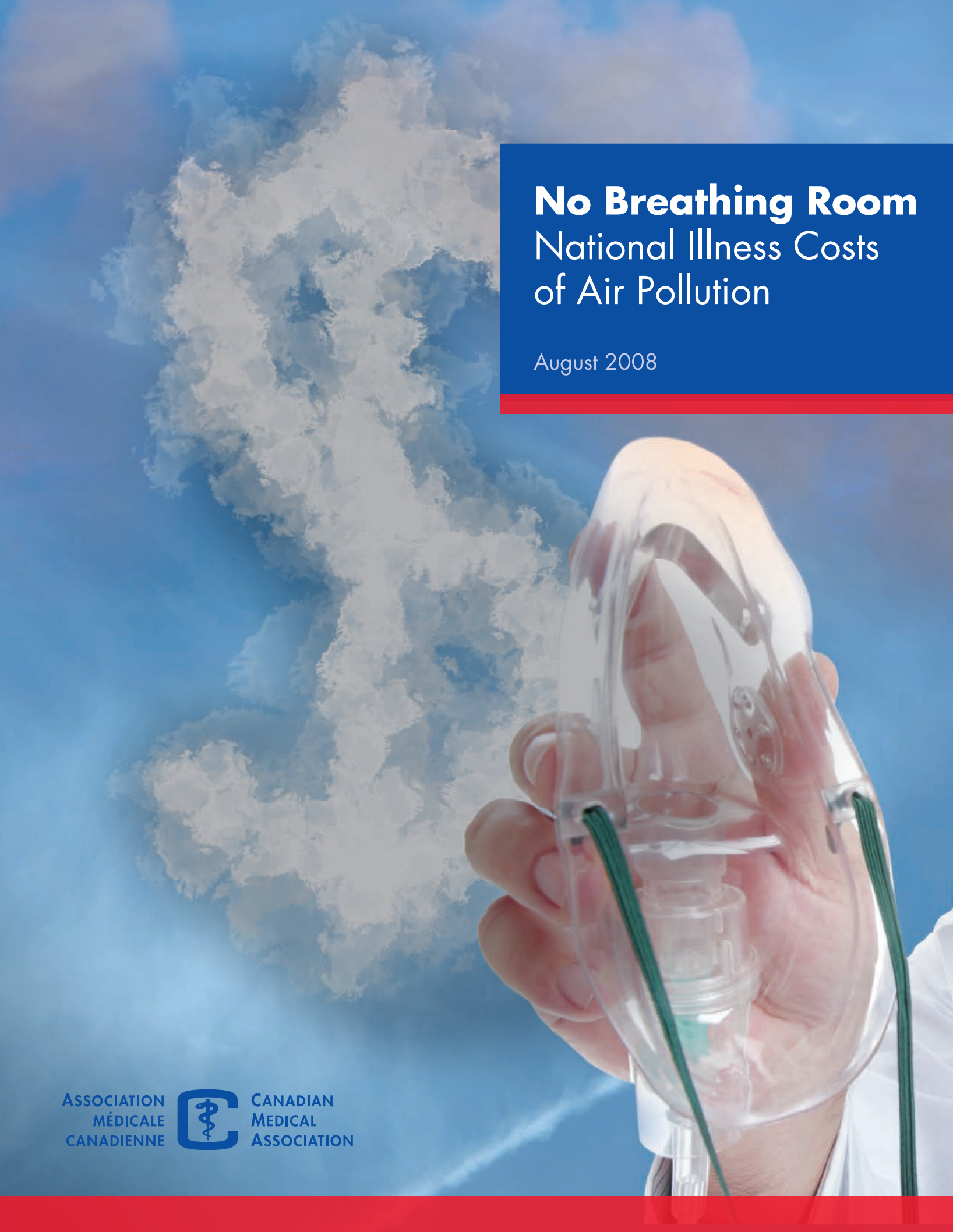

No Breathing Room
National Illness Costs of Air Pollution

August 2008

Association Médicale Canadienne
Canadian Medical Association

No Breathing Room

National Illness Costs of Air Pollution

Summary Report

August 2008

The Canadian Medical Association (CMA) is the national voice of Canadian physicians. Founded in 1867, the CMA's mission is to serve and unite the physicians of Canada and be the national advocate, in partnership with the people of Canada, of the highest standards of health and health care. The CMA is a voluntary professional organization representing the majority of Canada's physicians.

Acknowledgements

The Canadian Medical Association would like recognize the efforts of Jennifer Geduld, MHSc in preparing this summary from the Technical Report of ICAP Version 3.0.

The Canadian Medical Association thanks Environment Canada and Health Canada for their valuable contributions to this project. Without their assistance this work would not have been possible.

Contents

At a Glance

1. In 2008, 21,000 Canadians will die from the effects of air pollution. While most of these deaths will be due to chronic exposure over a number of years, 2,682 will be the result of acute short term exposure.

2. By 2031, almost 90,000 people will have died from the acute effects of air pollution. The number of deaths due to long-term exposure to air pollution will be 710,000.

3. 42% of air pollution associated acute premature deaths will be as a result of cardiovascular disease.

4. In 2008, over 80% of acute premature deaths (2,156 deaths) associated with air pollution will be in those over 65 years of age.

5. Approximately 25 deaths per year among those under 19 years of age will be attributable to short term exposure to air pollution; close to 600 premature deaths will accumulate between 2008 and 2031.

6. Quebec and Ontario will have the largest proportion of acute premature deaths (approximately 70%), yet only 62% of Canadians live in Central Canada.

7. The number of premature deaths associated with chronic exposure to air pollution is expected to rise 83% between 2008 and 2031.

8. In 2008, almost 11,000 hospital admissions will result from exposure to air pollution. By 2031, close to 18,000 people will be admitted because of air pollution - a 62% increase during that period.

9. Over 92,000 emergency department visits associated with air pollution exposure are expected in 2008 increasing to nearly 152,000 by 2031.

10. In 2008, it is estimated that there will be over 620,000 doctor's office visits because of air pollution. This total is expected to rise to over 940,000 visits in 2031 if air quality does not improve.

11. In 2008, economic costs of air pollution will top $8 billion. By 2031, these costs will have accumulated to over $250 billion.

1. Introduction

It is well known that air pollution is bad for our health. But just how bad is it and are there economic costs related to the impact of air pollution? The National Illness Cost of Air Pollution study seeks to quantify the national health and economic impacts of air pollution and put a dollar figure on the health care related costs of air pollution in Canada.

As practicing physicians, the members of the Canadian Medical Association see the impact of air pollution on their patients every day in terms of increased frequency of symptoms, medication use, emergency room visits, hospitalizations and premature deaths. Children, the elderly, and those with chronic health conditions are particularly vulnerable to the effects of air pollution. As an older Canadian population cohort – the baby-boomers - grows, the impact of air pollution will surely increase.

While it is clear that physicians and other health care providers have a large role in education, prevention and treatment of the health effects of air pollution there is a fundamental role for governments in preventing and controlling smog and poor air quality through healthy public policy and regulations. That is why this study was commissioned; in order to help policy makers make informed decisions based on both the health impact and the economic costs that air pollution has on Canadians.

2. Background

The Illness Costs of Air Pollution (ICAP) model was first developed in 2000 by the Ontario Medical Association (OMA) to estimate the health effects and economic costs of smog in the province of Ontario. Using a modified version of this model, the Canadian Medical Association (CMA) has developed estimates of health damages at the national level and for 10 Canadian provinces.

Although the negative impacts on health of air pollution has been known for decades, it is essential for policy development that detailed health and economic data are available. ICAP is based on a methodology designed for an integrated analytical system that uses the best available knowledge and data on air quality, human health and economics to produce forecasts of health impacts and expected costs relating to changes in air quality. The model estimates impacts within four age groups, using seven individual pollutants or a two-pollutant combined effect (ozone O_3 and particulate matter $PM_{2.5}$) and a wide range of health effects.

ICAP provides estimates of health effects and corresponding economic costs. The impacts are analyzed and grouped into the following five categories:

a) Premature Death
b) Hospital Admissions
c) Emergency Department Visits
d) Minor Illnesses
e) Doctor's Visits.

Major health categories may be further broken down by more specific illness categories, age groups and geographic locations. Corresponding economic costs are estimated according to four major cost categories, as follows:

a) Lost productivity
b) Healthcare costs
c) Pain and suffering
d) Loss of life.

3. Methods

This report summarizes the national aggregated health effects and economic costs from two pollutants (O_3 and $PM_{2.5}$). Province-specific versions of ICAP are available on the Canadian Medical Association website (www.cma.ca). Each provincial ICAP system provides specific health and economic costs by Statistics Canada census division. Summary data for each province are also available in Appendix A.

There have been a number of revisions and updates since the first release of ICAP in Ontario by the OMA in 2000 and the second release in 2005[1]. The following provides a brief summary of these changes. A full description of the methodology used in developing ICAP and further description of the revisions and updates is available in the technical report, *ICAP Model Version 3.0, Provincial Models and National Damage Estimates* also available on www.cma.ca.

Population Data
Population data has been updated to reflect the 2006 census. Population projections are based upon Statistics Canada forecasts. Four different Statistics Canada population forecasts (i.e. low growth, medium growth - medium migration trends, medium growth – central-west migration trends and high growth) can be used.

It is notable that in all projections, the proportion of the Canadian population that will be made up of people over 65 years of age is growing. This inherent feature of the Canadian population has significant implications for future health effects caused by air pollution given the relatively higher number of cases of illnesses related to air-pollution among those over 65.

Air Quality Data
There are default ambient concentrations for seven criteria pollutants (PM_{10}, $PM_{2.5}$, O_3, NO_2, SO_2, SO_4^2 and CO) for each census division. ICAP provides a number of forecasting tools that allow users to construct different air quality forecasts.
Based on the advice of an Expert Opinion Elicitation Process, the National ICAP model uses a two pollutant model based on two highly predictive pollutants: particulate matter ($PM_{2.5}$) and ozone (O_3).

[1] Ontario Medical Association, Illness cost of air pollution, 2005-2026 health and economic damage estimates, June 2005, http://www.oma.org/Health/smog/report/ICAP2005_Report.pdf

The model permits the user to develop multiple air quality forecasts. The default air quality forecast in ICAP is a continuation of the current ambient concentrations of air pollution (i.e. no change in air quality).

