

Protection from second-hand tobacco smoke in Ontario

*A review of the evidence regarding best
practices*

A Report of the Ontario Tobacco Research Unit, University of Toronto

Toronto, Ontario

May 2001

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Foreword

With funding from the Public Health Branch of the Ministry of Health and Long-Term Care, the Ontario Tobacco Research Unit of the University of Toronto coordinated the preparation of this report. A first draft of the report was prepared by Mr. Neil E. Collishaw, Research Director of Physicians for a Smoke-Free Canada, according to the following terms of reference:

- *Review existing meta-analyses, other reviews of the scientific literature (including criticisms of scientific reviews), and recent studies not included in previous reviews linking exposure to environmental tobacco smoke (ETS) and various diseases. Make conclusions about the public health consequences of exposure to ETS.*
- *Determine, through a review of the scientific literature, whether a safe and/or acceptable level of exposure for ETS exists.*
- *Evaluate the scientific evidence and determine whether ventilation of indoor air is an effective approach to eliminate the risk of diseases caused by ETS.*

An Expert Panel met in Toronto on October 2, 2000 to review the first draft.

The Panel assessed the draft report critically, accepted it as a good basis for a final report, and made suggestions for revisions. Comments of the Panel were incorporated into the next draft of the report.

The second draft was again reviewed by members of the Expert Panel. After some further revisions, all endorsed it as a complete, correct assessment of the evidence on the health effects of second hand smoke and the inadequacy of ventilation solutions to the problem of exposure to second-hand smoke.

Members of the panel included:

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Mr. James Repace
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Observers at the expert panel meeting included:

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Few issues have been subject to as many scientifically rigorous reviews as second-hand smoke. The conclusions from these reviews and our own review are clear:

- **Exposure to second-hand smoke causes the following diseases and conditions:**
 - **In adults**
 - *Heart disease*
 - *Lung cancer*
 - *Nasal sinus cancer*
 - **In children**
 - *Sudden infant death syndrome*
 - *Fetal growth impairment including low birth-weight and small for gestational age*
 - *Bronchitis, pneumonia and other lower respiratory tract infections*
 - *Asthma exacerbation*
 - *Middle ear disease*
 - *Respiratory symptoms*

- **Exposure to second-hand smoke has also been linked to other adverse health effects. The relationships may be causal. These include:**
 - **In adults:**
 - *Stroke*
 - *Breast cancer*
 - *Cervical cancer*
 - *Miscarriages*
 - **In children**
 - *Adverse impact on cognition and behaviour*
 - *Decreased lung function*
 - *Asthma induction*
 - *Exacerbation of cystic fibrosis.*

- **It is estimated that exposure to second-hand smoke causes between 1100 and 7800 deaths per year in Canada, at least one-third of them in Ontario.**

- **All involuntary exposure to tobacco smoke is harmful and should be eliminated.**

- **Ventilation provides no solution to the problem of exposure to second-hand tobacco smoke.**

- **Full compliance with the *Ontario Occupational Health and Safety Act* and its regulations requires eliminating all tobacco smoke from Ontario workplaces. Medical Officers of Health could issue orders to this effect.**

On the basis of these conclusions,

IT IS RECOMMENDED* THAT:

- *The Ontario government move immediately to comply with existing laws and regulations by making all workplaces governed by the *Ontario Occupational Health and Safety Act* smoke-free.*
- *The Ontario government take immediate steps to ensure that all other Ontario workplaces and public places are made smoke-free.*
- *The Ontario government should advise all Ontario residents to make their homes smoke-free in order to protect themselves, their children and their visitors from second-hand smoke.*

Ontario Tobacco Research Unit
University of Toronto

May 2001

*The recommendations made in this Report are solely those of the Ontario Tobacco Research Unit and not of the Ministry of Health and Long-Term Care.

Executive summary

A synthesis of knowledge on second-hand smoke

This report reviews current knowledge about the health effects of involuntary exposure to tobacco smoke. It discusses the inadequacy of ventilation options for providing protection from involuntary exposure to tobacco smoke. Finally, the current status of legislative protection from second-hand smoke in Ontario and other jurisdictions is reviewed.

The report does not attempt to repeat what has already been thoroughly documented elsewhere, but rather to bring together information from other syntheses of knowledge in order to provide in one concise document a summary of established scientific knowledge on the health effects of second-hand smoke, as well as best practices for control of this known health hazard. The most effective options for control of this known health hazard in Ontario can best be determined on the basis of a thorough understanding of the nature of the health hazards involved and the effectiveness of various control options.

Health effects of involuntary exposure to tobacco smoke

Six major scientific reviews carried out in the 1990s have identified fifteen diseases or conditions as known or suspected to be caused by exposure to second-hand smoke (See Table 2). These include four developmental diseases or conditions, seven respiratory diseases or conditions, three cancers and coronary heart disease.

On the basis of recent research, breast cancer and cerebrovascular disease should be added to the list of diseases for which second-hand smoke is a suspected cause.

It is concluded that:

- **Exposure to second-hand smoke causes the following diseases and conditions:**

In adults

- *Heart disease*
- *Lung cancer*
- *Nasal sinus cancer*

In children

- *Sudden infant death syndrome*

- *Fetal growth impairment including low birth-weight and small for gestational age*
 - *Bronchitis, pneumonia and other lower respiratory tract infections*
 - *Asthma exacerbation*
 - *Middle ear disease*
 - *Respiratory symptoms*
- **Exposure to second-hand smoke has also been linked to other adverse health effects. The relationships may be causal. These include:**

In adults:

- *Stroke*
- *Breast cancer*
- *Cervical cancer*
- *Miscarriages*

In children:

- *Adverse impact on cognition and behaviour*
- *Decreased lung function*
- *Asthma induction*
- *Exacerbation of cystic fibrosis.*

- **Exposure to second-hand smoke causes between 1100 and 7800 deaths per year in Canada, at least one-third of them in Ontario.**

Recommendations of scientific review reports

Recommendations in the reports of major scientific reviews have been expressed in many different ways. However, the message from all of them is clear, consistent and unanimous:

- **All involuntary exposure to tobacco smoke is harmful and should be eliminated.**

No solution through ventilation

The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the world's leading ventilation standard-setting organization, no longer provides standards for air with tobacco smoke in it, only for smoke-free air. Searches for ventilation solutions have proven fruitless. A panel of 14 experts in ventilation technology recently concluded that existing dilution ventilation technology could not effectively remove much tobacco smoke from indoor air. However, they speculated that under ideal conditions, displacement ventilation might be able to remove up to 90% of tobacco smoke from air.

A noted expert on second-hand smoke risk assessment, James Repace, analyzed these findings using risk assessment procedures and concluded that dilution ventilation would have to improve by a factor of 20,000 and displacement ventilation by a factor of 2000 in order to meet the level of public health protection normally expected against environmental contaminants.

Accommodation of tobacco smoke in the workplace, the solution proposed by the tobacco industry, was found to have no basis in science or public health protection. Its advocacy by members of the hospitality industry is similarly lacking in public health motivation. The tobacco industry has made payments to the hospitality industry to implement its Courtesy of Choice campaign.

Given all knowledge accumulated to date in the health, risk assessment and ventilation sciences, it is most unlikely that tobacco smoke in indoor environments could ever be reduced to safe levels through the application of ventilation technology.

- **Ventilation provides no solution to the problem of exposure to second-hand tobacco smoke.**

Effective workplace protection can be implemented

In North America, both California and British Columbia offer good protection from exposure to second-hand smoke. California provides protection to 100% of its workers, while British Columbia protects 85% of its workers and is expected to soon extend protection to the other 15%.

Ontario has a patchwork of provincial and municipal legislation, together with administrative rules in some workplaces, that create smoke-free workplaces for some, but still leave tens of thousands of Ontario workers exposed to second-hand smoke, and at risk for related health effects.

Legislative basis for effective protection from tobacco smoke in Ontario

Regulations under the *Ontario Occupational Health and Safety Act* list known toxic agents for which exposure values have not been established, and to which any exposure should be avoided. Seven of these toxic agents are known to be in the sidestream smoke emitted from at least 33 of the leading brands of cigarettes available for sale in Canada.

The *Health Protection and Promotion Act* places obligations on Medical Officers of Health in every region of Ontario (health unit) to take action to investigate complaints of occupational and environmental health hazards. Whether a complaint is received or not, the *Health Protection and Promotion Act* affords the Medical Officers of Health broad discretionary power to protect community health. Medical Officers of Health could use

their obligatory and discretionary powers to ensure the elimination of tobacco smoke from Ontario workplaces by ordering swift and effective compliance with the regulations under the *Occupational Health and Safety Act*.

- **Full compliance with the *Ontario Occupational Health and Safety Act* and its regulations requires eliminating all tobacco smoke from Ontario workplaces. Medical Officers of Health could issue orders to this effect.**

Health effects of involuntary exposure to tobacco smoke

Review of reviews:

Findings and conclusions of six major recent reviews of the health effects of exposure to second-hand smoke

Since 1992, six major scientific reviews of the health effects of second-hand tobacco smoke have been published. These include reports of the United States Environmental Protection Agency published in 1992;¹ the Australian National Health and Medical Research Council in 1997;² the California Environmental Protection Agency published in 1997,³ the United Kingdom Scientific Committee on Tobacco and Health in 1998;⁴ the World Health Organization in 1999,⁵ and the United States National Toxicology Program in 2000.⁶

The United States Occupational Safety and Health Administration has also reviewed health evidence related to tobacco smoke as part of a larger review and rule-making procedure related to indoor air quality.⁷ Recently the US National Academy of Sciences has published a report on asthma and indoor air exposures that discusses, among many other subjects, questions related to second-hand smoke and ventilation of indoor air.⁸ These latter two reports, while of some relevance to the subject at hand, have not been included in this review of reviews. Insofar as they have examined the same subject matter as the other six reviews, their scientific conclusions are in substantial agreement with the six reports that will be considered more completely here.

The six reviews were all scrupulous in their scientific rigour. They were either carried out by panels of independent and respected scientists, or prepared by government agencies and reviewed by scientific expert panels. Three reviews were conducted in the United States, one in Australia, one in the United Kingdom and one by an international scientific panel. All of the reviews were conducted independently.

In reviewing the findings of all six reports, one is struck by the high degree of consensus that has emerged on the health hazards of second-hand smoke. Not all reports reviewed all of the possible health effects of second-hand smoke. However, where evidence was reviewed on the same disease outcomes, the

reports came to very nearly the same conclusions, with remarkably little variation.

1992: Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders

This review, carried out by the United States Environmental Protection Agency (US EPA) and published in 1992, was restricted to respiratory disorders.

Based on the total weight of scientific evidence available up to the time of the review (1992), the US EPA reached the following major conclusions concerning exposure to environmental tobacco smoke:

In adults

- *Environmental tobacco smoke is a human lung carcinogen, responsible for approximately 3,000 lung cancer deaths annually in U.S. non-smokers.*
- *Environmental tobacco smoke has subtle but significant effects on the respiratory health of non-smokers, including reduced lung function, increased coughing, phlegm production, and chest discomfort.*

In children

- *Environmental tobacco smoke exposure is causally associated with an increased risk of lower respiratory tract infections such as bronchitis and pneumonia. This report estimates that 150,000 to 300,000 cases annually in infants and young children up to 18 months of age are attributable to ETS.*
- *Environmental tobacco smoke exposure is causally associated with an increased prevalence of fluid in the middle ear, symptoms of upper respiratory tract irritation, and a small but significant reduction in lung function.*
- *Environmental tobacco smoke exposure is causally associated with additional episodes and increased severity of symptoms in children with asthma, and this report estimates that 200,000 to 1,000,000 asthmatic children have their condition worsened by exposure to ETS.*

- *Environmental tobacco smoke is a risk factor for new cases of asthma in children who have not previously displayed symptoms.*

The US EPA report reviewed the evidence on the relationship between lung cancer and exposure to second-hand smoke in great detail and reached the following additional conclusion:

Based on the assessment of all the evidence considered in Chapters 3, 4 and 5 of this report and in accordance with the EPA Guidelines and causality criteria above for the interpretation of human data, this report concludes that ETS is a Group A human carcinogen, the EPA classification 'used only when there is sufficient evidence from epidemiological studies to support a causal association between exposure to the agents and cancer.'

1997: Health Effects of Passive Smoking

This 1997 Australian report provided estimates of the public health impact of second-hand smoke in the home:

The scientific evidence shows that passive smoking causes lower respiratory illness in children and lung cancer in adults and contributes to the symptoms of asthma in children. Passive smoking may also cause coronary heart disease in adults. It is estimated that passive smoking contributes to the symptoms of asthma in 46,500 Australian children each year and causes lower respiratory illness in 16,300 Australian children.

