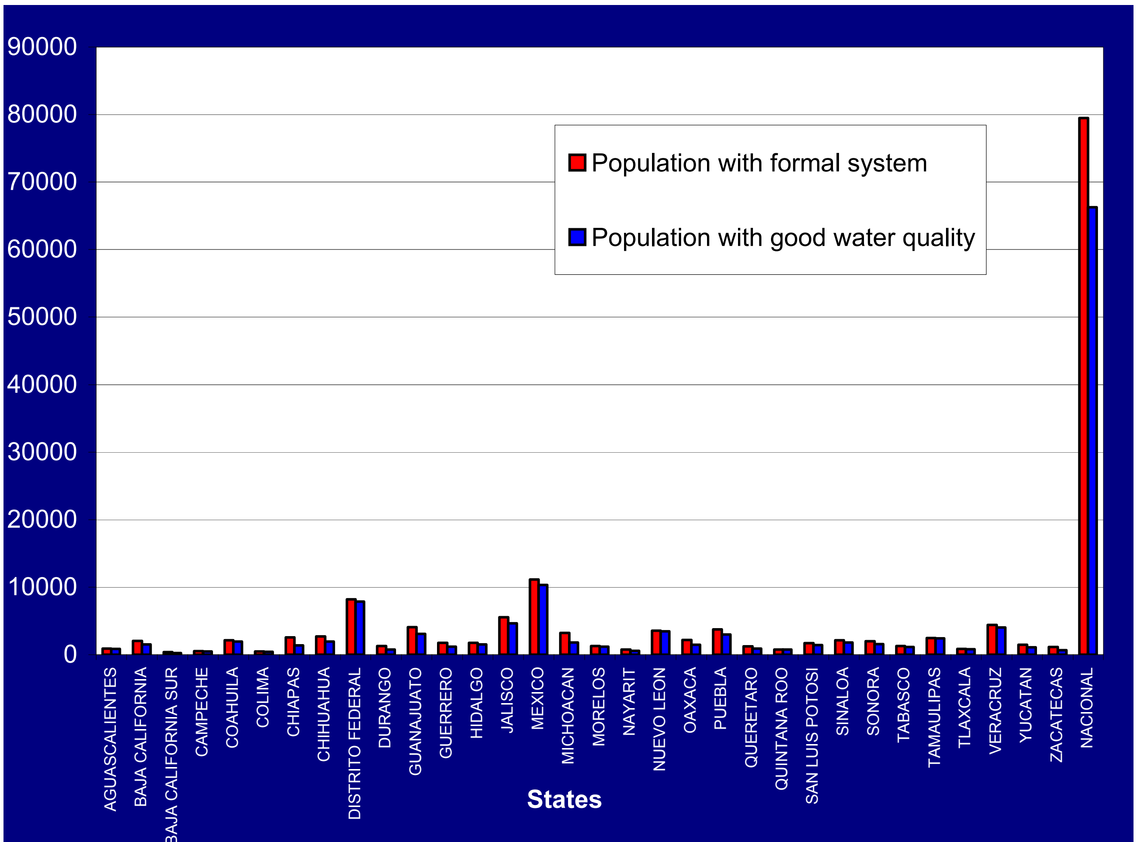
a) ICA = Mexican water quality indicator, a composite of 18 water quality parameters such as pH, BOD5, and suspended solids.
b) Measured in 535 surface water bodies of Mexico
Source: PNH 2001–2006

9.1 Drinking Water

The treatment of water for human use and consumption assures the destruction of most pathogens transmissible to human beings.

Maintaining residual chlorination above 0.2 mg/L is effective in destroying pathogenic bacteria and viruses that reach the water supply system. Monitoring of water's bacteriological safety is achieved by ongoing periodic monitoring of free residual chlorine in the water supply system.

Figure 9.1: Segment of Mexico's Population (in Thousands) with Access to Bacteriologically Safe Water by State, 2003

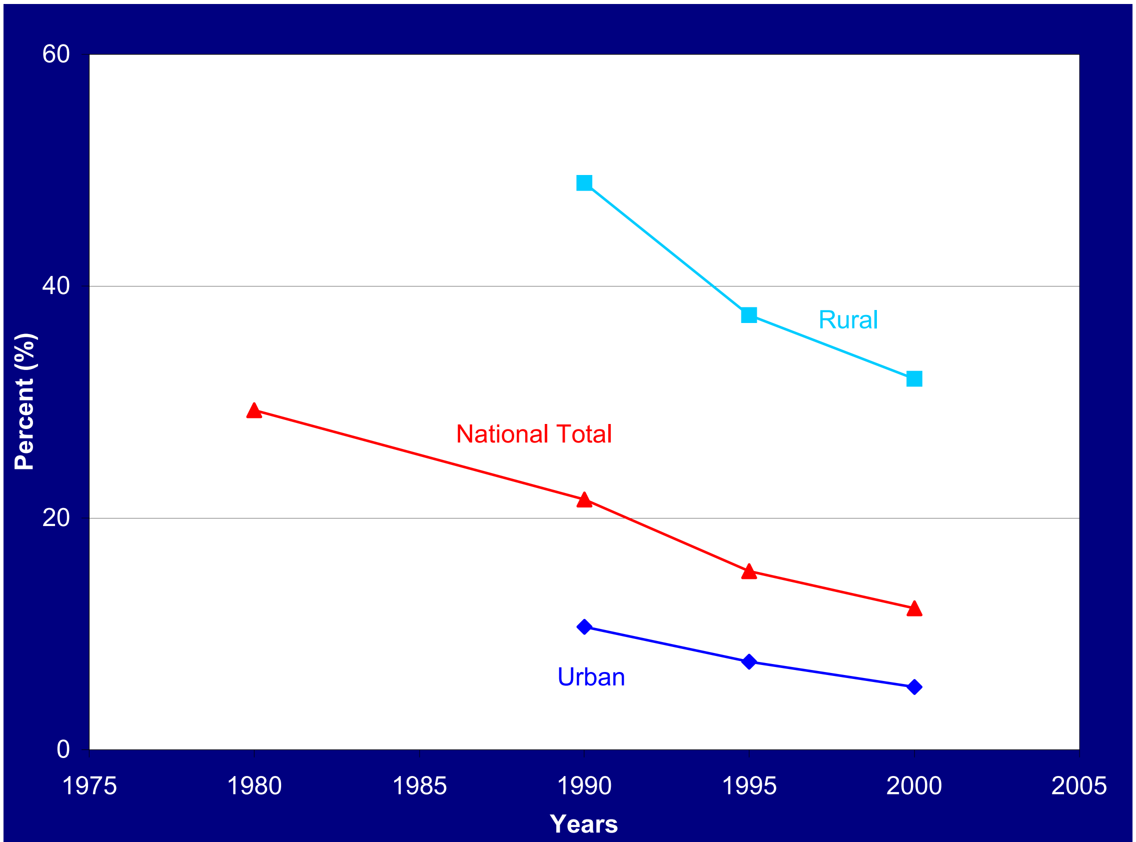


Source: Bacteriological Water Quality Program (*Programa de agua de calidad bacteriológica*), Federal Commission for the Protection against Health Risks (*Comisión Federal para la Protección contra Riesgos Sanitarios*—Cofepris)/SSA

Key Observations

- The chart shows the proportional distribution of the population having access to bacteriologically safe water versus the population whose homes are equipped with formal systems for 2003.

Figure 9.2: Percentage of the Population without Potable Water, in Mexico, 1980–2000



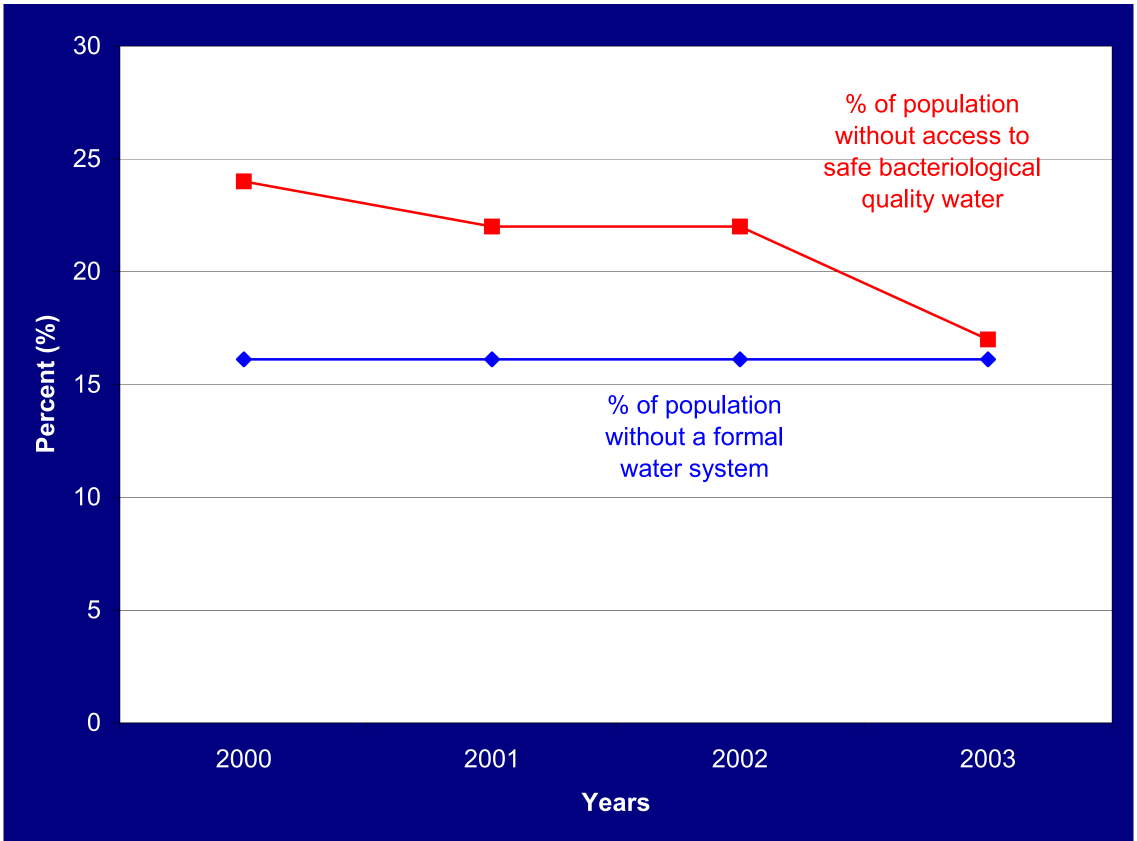
Source: Based on database of XII General Census of Population and Housing (*Censo General de Población y Vivienda XII, 2000)* INEGI 2000

Note: * There are no available separate data for urban and rural populations for 1980.

Key Observations

- The 1980 census reported only national figures. National data shows a decrease from 29 percent to 12 percent of the general population without access to potable water in the period from 1980 to 2000 respectively.
- The percent of the population without access to potable water in urban areas decreased by 5.2 percent from 10.6 percent in 1990 to 5.4 percent in 2000.
- The percent of the population without access to potable water rural areas decreased by approximately 17 percent, from 48.9 percent in 1990 to 32 percent in the 2000 census.

Figure 9.3: Percentage of the Population without Access to Bacteriologically Safe Water, in Mexico, 2000–2003

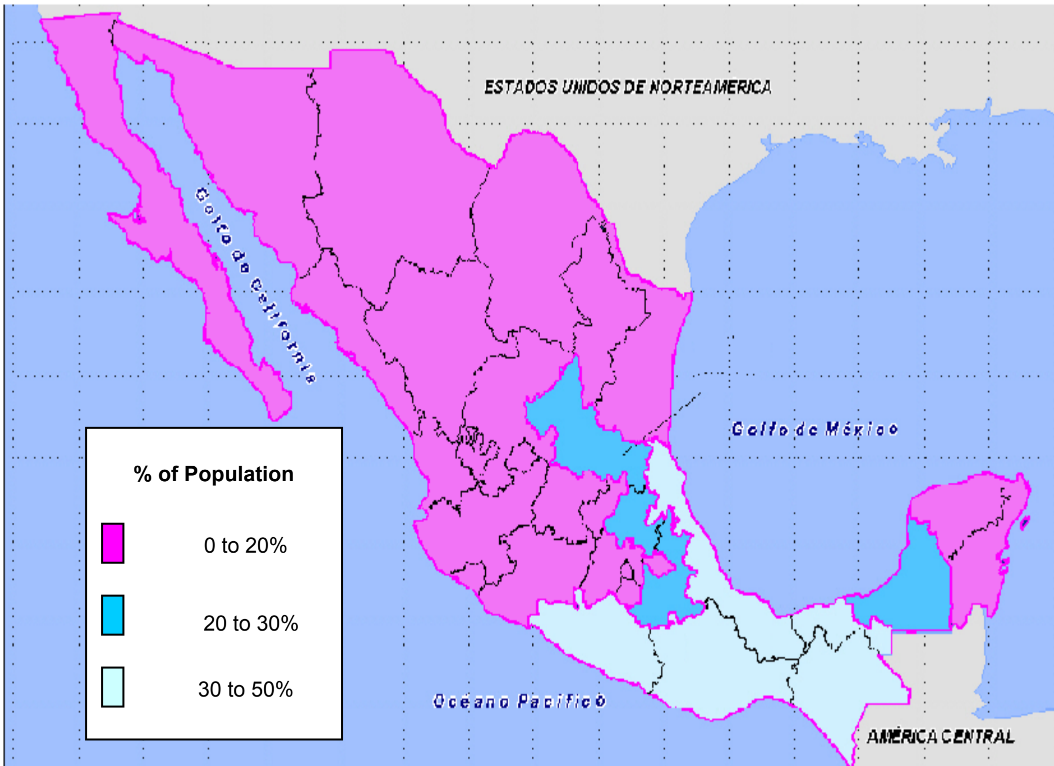


Source: Water Bacteriological Quality Program (*Programa de agua de calidad bacteriológica*), Cofepris/SSA.

Key Observations

- The percent of the population without access to safe bacteriological safe water has decreased from 24 percent in 2000 to 17 percent in 2003
- The percent of the population without a formal water system has remained stable at 16 percent from 2000 to 2003.

Figure 9.4: Percentage of the Population without Piped Water, by State, in Mexico, 2000



Source: *Comisión Nacional del Agua*—CNA

Key Observations:

- The highest percentage of Mexico's population without piped water supply is in the southern states, with 30 to 50 percent of the population without coverage.

9.2 Sanitation

In late 2002, approximately 76.4 million people had access to sewer services. Therefore, the PNH 1995–2000 goal for urban areas was attained, though progress in rural areas lagged seriously behind. In Mexico, the term *alcantarillado,* which translates directly as "sewer system," generally covers drainage systems, septic tanks, and direct drainage into furrows, ravines, or bodies of water; it is important to keep this in mind when making comparisons with other countries. Sewer coverage in Mexico is below the average for Latin America and the Caribbean as well as North America. Lack of access is marked in rural areas, especially in southeast Mexico.

Table 9.2: Drinking Water and Sewer Coverage in Mexico, February 2000 National Water Program, 2001–2006

Population type	Population in private dwellings (in millions)	Potable water		Sewerage	
		Million inhabitants	%	Million inhabitants	%
Urban	71.1	67.3	94.6	63.7	89.6
Rural	24.2	16.4	68.0	8.9	36.7
Total	95.3	83.7	87.8	72.6	76.2

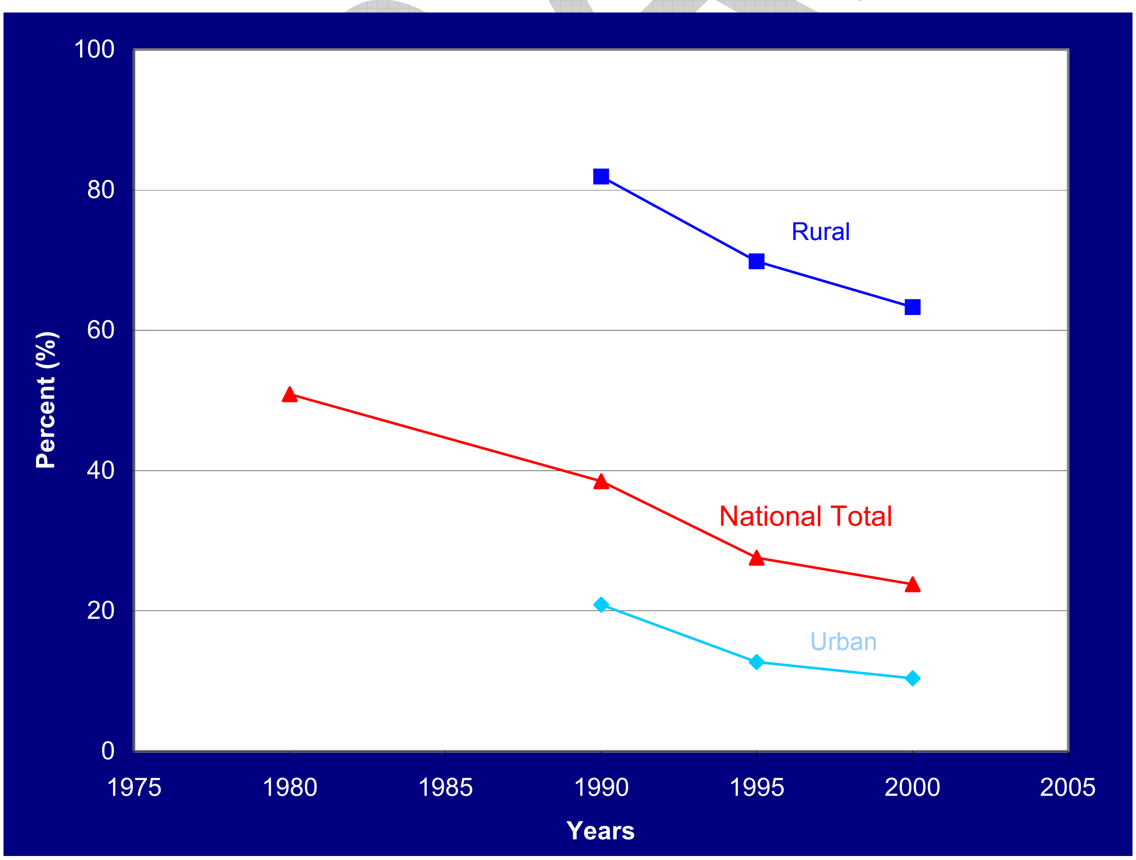
Source: Based on database of XII General Census of Population and Housing (*Censo General de Población y Vivienda XII, 2000)* INEGI 2000

Note: The census estimated the total population at 97.4 million, of whom 2.1 million lived in collective housing and it is unknown whether or not they have access to the service.

Key Observations

- A little over 72.6 million people had access to sewer services in 2000, approximately 76 percent of the population. This includes 63.7 million in urban areas and 8.9 million in rural areas. These figures include hook-ups to drainage systems (81 percent), septic tanks (15 percent) and other types of drainage. The number of persons without hook-ups fell from 32.3 to 22.7 million during the same period.

Figure 9.5: Percentage of the Population Not Served with Sewer Services, in Mexico, 1980–2000



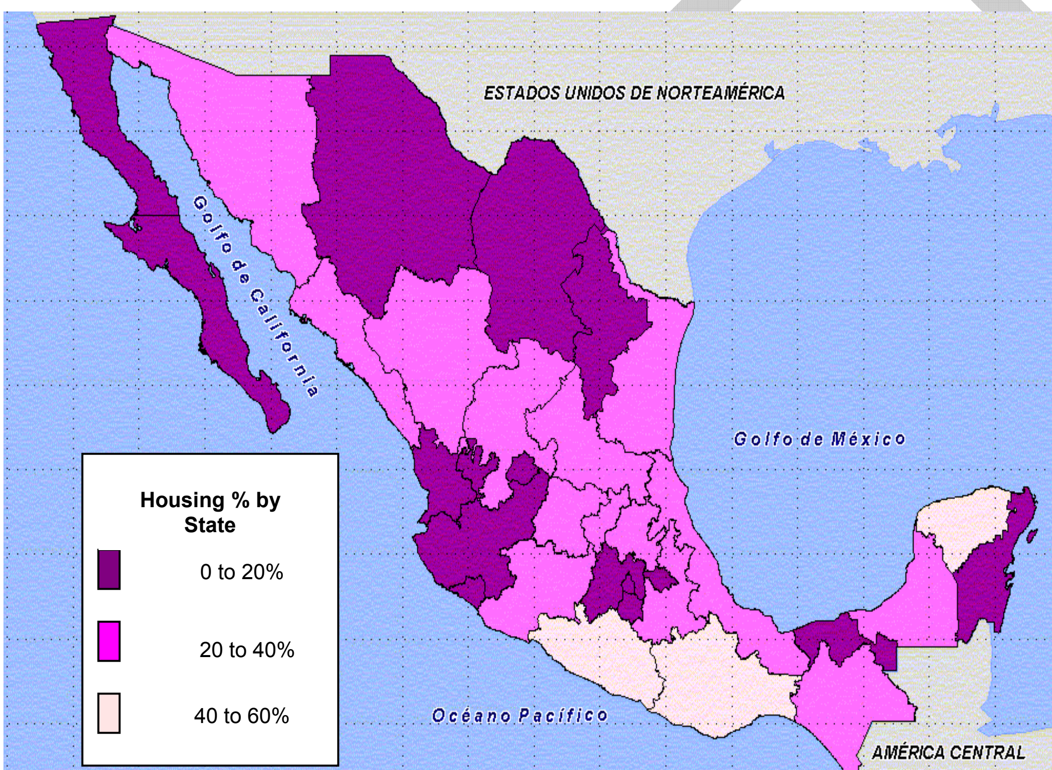
Source: Based on database of XII General Census of Population and Housing (*Censo General de Población y Vivienda XII, 2000)* INEGI 2000

Note: * Data for 1980 for urban and rural populations not available.

Key Observations

- The population without sewer service coverage decreased approximately 27 percent nationally, from 50 percent to 23 percent as reported in the 1980 and 2000 censuses respectively.
- Urban areas not covered by sewer services decreased from 21 percent to 10 percent, between 1990 and 2000 census data.
- Rural areas without sewer service coverage decreased by approximately 19 percent, from 82 percent in the 1990 census to 63 percent in the 2000 census.

Figure 9.6: Percentage of Homes without Sewer Services, by State, in Mexico, 2000



Source: XII General Census of Population and Housing (*Censo General de Población y Vivienda XII, 2000)* INEGI 2000

Key Observations:

- According to the INEGI population and housing census for 2000, the number of inhabitants with sewer services is 72,654,381, or 74 percent of the country's total population. This means that one of every four inhabitants does not have sewer services. The number of homes with sewer services is 10,202,934, representing 63 percent of the country's total. This means that one of every three homes does not have such service.
- The majority of homes without sewer services are located in southern Mexico, with 40 to 60 percent of households without coverage.

9.3 Waterborne Diseases

According to the World Health Organization, 80 percent of gastrointestinal infections and parasitic diseases and one-third of deaths caused by these are due to the use and consumption of unsafe water. The WHO also acknowledges that only 41 percent of the world's population drinks treated water that is disinfected so as to be considered safe.

Among the main environmental aspects that traditionally influence the causes of disease and death in our country are:

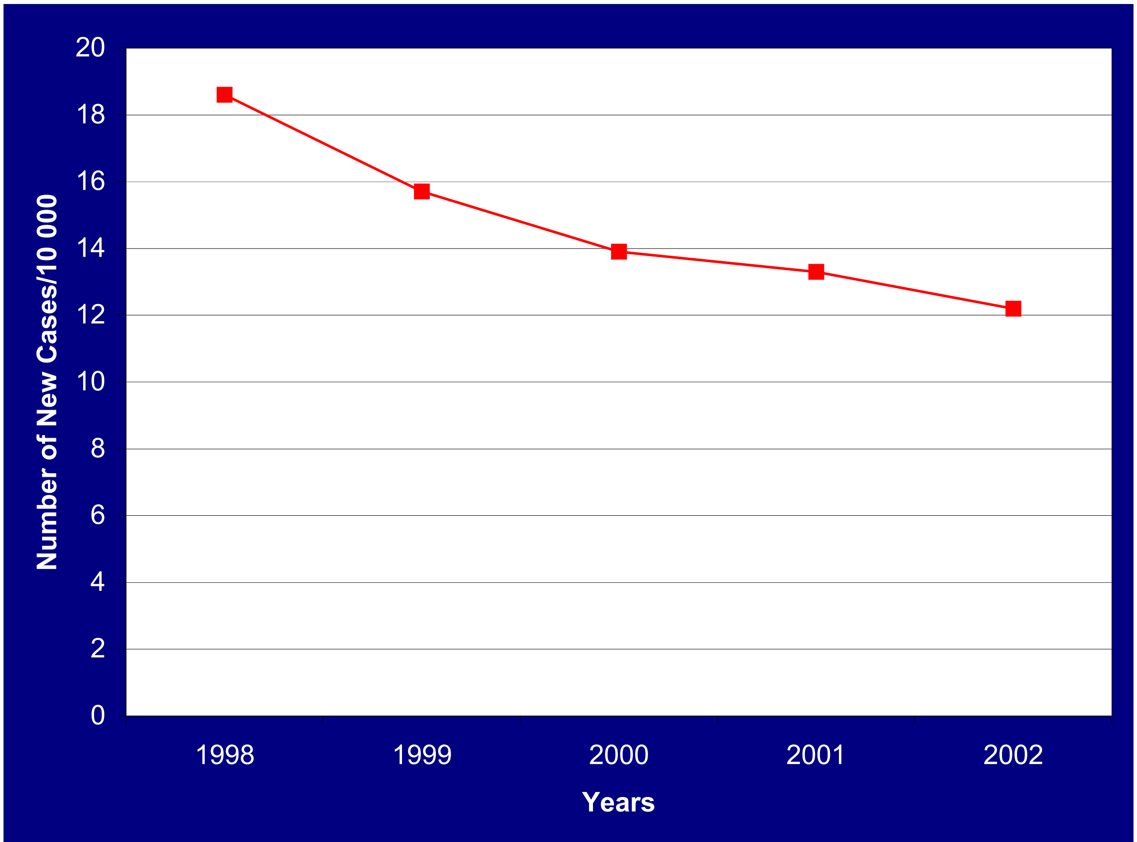
- Poor water quality for human use and consumption
- Inadequate disposal of human waste
- Inadequate municipal solid waste management
- Deficient pest control
- Poor hygiene conditions in dwellings and public spaces

The history of humanity has witnessed numerous disease outbreaks related to water, overcrowding, and deficient environmental conditions. These have been characterized by their high prevalence, high mortality, widespread nature, or unusual characteristics.

In countries like Mexico, diarrheal diseases continue to be a serious problem in children. These diseases are caused by bacteria, viruses, or pathogenic protozoans. They are spread via the fecal-oral route and are potentially transmissible through water used for various activities in the home, including personal hygiene, as well as through primary contact with contaminated recreational waters.

A key challenge for Mexico is to halve the population that lacks access to safe drinking water and basic sanitation services. In late 2001, 10.8 million people (including 7.5 million in rural areas) did not have piped water supply. More than 22 million still lack access to any form of sanitary drainage. Access to basic services such as clean water, sanitation, electricity, health care, and education in less-developed regions is considerably lower than the national average.

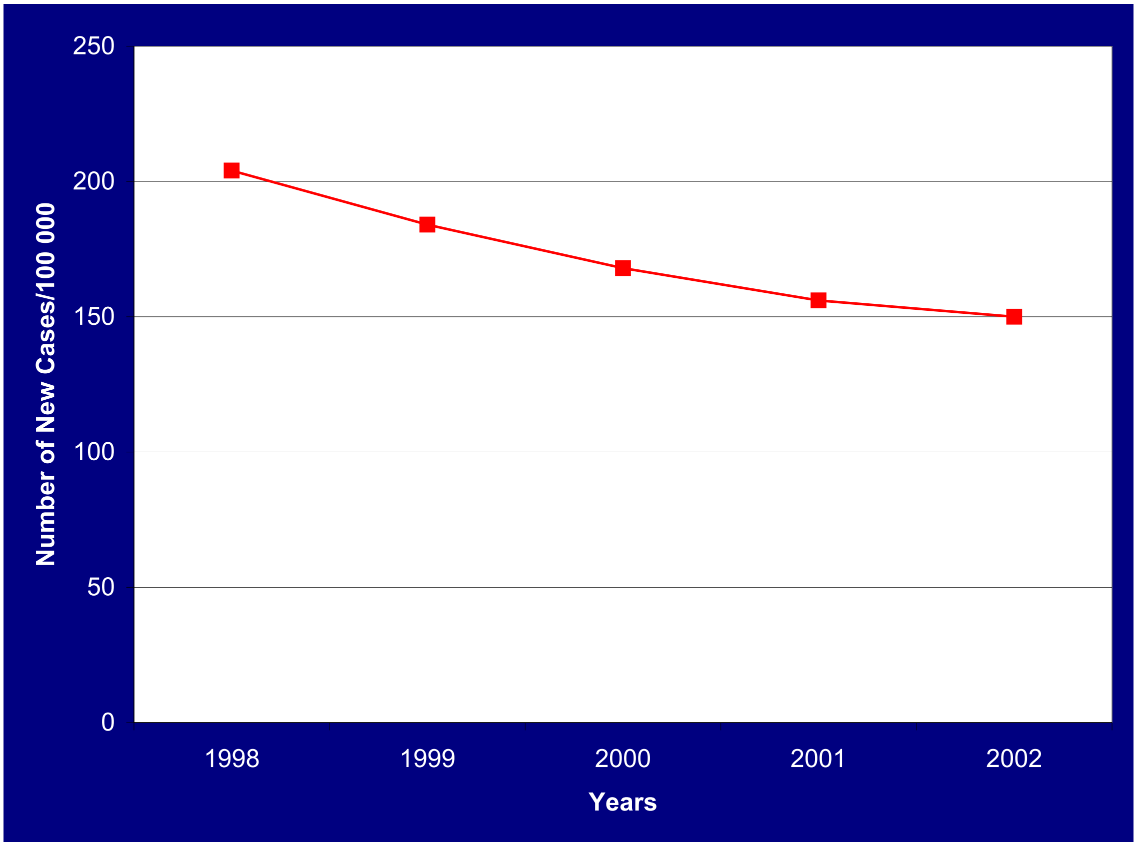
Figure 9.7: Incidence of Shigellosis in Children under the Age of Five, in Mexico, 1998–2002



Key Observations:

- Further to the measures taken to improve water quality, the chart shows that the national incidence of shigellosis in children under the age of five declined from 18.6 per 10,000 children in 1998 to 12.2 in 2002.

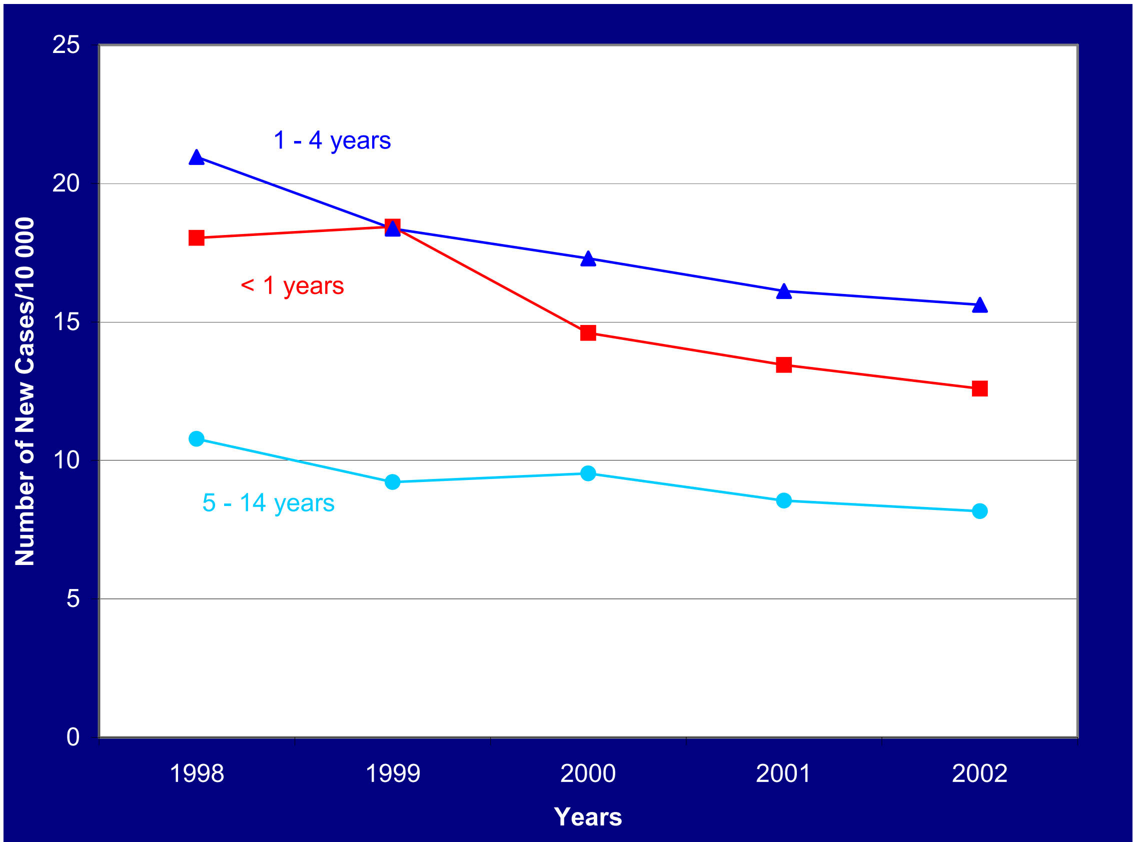
Figure 9.8: Incidence of Giardiasis in Children under the Age of Five, in Mexico, 1998–2002



Key Observations:

- As in the previous chart, the water quality improvement measures had an impact in decreasing the national incidence of this disease in children under the age of five; this chart shows that the incidence dropped from 204 per 100,000 in 1998 to 150 in 2002.

Figure 9.9: Incidence of Giardiasis among Children, by Age Group, in Mexico, 1998–2002

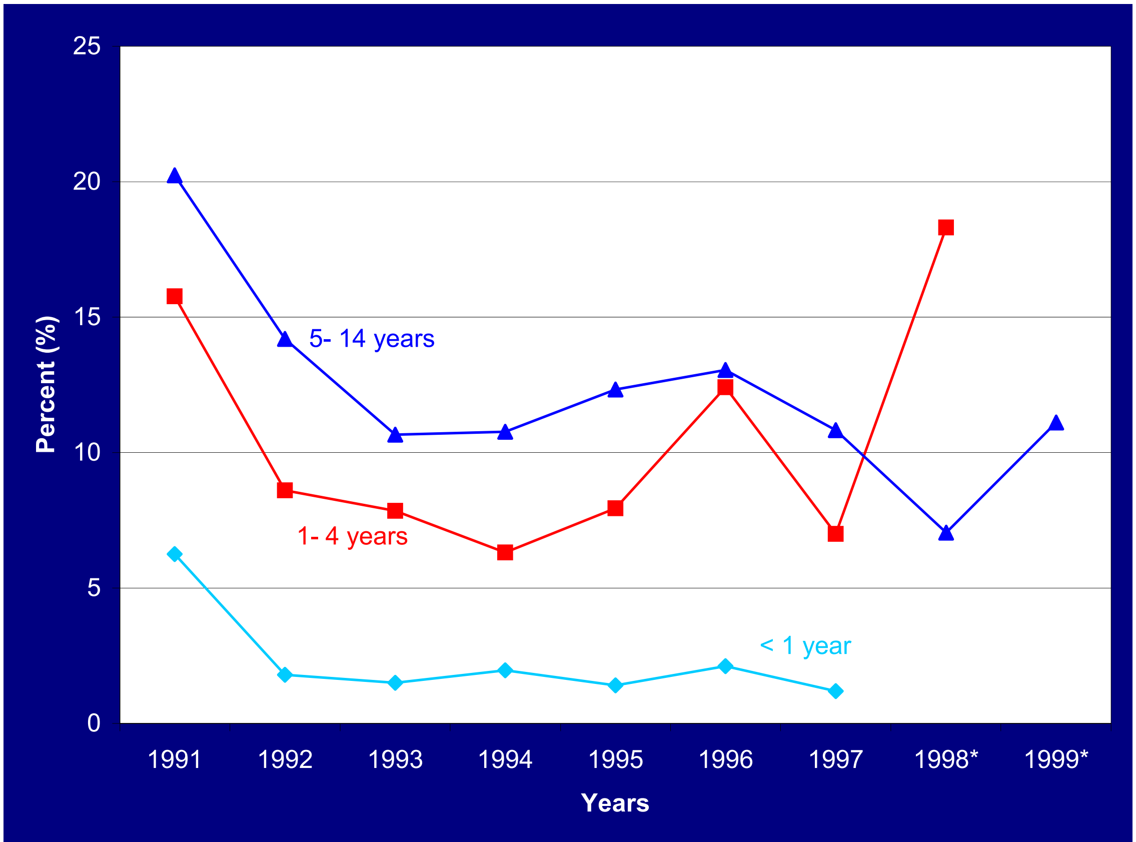


Source: Sole Epidemiological Information System (*Sistema Único de Información Epidemiológica*—SUIVE), SSA General Bureau of Epidemiology.