Doctor's Office Visits

The first point of contact with the healthcare system for many people is through their doctor's office. Doctor's office visits (DOV) constitute a significant proportion of overall costs but previous models were unable to estimate these costs. This version of ICAP attempts to capture the impact of DOV. Ontario was used to produce estimates of these DOV impacts. Base illness rates[2] for different types of illnesses treated by doctors were derived by the OMA with data from the Ontario Health Insurance Plan (OHIP). This summary report provides an estimate of DOV for all provinces (see section 4.5 and in appendix A) by proportionally extending the results from Ontario to the rest of Canada. Although doctor's office visits constitute a significant proportion of the total expenditure of healthcare resources, due to the limitations in province-specific data, the current provincial versions of ICAP do not include illness cases or costs associated with doctor's office visits in the provincial level damages estimates.

Early Development Impacts

There is compelling evidence that exposure of young people to air pollution during the critical stages of lung development (up to around 17 years of age) can cause irreversible damage. One of the impacts is reduced lung function, which is proportional to concentrations of air pollutants, in particular $PM_{2.5}$[3]. ICAP now includes a new routine to capture the potential magnitude of this early developmental effect on lung development. At this time, preliminary estimates are only available for Ontario and are not included in the overall totals.

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[2] Base illness rates are derived from health statistics and are a measure of the frequency of certain types of illnesses in a population. The health risks of exposure to air pollution are expressed relative to these base illness rates. For example, a relative risk of say, 5% means that the base illness rate in the exposed population will rise by 5% when air pollution increases by a certain amount.

[3] Avol, E.L., W.J. Gauderman, et al. 2001. Respiratory effects of relocating to areas of differing air pollution levels. Am J Respir Crit Care Med 164: 2067-2072

Gauderman W. J., G. F. Gilliland, H. Vora, E. Avol, D. Stram, R. McConnell, D. Thomas, F. Lurmann, H. G. Margolis, E. B. Rappaport, K. Berhane, and J. M. Peters.2002. Association between air pollution and lung function growth in Southern California children results from a second cohort. Am J Respir Crit Care Med 166(1): 76–84.

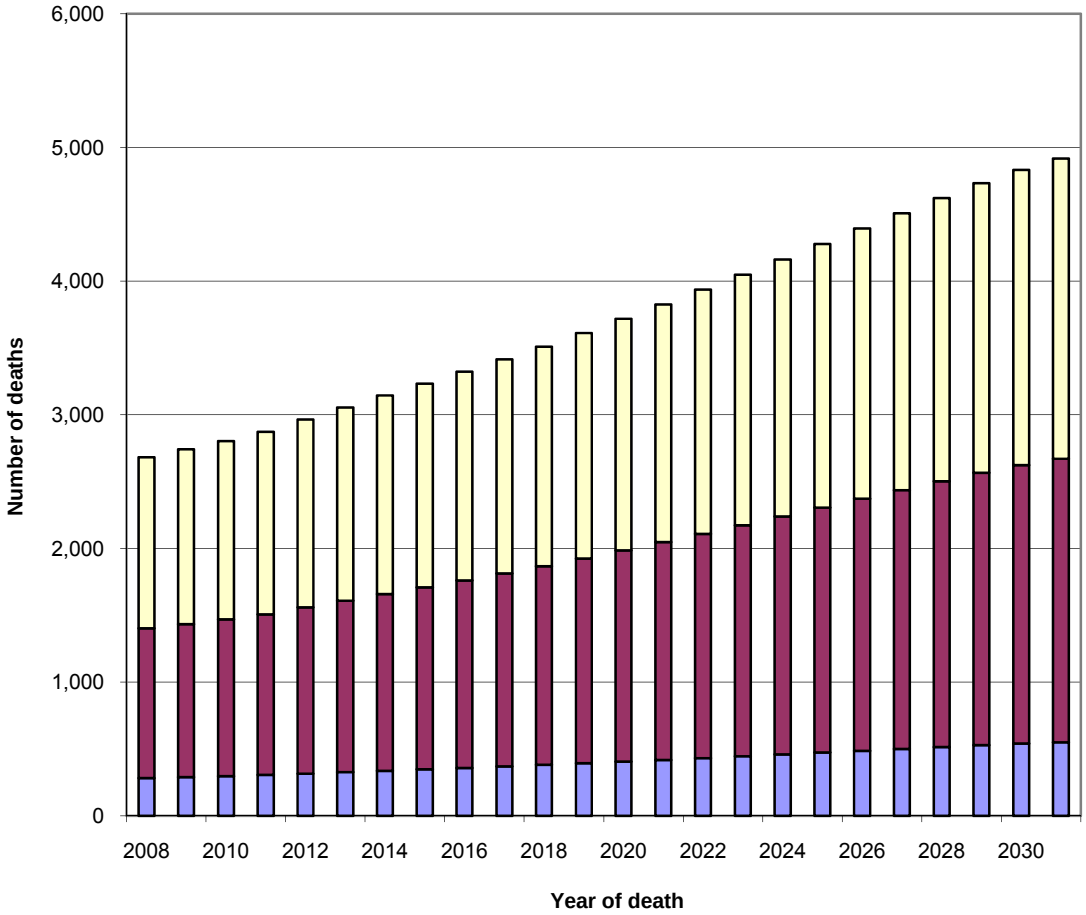
Islam, T, W. J. Gauderman, K. Berhane, R. McConnell, E. Avol, J. M. Peters and F. D. Gilliland. 2007. Relationship between air pollution, lung function and asthma in adolescents. Thorax 62: 957–963. doi: 10.1136/thx.2007.078964

4. Health Effects

4.1. Premature Death

Two measures of premature mortality are available using ICAP. *Acute premature mortality* is a measure of the immediate risk from short term exposure to air pollution. *Chronic premature mortality* results from chronic exposure and is a result of the cumulative effects of exposure over an extended period of time (i.e. years).

Figure 1
Acute premature deaths due to air pollution by cause and year of death

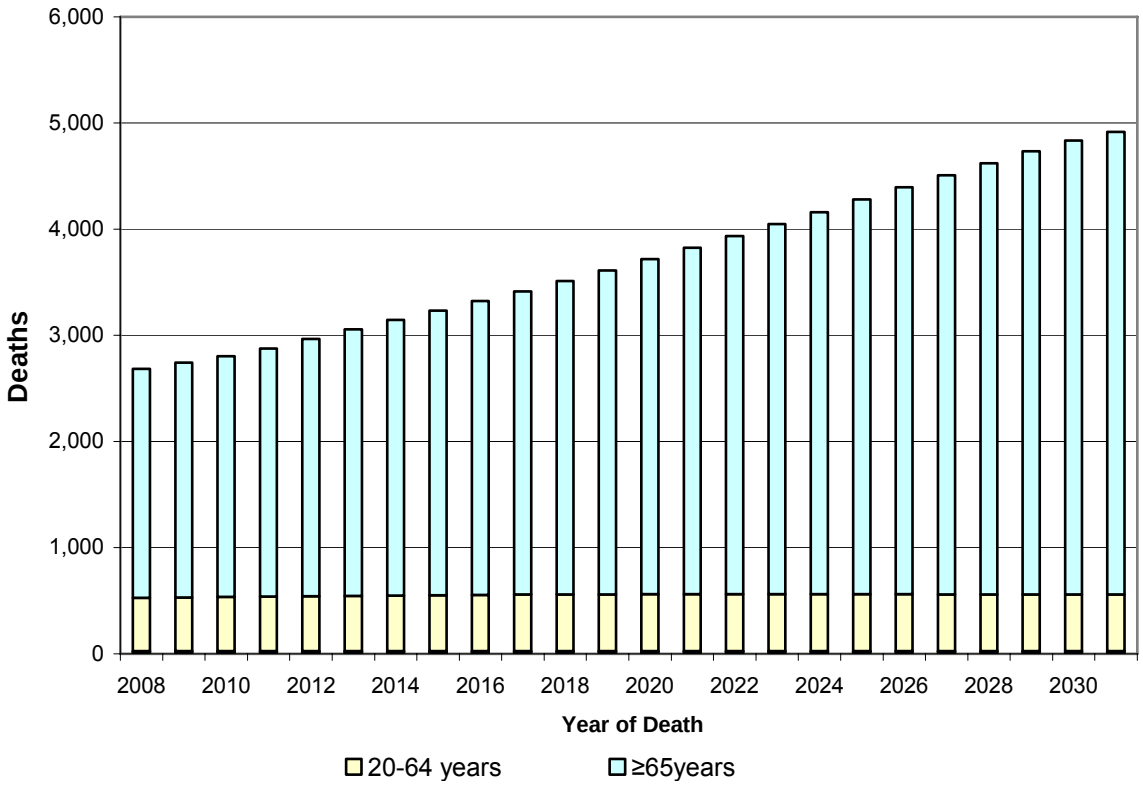


Note:
Attributable to O_3, $PM_{2.5}$
Other causes of acute premature mortality includes all causes of mortality due to air pollution that is non-traumatic and not cardiovascular or respiratory causes (e.g. diabetes and cancer)

As can be seen in Figure 1, the total number of acute premature deaths is expected to increase from 2,682 in 2008 to 4,913 deaths in 2031, and is rising faster than the overall growth of the population during that same time period. The accumulated number of premature deaths will be close to 90,000. Of the acute premature deaths due to air pollution 42% are related to cardiovascular conditions and 11% to respiratory conditions.

The vast majority of deaths are among people over 65 years of age (Figure 2). The aging of Canada's population combined with the vulnerability of those over 65 due to underlying illnesses such as heart disease probably accounts for the increasing numbers of deaths in the later decades of the projection. Children and infants with compromised health conditions are also at increased risk from air pollution. Although the numbers are too small to be seen in Figure 2, during the period between 2008 and 2031, approximately 25 children or youth under 19 years of age will die every year because short-term exposure to air pollution, accumulating to 600 deaths in total.