1997: Health Effects of Exposure to Environmental Tobacco Smoke

Of the six major reviews examined here, this review by the California Environmental Protection Agency was the most comprehensive, covering numerous health outcomes of exposure to second-hand smoke, and the most thorough. The report was five years in the making and is over 400 pages in length. In the preface to the NCI republication of the report (1999), Dr. David Satcher, United States Surgeon-General and Assistant Secretary for Health stated:

- *The California Environmental Protection Agency spent 5 years preparing this document, and it solicited input from all interested parties – including the tobacco industry and its consultants. Cal/EPA held several public workshops to solicit input and made drafts available for public comment and criticisms. The final draft was peer reviewed by California’s Scientific Review Panel, a body created under California law to provide independent peer review of many scientific aspects of the state’s toxic air contaminants and air pollution programs.*

The report reached the following conclusions:

Effects causally associated with ETS exposure

Developmental effects

- *Fetal growth low birth-weight or small for gestational age*
- *Sudden infant death syndrome (SIDS)*

Respiratory effects

- *Acute lower respiratory tract infections in children (e.g. bronchitis and pneumonia)*
- *Asthma induction and exacerbation in children*
- *Chronic respiratory symptoms in children*
- *Eye and nasal irritation in adults*
- *Middle ear infections in children*

Carcinogenic effects

- *Lung cancer*
- *Nasal sinus cancer*

Cardiovascular effects

- *Heart disease mortality*
- *Acute and chronic coronary heart disease morbidity*

Effects with suggestive evidence of a causal association with ETS exposure

Developmental effects

- *Spontaneous abortion*

- *Adverse impact on cognition and behaviour*

Respiratory effects

- *Exacerbation of cystic fibrosis*
- *Decreased pulmonary function*

Carcinogenic effects

- *Cervical cancer*

The report went on to estimate annual morbidity and mortality in non-smokers associated with exposure to second-hand smoke in California. The estimates are given in Table 1.

Canada and California have about the same population. Assuming that exposure to second-hand smoke is similar in the two jurisdictions and that it was also similar in the past, the estimates given in Table 1 may well apply about as well to Canada as they do to California.

**Table 1:
Estimated annual morbidity and mortality in
California non-smokers associated with ETS
exposure**

| CONDITION | NUMBER OF DEATHS OR CASES: CALIFORNIA |
|--|--|
| Developmental effects | |
| • Low birth-weight | 1,200 - 2,200 cases |
| • Sudden Infant Death Syndrome | 120 deaths |
| Respiratory effects in children | |
| • Middle ear disease | 78,600 to 188,700 physician office visits |
| • Asthma induction | 960 - 3,120 new cases |
| • Asthma exacerbation | 48,000 - 120,000 children |
| • Bronchitis or pneumonia | 18,000 - 36,000 cases |
| Cancer | |
| • Lung | 360 deaths |
| • Nasal sinus | Not available |
| Cardiovascular effects | |
| • Ischaemic heart disease | 4,200 - 7,440 deaths |

1998: United Kingdom Scientific Committee on Tobacco and Health

This report reviewed the health effects of active smoking and exposure to second-hand smoke. Here are the conclusions reached on the health effects of second-hand smoke:

- *Exposure to environmental tobacco smoke is a cause of lung cancer and, in those with long-term exposure, the increased risk is in the order of 20-30%.*
- *Exposure to environmental tobacco smoke is a cause of ischaemic heart disease and, if current published estimates of magnitude of relative risk are validated, such exposure represents a substantial public health hazard.*
- *Smoking in the presence of infants and children is a cause of serious respiratory illness and asthmatic attacks.*
- *Sudden infant death syndrome, the main cause of post-neonatal death in the first year of life, is associated with exposure to environmental tobacco smoke. The association is judged to be one of cause and effect.*
- *Middle ear disease in children is linked with parental smoking and this association is likely to be causal.*

1999: International Consultation on Environmental Tobacco Smoke (ETS) and Child Health

This report was prepared by an international committee that met in Geneva in 1999 under the auspices of the World Health Organization. The committee reached the following conclusions with respect to the health effects of second-hand smoke on children.

The Consultation concluded that ETS is a real and substantial threat to child health, causing death and suffering throughout the world. ETS exposure causes a wide variety of adverse health effects in children, including lower respiratory tract infections such as pneumonia and bronchitis, coughing and wheezing, worsening of asthma, and middle ear disease. Children's exposure to environmental tobacco smoke may also contribute to cardiovascular disease in adulthood and to neurobehavioural impairment.

In addition, the Consultation noted that ETS exposure among non-smoking pregnant women can cause a decrease in birth weight and that infant exposure to ETS may contribute to the risk of SIDS.

2000: Ninth Report on Carcinogens of the National Toxicology Program

In 2000 the United States National Toxicology Program added environmental tobacco smoke to its official list of known human carcinogens. The report concluded:

Environmental tobacco smoke (ETS) is known to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in humans that indicate a causal relationship between passive exposure to tobacco smoke and human lung cancer (reviewed by IARC V. 38 1986; US EPA 1992, CEPA 1997). Studies also support an association of ETS with cancers of the nasal sinus (CEPA 1997).

It has classified environmental tobacco smoke as one of 41 known human carcinogens. Many of the 41 known human carcinogens are components of tobacco smoke. These include:

- *4-aminobiphenyl*
- *arsenic*
- *benzene*
- *1,3-butadiene*
- *cadmium*
- *chromium VI*
- *2-naphthylamine*
- *vinyl chloride*

Other known human carcinogens on the list include asbestos, coke oven emissions, radon and mustard gas.

Table 2:
Summary of Conclusions
of six major reviews concerning exposure to second-hand smoke as a cause or possible cause of various diseases and conditions

| Disease or condition | 1992: US EPA | 1997: Australian NHMRC | 1997: Cal EPA | 1998: UK SCOTH | 1999: WHO | 2000: US National Toxicology Program |
|--|-----------------|------------------------------|------------------|-------------------|--------------|---|
| Developmental effects | | | | | | |
| • Fetal growth: low birth-weight or small for gestational age | | ✓ ? | ✓ | | ✓ | |
| • Sudden infant death syndrome (SIDS) | | ✓ | ✓ | ✓ | * | |
| • Spontaneous abortion | | | * | | | |
| • Adverse impact on cognition and behaviour | | | * | | * | |
| Respiratory effects | | | | | | |
| • Acute lower respiratory tract infections in children (e.g. bronchitis and pneumonia) | ✓ | ✓ | ✓ | ✓ | ✓ | |
| • Asthma exacerbation in children | ✓ | ✓ | ✓ | ✓ | ✓ | |
| • Asthma induction in children | * | ✓ ? | ✓ | | *? | |
| • Respiratory symptoms | ✓ | ✓ | ✓ | ✓ | ✓ | |
| • Middle ear disease in children | ✓ | ✓ | ✓ | ✓ | ✓ | |
| • Decreased pulmonary function | ✓ | ✓ | * | | * | |
| • Exacerbation of cystic fibrosis | | | * | | | |
| Carcinogenic Effects | | | | | | |
| • Lung cancer | ✓ | ✓ | ✓ | ✓ | | ✓ |
| • Nasal sinus cancer | | * | ✓ | | | ✓ ? |
| • Cervical cancer | | | * | | | |
| Cardiovascular effects | | | | | | |
| • Coronary heart disease | | * | ✓ | ✓ | | |

A check mark (✓) indicates that the review concluded the relationship to the disease or condition was causal. An asterisk (*) indicates that the review concluded the relationship was possibly causal. In both cases protective public health action is warranted. A blank cell indicates that the relationship was reviewed only briefly or not at all. A question mark (?) indicates some inconsistency or ambiguity in the report's conclusions as to whether the relationship is causal or not.

Summary of Report Conclusions

The findings of all six reviews are summarized in Table 2. From Table 2 it is clear that there is a remarkable scientific consensus that exposure to second-hand smoke is a known or suspected cause of a wide variety of diseases and conditions. At least three of the reviews have concluded that exposure to second-hand smoke is a known or suspected cause of the following ten diseases or conditions:

| Disease or Condition |
|---|
| Developmental effects |
| <ul style="list-style-type: none">• Fetal growth: low birth-weight or small for gestational age• Sudden Infant Death Syndrome |
| Respiratory effects in children |
| <ul style="list-style-type: none">• Acute lower respiratory tract infections in children (e.g. bronchitis and pneumonia)• Asthma exacerbation• Respiratory symptoms• Middle ear disease in children• Decreased pulmonary function |
| Carcinogenic Effects |
| <ul style="list-style-type: none">• Lung Cancer• Nasal sinus cancer |
| Cardiovascular effects |
| <ul style="list-style-type: none">• Coronary heart disease |

One or two of the reviews have identified exposure to second-hand smoke as a known or suspected cause of the following additional five diseases or conditions:

| Disease or Condition |
|--|
| Developmental effects |
| <ul style="list-style-type: none">• Spontaneous abortion• Adverse impact on cognition and behaviour |
| Respiratory effects in children |
| <ul style="list-style-type: none">• Asthma induction in children• Exacerbation of cystic fibrosis |
| Carcinogenic Effects |
| <ul style="list-style-type: none">• Cervical cancer |

Recent research findings:

Since these major reviews have been published, research has continued. New studies have been published that reinforce the results of these reviews. No new studies have provided any reason to call into question the findings of any of the six reviews summarized in Table 2.

However, there has been significant new research pointing to previously unrecognized effects of exposure to second-hand smoke. These include risks for cerebrovascular disease and breast cancer.

Exposure to second-hand smoke and cerebrovascular disease (stroke)

The two major types of cerebrovascular disease (stroke) are infarctions and hemorrhage. In a cerebrovascular infarction, blood vessels in the brain are blocked by a thrombus or an embolism. A cerebrovascular hemorrhage involves a burst blood vessel in the brain. The pathophysiological mechanisms that underlie the development of both heart disease and cerebrovascular disease have many points in common. Atherosclerosis, platelet aggregation, the formation of thrombi and thromboses are among the pathophysiological effects that can lead to both heart disease and strokes.⁹ The relationship between exposure to second-hand smoke and heart disease is now well established. Given the similarity in pathophysiology, it should not be surprising that evidence would emerge to demonstrate that like cardiovascular diseases, cerebrovascular diseases are also related to exposure to second-hand smoke.

You *et al.*¹⁰ conducted a case-control study of stroke risk and exposure to second-hand smoke in the United States. They found that the risk of stroke was twice as high for subjects whose spouses smoked as for those whose spouses did not smoke (CI=1.3 to 3.1), after adjustment for subject's own smoking, heart disease, hypertension, diabetes and education level.

Bonita *et al.*¹¹ also conducted a case-control study of exposure to second-hand smoke and stroke in New Zealand. They found that there was a significant increase in risk in both men (OR = 2.10; 95% CI = 1.33 to 3.32) and women (OR = 1.66; 95% CI = 1.07 to 2.57). The study also confirmed the higher risk of stroke for active smoking, and found that the stroke risk from active smoking was higher when those exposed to second-hand smoke were excluded from the reference group. This led them to conclude that studies investigating the adverse health effects of active smoking will underestimate the active smoking risk if exposure to ETS is not taken into account.