Key Observations:

- The epidemiological evidence of Giardiasis demonstrates that the most vulnerable group is that of the 1 to 4 years olds, showing a rate of incidence per 10,000 children for 1998 of 21 and diminishing to 16 for 2002.
- In the group of children below one year of age, the measures implemented for the Diarrhea programs have decreased the incidence of Giardiasis, from 18 to 13 per 10,000 children for 1998 and 2002 respectively.
- The incidence of Giardiasis among 5 to 14-year-olds has dropped from 11 cases per 10, 000 children in 1998 to 8 cases per 10,000 children in 2002

Figure 9.10: Percentage of Cases of Cholera among Children, by Age Group, in Mexico, 1991–1999



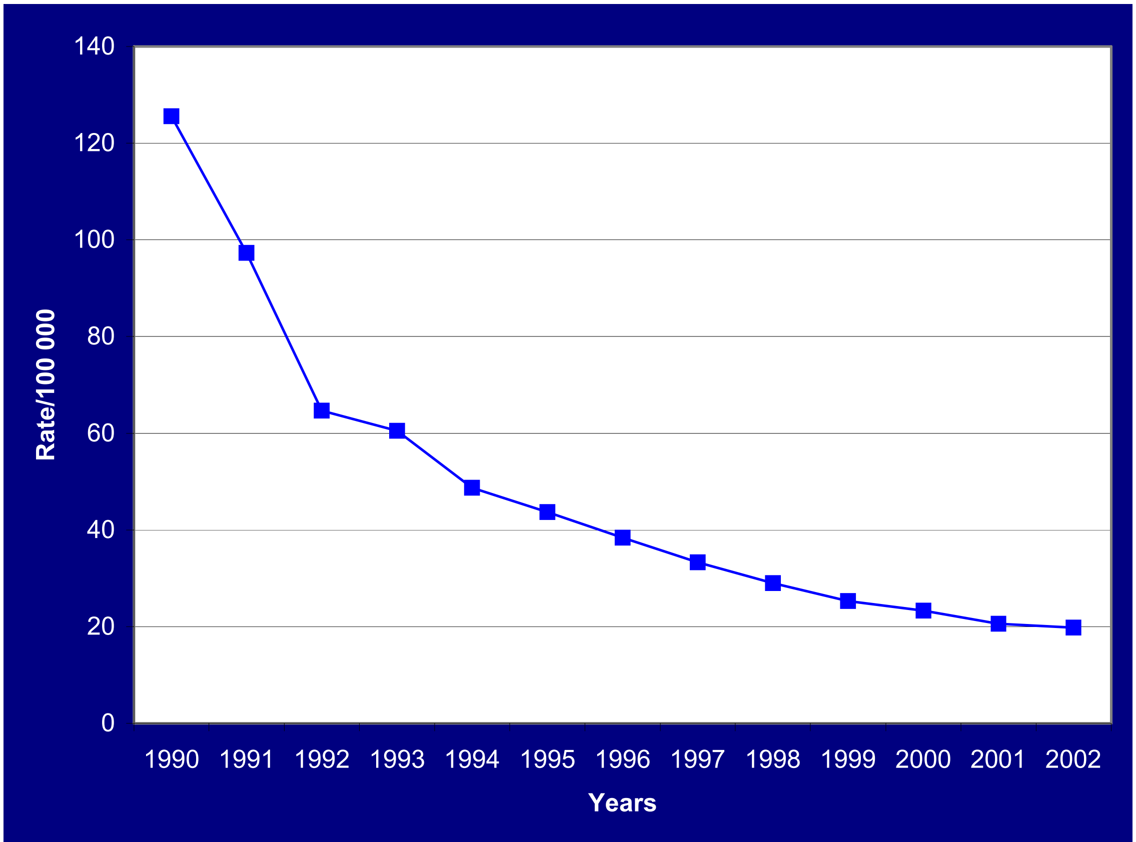
Source: Epidemiological Oversight Manual for Cholera (*Manual de Vigilancia Epidemiológica del Cólera*/SSA)

Note: * Data not available for children under one year old and one to four years old for 1999

Key Observations

- In the period from 1991 to 1998, children under one year of age had the lowest percentage of cases of cholera, with a general downward trend. No cases have arisen in this age group since 1998.
- The age group most affected by cholera is from one to four years of age, with the percentage of cases ranging from 6 percent to 18 percent of all cases.
- Cholera declined for the 5–14-year-old age group declines, from 20 percent in 1991 to 7 percent in 1998. The growing penetration of disinfected drinking water and the prevention measures to limit cholera outbreaks were effective in controlling this public health problem.

Figure 9.11: Mortality Rate from Diarrheic Diseases in Children under five, in Mexico, 1990–2002

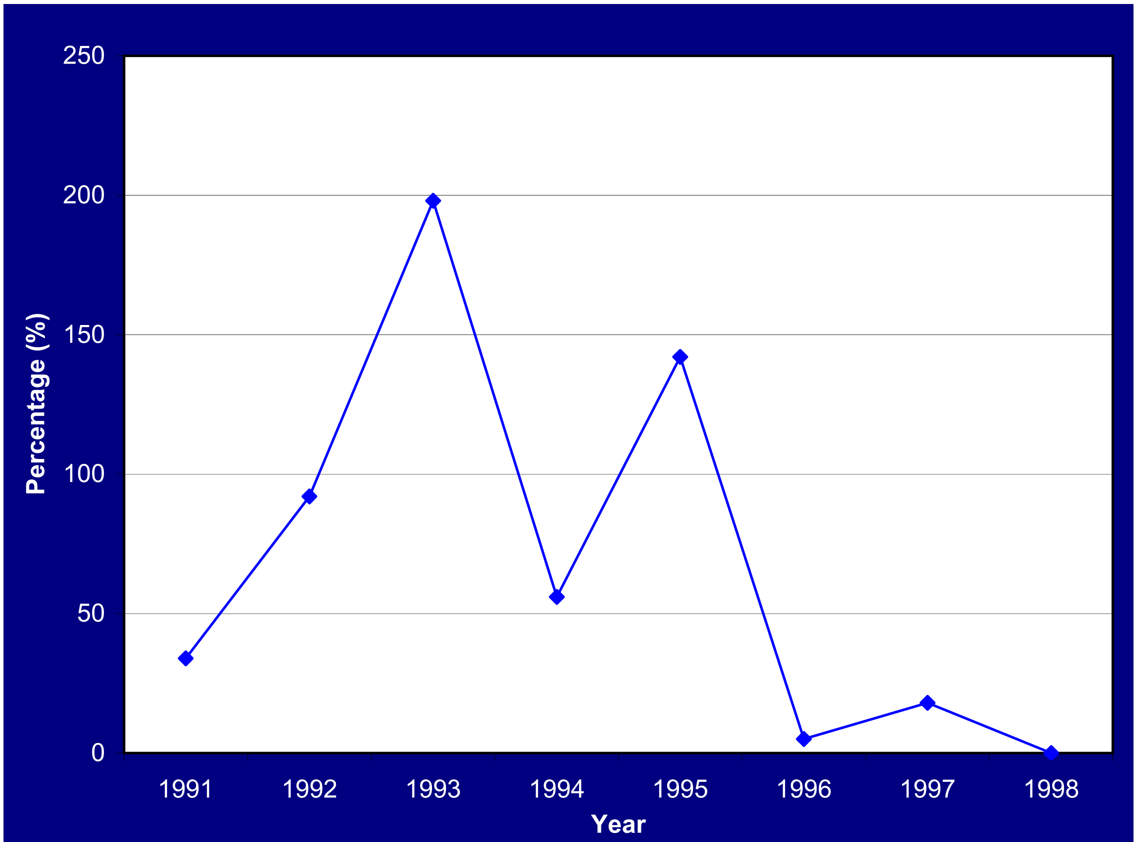


Source: INEGI, DGE, SSA. Statistical Information Bulletin 1990–2002 National Population Council (*Consejo Nacional de Población—Conapo*), Population Projections 1990–2002

Key Observations:

- The rate of mortality from diarrheic disease per 100,000 inhabitants under five decreased from 125.6 in 1990 to 33.32 in 1997, representing a reduction of 73.5 percent. This was above the original goal of 50 percent as stated in the World Children's Summit. By 2002, the mortality rate for children under five decreased to 20 per 100,000 inhabitants. This is primarily due to specific healthcare actions and the actions of other sectors, principally education and basic sanitation. It should be noted that the phenomenon is worse in marginalized urban and rural areas.

Figure 9.12: Mortality from Cholera in the General Population in Mexico, 1991–1998



Source: SSA National Cholera Oversight Program (*Programa Nacional de Vigilancia del Cólera*)

Key Observations:

- Recent decreases in mortality due to cholera (23 deaths over the period of 1996–1998 compared to 34 deaths in 1991 the lowest previous year) reflect prevention measures and the control of cholera dissemination managed under the Epidemiological Oversight Manual for Cholera created by the Secretariat of Health, and the health authorities' and field workers' flagging of the pandemic.
- The highest rate of mortality from cholera was in 1993 with 198 deaths.

10 Opportunities for Improvement

Outdoor Air Pollution

Mexico - Opportunities for improvement:

Finding ways in which Mexico's air quality monitoring network can support the future development of a population-based exposure indicator for outdoor air pollution is one area of opportunity. More information is needed on how pollutants that are monitored currently disperse in the environment as this will be important to extending the estimates of exposure in regions where no monitoring exists. In addition, efforts to expand monitoring to include PM2.5 and other air pollutants of concern to human health, and in particular children's health, would be worthwhile. Data on population exposures are not available at this time, thus efforts to generate this indicator will require the development of methods to combine census data with air quality data.

Indoor Air Pollution

Mexico - Opportunities for Improvement:

Work is underway in Mexico to develop a more direct measure of the percentage of children who are exposed to un-vented emissions from wood and charcoal use in the home. This indicator could provide further information on the regional distribution of these exposures in Mexico. In this report, Mexico presents some information on the exposure of children to environmental tobacco smoke (ETS) in the home. The ability to present a more complete ETS indicator in future reports will require increased monitoring, especially in the age groups most susceptible to adverse health effects from ETS exposure, from birth to 3 years. Further improvements could include the use of bio-monitoring of blood cotinine levels coupled with additional information on socio-economic factors.

Asthma

Mexico - Opportunities for Improvement:

Data from Mexico's National Epidemiological Surveillance System is used in presenting the indicators in this section. Information on incidence and prevalence of respiratory conditions presented is collected through the medical system, thus access to medical care is an important factor in the collection of this information. Work to improve the consistency of definitions and the diagnosis of these respiratory conditions is ongoing.

Blood Lead

Mexico - Opportunities for Improvement:

Numerous studies have investigated blood lead in children and adults in Mexico. While these studies provide insights into lead exposures they do not provide nationally representative data on blood lead levels in children. National blood lead data from direct measures would provide better information on children's exposures to lead, which could be used to identify populations at increased risk.

Lead in the Home

Mexico - Opportunities for Improvement:

Children that live or work in close proximity to lead based glazes are at increased risk of lead exposure as are children who eat food that has come in contact with lead-based pottery glaze. The availability of national blood lead data would improve the identification of home-based exposure to lead-based glazes and aid in targeting preventive actions.

Industrial Releases of Lead

Mexico - Opportunities for Improvement:

Lead is among the pollutants currently listed for reporting under *Mexico's Registro de Emisiones y Transferencias*. As the mandatory RETC system becomes operational, Mexico will likely be in a position to report industrial emissions of lead in future reports.

Industrial Releases of Other Chemicals, Including Pesticides

Mexico - Opportunities for Improvement:
Mexico's Pollutant Release and Transfer Register tracks a number of pollutants in common with to those tracked in Canada (NPRI) and the United States (TRI). Ensuring comparable reporting thresholds for those substances will be important in enabling tri-lateral comparability of data on industrial releases of selected chemicals. Future efforts could also focus on increasing the number of chemicals reported in common across North America.

Pesticides

Mexico - Opportunities for Improvement:
Mexico will review the availability of organophosphate pesticide residue measurements on fruits and vegetables to determine the feasibility of reporting on this indicator in the future. Surveillance programs for pesticide use as well as bio-monitoring programs may also be explored in preparation for future reports.

Drinking Water

Mexico - Opportunities for Improvement:
Mexico continues to increase the percentage of the population served with treated water. Efforts to measure access to potable water for rural and remote communities will be considered as a possible focus for future indicators. . Efforts to track data on violations of water quality standards would contribute to improved reporting of indicators in this area for future reports.

Sanitation

Mexico - Opportunities for Improvement:
The availability of sewer services as a means of reducing exposure to contaminants has been an important step in the management of waterborne diseases in Mexico. Indicators in future reports can be improved by measuring the availability of sewage treatment. Furthermore it is important to measure the lack of availability of sewer services and sewage treatment for children. Differentiating among levels of treatment would be useful in tracking efforts to prevent source water contamination.

Waterborne Diseases

Mexico - Opportunities for Improvement:
Efforts to ensure that diseases associated with waterborne morbidity and mortality are differentiated from other sources such as food are a part of the ongoing efforts to improve this indicator. Future efforts may include the measurement of additional waterborne diseases and/or priority chemicals of concern to children's health for which indicators can be developed.

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Appendix 5 Health of Indigenous Peoples

The Mexican population consists of approximately 10 percent indigenous peoples (one of the criteria for determining whether individuals or communities are indigenous or not is whether they refer to themselves as indigenous). There exist more than 50 ethnic groups and various languages and dialects. Nearly 72 percent of the indigenous population lives in southern and southeastern Mexico. The indigenous communities tend to be socially and economically marginalized with little access to basic environmental, health, and education services.

Frequently, areas with indigenous settlements have high environmental value and biodiversity. Indigenous communities are located in and around more than 30 percent of Mexico's main protected areas. The population of marginal (e.g., extremely arid or mountainous) lands is more than 50 percent indigenous. Nearly 90 percent of the forest resources of the state of Oaxaca are situated on land where indigenous communities are located.

In 1995, the indigenous population was estimated at 9.17 million. The growth rate was 1.23 percent with respect to 1990, nearly half that of the rest of the population (2.13 percent). The life expectancy at birth of indigenous people was estimated for 1995 at 69.5 years (67.6 for men and 71.5 for women), more than three years lower than the rest of the population. The infant mortality rate is nearly double that of the country as a whole (54 versus 29 deaths per 1,000 live births). The average number of children born to indigenous women was 4.1, versus 2.9 for non-indigenous women.

In 1995, the potential years of life lost (PYLL) per capita for the three main groups of causes of death showed premature mortality of 19.0 years for indigenous men versus 15.3 for non-indigenous men, and corresponding figures of 15.4 and 11.2 for women. There are differences between indigenous peoples that have yet to be sufficiently explained. For example, a lower rate of infant mortality is found for mothers who speak chontal (33 per 1,000 live births), maya (36), chinanteco (40) and zapoteco (40) as compared with those who speak chatino (77), popoluca (79), tarahumara (79), tepehuán (80), tzotzil (81) and tojolabal (87). Differences in the number of children are also found, with a minimum of 3.7 for chontal speakers and a maximum of 4.5 for tojolabal speakers.

Semarnat's special program for indigenous peoples promotes the sustainable use of natural resources and the conservation of biodiversity in areas where indigenous people live. It values their traditional knowledge and protects their intellectual property rights. Indigenous communities participate in drafting, implementing, and evaluating plans and programs that may affect them directly (e.g., land use planning, designation of protected natural areas and/or national parks, ecotourism projects).

Public authorities, NGOs and indigenous communities have formed corporations to promote innovative models of production and mobilization for indigenous communities, combining traditional values with modern technology and marketing. Successful examples include organic agriculture, coffee cooperatives, community-owned forestry companies, and natural/cultural tourism.

Appendix 6 Components of the National Surveillance System

CONAVE-CEVE The National Committee for Epidemiological Surveillance is a national standards body that facilitates, promotes and guides the country's epidemiological work. It is composed of the directors of each institution of the SNS. In each state of the Republic, CONAVE is represented by another collegiate body called the State Committee for Epidemiological Surveillance (CEVE) that coordinates the state-level efforts of all the institutions. It is composed of the directors of each SNS institution in that state.

SIGMESA The Mexican Georeferenced Health Information System is an information tool that provides morbidity and mortality data from the municipal to the national level in the form of thematic maps based on the digital cartography of Mexico.

RHOVE The Hospital Epidemiological Surveillance Network operates in general and specialty hospitals to cover the information requirements regarding reportable diseases and nosocomial infections. It currently operates in more than eighty hospitals and in the National Health Institutes.

SEED The Epidemiological and Statistical Death Reporting System compiles death certificate information with the objective of keeping a record of causes of death. This makes it possible to detect risks and take timely action to prevent the public from dying from such causes.

Special systems There are diseases which, because of their magnitude, consequence, characteristics, or the severity of the harm they cause, are given special attention by SUIVE. For epidemiological surveillance of these diseases, SUIVE has special information systems and specific operational strategies.

Communicable diseases	Non-communicable diseases
Vaccine-preventable	Histopathological Registry of Malignant Neoplasias
Vector-borne and zoonotic	Birth defects
HIV-AIDS and STDs	External lesions
Epidemiological emergencies and cholera outbreaks	Addictions
Microbacteria, tuberculosis and leprosy	Pesticide intoxication
Influenza	Breast cancer (in process)
ARI/ADD	Diabetes
Simplified Epidemiological Surveillance System	Cardiovascular diseases
International surveillance	Oral health

SUILAB The Unified Laboratory Information System is an automated laboratory system for the identification of clinical or environmental samples or isolations from the local level. It makes it possible to maintain the confidentiality and continuity of the diagnostic process at all stages of analysis of the sample through the use of advanced technology. This ensures efficacy in the delivery of quality results. The system also generates searchable historical data. SUILAB is composed of 3 modules: NETLAB records and tracks samples and allows for Internet transmission of results; the Internal Laboratory Information System (SILAB) tracks, captures and produces results from the various laboratories; and the National Public Health Laboratory Performance Information System tracks the performance of the laboratory network. SUILAB is a modern system whose design and implementation is based on cutting-edge technology.

Appendix 7 Indicator Templates

Percentage of days that exceed the Imeca air quality index in Mexico, 1999–2002	Type of indicator: Exposure
INDICATOR 2.- Description	
Definition	Mexico, like other countries, has developed more easily understandable pollution indices. Mexico uses the Metropolitan Air Quality Index (*Índice Metropolitano de la Calidad del Aire*—Imeca), whereby each pollutant's concentration under the Air Quality Standard is equal to 100 Imeca points. Imeca: Converts pollution concentrations to a relative number indicating the level of pollution in such a way that the population at large can understand it.
Rationale and role	This is an indirect measure of exposure to air pollution at levels that may cause negative health effects, such as asthma and other respiratory illnesses.
Data Range	1999–2002
Data sources, availability and quality	National Institute of Ecology (*Instituto Nacional de Ecología*—INE) through the National Air Quality Information System (*Sistema Nacional de Información de la Calidad del Aire*—Sinaica) Valley of Mexico Metropolitan Environment Commission (*Comisión Ambiental Metropolitana del Valle de México*—CAM)
Units of measurement	Imecas
Computation	Air quality per Imeca index: An Imeca score of 100 points represents air quality within the Mexican Official Standard (*Norma Oficial Mexicana*—NOM) for a given pollutant. Multiples of 100 are developed through simple algorithms taking accounting of environmental health criteria. *Imeca score* — *Air quality* 100 — Satisfactory 101–200 — Unsatisfactory 201–300 — Poor 301 or more — Very poor First the average is determined by dividing the total number of days that air quality was deemed Satisfactory, Unsatisfactory, Poor or Very Poor under by the Imeca index, by the total number of days in the year. Then, the percentage of averages exceeding the levels per standard.
Sources of further information	INE: http://www.ine.gob.mx CAM: http://www.edomexico.gob.mx/se/cam.htm Sinaica: http://www.sinaica.ine.gob.mx.
Scale of application	Metropolitan areas: Valley of Mexico (Mexico City and surrounding areas); Guadalajara; Monterrey; Valley of Toluca; Ciudad Juárez; Tijuana-Rosarito; Mexicali.
Useful references	Secretariat of the Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*—Semarnat): http://www.semarnat.gob.mx
Strengths of the Indicator	Monitoring information includes the country's primary metropolitan areas.

Metropolitan areas with air quality programs including air monitoring, Mexico, 2004	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Metropolitan areas with air quality improvement programs (*programas de mejoramiento de la calidad del aire*—Proaire): Include short- and medium-term goals to improve air quality and identify specific responsibilities for industry and the transportation sector. Environmental Monitoring Network (*Red de Monitoreo Ambiental*): Series of automatic or manual tracking stations to collect, analyze and systematically environmental air samples.
Rationale and role	Map shows the principal metropolitan areas with an Environmental Monitoring Network, enabling the location of such areas in national territory.
Data Range	1999–2002
Data sources, availability and quality	Semarnat INE through Sinaica CAM
Units of measurement	N/A
Computation	Number of cities or metropolitan areas with an environmental monitoring network and a regular system for recording air pollution measurements.
Sources of further information	INE: http://www.ine.gob.mx CAM: http://www.edomexico.gob.mx/se/cam.htm
Scale of application	Metropolitan areas: Valley of Mexico; Guadalajara; Monterrey; Valley of Toluca; Ciudad Juárez; Tijuana-Rosarito; Mexicali.
Useful references	Semarnat: http://www.semarnat.gob.mx
Strengths of the Indicator	Exact location of the metropolitan area on the map of Mexico.

Percentage of the general population exposed to biomass smoke, by region, Mexico, 2000 **Percentage of population under 19 years exposed to biomass smoke, by region, Mexico, 2000**	**Type of indicator: Body burden**
INDICATOR Description:	
Definition	Proportion of general population exposed to the use of biomass as household fuel. Proportion of population under 19 years of age exposed to the use of biomass as household fuel. The exposed population refers to all inhabitants of households that use biomass as cooking or heating fuel. Biomass: Wood and coal
Rationale and role	Household indoor air pollution caused by the burning of wood or coal for cooking constitutes a public health problem with repercussions for the child population, especially for children under 5 and women of reproductive age.
Data Range	2000
Data sources, availability and quality	The National Institute of Statistics, Geography and Information (*Instituto Nacional de Estadística, Geografía e Informática*—INEGI) conducts the National Population and Housing Census (*Censo Nacional de Población y Vivienda*) every 10 years. The information on this indicator was obtained from the 12th national census, conducted in 2000. The two main units analyzed in the census were habitual residents and households. Information was obtained from direct interviews with appropriate interviewees, defined as persons of at least 15 years of age who live in the household and know the information for all residents thereof. Two types of questionnaires (basic and extended) were used. The extended questionnaire was applied to a probability sample of households, while the basic questionnaire was applied exhaustively to all households. For further information on census methodology, see http://www.inegi.gob.mx
Units of measurement	Percentage
Computation	General population living in households using biomass as fuel/overall population living in households using biomass as fuel X 100 Population under 19 living in households using biomass as fuel/overall population living in households using biomass as fuel X 100
Sources of further information	National Population Council (*Consejo Nacional de Población*—Conapo): www.**conapo**.gob.mx
Scale of application	National
Useful references	Semarnat: http://www.semarnat.gob.mx

Strengths of the Indicator	Population and housing censuses provide the most complete information as to the geographic breakdown enabling an awareness of the national situation. With this information, various national sectors may prepare development plans and programs, analyze human settlement conditions and carry on a range of research, among other things.

Saturation of Fuel Wood User at the Municipal Level in Mexico, 2000	**Type of indicator: Effect**
INDICATOR Description	
Definition	Proportion of population per state that used wood and coal as fuel during 2000
Rationale and role	This is an indicator of potential risk to health, showing the predominantly rural states, with the most at-risk population, where wood and coal are most often used as fuel. That states that use the most wood include Oaxaca and Chiapas, where between 50 and 60 percent of the population is believed to use this kind of fuel. In general, Mexico's southern states have the greatest proportion of persons exposed to wood and coal use.
Data Range	Dates: 2000
Data sources, availability and quality	INEGI, 12th National Population and Housing Census
Units of measurement	Percentage
Computation	Number of inhabitants living in homes that use biomass fuel/Total population X 100
Sources of further information	National Population and Housing Census 2000 http://www.inegi.gob.mx
Scale of application	National
Useful references	Semarnat: http://www.semarnat.gob.mx
Strengths of the Indicator	These states are representative of the rural areas inhabited by the most at-risk populations most susceptible to exposure to pollutants from wood use.

Prevalence of Passive Smoking in Urban Populations (12–65) in Mexico, 2002 **Prevalence of Passive Smoking in Rural Populations (12–65) in Mexico, 2002**	**Type of indicator: Risk**
INDICATOR Description	
Definition	“Passive smoker” or “involuntary smokers” are those persons not classified as active smokers and exposed to tobacco smoke (environmental smoke) at home, the classroom or workplace. Around 48 million Mexicans are in such situation. Urban area: Urban population: Living in towns with a population of more than 2500 inhabitants. Rural area: Rural population: Living in towns with a population of no more than 2500 inhabitants
Rationale and role	Mexico is a country with a predominantly young population and has a certain social tolerance for tobacco additions. The regulation of the tobacco trade and protection for nonsmokers are still deficient, in both enforcement and compliance. Thus, the country may be highly vulnerable to the will of tobacco companies, with the resulting promotion of tobacco smoking and an increased number of smokers. Involuntary smoking causes a number of illnesses, such as lung cancer, various respiratory illnesses such as pneumonia and bronchitis, and cardiovascular disease. However, children exposed to tobacco smoke are at the greatest risk of illness, especially at an early age, given the immaturity of their immune systems. There is a potential health risk for passive smokers to suffer premature lung damage or begin a smoking habit.
Data Range	Date: 2002
Data sources, availability and quality	The information for this indicator was obtained from the National Additions Survey (*Encuesta Nacional de Adicciones*—ENA), composed of two parts. The first part summarizes the general aspects, methodology and organization of the survey, while the second part provides an executive summary of the most important indicators obtained from the information collected, as well as statistical precisions for the key variables. The information was collected using standardized questionnaires applied through face-to-face interviews by trained surveyors. The questionnaires used the basic indicators proposed by the World Health Organization (WHO) to assess substance use/abuse and dependence and the associated problems. The survey was designed as a random stratified sampling (probability sample) with a selection of conglomerates at various sampling stages. ENA 2002, National Council Against Addictions (*Consejo Nacional Contra las Adicciones*—Conadic), National Institute of Pediatrics (*Instituto Nacional de Pediatría*—INP), General Bureau of Epidemiology (*Dirección General de Epidemiología*—DGE), INEGI
Units of measurement	Rate

Computation	Number of inhabitants who smoke at homes/the number of exposed persons between 12 and 65 years of age. Divided into three zones: Northern, Central and Southern
Sources of further information	Conadic: http://www.conadic.gob.mx INEGI: http://www.inegi.gob.mx DGE: http://www.dgepi.salud.gob.mx
Scale of application	National and regional, urban and rural
Useful references	National Institute of Public Health (*Instituto Nacional de Salud Pública*—INSP): http://www.insp.gob.mx
Strengths of the Indicator	Every four years starting in 1988, the Secretariat of Health (*Secretaría de Salud*—SSA) has conducted this survey, which represents an important set of topical data that will doubtless support the performance of studies analyzing this area in greater depth.

Percentage of smokers, ex-smokers and non-smokers among adolescents (12–17), by gender, in urban locations in Mexico, 2002	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Population of adolescent smokers, ex-smokers, and non-smokers in urban areas.
Rationale and role	This indicator expresses the tobacco smoking habits of the adolescent population in urban areas, indicating the potential risk to health in early stages of life. According to data from the Anti-Tobacco Program developed by the National Council Against Additions, there are around 13 million smokers in Mexico, of whom 24.6 percent are women and 75.4 percent are men. In Mexico, studies have shown that adolescents begin smoking at increasingly early ages. At present, the average starting age is around 13. The prevalence of smokers in the adolescent age group in urban areas was 10.1 percent, equal to nearly one million individuals. The prevalence of ex-smokers in the urban population between 12 and 17 years of age was 7.1 percent, or 705,963 young people.
Data Range	Date: 2002
Data sources, availability and quality	ENA 2002, Conadic, INP, DGE, INEGI
Units of measurement	Percentage
Computation	Number of adolescent smokers, ex-smokers, and non-smokers in urban areas/number of exposed population between 12 and 17 years of age X 100
Sources of further information	Conadic: http://www.conadic.gob.mx INEGI: http://www.inegi.gob.mx DGE: http://www.dgepi.salud.gob.mx
Scale of application	National, urban
Useful references	INSP: http://www.insp.gob.mx
Strengths of the Indicator	Every four years starting in 1988, the SSA has conducted this survey, which represents an important set of topical data that will doubtless support the performance of studies analyzing this area in greater depth.

Percentage of smokers among adolescents, by age and gender, in urban locations in Mexico, 2002	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Percentage of population per age group of children under 17, by gender, who smoke and live in urban locations.
Rationale and role	This indicator expresses the tobacco smoking habits of the under-17 population in urban areas, indicating the potential risk to health in early stages of life.
Data Range	Date: 2002
Data sources, availability and quality	ENA 2002, Conadic, INP, DGE, INEGI.
Units of measurement	Percentage
Computation	Number of adolescents per gender and age group who smoke in urban households/total exposed population X 100
Sources of further information	Conadic: http://www.conadic.gob.mx INEGI: http://www.inegi.gob.mx DGE: http://www.dgepi.salud.gob.mx
Scale of application	National, urban
Useful references	INSP: http://www.insp.gob.mx
Strengths of the Indicator	Information obtained from national surveys conducted every four years.

Incidence of Asthma in children under 5 years old in Mexico, 1995–2002	Type of indicator: Health effects
INDICATOR 3.- Description	
Definition	Number of cases with a clinical diagnosis of asthma in children under 5, during 1995–2002 **Morbidity rate**: Number of cases handled in health centers for a given illness in a given year, for a given age group, per 100,000 inhabitants. **Asthma**: Any individual with an allergy history having attacks of thoracic oppression, dyspnea and sibilance, accompanied by an intense cough with heavy expectoration. In accordance with IDC 10th Review, includes: J45, J46 Asthma is a genetic illness with immunological alterations. It is the most common chronic illness among children, with early clinical manifestations, and thus its diagnosis is generally made in the first years of life.
Rationale and role	This indicator shows the extent of change in incidences of asthma, which may be related to exposure to indoor and outdoor air pollution. Although air pollution is only one of the several risk factors, it has been shown that respiratory symptoms are exacerbated by high pollution levels, especially in vulnerable groups. An asthmatic will have a greater symptomatic and functional response from being exposed to greater concentrations of pollution, including the frequency and duration of exposure. In Mexico, residents of coastal states have been found to show a greater number of asthma cases, possibly due to environmental humidity. These regions also are believed to have a higher frequency due to the use of air conditioning systems that hold a considerable amount of dust and fungus, which may trigger asthma attacks.
Data Range	Dates: 1995–2002 Age: Under 5
Data sources, availability and quality	In Mexico, statistical data on morbidity and mortality are compiled and analyzed as an official source through the National Epidemiological Oversight System (*Sistema Nacional de Vigilancia Epidemiológica*—Sinave), which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. The system is managed by the DGE. From its creation in 1995, Sinave has established the Sole Epidemiological Oversight Information System (*Sistema Único de Información para la Vigilancia Epidemiológica*—SUIVE), which systemizes morbidity and mortality information with the involvement of the entire health sector. The SUIVE homogenized the notification criteria, forms and procedures for the various institutions within the National Health System (*Sistema Nacional de Salud*—SNS). The SUIVE generates uniform health services information at the different technical-administrative levels. This information refers to the occurrence,

	distribution in terms of time, place and persons, risk factors and results of illness affecting human health, and is reported on special forms for each level. Local information is forwarded to the jurisdictional level, which is concentrated and forwarded to the state level, and the state levels forward information to the national level. Information is concentrated at each corresponding level and analyzed to guide and support decision-making in the design and application of nationwide health plans and programs. The Sole Automated Epidemiological Oversight System (*Sistema Único Automatizado para la Vigilancia Epidemiológica*—SUAVE) is a software package concentrating Sinave information generated by SNS institutions. The weekly reporting covers a total of 110 illnesses, of which 47 are nontransmittable and 63 are transmittable; 29 require immediate notification and a specific epidemiological study for final confirmation and final classification. Specific diagnostic criteria and procedures are applied for a more complete clinical and epidemiological characterization. Illnesses are reported on form SUIVE-1-2000. SUAVE is self-installing program that allows the user to operate it with limited knowledge of computing. It also provides for the emailing of entered data. This software offers graphical and mapped reporting with historical information on morbidity and concentrates information on new cases of illnesses. Epidemiological Information Bulletin 1995–2000, Population Projections 1990–2010/Conapo
Units of measurement	Morbidity rate
Computation	Number of cases of asthma reported for children between 0 and 5 years of age in a year/total population of same age group in same year Rate per 10,000 inhabitants
Sources of further information	SSA: http://www.ssa.gob.mx DGE: http://www.dgepi.salud.gob.mx Conapo: http://www.conapo.gob.mx
Scale of application	National. Epidemiological Information Bulletin 1995–2000, Population Projections 1990–2010/Conapo
Useful references	INSP: http://www.insp.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Incidence of Acute Respiratory Infections (ARIs) in children under 5 years old in Mexico, 1993–2002	**Type of indicator: Health effects**
INDICATOR 4.- Description	
Definition	There is a series of acute respiratory illnesses determined as being caused by virus, allergens and bacteria such as rhinopharyngitis, laryngitis, acute bronchitis, etc., with similar clinical diagnoses, the pathological causes of which are often difficult to identify. These are important given their extensive morbidity. Incidence rate: Number of new cases of illness / Exposed population Acute respiratory infections (ARIs): All children under 5 clinically diagnosed with sudden onset with obstruction or nasal secretion, throat pain or burning, dysphony, coughing with or without expectoration, fever, back pain, dyspnea or cyanosis. In accordance with IDC 10th review, including: J00, J01, J02.8, J02.9, J03.8, J06, J20, J21.
Rationale and role	This indicator shows the extent of changes in the prevalence of respiratory infections by age group, which may be related to the exposure to indoor and outdoor air pollution. The rate of incidence of ARIs varies throughout national territory due to factors influencing the increase or decrease of cases, such as poverty, marginalization, malnutrition, inaccess to health services, the physicochemical conditions and concentration of air pollution, and the meteorological and geographical conditions of the country's different regions.
Data Range	Date: 1990–2003 Age: Under 5
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. Epidemiological Information Bulletin 1995–2000, Population Projections 1990–2010/Conapo
Units of measurement	Rate
Computation	Number of new ARI cases reported for children between 0 and 5 years of age/Exposed population Rate per 100,000 inhabitants
Sources of further information	SSA: http://www.ssa.gob.mx DGE: http://www.dgepi.salud.gob.mx Conapo: http://www.conapo.gob.mx
Scale of application	National. Epidemiological Information Bulletin 1995–2000, Population Projections 1990–2010/Conapo
Useful references	INSP: http://www.insp.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Prevalence of Asthma among children, by age group, Mexico, 1998–2002	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Prevalence of asthma among children, by age group, Mexico, 1998–2002 **Asthma**: Any individual with an allergy history having attacks of thoracic oppression, dyspnea and sibilance, accompanied by an intense cough with heavy expectoration. In accordance with IDC 10th Review, includes: J45, J46 Prevalence rate: Number of new and old cases/Total exposed population.
Rationale and role	This indicator shows the extent of change in the prevalence of asthma, which may be related to exposure to indoor and outdoor air pollution. Although air pollution is only one of the several risk factors, it has been shown that respiratory symptoms are exacerbated by high pollution levels, especially in vulnerable groups. An asthmatic will have a greater symptomatic and functional response from being exposed to greater concentrations of pollution, including the frequency and duration of exposure.
Data Range	Dates: 1998–2002 Age: Under 1, 1 to 4 and 5 to 14 years.
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health.
Units of measurement	Prevalence rate
Computation	Number of cases (new and old) of ARIs in children under 1, from 1 to 4, and from 5 to 14/Total exposed population. Rate per 100,000 inhabitants.
Sources of further information	SSA: Epidemiological Information Bulletin 1995–2000: http://www.dgepi.salud.gob.mx Conapo: Population Projections 1990–2010/Conapo: http://www.conapo.gob.mx INEGI: http://www.inegi.gob.mx
Scale of application	National
Useful references	SSA: http://www.ssa.gob.mx INSP / Health Atlas: http://www.insp.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Incidence of Acute Respiratory Infections (ARI) among children, by age group, Mexico, 1998–2002	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Prevalence rate of ARIs in children per age group, in 1998–2002 ARIs: All children clinical diagnosed with sudden onset with obstruction or nasal secretion, throat pain or burning, dysphony, coughing with or without expectoration, fever, back pain, dyspnea or cyanosis. In accordance with IDC 10th review, including: J00, J01, J02.8, J02.9, J03.8, J06, J20, J21.
Rationale and role	This indicator shows the extent of changes in the prevalence of respiratory infections by age group, which may be related to the exposure to indoor and outdoor air pollution.
Data Range	Dates: 1998–2002 Age: Under 1, 1 to 4, and 5 to 14 years of age.
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. Epidemiological Information Bulletin 1995–2000, Population Projections 1990–2010/Conapo
Units of measurement	Prevalence rate
Computation	Number of cases (new and old) of ARIs in children under 1, from 1 to 4, and from 5 to 14/Total exposed population. Rate per 100,000 inhabitants.
Sources of further information	SSA: http://www.ssa.gob.mx DGE: http://www.dgepi.salud.gob.mx Conapo: http://www.conapo.gob.mx
Scale of application	National
Useful references	INSP: http://www.insp.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Rate of mortality by Acute Respiratory Infection (ARI) of children under five in Mexico, 1990–99	**Type of indicator:**
INDICATOR Description	
Definition	Mortality rate in children under five years of age from acute respiratory infections (ARIs), 1990–99. Mortality rate: Number of deaths from a specific cause among the total population in a given period of time.
Rationale and role	This indicator represents the declining mortality rate from ARIs in the stated age group, from 1990 to 1999.
Data Range	Date: 1990–99 Age: children under five
Data sources, availability and quality	Illness reported in the Epidemiological and Death Statistics System (*Sistema Epidemiológico y Estadístico de las Defunciones*—SEED). SEED compiles information from death certificates to record causes of death among the population, thereby detecting risks in order to develop health measures and prevent deaths from such causes. Population Projections 1990–2010/Conapo
Units of measurement	Mortality rate
Computation	Total deaths per age group, from ARIs in children under five/Total population of age group Rate calculated per 100,000 inhabitants
Sources of further information	SSA: http://www.ssa.gob.mx DGE: http://www.dgepi.salud.gob.mx Conapo: http://www.conapo.gob.mx
Scale of application	National
Useful references	INSP: http://www.insp.gob.mx
Strengths of the Indicator	This illness is reported in Sinave through SEED (SEED), for all first-, second- and third-tier care facilities.

Blood lead levels in rural and urban populations	Type of indicator: Action
INDICATOR Description:	
Definition	Mexico has data on the blood lead levels only from isolated studies in industrial zones and some pottery-making regions, although we do not have national basal information on blood lead levels.
Rationale and role	Lead has a wide range of toxic effects on several body systems. Elevated acute exposure leads to severe poisoning manifested by highly lethal encephalopathy. Chronic exposure produces a range of constitutional symptoms and a heightened risk of neuropsychological deficiencies, nephropathy, peripheral nephropathy, anemia and reproductive alterations. Lead has toxic effects even at low levels of exposure, with a notable, insidious effect on children's cognitive development. There is no threshold precisely indicating when lead begins to affect health, although clinical manifestations are believed to arise at 10 μg/dL, even though damage may occur at lower levels.
Data Range	Studies conducted between 1960 and 2000.
Data sources, availability and quality	Data obtained from studies published in indexed journals
Units of measurement	Micrograms per deciliter of blood
Computation	For further information, look up the respective study by author.
Sources of further information	See chart 8.1
Scale of application	Regional, urban and rural
Useful references	As specified in the chart
Strengths of the Indicator	Studies published in indexed journals

Atmospheric monitoring of lead and principal activities to reduce lead emissions in the Valley of Mexico Metropolitan Area, 1990–2000	Type of indicator:
INDICATOR Description	
Definition	Atmospheric monitoring of lead and principal activities to reduce lead emissions in the Valley of Mexico Metropolitan Area. Quarterly trends in lead monitoring, considering 1.5 μg/m^3 as the standard level for the metropolitan area. Tracking stations located at Tlalnepantla, Xalostoc, Merced, Pedregal, and Cerro de la Estrella, pertaining to the Environmental Monitoring Network. Series of automatic or manual tracking stations to collect, analyze and systematically environmental air samples.
Rationale and role	Lead has a wide range of toxic effects on several body systems. Elevated acute exposure leads to severe poisoning manifested by highly lethal encephalopathy. Chronic exposure produces a range of constitutional symptoms and a heightened risk of neuropsychological deficiencies, nephropathy, peripheral nephropathy, anemia and reproductive alterations. Lead has toxic effects even at low levels of exposure, with a notable, insidious effect on children's cognitive development. There is no threshold precisely indicating when lead begins to affect health, although clinical manifestations are believed to arise at 10 μg/dL, even though damage may occur at lower levels.
Data Range	Date: 1990–2000
Data sources, availability and quality	Mexico City Air Monitoring System (*Sistema de Monitoreo Atmosférico de la Ciudad de México*): http://www.sima.com.mx
Units of measurement	μg/m^3
Computation	Standard quarterly average value of 1.5 μg/m^3
Sources of further information	INE: http://www.ine.gob.mx CAM: http://www.edomexico.gob.mx/se/cam.htm NOM-026-SSA1-1993, "Environmental health. Criteria for assessing ambient air quality with respect to lead (Pb). Standard value for lead (Pb) concentration in ambient air as a public health protection measure."
Scale of application	Valley of Mexico Metropolitan Area
Useful references	Semarnat: http://www.semarnat.gob.mx
Strengths of the Indicator	Establishes the reference for decision-making in developing control and assessment programs.