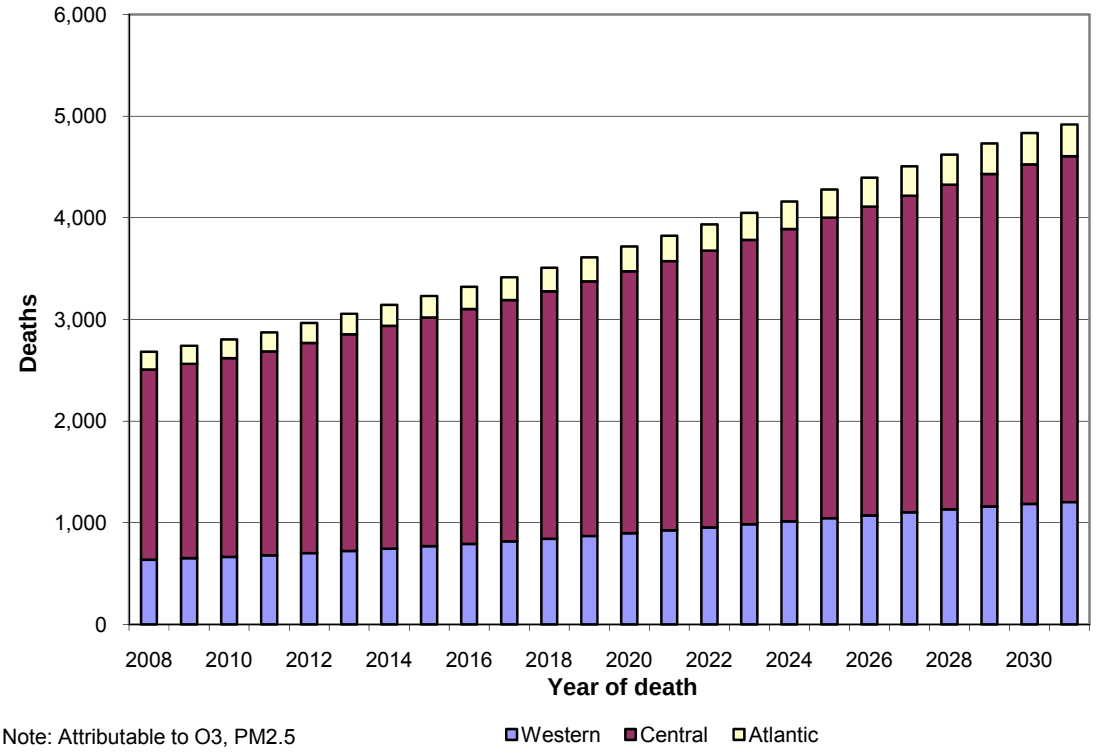
Figure 2
Acute deaths due to air pollution by age group and year of death



Attributable to O3, PM2.5

The distribution of acute premature deaths by major region of Canada is presented in Figure 3. Central Canada[4] is expected to have the largest proportion of acute premature deaths due to air pollution because it includes the two largest provinces, Ontario and Quebec, representing 62% of Canada's population. However, approximately 70% of acute premature deaths will come from these two provinces, possibly reflecting their poorer air quality relative to other parts of Canada. Western Canada, with approximately 30% of the population of Canada, accounts for one quarter of the acute premature deaths.

Figure 3
Acute premature deaths due to air pollution by region of Canada and year of death



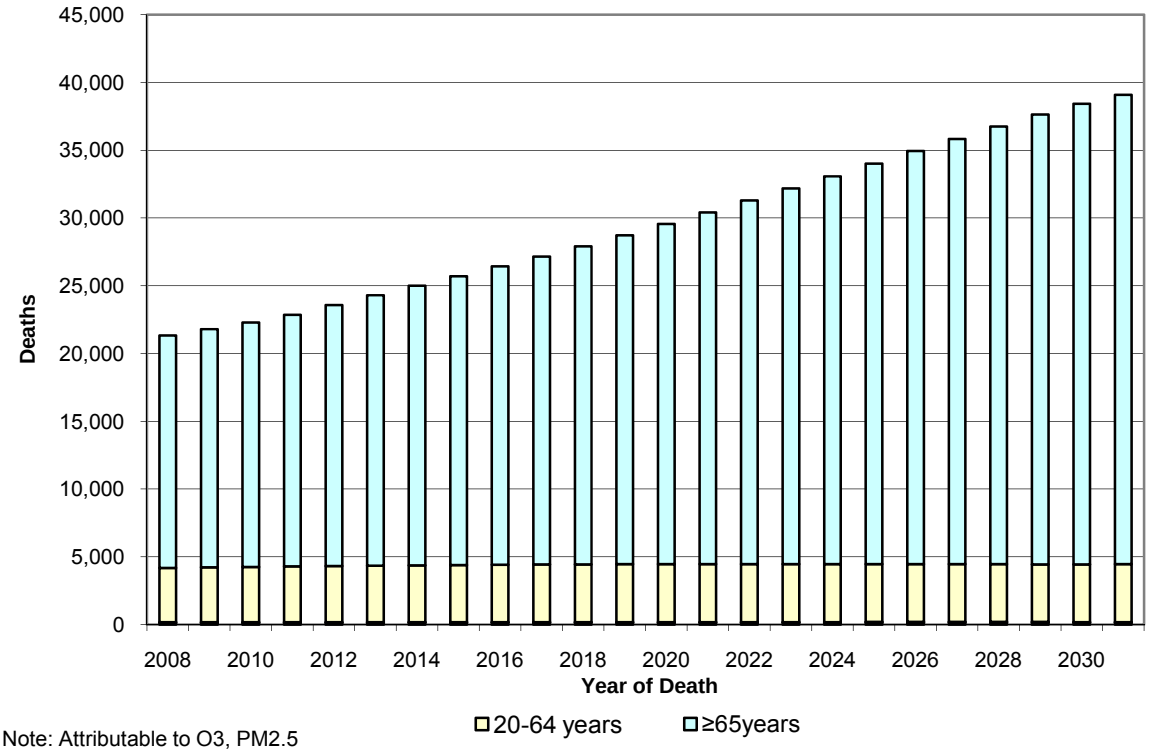
Note: Attributable to O3, PM2.5

Figure 4 shows that the number of premature deaths associated with chronic exposure to air pollution is expected to rise 83% between 2008 and 2031 (from about 21,000 to 39,000 deaths). The accumulated number of premature deaths will be close to 700,000. Over 80% of these deaths are expected to be among those over 65 years of age[5].

[4] Central Canada includes Ontario and Quebec; Western Canada includes British Columbia, Alberta, Saskatchewan and Manitoba and Atlantic Canada includes Newfoundland, Nova Scotia, New Brunswick and Prince Edward Island

[5] The estimated number of premature deaths associated with chronic exposure air pollution is about eight times higher than that of acute premature deaths. The two estimates should not be added together because the acute premature deaths are expected to be part of the estimates of chronic premature deaths.

Figure 4
Premature Chronic Deaths due to air pollution by age group and year of death



Note: Attributable to O3, PM2.5

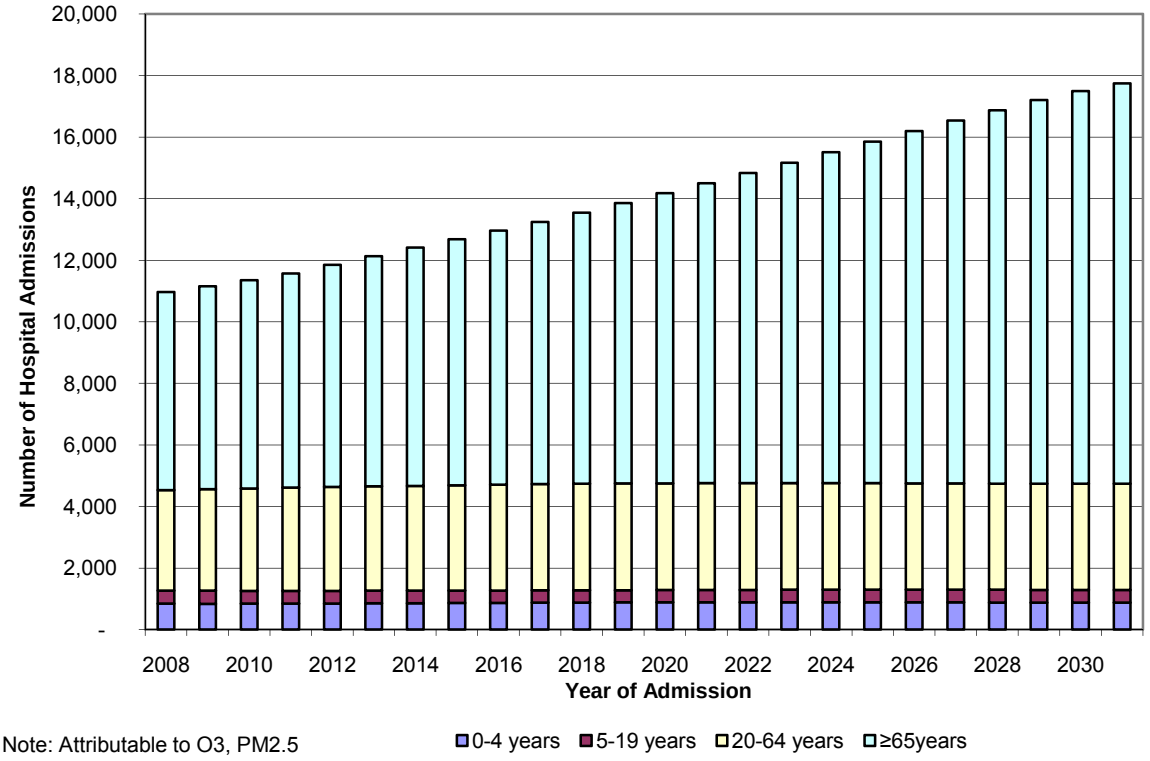
4.2. Hospital Admissions

Hospital admissions associated with exposure to air pollution were estimated for the two major causes, cardiovascular and respiratory illnesses. The model projects that almost 11,000 hospital admissions associated with air pollution will occur in 2008, increasing to close to 18,000 by 2031 (62% increase). Cardiovascular illnesses account for just over 60% of the admissions and just less than 40% are due to respiratory illnesses.

As seen in Figure 5, the largest proportion of the estimated hospital admissions due to air pollution will be among those over 65 years of age. The expected number of hospital admissions in this age group is estimated to rise 102% during the period between 2008 and 2031. Children under 4 years of age are projected to account for 6% of the air pollution associated admissions, while those aged 20-64 years will account for 24% of the admissions. As with other illness risk estimates, the proportion of cases associated with the over-65 year olds is forecast to increase substantially as the "baby-boomers" age.

The regional distribution of hospital admissions parallels that seen in acute premature deaths (not shown).