Exposure to second-hand smoke and breast cancer

Johnson *et al.*¹² made a similar observation in their investigation of exposure to second-hand smoke and breast cancer. They noted that 19 published studies that have compared ever smokers to never smokers have found little or no increased risk of breast cancer due to smoking. However, a number of recently-published studies, including their own, that have used a comparison group of women who have not smoked or had regular exposure

to second-hand smoke have permitted better comparisons of exposed to unexposed populations. Such studies have found both active smoking and exposure to second-hand smoke to be related to breast cancer.¹³ In the large Canadian study, among premenopausal women, both active smoking and exposure to second-hand smoke about doubled the risk of breast cancer, while among postmenopausal women risk increased by 20% for exposure to second-hand smoke and by 50% for active smoking. Dose-response relationships were also observed for both active smoking and exposure to second-hand smoke. When the nine published studies that have attempted to control properly for second-hand smoke exposure are considered together, the combined results suggest almost a doubling of breast cancer risk with long term active smoking or regular exposure to second-hand smoke, particularly among premenopausal women.¹⁴

These studies point to exposure to second-hand smoke as a possible cause of cerebrovascular disease and breast cancer. Importantly, they have also highlighted a problem inherent in most epidemiological studies of active smoking. Most have failed to account for exposure to second-hand smoke in the control group. Relationships of active smoking to disease outcomes are generally underestimated if the control group is defined as non-smokers or never smokers. Risks from either active smoking or exposure to second-hand smoke are better estimated if the control group is truly unexposed – as close as possible to the ideal of a group that never had exposure to tobacco smoke from active smoking or exposure to second-hand smoke.¹⁵

Canadian estimates of mortality due to exposure to second-hand smoke

Many people are exposed to tobacco smoke at work. The 1994-5 Survey on Smoking in Canada estimated that 60% of employed Canadians, about seven million people, worked in workplaces that had no restrictions or partial restrictions on smoking. In Ontario, about 52% of the workforce, 2.2 million people, worked in locations where at least some smoking was allowed.¹⁶

In Canada, lung cancer due to exposure to second-hand smoke is estimated to have caused 336 deaths in 1994 and 347 deaths in 1996.¹⁷ In 1992, heart disease due to exposure to second-hand smoke was estimated to have caused 2,051 deaths per year between 1985 and 1990 (438 +/- 242 annual deaths among men and 1, 613 +/- 687 annual deaths among women).¹⁸ In 2000, second-hand smoke is estimated to have caused 800 deaths a year due to residential exposure only.¹⁹ The same study estimated that about two million adult Canadians were regularly exposed to second-hand smoke at home. Results from the 1994-95 Survey on Smoking In Canada, cited above, suggest that up to seven million Canadians are exposed to tobacco smoke in the workplace to some degree. In round numbers, smoking is estimated to cause about 1100 to 2400 deaths per year among non-smokers from lung cancer (340 deaths per year) and heart disease (800 deaths per year due to residential exposure or 2050 +/- 930 deaths per year due to all exposure).

The only estimates available from Australia for lung cancer and heart disease deaths due to exposure to second-hand smoke are lower than estimates for Canada. However, the Australian estimates are for exposure to second-hand smoke at home only. No Australian estimates take into account exposure outside the home, nor effects of exposure to second-hand smoke on ex-smokers.

Meta-analyses have been performed on lung cancer and heart disease due to passive smoking at work. It has been concluded that workplace exposure to second-hand smoke results in relative risks of lung cancer²⁰ and heart disease²¹ in the United States that are about the same as the relative risks already established for residential exposure.

California has about the same population as Canada, and estimates of mortality for both lung cancer and sudden infant death syndrome (SIDS) due to exposure to second-hand smoke are broadly similar in the two jurisdictions. However, estimates for heart disease deaths due to exposure to second-hand smoke in California (4,200 – 7,440 deaths) are higher than estimates for Canada. The California estimates are derived from US national estimates prepared by the United States Environmental Protection Agency and others. Both the US national and California estimates are more recent and based on a larger number of epidemiological studies than the older Canadian estimates. If the California estimates are applied to Canada, it suggests that 4,500 – 7,800 deaths per year are due to exposure to second-hand smoke in Canada, just as in California.

Thirty-seven per cent of the Canadian population lives in Ontario. It can be conservatively assumed that exposure to second-hand smoke has been somewhat lower in Ontario than the Canadian average, and that about thirty-three per cent of the passive smoking deaths would occur in Ontario. It is therefore estimated that exposure to second-hand smoke causes between 1100 and 7800 deaths per year in Canada. Of these at least one-third, about 350 to 2600 deaths, occur in Ontario.

Summary of health effects of exposure to second-hand smoke

Six major scientific reviews carried out in the 1990s have identified 15 major disease groups or conditions as known or suspected to be caused by exposure to second-hand smoke (See Table 2). These include four developmental diseases or conditions, seven respiratory diseases or conditions, three cancers and coronary heart disease.

On the basis of recent research, breast cancer and cerebrovascular disease should be added to the list of diseases for which exposure to second-hand smoke is a suspected cause.

It is concluded that:

Exposure to second-hand smoke causes the following diseases and conditions:

- **In adults**

- Heart disease*

- Lung cancer*

- Nasal sinus cancer*

- **In children**

- Sudden infant death syndrome*

Fetal growth impairment including low birth-weight and small for gestational age

Bronchitis, pneumonia and other lower respiratory tract infections

Asthma exacerbation

Middle ear disease

Respiratory symptoms

- **Exposure to second-hand smoke has also been linked to other adverse health effects. The relationships may be causal. These include:**
 - **In adults:**
 - *Stroke*
 - *Breast cancer*
 - *Cervical cancer*
 - *Miscarriages*
 - **In children**
 - *Adverse impact on cognition and behaviour*
 - *Decreased lung function*
 - *Asthma induction*
 - *Exacerbation of cystic fibrosis.*
- **It is estimated that exposure to second-hand smoke causes between 1100 and 7800 deaths per year in Canada, at least one-third of them in Ontario.**

Recommendations of scientific reviews

Four of the six scientific review reports on the health effects of exposure to second-hand smoke in the 1990s also provided recommendations for action.

1993: Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders

In the preface to the 1993 NCI republication of the US EPA report, Dr Samuel Broder, Director of the US National Cancer Institute made the following policy recommendation:

I strongly recommend the implementation of comprehensive policies that will protect innocent bystanders in all public places to the fullest extent possible. Such policies are medically justified and consistent with our responsibility to protect the public from a demonstrated health risk.

1998: United Kingdom Scientific Committee on Tobacco and Health

The United Kingdom Special Committee on Tobacco and Health made the following recommendations with respect to passive smoking:

- *Smoking in public places should be restricted on the grounds of public health. The level of restriction should vary according to the different categories of public place but smoking should not be allowed in public service buildings or on public transport, other than in designated and isolated areas. Wherever possible, smoking should not be allowed in the work place.*
- *There is a need for public education about the risks of smoking in the home, particularly in relation to respiratory diseases in children.*
- *Health education programs should focus on the dangers of ETS in fetal development and, post-natally, in the sudden infant death syndrome.*

1999: Health Effects of Exposure to Environmental Tobacco Smoke

After reviewing this California Environmental Protection Agency report, Dr David Satcher, U.S. Surgeon-General and U.S. Assistant Secretary for Health made the following recommendation in the preface to the NCI republication of the report.

I call on everyone committed to public health to join with me in a renewed effort to complete the creation of a smoke-free society by:

- *Encouraging communities to enact clean indoor air ordinances requiring 100 percent smoke-free environments in all public areas and workplaces, including all restaurants and bars.*
- *Encouraging smokers as well as non-smokers to make their homes smoke-free to protect children and families from ETS exposure.*

1999: International Consultation on Environmental Tobacco Smoke (ETS) and Child Health

The international panel, meeting under the auspices of WHO, focussed their attention on the health effects of exposure to second-hand smoke on children. They concluded:

- *Almost half of the world's children are involuntarily exposed to tobacco smoke.*
- *Exposure to environmental tobacco smoke causes increased risks of several illnesses in children and may increase the risk of death from sudden infant death syndrome (SIDS). Exposure of non-smoking women to environmental tobacco smoke during pregnancy also causes reductions in foetal growth.*
- *Children do not choose this exposure. Their right to grow up in an environment free from tobacco smoke must be safeguarded through actions by national and local governments, voluntary bodies, community leaders, health workers, educators and parents.*

- *Reducing children's exposure to tobacco smoke requires a two-pronged strategy: reducing smoking in spaces where children live, play, and learn, and reducing overall tobacco consumption.*
- *Effective public policy is important to protect this vulnerable group.*
- *To maximize impact, policies to protect children from tobacco smoke exposure should be implemented as part of comprehensive tobacco control programmes.*
- *Legislated restrictions on smoking in public places and the workplace will protect non-smokers in general and vulnerable groups such as children and pregnant women in particular.*
- *Young children's greatest exposure to tobacco smoke occurs at home. Increasing the percentage of tobacco-free homes is generally not amenable to legislation but can be achieved by a combination of mass media campaigns and smoking restrictions in public places and the workplace.*
- *Programs to raise awareness and motivate behaviour change among pregnant women and their partners are needed to reduce the harmful effects of prenatal and postnatal exposure to tobacco smoke.*
- *Interventions through legislation and education need to be culturally specific.*
- *Surveys, using biomarkers where possible, will be necessary to plot changes in children's involuntary exposure and monitor the effectiveness of interventions.*

Other recent developments

1999: Action Will Speak Louder Than Words: Getting Serious about Tobacco Control in Ontario

An Ontario Expert Panel on the Renewal of the Ontario Tobacco Strategy,²² set up by the Minister of Health, recommended in 1999 that the Government of Ontario should:

- *Require that indoor public places be 100% smoke-free, with immediate implementation in youth recreation facilities.*

- *Incrementally ban smoking in all indoor workplaces except where smoking areas are separately-enclosed and separately-ventilated to the exterior, beginning at once with offices and industrial worksites.*
- *Implement media-based public education programs on the dangers of second-hand smoke.*

Recommendations made by the Ontario Expert Panel are very much in line with the scientific findings on second-hand smoke and very much in keeping with the recommendations of other health authorities in other jurisdictions. It recommended that protection from second-hand smoke should be integral to and incorporated into a comprehensive tobacco use reduction program to lessen the public health consequences of tobacco use in Ontario.

2000: Ninth Report on Carcinogens of the National Toxicology Program

In keeping with its usual practice, the National Toxicology Program does not make direct policy recommendations.

However, classifications of carcinogens by the US National Toxicology Program are taken very seriously by other agencies, like the American Conference of Governmental Industrial Hygienists (ACGIH) and the United States Environmental Protection Agency (US EPA). These and other agencies generally recognize that there is no safe level of exposure to known human carcinogens. The US National Toxicology Program has concluded that second-hand smoke is a known human carcinogen.

The ACGIH generally recommends no exposure to known human carcinogens. ACGIH recommendations are frequently incorporated into occupational health and safety regulations in many jurisdictions, including Ontario, other Canadian provinces and Canadian federal jurisdiction.

The US EPA usually takes regulatory action to ensure that lifetime cancer risks are no higher than the range of one in ten thousand to one in a million. The risks of lung cancer from exposure to second-hand smoke are in the range of one in five hundred to one in a thousand, more than ten times greater than the cancer risks that would normally elicit regulatory control action by the US EPA.

Classification of environmental tobacco smoke as a known human carcinogen by the US National Toxicology Program should elicit concerted action in all countries to eliminate, insofar as possible, all involuntary exposure to tobacco smoke.

No solution through ventilation

Introduction

In 1981, the United States National Academy of Sciences assembled an expert panel to review a variety of indoor pollution and ventilation issues, including tobacco smoke in the workplace.²³ For its time, the report of their work, entitled *Indoor Pollutants*, was the most authoritative scientific statement on indoor air pollution extant. The report concluded that a ventilation system capable of completely removing tobacco smoke from the air did not exist.

The information on ventilation in the 1981 National Academy of Sciences report has been surpassed by many advances in ventilation science over the past two decades. Our knowledge of the health hazards of second-hand smoke, in its infancy in 1981, has also grown exponentially, as has our knowledge of the physics and chemistry of tobacco smoke in indoor air.

Twenty years ago, techniques of air cleaning and recycling were less sophisticated than they are today. Little knowledge of the behaviour of tobacco smoke in indoor air was available. Now, we have predictive models that can tell us with great reliability how much of several components of tobacco smoke will be present in indoor air under different conditions of smoking and ventilation. In 1981, the very first papers were being published pointing to a possible relationship between exposure to second-hand smoke and lung cancer. Now, scientific consensus has been established that exposure to second-hand smoke causes lung cancer and is a known or suspected cause of many other diseases or conditions (see Table 2).

With these advances in science on several fronts, the conclusion about ventilation and tobacco smoke nevertheless remains the same as it was twenty years ago – the ventilation system capable of removing tobacco smoke from the air does not exist.

The policy implications of this fact are more profound than they were twenty years ago. In 1981, there was still scientific debate about whether or not exposure to second-hand smoke was hazardous, and whether or not exposure should be reduced. Now, scientific consensus has been established – exposure to second-hand smoke causes lung cancer, heart disease and many other diseases. Moreover, scientists around the world agree – the only safe level of exposure to second-hand smoke is no exposure at all. If ventilation were to offer an effective public health solution to the problem of exposure to second-

hand smoke in the workplace, it would have to ensure virtually no exposure to second-hand smoke.

In the remainder of this section, documentation will be provided demonstrating that such a ventilation system does not exist. It will also be demonstrated that a preferred control method is to ban smoking in all public places and workplaces.