Local Air Quality Data from Metallurgical Activities	**Type of indicator:**
INDICATOR Description:	
Definition	Quarterly trends in lead monitoring, considering 1.5 µg/m3 as the standard level for the area neighboring the company MET-MEX Peñoles, under NOM-026-SSA1-1993).
Rationale and role	The city of Torreón, Coahuila, located in northern Mexico, has a population of approximately 530,000 inhabitants. Latin America's largest, and the world's fourth largest, mining-metallurgical company, MET-MEX PEÑOLES, is located in this town, producing lead, silver and gold. The presence of this industry has led to the chronic environmental exposure to lead in the non-occupational population, particularly in children.
Data Range	Date: December 1999–January 2004
Data sources, availability and quality	Metals Program (*Programa de Metales*)/Coahuila State Secretariat of Health
Units of measurement	µg/m^3
Computation	Quarterly average of 1.5 µg/m^3, for values found at all tracking stations neighboring the company
Sources of further information	NOM-026-SSA1-1993, "Environmental health. Criteria for assessing ambient air quality with respect to lead (Pb). Standard value for lead (Pb) concentration in ambient air as a public health protection measure." Office of the Federal Attorney General for Environmental Protection (*Procuraduría Federal de Protección Ambiental*—Profepa): http://www.profepa.gob.mx
Scale of application	State of Coahuila
Useful references	Semarnat: http://www.semarnat.gob.mx INE: http://www.ine.gob.mx
Strengths of the Indicator	To address this situation, the state Secretariat of Health, Profepa and the company PEÑOLES implemented a series of actions including, among others, emissions control by the company, the oversight of the environmental authority and the medical care of the environmentally exposed population by the state Secretariat of Health.

Annual average lead in children's blood in the city of Torreón, 1998–2004. **Blood lead levels in children following 5 years of attendance in the metals program in Mexico, 2000.**	**Type of indicator: health effects**
INDICATOR Description	
Definition	Annual average lead in blood of children under 15 years of age. Total population of children under 15 recorded in the Metals Program with blood lead levels above the NOM-199-SSA1-2000 standard, setting a limit value of 10 µg/dL, as well as the blood lead value categories for intervention. Category — BLL I — < 10 µg/dL II — 10 to 14.9 µg/dL III — 15 to 24.9 µg/dL IV — 25 to 44.9 µg/dL V — 45 to 69.9 µg/dL VI — More than 70 µg/dL
Rationale and role	The results of formal studies performed since 1997 have shown a high concentration of lead in the soil and air, thereby documenting prolonged, historic pollution. One of these studies (García V.G. & coll., 2001) corroborated the presence of lead in the blood of school children, having a directly proportional relationship to their proximity to the metallurgical plant. The presence of this industry has led to the chronic environmental exposure to lead in the non-occupational population, particularly in children.
Data Range	Date: December 1999–January 2004
Data sources, availability and quality	Epidemiological oversight system under the Metals Program/Coahuila State Secretariat of Health
Units of measurement	µg/dL in blood
Computation	The state lead oversight system is based on the criteria and actions provided in the standard, which specify and categorize the values of lead in blood required for health authority intervention.
Sources of further information	NOM-199-SSA1-2000, Environmental health – levels of lead in blood and actions as health protection criteria for the non-occupationally exposed population. SSA: http://www.salud.gob.mx
Scale of application	Local
Useful references	García V.G. & col., 2001
Strengths of the Indicator	To address this situation, the state Secretariat of Health, Profepa and the company PEÑOLES implemented a series of actions including, among others, emissions control by the company, the oversight of the environmental authority and the medical care of the environmentally exposed population by the state Secretariat of Health.

Cases of pesticide poisonings in children (under 15 years old) and the general public in Mexico, 1993–2002	**Type of indicator: Health effects**
INDICATOR 5.- Description	
Definition	Annual pesticide poisoning cases in the overall population and in children under 15 years of age. Pesticide poisoning: Any person showing bradycardia, hypotensión, dizziness, increased salivatin, myosis or one or more of the following symptoms: convulsions, tremors, nausea, vomiting, increased sweating, pulmonary edema, hepatic degeneration, relaxation of sphincters, depression and coma. In accordance with IDC 10th review, includes: T60.
Rationale and role	Children may be especially vulnerable to the effects of pesticide, given their particular susceptibility and because they may be exposed to higher pesticide levels than adults. In proportion to their body mass, children eat more than adults and may be more exposed to certain pesticides by reason of their different, less varied diets than adults.
Data Range	1993 to 2002 for the overall population, and 1998 to 2002 for children under 15.
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. National Health Information System (*Sistema Nacional de Información en Salud*—Sinais): http://www.sinais.gob.mx SSA: http://www.salud.gob.mx INEGI: http://www.inegi.gob.mx
Units of measurement	Cases reported
Computation	Number of cases of pesticide poisoning in children under 15/Overall population
Sources of further information	DGE: http://www.dgepi.salud.gob.mx INEGI: http://www.inegi.gob.mx
Scale of application	State and federal information available
Useful references	SSA: http://www.salud.gob.mx Federal Commission for Protection Against Health Risks (*Comisión Federal de Protección Contra Riesgos a la Salud*—Cofepris): http://www.cofepris.gob.mx
Strengths of the Indicator	National coverage. Information processed in SUIVE. Poison control centers are being integrated to improve reporting.

Population (in thousands) with access to bacteriologically safe water, by state, Mexico, 2003 **Percentage of the population without access to bacteriologically safe water in Mexico, 2000–2003**	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Population receiving chlorinated water: Inhabitants with water from a supply network to which chlorine has been applied as a disinfection treatment. Bacteriologically safe water: Water suitable for human consumption and not containing microorganisms endangering health, in accordance with NOM-127-SSA1-1994 The disinfection of water intended for human use and consumption ensures the inactivation or destruction of most pathogens that may be transmitted to humans.
Rationale and role	The primary environmental and public health problems faced by the country are those relating to a lack of basic sanitation and poor water quality. Furthermore, limited water is available for its growing population. Therefore the availability of safe and reliable supply sources is fundamental to ensure adequate public health, since may illnesses are caused by chemical agents and pathogenic organisms living in polluted water. This indicator presents an overview of the population with water from a disinfected supply network. Not all piped water is bacteriologically safe.
Data Range	2003 2000–2003
Data sources, availability and quality	Water disinfection oversight is carried on with the periodic and ongoing tracking of free residual chlorine in the distribution network. Keeping residual chlorine above 0.2 mg/L is effective to inactivate pathogenic bacteria and viruses in the network. State Health Services; National Water Commission (*Comisión Nacional del Agua*—CNA): http://www.cna.gob.mx INEGI: http://www.inegi.gob.mx Conapo (population projections by gender, age groups and states, 1995–2005): http://www.conapo.gob.mx
Units of measurement	Thousands of inhabitants Percentage
Computation	Overall population receiving bacteriologically safe water. Overall population with bacteriologically safe water/Total population. Overall population with formal supply system/Total population.
Sources of further information	Modification to NOM-127-SSA1-1994, Environmental health. Water for human use and consumption. Allowable quality limits and treatment for drinkability. CNA: http://www.cna.gob.mx INEGI: http://www.inegi.gob.mx Conapo: http://www.conapo.gob.mx
Scale of application	State and national information available
Useful references	SSA: http://www.salud.gob.mx

	Cofepris: http://www.cofepris.gob.mx
Strengths of the Indicator	Representative, including the 32 Mexican states and information from official sources.

Percent of the population without potable water in Mexico, 1980–2000 Percent of the population without piped water, by State, Mexico, 2000 (map)	Type of indicator: Exposure
INDICATOR Description	
Definition	**Population receiving drinking water**: Inhabitants with water from a supply source. This indicator refers to urban and rural zones. Population census 1980–2000. Drinking water: Free of physicochemical and biological pollutants, under the modification to NOM-127-SSA1-1994.
Rationale and role	This indicator presents an overview of the differences between rural and urban populations as to the supply of piped water, and the population most at risk of waterborne illness given the inaccess to treated (chlorinated) water.
Data Range	Date: 1980–2000 Census 2000
Data sources, availability and quality	Database of the 12th General Population and Housing Census, 2000 Counting of Population and Housing, 1995 Database of the 12th General Population and Housing Census, 1990 Database of the 12th General Population and Housing Census, 1980 Modification to NOM-127-SSA1-1994, Environmental health. Water for human use and consumption. Allowable quality limits and treatment for drinkability.
Units of measurement	Percentage
Computation	Overall population receiving piped household water/Total population x 100.
Sources of further information	INEGI: http://www.inegi.gob.mx Conapo: http://www.conapo.gob.mx SSA: http://www.salud.gob.mx CNA: http://www.cna.gob.mx
Scale of application	Urban, rural and national Regional map: Central, northern and southern
Useful references	Semarnat: http://www.semarnat.gob.mx National Water Program: http://www.imacmexico.org/ev_es.php?ID=5876_201&ID2=DO_TOPIC
Strengths of the Indicator	Population and housing censuses provide the most complete information as to the geographic breakdown enabling an awareness of the national situation. With this information, various national sectors may prepare development plans and programs, analyze human settlement conditions and carry on a range of research, among other things.

Percent of the population not served with sewer services in Mexico, 1980–2000	**Type of indicator: Exposure**
INDICATOR Description	
Definition	**Population** with a drainage or sewer system for carrying and/or discharging sewage. **Households** per state with a drainage or sewer system for carrying and/or discharging sewage. In Mexico, the term “sewer” (*alcantarillado*) refers to drainage networks, septic tanks and direct drainage into trenches, ditches or bodies of water; this is important when comparing with other countries.
Rationale and role	This measure reflects the percentage of the population that may be exposed to untreated sewage and contract waterborne illnesses. May be expressed in terms of type of sewer or sewage treatment system (latrines, septic systems).
Data Range	1980–2000 2000
Data sources, availability and quality	Database of the General Population and Housing Census, 1980–2000 Database of the General Population and Housing Census, 2000
Units of measurement	Percentage
Computation	Population (households) with drainage or sewer systems/Total population X 100 Households with drainage or sewer systems/Counted households X 100
Sources of further information	National Population Council: http://www.conapo.gob.mx
Scale of application	National – Database of the General Population and Housing Census, 2000 State – (map)
Useful references	CNA: http://www.cna.gob.mx INEGI: http://www.inegi.gob.mx Cofepris: http://www.cofepris.gob.mx National Water Program: http://www.imacmexico.org/ev_es.php?ID=5876_201&ID2=DO_TOPIC
Strengths of the Indicator	Coverage; information obtained from census

Percent of homes without sewer services, by state, Mexico, 2000	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Population per state with a drainage or sewer system for carrying and/or discharging wastewater, based on the 2000 census. The indicator provides information on the increase in services in rural and urban areas.
Rationale and role	This measure reflects the percentage of the population that may be exposed to untreated sewage and contract waterborne illnesses. May be expressed in terms of type of sewer or sewage treatment system (latrines, septic systems).
Data Range	2000
Data sources, availability and quality	National Population and Housing Census 2000
Units of measurement	Percentage
Computation	Overall population (households) with drainage or sewer system/Total population
Sources of further information	National Population Council: http://www.conapo.gob.mx
Scale of application	National and state
Useful references	CNA: http://www.cna.gob.mx INEGI: http://www.inegi.gob.mx Cofepris: http://www.cofepris.gob.mx National Water Program: http://www.imacmexico.org/ev_es.php?ID=5876_201&ID2=DO_TOPIC
Strengths of the Indicator	Coverage; information obtained from census

Incidence of Shigellosis in children under 5 years old in Mexico, 1998–2002	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Shigellosis: Acute intestinal bacterial infection caused by the bacteria *shigella*, characterized by first watery and then bloody stools, accompanied by abdominal pain and fever, nausea and vomiting, lasting for 4 to 7 days. In accordance with IDC 10th review, includes: A03. Incidence rate: Number of new cases of illness in children under 5/total exposed population. Rate per 10,000 inhabitants.
Rationale and role	According to WHO, 80 percent of infectious and parasitic gastrointestinal illnesses, and a third of deaths caused thereby, are due to the consumption of insalubrious water. WHO further notes that only 41 percent of the world's population drinks water that is treated and disinfected to be deemed safe. The primary environmental aspects that traditionally influence the causes of illness and death in Mexico include: • Poor water quality for human use and consumption • Inadequate sewage disposal • Inadequate handling of municipal solid waste • Insufficient pest control • Poor hygiene conditions in homes and public areas In countries such as Mexico, diarrheic illnesses continue to be a serious problem for the child population. These illnesses are caused by bacteria, viruses and protozoan pathogens passed by the fecal-oral route and potentially transmitted by drinking water used in various household activities, including personal hygiene, and through primary contact with contaminated recreational waters.
Data Range	Date: 1998–2002
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. Sinais: Statistical Information Bulletin: http://www.sinais.gob.mx SSA: http://www.salud.gob.mx INEGI: http://www.inegi.gob.mx
Units of measurement	Incidence rate
Computation	Number of new Shigellosis cases in children under 5/Total exposed population of children under 5
Sources of further information	DGE: http://www.dgepi.gob.mx
Scale of application	National
Useful references	Conapo: http://www.conapo.gob.mx SSA: http://www.salud.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Incidence of Giardiasis in children under 5 years old in Mexico, 1998–2002	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Giardiasis: Inflammatory intestinal condition caused by the proliferation of *Giardia lamblia* protozoa, characterized by chronic diarrhea (more than 14 days), esteatorrhea, abdominal cramps, feeling of distension and the expulsion of loose, pale and fatty stools. In accordance with IDC 10th review, includes: A07.
Rationale and role	As mentioned for the preceding indicator, this infectious, parasitic gastrointestinal illness is caused by the consumption of contaminated water and deficient hygiene, passed by the fecal-oral route and potentially transmitted by drinking water used in various household activities, including personal hygiene, and through primary contact with contaminated recreational waters.
Data Range	Date: 1998–2002
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. Sinais: Statistical Information Bulletin: http://www.sinais.gob.mx SSA: http://www.salud.gob.mx INEGI: http://www.inegi.gob.mx
Units of measurement	Incidence rate
Computation	Number of new Giardiasis cases in children under 5/Total exposed population of children under 5.
Sources of further information	DGE: http://www.dgepi.gob.mx
Scale of application	National
Useful references	Conapo: http://www.conapo.gob.mx SSA: http://www.salud.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Incidence of Giardiasis among children, by age group, Mexico, 1998–2002	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Inflammatory intestinal condition caused by the proliferation of *Giardia lamblia* protozoa, characterized by chronic diarrhea (more than 14 days), esteatorrhea, abdominal cramps, feeling of distension and the expulsion of loose, pale and greasy stools. In accordance with IDC 10th review, includes: A07. Prevalence: Number of cases (new and old)/Total exposed population.
Rationale and role	This indicator shows the impact on the prevalence in children under 5 years of age. The illness is caused by the consumption of contaminated water and deficient hygiene, passed by the fecal-oral route and potentially transmitted by drinking water.
Data Range	Date: 1998–2002
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. Sinais: http://www.sinais.gob.mx SSA: http://www.salud.gob.mx INEGI: http://www.inegi.gob.mx
Units of measurement	Prevalence rate
Computation	Number of giardiasis cases (new and old) in children under 5/Total exposed population of children under 5.
Sources of further information	DGE: http://www.dgepi.gob.mx
Scale of application	National
Useful references	Conapo: http://www.conapo.gob.mx SSA: http://www.salud.gob.mx
Strengths of the Indicator	This illness is reported in SUIVE for all first-, second- and third-tier care facilities.

Percentage of cases of cholera among children, by age group, Mexico, 1991–99	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Cholera cases: All cases isolating toxogenic V. cholerae 01 or V. cholerae 139 in fecal matter or gastrointestinal contents or showing seroconversion of vibriocidal antibodies or cholera antitoxin. Outbreak: Association of two or more cases sharing original source of infection.
Rationale and role	This indicator shows the impact of cholera outbreaks in Mexico in different years. Epidemiological oversight of this illness is needed because the climate and sanitary conditions enabling such outbreaks are present in the country. For this reason, there is a special cholera oversight system in which all institutional and international health authorities cooperate.
Data Range	Date: 1991–99 Age: Under 1; 1–4 and 5 to 14 years of age.
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. This is one of the 29 illnesses requiring immediate notification and a specific epidemiological study for final confirmation and final classification. Specific diagnostic criteria and procedures are applied for a more complete clinical and epidemiological characterization. Epidemiological information on transmittable diseases is also obtained from active oversight in first- and second-tier healthcare facilities, nominal case reporting, the review of death certificates and health surveys, as required. Given their epidemiological importance some mandatory-reporting illnesses require comprehensive study and exhaustive tracking. In recent years, special epidemiological oversight systems have been established, supported by an increasingly broad infrastructure of human resources and laboratories, increasing the sensitivity and specificity of epidemiological oversight. DGE: Source: Epidemiological Oversight Manual for Cholera (*Manual de Vigilancia Epidemiológica del Cólera*/SSA): http://www.dgepi.salud.gob.mx
Units of measurement	Percentage
Computation	Number of cases of cholera per under-14 age group / total exposed population X 100.
Sources of further information	DGE: http://www.dgepi.salud.gob.mx SSA: http://www.salud.gob.mx
Scale of application	National
Useful references	Sinais: http://www.sinais.gob.mx
Strengths of the Indicator	Illness subject to epidemiological oversight with immediate notice. This illness is covered by the special ADI/ARI program system, with a specific

	laboratory diagnosis procedure.

Mortality rate from diarrheic diseases in children under 5 years old in Mexico, 1990–2002	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Diarrhea: Under the program for children under 5, diarrhea is the presence of liquid, watery or formless stools and more than 3 evacuations in 24 hours. **Death from diarrhea:** Death where diarrhea is the primary cause of death in children under 5. **Total population of children under 5:** Number of living children under 5 years of age.
Rationale and role	Acute diarrheic illnesses (ADIs) represent an important public health concern worldwide; these illnesses affect all age groups, although children under 5 are most vulnerable. ADIs are almost always infectious and self-limiting. The disease agents are generally transmitted in the fecal-oral route and may potentially be transmitted through drinking water. They adopt various modalities depending on the vehicles and means of transmission. According to WHO and UNICEF studies, the two primary complications in ADIs are dehydration and malnutrition. SEED records deaths from diarrhea and gastrointestinal infections, although the proportion caused by water contamination is not known.
Data Range	Date: 1990–2002 Age: Under 5
Data sources, availability and quality	Data obtained by DGE's Sinave, which is an action program involving a set of strategies and actions enabling the identification and detection of harms and risks to health. Illness reported in SEED. SEED compiles information from death certificates to record causes of death among the population, thereby detecting risks in order to develop health measures and prevent deaths from such causes. INEGI, DGE, SSA. Statistical Information Bulletin 1990–2002 National Conapo, Population Projections 1990–2002
Units of measurement	Specific mortality rate
Computation	Total number of deaths from diarrhea in children under 5 in a given year. Total population of children under 5 in the same year.
Sources of further information	DGE: http://www.dgepi.salud.gob.mx SSA: http://www.salud.gob.mx
Scale of application	National
Useful references	SSA: http://www.salud.gob.mx DGE: http://www.dgepi.salud.gob.mx
Strengths of the	Consistency of information; reported to SEED; methodology includes verbal

Indicator	autopsies.

Mortality from Cholera in Mexico, 1991–98	**Type of indicator: Health effects**
INDICATOR Description	
Definition	Cholera cases: All cases isolating toxogenic V. cholerae 01 or V. cholerae 139 in fecal matter or gastrointestinal contents or showing seroconversion of vibriocidal antibodies or cholera antitoxin. Mortality from cholera: Death with a diagnosis of cholera in either listed serotype.
Rationale and role	The indicator represents the impact on cholera deaths in its different outbreaks in Mexico from 1991 to 1998.
Data Range	Date: 1991–98 General population
Data sources, availability and quality	Illness reported in SEED SEED compiles information from death certificates to record causes of death among the population, thereby detecting risks in order to develop health measures and prevent deaths from such causes. DGE: http://www.dgepi.salud.gob.mx Source: SSA Epidemiological Oversight Manual for Cholera.
Units of measurement	Percentage
Computation	Number of cholera deaths/total exposed population
Sources of further information	DGE: http://www.dgepi.salud.gob.mx SSA: http://www.salud.gob.mx
Scale of application	National
Useful references	Sinais: http://www.sinais.gob.mx
Strengths of the Indicator	Illness subject to epidemiological oversight with immediate notice. This illness is covered by the special ADI/ARI program system, with a specific laboratory diagnosis procedure.

Appendix 8 Indicators Steering Group—Mexico

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COUNTRY REPORT: UNITED STATES
Prepared by the US Environmental Protection Agency

Executive Summary

Children's Health and the Environment in North America: A First Report on Available Indicators and Measures is the United States' contribution to the development of children's environmental health indicators for North America. Children's environmental health indicators provide quantitative information that can improve understanding of children's health and the environment. The aim is to increase awareness of the relationship between environmental issues and children's health and to provide a means of measuring change, assess trends, assist in assessing the effectiveness of interventions and policy, and help identify priorities for further research and policies.

Context

Children under the age of 18 accounted for about 26 percent of the US population, with approximately 72 million children in 2000. Over the last decade, the overall well-being of America's children has shown gains in some areas but has declined in others. The teen birth rate is at a new low, youth are less likely to become the victims of violent crimes, and the death rate has declined for children and young teens. There has been a small increase in the percentage of low birthweight infants, the percentage of infants who die before their first birthday, and the percentage of children related to their householders who are living in poverty.

Key Findings for Children's Environmental Health Indicators

Asthma and Respiratory Diseases

Outdoor Air Pollution

- In 1990, about 2 percent of children lived in counties that exceeded the three-month standard for airborne lead. In 2003, only one county, with less than 0.1 percent of US children, had lead measurements that exceeded the standard for lead.
- The percentage of children living in counties that exceeded the annual Particulate Matter 2.5 microns or greater (PM2.5) standard decreased from 33 percent in 1999 to approximately 21 percent in 2003.
- The highest number of exceedances is consistently reported for ozone. In 1990, approximately 61 percent of children lived in counties in which the eight-hour ozone standard was exceeded on at least one day per year. In 2003, approximately 60 percent of children lived in such counties.

Indoor Air Quality

- The percentage of children ages 6 and under who are regularly exposed to environmental tobacco smoke in the home decreased from 27 percent in 1994 to 11 percent in 2003.
- Children's blood cotinine levels, a marker for exposure to environmental tobacco smoke, dropped between 1988–94 and 1999–2000. Overall, 64 percent of children ages 4 to 11 had cotinine in their blood in 1999–2000, down from 88 percent in 1988–94.

Asthma

- Between 1980 and 1996, the percentage of children with asthma ranged from 3.6 percent to 6.2 percent, representing an annual increase of 4.3 percent per year during that period.
- In 2003, about 13 percent of children had been diagnosed with asthma at some time in their lives, though some of those children may no longer have asthma.

- About 9 percent of children were reported to currently have asthma. These include children with active asthma symptoms and those whose asthma is well-controlled.

Effects of Lead and Other Chemicals, Including Pesticides

Lead

- The median concentration of lead in the blood of children 5 years old and under dropped from 15 micrograms per deciliter (µg/dL) in 1976–80 to 1.7 µg/dL in 2001–2002, a decline of 89 percent.
- The decline in blood lead levels is due largely to the phasing out of lead in gasoline between 1973 and 1995 and to the reduction in the number of homes with lead-based paint from 64 million in 1990 to 38 million in 2000. Some decline also was a result of EPA regulations reducing lead levels in drinking water, as well as legislation banning lead from paint and restricting the content of lead in solder, faucets, pipes, and plumbing. Lead also has been eliminated or reduced in food and beverage containers and ceramic ware, and in products such as toys, mini-blinds, and playground equipment.
- In 1999–2000 the median blood lead level in children ages 1–5 was 2.2 µg/dL. The median blood lead level for children living in families with incomes below the poverty level was 2.8 µg/dL and for children living in families above the poverty level it was 1.9 µg/dL.
- In 1999–2000, White non-Hispanic children ages 1–5 had a median blood lead level of about 2 µg/dL, unchanged from the level in 1992–1994. In 1992–94, Black non-Hispanic children ages 1–5 had a median blood lead level of 3.9 µg/dL and in 1999–2000 they had a median blood lead level of 2.8 µg/dL. In 1992–94, Hispanic children ages 1–5 had a median blood lead level of 2.6 µg/dL and in 1999–2000 they had a median blood lead level of 2.0 µg/dL.
- In 1998–2000, 40 percent of houses in the United States had paint that had some lead in it. Twenty-five percent of houses had a significant lead based paint hazard, which could be from deteriorating paint, contaminated dust, or contaminated soil outside the house

Industrial Releases of Chemicals

- The total industrial facilities reporting releases of the 153 “matched” chemicals (from a data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US TRI are included) decreased over the reporting period of 1998 to 2001 as did the total releases which went from 1,464,686 tonnes (metric tons) in 1998 to 1,231,996 tonnes in 2001, a decrease of 16 percent. There were reductions in releases to on-site air, land, water and underground injection with off-site releases reporting the only increase.

Pesticides

- Between 1994 and 2001, the percentage of food samples with detectable organophosphate pesticide residues ranged between 19 percent and 29 percent. The highest detection rates were observed during 1996 and 1997, while the lowest detection rate was observed in 2001.

Waterborne Diseases

Drinking Water

- The percentage of children served by public water systems that reported exceeding a Maximum Contaminant Level (MCL) or violated a treatment standard decreased from 20 percent in 1993 to 8 percent in 1999.
- In 1993, approximately 22 percent of children lived in an area served by a public water system that had at least one major monitoring and reporting violation. This figure decreased to about 10 percent in 1999.

Waterborne Diseases

- Between 1971 and 2000, there were 751 reported waterborne disease outbreaks associated with drinking water from individual, non-community systems, and community water systems.

11 Introduction

Children's Health and the Environment in North America: A First Report on Available Indicators and Measures is the United States' contribution to the development of children's environmental health indicators for North America. Children's environmental health indicators provide quantitative information that can improve understanding of children's health and the environment. The aim is to increase awareness of the relationship between environmental issues and children's health and to provide a means of measuring change, assess trends, assist in assessing the effectiveness of interventions and policy, and help identify priorities for further research and policies.

Environmental contaminants can affect children quite differently than adults, both because children may be more highly exposed to contaminants and because they may be more vulnerable to the toxic effects of contaminants. Children generally eat more food, drink more water, and breathe more air relative to their size than adults do, and consequently may be exposed to relatively higher amounts of contaminants. Children's normal activities, such as putting their hands in their mouths or playing on the ground, can result in exposures to contaminants that adults do not face. In addition, environmental contaminants may affect children disproportionately because their immune defenses are not fully developed and their growing organs are more easily harmed.

In June 2002, the environment ministers of Canada, Mexico and the United States, members of the Council of the 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. The core set of indicators were based on the three priority areas that are associated with illness and death in North American children identified by the CEC Council:

- Asthma and Respiratory Diseases
- Effects of Lead and Other Toxics Substances
- Water-borne Diseases

A Steering Group was established from the three countries and it recommended the use of the World Health Organization's (WHO) Multiple Exposure – Multiple Effect (MEME) model (see Figure 11.1) as the guiding framework for developing children's environmental health indicators. The MEME model illustrates 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 factors are among a number of factors that are known to influence health outcomes and are frequently referred to as determinants of health.

Figure 11.1: The MEME model

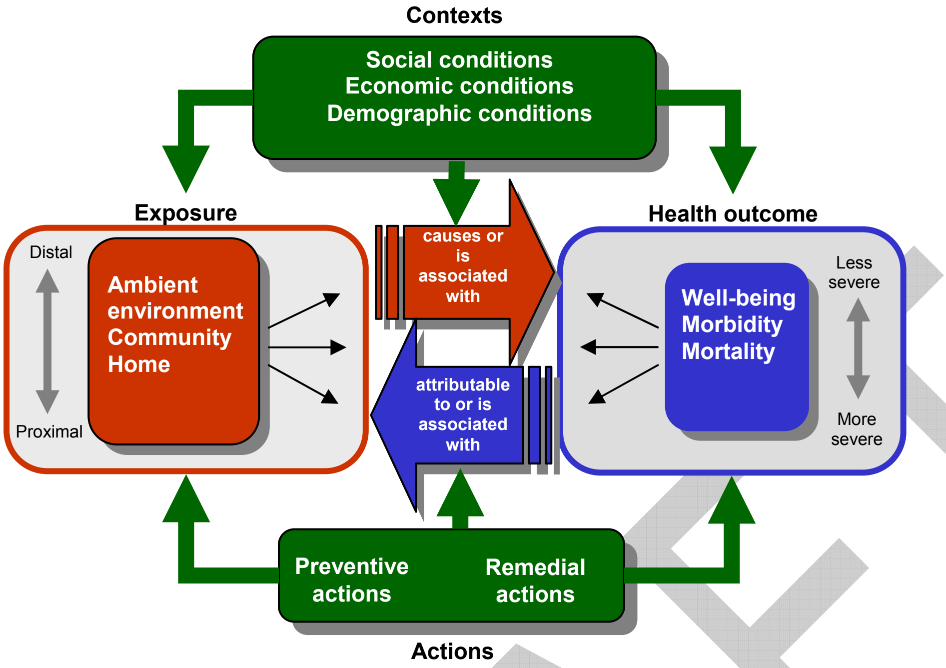


Figure 11.1:The MEME model
The Multiple Exposure-Multiple Effect (MEME) model emphasizes the many-to-many links between environment and health. Exposures, in different environmental settings (on the left) lead to many different health effects (on the right). Individual health effects (on the right) can be traced back to many different exposures (on the left). Both exposures and health outcomes—as well as the associations between them—are affected by contextual conditions, such as social, economic or demographic factors.Actions can be targeted at either exposures or health outcomes (and in the longer term, also, at the underlying contexts).[1]

The Steering Committee also recommended that the three countries report a set of initial 12 indicators of children's health and the environment based on the four priority areas identified by the CEC Council (Table 11.1). The indicators presented by the US are shown alongside.

Table 11.1: Children's health indicator priority areas identified by the CEC council, the 12 target indicators and the US indicators presented in this report

Indicator Area	Target Indicator	Indicator Used in the US Report
Indicators Related to Asthma and Respiratory Diseases		
Indicator No. 1 – Outdoor Air Quality	Percentage of children living in urban areas where air pollution levels exceed relevant air quality standards	Percentage of children living in counties in which air quality standards were exceeded in the United States, 1990–2003
		Percentage of children's days with good, moderate, or unhealthy air quality
Indicator No. 2 – Indoor Air Quality	Indoor air quality	Percentage of children ages 6 and under regularly exposed to secondhand smoke in US homes, 1994–2003

		Percentage of children ages 4-11 with detectable blood cotinine by race and ethnicity, 1988–94 and 1999–2000
Indicator No. 3 – Asthma prevalence	Prevalence of asthma in children	Percentage of children with asthma in the United States, 1980–2003
		Percentage of children having an asthma attack in the previous 12 months, by race/ethnicity and family income, 1997–2000
Indicators Related to the Effects of Lead and Other Toxic Substances		
Indicator No. 4 – Blood lead levels	Blood lead levels in children	Concentrations of lead in the blood of children five and under in the United States, 1976–2000
		Distribution of concentrations of lead in blood of children ages 1-5 in the United States, 1999–2000
		Median concentrations of lead in blood of children ages 1-5, by race/ethnicity and family income, 1999–2000
Indicator No. 5 – Lead in the Home	Children living in homes with a source of lead	Lead in US housing, 1998–2000
		Lead-based paint and year of housing unit construction
Indicator No. 6 – Industrial Releases of Lead	Pollutant Release and Transfer Register (PRTR) data	On- and off-site releases of lead (and its compounds) in the United States, 1995–2000 from industrial facilities
Indicator No. 7 – Industrial Releases of Certain Toxic Chemicals	Pollutant Release and Transfer Register (PRTR) data	On- and off-site releases of matched chemicals in the United States, 1998–2001 from industrial facilities
		On- and off-site releases of matched chemicals by sector in the United States, 1998–2001 from industrial facilities
		Distribution of TRI on-site and off-site disposal or other releases, 1998–2003
Indicator No. 8 – Pesticides	Pesticides (body burden, residue levels on food, or use)	Percentage of fruits, vegetables, and grains with detectable residues of organophosphate pesticides
Indicators Related to Waterborne Diseases		
Indicator No. 9 – Drinking Water Quality	Percentage of households served with treated water	Not provided
Indicator No. 10 – Sanitation	Percent of children (households) served with sanitary sewers	Not provided
Indicator No. 11 – Morbidity Due to Waterborne Diseases	Morbidity (number of childhood diseases attributed to waterborne	Waterborne disease outbreaks by year and type of water system in the United States, 1971–2000

	diseases)	
Indicator No. 12 – Mortality Due to Waterborne Diseases	Mortality (number of child deaths attributed to waterborne diseases)	Not provided
Indicator No. 13 – Drinking water systems in violation of standards	Percentage of children living in areas served by public water systems in violation of local standards	Percentage of children living in areas served by public water systems that exceeded a drinking water standard or violated a treatment requirement, 1993-1999
		Percentage of children living in areas served by public water systems with major violations of drinking water monitoring and reporting requirements in the United States, 1993-1999

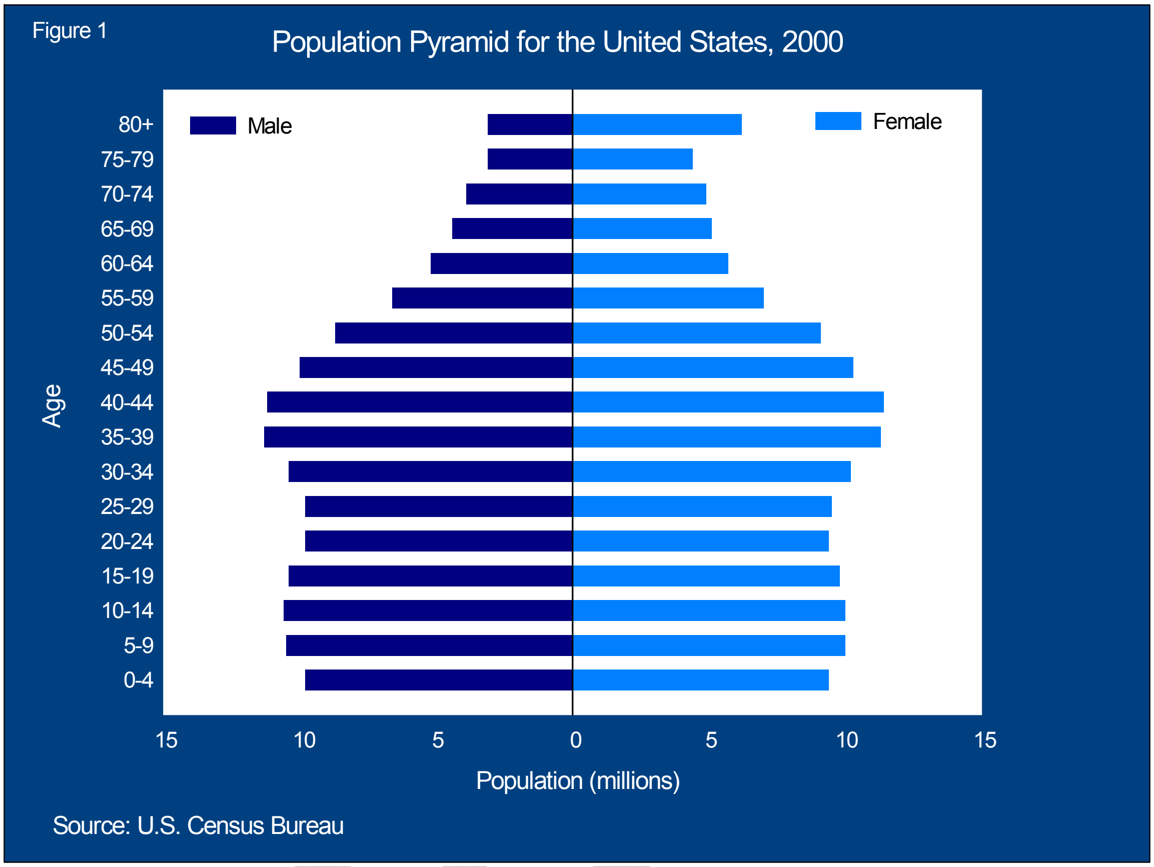
11.1 Context Indicators

The effects of environmental exposures and health outcomes are influenced by social, economic, and demographic factors. Socioeconomic factors, such as family income and parental education, can influence a child's health status. For example, children living in poverty are more likely to suffer certain health effects and may be less likely to have access to care than are children living in middle- or upper-class homes. In addition, the health status of children can influence a child's response to environmental contaminants. For example, children with existing asthma can be more sensitive to exposure to air pollution. This section provides a set of common indicators used by Canada, the United States, and Mexico to provide basic information on child well-being and demographics.

11.1.1 Overview of Population Demographics

In the United States, 28 percent of its 281 million citizens were 19 years of age or under as of 2000. (See figure 11.2 below and Vol. 1) This is a reduction from the peak at the end of the baby boom in 1964, when children comprised 36 percent of the population. Children (defined in this report as under the age of 18, unless otherwise indicated) are projected to be 24 percent of the population by 2020.[2] The current child population in the United States is evenly distributed among the age groups 0–4, 5–9, 10–14, and 15–19. (Table 12.2)

Figure 11.2: Population Pyramid for the United States, 2000



The crude birth rate in the United State fell 16 percent from 16.7 births per 1,000 persons in 1990 to 14.1 in 2001. During this time, the rate declined in all by 2 years (1998 and 2000). Between 1990 and 1997, the rate fell 15 percent accounting for most of the decline. The most striking decline in birth rate has been among teenagers of ages 15 to 19, which dropped steadily since 1991 to a record low of 24.7 births per 1,000 among teenagers of ages 15 to 17 in 2002. The steepest decline has been among Black, non-Hispanic adolescents who experienced a decline of more than half between 1991 and 2002 (from 86 to 41 per 1,000, respectively). The birth rate for older teenagers also declined during this period but the decline was more moderate.[3]

Table 11.2: US Child Population by Age Group, 2000

Age	Population (millions)
0–4	19.2
5–9	20.2
10–14	20.6
15–19	20.3

Source: US Census Bureau
http://www.census.gov/cgi-bin/ipc/idbsum?cty=US

*Note that the Census does not provide an age breakdown for 18 and under to correspond with this report's definition of children.