Figure 5
Hospital admissions due to air pollution by age group and year of admission



Note: Attributable to O3, PM2.5

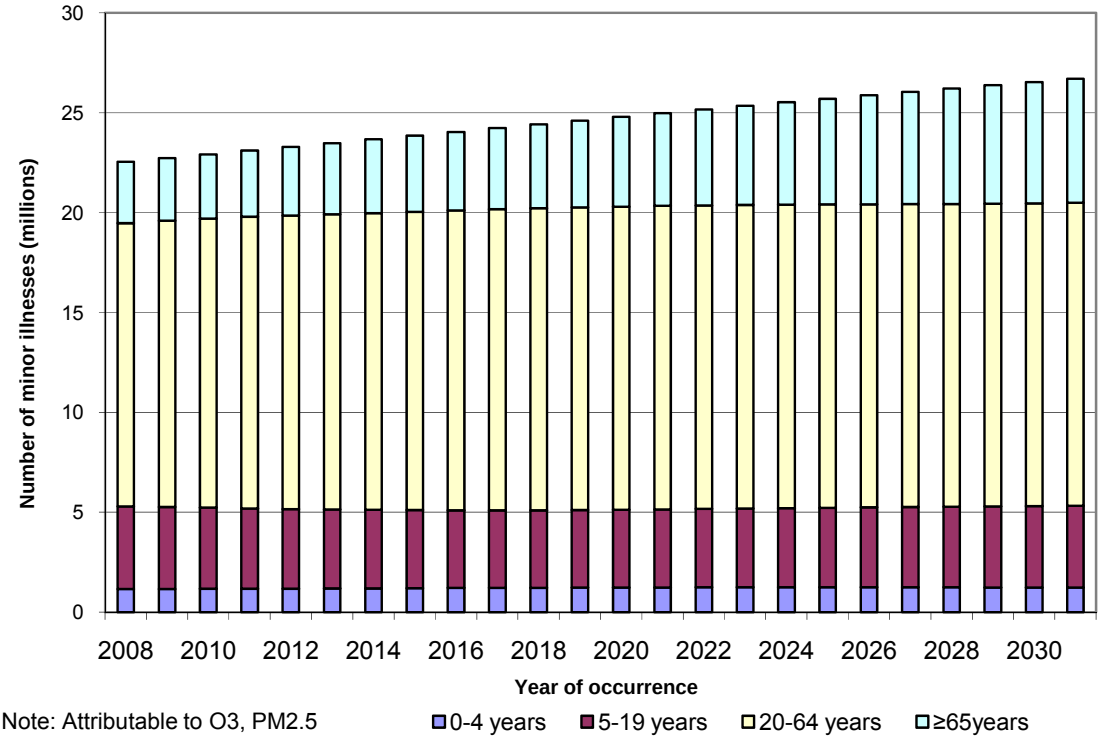
4.3. Emergency Department Visits

Respiratory and cardiovascular illnesses can result in unscheduled emergency department visits. Over 92,000 emergency department visits associated with air pollution exposure are expected in 2008, increasing to close to 152,000 in 2031. The proportion of emergency department visits caused by cardiovascular illness is about 60% and 40% are due to respiratory illness, as seen with hospital admissions. The age distribution is also similar to that for hospital admissions with the highest proportion among those over 65.

4.4. Minor Illnesses

Minor illnesses are the least severe adverse health outcome associated with air pollution exposure but they are very much more common. Over 20 million minor illnesses could be attributed to air pollution in 2008, climbing to over 26 million by 2031. (Figure 6)

Figure 6
Minor Illnesses due to air pollution by age group and year of occurrence

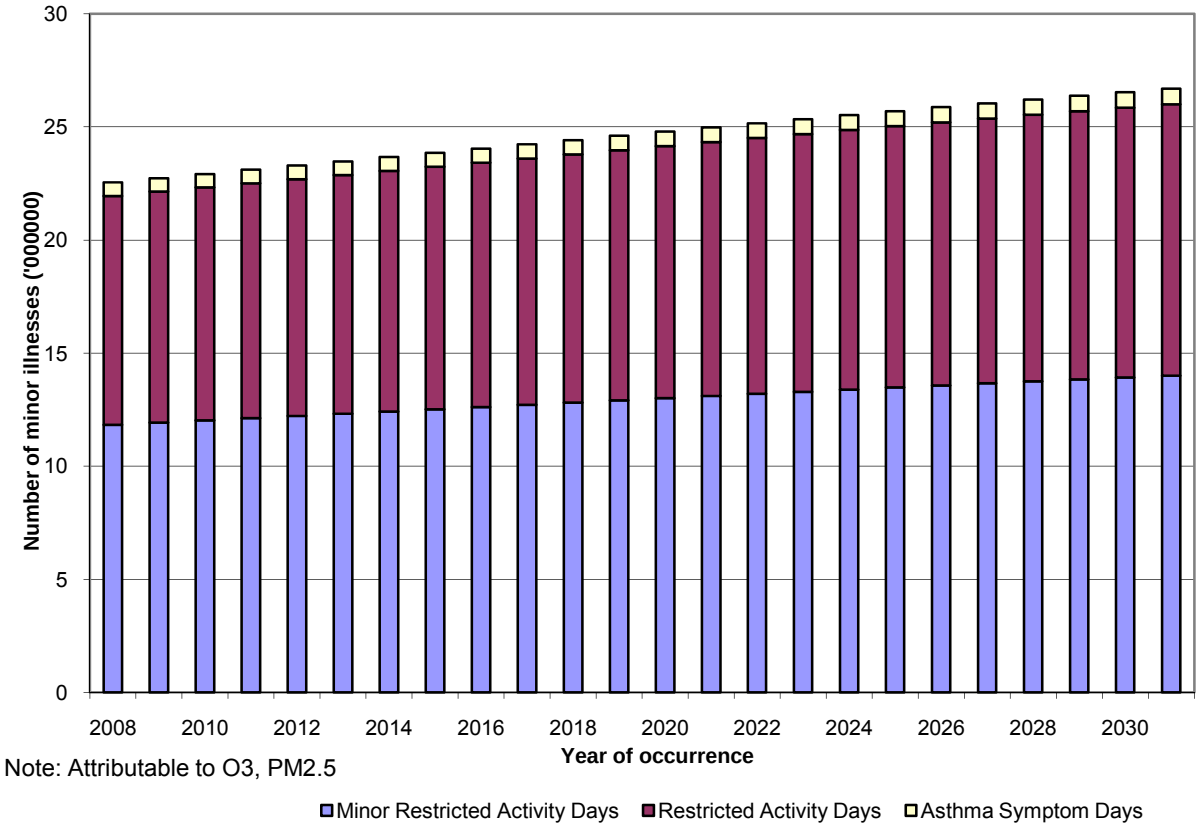


The expected number of minor illnesses associated with exposure to air pollution has been divided into three minor illness types: minor restricted activity days, restricted activity days and asthma symptom days[6]. (Figure 7)

Approximately 45% of these cases will be restricted activity or asthma symptom days which will potentially require time at home to recover resulting in absenteeism from work or school. Most will occur among people 20-64

[6] *Minor Restricted Activity Day* involves a low grade illness in which the normal activities of a person would be restricted but they would still be able to function (e.g., go to work). *Restricted Activity Day* would still be low grade and would not require medical care but would result in absenteeism in many cases. *Asthma Symptom Day* is similar to a restricted activity day except that it is associated only with asthma suffers and involves sufficient severe asthma symptoms to result in absenteeism in many cases.

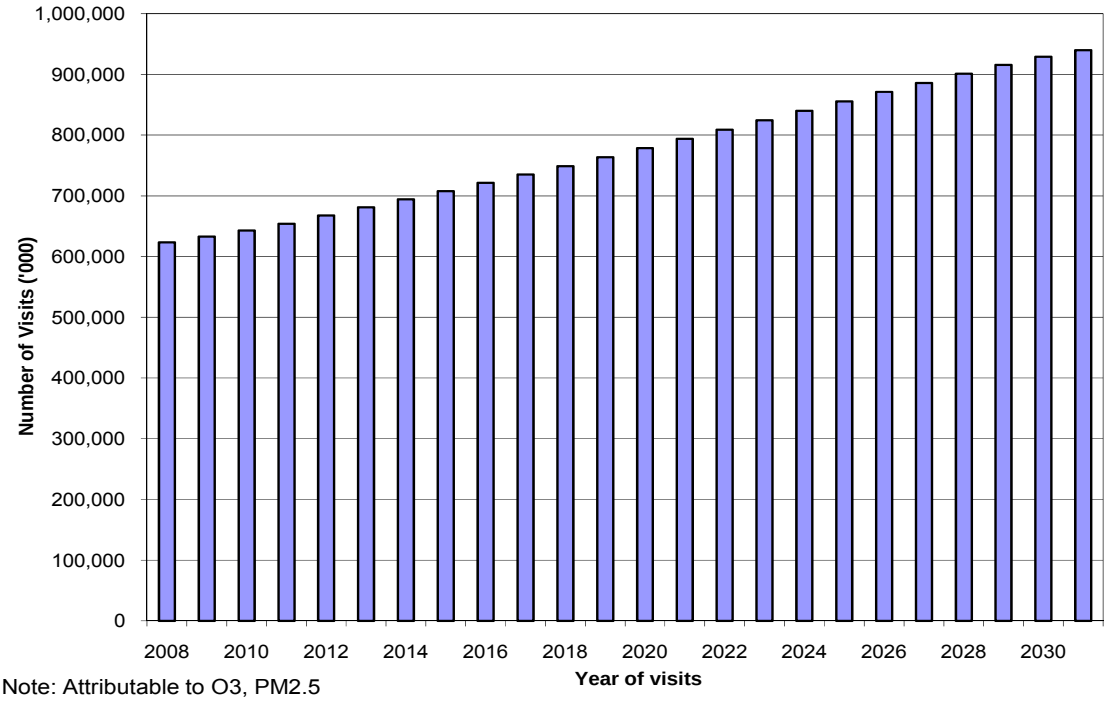
Figure 7
Minor Illnesses due to air pollution by type of illness by year of occurrence



4.5. Doctor's Office Visits

The model predicts that over 620,000 doctor's office visits in 2008 will be associated with air pollution exposure. This total is expected to rise to over 940,000 visits in 2031 if air quality does not change over that time (Figure 8). Most of these cases are anticipated to be associated with cardiovascular illnesses. The distribution of these visits by age group is similar to that seen among hospital admissions with a larger proportion among those over 65 years of age.