Ventilation standards

Heating, ventilation and air conditioning engineers around the world look to the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) for guidance and standard setting on determining ventilation rates for the buildings they design and manage. ASHRAE standards are frequently written into laws and regulations governing ventilation rates. Even when they are not written into law, they are widely followed by engineers and building managers as the preferred code of practice for ventilation rates. ASHRAE standards are the most widely observed code of ventilation practice in Canada.

The ASHRAE standard that governs indoor air quality is called *Ventilation for Acceptable Indoor Air Quality*, ASHRAE Standard 62-1999. This standard was revised in 1973, 1981, 1989 and 1999. The most recent revision is significant because it takes into account new knowledge on the health effects of second-hand tobacco smoke (See Table 2).

The revision removed a provision (present in the 1989 version of the standard) that recommended ventilation rates for the control of odours from second-hand tobacco smoke.²⁴ With the 1999 revision, ASHRAE, in essence, deferred to other authorities for standard setting on second-hand tobacco smoke, a known carcinogen. Now ventilation rates proposed by ASHRAE only apply to air free from tobacco smoke. For dealing with tobacco smoke, ASHRAE recommends the reduction of “the concentration of all known contaminants of concern to some specified acceptable level.” To determine this level, one is referred to a list of health authorities that include the US Environmental Protection Agency, the World Health Organization, the American Medical Association, the American Lung Association, the National Institutes for Occupational Safety and Health, the National Academy of Sciences, the Occupational Safety and Health Administration and the Surgeon General. There is consensus among all these scientific agencies – there should be no exposure to second-hand tobacco smoke.

In revising its standard, ASHRAE adhered to a time-tested principle of sound public health and ventilation engineering practice. First, remove known sources of air pollution, and only then apply air cleaning and ventilation techniques. Revised standard 62-1999 adheres closely to this principle. ASHRAE no longer provides ventilation standards for air with tobacco smoke in it, only for air in smoke-free buildings.

To sum up, ASHRAE, the premier ventilation rate standard-setting agency in the world has said, in essence, the only air for which it sets ventilation standards is air that is already smoke-free.

Searching for a ventilation solution

The revised ASHRAE standard was adopted only after considerable debate. Appeals were heard from many interests. Appellants included ventilation engineers, the tobacco industry and the Neighbourhood Pub Owners' Association of British Columbia.²⁵ All points of view were heard and considered before revisions to the standard were decided. Throughout the appeals procedure, the appeals panel indicated that ventilation standards could possibly be developed if cognizant health authorities were to define some safe non-zero level of exposure to second-hand smoke. That has not happened. In fact the appeals panel remarked, "The statements of cognizant health authorities have become more definitive and are unanimous with respect to the health impacts of ETS." As described earlier, health authorities have been unanimous in recommending that we move as quickly as reasonably possible towards eliminating all exposure to second-hand tobacco smoke. No scientific basis has been found for recommending a non-zero limit for exposure to second-hand tobacco smoke.

Notwithstanding the scientific conclusion that all exposure to second-hand smoke should be avoided, the search for a ventilation solution continued. In 1998, US OSHA and ACGIH teamed up to sponsor a scientific review by a panel of fourteen ventilation experts to determine if there were technically and economically feasible engineering controls for environmental tobacco smoke in restaurants, bars and casinos. Their review was conducted in a scientific workshop held in Fort Mitchell, Kentucky in June 1998. The panel was instructed to conduct their work assuming that total elimination of second-hand tobacco smoke was not an option.²⁶

Panelists concluded that well-mixed dilution ventilation, the overwhelming majority of current installations, was unsatisfactory for controlling worker exposure to ETS in hospitality venues. Local area exhaust ventilation, smokeless ashtrays, air cleaning, and displacement ventilation were identified as potentially more effective. Of these, displacement ventilation was thought to hold the most promise. Based on professional judgement, not measured data, panelists felt that a 90% reduction in levels of ambient tobacco smoke could be achieved under the most favourable conditions. Panelists noted, however, a number of practical problems: most ventilation engineers are unfamiliar with displacement technology; there would be difficulty in retrofitting existing installations; and there could be aesthetic problems.

Why ventilation solutions do not work

The United States Occupational Safety and Health Administration (OSHA) has proposed (but not yet implemented) a rule on smoking in the workplace that would reduce exposure to tobacco smoke to zero for many workers in many workplaces.⁷ Banning smoking in the workplace is the preferred option under the proposed rule. However, smoking could be allowed under certain circumstances that were intended to greatly reduce exposure to tobacco smoke for non-smoking workers:

Tobacco smoke.

(i) In workplaces where the smoking of tobacco products is not prohibited, the employer shall establish designated smoking areas and permit smoking only in such areas;

(ii) The employer shall assure that designated smoking areas are enclosed and exhausted directly to the outside, and are maintained under negative pressure (with respect to surrounding spaces) sufficient to contain tobacco smoke within the designated area;

(iii) The employer shall assure that cleaning and maintenance work in designated smoking areas is conducted only when no smoking is taking place;

(iv) The employer shall assure that employees are not required to enter designated smoking areas in the performance of normal work activities;

(v) The employer shall post signs clearly indicating areas that are designated smoking areas;

(vi) The employer shall post signs that will clearly inform anyone entering the workplace that smoking is restricted to designated areas; and

(vii) The employer shall prohibit smoking within designated smoking areas during any period that the exhaust ventilation system servicing that area is not properly operating.

This proposed rule has not been implemented in the United States. Under current legislation, it could not possibly be implemented in Ontario. Under the proposed OSHA scheme, tobacco smoke would be present in the working areas. Smokers would be exposed to it during the main working hours. Cleaning staff (who may be smokers or non-smokers) would enter at other times and be exposed to tobacco smoke remaining in the air, tobacco smoke particulates adhering to surfaces, and tobacco smoke re-released into the air. These exposures to tobacco smoke, affecting both smokers and cleaning staff that enter the smoking rooms, would be contrary to the *Ontario Occupational Health and Safety Act*. They would all necessarily result in worker exposure to seventeen chemicals in tobacco smoke (see Table 3 p. 39) which, under the regulations, are “known toxic agents for which exposure values have not been established, and to which any exposure should be avoided.”

In further considering the limitations of their proposed rule, OSHA recognized that smoking areas could not easily be constructed in bars, restaurants and casinos, prompting OSHA to co-sponsor with ACGIH the 1998 scientific workshop referred to above. However, the workshop did not produce any ready answers to the question of how smoking could continue to be allowed in bars, restaurants and casinos and still ensure the health and safety of workers and patrons.

At the request of the California Department of Health Services, James Repace conducted such a further analysis. The analysis was completed in June 2000 and has been published electronically by the California Department of Health Services.²⁷ Repace provided a synopsis of the Fort Mitchell Workshop proceedings and then noted a number of shortcomings:

Despite the wealth of ETS data in the literature compiled in more than a half dozen reports, plus the fact that indoor air quality models have been under development for more than forty years, the panel did not use either models or data to characterize existing ETS exposures in hospitality venues. The panel did not apply the indoor air quality procedure in ASHRAE 62, section 6.2, which provides a direct solution to the problem by restricting concentration of ETS to some specified acceptable level. No data were presented to substantiate the panelists' belief that 90% reductions in ETS concentrations were obtainable under either controlled studies or in the field, especially in the view of the caveats raised about placement of supply air ducts, turbulent flows, and blowing smoke down or towards the workers (as often happens in casinos). Moreover, in view of OSHA's estimates of more than 13,000 workers' deaths per year from ETS exposure, the panel's attitude that only a 90% reduction is sufficient for ETS control seems cavalier. The panel's confidence in displacement ventilation is not well founded. In addition, the panel's conclusion on ETS-RSP being poorly correlated to more specific measures is not supported. Individual variability in cotinine levels does not compromise assessment of ETS dose.

In his comment, Repace noted that the ASHRAE standard does recommend application of the Indoor Air Quality Procedure when human carcinogens (such as tobacco smoke) are present. Repace then applies this procedure to the problem of tobacco smoke in hospitality venues.

In the first step, hazard assessment, Repace reviewed much of the same scientific literature reviewed in the "Health effects of involuntary exposure to tobacco smoke" section of this report, and noted essentially the same conclusion – scientific and health authorities are unanimous – all involuntary exposure to tobacco smoke should be avoided.

He noted that 103 chemicals in tobacco smoke have been identified as hazardous by various scientific and regulatory authorities in the United States and identified respirable small particles (RSP), together with nicotine and its metabolite, cotinine, as markers for tobacco smoke in ambient air.

The Fort Mitchell Workshop noted that general dilution ventilation accounted for about 99% of current heating, ventilation and air-conditioning installations. In the parlance of outdoor air pollution control, general dilution ventilation would be called reasonably achievable control technology (RACT). RACT is characterized by the US Environmental Protection Agency for outdoor air pollution control purposes as the lowest limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.

The Fort Mitchell Workshop also concluded, based on the professional judgement of the participants, that a 90% reduction in tobacco smoke in indoor air could be achieved through application of displacement ventilation, coupled with the use of ventilated, downdraft ashtrays. Dilution ventilation requires the air to be well mixed, while displacement ventilation uses the opposite strategy. Supply air is released at floor level and is 5-10 degrees cooler than room air. Convection currents cause the air to rise, along with warm tobacco smoke. The tobacco-smoke-laden air is then exhausted through exhaust grilles near the ceiling on the opposite side of the room from the supply vents. While workshop participants noted a number of problems with displacement ventilation, it can nevertheless be considered the best available control technology (BACT).

Repace then provided quantitative risk assessments of exposure to second-hand smoke under both RACT and BACT. Under the BACT model, he assumed that a 90% reduction in environmental tobacco smoke could actually be achieved with displacement ventilation, despite the reservations that Fort Mitchell workshop participants noted about this technology. Based on the extensive scientific literature on the subject, Repace used a combination of field measurement data and risk modeling techniques to provide estimates of tobacco smoke concentrations (as measured by RSP-ETS) in smoking lounges, bars, restaurants, casinos and bowling alleys.

In the United States, there are no national regulatory standards for tobacco smoke in the workplace.* However, there are many other standards for regulating contaminants in both indoor and outdoor air. These standards are based on a considerable body of literature that provides the philosophical and scientific basis for standard setting for indoor and outdoor air contamination control. Travis *et al.*²⁸ discuss the concepts of *de minimis* and *de manifestis* risks. In general, *de minimis* risks are so low that regulatory agencies almost never take action to reduce the risks to a lower level. *De manifestis* risks are so high that regulatory action is almost always imperative. Travis *et al.* reviewed 132 past regulatory decisions and concluded that *de manifestis* risk in practice corresponded to a lifetime risk of mortality of 3 per ten thousand (3×10^{-4}) while *de minimis* risk was one in a million (1×10^{-6}). However, these proposals have not been adopted. In Canada, greater levels of protection have been indicated. The Canadian Environmental Assessment Agency has observed that conventional levels of acceptable risk (*de minimis* risk) range from a low of one in 10 million (1×10^{-7}) to a high of one in ten thousand (1×10^{-4}).²⁹

* This is not the case in Ontario. In Ontario, strict application of the *Occupational Health and Safety Act* and its associated regulation *Control of Exposure to Biological or Chemical Agents* would result in the elimination of tobacco smoke from Ontario workplaces.

The United States Occupational Safety and Health Administration has also defined a 45-year working lifetime risk level of 1 death per 1000 workers at risk as corresponding to a “significant risk of material impairment of health.”

Using data from observations of respirable suspended particulate from environmental tobacco smoke (RSP-ETS), known risk-exposure relationships and risk modeling techniques, Repace estimated excess lifetime mortality risk in smoking lounges, bars, restaurants, casinos and bowling alleys. He compared these to *de manifestis* and *de minimis* risks as described by Travis *et al.*, and to the significant risk level defined by OSHA.

Excess mortality for workers due to exposure to tobacco smoke in these locations ranges from 15 to 26 times higher than the one-in-a-thousand significant risk level defined by OSHA. It is 1.5 to 2.6 million times higher than the lowest (one-in-ten million) level of acceptable risk discussed by the Canadian Environmental Assessment Agency. Regular patrons of these hospitality industry establishments fare little better. Even if they were exposed only about 10% of the time of employees, their level of risk would also exceed the OSHA significant risk level.

Repace then discusses how well various ventilation alternatives protect workers in the hospitality industry. Using ordinary dilution ventilation (reasonably available control technology – RACT), workers are still exposed to risks 20,000 times the *de minimis* level.