11.1.2 Overview of Child Mortality and Morbidity

In the United States, infant mortality rates (infants are defined as less than one year old) were 6.9 deaths per 1000 live births in 2000, while child mortality for children 1 to 4 years was 0.3 per 1000 in the same year. Table 12.3 shows the leading causes of child mortality in the United States for various age groups. The leading cause of mortality for children up to one year was congenital malformations, deformations and chromosomal abnormalities. After the first year of life, the primary cause of death for US children 1 to 17 years of age is unintentional injuries (e.g., accidents and poisonings, though the US also includes homicide/suicide in addition to injuries for ages 15 to 19). For children 15 to 19 years of age, the leading cause of death were injuries including homicide and suicide. Table 2.4 shows the leading causes of hospitalizations. The leading cause of hospitalization for ages 1-9 years of age was respiratory disease and the leading cause of hospitalization for children 10–14 years of age was mental disorders. Lastly, for 15 to 19-year-olds, the leading cause of hospitalization in the United States was pregnancy/childbirth. Note that unless otherwise indicated, this report defines “children” as under the age of 18. Table 12.5 provides additional general indicators of children’s health.

Table 11.3: Leading Causes of Child Mortality in the United States, by Age Group, 2000

Age	Top Three Causes of Mortality
0–1	1. Congenital malformations, deformations, and chromosomal abnormalities 2. Disorders related to short gestation and low birth weight 3. Sudden Infant Death Syndrome
1–4	1. Unintentional injuries 2. Birth defects 3. Cancer
5–14	1. Unintentional injuries 2. Birth defects 3. Cancer
15–19	1. Injuries (including homicide/suicide) 2. Birth defects 3. Cancer

Source:
Ages 0-1: Centers for Disease Control and Prevention, 2002, Infant mortality statistics from the 2000 period linked birth/infant death data set. National Vital Statistics Reports, 50 (12). http://www.cdc.gov/nchs/data/nvsr/nvsr50/nvsr50_12.pdf.
Ages 1-14: Federal Interagency Forum on Child and Family Statistics, *America’s Children 2003* http://www.childstats.gov/ac2003/indicators.asp?IID=126&id=4;
Adolescents: Federal Interagency Forum on Child and Family Statistics, *America’s Children 2003* http://www.childstats.gov/ac2003/indicators.asp?IID=130&id=4

Table 11.4: Leading Causes of Child Hospitalizations in the United States, by Age Group, 2000

Age	Top Three Causes of Hospitalizations
1–4	1. Respiratory diseases 2. Endocrine, nutritional, and metabolic diseases and immunity disorders 3. Infectious and parasitic diseases
5–9	1. Respiratory diseases 2. Diseases of the digestive system 3. Accidents
10–14	1. Mental disorders 2. Diseases of the digestive system 3. Injury
15–19	1. Pregnancy/childbirth 2. Mental disorders 3. Injury

Source: Maternal and Child Health Bureau, US Department of Health and Human Services, 2003. *Child Health USA 2002.* http://www.mchirc.net/HTML/CHUSA-02/main_pages/page_30.htm

Table 11.5: General Children's Health Indicators, 2000

	Rate	Source
Infant Mortality*	6.9 per 1,000 live births	US Centers for Disease Control and Prevention, National Center for Health Statistics http://www.cdc.gov/nchs/data/hus/tables/2003/03hus002.pdf
Perinatal Mortality**	6.9 per 1,000 live births	US Centers for Disease Control and Prevention, National Center for Health Statistics http://www.cdc.gov/nchs/data/hus/tables/2003/03hus002.pdf
Child Mortality (ages 1-4 years)	32 per 100.000 children aged 1-4 years	Federal Interagency Forum on Child and Family Statistics, *America's Children 2003* http://www.childstats.gov/ac2003/indicators.asp?IID=126&id=4
Immunization Combined series***	76%	Federal Interagency Forum on Child and Family Statistics, *America's Children 2003* http://www.childstats.gov/ac2003/tbl.asp?iid=123&id=4&indcode=HEALTH4
Measles only	91%	Federal Interagency Forum on Child and Family Statistics, *America's Children 2003* http://www.childstats.gov/ac2003/tbl.asp?iid=123&id=4&indcode=HEALTH4

*Infant death is defined as the death of a live-born child before its first birthday.
** Perinatal death is defined as death around the time of birth, including late fetal death as well as infant death within 7 days of birth.
****Vaccinations in the combined series are 4 doses of a vaccine containing diphtheria and tetanus toxoids (either diphtheria, tetanus toxoids, and pertussis vaccine [DTP] or diphtheria and tetanus toxoids vaccine [DT]), 3 doses of polio vaccine, 1 dose of a measles-containing vaccine (MCV), and 3 doses of Haemophilus influenzae type b (Hib) vaccine. The recommended immunization schedule for children is available at http://www.cdc.gov/nip/recs/child-schedule.pdf.

11.1.3 Socioeconomic Information and Other Determinants of Health

Socioeconomic factors, such as family income and parental education, are important social determinants of child health. In addition, particular racial or ethnic groups can be at higher risk for certain childhood diseases. Children who have lower socioeconomic status may also be more exposed to environmental pollutants. Similarly, children of different race and ethnic groups may be at higher risk for certain environmental hazards.

In 2000, Non-Hispanic White children made up 60.9 percent of the US child population, Hispanic children made up 17.1 percent, Non-Hispanic Black children made up 14.7 percent, Asian and Pacific Islanders made up 3.4 percent, and Native American and Alaska Natives made up 1.2 percent.[4]

In the United States, 21.7 percent of children were born to mothers with less than 12 years of education (Table 12.6).[5] The proportion of children living in absolute poverty (living under nationally defined poverty level) in 2000 was 16.1 percent.

In 2002, the number of children under 18 in poverty was 12.1 million, up from 11.7 million in 2001. Children represented a larger share of the people in poverty (35.1 percent), than represented in the overall population (one-fourth of total population). In 2002, the poverty rate for related children under 6 was 18.5 percent, unchanged from 2001.[5]

As part of the North American Indicators effort, all three countries are reporting on the same socioeconomic information, including maternal educational level, the proportion of children living in poverty, and the percentage of the population living in urban and rural areas. In addition, racial and ethnic information is provided above, since race and ethnicity are important determinants of health.

Table 11.6: Determinants of Health

Maternal Educational Level, 2000	Proportion of Children Living in Poverty, 2000	Percentage of Population Living in Urban/Rural Areas, 2000
Less than 12 years of education: 21.7 percent of live births **At least 16 years of education:** 24.7 percent of live births	**Children living in absolute poverty (living under nationally defined poverty level):** 16.1% of total population under age 18. **Children living in relative poverty (families in the lowest income quintile):** 22.6%.	**Urban:** 79% **Rural:** 21%
Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System, Birth Files. http://www.cdc.gov/nchs/data/hus/tables/2003/03hus010.pdf	Source: US Census Bureau Absolute poverty: http://ferret.bls.census.gov/macro/032001/pov/new25_003.htm Relative poverty: Calculated from Census data.	Source: US Census Bureau http://factfinder.census.gov/servlet/DTTable?ds_name=D&geo_id=D&mt_name=DEC_2000_SF1_U_P002&_lang=en

Additional indicators on child well-being that relate to health, economic, and social measures where children live can be found in *America's Children in Brief: Key National Indicators of Well-Being, 2004,* which provides a useful context on the health of America's children.[2]

12 Asthma and Respiratory Disease

12.1 Outdoor Air Pollution

Common (Criteria) Air Pollutants

Air pollution contributes to a wide variety of adverse health effects. Six of the most common air pollutants—carbon monoxide, lead, ground-level ozone, particulate matter, nitrogen dioxide, and sulfur dioxide—are known as “criteria” pollutants because the US EPA uses health-based criteria as the basis for setting permissible levels of these pollutants in the atmosphere.

EPA periodically conducts comprehensive reviews of the scientific literature on health effects associated with exposure to the criteria air pollutants. The resulting “criteria documents” critically assess the scientific literature and serve as the basis for making regulatory decisions about whether to retain or revise the National Ambient Air Quality Standards (NAAQS) that specify the allowable concentrations of each of these pollutants in the air. The standards are set at a level that protects public health with an adequate margin of safety. However, the standards are not “risk free.” Even in areas that meet the standards, there may be days when unusually sensitive individuals, including children, experience health effects related to air pollution. This is especially the case for pollutants such as ozone and particulate matter that do not have discernible thresholds below which health effects are absent.

Some of the standards are designed to protect the public from adverse health effects that can occur after being exposed for a short time, such as one hour or one day. Other standards are designed to protect people from health effects that can occur after being exposed for a much longer time, such as a year. For example, current standards for carbon monoxide are for short-term periods of one hour and eight hours. By contrast, the current standard for nitrogen dioxide is for one year. Some pollutants have both short-term and long-term standards.

Ground-level Ozone
Short-term (also known as “acute”) exposure to ground-level ozone can cause a variety of respiratory health effects, including inflammation of the lung, reduced lung function, and respiratory symptoms such as cough, chest pain, and shortness of breath. It also can decrease the capacity to perform exercise.[6] Exposure to ambient concentrations of ozone also has been associated with the exacerbation of asthma, bronchitis, and respiratory effects serious enough to require emergency room visits and hospital admissions.[6] Some evidence suggests that high ozone concentrations may contribute to increased mortality.[6]

Health effects associated with long-term (also known as “chronic”) exposure to ozone are not as well established and documented as health effects associated with short-term exposure, but long-term exposures also are of concern. In 1996, EPA’s criteria document for ozone concluded that there was insufficient evidence to determine whether health effects resulted directly from long-term exposure, although the evidence suggested that long-term ozone exposure, along with other environmental factors, could be responsible for health effects.[6] Since 1996, a few studies suggest that long-term exposure to ozone is associated with decreases in lung function in humans,[7] increased prevalence of asthma,[8] increased development of asthma in children who exercise outdoors,[9] and exacerbation of existing asthma.[10]

Particulate Matter
Particulate matter has been found to cause increased risk of mortality (death), hospital admissions and emergency room visits for heart and lung diseases, respiratory effects including incidence of asthma and other respiratory symptoms such as bronchitis, and decreases in lung function.[11] Such health effects have been associated with both short-term and long-term exposure to particulate matter. Children and adults

with asthma are considered to be among the groups more sensitive to respiratory effects.[11-15] Studies also have confirmed that chronic exposure to particulate matter is associated with mortality in adults[16-18] and suggest that it may be associated with mortality in infants.[11,19] In addition, while there is limited evidence on the potential risks from particulate matter on other important child health outcomes, such as low birthweight and preterm birth, this has been identified as an emerging area of concern.[11]

Prior to 1997, the National Ambient Air Quality Standard for particulate matter was based on particulate matter measuring 10 microns or less (PM_{10}). In 1997, the standard was revised based on scientific evidence to address the health risks from particulate matter measuring 2.5 microns or less ($PM_{2.5}$).

Lead
Lead accumulates in bones, blood, and soft tissues of the body. Exposure to lead can affect development of the central nervous system in young children, resulting in neurobehavioral effects such as reduced intelligence and cognitive development.[20-22] Studies also have found that childhood exposure to lead contributes to attention-deficit/hyperactivity disorder[23] and hyperactivity and distractibility;[24-26] increases the likelihood of dropping out of high school, having a reading disability, lower vocabulary, and lower class standing in high school;[27] and increases the risk for antisocial and delinquent behavior.[28]

Sulfur Dioxide
Sulfur dioxide poses particular concerns for those with asthma, who are considered to be especially susceptible to its effects.[29] Short-term exposures of asthmatic individuals to elevated levels of sulfur dioxide while exercising at a moderate level may result in breathing difficulties accompanied by symptoms such as wheezing, chest tightness, or shortness of breath. Effects that have been associated with longer-term exposures to high concentrations of sulfur dioxide, in conjunction with high levels of particulate matter include respiratory illness, alterations in the lung's defenses, and aggravation of existing cardiovascular diseases.

Carbon Monoxide
Exposure to carbon monoxide reduces the capacity of the blood to carry oxygen, thereby decreasing the supply of oxygen to tissues and organs such as the heart. Short-term exposure can cause effects such as reduced time to onset of angina pain, neurobehavioral effects, and a reduction in exercise performance.[30] Long-term exposure has not been studied adequately in humans to draw conclusions regarding possible chronic effects, though a recent study reported an association between long-term exposure to carbon monoxide and other traffic-related pollutants and respiratory symptoms in children.[31]

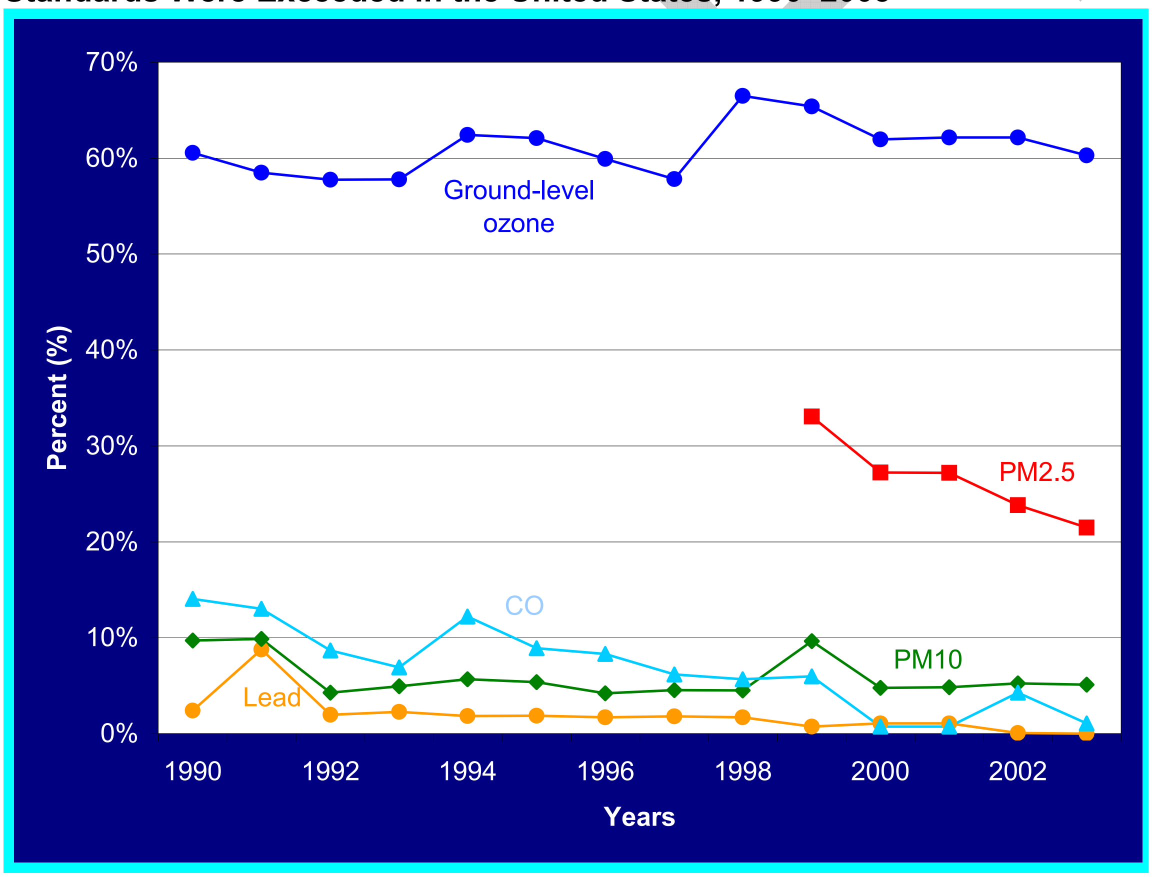
Nitrogen Dioxide
Exposure to nitrogen dioxide has been associated with a variety of health effects.[32] Effects include decreased lung function,[31,33,34] increased respiratory symptoms or illness,[12,31,35-37] and increased symptoms in children with asthma.[38] Nitrogen dioxide also is a major contributor to the formation of ground-level ozone.[6]

Percentage of Children Living In Counties in Which Air Quality Standards Were Exceeded in the United States

This indicator uses EPA air quality data from counties with monitors across the United States. One use of the monitors is to inform the public about their air quality through the Air Quality Index and National Ambient Air Quality Standards. The indicator simply shows whether the level of any standard was exceeded at any time during a year. The indicator shows the percentage of children living in counties with any such exceedances. These children may be exposed to poor daily air quality at some point during a year. The measure includes air quality data for ozone, particulate matter, lead, and carbon monoxide (nitrogen dioxide and sulfur dioxide had essentially no exceedances).

This measure does not differentiate between counties in which the indicators are exceeded frequently or by a large margin, and counties in which indicators are exceeded only rarely or by a small margin. It should be noted that this measure is slightly different from the air quality standard used by EPA to identify areas that must develop plans to lower air pollution levels. For ozone, the standard for developing further plans is based on the day with the 4th highest 8-hour average ozone concentration.

Figure 12.1: Percentage of Children Living In Counties in Which Air Quality Standards Were Exceeded in the United States, 1990–2003



Source: US Environmental Protection Agency, Office of Air and Radiation, Aerometric Information Retrieval System

Key Observations

- The highest number of exceedances is consistently reported for ozone. In 1990, approximately 61 percent of children lived in counties in which the eight-hour ozone standard was exceeded on at least one day per year. In 2003, approximately 60 percent of children lived in such counties.
- In 1999, approximately 33 percent of children lived in counties that exceeded the annual $PM_{2.5}$ standard. In 2003, approximately 21 percent of children lived in such counties. The standard for particulate matter was revised in 1997 to include PM2.5. The standard is intended to protect against both short-term and long-term health effects.
- In 1990, approximately 14 percent of children lived in counties in which the carbon monoxide standard was exceeded. In 2003, approximately 1 percent of children lived in such counties.
- From 1990 to 2001, the percentage of children living in counties that exceeded the one-day standard for PM_{10} fluctuated, but was as high as 10 percent in 1990, 1991, and 1999. The percentage remained around 5 percent from 2000–2003.
- In 1990, about 2 percent of children lived in counties that exceeded the three-month standard for lead. In 2003, only one county, with less than 0.1 percent of US children, had lead measurements that exceeded the standard for lead.
- Few exceedances of the sulfur dioxide and nitrogen dioxide standard have occurred since 1993. Consequently, it was not included on the graph.

Data Table 12.1: Percentage of Children Living in Countries in Which Air Quality Standards were Exceeded in the United States, 1990–2003

1990-1995						
	1990	**1991**	**1992**	**1993**	**1994**	**1995**
Ozone	60.6%	58.5%	57.7%	57.8%	62.4%	62.1%
PM_{10}	9.7%	9.9%	4.3%	4.9%	5.7%	5.4%
Carbon monoxide	14.0%	13.0%	8.7%	6.9%	12.2%	8.9%
Lead	2.4%	8.8%	2.0%	2.3%	1.8%	1.9%
Sulfur dioxide	0.7%	2.7%	0.2%	0.6%	0.3%	0.1%
Nitrogen dioxide	4.1%	4.1%	0.0%	0.0%	0.0%	0.0%
Any standard*	64.0%	62.9%	59.3%	59.0%	63.8%	64.0%
1996–2001						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Ozone	59.9%	57.8%	66.5%	65.4%	62.0%	62.2%
PM_{10}	4.2%	4.5%	4.5%	9.7%	4.8%	4.8%
$PM_{2.5}$				33.1%	27.2%	27.2%
Carbon monoxide	8.3%	6.2%	5.7%	6.0%	0.7%	0.7%
Lead	1.7%	1.8%	1.7%	0.7%	1.1%	1.1%
Sulfur dioxide	0.2%	0.1%	0.1%	0.5%	0.1%	0.1%
Nitrogen dioxide	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Any standard*	60.7%	58.6%	67.2%	69.5%	65.4%	65.6%
2002–2003	**2002**	**2003**				
Ozone	62.1%	60.3%				
PM_{10}	5.2%	5.1%				
$PM_{2.5}$	23.8%	21.5%				
Carbon monoxide	4.3%	1.1%				

Lead	0.1%	0.0%				
Sulfur dioxide	0.1%	0.1%				
Nitrogen dioxide	0.0%	0.0%				
Any standard*	63.5%	62.1%				

*Does not include the $PM_{2.5}$ standard

SOURCE: US Environmental Protection Agency, Office of Air and Radiation, Aerometric Information Retrieval System

Limitations

This indicator does not differentiate between counties in which the indicators are exceeded frequently or by a large margin, and counties in which indicators are exceeded only rarely or by a small margin. It should be noted that this measure is slightly different from the air quality standard used by EPA to identify areas that must develop plans to lower air pollution levels. For ozone, the standard for developing further plans is based on the day with the 4th highest 8-hour average ozone concentration. The standards are set at a level that protects public health with an adequate margin of safety. However, the standards are not "risk free." Even in areas that meet the standards, there may be days when unusually sensitive individuals, including children, experience health effects related to air pollution. This is especially the case for pollutants such as ozone and particulate matter that do not have discernible thresholds below which health effects are absent.

Additional Indicators

EPA has prepared additional indicators for criteria air pollutants and respiratory diseases, available at www.epa.gov/envirohealth/children, including:

- Children's emergency room visits for asthma and other respiratory causes
- Children's hospital admissions for asthma and other respiratory causes
- Percentage of children's days with good, moderate, or unhealthy air quality
- Long-term trends in annual average concentrations of criteria pollutants
- Number of children living in counties with high annual averages of PM_{10}

Opportunities for Improvement

The indicators could provide additional information to reflect the number, margin, and duration of exceedances to help distinguish among exceedances.

Related Programs/Activities

Objective 8-01 of Healthy People 2010 aims to reduce the proportion of persons exposed to air that exceeds the levels of the US Environmental Protection Agency's health-based standards for harmful air pollutants.

AIRNow, is a government-backed program and through AIRNow, EPA, the National Oceanic and Atmospheric Administration (NOAA), National Air and Space Agency (NASA) Langley Laboratory, National Park Services (NPS) Air Resources and Environment Canada, and news media, tribal, state and local agencies work together to report conditions for ozone and particle pollution. http://www.epa.gov/airnow/

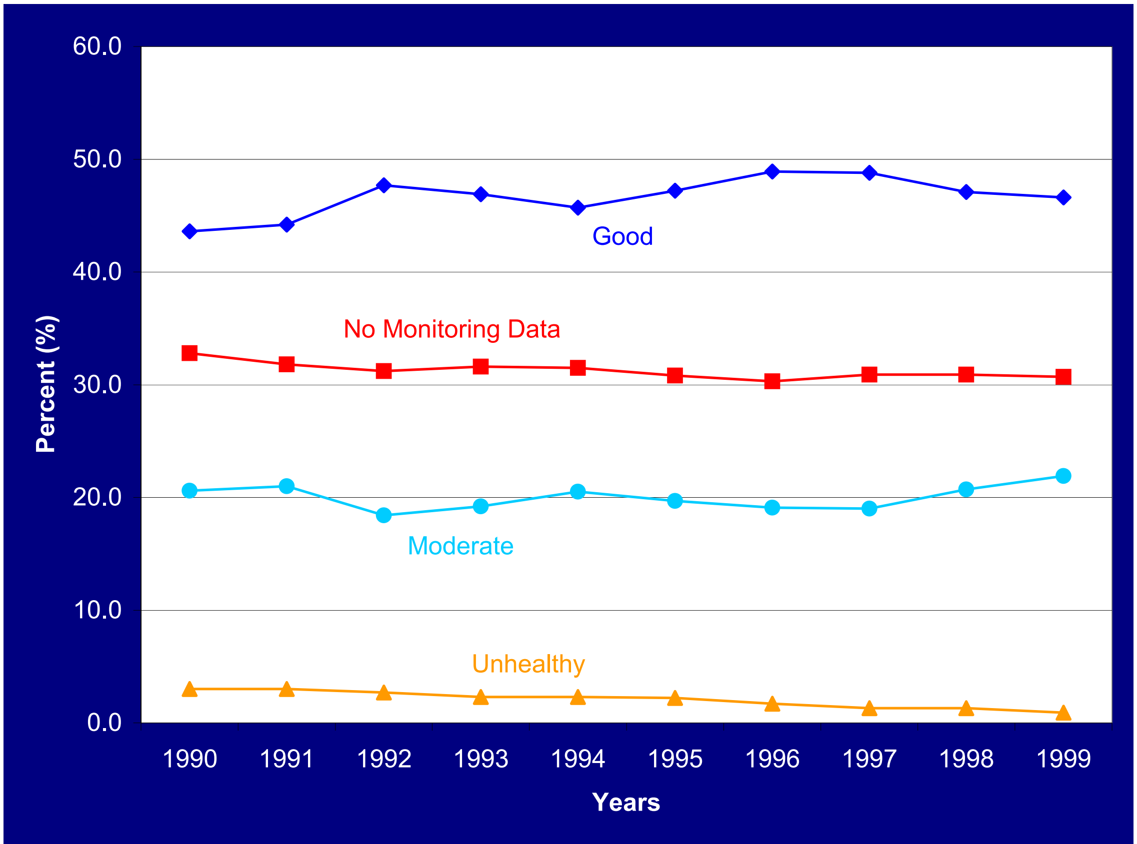
Daily Air Quality

EPA provides an Air Quality Index (AQI) that represents air quality for specific days and is widely reported in newspapers and other media outlets in metropolitan areas.

The AQI is based on measurements of up to five of the six air quality criteria pollutants (carbon monoxide, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide). Lead is not included in the AQI. The specific pollutants considered in the AQI for each metropolitan area depend on which pollutants are monitored in that area. Each pollutant concentration is given a value on a scale that is related to the air quality standards for that pollutant. An AQI value of 100 for a criteria pollutant generally corresponds to the short-term National Ambient Air Quality Standard for that pollutant, and is the level EPA has set to protect public health for a single day. Above this level, pollutant-specific health advisories are issued. The daily AQI is based on the pollutant with the highest index value on the scale that day. It does not add up values for more than one pollutant. Therefore, it does not reflect the possible effects of simultaneous exposure to high levels of multiple pollutants.

EPA has divided the AQI scale into categories. Air quality is considered “good” if the AQI is between 0 and 50, posing little or no risk. Air quality is considered “moderate” if the AQI is between 51 and 100. Some pollutants at this level may present a moderate health concern for a small number of individuals. Moreover, such a level may pose health risks if maintained over many days. Air quality is considered “unhealthy for sensitive groups” if the AQI is between 101 and 150. Members of sensitive groups such as children may experience health effects, but the general population is unlikely to be affected. Air quality is considered “unhealthy” if the AQI is between 151 and 200. The general population may begin to experience health effects, and members of sensitive groups may experience more serious health effects.
Figure 12.2 is based on the reported AQI for counties of the United States. (Not all counties have air quality monitoring stations.) This indicator was developed by reviewing the air quality designation for each day for each county and weighting the daily designations by the number of children living in each county. The overall indicator reports the percentage of children’s days of exposure considered to be of good, moderate, or unhealthy air quality.

Figure 12.2: Percentage of Children's Days with Good, Moderate, or Unhealthy Air Quality, in the United States, 1990 - 1999



Source: US Environmental Protection Agency, Office of Air and Radiation, Aerometric Information Retrieval System

Key Observations

- The percentage of days that were designated as having "unhealthy" air quality (including days that were unhealthy for everyone as well as those that were unhealthy for sensitive groups) decreased between 1990 and 1999, dropping from 3 percent in 1990 to less than 1 percent in 1999. The percentage of days with "moderate" air quality remained around 20 percent between 1990 and 1999, although an upward trend is suggested by the fact that the percentage of moderate air quality days was higher in 1999 than for any other year in this analysis. As the percentage of either unhealthy or good air days decreases, the percentage of moderate days would be expected to increase.
- The coverage of monitoring for this measure, in terms of area and percentage of days monitored, was largely unchanged between 1990 and 1999. Approximately 30 percent of children's days of exposure to air pollutants were not monitored. This percentage includes days for which no AQI was reported in counties where the AQI is sometimes reported, as well as counties in which the AQI is not reported at all. On days that were monitored, in many cases only one or a few pollutants were monitored.

Data Table 12.2: Percentage of Children's Days with Good, Moderate, or Unhealthy Air Quality

1990–1995						
Pollution Level	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Good	43.6%	44.2%	47.7%	46.9%	45.7%	47.2%
Moderate	20.6%	21.0%	18.4%	19.2%	20.5%	19.7%
Unhealthy	3.0%	3.0%	2.7%	2.3%	2.3%	2.2%
No Monitoring Data	32.8%	31.8%	31.2%	31.6%	31.5%	30.8%
1996–1999						
Pollution Level	**1996**	**1997**	**1998**	**1999**		
Good	48.9%	48.8%	47.1%	46.6%		
Moderate	19.1%	19.0%	20.7%	21.9%		
Unhealthy	1.7%	1.3%	1.3%	0.9%		
No Monitoring Data	30.3%	30.9%	30.9%	30.7%		

Limitations
Not all counties have air quality monitoring stations. The AQI is based on the single pollutant with the highest value for each day; it does not reflect any combined effect of multiple pollutants. It reflects only short-term, daily pollution burdens. It does not include lead. The approach is influenced by the frequency of measurements. Because the AQI is reported daily, pollutants that are measured daily—such as ozone—will appear to have more effect than those that are measured less frequently, such as PM_{10}, which typically is measured every six days. Also, the AQI is not well-suited for reporting concentrations of nitrogen dioxide, because this pollutant does not have a short-term standard.

Additional Indicators
EPA has prepared additional indicators for criteria air pollutants and respiratory diseases, available at www.epa.gov/envirohealth/children, including:

- Children's emergency room visits for asthma and other respiratory causes
- Children's hospital admissions for asthma and other respiratory causes
- Long-term trends in annual average concentrations of criteria pollutants
- Number of children living in counties with high annual averages of PM_{10}

Opportunities for Improvement
More frequent measurement of PM_{10} and other pollutants to include in the Air Quality Index may more accurately reflect air quality. The combination of multiple pollutants as part of an overall air quality index might better replicate the health impacts of high pollution days and provide more useful information on potential air quality hazards to sensitive populations. In addition, consideration of the potential for health risks from long-term exposures to pollutants could be incorporated into an indicator as well as expansion of monitor locations to additional counties across the US to better reflect child population exposure.

Related Programs/Activities
Objective 8-01 of Healthy People 2010 aims to reduce the proportion of persons exposed to air that exceeds the levels of the US Environmental Protection Agency's health-based standards for harmful air pollutants.

AIRNow, is a government-backed program and through AIRNow, EPA, the National Oceanic and Atmospheric Administration (NOAA), National Air and Space Agency (NASA) Langley Laboratory, National Park Services (NPS) Air Resources and Environment Canada, and news media, tribal, state and local agencies work together to report conditions for ozone and particle pollution.
http://www.epa.gov/airnow/

12.2 Indoor Air Pollution

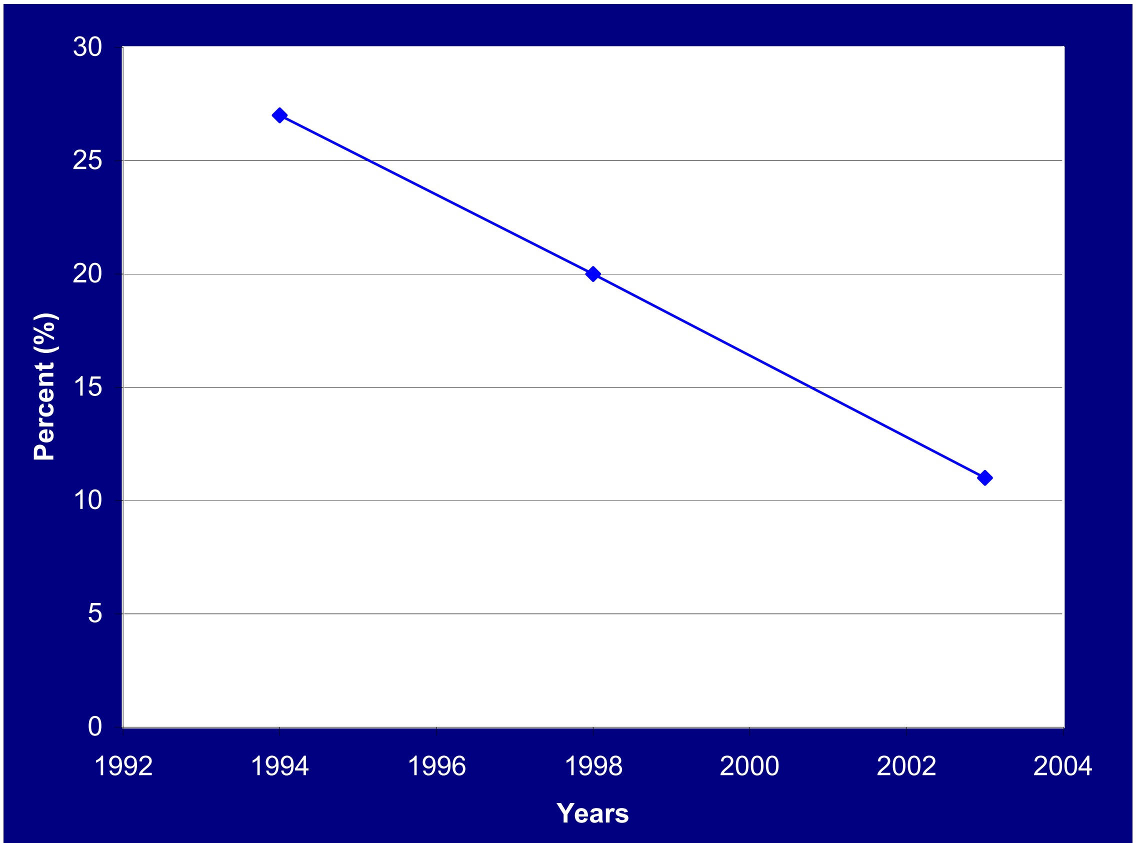
Children can be exposed to a number of air pollutants that come from sources inside homes, schools, and other buildings. Indoor sources include combustion sources such as gas stoves, fireplaces, and cigarettes; building materials such as treated wood and paints, furnishings, carpet, and fabrics; and consumer products such as sprays, pesticides, window cleaners, and laundry soap. Indoor air pollutants also can come from outside, as air pollution penetrates indoors. Information on the toxic effects of air pollutants from indoor sources indicates that they could pose health risks to children.[39,40]

Children who are exposed to environmental tobacco smoke, also known as secondhand smoke, are at increased risk for a number of adverse health effects, including lower respiratory tract infections, bronchitis, pneumonia, fluid in the middle ear, asthma symptoms, and sudden infant death syndrome (SIDS).[41-46] Exposure to environmental tobacco smoke also may be a risk factor contributing to the development of new cases of asthma.[46-48] Young children appear to be more susceptible to the effects of environmental tobacco smoke than older children are.[40,46]

Smoking in the home is an important source of exposure because young children spend most of their time at home and indoors. The measure for environmental tobacco smoke shows the percentage of homes with children ages 6 and under in which someone smokes regularly. Most often the smoker in the home is a parent.

This measure is a surrogate for the exposure of children to tobacco smoke. The data come from national surveys and are available for 1994, 1998, and 2003.

Figure 12.3: Percentage of Children Aged 6 and Under Regularly Exposed to Secondhand Smoke in US Homes, 1994 – 2003



Source: Data for 1994 and 1998: National Health Interview Survey. National Center for Health Statistics, Centers for Disease Control and Prevention. Data for 2003: National Survey on Environmental Management of Asthma and Children's Exposure to Tobacco Smoke. United States Environmental Protection Agency Indoor Environments Division.

Key Observations

- The percentage of children ages 6 and under who are regularly exposed to secondhand smoke in the home decreased from 27 percent in 1994 to 11 percent in 2003.

Data Table 12.3: Percentage of Children Aged 6 and Under Regularly Exposed to Secondhand Smoke in US homes, 1994–2003

1994	1998	2003
27%	20%	11%

SOURCE: 1994 and 1998: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey. 2003: US EPA, Indoor Environments Division, National Survey on Environmental Management of Asthma and Children's Exposure to Environmental Tobacco Smoke.

Limitations:
The data used for this indicator are gathered only periodically to assess progress toward Healthy People 2010 goals, and are not available on an annual basis.

Additional Indicators
Another indicator is provided here on concentrations of cotinine (a metabolite of nicotine that is used as a biomarker for exposure to secondhand smoke) in the blood of children.

In addition, EPA has prepared indicators for respiratory diseases, available at www.epa.gov/envirohealth/children, including:

- Children's emergency room visits for asthma and other respiratory causes
- Children's hospital admissions for asthma and other respiratory causes

Opportunities for Improvement
For indoor air quality in general, the most important improvement would be to add data about sources of other indoor air pollutants, such as consumer products, gas stoves, and furnishings, for both homes and schools.

For the indicator on the percentage of children ages 6 and under regularly exposed to secondhand smoke in the home, a possible improvement would be more regular reporting, such as annual or biannual instead of periodic reporting.