Figure 8
Doctor's office visits due to air pollution by year of visit



Note: Attributable to O3, PM2.5

4.6. Summary

Table 1 provides a national summary of the health effects associated with air pollution in three specific years and over the study period. More detailed provincial results can be found in Appendix A and on the CMA website (www.cma.ca).

Table 1- National Health Effects Summary: 2008, 2015 and 2031 and Total (2008-2031)

	2008	2015	2031	Total (2008-2031)
Acute Premature Deaths	2,682	3,233	4,917	**89,331**
Hospital Admissions	10,966	12,685	17.748	**339,830**
Emergency Dept. Visits	92,690	107,896	152,266	**2,889,030**
Minor Illnesses	22,542,500	23,853,900	26,691,900	**592,088,400**
Doctor's Office Visits ('000)	623,369	707,872	940,055	**18,618,523**

5. Economic Costs

In addition to estimates of actual health effects, ICAP provides estimates of the corresponding economic costs that these illnesses represent. These economic costs are estimated according to four major cost categories:

a) Lost productivity:

The time lost due to treatment and recovery from air pollution-related illnesses. It includes time lost from work by patients and their caregivers. Lost time is valued at the going average wage rate for the age of the person affected.

b) Healthcare costs:

These are the costs of institutional care plus medication.

c) Quality of life:

To attach a dollar value to reduced quality of life due to illness (i.e., pain and suffering), ICAP uses a well established standard method that determines how much people would be willing to pay to avoid illness.

d) **Loss of life:**

In this model, a dollar value for premature death is estimated based on the amount of money people are willing to pay to reduce their risk of premature death (i.e., to reduce the risk of premature death due to air pollution exposure).

Table 2 outlines the four major cost categories for acute premature mortality in three example years and the total costs for the period between 2008 and 2031. Total costs for the four combined economic damage categories are seen in the bottom row. The grand total cost of air pollution for acute premature mortality over the study period is estimated to be over 250 billion dollars. These estimates are certainly an underestimate; for example they do not include economic damages associated with chronic premature mortality DOVs or early childhood effects.

Table 2- National Economic Costs Summary: 2008, 2015, 2031 and Total (2008-2031) [1](Costs expressed in millions)

	2008	2015	2031	Total (2008-2031)
Lost Productivity	**$688**	**$721**	**$765**	**$17,576**
Healthcare Costs	**$438**	**$485**	**$614**	**$12,549**
Quality of Life	**$379**	**$410**	**$487**	**$10,370**
Loss of Life	**$6,552**	**$7,905**	**$11,836**	**$217,439**
Total Cost	**$8,058**	**$9,522**	**$13,702**	**$257,934**

1. All economic values are shown using constant 2006 dollars

5.1. Regional Distribution of Costs

Table 3 shows the economic costs estimates by region. The regional distribution of costs is closely tied to the regional distribution of Canada's population. High population densities tend to be associated with poorer air quality so this further concentrates the costs in these regions (Table 3).

Table 3- Summary of Region Total Costs: 2008, 2015, 2031 and Total (2008-2031) [1]
(Costs expressed in millions)

	2008	2015	2031	Total (2008-2031)
Western	$1,923	$2,282	$3,370	**$62,606**
Central	$5,627	$6,635	$9,498	**$179,169**
Atlantic	$508	$605	$834	**$16,159**
Total Cost	**$8,058**	**$9,522**	**$13,702**	**$257,934**

1 All economic values are shown using constant 2006 dollars

6. Discussion

For most people in good health, the symptoms of exposure to air pollution tend to go unnoticed or go away as soon as there is an improvement to the air quality. However, air pollution disproportionately affects different population groups. The most susceptible are those over 65 and those with pre-existing respiratory and cardiovascular problems such as asthma, congestive heart failure or chronic obstructive pulmonary disease (COPD).

In this analysis the level of pollution is held constant. As a result the trend of increasing health damages over time can be largely ascribed to the aging of the Canadian population. There are plausible biological explanations why the elderly should be more susceptible to injury from air pollution: multiple diseases, reduced heart and lung function, diminished capacity to adapt to stress, lower incomes.

Children are at increased risk of health effects of air pollution due to a number of factors. Children and newborns inhale a higher volume of air for their body weight compared to adults and consequently take in higher levels of pollutants. They are still growing and developing and therefore their defense mechanisms are less well equipped than those of adults. A greater proportion of a child's time is spent outdoors and they are more active than adults, which also increases the amount of exposure to air pollutants. Although the numbers of children affected in terms of acute illnesses is relatively small, the loss of a child to a preventable exposure is tragic. Even more tragic is when the future health of a child is irreversibly affected by exposure to air pollution during the early years of life.

The new provincial ICAP models helps to better understand and respond positively to the increasing evidence that air pollution has chronic, adverse effects on lung growth and development in children leading to clinically and statistically significant deficits in lung function in adulthood, putting them at risk for illness and premature death as adults[7]. However, the national forecasts do not include the impact and cost of early exposure because the literature still does not have data to forecast the long term impact on health of early reductions in lung function. For the purposes of illustration, each provincial model allows a calculation to be made, but clearly the data cannot yet be included in the national roll-up. The effect is likely to be an underestimate of the true costs of air pollution.

Projections of the time required to recover from doctor's office visits, emergency room visits and minor illnesses show the large impact that air pollution is having on the ability of Canadians to work.

Doctor's office visits and early development effects will be more fully developed in future versions of ICAP, as data and evidence accumulate to permit further analysis.

7. Conclusions

The results from this national analysis of air pollution impacts on human health show the magnitude of damages that air pollution will have in the next two decades in Canada. The health and economic damages of air pollution on the health of Canadians is significant and will become more so over time. These damages are experienced by all Canadians, either directly due to reduced personal health and quality of life, or through the impaired health of family members and friends or through increased costs of our national healthcare system. As well, air pollution is affecting the overall productivity of the Canadian economy through absenteeism and poorer health of the workforce.

It is hoped that the current and future enhanced versions of ICAP will help policy makers in their discussions about the impact of air pollution on the health and economy of Canada.

[7] *N Engl J Med.* 2004;351:1057-1067, 1132-1134

8. Appendix A Provincial ICAP Data

Newfoundland and Labrador

Figure 1: Number of cases in Newfoundland and Labrador by year of occurrence

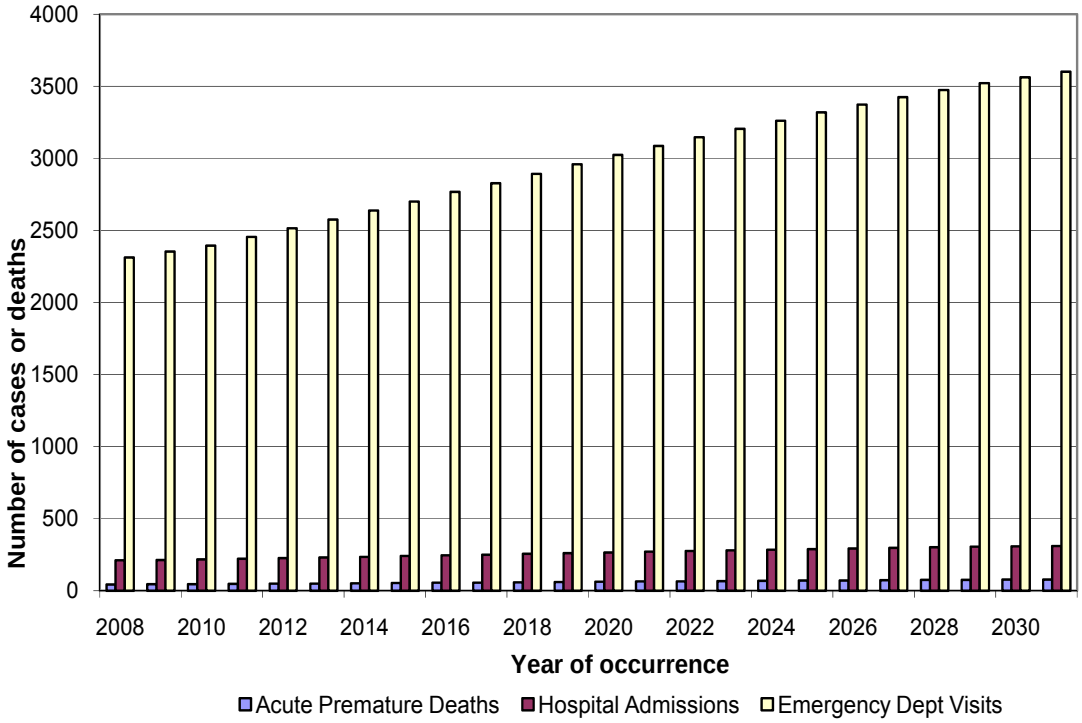


Table 1 : Newfoundland and Labrador health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	43	54	78	**1,463**
Hospital Admissions	211	241	311	**6,295**
Emergency Dept. Visits	2,312	2,700	3,602	**71,383**
Minor Illnesses	297,764	296,315	293,426	**7,101,602**
Doctor's Office Visits	13,995	15,801	19,650	**407,720**

Table 2: Newfoundland and Labrador economic damages summary [1] (damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$6,345	$6,128	$5,533	**$142,656**
Healthcare Costs	$7,071	$7,756	$9,372	**$198,046**
Quality of Life	$5,863	$6,167	$6,884	**$153,390**
Loss of Life	$106,372	$131,954	$186,612	**$3,568,639**
Total Cost	**$125,652**	**$152,005**	**$208,402**	**$4,062,731**