Despite doubts about the achievability of a 90% reduction in tobacco smoke with displacement ventilation (best available control technology – BACT), Repace nevertheless assumed that a 90% reduction was achievable. Even with optimum performance of this best available technology, hospitality workers would still be exposed to risks two thousand times greater than the *de minimis* risk level. There is no known way to make dilution ventilation twenty thousand times more effective at providing protection from tobacco smoke, nor any known way of making displacement ventilation two thousand times more effective.

Repace concluded by noting that there is an obvious solution to the problem of tobacco smoke in hospitality venues, and more generally all workplaces. Banning smoking in the workplace would remove the risk entirely at no cost, while providing significant health benefits to workers and the public.

Could there be a ventilation solution in the future?

Improvements in ventilation technology. It seems entirely unlikely that ventilation technology could become twenty thousand times more effective at removing tobacco smoke from the air, even with the most remarkable of technological advances. Systems have been imagined that are ten times more effective, but as Repace has demonstrated, even these systems would have to become a further two thousand times more effective to achieve the requisite level of protection.

Improvements in air cleaning technology. ASHRAE has examined air cleaning technology carefully and concluded that none exists to effectively reduce tobacco smoke in the air to levels that would provide adequate public health protection.³³ In response to a query on this matter, an ASHRAE appeal panel replied:

Before air cleaning can be applied in a definitive manner, target concentrations of all ETS constituents that affect health or cause odour or irritation must be identified, and the removal efficiency of the air cleaning device with respect to each of these constituents must be established by a repeatable rating procedure. The state-of-the-art is not yet at this level. In particular, no cognizant health authorities have established ETS concentrations that result in a reasonable health risk. Until these technical issues are addressed, the standard cannot provide definitive procedures for using air cleaners to control ETS.

Development of new technology capable of removing or reducing most of the more than 100 toxic agents from air polluted by tobacco smoke seems unlikely. Even if it were to happen, it would be a long time before the new technology found its way into an ASHRAE standard. ASHRAE takes a prudent, deliberate and cautious approach to changing its air quality standards.

Allowing some exposure to tobacco smoke. ASHRAE has indicated that a ventilation standard could be proposed for smoking areas if, in the future, recognized health authorities were to propose some non-zero standard for exposure to tobacco smoke. However, this seems unlikely. On the basis of current knowledge, health authorities agree that there is no safe level of exposure to second-hand smoke. Furthermore, as knowledge has advanced, we have found more, not fewer, diseases to be associated with second-hand tobacco smoke. Recent findings have pointed to second-hand smoke as a possible risk factor for breast cancer and strokes. With more knowledge of the health effects of second-hand smoke, we will likely see development of reasonably accurate estimates of mortality attributable to exposure to second-hand smoke for these additional diseases. The continuing development of more accurate knowledge of more diseases associated with second-hand smoke makes it unlikely that any scenario could be foreseen where health authorities would recommend a non-zero level of exposure to second-hand smoke as safe. ASHRAE has indicated that it is developing guidance for restaurants where smoking is permitted. To date, however, no such guidance has been published.³⁰

Separate smoking areas with separate ventilation. OSHA has proposed a system whereby smoking areas and their air exhaust could be kept entirely separate from other work areas.³⁵ Under this scheme, workers could not be required to enter the smoking areas. Smoking areas would be required to have separate exhaust to the outside and negative pressure ventilation. However, this proposed system could not be implemented in Ontario without coming into conflict with Ontario regulations that declare, “any exposure should be avoided” to “known toxic agents,” of which seventeen so identified in the Ontario regulations are also present among the 103 known poisons in tobacco smoke.

Accommodating smokers and non-smokers. By the expedient of simply disagreeing with the scientific findings on the health hazards of second-hand tobacco smoke, the tobacco industry promotes the notion that smokers and non-smokers can accommodate each other in workplaces and, in particular, in the hospitality industry. Statements to this effect appear on the web sites of all major tobacco companies.³¹ To this end the tobacco industry sponsors the Courtesy of Choice campaign for the hospitality industry. Many hotels, bars and restaurants endorse this principle of accommodation and participate in the Courtesy of Choice campaign. However, there are no scientific findings or public health protection principles underlying the notion of the safe accommodation of tobacco smoke in indoor air. The Hotel Association of Canada has so far received a total of \$3.2 million at the rate of \$800,000 per year from the Canadian Tobacco Manufacturers' Council to operate the Courtesy of Choice campaign.³² The notion of accommodation of tobacco smoke in the workplace is not based on any principle of public health protection and flies in the face of the scientific findings that any exposure to second-hand smoke is hazardous. Finding some way of accommodating tobacco smoke in the workplace, as advocated by the tobacco industry and their financial partners in the hospitality industry, will not provide protection from second-hand smoke.

A ventilation solution is unlikely in the future. Sound science remains open to new possibilities in the future. However, given all knowledge accumulated to date in the health, risk assessment and ventilation sciences, it seems entirely unlikely that tobacco smoke in indoor workplaces could ever be reduced to safe levels through the application of ventilation technology.

Ventilation provides no solution to the problem of exposure to second-hand smoke.

Action to control second-hand smoke in selected jurisdictions

Public health authorities around the world agree – action should be taken to progressively eliminate all involuntary exposure to tobacco smoke. A wide variety of actions are needed, all working together in comprehensive programs. The best programs will judiciously combine promotional and educational messages with effective legislative measures. In the interests of brevity, this review will examine only the most significant of recent legislative measures to control exposure to tobacco smoke in public places and workplaces.

Some jurisdictions have made more progress in this area than others. In the United States, California has the longest history of controls on second-hand smoke. Its controls on second-hand smoke now rank among the best in the world in terms of their effectiveness for public health protection. In addition, most of the measures implemented have been carefully evaluated. The evaluation reports provide invaluable guidance for the implementation of effective second-hand smoke control measures in other jurisdictions. The California experience with second-hand smoke control measures is briefly reviewed in this section.

Canadian federal jurisdiction and Canadian provinces, with special mention of British Columbia (where the most effective set of municipal and provincial controls exists) are also reviewed. A discussion of the current status of provincial and municipal controls in Ontario completes this section.

California

Most Californians are protected from tobacco smoke in public places and workplaces. Protection is guaranteed by local ordinances (bylaws) in hundreds of California municipalities. In addition, the *1995 California Clean Air Act* provides statewide protection from second-hand smoke. In 1998, a provision of this law came into effect adding all California bars and bar-restaurants to the list of establishments where smoking was banned.

There is evidence that more non-smokers avoid going to bars and restaurants because of the smoke than there are smokers who frequent such establishments. Accordingly, it stands to reason that a smoking ban would, on balance, be good for business. A Massachusetts study found that 880,000 Massachusetts non-smokers avoided going to bars because of the smoke, 80,000 more than the total number of smokers in the whole

state.³³ Most Californians strongly support clean air policies in their state. More than 86% of California adults – including 71% of smokers – feel that all workplaces should be smoke-free.

Most Californians (88%) prefer to eat in smoke-free restaurants. Now, all restaurants in California are smoke-free and all 890,000 food service employees in the state are protected from second-hand smoke at work.³⁴

Canada: federal jurisdiction

Since 1988, the federal *Non-Smokers' Health Act* has partially protected workers under federal jurisdiction (about 8% of the workforce) from exposure to second-hand smoke in the workplace.³⁵ Smoking is allowed only in enclosed rooms specifically designated for that purpose. There have been nearly no implementation or enforcement problems with the law. It is widely respected and provides a measure of protection from exposure to second-hand smoke, albeit one step below that which is recommended, based on current scientific knowledge.

The law does not provide complete protection from second-hand smoke. Non-smoking employees may be required to enter smoking rooms from time to time. Moreover, except in new federal buildings, there is no requirement that smoking rooms be separately ventilated. Thus, smoke can drift out of the smoking room or be circulated to the rest of the building by the ventilation system.

Smoke-free restaurants and bars in Canada:

Restaurant and bar workers are among the occupational groups most exposed to second-hand smoke. Yet creating rules to protect them has proved to be contentious. They are the last group of workers to receive legal protection from second-hand smoke. However, the level of protection for them is growing across the country.

As of January 2000, bylaws to ban smoking in restaurants and bars or both were in place or coming into force at a later date in at least 51 Canadian municipalities. These included 30 municipalities in B.C., 5 in Alberta and 16 in Ontario.

British Columbia has finalized revised Workmen's Compensation Board regulations that will soon ban smoking in all bars and restaurants in British Columbia.

Canada: provincial jurisdiction

All provinces control smoking under their jurisdiction to some extent, either as a matter of policy, law, or both.³⁶ Only Prince Edward Island and Nova Scotia have no laws restricting smoking. However, the former has administrative rules to restrict smoking in provincial government workplaces and the latter bans it by administrative fiat. Seven

provinces (all except P.E.I., N.S. and Quebec) authorize municipalities to enact bylaws to control smoking in public places and workplaces. Smoking is prohibited in a large number of public places in British Columbia, Manitoba, Ontario, Quebec and Newfoundland. Smoking is prohibited in provincial government workplaces by policy directives in British Columbia, Saskatchewan, Ontario, New Brunswick, Nova Scotia and Newfoundland. Through specific smoking in the workplace provisions in law or in regulation, smoking is prohibited in at least some private sector workplaces under provincial jurisdiction in British Columbia, Quebec and Newfoundland. British Columbia regulation offers the most widespread protection from second-hand smoke in the workplace of any provincial jurisdiction.

British Columbia

The British Columbia government has a comprehensive tobacco control policy, covering all aspects of the tobacco problem. Under the policy, responsibility for protecting workers has been assigned to the Workers' Compensation Board (WCB). The WCB has taken this responsibility seriously. In 1998, it adopted new regulations providing protection from second-hand smoke to 85% of British Columbia workers, by banning smoking in most workplaces. These rules were implemented with little problem and continue to be respected throughout the British Columbia workplaces to which they apply. The remaining 15% of the workers (those working in restaurants, bars, games rooms, sporting arenas, long term care facilities and correctional facilities) became smoke-free on January 1, 2000. However, there were objections, and in March, 2000, a B.C. judge ruled the ban on smoking in these facilities void, pending more public consultations. Those public consultations have now been concluded, and the WCB has reintroduced regulations to extend full protection from second-hand smoke to the remaining 15% of British Columbia workplaces.³⁷

Notwithstanding the suspension of the workplace smoking ban in restaurants, bars, games rooms, sporting arenas, long term care facilities and correctional facilities, the most populous British Columbia municipalities in the Lower Mainland and the Capital Regional District (see marginal note: Smoke-free restaurants and bars in Canada) have bylaws that ban smoking in bars and restaurants. Other B.C. municipalities have partial bans on smoking in bars and restaurants. Usually, B.C. municipal smoking bylaws also restrict (but do not ban) smoking in games rooms (bingo halls, pool halls, bowling alleys and casinos).³⁸

Ontario

Municipal bylaws

Protection from second-hand smoke exists at both the municipal and provincial level in Ontario. Over 100 Ontario municipalities have bylaws that ban or restrict smoking in at least some public places and workplaces.

The Waterloo Regional Municipality has a bylaw banning smoking in all workplaces, including restaurants, bars, taverns and casinos. This bylaw survived a court challenge earlier this year.³⁹ During the court proceedings, the judge showed that he was aware of the scientific consensus that exposure to second-hand smoke is hazardous.⁴⁰ Lawyer Paul Brooks, acting for the bar and restaurant owners who filed the formal complaint, claimed during the court proceedings that the regional council had not considered enough scientific evidence about the harm of second-hand smoke. There ensued this exchange between Mr. Justice Robert Reilly and lawyer Paul Brooks:

Mr. Justice Robert Reilly: *Are you suggesting that there is still an ongoing debate about the harmful effects of tobacco?*

Mr. Paul Brooks: *Yes, I am.*

Mr. Justice Robert Reilly: *Well, I guess there are still Holocaust deniers, too.*

Ontario municipalities that have implemented bylaws banning smoking in bars and restaurants in 2000 include:

- *Guelph*
- *Peterborough*
- *Regional Municipality of Waterloo (seven municipalities)*
- *Region of Hamilton-Wentworth (Ancaster, Dundas, Flamborough, Hamilton)*
- *South Easthope and Perth South*
- *Vaughan*
- *Windsor*

Ontario municipalities with bylaws banning smoking in bars and restaurants slated to come into force in 2001 or later include:

- *Brantford*
- *London*
- *North Easthope*
- *Ottawa*
- *Region of Peel (Brampton, Caledon, Mississauga)*
- *Sudbury*
- *Toronto*

Provincial statutes

In addition to municipal bylaws, there are two provincial statutes that deal specifically with smoke in workplaces. These are the *Tobacco Control Act* and the *Smoking in the Workplace Act*.⁴¹ The *Tobacco Control Act* was adopted in 1994 and prohibits or restricts smoking in indoor places frequented by members of the public. These include the public access parts of provincial government offices, schools, stores and other places where goods or services are sold to the general public. The *Smoking in the Workplace Act* restricts smoking in workplaces to 25% or less of the total floor area of a workplace. Although few enforcement difficulties have been reported, this law provides little public health protection. There is no requirement that smoking areas be limited in number, enclosed or separately ventilated. Full compliance with the *Smoking in the Workplace Act* would not fulfil the recommendations of the Ontario Expert Panel²² for protection from second-hand smoke. Nor would it respond satisfactorily to the scientific findings of the six reviews that reported on the effects of second-hand smoke, reviewed earlier in this report.