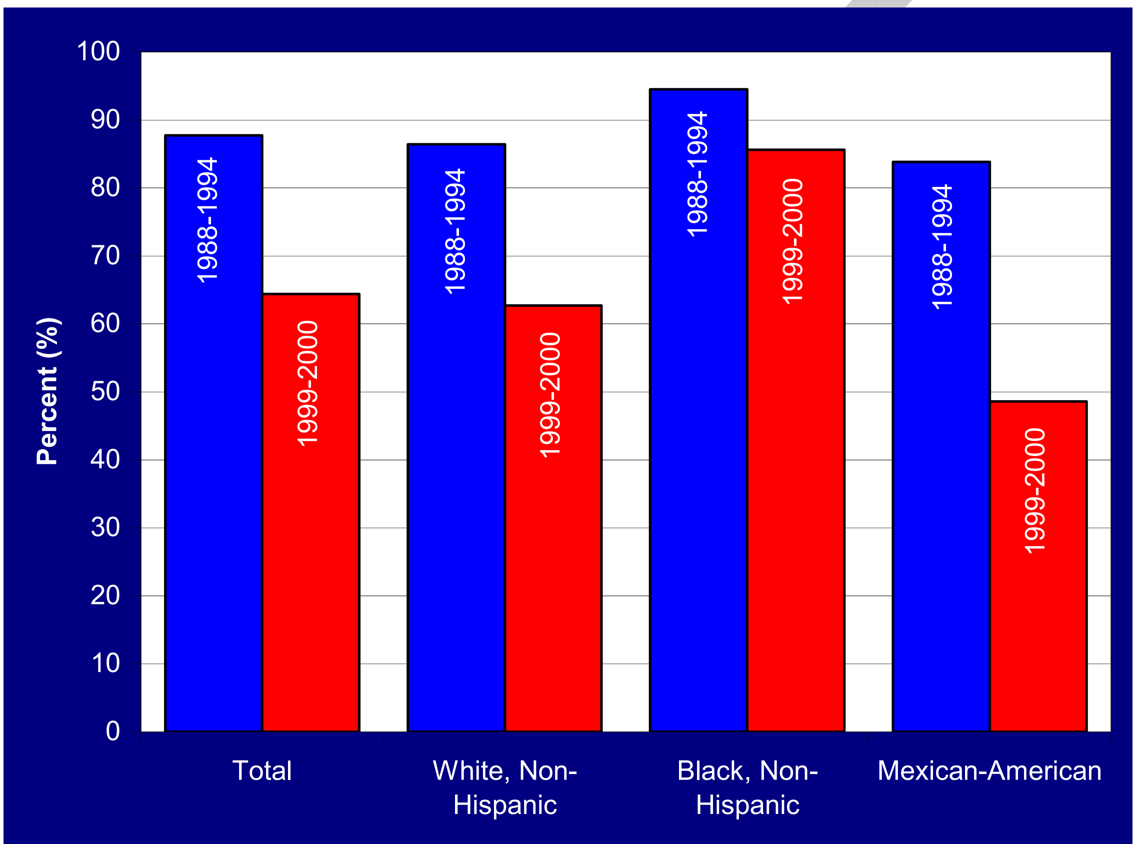
Related Programs/Activities
Objective 27-9 of the federal Healthy People 2010 initiative is to reduce the proportion of children who are regularly exposed to tobacco smoke at home.

EPA's Smoke-Free Homes initiative provides public education on the topic: http://www.epa.gov/smokefree

Cotinine in the Blood of Children

Cotinine is a breakdown product of nicotine in blood. Measurements of cotinine in blood serum are a marker for exposure to environmental tobacco smoke in the previous 1 to 2 days.[49] Children can be exposed to ETS in their homes or in places where people are allowed to smoke, such as some restaurants. This measure presents cotinine levels for non-tobacco-users only. Children who smoke were excluded from these statistics.

Figure 12.4: Percentage of Children Aged 4-11 with Detectable Levels of Blood Cotinine by Race and Ethnicity, in the United States, 1988–94 and 1999–2000



Source: National Health and Nutrition Examination Survey. National Center for Health Statistics, Centers for Disease Control and Prevention.

Key Observations

- The percentage of children ages 4-11 exposed to environmental tobacco smoke, as indicated by detection of cotinine in their blood, decreased between 1988–94 and 1999–2000. Overall, 64 percent of children ages 4 to 11 had cotinine in their blood in 1999–2000, down from 88 percent in 1988–94.
- In 1999–2000, 86 percent of Black, non-Hispanic children ages 4 to 11 had cotinine in their blood compared with 63 percent of White, non-Hispanic children and 49 percent of Mexican American children.
- Despite the overall decrease, in 1999–2000 the median levels of cotinine in children ages 3–11 and 12-19 were more than twice as high as those of adults. (Data not shown; see the Centers for

Disease Control and Prevention, 2003, Second National Report on Human Exposure to Environmental Chemicals, http://www.cdc.gov/exposurereport/.)

Data Table 12.4: Percentage of Children aged 4–11 with Detectable Levels of Blood Cotinine by Race and Ethnicity in the United States, 1988–94 and 1999–2000

Race/Ethnicity and Cotinine Level	1988–94	1999–2000
Total		
Any detectable cotinine	87.7%	64.4%
White, non-Hispanic		
Any detectable cotinine	86.4%	62.7%
Black, non-Hispanic		
Any detectable cotinine	94.5%	85.6%
Mexican American		
Any detectable cotinine	83.8%	48.6%

SOURCE: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

Limitations:
Cotinine remains in the body for only a discrete period of time, and thus is only a short-term indicator of exposure to secondhand smoke. This indicator cannot isolate or differentiate home exposure from other sources (e.g., from a daily child care provider) without an additional interview screening component.

In addition, NHANES only tested children ages 4 and older during the periods shown in this indicator. No results are available for ages 0-3, when children are most vulnerable to adverse respiratory health consequences. NHANES recently began testing children down to age 3, and future indicators will include these data.

Additional Indicators
EPA has prepared additional indicators on secondhand smoke and respiratory diseases, available at www.epa.gov/envirohealth/children:

- Percentage of homes with children under seven where someone smokes regularly
- Children's emergency room visits for asthma and other respiratory causes
- Children's hospital admissions for asthma and other respiratory causes

Opportunities for Improvement
This indicator could be improved by finding a consistent and reliable method to measure exposure levels in infants and toddlers (ages 0–3).

Related Programs/Activities
Objective 27-9 of the federal Healthy People 2010 initiative is to reduce the proportion of children who are regularly exposed to tobacco smoke at home.

EPA's Smoke-Free Homes initiative provides public education on the topic:
<http://www.epa.gov/smokefree>

12.3 Asthma

Asthma is a disease of the lungs that can cause wheezing, difficulty in breathing, and chest pain. It is the most common chronic disease among children and is costly in both human and monetary terms.[40] Asthma is one of the leading causes of school absenteeism – 14 million school days are missed each year. In 1998, the cost of asthma to the US economy was 11.3 billion.[50]

Asthma varies greatly in severity. Some children who have been diagnosed with asthma may not experience any serious respiratory effects. Other children may have mild symptoms or may respond well to management of their asthma, typically through use of medication. Some children with asthma may suffer serious attacks that greatly limit their activities, result in visits to emergency rooms or hospitals, or, in rare cases, cause death.

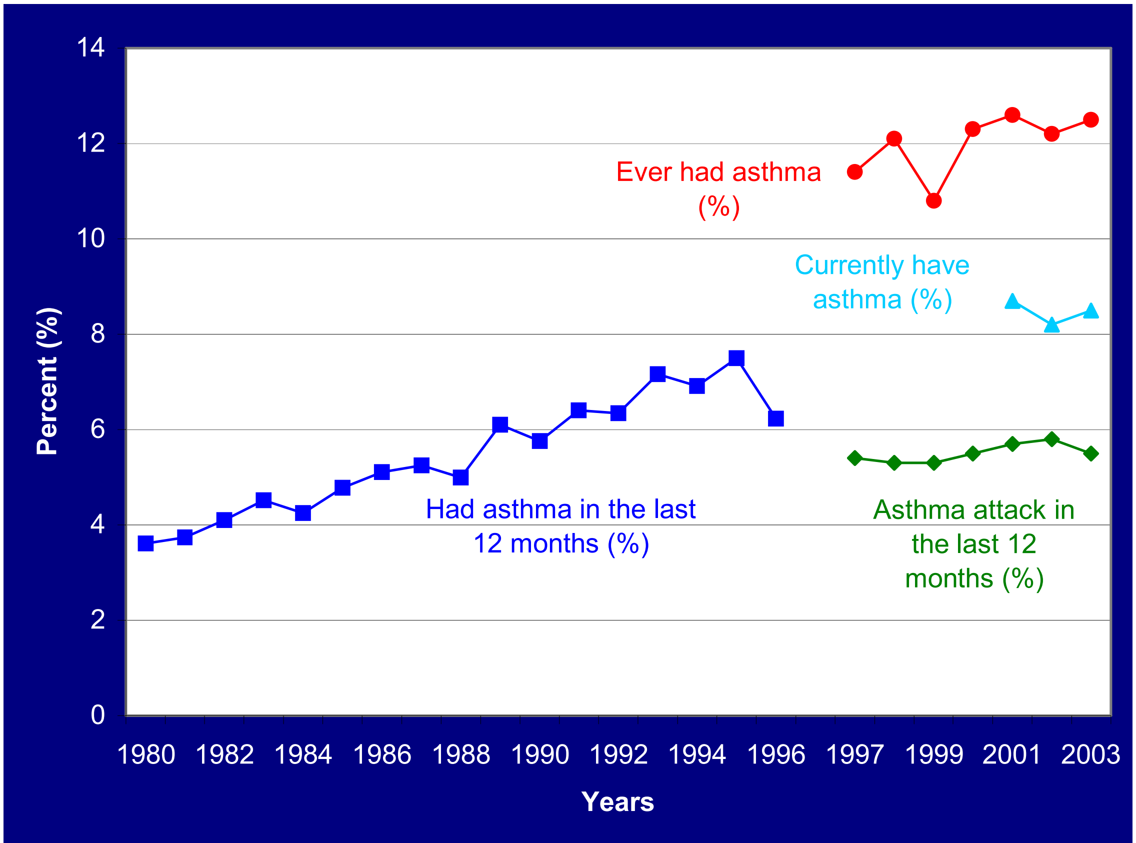
Asthma among children is increasing in the United States. Researchers do not understand completely why children develop asthma. The tendency to develop asthma can be inherited, but genetic factors alone are unlikely to explain the significant increases that have occurred in the last 20 years.[40]

Research on environmental factors that exacerbate or may contribute to causing asthma has focused on environmental agents found outdoors and indoors. The Institute of Medicine concluded that exposure to dust mites causes asthma in susceptible children.[15] Cockroaches and tobacco smoke are likely to cause asthma in young children.[40] Other studies have evaluated the role of indoor air pollutants such as nitrogen dioxide, pesticides, plasticizers, and volatile organic pollutants. Some of these pollutants may play a role in asthma.[40] One recent study suggests that chronic exposure to ozone may be associated with the development of asthma in children who exercise outside,[9] and two other studies suggest that chronic exposure to particulate matter may affect lung function and growth.[51,52]

Environmental factors may increase the severity or frequency of asthma attacks in children who have the disease. Children with asthma are particularly sensitive to outdoor air pollutants, including ozone, particulate matter, and sulfur dioxide.[11,29,31,38,53-61] These pollutants can exacerbate asthma, leading to difficulty in breathing, an increased use of medication, visits to doctors' offices, trips to emergency rooms, and admissions to the hospital. In addition, one study reported a relationship between exposure to hazardous air pollutants and increases in chronic respiratory symptoms that are characteristic of asthma.[62]

Data from the National Health Interview Survey were used to estimate the prevalence of childhood asthma. For 1980 to 1996, the percentage of children reported to have asthma in the preceding 12 months is shown. In 1997, the survey's method for measuring childhood asthma changed. For 1997 to 2001, the measure shows the percentage of children who had ever been told by a doctor or health professional that they have asthma, as well as the percentage of children who were ever diagnosed with asthma and who had an asthma attack in the preceding 12 months. Some children may have asthma when they are young and outgrow it as they get older, or their asthma may be well controlled through medication and by avoiding triggers of asthma attacks. In such cases, children may have asthma but may not have experienced any attacks in a long time. In 2001, the survey's method was changed to add an additional question to measure the percentage of children who currently have asthma.

Figure 12.5: Percentage of Children with Asthma, in the United States, 1980 - 2003



Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey.

Note: The survey questions for asthma changed in 1997; data before 1997 cannot be directly compared to data in 1997 or later.

Key Observations

- Between 1980 and 1995, the percentage of children with asthma (as measured by "children with asthma in past twelve months") doubled, from 3.6 percent in 1980 to 7.5 percent in 1995. A decrease in the percentage of children occurred between 1995 and 1996, but it is difficult to interpret single-year changes.
- In 2003, about 13 percent of children had been diagnosed with asthma at some time in their lives, though some of those children may no longer have asthma.
- About 9 percent of children were reported to currently have asthma. These include children with active asthma symptoms and those whose asthma is well-controlled.
- Prior to 1997, the percentage of children with asthma was measured by asking parents if a child in their family had asthma during the previous 12 months. In 1997–2001, a parent was asked if his or her child had ever been diagnosed with asthma by a health professional. If the parent answered yes, then he or she was asked if the child had an asthma attack or episode in the last 12 months. The percentage of children with an asthma attack in the last 12 months measures the population with incomplete control of asthma. For 1997–2000, available data do not distinguish between those children who may no longer have active asthma and those whose asthma is well controlled.

- Approximately 6 percent of all children had one or more asthma attacks in the previous twelve months. These children have ongoing asthma symptoms that could put them at risk for poorer outcomes, including hospitalizations and death. About two-thirds of children who currently have asthma have on-going asthma symptoms (2001–2003).
- Emergency room visits for asthma and other respiratory causes were 369 per 10,000 children in 1992 and 379 per 10,000 children in 1999. Hospital admissions for asthma and other respiratory causes were 55 per 10,000 children in 1980 and 66 per 10,000 children in 1999.

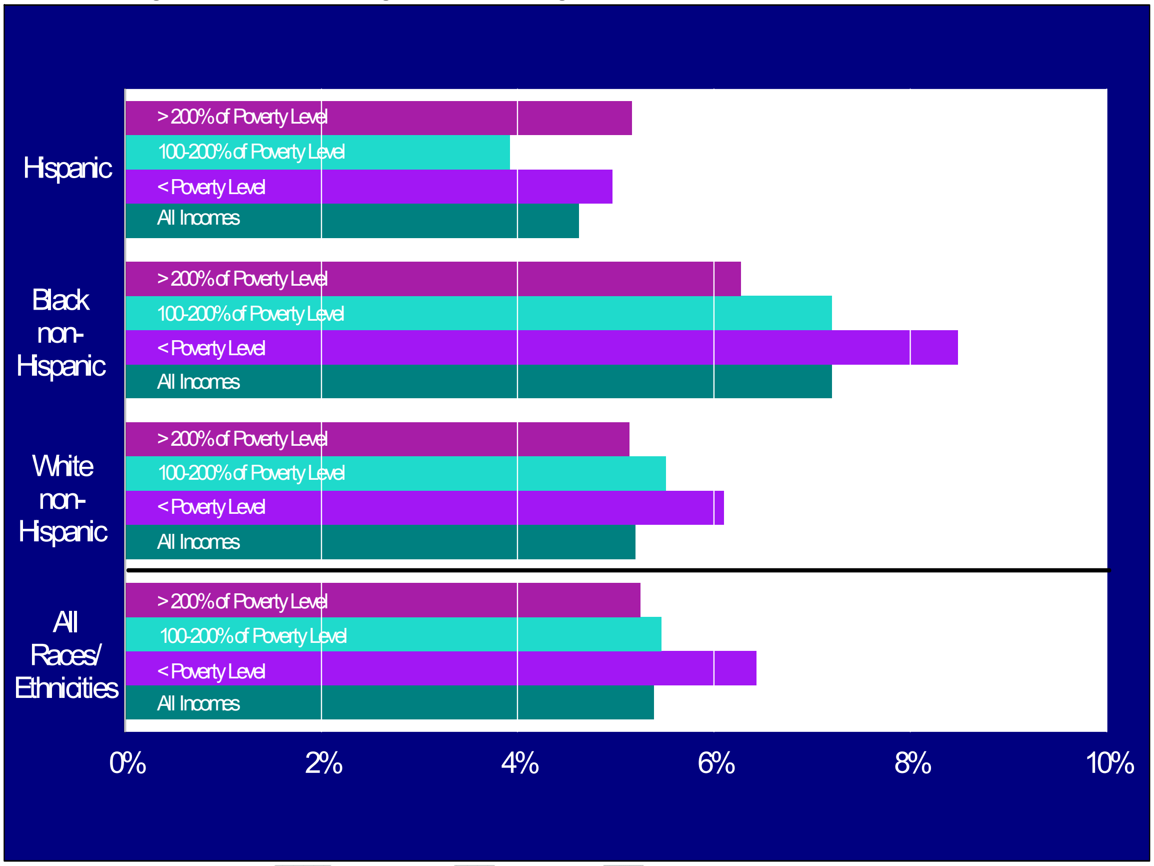
Data Table 12.5: Percentage of Children with Asthma in the United States, 1980–2003

1980–1985						
	1980	**1981**	**1982**	**1983**	**1984**	**1985**
Percentage of children with asthma in the past 12 months	3.6%	3.7%	4.1%	4.5%	4.3%	4.8%
1986–1991						
	1986	**1987**	**1988**	**1989**	**1990**	**1991**
Percentage of children with asthma in the past 12 months	5.1%	5.3%	5.0%	6.1%	5.8%	6.4%
1992–1996						
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
Percentage of children with asthma in the past 12 months	6.3%	7.2%	6.9%	7.5%	6.2%	
1997–2001*						
	1997	**1998**	**1999**	**2000**	**2001**	
Children ever diagnosed with asthma and having an asthma attack in the past 12 months	5.4%	5.3%	5.3%	5.5%	5.7%	
Children ever diagnosed with asthma	11.4%	12.1%	10.8%	12.3%	12.6%	
Children who currently have asthma					8.7%	
2002–2003						
	2002	**2003**				
Children ever diagnosed with asthma and having an asthma attack in the past 12 months	5.8%	5.5%				
Children ever diagnosed with asthma	12.2%	12.5%				
Children who currently have asthma	8.2%	8.5%				

SOURCE: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

Note: *The survey questions for asthma changed in 1997; data before 1997 cannot be directly compared to data in 1997 and later.

Figure 12.6: Percentage of Children Having an Asthma Attack in the Previous 12 Months, by Race/Ethnicity and Family Income, in the United States, 1997–2000



Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

Key Observations

- The percentage of children with asthma differs by race/ethnicity and family income. In 1997–2000, more than 8 percent of Black non-Hispanic children living in families with incomes below the poverty level had an asthma attack in the previous 12 months. Approximately 6 percent of White non-Hispanic children and 5 percent of Hispanic children living in families with incomes below the poverty level had an asthma attack in the previous 12 months.
- More than 6 percent of children living in families with incomes below the poverty level had an asthma attack in the previous 12 months. About 5 percent of children living in families with incomes at the poverty level and higher had an asthma attack in the previous 12 months.

Data Table 12.6: Percentage of Children Having an Asthma Attack in the Previous 12 months, by Race/Ethnicity and Family Income in the United States, 1997–2000.

	All Incomes	< Poverty Level	100–200% of Poverty Level	> 200% of Poverty Level	Unknown Income
All races/ethnicities	5.4%	6.4%	5.5%	5.3%	4.9%
White non-Hispanic	5.2%	6.1%	5.5%	5.1%	4.7%
Black non-Hispanic	7.2%	8.5%	7.2%	6.3%	6.5%
Hispanic	4.6%	5.0%	3.9%	5.2%	4.3%

SOURCE: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

Limitations
It is difficult to obtain an accurate measurement of how many children have asthma, because asthma is a complex disease that can be difficult to differentiate from other wheezing disorders, especially in children under the age of 6 years.

Additional Indicators
EPA has prepared additional indicators for asthma and other respiratory disorders and for air pollutants, available at www.epa.gov/envirohealth/children, including:

- Children's emergency room visits for asthma and other respiratory causes
- Children's hospital admissions for asthma and other respiratory causes
- Percentage of children living in counties in which air quality standards were exceeded
- Percentage of children's days with good, moderate, or unhealthy air quality
- Long-term trends in annual average concentrations of criteria pollutants
- Number of children living in counties with high annual averages of PM_{10}
- Percentage of homes with children under 7 where someone smokes regularly
- Concentrations of cotinine in blood of children

Opportunities for Improvement
Continuing refinements in the National Health Interview Survey questions may help reduce any false self-reporting of asthma. The questions now ask whether a health professional has diagnosed a child with asthma. Additional research could be conducted to document the role of environmental factors in the prevalence of asthma.

Related Programs/Activities
The US National Institutes of Health coordinates the National Asthma Education and Prevention Program to address the growing problem of asthma in the United States. http://www.nhlbi.nih.gov/about/naepp/

EPA's Indoor Environments Division has launched a national public education and prevention program to raise awareness of indoor asthma triggers. http://www.epa.gov/iaq/asthma/iedasthmaprog.html

Objective 1-9 of Healthy People 2010 aims to reduce hospitalization rates for three ambulatory-care-sensitive conditions—pediatric asthma, uncontrolled diabetes, and immunization-preventable pneumonia and influenza. Objective 24-1 is to reduce asthma deaths, Objective 24-2 is to reduce hospitalizations for asthma, Objective 24-3 is to reduce hospital emergency department visits for asthma, and Objective 24-5 is to reduce the number of school or work days missed by people with asthma due to asthma.

13 Lead and Other Chemicals, Including Pesticides

Lead, along with other chemicals, can be important environmental hazards for young children both inside and outside their homes.

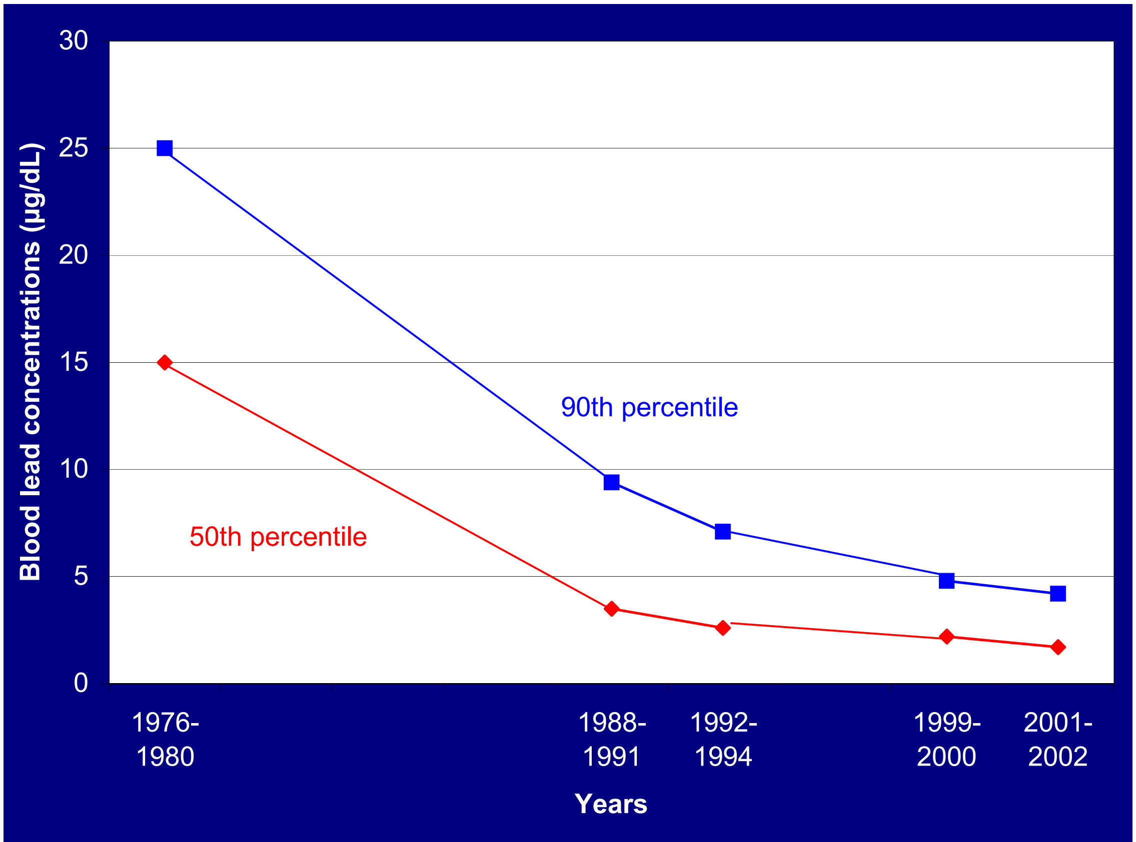
13.1 Blood Lead Levels

Lead is a serious environmental health hazard for young children. A child's brain and nervous system are vulnerable to adverse impacts from lead because they go through a long developmental process beginning shortly after conception and continuing through adolescence.[63,64] Studies have found that lead can damage children's developing brain and nervous system. Lead contributes to learning problems such as reduced intelligence and cognitive development.[20-22] Childhood exposure to lead contributes to attention-deficit/hyperactivity disorder[23] and hyperactivity and distractibility;[24-26] increases the likelihood of dropping out of high school, having a reading disability, lower vocabulary, and lower class standing in high school;[27] and increases the risk for antisocial and delinquent behavior.[28] A blood lead level of 10 micrograms per deciliter (µg/dL) or greater is considered elevated,[65,66] but there is no demonstrated safe concentration of lead in blood.[67] Adverse health effects can occur at lower concentrations.[21,22,68]

In the past, ambient concentrations of lead from leaded gasoline were a major contributor to blood lead levels in children.[68] Today, elevated blood lead levels are due mostly to ingestion of contaminated dust, paint and soil.[65] Soil and dust that are contaminated with lead are important sources of exposure because children play outside, and very small children frequently put their hands in their mouths.[69,70] Deterioration of lead-based paint can generate contaminated dust and soil, and past emissions of lead in gasoline that subsequently were deposited in the soil also contribute to lead-contaminated soil and house dust.[69-71] As of 1998–2000, lead-based paint was present in 40 percent of US homes.[72] Sixteen percent of homes had dust lead hazards, and 7 percent of homes had soil lead hazards.[72] Some small fraction of children also are exposed through direct ingestion of lead-containing paint chips and lead contaminated non-food items, as commonly found among children with pica.[73,74]

Although the concentration of lead in blood is an important indicator of risk, it reflects only current exposures. Lead also accumulates in bone and teeth. Recent research suggests that concentrations of lead in bone may be more related to adverse health outcomes in children than are concentrations in blood, as this would reflect exposure over a longer timeframe .[75] This finding suggests that concentrations in bone may better reflect the net burden of exposure. However, methods for measuring lead in bone are more time-consuming and expensive than those for measuring lead in blood, and nationally representative data are not available.

Figure 13.1: Concentration of Lead in the Blood of Children Five and Under, in the United States, 1976–2002



Source: US Environmental Protection Agency. 2003. America's Children and the Environment: Measures of Contaminants, Body Burdens and Illness. www.epa.gov/envirohealth/children

Data: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

Note: 10 µg of blood has been identified by CDC as elevated, which indicated need for intervention. There is no demonstrated safe concentration of lead in blood. Adverse effects may occur at lower concentrations.

Key Observations

- The median concentration of lead in the blood of children 5 years old and under dropped from 15 micrograms per deciliter (µg/dL) in 1976-1980 to 1.7 µg/dL in 2001–2002, a decline of 89 percent.
- The concentration of lead in blood at the 90th percentile in children 5 years old and under dropped from 25 µg/dL in 1976-1980 to 4.2 µg/dL in 2001–2002. This means that 10 percent of children had blood lead levels above 4.2 µg/dL and 90 percent had blood lead levels below 4.2 µg/dL.
- The decline in blood lead levels is due largely to the phasing out of lead in gasoline between 1973 and 1995 [76] and to the reduction in the number of homes with lead-based paint from 64 million in 1990 to 38 million in 2000.[72] Some decline also was a result of EPA regulations reducing lead levels in drinking water, as well as legislation banning lead from paint and restricting the content of lead in solder, faucets, pipes, and plumbing. Lead also has been eliminated or reduced in food and beverage containers and ceramic ware, and in products such as toys, mini-blinds, and playground equipment.

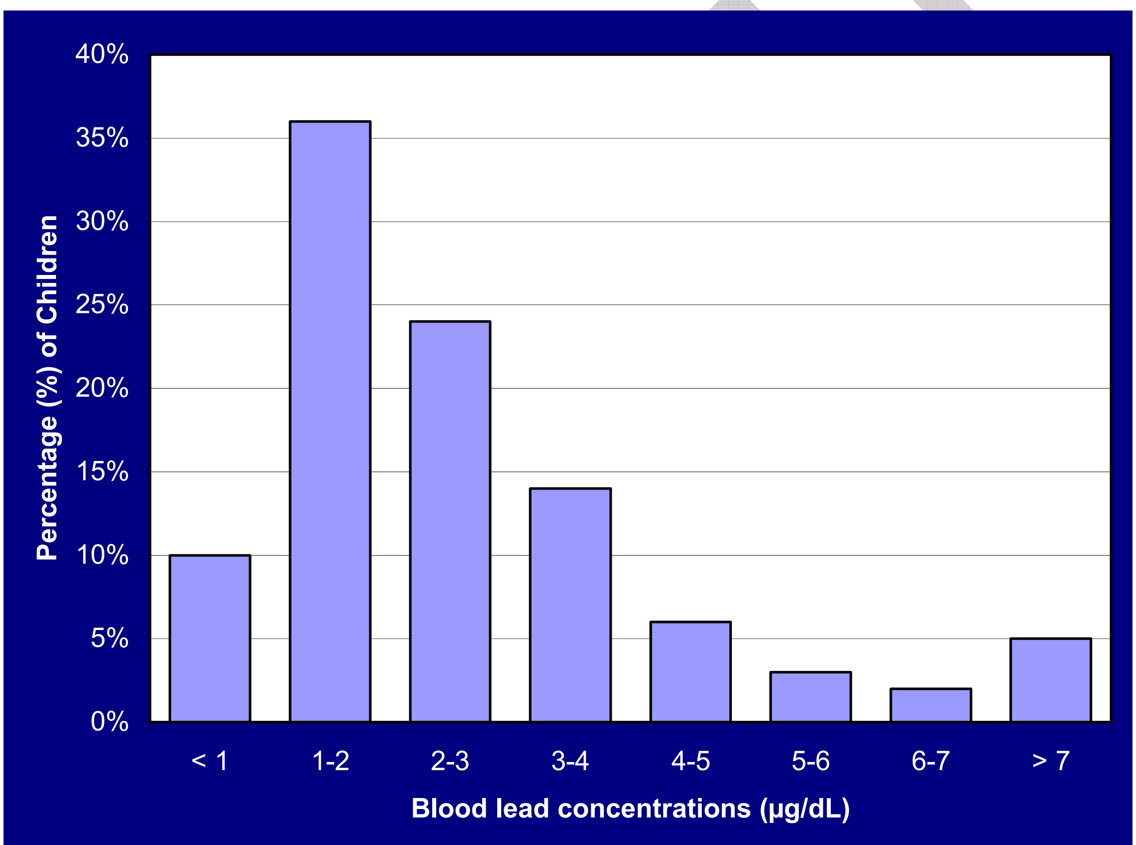
Data Table 13.1: Concentration of Lead in the Blood of Children Five and Under in the United States, 1976–2002

	Blood lead concentrations (µg/dL)				
	1976–80	1988–91	1992–94	1999–2000	2001–2002
50th percentile	15.0	3.5	2.6	2.2	1.7
90th percentile	25.0	9.4	7.1	4.8	4.2

Source: US Environmental Protection Agency. 2003. America's Children and the Environment: Measures of Contaminants, Body Burdens and Illness. www.epa.gov/envirohealth/children

Data: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

Figure 13.2: Distribution of Concentrations of Lead in Blood of Children Aged One to Five, in the United States, 1999–2000



Source: US Environmental Protection Agency. 2003. America's Children and the Environment: Measures of Contaminants, Body Burdens and Illness. www.epa.gov/envirohealth/children.

Key Observations

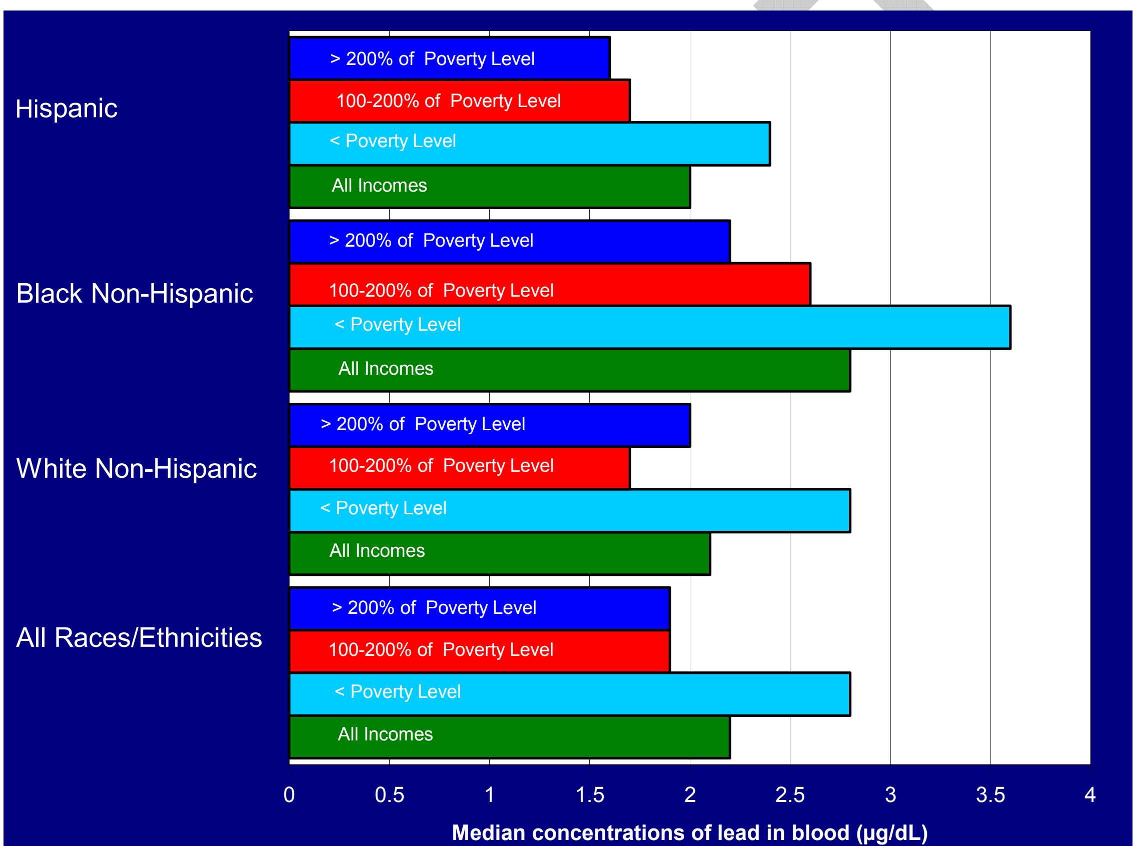
- Based on the 1999–2000 survey, 2.2 percent of US children aged 1-5 years have a blood lead level greater than or equal to 10 µg/dL. In the 1976–1980 survey, 88.2 percent of children had a blood lead level above or equal to 10 µg/dL.
- In the 1999–2000 survey, 434,000 US children aged 1-5 years were estimated to have a blood lead level of 10 µg/dL or more. In the 1976-1980 survey, the comparable estimate was 13,500,000 children.

Data Table 13.2: Distribution of Concentrations of Lead in Blood of Children Aged 1 to 5 in the United States, 1999–2000

Blood lead concentrations (µg/dL)							
< 1	1-2	2-3	3-4	4-5	5-6	6-7	> 7
10%	36%	24%	14%	6%	3%	2%	5%

SOURCE: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

Figure 13.3: Median Concentrations of Lead in Blood of Children Aged One to Five, by Race/Ethnicity and Family Income, in the United States, 1999–2000



Source: US Environmental Protection Agency. 2003. America's Children and the Environment: Measures of Contaminants, Body Burdens and Illness. www.epa.gov/envirohealth/children.

Key Observations

- In 1999–2000 the median blood lead level in children ages 1–5 was 2.2 µg/dL. The median blood lead level for children living in families with incomes below the poverty level was 2.8 µg/dL and for children living in families above the poverty level it was 1.9 µg/dL.
- In 1999–2000, White non-Hispanic children ages 1-5 had a median blood lead level of about 2 µg/dL, unchanged from the level in 1992–94.
- In 1992–94, Black non-Hispanic children ages 1-5 had a median blood lead level of 3.9 µg/dL and in 1999–2000 they had a median blood lead level of 2.8 µg/dL.

- In 1992–94, Hispanic children ages 1–5 had a median blood lead level of 2.6 µg/dL and in 1999–2000 they had a median blood lead level of 2.0 µg/dL.

Data Table 13.3: Median Concentrations of Lead in Blood of Children aged 1 to 5, by Race/Ethnicity and Family Income, 1999–2000

	Blood lead concentrations (µg/dL)				
	All Incomes	**< Poverty Level**	**100–200% of Poverty Level**	**> 200% of Poverty Level**	**Unknown Income**
All Races/Ethnicities	2.2	2.8	1.9	1.9	2.9
White non-Hispanic	2.1	2.8	1.7	2.0	3.2
Black non-Hispanic	2.8	3.6	2.6	2.2	2.7
Hispanic	2.0	2.4	1.7	1.6	2.3

Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

Limitations

The percentage of children with blood lead levels greater than 10 µg/dL is influenced by the proportion of nonresponses within each category. Families with incomes below the poverty level had a lower response rate than families with incomes at or above the poverty level. The percentages are thus the best estimates available, but may be biased by the variation of nonresponses by family income. These data only represent national averages. They do not adequately represent very high exposures that could occur because of local sources, such as high concentrations of housing with deteriorated lead paint. In November 2004, the Advisory Committee on Childhood Lead Poisoning Prevention recommended the adoption of a housing-based approach to continue community lead poisoning prevention efforts, particularly in high risk communities.

Additional Indicators

EPA has created additional indicators for lead exposure in children, available at www.epa.gov/envirohealth/children, including:

- Median concentrations of lead in blood of children ages 1–5, by race/ethnicity and family income, 1999–2000.
- Children reported to have mental retardation, by race/ethnicity and family income, 1997–2000

Opportunities for Improvement

Enhanced monitoring at the state level could improve the availability of geographically specified data and could provide more information about existence of higher end exposures.

Related Programs/Activities

The US Department of Health and Human Services' Healthy People 2010 initiative has set a national goal of eliminating blood lead levels equal to or greater than 10 µg/dL among children aged 1–5 years by 2010.

The US Department of Housing and Urban Development (HUD) and EPA also are implementing targeted strategies to prevent lead exposure through addressing lead hazards in the nation's public and private housing stock, certifying building professions in safe lead paint management and in providing education and outreach to homebuyers, tenants and the general public regarding lead hazards and their management. See http://www.epa.gov/lead/index.html and http://www.hud.gov/offices/lead/index.cfm.

The National Lead Information Center at http://www.epa.gov/opptintr/lead/nlic.htm provides public information and outreach on the risks of lead exposure.