1. All economic values are shown using constant 2006 dollars

Nova Scotia

Figure 2: Number of Cases in Nova Scotia by year occurrence

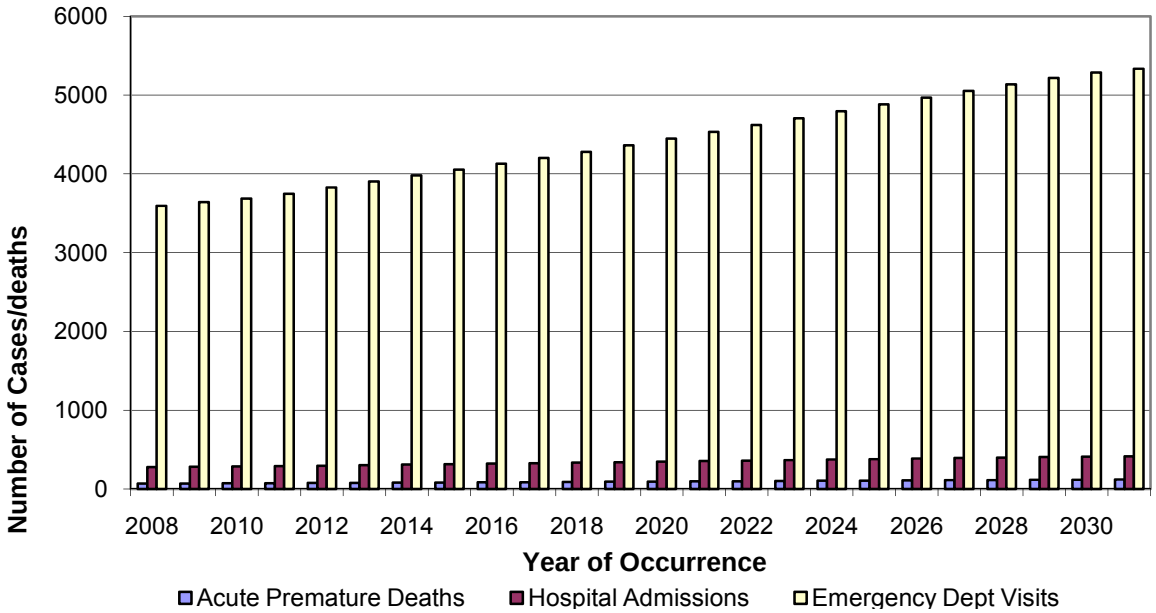


Table 3: Nova Scotia health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	69	82	120	**2,234**
Hospital Admissions	277	315	416	**8,269**
Emergency Dept. Visits	3,596	4,054	5,335	**106,405**
Minor Illnesses	457,795	464,090	475,907	**11,231,259**
Doctor's Office Visits	20,207	22,254	27,593	**572,399**

Table 4: Nova Scotia economic damages summary [1] (damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$11,098	$11,005	$10,380	**$259,154**
Healthcare Costs	$10,159	$11,018	$13,305	**$280,714**
Quality of Life	$8,991	$9,460	$10,690	**$235,900**
Loss of Life	$167,350	$201,201	$286,585	**$5,436,152**
Total Cost	**$197,598**	**$232,684**	**$320,960**	**$6,211,920**

1. All economic values are shown using constant 2006 dollars

New Brunswick

Figure 3: Number of cases in New Brunswick by year of occurrence

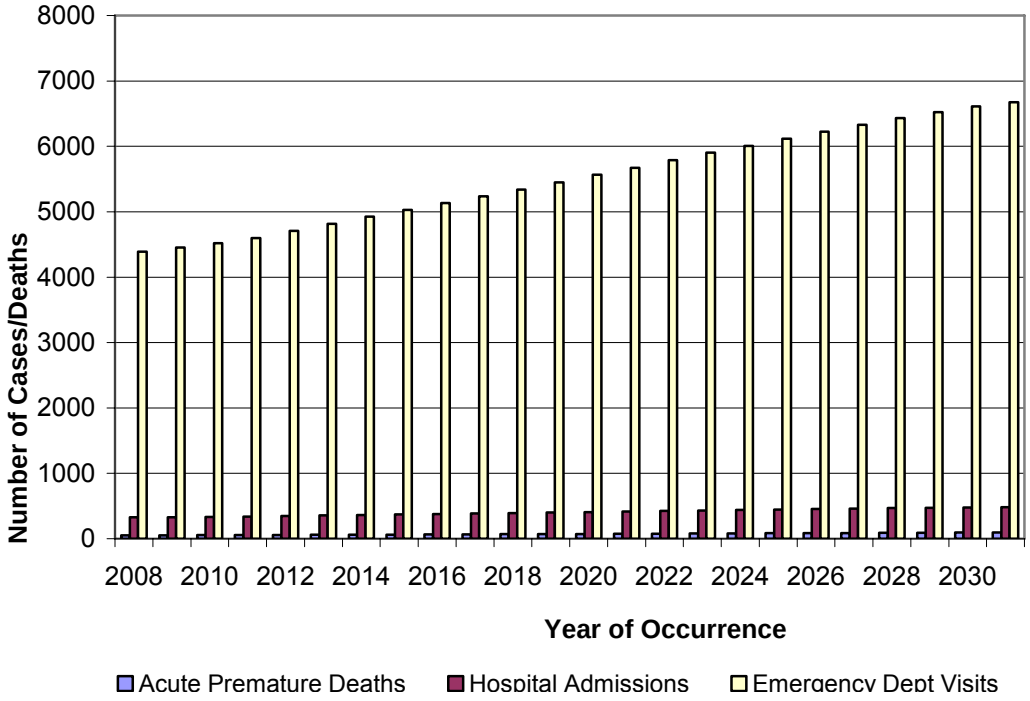


Table 5 : New Brunswick health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	54	65	96	**1,783**
Hospital Admissions	327	371	486	**9,726**
Emergency Dept. Visits	4,392	5,031	6,676	**132,460**
Minor Illnesses	374,254	377,424	380,832	**9,091,375**
Doctor's Office Visits	24,312	27,107	33,752	**698,343**

Table 6: New Brunswick economic damages summary [1]
(damages expressed in thousands)

	2008	2015	2031	Total(2008-31)
Lost Productivity	$7,770	$7,629	$6,992	**$178,278**
Healthcare Costs	$8,954	$9,765	$11,835	**$249,199**
Quality of Life	$8,474	$9,034	$10,415	**$226,772**
Loss of Life	$131,125	$159,450	$228,486	**$4,322,514**
Total Cost	**$156,323**	**$185,878**	**$257,727**	**$4,976,763**

1. All economic values are shown using constant 2006 dollars

Prince Edward Island

Figure 4: Number of cases in Prince Edward Island by year of occurrence

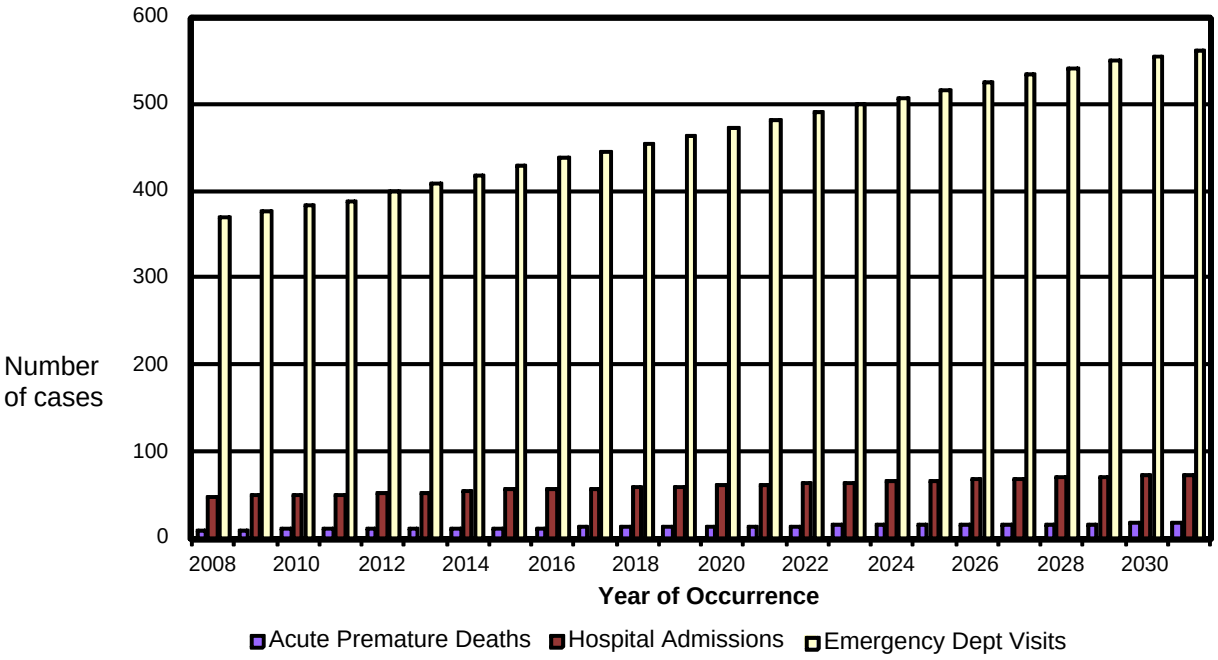


Table 7: Prince Edward Island health damages summary

	2008	2015	2031	Total
Acute Premature Deaths	10	12	18	329
Hospital Admissions	49	56	73	1,458
Emergency Dept. Visits	370	428	561	11,201
Minor Illnesses	66,826	68,480	71,490	1,665,870
Doctor's Office Visits	1,502	1,693	2,079	43,339

Table 8: Prince Edward Island economic damages summary[1]
(damages expressed in thousands)

	2008	2015	2031	Total
Lost Productivity	$1,565	$1,578	$1,553	**$37,643**
Healthcare Costs	$1,361	$1,490	$1,782	**$37,819**
Quality of Life	$1,211	$1,286	$1,446	**$32,005**
Loss of Life	$24,035	$29,706	$41,881	**$798,300**
Total Cost	**$28,172**	**$34,060**	**$46,662**	**$905,767**