Legislative basis for effective protection from tobacco smoke in Ontario workplaces

There are two other Ontario laws that have significance for tobacco control. While tobacco is not specifically mentioned in either the *Occupational Health and Safety Act* or the *Health Protection and Promotion Act*,³⁵ both have great significance for protection from tobacco smoke, because of their general approach to providing protection from health hazards. Exposure to tobacco smoke is clearly a health hazard.

Occupational Health and Safety Act

The *Occupational Health and Safety Act*, in effect, bans smoking in most workplaces under provincial jurisdiction. However, most people are unaware that this is the case, and the provisions of the law that should ban smoking in the workplace are not applied.

To better understand the relationship between tobacco smoke and the *Occupational Health and Safety Act*, it is necessary to understand the nature of tobacco smoke and the toxic chemicals it contains. Tobacco smoke is a complex chemical mixture. It has most recently been estimated to contain over 4,000 chemicals. Quantitative determinations have been made for about 400 of these⁴², and 103 have been identified as poisonous to humans (See Appendix A). The International Agency for Research on Cancer has determined that there is sufficient evidence of carcinogenicity in animals for 43 chemicals in tobacco smoke.⁴³

The British Columbia government requires 44 toxic chemicals in tobacco smoke to be reported in mainstream and sidestream smoke under two smoking conditions. These chemicals are all carcinogenic or otherwise toxic. Full reports were received for 33 popular brands of Canadian cigarettes in March 2000. Reports for all brands have been published on the British Columbia Department of Health website.⁴⁴

The Ontario government regulates 587 chemicals in the workplace. Recently, new or revised limits were proposed for 213 chemicals. These came into force on September 30, 2000.⁴⁵ About half of all the known poisons in tobacco smoke, about half of all the known carcinogens and about three-quarters of the toxic chemicals in tobacco smoke from popular brands of Canadian cigarettes reported to the British Columbia government are also toxic chemicals listed in the Ontario regulations.

Excluded from the provisions of the *Occupational Health and Safety Act* that ban smoking in the workplace are occupants of private residences and their on-site employees, teachers, farmers, and construction workers. All other workers in Ontario are covered by the *Occupational Health and Safety Act*.

While the *Act* does not explicitly ban smoking in the workplace, it prohibits exposure to fifteen “known toxic agents for which exposure values have not been established, and to which any exposure should be avoided.” These chemicals are listed in Part 10 of the *Schedule to the Control of Exposure to Biological or Chemical Agents Regulations*,⁴⁶ adopted pursuant to the *Occupational Health and Safety Act*. These fifteen chemicals include fourteen specific chemical agents and one entire class of chemicals – n-nitrosamines. Of the fourteen specific chemicals, five are found in tobacco smoke. In addition, there are twelve n-nitrosamines in tobacco smoke, including four tobacco-specific n-nitrosamines.⁴⁷ Of these seventeen chemicals in tobacco smoke, seven of them are among the forty-four chemicals that tobacco companies are required to report to the government of British Columbia as regulatory requirement under the *British Columbia Tobacco Sales Amendment Act*. These seven chemicals are present in both the mainstream and sidestream smoke of all 33 brands reported to the B.C. government in May, 2000. These 33 brands account for 69% of the cigarettes smoked in Canada. The amounts vary by brand. However, there are consistently higher levels of these seven chemicals in sidestream smoke than in mainstream smoke. Classifications of these chemicals by the Ontario government, the International Agency for Research on Cancer and the Canadian tobacco industry, as reported to the British Columbia government, are summarized in Table 3.

Over 20 of the chemicals, for which occupational exposure limits were reduced in Ontario, effective September 30, 2000, but that are still greater than zero, are also known poisons present in tobacco smoke.

There are 14 toxic substances and one class of toxic substances (n-nitrosamines) that Ontario regulations identify as “known toxic agents for which exposure values have not been established, and to which any exposure should be avoided.” Tobacco smoke contains over 100 known poisons. Of these, seventeen toxic substances, twelve n-nitrosamines and five other substances are included on the Ontario zero-exposure list. British Columbia requires information on 44 chemicals in tobacco smoke. Of these, seven toxic substances, four n-nitrosamines and three other chemicals, are also on the Ontario zero-exposure list (Table 3).

Table 3:
Known toxic agents for which exposure values have not been established, and to which any exposure should be avoided
(Part 10 of the Schedule to Control of Exposure to Biological or Chemical Agents Regulations under the Ontario Occupational Health and Safety Act)

| Known Toxic Agent | Listed by IARC as present in tobacco smoke | Reported as present in at least 33 brands of Canadian cigarettes |
|---|---|---|
| Benzidine – skin | | |
| Benzo(a)pyrene | √ | √ |
| (1,1'-biphenyl)-4-amine – skin | √ | √ |
| Chloromethyl methyl ether | | |
| Chrysene | √ | |
| 1,2-Dibromoethane – skin | | |
| 3,3'-Dichlorobenzidine - skin | | |
| 3,3'-Dimethyl-(1,1'-biphenyl)-4,4'-diamine – skin | | |
| Dimethylcarbamoyl chloride | | |
| Hexamethylphosphoric triamide - skin | | |
| Beta-Naphthylamine | √ | √ |
| 4-Nitrobiphenyl | | |
| N-nitrosamines – skin | √ 12 CHEMICALS | √ (NNN, NNK, NAT, NAB) |
| 1,2 Oxathiolane 2,2-dioxide | | |
| N-Phenyl-beta-naphthylamine | √ | |

In addition, Ontario regulates eleven “designated chemicals” in the workplace to which special rules apply.⁴⁸ The designated chemicals are:

- *Acrylonitrile**
- *Arsenic**
- *Asbestos*
- *Benzene**
- *Coke oven emissions*
- *Ethylene oxide*
- *Isocyanates*
- *Lead**
- *Mercury**
- *Silica*
- *Vinyl chloride**

Six of these eleven substances (the chemicals marked with an asterisk) are also present in tobacco smoke.

Here is an example of one of the special rules for acrylonitrile, a chemical present in tobacco smoke:

Where a worker is exposed to airborne acrylonitrile, the worker may request a respirator regardless of the level of exposure and the employer shall provide it.

The Occupational Safety and Health Administration (OSHA) regulates chemicals of a similar nature differently in the United States.⁴⁹ There, a particular regulation applies to 13 known human carcinogens, including many of the ones shown in Table 3. The list of thirteen chemicals includes four that are found in tobacco smoke (alpha-naphthylamine, beta-naphthylamine, (1,1'-biphenyl)-4-amine, and n-nitrosodimethylamine). Unlike Ontario, exposure is allowed to these chemicals in the United States, but only in closed-system operations and even then only under severely restricted conditions. The conditions are detailed in eleven pages of regulations. Some of the conditions under which exposure is permitted include:

- *Employees shall be provided with, and required to wear, clean, full body protective clothing (smocks, coveralls, or long-sleeved shirt and pants), shoe covers and gloves prior to entering the regulated area.*
- *Entrances to regulated areas shall be posted with signs bearing the legend:*

***CANCER – SUSPECT AGENT
AUTHORIZED PERSONNEL ONLY***

The approach in Ontario is more prudent than in the United States. While exposure under highly restricted conditions is allowed in the United States to 13 known human carcinogens, including 4 known to be present in tobacco smoke, in Ontario, no exposure is allowed under any circumstances to 17 chemicals present in tobacco smoke.

Part 2 of the *Schedule to the Control of Exposure to Biological or Chemical Agents Regulation* sets out methods for calculating time-weighted average exposure values for mixtures of chemicals where the effects of chemicals are additive, and the mixture contains no substances listed in Part 10 (toxic agents to which no exposure should be allowed). If the mixture contains any substances listed in Part 10, the formula for mixtures cannot be used because some of the terms in it would involve division by zero and therefore would be undefined. Tobacco smoke is a mixture of more than 4,000 chemicals, seventeen of which are listed in Part 10. Therefore, the formula for mixtures shown in Part 2 of the *Schedule to the Regulation* cannot be used for regulatory decision-making with respect to tobacco. Elimination of tobacco smoke remains the only option for full regulatory compliance.

In order to assess the relative hazards of smoke from American and Canadian cigarettes, Rickert has applied a modified version of the American Conference of Governmental and Industrial Hygienists (ACGIH) formula for mixtures, such as tobacco smoke from

Canadian and American cigarettes.⁵⁰ The ACGIH formula is very similar to that described in the Ontario *Regulation*. In order to complete the calculations, Rickert omitted chemicals in tobacco smoke with zero exposure limits. While unacceptable as a regulatory procedure, this modification did permit construction of a Relative Exposure Index that allowed relative hazards of Canadian and American cigarette smoke to be compared, with hazard measures based on exposure limits proposed by ACGIH (very similar to exposure values in the Ontario Regulation). By the measure of the Relative Exposure Index proposed by Rickert, smoke from Canadian cigarettes was more hazardous than smoke from an American blended cigarette. The Relative Exposure Index score for Canadian cigarette smoke was 24.3, while it was 14.6 for smoke from an American blended cigarette.

The Ontario Government has recently revised and updated its occupational exposure limits (OELs), with the revised limits that came into effect on September 30, 2000. Revisions were made to about 200 of the nearly 600 OELs specified in Ontario regulations. The changes have all been made in the interests of providing greater levels of health protection. However, no changes have been made to Part 10 of the *Schedule*. Under the revised regulation, no exposure is still recommended for all the toxic substances shown in Table 3. The commitment of the government to enforcement of the updated regulations is strong. When the Minister of Labour announced the Government's intention in the Legislature on November 16, 1999, he stated:

*I emphasize, Mr. Speaker, that compliance with the new occupational exposure limits will be required – and enforced. When the new limits are in place, Ontario will not only be up to date – it will be ahead of the pack.*⁵¹

When the consultation process was finalized, another announcement was made. The government committed an additional \$2 million to enforcement of the updated OELs. On June 27, 2000, the Honourable Mr. Stockwell, Minister of Labour stated:

- *This action demonstrates once again this government's commitment to make Ontario workplaces among the safest in the world.*
- *Today's announcement ensures that Ontario workers are protected by OELs that are current and up-to-date.*⁵²

This Ministerial commitment to renewed enforcement in the interest of the health and safety of the workers, together with the structure and provisions of the *Occupational Health and Safety Act* and its regulations, means that there should be no policy or technical barriers to eliminate tobacco smoke from Ontario workplaces in order to be in conformity with the *Act*. Normally, investigation for the presence of toxic substances would require air sampling and testing. However, from the information obtained on sidestream tobacco smoke pursuant to regulations in British Columbia in May 2000, it is clear that all major brands of cigarettes consumed in Canada produce measurable amounts of at least seven toxic substances “to which any exposure should be avoided.” In these circumstances, any presence of tobacco smoke in the air will indicate that the *Act*

is being violated, and the corrective action to achieve conformity will be the elimination of tobacco smoke. No air sampling and testing will be needed.

Under the *Act*, Ontario has in place an elaborate and effective system of consultation, surveillance, monitoring and enforcement to ensure health and safety in the workplace. Only the controls on toxic substances with respect to tobacco smoke appear to have escaped the surveillance and enforcement systems that apply effectively to all other major potential workplace hazards.

Failure to eliminate tobacco smoke from Ontario workplaces, as is required by Part 10 of the *Schedule to the Regulation*, would leave the Province vulnerable to large numbers of workers exercising their right to refuse dangerous work. Part V of the *Act* spells out the conditions under which a worker may exercise his or her right to refuse dangerous work. If the dangerous working condition is not “inherent in the worker’s work or is a normal condition of the worker’s employment,” then the worker may exercise his or her right to refuse to work if “the physical condition of the workplace or the part in which he or she works or is to work is likely to endanger himself or herself or...[if it] is in contravention of this *Act* or the regulations and such contravention is likely to endanger himself, herself or another worker.”