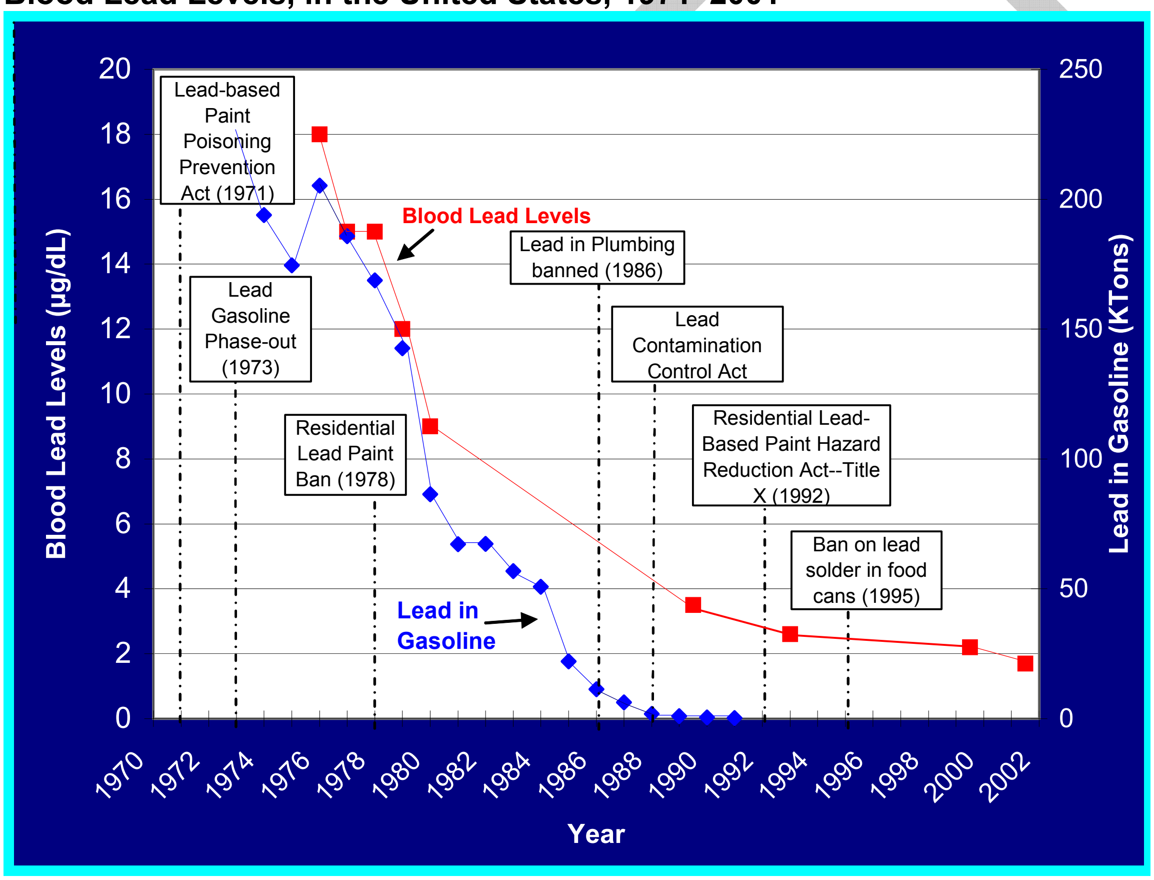
EPA also operates a Lead Awareness Program, at http://www.epa.gov/opptintr/lead/, which works to raise awareness of lead in paint, dust, and soil.

CASE STUDY

Blood Lead Levels in Response to Restrictions on Lead in Gasoline, 1976–91

The decline in blood lead levels is due largely to the phasing out of lead in gasoline between 1973 and 1995 [76] and to the reduction in the number of homes with lead-based paint from 64 million in 1990 to 38 million in 2000.[72] Some decline also was a result of EPA regulations reducing lead levels in drinking water, as well as legislation banning lead from paint and restricting the content of lead in solder, faucets, pipes, and plumbing. Lead also has been eliminated or reduced in food and beverage containers and ceramic ware, and in products such as toys, mini-blinds, and playground equipment. As a result of these past and ongoing efforts, children's blood-lead levels have declined by 89 percent since the mid 1970s.

Figure 13.4: Impact of Lead Poisoning Prevention Policy on Reducing Children's Blood Lead Levels, in the United States, 1971–2001



Source: Blood lead levels: National Health and Nutrition Examination Survey. National Center for Health Statistics, Centers for Disease Control and Prevention. Lead in gasoline: 1967-1975: Unpublished data from industry, provided by US EPA. 1976-1991: Unpublished data from refiner reports to US EPA.

Key Observations:

- The median concentration of lead in the blood of children five years old and under dropped from 15 micrograms per deciliter (µg/dL) in 1976–80 to 1.7µg/dL in 2001–2002, a decline of 89 percent.

Data Table 13.4: Impact of Lead Poisoning Prevention Policy on Reducing Children's Blood Lead Levels in the United States, 1971–2001

Year	Blood Lead Levels (µg/dL)	Lead in Gasoline (Ktons)
1972		226
1973		226
1974		194
1975		175
1976	18	205
1977	15	186
1978	15	169
1979	12	143
1980	9	86
1981		67
1982		67
1983		57
1984		51
1985		22
1986		11
1987		6.2
1988		1. 9
1989		1.01
1990		0.47
1991		0.28
1993	2.6	
Data with "mid-year" lead blood lead levels		
1989.5	3.5	
1999.5	2.2	
2001.5	1.7	

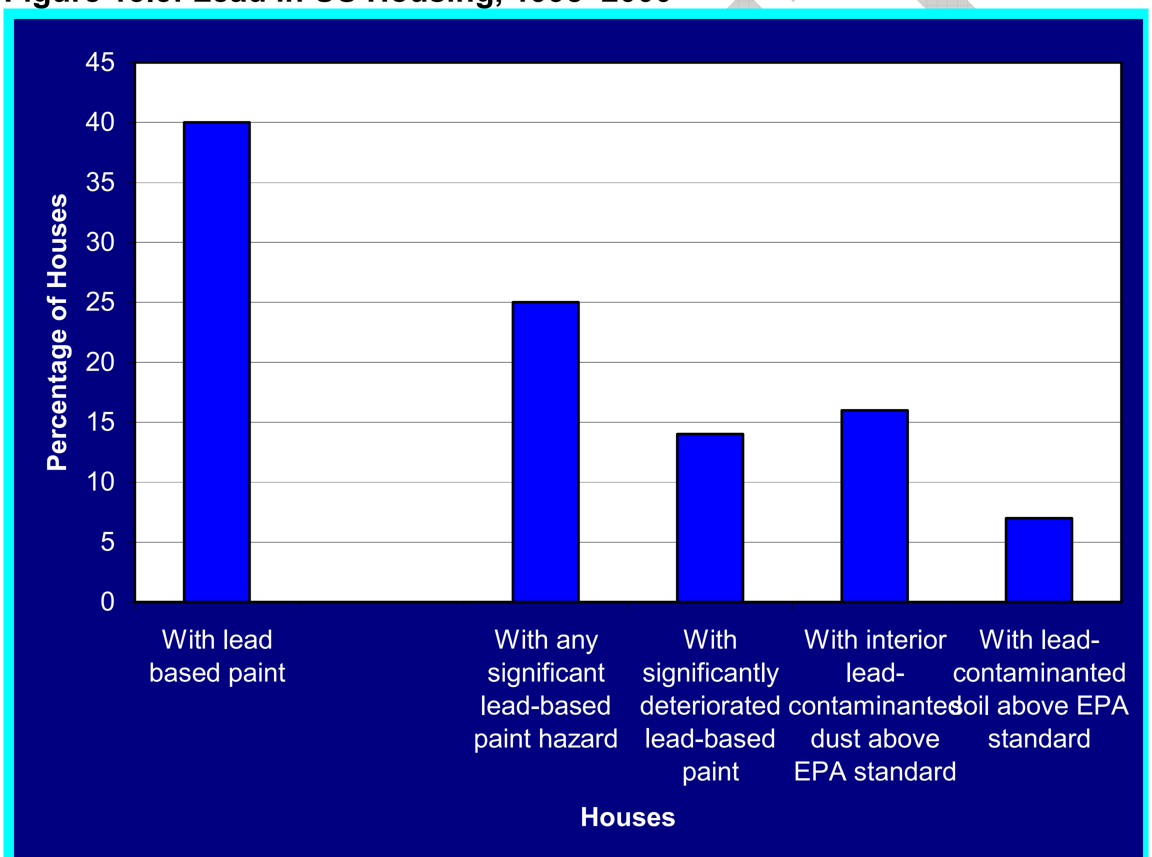
Source: Blood lead levels from Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. Lead in Gasoline data from industry data (1967-1975 and refiner reports to US EPA (for 1976-1991).

13.2 Lead in the Home

Today, elevated blood lead levels in the United States are due mostly to ingestion of contaminated dust, paint and soil.[65] Soil and dust that are contaminated with lead are important sources of exposure because children play outside, and very small children frequently put their hands in their mouths.[69-71] Deterioration of lead-based paint can generate contaminated dust and soil, and past emissions of lead in gasoline that subsequently were deposited in the soil also contribute to lead-contaminated soil and house dust.[69-71]

The National Survey of Lead and Allergens in Housing, conducted under the sponsorship of the Department of Housing and Urban Development (HUD) and the National Institute of Environmental Health Sciences (NIEHS), provides national estimates of children's potential household exposure to lead and allergens.

Figure 13.5: Lead in US Housing, 1998–2000



Source: "National Survey of Lead and Allergens in Housing, Final Report, Volume I, Analysis of Lead Hazards, Revision 6.0", April 18, 2001.

Key Observations

- In 1998–2000, 40 percent of houses in the United States had paint that had some lead in it. Twenty-five percent of houses had a significant lead based paint hazard, which could be from deteriorating paint, contaminated dust, or contaminated soil outside the house.
- In 1998–2000, 14 percent of houses had significantly deteriorated lead based paint and 16 percent of houses in the United States had lead in dust above EPA standards. Seven percent of houses had lead in soil outside the house greater than the EPA standard.

- An estimated 38 million homes have lead-based paint somewhere in the building, however most have relatively small surfaces; the average home has an estimated 259 square feet of interior lead-based paint and 996 square feet of exterior lead-based paint.[77]

Data Table 13.5: Lead in US Housing, 1998–2000

	Percent
With lead based paint	40
Any significant lead-based paint hazard	25
Significantly deteriorated lead-based paint	14
Interior lead-contaminated dust above EPA standard	16
Lead-contaminated soil above EPA standard	7

Source: "National Survey of Lead and Allergens in Housing, Final Report, Volume I, Analysis of Lead Hazards, Revision 6.0", April 18, 2001.

Note: "Lead-based paint" is defined as a paint or coating with a lead content $\geq$ 1 mg/cm^2 or 0.5% by weight. "Significant lead-based paint hazard" is defined as an area of deteriorated lead-based paint above the *de minimis* levels specified by the US Department of Housing and Urban Development, which are ≤ 20 ft^2 (exterior) or ≤ 2 ft^2 (interior) of lead-based paint on large surface area components (walls, doors), or damage to ≤ 10% of the total surface area of interior small surface area component types (windowsills, baseboards, trim).

Limitations

The national survey identified lead hazards to include deteriorated lead based paint, lead contaminated dust and soil within the context of individual housing. This does not reflect the hazards that children may encounter in schools or day care centers or in areas in the community, such as parks or lots, where housing or other structures painted with lead based paint may be been demolished unsafely and lead contaminated soil remains.

Additional Indicators

EPA has prepared additional indicators for lead in the blood of children, available at www.epa.gov/envirohealth/children, including:

- Concentrations of lead in blood of children ages 5 and under
- Median concentrations of lead in blood of children ages 1-5, by race/ethnicity and family income, 1999–2000
- Distribution of concentrations of lead in blood of children ages 1-5, 1999–2000

Opportunities for Improvement

As lead has been used in paint as well as gasoline and many industries and is a common hazardous contaminant, it may be appropriate to expand this indicator to look at the proximity of children to older industry sectors known to use lead such as historic or abandoned smelters, foundries and other industrial facilities now considered Brownfields.

Data on lead in paint at schools and day care facilities would also be an additional important area for coverage.

Develop methodology to link state and local surveillance study to provide robust national risk information.

Related Programs/Activities

EPA's school program is developing a comprehensive tool to assist school managers in managing potential hazards, such as lead-based paint, as part of their maintenance and repair programs. http://cfpub.epa.gov/schools/index.cfm

HUD Office of Healthy Homes and Lead Hazard Control. http://www.hud.gov/offices/lead/

US EPA Lead Awareness Program - http://www.epa.gov/lead/

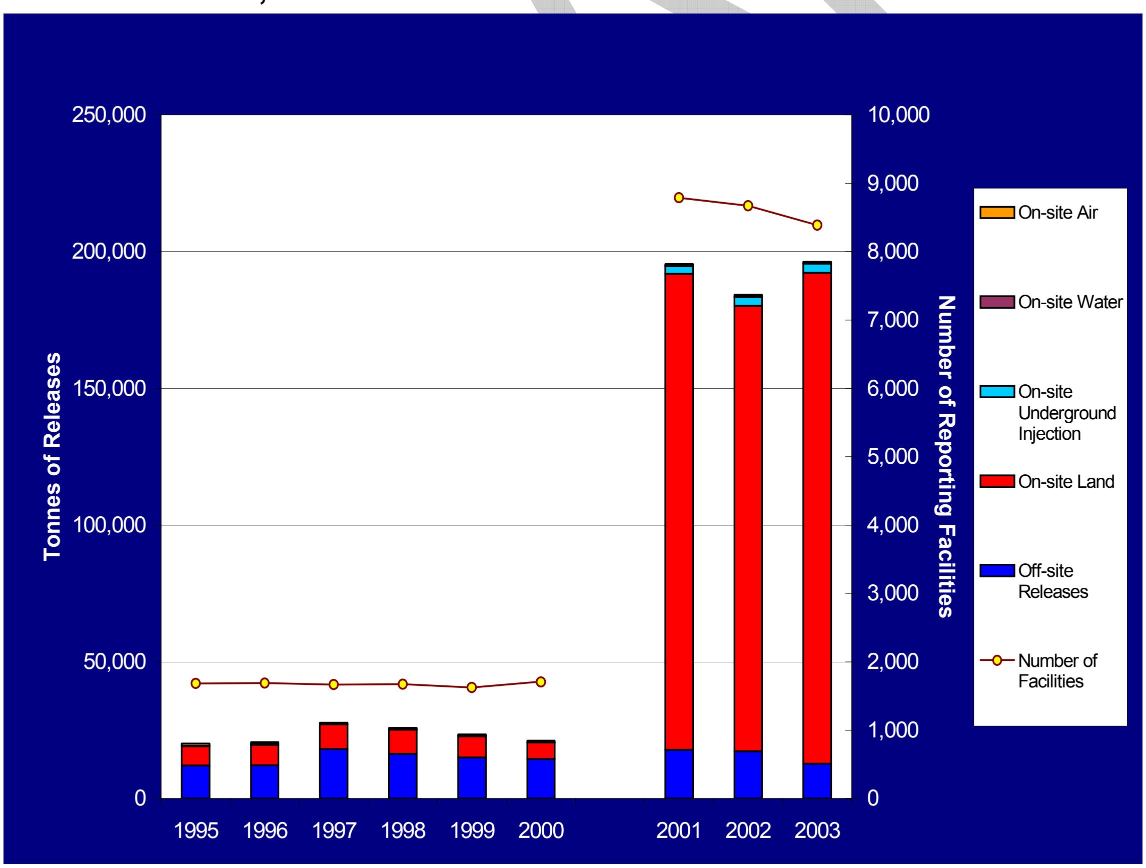
Objective 8-11 of Healthy People 2010 aims to totally eliminate elevated blood lead levels (target level is 0 µg/dL) in children by the year 2010.

13.3 Industrial Releases of Lead

In the United States, certain industries and facilities are required to report their annual releases of certain chemical substances, and how they are managed as waste, to the US EPA, state, local, and tribal governments. Facilities that operate within certain industry sectors; have 10 or more employees; and manufacture, process, or use certain chemicals over defined quantities are required to report. This information is made available to the public in the Toxics Release Inventory (TRI), a database maintained by the US EPA. Lead is one of the compounds required for reporting. The requirements for chemicals that persist or bioaccumulate were changed in 2001, so that releases over 0.1 gram for dioxin and dioxin-like compounds, and 10 or 100 pounds for lead and for other persistent and bioaccumulative chemicals, have to be reported.

Figure 13.6 below illustrates the environmental releases (expressed in tonnes) of lead from lead and lead compounds from major industrial facilities as reported to EPA's Toxics Release Inventory Program for reporting years 1995 through 2003.

Figure 13.6: On- and Off-site Industrial Releases of Lead (and its compounds) in the United States, 1995–2003



Source: Toxics Release Inventory, Environmental Protection Agency.

Key Observations

- The amount of industrial releases of lead was about 23,500 tonnes (metric tons) in 1995 and 23,100 tonnes in 2000. There was an increase in the total industrial releases of lead seen in 1997 with reductions in each subsequent reporting year up to 2000. Most of the increase was due to a 45 percent increase in the amount of lead released off-site (off-site releases are primarily transfers to landfills) between 1996 and 1997. The decrease in later years was not enough to offset the earlier increase so that the change for the period 1995–2000 was an increase of 5 percent.
- The largest decrease in lead emissions over the 1995–2000 period occurred for releases to on-site land by an overall decrease of 20 percent. Air releases of lead decreased by about 390 tonnes or 28 percent over the reporting period.
- For the 2001 reporting year, the quantities of lead reported as being released or otherwise managed as waste within the United States increased sharply because more facilities were required to report to the Toxics Release Inventory. This increase does not mean that the release of lead has increased from industrial facilities, but rather that more industrial facilities are required to report their releases of lead.

Data Table 13.6: On- and Off-site Industrial Releases of Lead (and its compounds) in the United States, 1995–2003

	Tonnes						
	On-site Air	On-site Water	On-site Underground Injection	On-site Land	Off-site Releases	Total On- and Off-site Releases	Number of Facilities
1995	1,384	48	83	7,919	14,034	23,469	1,817
1996	1,332	35	303	8,192	14,478	24,340	1,820
1997	1,116	29	120	9,812	20,943	32,021	1,800
1998	1,041	36	82	9,555	18,480	29,193	1,808
1999	963	26	83	8,402	16,337	25,811	1,765
2000	992	28	98	6,365	15,627	23,110	1,848
2001	697	72	2,833	173,971	17,909	195,482	8,793
2002	644	64	3,263	162,938	17,322	184,230	8,676
2003	577	63	3,443	179,537	12,736	196,357	8,388

Source: Toxics Release Inventory, Environmental Protection Agency.

Limitations

These data for lead from industry and facility sources are subject to the reporting requirements of the Emergency Planning and Community Right-to-Know Act of 1986. These reporting requirements do not cover all industry sectors or facilities that may release lead into the environment, nor do they cover all anthropogenic sources or natural sources of environmental releases of lead.

Additional Indicators

The Centers for Disease Control and Prevention (CDC) has established five environmental health indicators that pertain to lead including: two core indicators; blood lead level in children and lead poisoning in children; and three indicators that are optional or under development; lead contamination in the environment, residence near metal processing industries, and lead elimination programs. For additional information, go to the http://www.cdc.gov/ and follow the link to environmental health tracking.

Opportunities for Improvement

TRI lead and lead compound emission data could be used as well as State and local surveillance and prevalence studies to assist in better characterizing and managing lead hazards in communities. For additional information on surveillance and prevalence programs, go to the http://www.cdc.gov/ and follow the link to lead poisoning prevention programs.

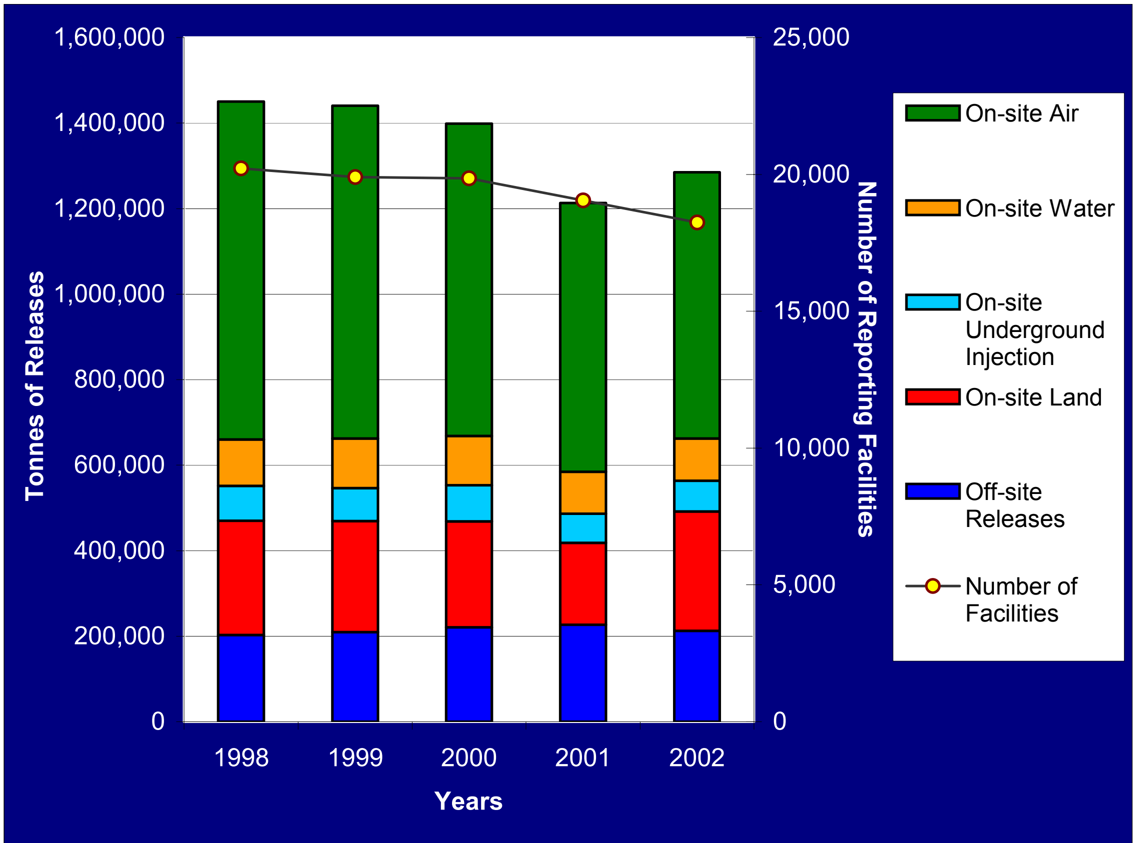
Related Programs/Activities
The US EPA is working with CDC and other partners to link environmental indicators and state and local surveillance activities. For additional information, go to the http://www.cdc.gov/ and follow the link to lead poisoning prevention.

The US EPA does not have the authority to regulated leaded gasoline used in racing and the Federal Aviation Administration regulates aircraft fuels. In 2002, however, the US EPA chose to release the PBT National Action Plan for Alkyl-lead as a voluntary effort to phase out the continued use of alkyl-lead in leaded gasoline fuels predominantly used in aviation (piston engine) industry, but also in non-road competition race vehicles (cars, boats, etc). For additional information on leaded gasoline phase out activities, see http://www.epa.gov/opptintr/pbt/pubs/Alkyl_lead_action_plan_final.pdf.

13.4 Industrial Releases of Selected Chemicals

The Toxics Release Inventory (TRI) is a publicly available database maintained by the US EPA that contains information on toxic chemical releases and other waste management activities for more than 650 chemicals reported annually by certain covered industries as well as by federal facilities. A federal law called the Emergency Planning and Community Right to Know Act gives the public the right to know about toxic chemicals being released into the environment. The law requires facilities in certain industries, which manufacture, process, or use significant amounts of toxic chemicals, to report annually on their releases and other waste management of these chemicals. The reports contain information about the types and amounts of toxic chemicals that are released each year to the air, water and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management.

Figure 13.7: On- and Off-site Releases of Matched Chemicals From Major Industrial Sources, in the United States, 1998–2002



Source: Toxics Release Inventory, Environmental Protection Agency. The data shown are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US TRI are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at www.cec.org/takingstock/.

Key Observations

- The total facilities reporting releases of the 153 matched chemicals decreased over the reporting period 1998 to 2002, as did the total releases, which went from a high of 1,45 million tonnes in 1998 to a low of 1,21 million tonnes in 2001 but then increased to 1,28 million tonnes in 2002, for an overall decrease of 11 percent from 1998 to 2002. There were reductions in releases to on-site air, water and underground injection, with on-site land and off-site releases (primarily transfers to landfills) showing an increase

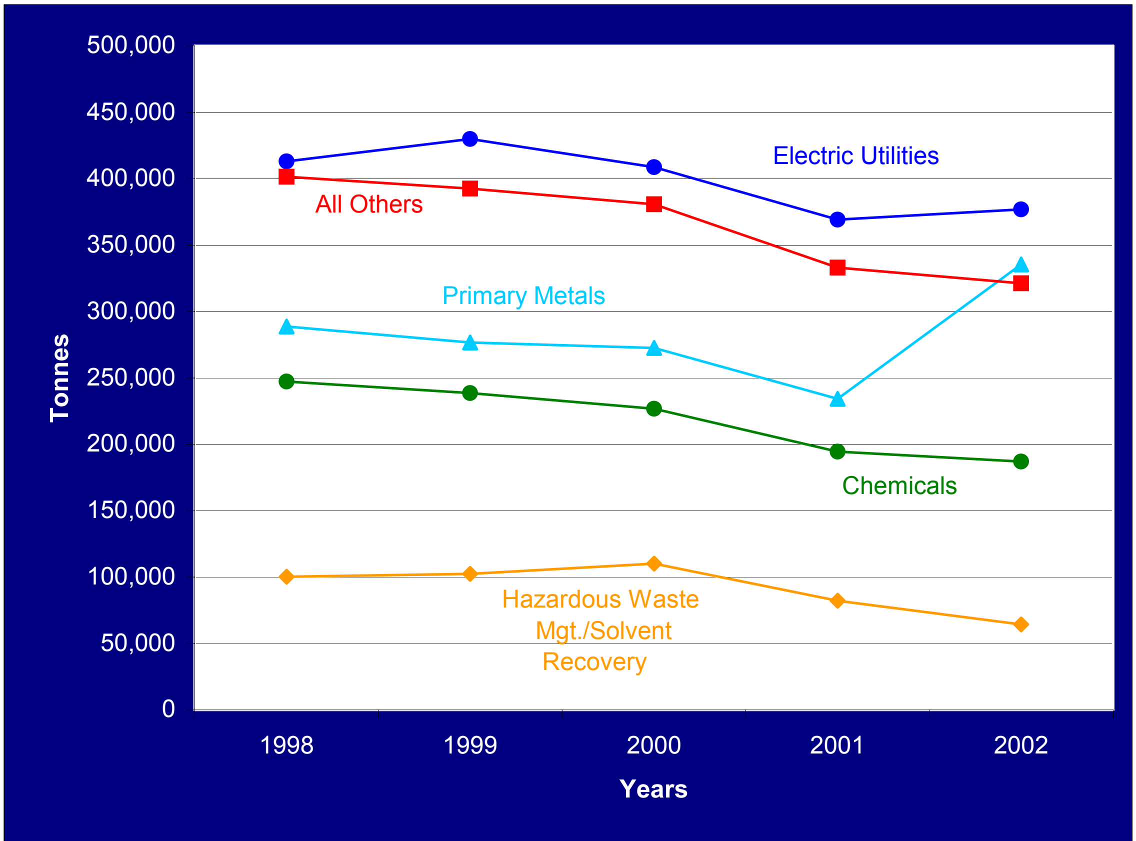
Data Table 13.7: On- and Off-site Releases of Matched Chemicals From Major Industrial Sources in the United States, 1998–2001

	Tonnes						
	On-site Air	On-site Water	On-site Underground Injection	On-site Land	Off-site Releases (adjusted)	Total On- and Off-site Releases	Number of Facilities
1998	871,476	113,870	85,532	291,787	204,573	1,567,357	21,661
1999	862,039	122,083	80,317	293,777	205,692	1,564,029	21,406
2000	818,847	121,738	88,623	274,031	202,203	1,505,549	21,373

2001	713,698	100,275	70,618	217,325	222,373	1,324,391	20,575

Source: Toxics Release Inventory, Environmental Protection Agency. The data shown are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US TRI are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at www.cec.org/takingstock/.

Figure 13.8: Total On- and Off-site Releases of Matched Chemicals, by Industry Sector, in the United States, 1998–2002



Source: Toxics Release Inventory, Environmental Protection Agency. The data shown are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US TRI are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at www.cec.org/takingstock/.

Note: Industry sectors with largest total releases on and off-site, 2001

Key Observations

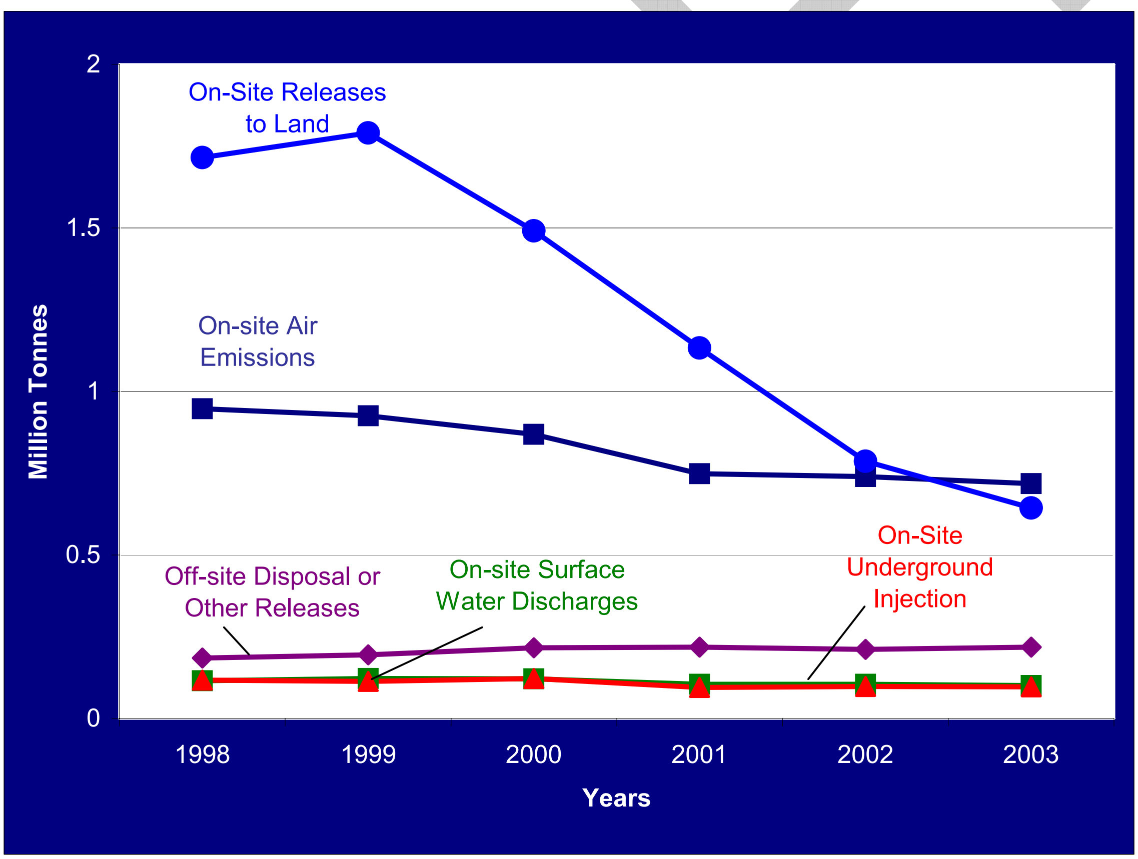
- The electric utilities sector reported the largest total releases and showed a decrease of 9 percent from 1998 to 2002. The primary metals sector, the second largest sector, reported an increase of 16 percent in releases over the same time period. The chemical manufacturing sector and the hazardous waste management sectors reported the third and fourth largest total releases, with overall decreases of 24 percent and 36 percent respectively. The other industry sectors combined, the "all others" category (which includes, among others, the food, paper, transportation equipment and plastics manufacturing industries), had about 401,000 tonnes of releases in 1998 and about 321,000 tonnes in 2002

Data Table 13.8: Total On- and Off-site Releases of Matched Chemicals by Major Industrial Sectors in the United States, 1998–2001

	1998	1999	2000	2001
	Tonnes			
Electric Utilities	416,189,195	432,843,563	411,719,730	374,141,806
Primary Metals	293,644,983	281,528,238	276,083,767	248,224,332
Chemicals	247,771,112	239,033,181	229,020,976	194,239,858
Hazardous Wastes Mgt/Solvent Recovery	105,457,682	105,668,529	113,904,968	86,076,261
All Others	401,623,296	393,011,609	383,167,538	329,314,063

Source: Toxics Release Inventory, Environmental Protection Agency. The data shown are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US TRI are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at www.cec.org/takingstock/.

Figure 13.9: Location of Releases or Transfers of Chemicals from Major Industrial Sources, in the United States, 1998–2003



Source: Toxics Release Inventory, Environmental Protection Agency.

Key Observations

- In 2001, total on- and off-site releases for all Toxics Release Inventory facilities were 6.16 billion pounds. Of these releases, 56 percent were to land, 27 percent were to air, 4 percent were to water, 3.5 percent were to underground injection wells, and 9 percent were chemicals disposed of off-site to land or underground injection.

- Between 1998 and 2001, total on- and off-site releases of TRI chemicals decreased by 22 percent, a net decrease of 1.58 billion pounds. On-site releases decreased by 25 percent, but off-site releases (transfers off-site to disposal) increased by 26 percent.
- For the core set of chemicals from industries that have reported consistently since 1988, total on- and off-site releases decreased by 54.5 percent between 1988 and 2001, a reduction of 1.72 billion pounds.

Data Table 13.9: Location of Releases or Transfers of Chemicals from Major Industrial Sources in the United States, 1998–2003

Year	Emissions (tonnes)					
	On-site Air Emissions	On-site Surface Water Discharges	On-Site Underground Injection	On-Site Releases to Land	Off-site Disposal or Other Releases	Total On- and Off-site Disposal or Other Releases
1998	947,113	115,250	117,216	1,715,458	184,755	3,079,793
1999	925,834	121,884	113,732	1,790,445	194,591	3,146,486
2000	868,418	121,090	122,187	1,490,949	216,698	2,819,341
2001	748,734	104,472	94,463	1,133,253	217,830	2,298,752
2002	739,834	105,006	97,563	786,940	211,815	1,941,158
2003	718,032	100,526	96,931	644,087	218,436	1,778,012

Source: Toxics Release Inventory, Environmental Protection Agency.

Limitations:
TRI data are an input to determine exposure or calculate potential risks to human health and the environment, but by themselves do not represent risk. The determination of potential risk depends on many factors, including toxicity, chemical fate after release, release location, and population concentrations. In addition, although the US EPA has expanded the TRI program, it does not cover all sources of releases and other waste management activities, such as vehicle emissions, nor does it cover all toxic chemicals or industry sectors. Also, while many facilities base their TRI data on monitoring data, others report estimated data to TRI as the program does not mandate release monitoring. Finally, facilities that do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report.

In general, the Toxics Release Inventory (TRI) only includes data from facilities that exceed certain threshold requirements and are required to report releases and transfers to TRI. The threshold criteria include:

- Operations within certain industry sectors;
- Operations that employ more than 10 people;
- Operations that manufacture or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. These reporting triggers do not include persistent, bioaccumulative, and toxic (PBT) chemicals, such as lead, where the thresholds are 0.1 gram for dioxin and dioxin-like compounds, 10 pounds for other highly persistent and highly bioaccumulative compounds, and 100 pounds for lead and other PBT chemicals. These lower limits were established in 2001.

Additional Indicators
EPA has prepared a report on trends in Toxics Release Inventory waste minimization priority chemicals (a subset of the TRI chemicals) from 1991–2000, available online at http://www.epa.gov/epaoswer/hazwaste/minimize/trends.htm.

EPA also has prepared an indicator on the proximity of children to Superfund sites, available in *America's Children and the Environment*, 2003 (www.epa.gov/envirohealth/children)

Opportunities for Improvement
Canada, Mexico, and the United States are working to enhance the comparability of the North American Pollutant Release and Transfer Registers (PRTRs) through CEC's PRTR project. The three nations developed *An Action Plan to Enhance the Comparability of PRTRs in North America* that was adopted by the CEC Council in June 2002. This action plan currently is being updated.

PRTR data could be analyzed using particular subsets of chemicals that are most important to children's health (e.g., PBTs, carcinogens). This information could be examined at a regional, geographic, facility, or industry sector level to identify areas or facilities to work with to set priorities, measure progress, and target areas of special and immediate concern.

Related Programs/Activities
A federal law called the Emergency Planning and Community Right to Know Act gives the public the right to know about toxic chemicals being released into the environment. The law requires facilities in certain industries, which manufacture, process, or use significant amounts of toxic chemicals, to report annually on their releases of these chemicals. The reports contain information about the types and amounts of toxic chemicals that are released each year to the air, water, and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management. EPA compiles the TRI data each year and makes them available through several data access tools, including the TRI Explorer (http://www.epa.gov/triexplorer) and Envirofacts (http://www.epa.gov/enviro). Additional TRI information, including EPA's annual Public Data Release, also is available on the TRI Web site at http://www.epa.gov/tri.

13.5 Pesticide

Children may be exposed to pesticides and other contaminants in their food and through day-to-day activities around the home. EPA regulates the amounts of pesticides in food, termed "residues," through standards called "food tolerances." A tolerance is a legal limit on the amount of pesticide residue in a particular food. Children's exposures to pesticides may be higher than the exposures of most adults. Pound for pound, children generally eat more than adults, and they may be exposed more heavily to certain pesticides because they consume a diet different from that of adults.[78] Among the agricultural commodities that are consumed by children in large amounts are apples, corn, oranges, rice, and wheat.