1. All economic values are shown in millions using constant 2006 dollars

Quebec

Figure 5: Number of cases in Quebec by year of occurrence

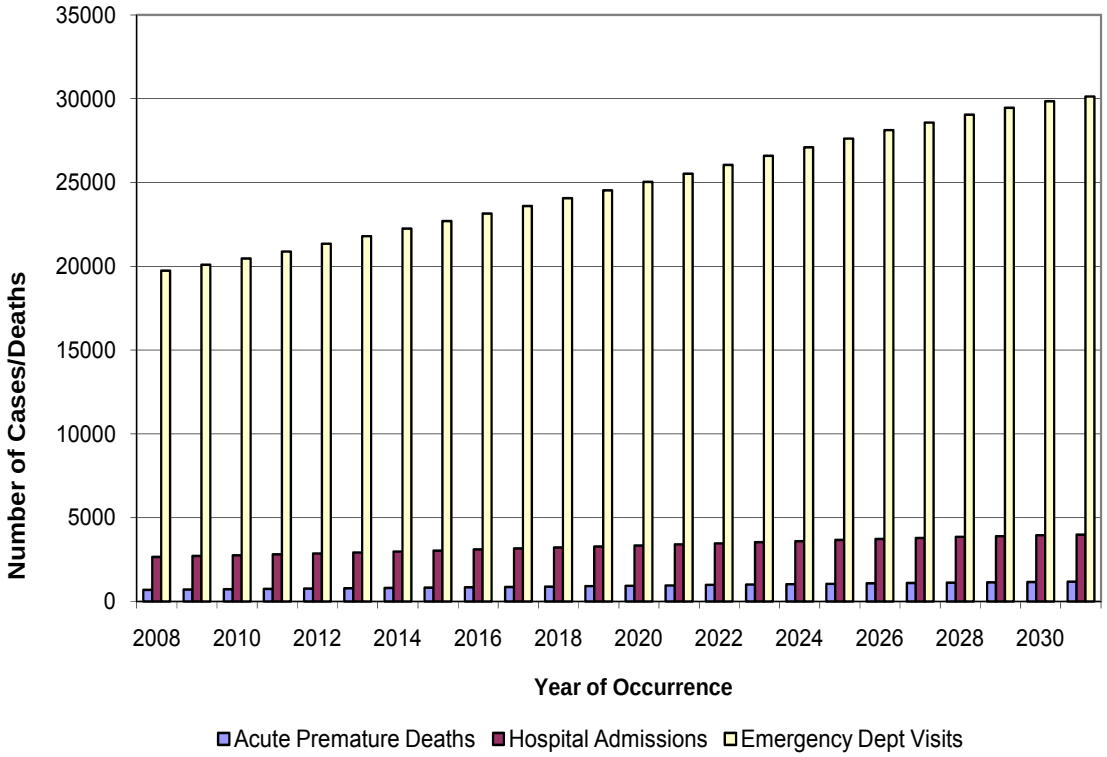


Table 9: Quebec health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	691	825	1,179	**22,332**
Hospital Admissions	2,667	3,043	3,988	**79,781**
Emergency Dept. Visits	19,730	22,692	30,139	**597,696**
Minor Illnesses	5,577,100	5,758,700	6,046,400	**140,253,300**
Doctor's Office Visits	143,629	161,093	201,080	**4,153,940**

Table 10: Quebec economic damages summary [1] (damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$156,700	$158,200	$156,200	**$3,777,500**
Healthcare Costs	$103,000	$111,400	$130,700	**$2,810,600**
Quality of Life	$91,800	$96,900	$107,600	**$2,401,900**
Loss of Life	$1,693,200	$2,020,600	$2,830,000	**$54,356,500**
Total Cost	**$2,044,700**	**$2,387,100**	**$3,224,500**	**$63,346,500**

1. All economic values are shown using constant 2006 dollars

Ontario

Figure 6: Number of cases in Ontario by year of occurrence

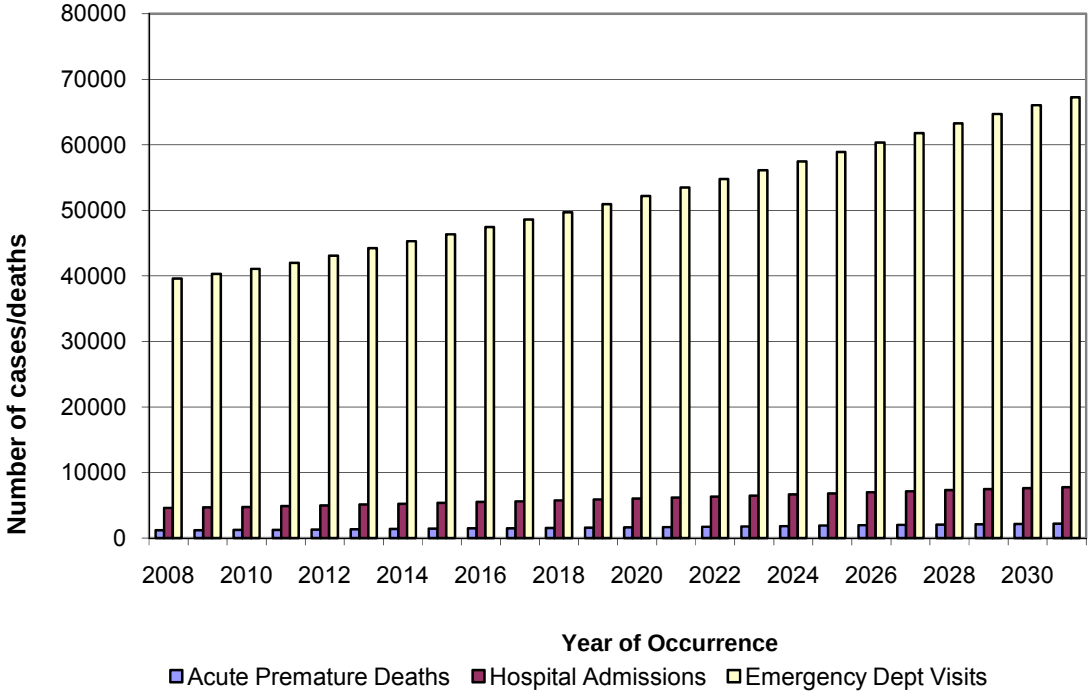


Table 11: Ontario health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	1,178	1,424	2,222	**39,600**
Hospital Admissions	4,597	5,371	7,774	**145,309**
Emergency Dept. Visits	39,575	46,375	67,239	**1,255,167**
Minor Illnesses	10,383,000	11,152,400	12,920,100	**279,765,700**
Doctor's Office Visits	262,315	300,662	412,371	**7,979,206**

Table 12: Ontario economic damages summary [1] (damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$349,400	$374,400	$412,700	**$9,230,500**
Healthcare Costs	$221,800	$248,700	$325,200	**$6,490,300**
Quality of Life	$194,100	$213,500	$265,000	**$5,476,900**
Loss of Life	$2,878,800	$3,481,900	$5,364,300	**$96,475,800**
Total Cost	**$3,644,100**	**$4,318,500**	**$6,367,200**	**$117,674,500**

1. All economic values are shown using constant 2006 dollars

Manitoba

Figure 7: Number of cases in Manitoba by year of occurrence

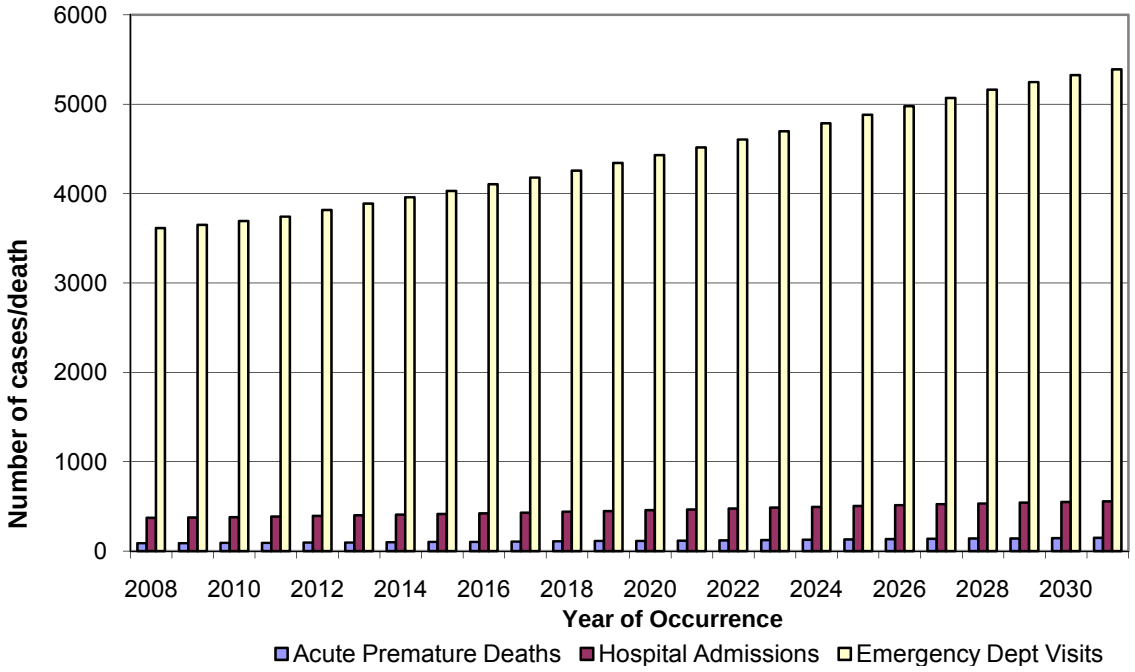


Table 13: Manitoba health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	89	102	148	2,777
Hospital Admissions	373	415	558	10,983
Emergency Dept. Visits	3,613	4,030	5,388	106,356
Minor Illnesses	650,279	676,183	736,596	16,649,802
Doctor's Office Visits	22,968	25,104	31,801	650,500

Table 14: Manitoba economic damages summary [1] (damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	**$18,152**	**$18,762**	**$19,420**	**$453,778**
Healthcare Costs	**$12,444**	**$13,365**	**$16,186**	**$340,721**
Quality of Life	**$11,647**	**$12,351**	**$14,337**	**$310,414**
Loss of Life	**$214,869**	**$248,228**	**$356,338**	**$6,737,892**
Total Cost	**$257,112**	**$292,705**	**$406,281**	**$7,842,805**