Despite the evidence that tobacco smoke in the workplace is in violation of the *Occupational Health and Safety Act*, it is also clear that there is plenty of tobacco smoke in Ontario’s workplaces. In fairness to the officials responsible for the *Act*, information has only recently come to light describing the presence in the smoke from all major brands of Canadian cigarettes of seven toxic substances to which there should be no exposure. Armed with this new information, officials should now be able to take enforcement action to ensure full compliance with the *Act* by eliminating tobacco smoke from Ontario workplaces to which the *Act* applies.

There are many ways that action could be taken to move towards full compliance. One way that would be credible and effective would be for Medical Officers of Health to order compliance with the *Occupational Health and Safety Act* in respect of tobacco smoke in the workplace. The powers expressed in two statutes, the *Health Protection and Promotion Act* and the *Occupational Health and Safety Act*, could both be invoked to ensure effective compliance and enforcement of orders from Medical Officers of Health to ban smoking in workplaces.

An argument may be raised that there appears to be a conflict between the *Occupational Health and Safety Act*, which bans smoking in nearly all workplaces, and the *Smoking in the Workplace Act*, which restricts smoking to 25% or less of the total area of the workplace. It might be thought that since, the latter *Act* deals specifically with smoking, it would take precedence over the former, which regulates toxic substances in the tobacco smoke mixture, but does not specifically regulate tobacco smoke *per se*. However, this interpretation is erroneous. The two *Acts* both have clauses making it clear that, in the matter of worker protection, the *Act* that is most protective takes precedence. In this case, the *Occupational Health and Safety Act* is the most protective. The *Smoking in the Workplace Act* states:

In the event of a conflict between this Act and another Act or a regulation or a municipal by-law respecting smoking in the workplace, the provision that is most restrictive of smoking prevails.

The *Tobacco Control Act* has a similar provision:

If there is a conflict between Sections 9 and 10 of this Act and a provision of another Act, a regulation or a municipal by-law that deals with smoking, the provision that is more restrictive of smoking prevails...

The *Occupational Health and Safety Act* states:

Despite anything in any general or special Act, the provisions of this Act and regulations shall prevail.

Summary

Regulations under the *Occupational Health and Safety Act* ban any workplace exposure to seventeen chemicals known to be in tobacco smoke. Current data exist documenting the presence of seven of these chemicals in the sidestream smoke emitted by all major brands of Canadian cigarettes. Ontario law therefore, in effect, bans smoking in all workplaces under provincial health and safety jurisdiction. The Ontario government may wish to move quickly to ensure that the law is soon respected and enforced and that tobacco smoke is eliminated from Ontario workplaces. Failure to do so could result in a great many workers exercising their right to refuse work on the grounds that they are being exposed to a known danger—second-hand tobacco smoke—from which they should expect to be protected by toxic substance regulations.

Health Protection and Promotion Act

The *Health Protection and Promotion Act* places obligations on Medical Officers of Health in every region (health unit) to take action to investigate complaints of occupational and environmental health hazards. If, for example, a complaint were made to a Medical Officer of Health about smoking in the workplace, he or she would then be obliged to report the matter to the Ministry of Labour and in consultation with Ministry of Labour officials determine whether or not a health hazard exists. Given that the mere presence of tobacco smoke in the workplace places employers in the position of non-compliance with the *Control of Exposure to Biological or Chemical Agents Regulations*, it seems very likely that Medical Officers of Health would find that tobacco smoke in the workplace was a health hazard.

Whether a complaint is received or not, the *Health Protection and Promotion Act* affords the Medical Officers of Health broad discretionary power to protect community health. If, for example, a Medical Officer of Health was of the opinion, on reasonable and

probable grounds, that there was no safe level of exposure to tobacco smoke in any workplace, the *Act* grants the Medical Officers of Health discretionary power to order the elimination of tobacco smoke from all workplaces in their health unit.

Full compliance with the *Ontario Occupational Health and Safety Act* and its regulations would require eliminating all tobacco smoke from Ontario workplaces. Medical Officers of Health could issue orders to this effect.

Conclusions

Health effects of involuntary exposure to tobacco smoke

Six major scientific reviews carried out in the 1990s have identified 15 major disease groups or conditions as known or suspected to be caused by exposure to second-hand smoke (See Table 2). These include four developmental diseases or conditions, seven respiratory diseases or conditions, three cancers and coronary heart disease.

On the basis of recent research, breast cancer and cerebrovascular disease should be added to the list of diseases for which exposure to second-hand smoke is a suspected cause.

It is concluded that:

- **Exposure to second-hand smoke causes the following diseases and conditions:**
 - **In adults**
 - *Heart disease*
 - *Lung cancer*
 - *Nasal sinus cancer*
 - **In children**
 - *Sudden infant death syndrome*
 - *Fetal growth impairment including low birth-weight and small for gestational age*
 - *Bronchitis, pneumonia and other lower respiratory tract infections*
 - *Asthma exacerbation*
 - *Middle ear disease*
 - *Respiratory symptoms*
 - **Exposure to second-hand smoke has also been linked to other adverse health effects. The relationships may be causal. These include:**
 - **In adults:**
 - *Stroke*
 - *Breast cancer*

- *Cervical cancer*
- *Miscarriages*
- **In children**
 - *Adverse impact on cognition and behaviour*
 - *Decreased lung function*
 - *Asthma induction*
 - *Exacerbation of cystic fibrosis.*
- **It is estimated that exposure to second-hand smoke causes between 1100 and 7800 deaths per year in Canada, at least one-third of them in Ontario.**

Recommendations of scientific reviews

Not all of the reports of the six scientific reviews contain policy recommendations. However, of the four that do, they are unanimous in the view that all exposure to second-hand smoke should be avoided. Dr. David Satcher, the United States Surgeon-General, was most specific in his recommendation, contained in the preface to the California Environmental Protection Agency Report.

I call on everyone committed to public health to join with me in a renewed effort to complete the creation of a smoke-free society by:

- *Encouraging communities to enact clean indoor air ordinances requiring 100 percent smoke-free environments in all public areas and workplaces, including all restaurants and bars.*
- *Encourage smokers as well as non-smokers to make their homes smoke-free to protect children and families from ETS exposure.*

Dr Satcher's recommendations and those of other scientific reviews, are consistent with the recommendations of an Ontario Expert Panel that reported in 1999.

- *Require that indoor public places be 100% smoke-free, with immediate implementation in youth recreation facilities.*
- *Incrementally ban smoking in all indoor workplaces except where smoking areas are separately-enclosed and separately-ventilated to the exterior, beginning at once with offices and industrial worksites.*
- *Implement media-based public education programs on the dangers of second-hand smoke.*

Recommendations have been stated in many different words. However, the message is clear, consistent and unanimous – **all involuntary exposure is harmful and should be eliminated.**

No solution through ventilation

ASHRAE, the world's leading ventilation standard-setting organization, no longer provides standards for air with tobacco smoke in it, only for smoke-free air. Searches for ventilation solutions have proven fruitless. A panel of 14 experts in ventilation technology concluded that existing dilution ventilation technology could not effectively remove much tobacco smoke from indoor air. However, they speculated that displacement ventilation might be able to remove up to 90% of tobacco smoke from air.

Repace analyzed these findings using risk assessment procedures and concluded that dilution ventilation would have to improve by a factor of 20,000 and displacement ventilation by a factor of 2000 in order to meet the level of public health protection normally expected for environmental contaminants.

Accommodation of tobacco smoke in the workplace, the solution proposed by the tobacco industry, was found to have no basis in science or public health protection. Its advocacy by members of the hospitality industry is similarly lacking in public health motivation. The tobacco industry has made payments to the hospitality industry to implement its Courtesy of Choice campaign.

Given all knowledge accumulated to date in the health, risk assessment and ventilation sciences, it seems most unlikely that tobacco smoke in indoor workplaces could ever be reduced to safe levels through the application of ventilation technology.

Ventilation provides no solution to the problem of exposure to second-hand smoke.

Action to control second-hand smoke in selected jurisdictions

California: Smoking is banned in all workplaces in California. The ban is widely respected and strongly supported by Californians.

Canada - federal jurisdiction: The *Non-Smokers' Health Act* limits smoking to separate smoking rooms for the 8% of workers under federal jurisdiction. The law is widely respected, but guarantees less than complete protection from second-hand smoke.

Canada – provincial jurisdiction: Legislation varies widely across the country. Workers in British Columbia have the best *de facto* protection from second-hand smoke.

British Columbia: Smoking is banned in 85% of workplaces in British Columbia. The ban is a widely respected and an effective public health protection measure. It is expected that the ban will soon be extended to the other 15% of British Columbia

workplaces covering bars, restaurants and games rooms, long-term care institutions and correctional facilities.

Ontario: Over 100 municipalities have smoking by-laws. Their provisions vary widely. The *Tobacco Control Act* prohibits or restricts smoking in provincial government offices, schools, stores and other places frequented by members of the general public. The provincial *Smoking in the Workplace Act* limits smoking areas to 25% of the workspace, providing little public health protection.

Legislative basis for effective protection from tobacco smoke in Ontario

Regulations under the *Ontario Occupational Health and Safety Act* list known toxic agents for which exposure values have not been established, and to which any exposure should be avoided. Seven of these toxic agents are known to be in the sidestream smoke emitted from at least 33 of the leading brands of cigarettes available for sale in Canada.

The *Health Protection and Promotion Act* places obligations on Medical Officers of Health in every region of Ontario (health unit) to take action to investigate complaints of occupational and environmental health hazards. Whether a complaint is received or not, the *Health Protection and Promotion Act* affords the Medical Officers of Health broad discretionary power to protect community health. Medical Officers of Health could use their obligatory and discretionary powers to order the elimination of tobacco smoke from Ontario workplaces by ordering swift and effective compliance with the regulations under the *Occupational Health and Safety Act*.

Full compliance with the *Ontario Occupational Health and Safety Act* and its regulations would require eliminating all tobacco smoke from Ontario workplaces. Medical Officers of Health could issue orders to this effect.

References

- ¹ United States Environmental Protection Agency. *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders*. Office of Research and Development, EPA/600/6-90/006F, Washington, USA, December 1992. (<http://www.epa.gov/ncea/smoking.htm>)
also published as: National Institutes of Health. National Cancer Institute. *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders: The Report of the U.S. Environmental Protection Agency. Smoking and Tobacco Control Monograph Number 4*. NIH Publication No. 93-3605, Washington, USA, August, 1993.
- ² National Health and Medical Research Council. *The health effects of passive smoking*. Australia, November, 1997. (<http://www.health.gov.au/nhmrc/publicat/synopses/ph23syn.htm>)
- ³ California Environmental Protection Agency. *Health Effects of Exposure to Environmental Tobacco Smoke*. Office of Environmental Health Hazard Assessment, September, 1997. (http://www.oehha.org/air/environmental_tobacco/index.html)
also published as: National Institutes of Health. National Cancer Institute. *Health Effects of Exposure to Environmental Tobacco Smoke: The Report of the California Environmental Protection Agency. Smoking and Tobacco Control Monograph Number 10*. NIH Publication No. 99-4645, Washington, USA, August, 1999. (http://rex.nci.nih.gov/NCI_MONOGRAPHS/MONO10/MONO10.HTM)
- ⁴ Department of Health. *Report of the Scientific Committee on Tobacco and Health*. The Stationery Office. London, United Kingdom, March, 1998. (<http://www.official-documents.co.uk/document/doh/tobacco/contents.htm>)
- ⁵ World Health Organization. Tobacco Free Initiative. *International Consultation on Environmental Tobacco Smoke (ETS) and Child Health: Consultation Report*. WHO Technical Document Number WHO/TFI/99.10. 1999. (<http://www.who.int/en/health/int-consult.html>)
- ⁶ U.S. Department of Health and Human Services. Public Health Service. National Toxicology Program. *9th Report on Carcinogens*. Washington, USA, 2000. (<http://ehis.niehs.nih.gov/roc/ninth/known/ets.pdf>)
- ⁷ United States Department of Labour. Occupational Safety and Health Administration. *Notice of proposed rulemaking; notice of informal public hearing*. Federal Register, Indoor Air Quality – 59:15968-16039, 1994. http://www.osha-slc.gov/FedReg_oseha_data/FED19940405.html.

⁸ National Academy of Sciences. *Clearing the Air: Asthma and Indoor Air Exposures*, Washington, 2000. <http://books.nap.edu/books/0309064961/html/index.html>.