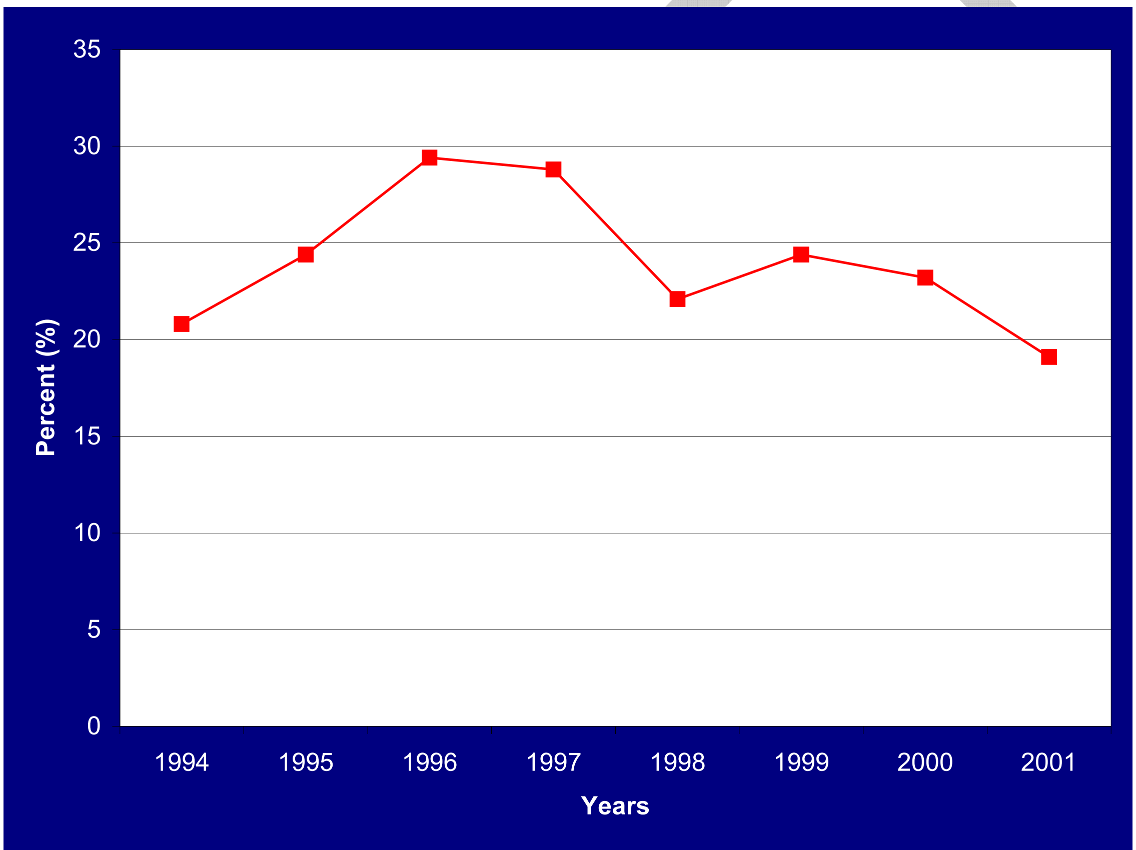
Organophosphate pesticides frequently are applied to many of the foods important in children's diets, and certain organophosphate pesticide residues can be detected in small quantities. When exposure to organophosphate pesticides is sufficiently high, they interfere with the proper functioning of the nervous system.[79] There are approximately 40 organophosphates, and as a group they account for approximately half of the insecticide use in the United States. The majority of organophosphate use is on food crops—including corn, fruits, vegetables, and nuts. In addition, organophosphate pesticides often have been used in and around the home. Examples of organophosphate pesticides include chlorpyrifos, azinphos methyl, methyl parathion, and phosmet.

The US Department of Agriculture (USDA) collects annual data on pesticide residues in food. Among the foods sampled by the USDA's Pesticide Data Program in recent years are several that are important parts of children's diets, including apples, apple juice, bananas, carrots, green beans, orange juice, peaches, pears, potatoes, and tomatoes.

The chart below displays the percentage of food samples with detectable organophosphate pesticide residues reported by the Pesticide Data Program from 1994 to 2001. The 34 organophosphates that were sampled in each of these years are included; other organophosphates that have been added to the program in recent years are excluded so that the chart represents a consistent set of pesticides for all years shown. This measure is a surrogate for children's exposure to pesticides in foods: If the frequency of detectable levels of pesticides in foods decreases, it is likely that exposures will decrease. However, this measure does not account for many additional factors that affect the risk to children. For example, some organophosphates pose greater risks to children than others do, and residues on some foods may pose greater risks than residues on other foods due to differences in amounts consumed. In addition, year-to-year changes in the percentage of samples with detectable pesticide residues may be affected by changes in the selection of foods that are sampled each year.

In accordance with the Food Quality Protection Act (FQPA) of 1996, EPA currently is reassessing all food tolerances to assure that they comply with the FQPA's "reasonable certainty of no harm" standard, with a particular focus on protecting children's health. EPA has concluded that a substantial portion of the existing tolerances for organophosphate pesticides meet the stringent safety standards of the FQPA and that a significant portion of the potential exposure to organophosphate pesticides is associated with only a small number of uses of these compounds.

Figure 13.10: Percentage of Fruits, Vegetables and Grains with Detectable Residues of Organophosphate Pesticides, in the United States, 1994–2001



Source: US Environmental Protection Agency. 2003. America's Children and the Environment: Measures of Contaminants, Body Burdens and Illnesses.<www.epa.gov/envirohealth/children>.

Key Observations

- Between 1994 and 2001, the percentage of food samples with detectable organophosphate pesticide residues ranged between 19 percent and 29 percent. The highest detection rates were observed during 1996 and 1997, while the lowest detection rate was observed in 2001.

- Between 1993 and 2001, the amount of organophosphate pesticides used on foods most frequently consumed by children declined by 44 percent, from 25 million pounds to 14 million pounds.
- In 1999–2000, EPA imposed new restrictions on the use of the organophosphate pesticides azinphos methyl, chlorpyrifos, and methyl parathion on certain food crops and around the home, due largely to concerns about potential exposures of children.

Data Table 13.10: Percentage of Fruits, Vegetables, and Grains with Detectable Residues of Organophosphate Pesticides in the United States, 1994–2001

1994	1995	1996	1997	1998	1999	2000	2001
20.8%	24.4%	29.4%	28.8%	22.1%	24.4%	23.2%	19.1%

SOURCE: US Department of Agriculture, Pesticide Data Program

Limitations

This indicator is a surrogate for children's exposure to pesticides in foods: If the frequency of detectable levels of pesticides in foods decreases, it is likely that exposures will decrease. However, this indicator does not account for many additional factors that affect the risk to children. For example, some organophosphates pose greater risks to children than others do, and residues on some foods may pose greater risks than residues on other foods due to differences in amounts consumed. In addition, year-to-year changes in the percentage of samples with detectable pesticide residues may be affected by changes in the selection of foods that are sampled each year. This indicator does not represent all pesticides that may be present as residues on food, nor does it represent all pesticides to which children may be exposed. Such exposures may occur in a variety of settings, including in and around the home, day care facilities, play areas, or in agricultural areas, for example.

Additional Indicators

EPA has prepared an additional indicator based on available data from Minnesota, which examines the issue of pesticide use in schools. This indicator is available at www.epa.gov/envirohealth/children:

- Frequency of application of pesticides in Minnesota K-12 schools, 1999

Opportunities for Improvement

As required by the Food Quality Protection Act, EPA currently is conducting a cumulative risk assessment for the organophosphate pesticides. For the first time ever, this scientific assessment evaluates the potential risks to children from the combined estimates of all contributing organophosphate residues in food and drinking water consumption, and from activities around the home. EPA already has imposed various restrictions on many individual uses of organophosphates, particularly those that may pose greater risk to children from dietary and residential sources. These restrictions, and others that may be imposed as a result of the cumulative assessment, are expected to lower children's potential exposure to these pesticides and thereby reduce potential health risks. EPA will evaluate the outputs from the cumulative risk assessments to determine how they may be used in developing measures that better reflect increases or decreases in pesticide exposure or risk. In addition, the Agency expects to add indicators of pesticide exposures to the body burdens section of future editions of the America's Children and the Environment report.

Related Programs/Activities

EPA is conducting research to develop and implement an approach to examine the cumulative risks and possible health effects from persistent exposure to pesticides via multiple sources and pathways in children living along the US-Mexico Border. For more information, see http://www.epa.gov/orsearth/projects_publications/urincary_biomarker_data_analysis_and_study_design_for_children.html.

EPA also helps support the “For Healthy Kids” project, which focuses on preventing children's exposure to pesticides by educating agricultural workers on preventing "the take home pathway" for pesticide residue. More information is available at: http://www.epa.prosser.wsu.edu/kids.html.

Objective 8-13 of Healthy People 2010 aims to reduce pesticide exposures that result in visits to a health care facility, and Objective 8-24 aims to reduce exposure to pesticides as measured by urine concentrations of metabolites.

14 Waterborne Diseases

14.1 Drinking Water

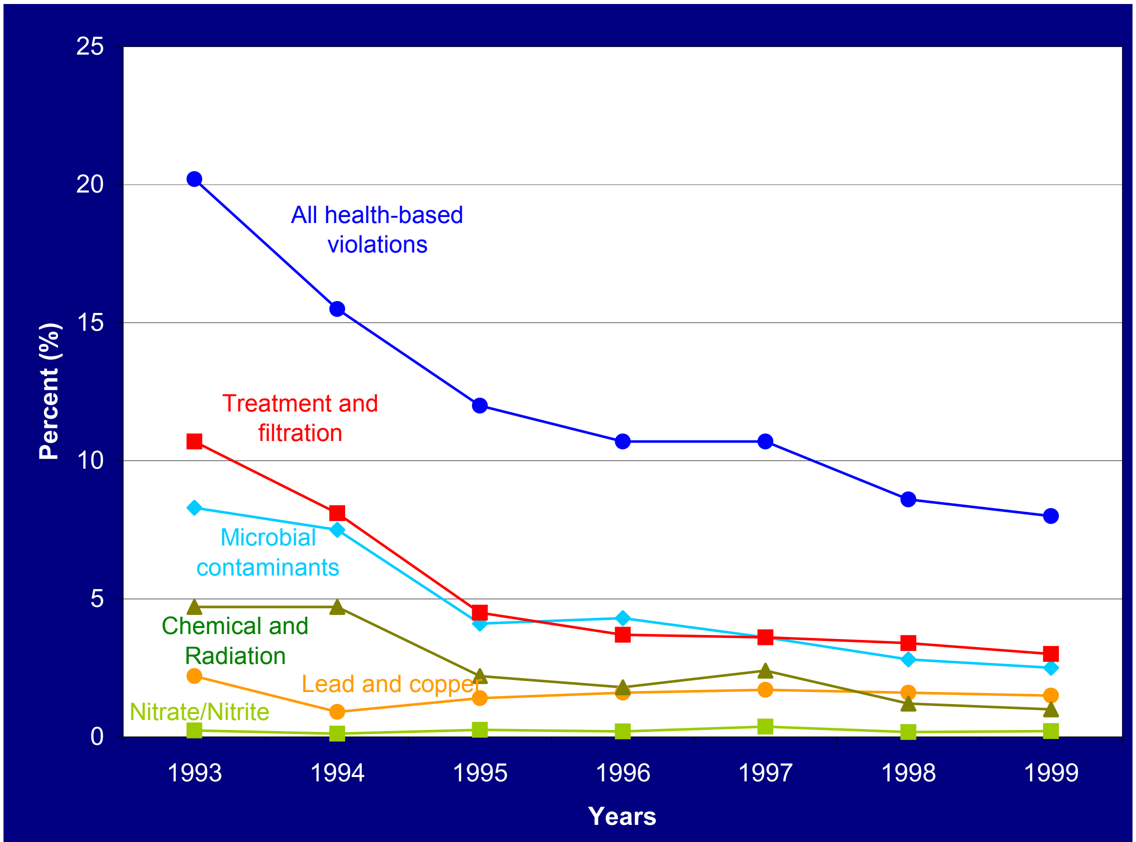
The contaminants in drinking water are quite varied and may cause a range of diseases in children, including acute diseases such as gastrointestinal illness, developmental effects such as learning disorders, and cancer.[80] Children are particularly sensitive to microbial contaminants because their immune systems are less developed than those of most adults.[80] Children are sensitive to lead, which affects brain development,[20,23-28,81] and to nitrates and nitrites, which can cause methemoglobinemia (blue baby syndrome).[82-84] Fertilizer, livestock manures, and human sewage are significant contributors of nitrates and nitrites in groundwater sources used for drinking water.[85-87]

Public water systems regulated by EPA, and delegated states and tribes, provide drinking water to an estimated 90 percent of Americans. Through the Public Water System Supervision program, EPA sets and enforces drinking water standards, referred to as Maximum Contaminant Levels (MCLs).[88] These standards are designed to protect people against adverse health effects from contaminants in drinking water while taking into account the technical feasibility of meeting the standard and balancing costs and benefits. EPA has set MCLs for more than 80 microbial contaminants, chemicals, and radionuclides. EPA also has developed regulations to protect drinking water sources and to require treatment of drinking water. An important treatment-related regulation, the Surface Water Treatment Rule, requires treatment of surface waters used for drinking water by filtration to remove microbial contaminants.

Drinking water rules often are added or modified. For example, EPA established more stringent filter performance requirements in 1998 to further strengthen protection against microbial contaminants. In the same year, EPA also established new drinking water standards for disinfection byproducts, exposure to which has been associated with bladder cancer[89] and possible reproductive effects.[90] In 2000, EPA finalized standards protecting against radionuclides in drinking water.[91] In addition, EPA strengthened the existing standard for arsenic in 2001. Changes in regulatory requirements may affect the outcome of the measures presented in this report, as the resulting trends sometimes may be related to changes in standards rather than changes in exposures.

Unlike public water systems, EPA does not have the authority to regulate private drinking water wells. An estimated 28 million people or nearly 10 percent of Americans have their own sources of drinking water, such as wells, cisterns, and springs.[92] Unlike public drinking water systems serving many people, they do not have experts regularly checking the water's source and its quality before it is sent through pipes to the community.

Figure 14.1: Percentage of Children Living in Areas Served by Public Water Systems that Exceeded a Drinking Water Standard or Violated a Treatment Requirement, in the United States, 1993–1999



Source: United States Environmental Protection Agency. 2003. America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses. <www.epa.gov/envirohealth/children>.

Data Source: Safe Drinking Water Information System. Office of Water, US Environmental Protection Agency.

Key Observations

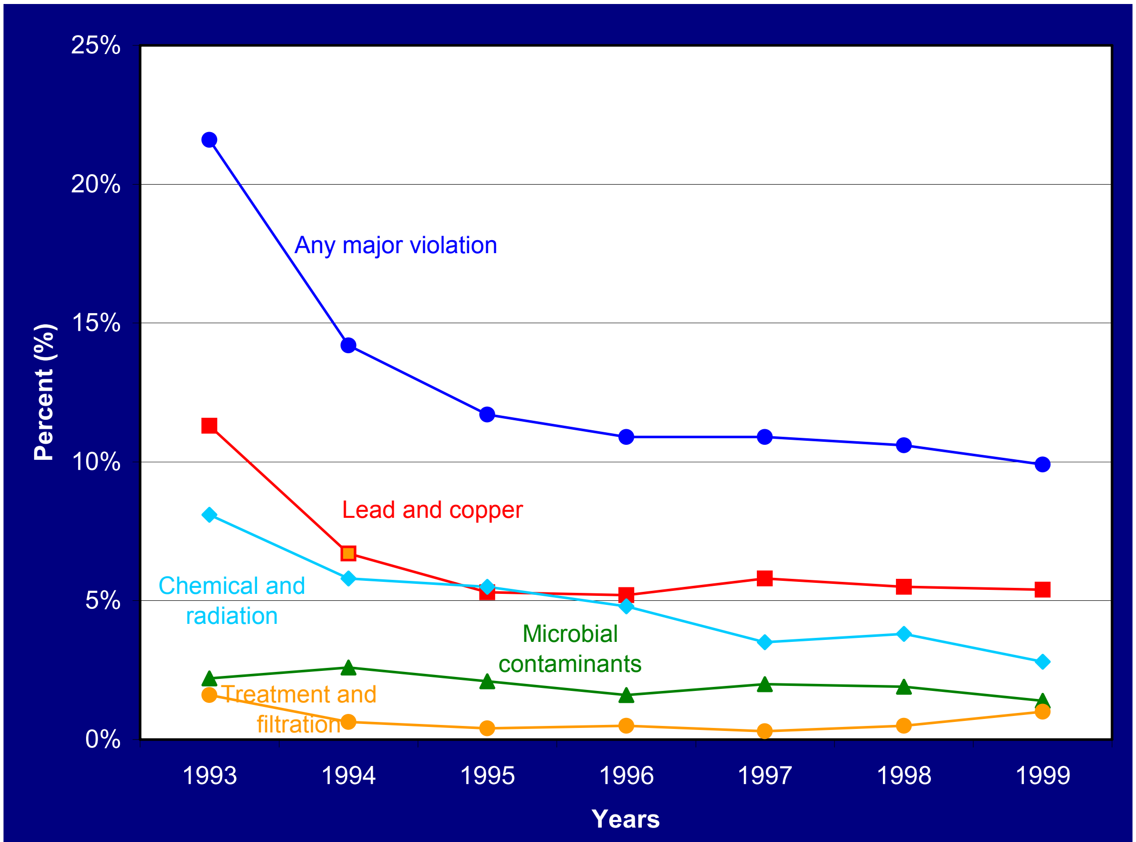
- The percentage of children served by public water systems that reported exceeding a Maximum Contaminant Level (MCL) or violated a treatment standard decreased from 20 percent in 1993 to 8 percent in 1999.
- Every category of reported violation decreased between 1993 and 1999 except for nitrates and nitrites, which remained steady. The largest decline was for violations of the treatment and filtration standards.
- From 1993-1999, approximately 0.2 percent of the children served by public water systems were served by systems that reported violations of the nitrate or nitrite standard.

Data Table 14.1: Percentage of Children Living in Areas Served by Public Water Systems that Exceeded a Drinking Water Standard or Violated a Treatment Requirement in the United States, 1993–1999

1993-1997					
Type of standard violated	**1993**	**1994**	**1995**	**1996**	**1997**
Lead and copper*	2.2%	0.9%	1.4%	1.6%	1.7%
Microbial contaminants	8.3%	7.5%	4.1%	4.3%	3.6%
Chemical and radiation	4.7%	4.7%	2.2%	1.8%	2.4%
Nitrate/nitrite	0.23%	0.12%	0.25%	0.20%	0.37%
Treatment and filtration	10.7%	8.1%	4.5%	3.7%	3.6%
Any health-based violations	20.2%	15.5%	12.0%	10.7%	10.7%
1998-1999					
Type of standard violated	**1998**	**1999**			
Lead and copper*	1.6%	1.5%			
Microbial contaminants	2.8%	2.5%			
Chemical and radiation	1.2%	1.0%			
Nitrate/nitrite	0.17%	0.21%			
Treatment and filtration	3.4%	3.0%			
Any health-based violations	8.6%	8.0%			

Source: US Environmental Protection Agency, Office of Water, Safe Drinking Water Information System

Figure 14.2: Percentage of Children Living in Areas Served by Public Water Systems with Major Violations of Drinking Water Monitoring and Reporting Requirements, in the United States, 1993–1999



Source: US Environmental Protection Agency. 2003. America's Children and the Environment: Measure of Contaminates, Body Burdens, and Illness. www.epa.gov/envirohealth/children

Data: US Environmental Protection Agency. Office of Water. Safe Drinking Water Information Systems (percentages are estimated)

Key Observations

- In 1993, approximately 22 percent of children lived in an area served by a public water system that had at least one major monitoring and reporting violation. This figure decreased to about 10 percent in 1999.
- The largest number of monitoring and reporting violations occurred for the lead and copper standards. Approximately 11 percent of children in 1993 were served by public water systems with monitoring and reporting violations for lead and copper, decreasing to about 5 percent in 1995. The number has remained relatively constant since then.

Table 14.2: Percentage of Children Living in Areas Served by Public Water Systems with Major Violations of Drinking Water Monitoring and Reporting Requirements in the United States, 1993–1999

1993-1997					
Type of standard violated	**1993**	**1994**	**1995**	**1996**	**1997**
Lead and copper	11.3%	6.7%	5.3%	5.2%	5.8%
Microbial contaminants	2.2%	2.6%	2.1%	1.6%	2.0%
Chemical and radiation	8.1%	5.8%	5.5%	4.8%	3.5%
Treatment and filtration	1.6%	0.6%	0.4%	0.5%	0.3%
Any major violation	21.6%	14.2%	11.7%	10.9%	10.9%
1998-1999					
Type of standard violated	**1998**	**1999**			
Lead and copper	5.5%	5.4%			
Microbial contaminants	1.9%	1.4%			
Chemical and radiation	3.8%	2.8%			
Treatment and filtration	0.5%	1.0%			
Any major violation	10.6%	9.9%			

Source: US Environmental Protection Agency, Office of Water, Safe Drinking Water Information System

Limitations

The Safe Drinking Water Information System (SDWIS) does not track concentrations of contaminants in drinking water, but instead tracks the frequency with which standards are exceeded. SDWIS also does not collect data on the number of children served by public water systems, but only on the total population served. EPA has estimated the number of children affected based on county-level census data. Data are available only for public water systems. Approximately 28 million people are served by private water systems that are not required to monitor and report the quality of drinking water.[92] Many people served by private water supplies live in rural and agricultural areas, which may be at increased risk for nitrate and nitrite contamination. Conversely, many children served by public water systems may not drink the tap water or may use a water filtration device to further purify the water. Thus, the indicator may overestimate the percentage of children exposed to contaminated drinking water. In addition, the drinking water contaminant measures in this report rely on the MCL standards, which are based partly on health considerations but also take into account technical feasibility and cost-benefit considerations.

Additional Indicators

None

Opportunities for Improvement
Each Maximum Contaminant Level in the drinking water standards also has a corresponding Maximum Contaminant Level Goal (MCLG), which is based only on health considerations. The MCLGs could be considered for measures in future reports. Actual measured contaminant concentrations would provide the most relevant measures of potential risks to children. The most complete data on contaminants in drinking water are collected at the state level; information from the states would have to be compiled nationally to improve the indicators for drinking water. Another limitation of the data on drinking water is that many water systems do not adequately monitor for contaminants, so no information about potential risks to children in those areas is available.

Related Programs/Activities
Objective 8-05 of the federal Healthy People 2010 initiative seeks to increase the number of people served by community water systems that meet the regulations of the Safe Drinking Water Act.

EPA's "Drinking Water for Kids" site provides information for parents and children about safe drinking water: http://www.epa.gov/safewater/kids/index.html.

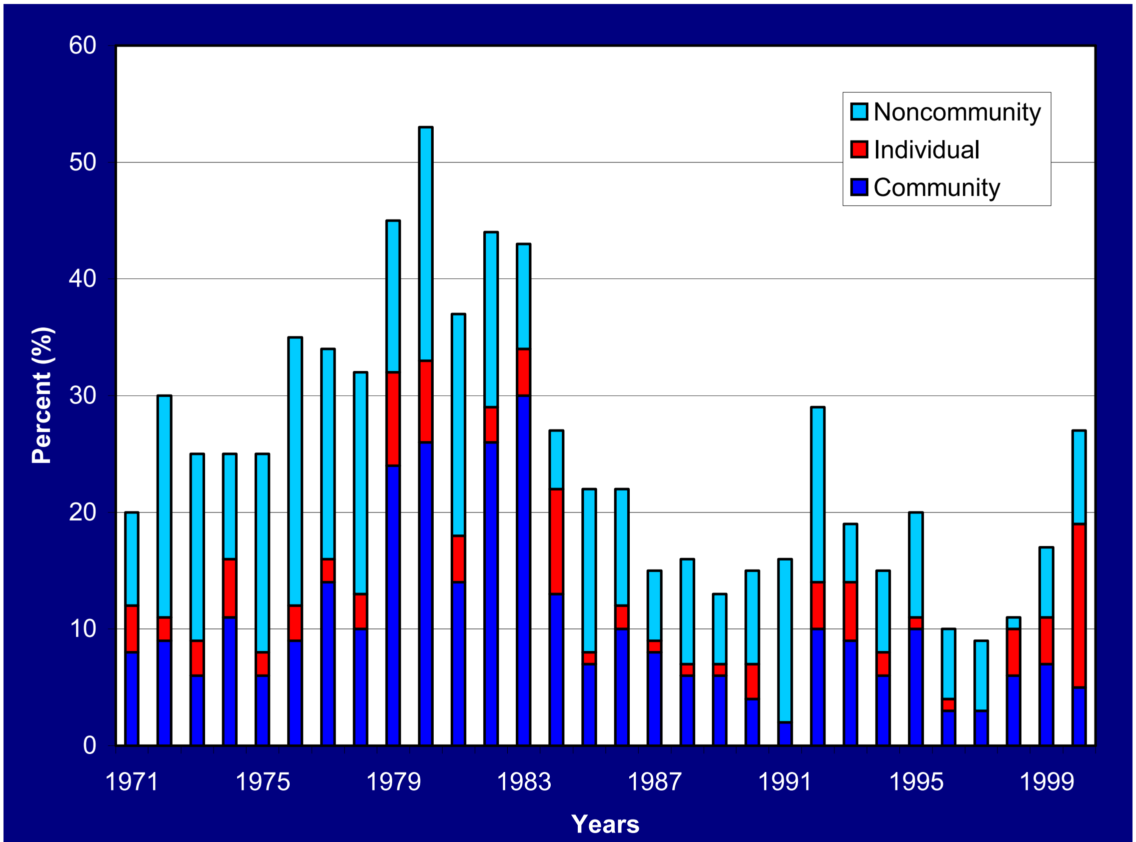
14.2 Sanitation

Canada and the United States have elected not to report on this indicator due to the high percentage of coverage for sewage collection and treatment in both urban and rural environments in both countries. Most urban and rural communities are served with sewerage and sanitation services or have septic systems to collect and treat sewage. Canada has presented this indicator in their country report (see Volume II).

14.3 Waterborne Diseases

The United States does not collect waterborne disease outbreak information focused exclusively on children. However, data are available to present an indicator of waterborne disease outbreaks by year and type of water system for the whole population. The data are based on a voluntary reporting system and are for outbreaks, not individual cases. The outbreaks are reported based on illness after either ingestion of drinking water or exposure to water either at work or recreationally.

Figure 14.3: Waterborne Disease Outbreaks by Year and Type of Water System, in the United States, 1971–2000



Source: Based on data presented in Craun, G.F. and R.L. Calderon. "Waterborne Outbreaks in the United States, 1971–2000". In Frederick W. Pontius (ed.), Drinking Water Regulations and Health, New York, NY: John Wiley & Sons: 2003, 40-56.

Note: A waterborne disease outbreak is defined as an event which 1) more than two persons have experienced an illness after either the ingestion or drinking water or exposure to water encountered in recreational or occupational settings, and 2) epidemiologic evidence implicates water as the probable source of illness.

Key Observations

- Between 1971 and 2000, there were 751 reported waterborne disease outbreaks associated with drinking water from individual, non-community systems, and community water systems.
- During 1999–2000, a total of 44 outbreaks (18 from private wells, 14 from non-community systems, and 12 from community systems) associated with drinking water were reported by 25 states.
- *Non-community water systems* are systems that either 1) regularly supply water to at least 25 of the same people at least 6 months per year but not year round (e.g., schools, factories, office buildings, and hospitals that have their own water systems), or 2) provide water in a place where people do not remain for long periods of time (e.g., a gas station or campground). *Individual water systems* are not regulated by the Safe Drinking Water Act and serve fewer than 25 persons or 15 service connections, including many private wells. *Community water systems* provide water to at least 25 of the same people or service connections year round.
- In 2002, giardiasis became a nationally notifiable disease to the Centers for Disease Control and Prevention (CDC). From 1998 through 2002, the total number of reported cases of giardiasis

decreased from 24,226 for 1998 to 19,708 for 2001 and then increased to 21,300 for 2002. The number of states reporting giardiasis cases increased from 42 to 46; however, the number of states reporting more than 15 cases per 100,000 people decreased from 10 to five. A greater number of case reports were received for children aged 1–9 years and for adults aged 30–39 years compared with other age groups. Incidence of giardiasis was highest in northern states. Peak onset of illness occurred annually during early summer through early fall. The seasonal peak in age-specific case reports coincides with the summer recreational water season and might reflect increased use of communal swimming venues (e.g., lakes, rivers, swimming pools, and water parks) by young children.

Data Table 14.3: Waterborne Disease Outbreaks by Year and Type of Water System in the United States, 1971–2000 (n=751)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Community water systems	8	9	6	11	6	9	14	10	24	26
Individual water systems	4	2	3	5	2	3	2	3	8	7
Non-community water systems	8	19	16	9	17	23	18	19	13	20

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Community water systems	14	26	30	13	7	10	8	6	6	4
Individual water systems	4	3	4	9	1	2	1	1	1	3
Non-community water systems	19	15	9	5	14	10	6	9	6	8

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Community water systems	2	10	9	6	10	3	3	6	7	5
Individual water systems	0	4	5	2	1	1	0	4	4	14
Non-community water systems	14	15	5	7	9	6	6	1	6	8

Source: Based on data presented in Craun, G.F. and R.L. Calderon. "Waterborne Outbreaks in the United States, 1971–2000." In: Frederick W. Pontius (ed.), Drinking Water Regulations and Health, New York, NY: John Wiley & Sons, 2003, 40–56.

Limitations

Many factors can influence whether a water-borne disease outbreak (WBDO) is recognized and investigated by local, territorial, and state public health agencies. For example, the size of the outbreak, severity of the disease caused by the outbreak, public awareness of the outbreak, whether people seek medical care or report to a local health authority, reporting requirements, routine laboratory testing for organisms, and resources for investigation can all influence the identification and investigation of a WBDO. In addition, this system is a voluntary reporting system, so not every state or relevant public health agency may be reporting information to the system. This system underreports the true number of outbreaks because of the multiple steps required before an outbreak is identified and investigated. Thus, an increase in the number of outbreaks reported could either reflect an actual increase or improved surveillance and reporting at the local and state level. This indicator provides data only on microbial outbreaks and does not include other contaminants that are relevant to children's health, such as lead. Furthermore, the indicator provides data on the entire population, not just children.

Additional Indicators
EPA has prepared an additional indicators on drinking water quality, available at www.epa.gov/envirohealth/children:

- Percentage of children living in areas served by public water systems that exceeded a drinking water standard or violated treatment requirements
- Percentage of children living in areas with major violations of drinking water monitoring and reporting requirements

Opportunities for Improvement
Standardized surveillance and collection of data could be implemented to provide reliable estimates of waterborne disease outbreaks. In addition, this data is not specific to children, so additional information could be collected on the age of the population affected.

Related Programs/Activities
The Centers for Disease Control and Prevention and EPA are collaborating on a series of epidemiology studies to assess the magnitude of non-outbreak waterborne illness associated with consumption of municipal drinking water.

Objective 8-05 of the federal Healthy People 2010 initiative seeks to increase the number of people served by community water systems that meet the regulations of the Safe Drinking Water Act.

EPA's "Drinking Water for Kids" site provides information for parents and children about safe drinking water: http://www.epa.gov/safewater/kids/index.html.

15 Opportunities for Improvement

Ideally, data sources for all indicators would provide information collected in a consistent manner for all of the nation's children. Data also would be available for 10 years or more to provide information about changes over time, and to show whether the changes were statistically significant. Information would be available on differences among geographic areas, by race/ethnicity, and by economic status.

15.1 Indicators Related to Asthma and Respiratory Disease

15.1.1 Outdoor Air Pollution

The indicators could provided additional information to reflect the number, margin, and duration of exceedances to help distinguish among exceedances. More frequent measurement of PM_{10} and other pollutants to include in the Air Quality Index may more accurately reflect air quality. The combination of multiple pollutants as part of an overall air quality index might better replicate the health impacts of high pollution days and provide more useful information on potential air quality hazards to sensitive populations. In addition, consideration of the potential for health risks from long-term exposures to pollutants could be incorporated into an indicator.

15.1.2 Indoor Air Pollution

For indoor air quality in general, the most important improvement would be to add data about sources of other indoor air pollutants, such as consumer products, gas stoves, and furnishings, for both homes and schools.

For the indicator on the percentage of children ages 6 and under regularly exposed to secondhand smoke in the home, it would be ideal if data were available on an annual rather than periodic basis.

The indicators on cotinine could be improved by finding a consistent and reliable method to measure exposure levels in infants and toddlers (ages 0–3).

15.1.3 Asthma

Continuing refinements in the National Health Interview Survey questions may help reduce any false self-reporting of asthma. The questions now ask whether a health professional has diagnosed a child with asthma. Additional research could be conducted to document the role of environmental factors in the prevalence of asthma

15.2 Indicators Related to the Effects of Lead and Chemicals, Including Pesticides

15.2.1 Blood Lead Levels

Enhanced monitoring at the state level could improve the availability of geographically specified data and could provide more information about existence of higher end exposures.

15.2.2 Lead in the Home

As lead has been used in paint as well as gasoline and many industries and is a common hazardous contaminant, it may be appropriate to expand this indicator to look at the proximity of children to older industry sectors known to use lead such as historic or abandoned smelters, foundries and other industrial facilities now considered Brownfields.

Data on lead in paint at schools and day cares would also be an additional important area for coverage.

15.2.3 Industrial Releases of Lead

Improved coordination between state and local health agencies conducting surveillance in areas where industrial emissions may pose health risks to communities.

15.2.3 Industrial Releases of Certain Toxic Chemicals

Canada, Mexico, and the United States are working to enhance the comparability of the North American Pollutant Release and Transfer Registers (PRTRs) through CEC's PRTR project. The three nations developed *An Action Plan to Enhance the Comparability of PRTRs in North America* that was adopted by the CEC Council in June 2002. This action plan currently is being updated.

PRTR data could be analyzed using particular subsets of chemicals that are most important to children's health (e.g., PBTs, carcinogens). This information could be examined at a regional, geographic, facility, or industry sector level to identify areas or facilities to work with to set priorities, measure progress, and target areas of special and immediate concern.

15.2.3 Pesticide

As required by the Food Quality Protection Act, EPA currently is conducting a cumulative risk assessment for the organophosphate pesticides. For the first time ever, this scientific assessment evaluates the potential risks to children from the combined estimates of all contributing organophosphate residues in food and drinking water consumption, and from activities around the home. EPA already has imposed various restrictions on many individual uses of organophosphates, particularly those that may pose greater risk to children from dietary and residential sources. These restrictions, and others that may be imposed as a result of the cumulative assessment, are expected to lower children's potential exposure to these pesticides and thereby reduce potential health risks. EPA will evaluate the outputs from the cumulative risk assessments to determine how they may be used in developing measures that better reflect increases or decreases in pesticide exposure or risk. In addition, the Agency expects to add indicators of pesticide exposures to the body burdens section of future editions of the America's Children and the Environment report.

15.3 Indicators Related to Waterborne Diseases

15.3.1 Drinking Water Systems in Violation of Standards

Each Maximum Contaminant Level in the drinking water standards also has a corresponding Maximum Contaminant Level Goal (MCLG), which is based only on health considerations. The MCLGs could be considered for measures in future reports.

Actual measured contaminant concentrations would provide the most relevant measures of potential risks to children. The most complete data on contaminants in drinking water are collected at the state level; information from the states would have to be compiled nationally to improve the indicators for drinking water.

Another limitation of the data on drinking water is that many water systems do not adequately monitor for contaminants, so no information about potential risks to children in those areas is available.

15.3.3. Waterborne Diseases

Standardized surveillance and collection of data could be implemented to provide reliable estimates of waterborne disease outbreaks. In addition, this data is not specific to children, so additional information could be collected on the age of the population affected.

16 References

Many of the indicators presented here were originally developed for the following two reports:

America's Children and the Environment, US EPA, 2003.
Web site: http://www.epa.gov/envirohealth/children

Draft Report on the Environment, US EPA, 2003.
Web site: http://www.epa.gov/indicators/roe/

Specific information sources used to develop the indicators are listed below.

Air Quality Standards

US Environmental Protection Agency, Office of Air Quality Planning and Standards, Aerometric Information Retrieval System (now the Air Quality System)
Web site: http://www.epa.gov/ttn/airs/airsaqs/

Indoor Air Quality

Data from US Centers for Disease Control, National Center for Health Statistics.

National Health Interview Survey.
Web site: http://www.cdc.gov/nchs/nhis.htm

National Health and Nutrition Examination Survey.
Web site: http://www.cdc.gov/nchs/nhanes.htm

Asthma Prevalence

US Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey.
Web site: http://www.cdc.gov/nchs/nhis.htm

Blood Lead Levels

Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey.
Web site: http://www.cdc.gov/nchs/nhanes.htm

Pesticide Residues

US Department of Agriculture, Pesticide Data Program.
Web site: http://www.ams.usda.gov/science/pdp/

US Environmental Protection Agency, Office of Pesticide Programs.
Web site: http://www.epa.gov/pesticides

Pollutant Release and Transfer Registers Data

EPA Office of Environmental Information, *2001 Toxics Release Inventory (TRI) Public Data Release Report*, June 2003
Web site: http://www.epa.gov/tri

Drinking Water Standards and Treated Water

US Environmental Protection Agency, Safe Drinking Water Information System
Web site at http://www.epa.gov/safewater/sdwisfed/sdwis.htm

Morbidity (Number of Childhood Illnesses Attributed to Waterborne Disease)
Craun, G.F. and R.L. Calderon. "Waterborne Outbreaks in the United States, 1971–2000." In: Frederick W. Pontius (ed.), Drinking Water Regulations and Health, New York, NY: John Wiley & Sons, 2003, 40–56.

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Appendix 1 US Metadata for the Indicators

Percentage of children living in counties in which air quality standards were exceeded in the United States, 1990–2003	**Type of indicator: Exposure surrogate**
INDICATOR Description	
Definition	The percentage of US children living in counties in which national air quality standards were exceeded.
Rationale and role	Air pollution contributes to a wide variety of adverse health effects. The US Environmental Protection Agency has set National Ambient Air Quality Standards that specify allowable concentrations of the most common air pollutants. The standards are set at a level that protects public health with an adequate margin of safety. The indicator shows the percentage of children living in counties in which these air quality standards were exceeded.
Data Range	Dates: 1990–2003. Ages: 0–18.
Data sources, availability and quality	State and local environmental agencies conduct air monitoring programs to measure concentrations of common air pollutants. The individual measurements are submitted to EPA for inclusion in a national database called the Air Quality System. EPA identifies instances in which levels of air pollutants measured in the air are greater than the air quality standards. Data quality is considered high, but not all counties measure all air pollutants and some do not measure any. Agency Contact: David Mintz (mintz.david@epa.gov) or James Hemby (hemby.james@epa.gov), US EPA, Office of Air Quality Planning and Standards. Details on the Census data used are available in America's Children and the Environment, at <http://www.epa.gov/envirohealth/children>.
Units of measurement	Air quality standards use various units of measurement depending on the pollutant. The values representing an exceedance for the pollutants presented here are shown in Table 1 at http://www.epa.gov/envirohealth/children/contaminants/data.htm.
Computation	EPA's Air Quality System reports counties that exceeded the various standards. Census data were used to determine the number of children living in these counties. The percentage of children living in counties that exceeded the various standards was then calculated by dividing the number of children living in these counties by the total number of children in the United States.
Sources of further information	Data are from the Aerometric Information Retrieval System (now the Air Quality System), at http://www.epa.gov/ttn/airs/airsaqs/, US Environmental Protection Agency, Office of Air Quality Planning and Standards.
Scale of application	National. This indicator aggregates county-level data for all counties in the United States that monitor common air pollutants. Note that many counties monitor only some air pollutants and some counties do not monitor any.
Useful references	US Environmental Protection Agency, Office of Air Quality Planning and Standards, Aerometric Information Retrieval System (now the Air Quality System), at <http://www.epa.gov/ttn/airs/airsaqs/>.
Strengths of the Indicator	The indicator provides national-scale data on the percentage of children living in counties in which air quality concentrations were above the level of the standard.