1. All economic values are shown using constant 2006 dollars

Saskatchewan

Figure 8: Number of cases in Saskatchewan by year of occurrence

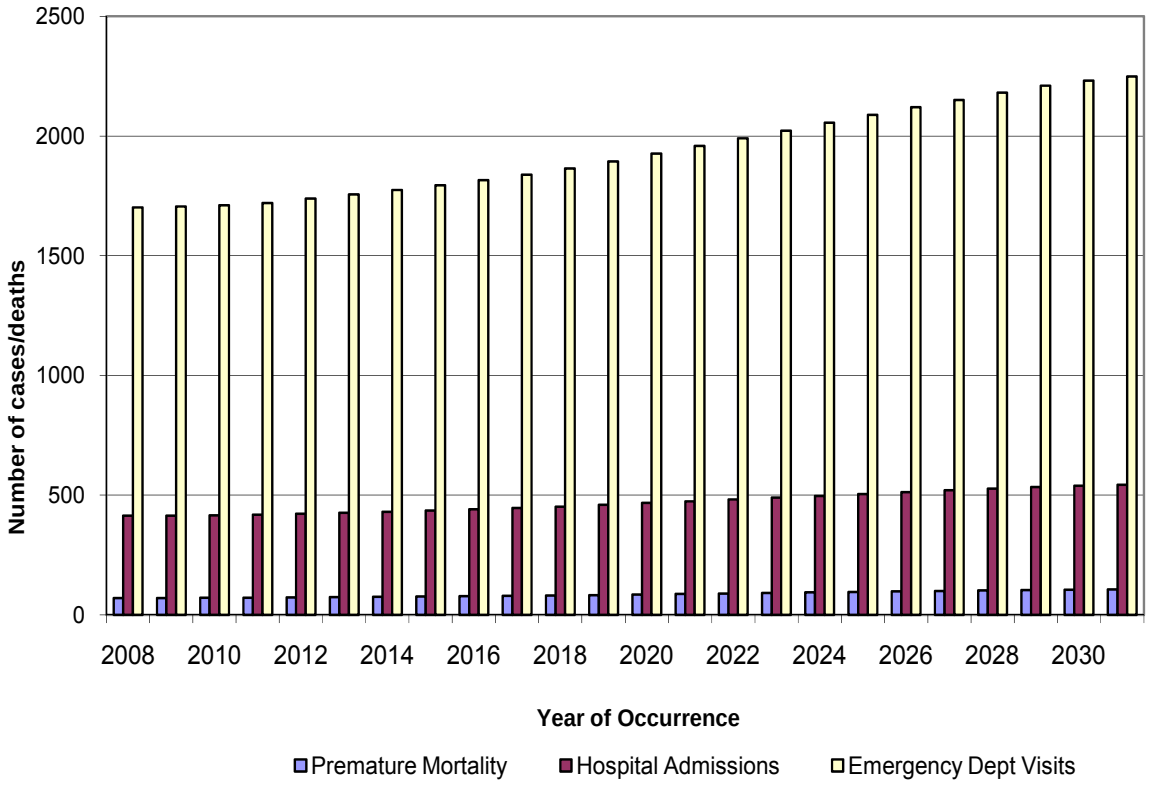


Table 15: Saskatchewan health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	70	76	106	**2,055**
Hospital Admissions	415	436	543	**11,266**
Emergency Dept. Visits	1,702	1794	2,248	**46,496**
Minor Illnesses	474,138	470,166	469,849	**11,292,890**
Doctor's Office Visits	17,442	17,980	21,187	**456,654**

Table 16: Saskatchewan economic damages summary [1]
(damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$13,608	$13,439	$12,609	**$315,831**
Healthcare Costs	$10,582	$10,882	$12,652	**$274,746**
Quality of Life	$8,024	$8,071	$8,560	**$197,558**
Loss of Life	$168,605	$183,890	$254,354	**$4,961,937**
Total Cost	**$200,819**	**$216,281**	**$288,175**	**$5,750,072**

1. All economic values are shown using constant 2006 dollars

Alberta

Figure 9: Number of cases in Alberta by year of occurrence

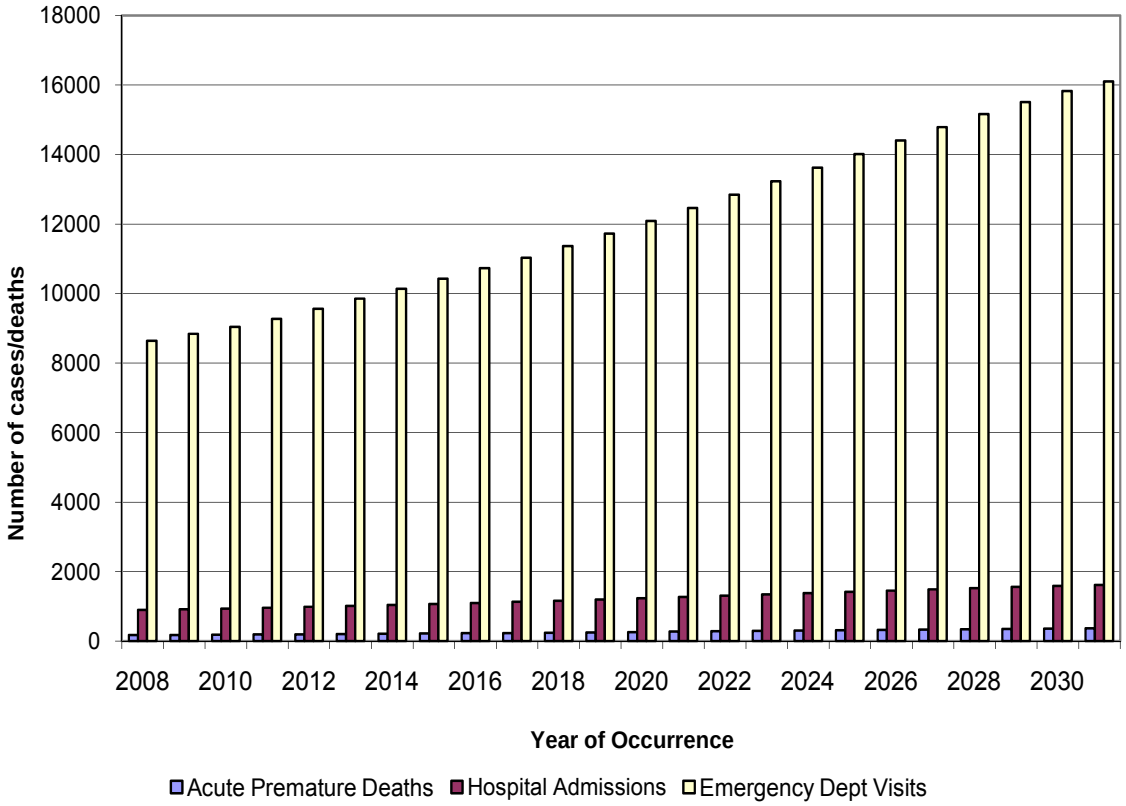


Table 17: Alberta health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	173	217	366	**6,274**
Hospital Admissions	894	1,068	1,616	**29,539**
Emergency Dept. Visits	8,638	10,426	16,103	**290,660**
Minor Illnesses	1,734,300	1,868,300	2,137,300	**46,696,500**
Doctor's Office Visits	54,887	64,211	91,966	**1,740,698**

Table 18: Alberta economic damages summary [1] (damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$61,824	$66,017	$71,025	**$1,614,951**
Healthcare Costs	$34,922	$39,812	$53,822	**$1,054,699**
Quality of Life	$30,043	$33,321	$41,691	**$858,553**
Loss of Life	$422,712	$531,913	$882,696	**$15,307,763**
Total Cost	**$549,500**	**$671,063**	**$1,049,234**	**$18,835,966**

1. All economic values are shown using constant 2006 dollars

British Columbia

Figure 10: Number of cases in British Columbia by year of occurrence

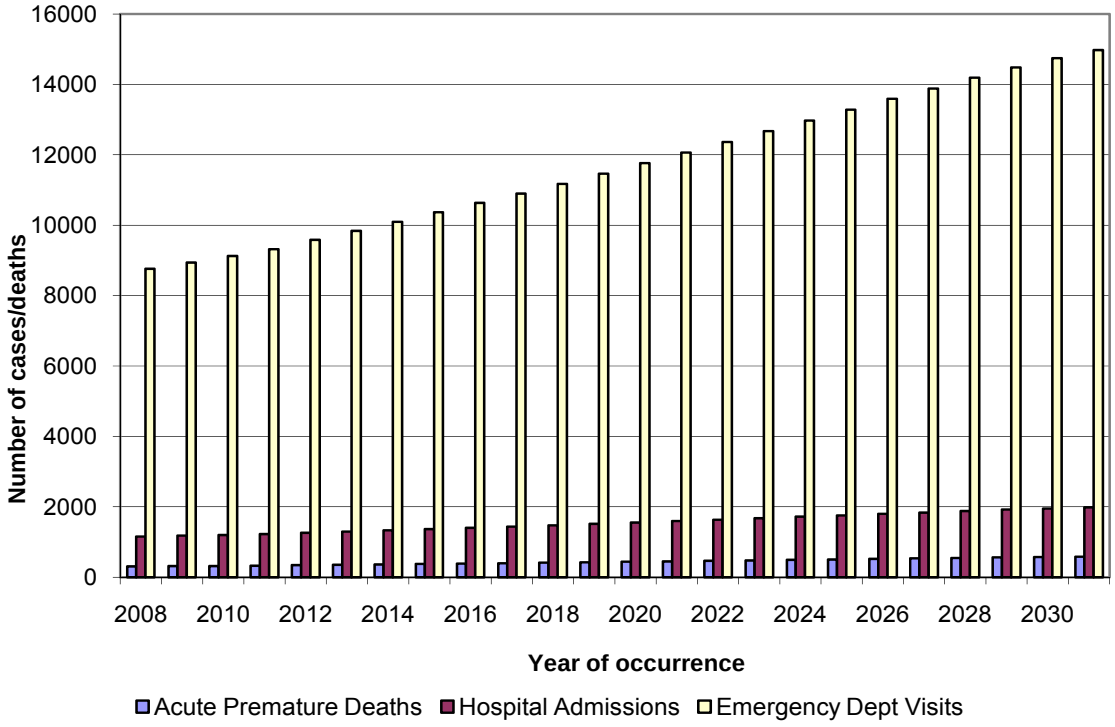


Table 19: British Columbia health damages summary

	2008	2015	2031	Total (2008-31)
Acute Premature Deaths	306	375	585	**10,483**
Hospital Admissions	1,158	1,369	1,985	**37,204**
Emergency Dept. Visits	8,763	10,366	14,975	**281,208**
Minor Illnesses	2,526,900	2,721,800	3,160,000	**68,340,200**
Doctor's Office Visits	62,112	71,968	98,578	**1,915,724**

Table 20: British Columbia economic damages summary [1]
(damages expressed in thousands)

	2008	2015	2031	Total (2008-31)
Lost Productivity	$78,000	$82,900	$90,600	**$2,037,200**
Healthcare Costs	$51,100	$57,800	$76,000	**$1,513,900**
Quality of Life	$41,200	$45,200	$55,200	**$1,154,700**
Loss of Life	$744,900	$916,100	$1,404,700	**$25,471,400**
Total Cost	**$915,200**	**$110,200**	**$162,650**	**$30,177,200**

1. All economic values are shown using constant 2006 dollars

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