Percentage of children's days with good, moderate, or unhealthy air quality	Type of indicator: Exposure surrogate
INDICATOR Description	
Definition	The percentage of US children's days with good, moderate, or unhealthy air quality, as defined by the US Environmental Protection Agency's Air Quality Index.
Rationale and role	Air pollution contributes to a wide variety of adverse health effects. The US Environmental Protection Agency has set National Ambient Air Quality Standards that specify allowable concentrations of the most common air pollutants. The standards are set at a level that protects public health with an adequate margin of safety. The indicator shows the percentage of children's days of exposure considered to be of good, moderate, or unhealthy air quality .
Data Range	Dates: 1990–1999. Ages: 0–18.
Data sources, availability and quality	State and local environmental agencies conduct air monitoring programs to measure concentrations of common air pollutants. The individual measurements are submitted to EPA for inclusion in a national database called the Air Quality System. EPA provides an Air Quality Index (AQI) that represents air quality for specific days and is widely reported in newspapers and other media outlets in metropolitan areas. Data quality is considered high, but not all counties measure all air pollutants and some do not measure any. Agency Contact: David Mintz (mintz.david@epa.gov) or James Hemby (hemby.james@epa.gov), US EPA, Office of Air Quality Planning and Standards.
Units of measurement	Air quality standards use various units of measurement depending on the pollutant.
Computation	The AQI is based on measurements of up to five of the six air quality criteria pollutants (carbon monoxide, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide). Lead is not included in the AQI. An AQI value of 100 for a criteria pollutant generally corresponds to the short-term National Ambient Air Quality Standard for that pollutant, and is the level EPA has set to protect public health for a single day. Above this level, pollutant-specific health advisories are issued. EPA has divided the AQI scale into categories. Air quality is considered "good" if the AQI is between 0 and 50, posing little or no risk. Air quality is considered "moderate" if the AQI is between 51 and 100. Some pollutants at this level may present a moderate health concern for a small number of individuals. Moreover, such a level may pose health risks if maintained over many days. Air quality is considered "unhealthy for sensitive groups" if the AQI is between 101 and 150. Members of sensitive groups such as children may experience health effects, but the general population is unlikely to be affected. Air quality is considered "unhealthy" if the AQI is between 151 and 200. This indicator was developed by reviewing the air quality designation for each day for each county and weighting the daily designations by the number of children living in each county. The overall measure reports the percentage of children's days of exposure considered to be of good, moderate, or unhealthy air quality.
Sources of further information	Data are from the Aerometric Information Retrieval System (now the Air Quality System), at http://www.epa.gov/ttn/airs/airsaqs/, US Environmental Protection Agency, Office of Air Quality Planning and Standards
Scale of application	National. This indicator aggregates county-level data for all counties in the United States that monitor common air pollutants. Note that many counties monitor only some air pollutants and some counties do not monitor any.
Useful references	US Environmental Protection Agency, Office of Air Quality Planning and Standards, Aerometric Information Retrieval System (now the Air Quality System), at http://www.epa.gov/ttn/airs/airsaqs/
Strengths of the Indicator	The indicator provides a sense of the intensity of pollution over the course of a year. This method provides data on the air quality category for each day, rather than simply reporting whether a county ever exceeds any standard for any pollutant. Counties in which air quality concentrations were above the level of the standard.

Percentage of children ages 6 and under regularly exposed to secondhand smoke in US homes, 1994–2003	**Type of indicator: Measure of exposure**
INDICATOR Description	
Definition	The percentage of children ages 6 and under regularly exposed to secondhand smoke in the home.
Rationale and role	Children who are exposed to secondhand smoke are at increased risk for a number of adverse health effects, including lower respiratory tract infections, bronchitis, pneumonia, fluid in the middle ear, asthma symptoms, and sudden infant death syndrome. Exposure to secondhand smoke also may be a risk factor contributing to the development of new cases of asthma. Smoking in the home is an important source of exposure because young children spend most of their time at home and indoors.
Data Range	Dates: 1994–2003. Ages: 0–6 years old.
Data sources, availability and quality	For 1994 and 1998, exposure in the home was measured by data from the National Health Interview Survey (NHIS), administered by the Centers for Disease Control and Prevention's National Center for Health Statistics. Specifically, the measure indicates the percentage of children 6 years and under who are exposed regularly (4 or more days per week) to secondhand smoke in the home. For 2003, data are from US EPA Indoor Environments Division, National Survey on Environmental Management of Asthma and Children's Exposure to Tobacco Smoke.
Units of measurement	Simple percentage, based on survey results.
Computation	Results are calculated from responses to the survey questions
Sources of further information	NHIS Web site: http://www.cdc.gov/nchs/nhis.htm *Respiratory Health Effects of Passive Smoking* (EPA, 1992): http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=2835 *Health Effects of Exposure to Environmental Tobacco Smoke* (California EPA, 1997): http://www.oehha.org/air/environmental_tobacco/finalets.html
Scale of application	National.
Useful references	NHIS Web site: http://www.cdc.gov/nchs/nhis.htm EPA Smoke-free Homes site: http://www.epa.gov/smokefree/
Strengths of the Indicator	This indicator is a measure of the exposure of children to tobacco smoke, an important indoor pollutant. The measure is based on nationally representative survey data.

Percentage of children ages 4-11 with detectable blood cotinine by race and ethnicity, 1988–94 and 1999–2000	**Type of indicator: Body burden**
INDICATOR Description	
Definition	The percentage of US nonsmoking children ages 4–11 with specified levels of serum cotinine, by race and ethnicity.
Rationale and role	Children who are exposed to secondhand smoke are at increased risk for a number of adverse health effects, including lower respiratory tract infections, bronchitis, pneumonia, fluid in the middle ear, asthma symptoms, and sudden infant death syndrome. Exposure to secondhand smoke also may be a risk factor contributing to the development of new cases of asthma. Smoking in the home is an important source of exposure because young children spend most of their time at home and indoors.
Data Range	Dates: 1988–94, 1999–2000. Ages: 4–11
Data sources, availability and quality	Data on children's cotinine levels were obtained from the National Health and Nutrition Examination Surveys (NHANES) III, and NHANES 1999–2000, conducted by the National Center for Health Statistics. The survey is designed to assess the health and nutritional status of the non-institutionalized civilian population with direct physical examinations and interviews, using a complex multi-stage, stratified, clustered sampling design. Interviewers obtain information on personal and demographic characteristics, including age, household income, and race and ethnicity by self-reporting or as reported by an informant. NHANES III covers the period 1988–1994. Starting in 1999, NHANES changed to a continuous survey visiting 15 US locations per year and surveying and reporting for approximately 5,000 people annually.
Units of measurement	Simple percentage, based on survey results.
Computation	Exposure is measured by analyzing the cotinine levels in the blood. Data presented for nonsmokers only, defined as those with less than 11 ng/mL serum cotinine. Detectable cotinine levels are at or above 0.05 ng/mL.
Sources of further information	Clifford Johnson, National Center for Health Statistics, clj1@cdc.gov
Scale of application	National.
Useful references	National Health and Nutrition Examination Survey web site: www.cdc.gov/nchs/nhanes.htm Centers for Disease Control and Prevention: Second National Report on Human Exposure to Environmental Chemicals: http://www.cdc.gov/exposurereport/
Strengths of the Indicator	Cotinine, one of the major metabolites of nicotine, is considered a very good biomarker of recent exposure to secondhand smoke. The indicator is based on nationally representative survey data.

Percentage of children with asthma in the United States, 1980–2003	**Type of indicator: Effect**
INDICATOR Description	
Definition	The percentage of children in the United States with asthma, from 1980–2003.
Rationale and role	Asthma is the most common chronic disease among children and is costly in both human and monetary terms. Environmental factors may increase the severity or frequency of asthma attacks in children who have the disease. Children with asthma are particularly sensitive to outdoor air pollutants, including ozone, particulate matter, and sulfur dioxide. These pollutants can exacerbate asthma.
Data Range	Dates: 1980–2003. Ages: 0–18.
Data sources, availability and quality	Data are from the US Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey. Data are collected through personal household interviews.
Units of measurement	Simple percentage of children reported or diagnosed as having asthma.
Computation	Simple tabulation of children reported as having asthma or having been diagnosed as having asthma. Prior to 1997, the National Health Interview Survey asked parents if their child had asthma in the past 12 months. From 1997–2000, the survey asked parents the following two questions: “Has a doctor or other health professional ever told you that [child’s name] had asthma?” and if yes, “During the past 12 months, has [child’s name] had an episode of asthma or an asthma attack?” In 2001, the NHIS added the following new question: “Does [child’s name] still have asthma?” This question was used to estimate the percentage of children who currently have asthma.
Sources of further information	Laura Montgomery, National Center for Health Statistics, lem3@cdc.gov. National Health Interview Survey Web site: http://www.cdc.gov/nchs/nhis.htm
Scale of application	National.
Useful references	National Health Interview Survey Web site: http://www.cdc.gov/nchs/nhis.htm. The indicator was developed for EPA’s report, America’s Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003); www.epa.gov/envirohealth/children/.
Strengths of the Indicator	A national-scale indicator of the prevalence of asthma, based on direct interviews.

Percentage of children having an asthma attack in the previous 12 months, by race/ethnicity and family income, 1997–2000	**Type of indicator: Effect**
INDICATOR Description	
Definition	The percentage of children in the United States having an asthma attack in the previous 12 months, by race/ethnicity and family income, 1997–2000.
Rationale and role	Asthma is the most common chronic disease among children and is costly in both human and monetary terms. Environmental factors may increase the severity or frequency of asthma attacks in children who have the disease. Children with asthma are particularly sensitive to outdoor air pollutants, including ozone, particulate matter, and sulfur dioxide. These pollutants can exacerbate asthma. Risk for asthma may differ by race/ethnicity and socioeconomic status.
Data Range	Dates: 1997–2000. Ages: 0–18.
Data sources, availability and quality	Data are from the US Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey. Data are collected through personal household interviews.
Units of measurement	Simple percentage of children reported or diagnosed as having asthma.
Computation	From 1997–2000, the survey asked parents the following two questions: "Has a doctor or other health professional ever told you that [child's name] had asthma?" and if yes, "During the past 12 months, has [child's name] had an episode of asthma or an asthma attack?"
Sources of further information	Laura Montgomery, National Center for Health Statistics, lem3@cdc.gov. National Health Interview Survey Web site: http://www.cdc.gov/nchs/nhis.htm
Scale of application	National.
Useful references	National Health Interview Survey Web site: http://www.cdc.gov/nchs/nhis.htm. The indicator was developed for EPA's report, America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003); www.epa.gov/envirohealth/children/.
Strengths of the Indicator	A national-scale indicator of the prevalence of asthma, based on direct interviews.

Concentrations of lead in the blood of children five and under in the United States, 1976–2002	**Type of indicator: Exposure**
INDICATOR Description	
Definition	The distribution of blood lead levels among children for the years 1999–2000.
Rationale and role	Lead is an important environmental health hazard for young children. Lead contributes to learning problems such as reduced intelligence and cognitive development. Studies also have found that childhood exposure to lead contributes to attention-deficit/hyperactivity disorder and hyperactivity and distractibility; increases the likelihood of dropping out of high school, having a reading disability, lower vocabulary, and lower class standing in high school; and increases the risk for antisocial and delinquent behavior. A blood lead level of 10 micrograms per deciliter (µg/dL) or greater is considered elevated, but there is no demonstrated safe concentration of lead in blood. Adverse health effects can occur at lower concentrations.
Data Range	Dates: 1976–2001 Ages: 0–5
Data sources, availability and quality	Data are from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. Body burden data from NHANES 1999–2000 are presented in: Second National Report on Human Exposure to Environmental Chemicals. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Environmental Health, January 2003. http://www.cdc.gov/nchs/nhanes.htm. Contact: Clifford Johnson (clj1@cdc.gov)
Units of measurement	Blood lead concentrations are measured in micrograms per deciliter of blood.
Computation	Data on children's blood lead levels were obtained from the National Health and Nutrition Examination Surveys (NHANES) II and III, and NHANES 1999–2000, conducted by the National Center for Health Statistics. The survey is designed to assess the health and nutritional status of the non-institutionalized civilian population with direct physical examinations and interviews, using a complex multi-stage, stratified, clustered sampling design. Interviewers obtain information on personal and demographic characteristics, including age, household income, and race and ethnicity by self-reporting or as reported by an informant. The first survey, NHANES I, was conducted during the periods 1971–1974 and 1974–1975; NHANES II covered the period 1976–1980; and NHANES III covered the period 1988–1994. Only NHANES II and III, however, contain data on blood lead levels. NHANES II provided blood lead data for children ages 6 months to 5 years; NHANES III provided data on children ages 1–5 years. Starting in 1999, NHANES changed to a continuous survey visiting 15 US locations per year and surveying and reporting for approximately 5,000 people annually. The percentage of children with blood lead levels greater than 10 µg/dL is influenced by the proportion of nonresponses within each category. Families with incomes below the poverty level had a lower response rate than families with incomes at or above the poverty level. The percentages are thus the best estimates available, but may be biased by the variation of nonresponses by family income.
Sources of further information	Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. http://www.cdc.gov/nchs/nhanes.htm.
Scale of application	National.
Useful references	Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. http://www.cdc.gov/nchs/nhanes.htm. The indicator was developed for EPA's report, America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003); www.epa.gov/envirohealth/children/.
Strengths of the Indicator	Provides representative national data on blood lead levels of children ages 5 and under.

Distribution of concentrations of lead in blood of children ages 1-5 in the United States, 1999–2000	**Type of indicator: Exposure**
INDICATOR Description	
Definition	The distribution of blood lead levels among children for the years 1999–2000.
Rationale and role	A blood lead level of 10 micrograms per deciliter or greater is considered elevated, but there is no demonstrated safe concentration of lead in blood. Adverse health effects can occur at lower concentrations. A growing body of research has found measurable adverse neurological effects in children at blood lead concentrations as low as 1 microgram per deciliter. EPA believes that effects may occur at blood lead levels so low that there is essentially no "safe" level of lead.
Data Range	Dates: 1999–2000. Ages: 1–5.
Data sources, availability and quality	Data are from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. Body burden data from NHANES 1999–2000 are presented in: Second National Report on Human Exposure to Environmental Chemicals. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Environmental Health, January 2003. http://www.cdc.gov/nchs/nhanes.htm. Contact: Clifford Johnson (clj1@cdc.gov)
Units of measurement	Percentage of children; blood lead concentrations are measured in micrograms per deciliter of blood.
Computation	Simple distribution (histogram) of percentage of children with various ranges of blood concentrations (0–1, 1–2, 2–3, 3–4, 4–5, 5–6, 6–7, and greater than 7 micrograms per deciliter).
Sources of further information	Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. http://www.cdc.gov/nchs/nhanes.htm.
Scale of application	National.
Useful references	Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. http://www.cdc.gov/nchs/nhanes.htm. The indicator was developed for EPA's report, America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003); www.epa.gov/envirohealth/children/.
Strengths of the Indicator	Provides representative national data on blood lead levels of children ages 5 and under.

Median concentrations of lead in blood of children ages 1–5, by race/ethnicity and family income, 1999–2000	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Median concentrations of lead in the blood of children for the years 1999–2000.
Rationale and role	A blood lead level of 10 micrograms per deciliter or greater is considered elevated, but there is no demonstrated safe concentration of lead in blood. Adverse health effects can occur at lower concentrations. A growing body of research has found measurable adverse neurological effects in children at blood lead concentrations as low as 1 microgram per deciliter. EPA believes that effects may occur at blood lead levels so low that there is essentially no "safe" level of lead.
Data Range	Dates: 1999–2000. Ages: 1–5.
Data sources, availability and quality	Data are from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. Body burden data from NHANES 1999–2000 are presented in: Second National Report on Human Exposure to Environmental Chemicals. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Environmental Health, January 2003. http://www.cdc.gov/nchs/nhanes.htm. Contact: Clifford Johnson (clj1@cdc.gov)
Units of measurement	Percentage of children; blood lead concentrations are measured in micrograms per deciliter of blood.
Computation	Percentage calculated from survey results.
Sources of further information	Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. http://www.cdc.gov/nchs/nhanes.htm.
Scale of application	National.
Useful references	Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. http://www.cdc.gov/nchs/nhanes.htm. The indicator was developed for EPA's report, America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003); www.epa.gov/envirohealth/children/.
Strengths of the Indicator	Provides representative national data on median blood lead levels of children ages 5 and under by race/ethnicity and family income.

Lead in US housing, 1998–2000	Type of indicator: Exposure
INDICATOR Description	
Definition	Percentage of US homes with paint that had some lead in it, 1998–2000.
Rationale and role	Today, elevated blood lead levels in the United States are due mostly to ingestion of contaminated dust, paint, and soil.
Data Range	Dates: 1998–2000.
Data sources, availability and quality	Data are from the National Survey of Lead and Allergens in Housing, under sponsorship of the Department of Housing and Urban Development and the National Institute of Environmental Health Sciences.
Units of measurement	Percentage of houses.
Computation	Percentage calculated from survey results.
Sources of further information	National Survey of Lead and Allergens in Housing, under sponsorship of the Department of Housing and Urban Development and the National Institute of Environmental Health Sciences. http://www.hud.gov/utilities/intercept.cfm?/offices/lead/hhi/HUD_NSLAH_Vol1.pdf.
Scale of application	National.
Useful references	National Survey of Lead and Allergens in Housing, under sponsorship of the Department of Housing and Urban Development and the National Institute of Environmental Health Sciences. http://www.hud.gov/utilities/intercept.cfm?/offices/lead/hhi/HUD_NSLAH_Vol1.pdf.
Strengths of the Indicator	Provides representative national data on lead-based paint in homes.

Lead-based paint and year of housing unit construction	Type of indicator: Exposure
INDICATOR Description	
Definition	Number of housing units in the United States with significant deterioration, de minimus deterioration, undamaged lead-based paint, or no lead-based paint.
Rationale and role	Today, elevated blood lead levels in the United States are due mostly to ingestion of contaminated dust, paint, and soil.
Data Range	Housing unit construction dates: pre–1940 to 1998
Data sources, availability and quality	Data are from the National Survey of Lead and Allergens in Housing, under sponsorship of the Department of Housing and Urban Development and the National Institute of Environmental Health Sciences.
Units of measurement	Number of housing units.
Computation	Percentage calculated from survey results.
Sources of further information	National Survey of Lead and Allergens in Housing, under sponsorship of the Department of Housing and Urban Development and the National Institute of Environmental Health Sciences. http://www.hud.gov/utilities/intercept.cfm?/offices/lead/hhi/HUD_NSLAH_Vol1.pdf.
Scale of application	National.
Useful references	National Survey of Lead and Allergens in Housing, under sponsorship of the Department of Housing and Urban Development and the National Institute of Environmental Health Sciences. http://www.hud.gov/utilities/intercept.cfm?/offices/lead/hhi/HUD_NSLAH_Vol1.pdf.
Strengths of the Indicator	Provides representative national data on condition of lead-based paint in homes.

On- and off-site releases of lead (and its compounds) in the United States, 1995–2003	Type of indicator: Exposure
INDICATOR Description	
Definition	Releases of lead and its compounds from manufacturing facilities between 1995 and 2000.
Rationale and role	Today, elevated blood lead levels in the United States are due mostly to ingestion of contaminated dust, paint, and soil.
Data Range	Dates: 1995–2000.
Data sources, availability and quality	Data are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US Toxics Release Inventory (TRI) are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at www.cec.org/takingstock/. For the TRI, facilities in all parts of the United States report their releases of over 650 toxic chemicals and chemical compounds to EPA and state agencies. Facilities indicate whether the releases were to land, air, water, underground injection well, or offsite disposal facilities. TRI includes a large amount of information on more than 600 chemicals and 30 chemical categories, including arsenic, cyanide, dioxin, lead, mercury, and nitrate compounds, and provides information on the amount and trends in releases and other waste management of chemicals, including recycling, energy recovery, and treatment. Under the Emergency Planning and Community Right to Know Act of 1986 and the Pollution Prevention Act of 1990, EPA's Office of Environmental Information makes these data available to the public annually via the *Toxics Release Inventory (TRI) Public Data Release Report*, as well as through several data access tools, including TRI Explorer (http://www.epa.gov/triexplorer) and Envirofacts (http://www.epa.gov/enviro). The Toxics Release Inventory (TRI) is a publicly available database that contains information on toxic chemical releases and other waste management activities for more than 600 chemicals reported annually by certain covered industries as well as by federal facilities. TRI data are an input to determine exposure or calculate potential risks to human health and the environment, but by themselves do not represent risk. The determination of potential risk depends on many factors, including toxicity, chemical fate after release, release location, and population concentrations. In addition, although EPA has expanded the TRI program, it does not cover all sources of releases and other waste management activities, such as vehicle emissions, nor does it cover all toxic chemicals or industry sectors. Also, while many facilities base their TRI data on monitoring data, others report estimated date to TRI as the program does not mandate release monitoring. Finally, facilities that do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report.
Units of measurement	Metric tons. One metric ton (tonne) equals 1.1 short tons.
Computation	While many facilities base their TRI data on monitoring data, others report estimated data to TRI as the program does not mandate additional release monitoring. Various estimation techniques are used when monitoring data are not available, and EPA has published estimation guidance for the regulated community. Variations between facilities can result from the use of different estimation methodologies. Facilities report information about the estimation methods when they report their release and waste management information. These factors should be taken into account when considering data accuracy and comparability.
Sources of further information	US EPA, Toxics Release Inventory <http://www.epa.gov/tri/>.
Scale of application	National.

Useful references	US EPA, Toxics Release Inventory <http://www.epa.gov/tri/>.
Strengths of the Indicator	Provides national data on releases of lead from manufacturing facilities.

On- and off-site releases of matched chemicals in the United States, 1998–2001	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Releases of toxic chemical in the United States between 1998 and 2001.
Rationale and role	Toxic chemicals, including some pesticides, can lead to a variety of acute or chronic health problems. The US Environmental Protection Agency (EPA) collects data using the Toxics Release Inventory (TRI), which represents a part of a broader universe of the chemicals that are used and released into the environment.
Data Range	Dates: 1998–2001.
Data sources, availability and quality	Data are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US Toxics Release Inventory (TRI) are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at www.cec.org/takingstock/. For the TRI, facilities in all parts of the United States report their releases of over 650 toxic chemicals and chemical compounds to EPA and state agencies. Facilities indicate whether the releases were to land, air, water, underground injection well, or offsite disposal facilities. TRI includes a large amount of information on more than 600 chemicals and 30 chemical categories, including arsenic, cyanide, dioxin, lead, mercury, and nitrate compounds, and provides information on the amount and trends in releases and other waste management of chemicals, including recycling, energy recovery, and treatment. Under the Emergency Planning and Community Right to Know Act of 1986 and the Pollution Prevention Act of 1990, EPA Office of Environmental Information makes these data available to the public annually via the *Toxics Release Inventory (TRI) Public Data Release Report*, as well as through several data access tools, including TRI Explorer (http://www.epa.gov/triexplorer) and Envirofacts (http://www.epa.gov/enviro). The Toxics Release Inventory (TRI) is a publicly available database that contains information on toxic chemical releases and other waste management activities for more than 600 chemicals reported annually by certain covered industries as well as by federal facilities. TRI data are an input to determine exposure or calculate potential risks to human health and the environment, but by themselves do not represent risk. The determination of potential risk depends on many factors, including toxicity, chemical fate after release, release location, and population concentrations. In addition, although EPA has expanded the TRI program, it does not cover all sources of releases and other waste management activities, such as vehicle emissions, nor does it cover all toxic chemicals or industry sectors. Also, while many facilities base their TRI data on monitoring data, others report estimated date to TRI as the program does not mandate release monitoring. Finally, facilities that do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report.
Units of measurement	Metric tons. One metric ton (tonne) equals 1.1 short tons.
Computation	While many facilities base their TRI data on monitoring data, others report estimated data to TRI as the program does not mandate additional release monitoring. Various estimation techniques are used when monitoring data are not available, and EPA has published estimation guidance for the regulated community. Variations between facilities can result from the use of different estimation methodologies. Facilities report information about the estimation methods when they report their release and waste management information. These factors should be taken into account when considering data accuracy and comparability.
Sources of further information	US EPA, Toxics Release Inventory <http://www.epa.gov/tri/>.
Scale of application	National.
Useful references	US Toxics Release Inventory <http://www.epa.gov/tri/>.

Strengths of the Indicator	Provides information about the releases of 153 matched chemicals to on-site air, land, water, and underground injections, as well as off-site releases.

On- and off-site releases of matched chemicals by sector in the United States, 1998–2001	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Releases of toxic chemical in the United States by sector between 1998 and 2001.
Rationale and role	Toxic chemicals, including some pesticides, can lead to a variety of acute or chronic health problems. The US Environmental Protection Agency (EPA) collects data using the Toxics Release Inventory (TRI), which represents a part of a broader universe of the chemicals that are used and released into the environment.
Data Range	Dates: 1998–2001.
Data sources, availability and quality	Data are from a 'matched' data set compiled by the CEC in which only chemicals that are reported by both Canada NPRI and the US Toxics Release Inventory (TRI) are included. For information on the methods used to compile the matched data sets used for these analyses, please refer to the CEC's annual *Taking Stock* report, available at <www.cec.org/takingstock/>. For the TRI, facilities in all parts of the United States report their releases of over 650 toxic chemicals and chemical compounds to EPA and state agencies. Facilities indicate whether the releases were to land, air, water, underground injection well, or offsite disposal facilities. TRI includes a large amount of information on more than 600 chemicals and 30 chemical categories, including arsenic, cyanide, dioxin, lead, mercury, and nitrate compounds, and provides information on the amount and trends in releases and other waste management of chemicals, including recycling, energy recovery, and treatment. Under the Emergency Planning and Community Right to Know Act of 1986 and the Pollution Prevention Act of 1990, EPA Office of Environmental Information makes these data available to the public annually via the *Toxics Release Inventory (TRI) Public Data Release Report*, as well as through several data access tools, including TRI Explorer <http://www.epa.gov/triexplorer> and Envirofacts <http://www.epa.gov/enviro>. The Toxics Release Inventory (TRI) is a publicly available database that contains information on toxic chemical releases and other waste management activities for more than 600 chemicals reported annually by certain covered industries as well as by federal facilities. TRI data are an input to determine exposure or calculate potential risks to human health and the environment, but by themselves do not represent risk. The determination of potential risk depends on many factors, including toxicity, chemical fate after release, release location, and population concentrations. In addition, although EPA has expanded the TRI program, it does not cover all sources of releases and other waste management activities, such as vehicle emissions, nor does it cover all toxic chemicals or industry sectors. Also, while many facilities base their TRI data on monitoring data, others report estimated date to TRI as the program does not mandate release monitoring. Finally, facilities that do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report.
Units of measurement	Metric tons. One metric ton (tonne) equals 1.1 short tons.
Computation	While many facilities base their TRI data on monitoring data, others report estimated data to TRI as the program does not mandate additional release monitoring. Various estimation techniques are used when monitoring data are not available, and EPA has published estimation guidance for the regulated community. Variations between facilities can result from the use of different estimation methodologies. Facilities report information about the estimation methods when they report their release and waste management information. These factors should be taken into account when considering data accuracy and comparability.
Sources of further information	US EPA, Toxics Release Inventory <http://www.epa.gov/tri/>.
Scale of application	National.
Useful references	US Toxics Release Inventory <http://www.epa.gov/tri/>.
Strengths of the	Provides information about the releases of 153 matched chemicals to on-site air,

Indicator	land, water, and underground injections, as well as off-site releases.

Distribution of TRI on-site and off-site disposal or other releases, 1998–2003	**Type of indicator: Exposure**
INDICATOR Description	
Definition	Distribution of US Toxics Release Inventory on-site and off-site disposal or other releases of toxic chemical in the United States between 1998 and 2003.
Rationale and role	Toxic chemicals, including some pesticides, can lead to a variety of acute or chronic health problems. The US Environmental Protection Agency (EPA) collects data using the Toxics Release Inventory (TRI), which represents a part of a broader universe of the chemicals that are used and released into the environment.
Data Range	Dates: 1998–2003.
Data sources, availability and quality	For the Toxics Release Inventory (TRI), facilities in all parts of the United States report their releases of over 650 toxic chemicals and chemical compounds to EPA and state agencies. Facilities indicate whether the releases were to land, air, water, underground injection well, or offsite disposal facilities. TRI includes a large amount of information on more than 600 chemicals and 30 chemical categories, including arsenic, cyanide, dioxin, lead, mercury, and nitrate compounds, and provides information on the amount and trends in releases and other waste management of chemicals, including recycling, energy recovery, and treatment. Under the Emergency Planning and Community Right to Know Act of 1986 and the Pollution Prevention Act of 1990, EPA Office of Environmental Information makes these data available to the public annually via the *Toxics Release Inventory (TRI) Public Data Release Report*, as well as through several data access tools, including TRI Explorer <http://www.epa.gov/triexplorer> and Envirofacts <http://www.epa.gov/enviro>. The Toxics Release Inventory (TRI) is a publicly available database that contains information on toxic chemical releases and other waste management activities for more than 600 chemicals reported annually by certain covered industries as well as by federal facilities. TRI data are an input to determine exposure or calculate potential risks to human health and the environment, but by themselves do not represent risk. The determination of potential risk depends on many factors, including toxicity, chemical fate after release, release location, and population concentrations. In addition, although EPA has expanded the TRI program, it does not cover all sources of releases and other waste management activities, such as vehicle emissions, nor does it cover all toxic chemicals or industry sectors. Also, while many facilities base their TRI data on monitoring data, others report estimated date to TRI as the program does not mandate release monitoring. Finally, facilities that do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report.
Units of measurement	Metric tons. One metric ton (tonne) equals 1.1 short tons.
Computation	While many facilities base their TRI data on monitoring data, others report estimated data to TRI as the program does not mandate additional release monitoring. Various estimation techniques are used when monitoring data are not available, and EPA has published estimation guidance for the regulated community. Variations between facilities can result from the use of different estimation methodologies. Facilities report information about the estimation methods when they report their release and waste management information. These factors should be taken into account when considering data accuracy and comparability.
Sources of further information	US EPA, Toxics Release Inventory <http://www.epa.gov/tri/>.
Scale of application	National.
Useful references	US Toxics Release Inventory <http://www.epa.gov/tri/>.
Strengths of the Indicator	Provides information about the disposal or other releases to land, water, air, on-site underground injection, or off-site disposal.

Percentage of fruits, vegetables, and grains with detectable residues of organophosphate pesticides	Type of indicator: Exposure surrogate
INDICATOR Description	
Definition	The percentage of food samples with detectable organophosphate pesticide residues reported by the US Department of Agriculture's Pesticide Data Program from 1994–2001.
Rationale and role	Children may be exposed to pesticides and other contaminants in their food and through day-to-day activities around the home. Children's exposures to pesticides may be higher than the exposures of most adults. Pound for pound, children generally eat more than adults, and they may be exposed more heavily to certain pesticides because they consume a diet different from that of adults. The US Department of Agriculture's Pesticide Data Program (PDP) concentrates its efforts on providing better pesticide residue data on foods most consumed by children. This PDP policy is guided by the requirements of the 1996 Food Quality Protection Act and by recommendations made in 1993 by the National Academy of Sciences in its report, *Pesticides in the Diets of Infants and Children*. Details on the commodities and pesticides tested by the PDP are available at http://www.ams.usda.gov/science/pdp/Overview.htm
Data Range	Dates: 1994–2001. Ages: 0-18 years old.
Data sources, availability and quality	Data from US Department of Agriculture's Pesticide Data Program. The program samples foods for pesticide residues. The analytical testing methods used in the monitoring efforts are standardized, validated, and subject to strict quality control and quality assurance programs The program Web site is http://www.ams.usda.gov/science/pdp/
Units of measurement	Simple percentage, based on reported results.
Computation	Each sample of food tested in the Pesticide Data Program is analyzed to determine whether the residues of a variety of different pesticides are present. The number of organophosphate pesticides and metabolites analyzed by PDP has increased from 34 in 1994 to 77 in 2001, and measurement techniques have become more sensitive during that time. In order to maintain comparability across the years 1994–2001, the organophosphate detection rates reported here include only detection of the original 34 pesticides included in the PDP at or above the original limits of detection available in 1994.
Sources of further information	For PDP information (PDP survey data): http://www.ams.usda.gov/science/pdp For EPA Office of Pesticide Programs information (risk assessment): http://www.epa.gov/pesticides
Scale of application	National.
Useful references	Data are from U.SDA, Pesticide Data Program. The indicator was developed for EPA's report, America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003); www.epa.gov/envirohealth/children/.
Strengths of the Indicator	The indicator shows pesticide residues on foods that are frequently consumed by children. The measure is based on nationally representative data.

Percentage of children living in areas served by public water systems that exceeded a drinking water standard or violated a treatment requirement, 1993–1999	Type of indicator: Exposure
INDICATOR Description	
Definition	The percentage of children served by public water systems that reported exceeding a Maximum Contaminant Level (MCL) or violated a treatment standard.
Rationale and role	Microbiological, chemical, and radiological contaminants can enter water supplies as a result of human activity and from natural sources. Disinfection of drinking water is a critical public health measure as it provides a barrier against harmful contaminants. Under the Safe Drinking Water Act, all public water systems must monitor the quality of their drinking water and report the monitoring results to the states, who in turn reports violations to EPA quarterly. National health-based standards exist for about 90 regulated contaminants. The Safe Drinking Water Act, as amended in 1996, mandates that EPA, states, and water systems implement multiple barriers to protect consumers from the risks of unsafe drinking water.
Data Range	Dates: 1993–1999.
Data sources, availability and quality	Community water systems report monitoring violations quarterly to the states and data are compiled by EPA. The Safe Drinking Water Information System, Federal version (SDWIS/FED) contains information about public water systems and their violations of EPA's drinking water regulations, as reported to EPA by states and EPA Regions in conformance with reporting requirements. The SDWIS includes information on the nation's 170,000 public water systems and violations of drinking water regulations. Data are available at http://www.epa.gov/OGWD/datagbases.html for each year since 1993. The overall quality of the violations data is high for the Total Coliform Rule standard, but is very low for other health-based standards and for monitoring and reporting. Source: EPA *2000 National Public Water Systems Compliance Report, National Summary*, July 2002.
Units of measurement	Percentage of children.
Computation	States report the following information to EPA on a quarterly basis: • Basic information including name, ID number, number of people served, type of system (year round or seasonal), and source (groundwater or surface water); • Violation information for each water system, including whether it has followed established monitoring and reporting schedules, complied with mandated treatment techniques, or violated any MCLs; • Enforcement information: Actions taken by states to ensure drinking water systems return to compliance if they are in violation of a regulation; and • Sampling results for unregulated contaminants and for regulated contaminants when the monitoring results exceed the MCL.
Sources of further information	Data were obtained from EPA, Office of Water, *Safe Drinking Water Information Systems/Federal version, (SDWIS/FED)*, 2003. http://www.epa.gov/safewater/sdwisfed/sdwis.htm
Scale of application	National.
Useful references	EPA *2000 National Public Water Systems Compliance Report, National Summary*, July 2002. Document located at: http://www.epa.gov/safewater/annual/sdwcom2002.pdf.
Strengths of the Indicator	The indicator provides a national-scale measure of the percentage of children served by public water systems who may be exposed to poor water quality.

Percentage of children living in areas served by public water systems with major violations of drinking water monitoring and reporting requirements in the United States, 1993–1997	Type of indicator: Exposure
INDICATOR Description	
Definition	The percentage of children served by public water systems that had at least one major monitoring and reporting violations.
Rationale and role	Microbiological, chemical, and radiological contaminants can enter water supplies as a result of human activity and from natural sources. Disinfection of drinking water is a critical public health measure as it provides a barrier against harmful contaminants. Under the Safe Drinking Water Act, all public water systems must monitor the quality of their drinking water and report the monitoring results to the states, who in turn reports violations to EPA quarterly. National health-based standards exist for about 90 regulated contaminants. The Safe Drinking Water Act, as amended in 1996, mandates that EPA, states, and water systems implement multiple barriers to protect consumers from the risks of unsafe drinking water.
Data Range	Dates: 1993–1997.
Data sources, availability and quality	Community water systems report monitoring violations quarterly to the states and data are compiled by EPA. The Safe Drinking Water Information System, Federal version (SDWIS/FED) contains information about public water systems and their violations of EPA's drinking water regulations, as reported to EPA by states and EPA Regions in conformance with reporting requirements. The SDWIS includes information on the nation's 170,000 public water systems and violations of drinking water regulations. Data are available at http://www.epa.gov/OGWD/datagbases.html for each year since 1993. The overall quality of the violations data is high for the Total Coliform Rule standard, but is very low for other health-based standards and for monitoring and reporting. Source: EPA *2000 National Public Water Systems Compliance Report, National Summary*, July 2002.
Units of measurement	Percentage of children.
Computation	States report the following information to EPA on a quarterly basis: • Basic information including name, ID number, number of people served, type of system (year round or seasonal), and source (groundwater or surface water); • Violation information for each water system, including whether it has followed established monitoring and reporting schedules, complied with mandated treatment techniques, or violated any MCLs; • Enforcement information: Actions taken by states to ensure drinking water systems return to compliance if they are in violation of a regulation; and • Sampling results for unregulated contaminants and for regulated contaminants when the monitoring results exceed the MCL.
Sources of further information	Data were obtained from EPA, Office of Water, *Safe Drinking Water Information Systems/Federal version, (SDWIS/FED)*, 2003. http://www.epa.gov/safewater/sdwisfed/sdwis.htm
Scale of application	National.
Useful references	EPA *2000 National Public Water Systems Compliance Report, National Summary*, July 2002. Document located at: http://www.epa.gov/safewater/annual/sdwcom2002.pdf.
Strengths of the Indicator	The indicator provides a national-scale measure of the percentage of children served by public water systems who may be exposed to poor water quality.

Waterborne disease outbreaks by year and type of water system in the United States, 1971–2000	**Type of indicator: Effect**
INDICATOR Description	
Definition	The number of voluntarily reported waterborne disease outbreaks (WBDOs) associated with drinking water (e.g., typhoid, cholera, hepatitis, and gastrointestinal illness) in the United States.
Rationale and role	The potential health effects of consuming contaminated drinking water range from minor to fatal. A system for reporting food and waterborne disease outbreaks has been in place since 1971 in the United States. The system allows public health officials to investigate and determine the role of food and water in contributing to intestinal illness, and identify actions that may be needed to protect public health.
Data Range	Dates: 1971–2000. All ages
Data sources, availability and quality	The Centers for Disease Control and Prevention and the Council of State and Territorial Epidemiologists maintain a collaborative surveillance system for the occurrences and causes of WBDOs. The data identify types of water systems, their deficiencies, and the etiologic agents associated with the outbreaks. The system reports outbreaks and the estimated numbers of people who become ill.
Units of measurement	Number of outbreaks per year.
Computation	State, territorial, and local public health agencies are primarily responsible for detecting and investigating WBDOs and voluntarily reporting them to CDC.
Sources of further information	Craun, G.F. and R.L. Calderon. “Waterborne Outbreaks in the United States, 1971–2000.” In: Frederick W. Pontius (ed.), Drinking Water Regulations and Health, New York, NY: John Wiley & Sons, 2003, 40-56.
Scale of application	National.
Useful references	Prevalence of 7 waterborne diseases can be found at: Morbidity and Mortality Weekly Report: http://www.cdc.gov/mmwr and Summary of Notifiable Diseases: http://www.cdc.gov/epo/dphsi/annsum.
Strengths of the Indicator	Data are used to evaluate current technologies for providing safe drinking water and safe recreational waters.

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