⁹ For further information on these subjects, see:

United States Department of Health and Human Services. *The Health Consequences of Smoking: Cardiovascular Disease: a Report of the Surgeon-General*: 1983. Washington, D.C., 1983 (DHHS Publication no. (PHS) 84-50204).

United States Department of Health and Human Services. *Reducing the Health Consequences of Smoking: 25 Years of Progress. A Report of the Surgeon-General*. U.S. Department of Health and Human Services, Public Health Service, Centres for Disease Control, Centre for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. DHHS Publication No. (CDC) 8908411, 1989.

Glantz SA, Parmley WW. Passive smoking and heart disease: epidemiology, physiology, and biochemistry. *Circulation* 1991; 83: 1-12.

Law MR, Morris JK, Wald NJ. Environmental tobacco smoke exposure and ischaemic heart disease: an evaluation of the evidence. *British Medical Journal* 1997; 315: 973-988.

¹⁰ You RX, Thrift AG, McNeill JJ *et al.* Ischaemic stroke risk and passive exposure to spouses' cigarette smoking. *American Journal of Public Health* 1999; 89: 572-575.

¹¹ Bonita R *et al.* Passive smoking as well as active smoking increases the risk of acute stroke. *Tobacco Control* 1999; 8: 156-160.

¹² Johnson KC, Hu J, Mao Y and the Canadian Cancer Registries Epidemiology Research Group. Passive and active smoking and breast cancer risk in Canada, 1994-1997. *Cancer Causes and Control* 2000; 11: 211-221.

¹³ The other published studies of breast cancer and passive smoking which include adult passive smoking exposure include:

Hirayama T. Cancer de mama. Avances en diagnostico y tratamiento. In Diaz-Faco J. (ed) *Epidemiologia y Factores de riesgo del Cancer de Mama*. Leon, Spain: Santiago Garcia, 1990, pp. 21-38.

Sandler DP, Wilcox AJ, Everson RB. Passive smoking in adulthood and cancer risk. *American Journal of Epidemiology* 1985; 121: 37-48.

Smith SJ, Deacon JM, Chilvers CE. Alcohol, smoking, passive smoking and caffeine in relation to breast cancer risk in young women. UK National Case-Control Study Group. *British Journal of Cancer* 1994; 70: 112-119.

Morabia A, Berstein M, Heritier S, Khatchatrian N. Relation of breast cancer with passive and active exposure to tobacco smoke. *American Journal of Epidemiology* 1996; 149: 5-12.

Lash TL and Aschengrau A. Active and passive cigarette smoking and the occurrence of breast cancer. *Am J Epidemiol* 1999; 149:5-12.

Jee SH, Ohr H, Kim IS. Effects of husbands' smoking on the incidence of lung cancer in Korean women. *International Journal of Epidemiology* 1999; 28: 824-828.

Wartenberg D, Calle EE, Thun MJ, Heath Jr. CW, Lally C, Woodruff T. Passive smoking exposure and female breast cancer mortality. *Journal of the National Cancer Institute* 2000; 92(20): 1666-1673.

Zhao Y, Shi Z, Liu L. [Matched case-control study for detecting risk factors of breast cancer in women living in Chengdu]. *Chung Hua Hsing Ping Hsueh Tsa Chih* 1999; 20: 91-94.

¹⁴ In addition to the reports cited above, the following publications provide supporting, adjunct or mechanism information that has also been considered in arriving at the conclusion that there is mounting evidence suggesting that both active and passive smoking may increase the risk of breast cancer:

Hirayama T. Lung cancer and other diseases related to passive smoking: a large-scale cohort study: In Gupta PC, Hamner, III JE, Murti PR, eds. *Control of Tobacco-related Cancers and Other Diseases*. International Symposium, 1990. Bombay: Oxford University Press; 1992: 129-137.

Hirayama T. Life style and mortality: a large-scale census-based cohort study from Japan. Volume 6, *Contributions to Epidemiology and Biostatistics*. Basel: Karger; 1990.

Millikan RC et al. Cigarette smoking, N-acetyltransferases 1 and 2, and breast cancer risk. *Cancer Epidemiology, Biomarkers & Prevention* 1998; 7:371-8.

Delfino RJ et al. Breast cancer, passive and active cigarette smoking and N-acetyltransferase 2 genotype. *Pharmacogenetics* 2000; 10:461-9.

Jee SH, Ohr H, Kim IS. Effects of husbands' smoking on the incidence of lung cancer in Korean women. *International Journal of Epidemiology* 1999; 28: 824-828.

Rookus MA, Verloop J., de Vries F, van der Kooy K, van Leeuwen FE. Passive smoking and the risk of breast cancer [abstract]. *American Journal of Epidemiology* 2000; 151 (Supplement): S28.

Woo C, Davis D, Gravitt P, et al. A prospective study of passive cigarette smoking exposure and breast cancer [abstract]. *American Journal of Epidemiology* 2000; 151 (Supplement): S72.

Wartenberg D, Calle EE, Thun MJ, Heath Jr. CW, Lally C, Woodruff T. Passive smoking exposure and female breast cancer mortality. *Journal of the National Cancer Institute* 2000; 92: 1666-1673.

Calle EE, Miracle-McMahill HL, Thun MJ, Heath, Jr. CW. Cigarette smoking and risk of fatal breast cancer. *American Journal of Epidemiology* 1994;139: 1001-1007.

¹⁵ Repace J, Johnson KC. Turning over the wrong stone. Letter. *British Medical Journal* 2000; 321: 1221, November 11, 2000.

¹⁶ Lowe GS. *Workplace smoking: Trends, issues and effective strategies*. prepared for Health Canada's Strategic Planning Workshop to Reduce ETS Exposure, Ottawa, October 19-20, 1995. University of Alberta, Edmonton, Alberta, Canada, 1995.

¹⁷ Makomaski Illing EM, Kaiserman MJ. Mortality attributable to tobacco use in Canada and its regions, 1994 and 1996. *Chronic Disease in Canada* 1999; 20(3).

¹⁸ Decou ML. Impact of passive smoking to coronary heart disease mortality. M.Sc. Thesis. Queen's University. Kingston, Ontario, Canada, 1992.

¹⁹ de Groh M and Morrison HI. Environmental tobacco smoke and deaths from coronary heart disease in Canada. Health Canada. unpublished. 2000.

²⁰ Wells AJ. Lung cancer from passive smoking at work. *American Journal of Public Health* 1998; 88: 1025-1029.

²¹ Wells AJ. Heart disease from passive smoking in the workplace. *Journal of the American College of Cardiology* 1998; 31: 1-9.

²² Ashley MJ, Boadway T, Cameron R, d'Avernas J, Ferrence R, Pipe A, Schabas R, Thomsen P. Actions will speak louder than words: Getting serious about tobacco control in Ontario. A Report to the Minister of Health from her Expert Panel on the Renewal of the Ontario Tobacco Strategy. /Les actes sont plus éloquents que les mots: Un plan d'attaque au tabagisme en Ontario. Rapport présenté à la ministre de la Santé par son Comité d'experts sur la relance de la Stratégie antitabac de l'Ontario. Toronto, Canada: *Expert Panel on the Renewal of the Ontario Tobacco Strategy*; February 1999. ISBN 0-9686913-0-7 (<http://www.camh.net/otru>).

²³ National Academy of Sciences. *Indoor Pollutants*. National Academy Press, Washington, D.C., 1981.

²⁴ American Society of Heating, Refrigeration and Air-Conditioning Engineers. *ASHRAE Publishes Updated IAQ Standard*. News release. September 17, 1999. <http://www.ashrae.com/about/upiaq.htm>.

²⁵ ASHRAE. *Appeals to Addendum e ANSI/ASHRAE Standard 62-1989*, Atlanta, Georgia, May 18, 1999. <http://www.ash.org/june99/06-24-99-5.html>.

²⁶ United States Department of Labour, Occupational Safety and Health Administration. *Proceedings of the Workshop on Ventilation Engineering Controls for Environmental Tobacco Smoke in the Hospitality Industry*, 1998.

- ²⁷ Repace J. *Can Ventilation Control Second-hand Smoke in the Hospitality Industry?*, June 2000. <http://www.dhs.ca.gov/tobacco/documents/FedOHSHAets.pdf>.
- ²⁸ Travis CC *et al.* Cancer risk management. *Environmental Science and Technology* 1987; 21: 415-420
- ²⁹ Canadian Environmental Assessment Agency. *Reference Guide: Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects*. 1999. http://www.ceaa.gc.ca/publications_e/ra_guide/guide3_e.htm.
- ³⁰ ASHRAE. *Interpretation IC 62-1999-08 of ASHRAE Standard 62-1999, Ventilation for Acceptable Indoor Air Quality*, June 24, 2000. <http://www.ashrae.org/standards/6208.htm>.
- ³¹ See the following web sites: Philip Morris (<http://www.philipmorris.com>), British-American Tobacco (<http://www.bat.com>) and RJ Reynolds (<http://www.rjr.com>).
- ³² Heidemann D. *Who's funding the fight against the smoking ban in B.C.?* BCTV. June 15, 2000.
- ³³ Biener L, Fitzgerald G. Smoky bars and restaurants: who avoids them and why? *Journal of Public Health Management Practice* 1999; 5: 74-78.
- ³⁴ California Tobacco Control Update. California Department of Health Services, Tobacco Control Section. Summary of presentations at the Eleventh World Conference on Tobacco or Health. Chicago, August 2000.
- ³⁵ Non-Smokers' Health Act. *Revised Statutes of Canada*. Chapter N-23.6 (R.S., 1985, c. 15 (4th supp.)).
- ³⁶ Provincial statutes restricting smoking were summarized by the Canadian Council for Tobacco Control in 1999 and can be viewed at <http://www.cctc.ca/ncth/docs/legislation/ncthproj/ros.html>.
- ³⁷ WCB Regulation Background. Clean Air Coalition of British Columbia, 2000. <http://www.cleanaircoalitionbc.com/cacontentwcbregdesc.htm>.
- ³⁸ WCB Regulation Background. Clean Air Coalition of British Columbia, 2000. <http://www.cleanaircoalitionbc.com/cacontentlmbylaws.htm>.
- ³⁹ Judge upholds Waterloo Region's anti-smoking bylaw. *Toronto Star*, July 26, 2000.
- ⁴⁰ Lawsuit hasn't shown smoking bylaw has caused any damage, judge says. *Kitchener Waterloo-Record*, June 9, 2000.
- ⁴¹ Revised Statutes of Ontario, 1990. <http://209.195.107.57>.
- ⁴² National Institutes of Health. National Cancer Institute. *Health Effects of Exposure to Environmental Tobacco Smoke: The Report of the California Environmental Protection Agency*. Smoking and Tobacco Control Monograph Number 10. NIH Publication No. 99-4645, Washington, USA, August 1999.

⁴³ *Tobacco Smoking*. Lyon, International Agency for Research on Cancer, 1986 (IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, Volume 38, Appendix 2.

⁴⁴ Full reports of all 44 chemicals obligatorily required by the British Columbia government became available for the first time in March 2000. Reports for 33 brands so far provided can be found at: <http://www.hlth.gov.bc.ca/ttdr/pdf/sc.html>.

⁴⁵ Ontario Ministry of Labour. Ontario adopts more protective occupational exposure limits. Backgrounder 00-34. June 27, 2000. <http://www.gov.on.ca/lab/ann/00-34be.htm>.

⁴⁶ Revised Regulations of Ontario, 1990, Regulation 833. <http://209.195.107.57>.

⁴⁷ *Tobacco Smoking*. Lyon, International Agency for Research on Cancer, 1986 .IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, Volume 38, Appendix 2.

⁴⁸ Revised Regulations of Ontario, 1990, Regulations 835 to 846. <http://209.195.107.57>

⁴⁹ Occupational Safety and Health Administration. OSHA Regulations (Standards – 29 CFR) 13 Carcinogens (4-Nitrobiphenyl, etc.). – 1910.1003. http://www.osha-slc.gov/OshStd_data/1910_1003.html.

⁵⁰ Rickert WS. Development of an Index for Mainstream Tobacco Smoke Based on Chemical Composition. Presented at the 52nd Tobacco Scientists' Research Conference, 1998.

⁵¹ Statement to the Legislature by the Honourable Chris Stockwell, Minister of Labour for Ontario regarding the updating of Occupational Exposure Limits for Hazardous Chemical Substances, Queen's Park, Toronto, November 16, 1999. <http://www.gov.on.ca/lab/99-55se.htm>.

⁵² Ontario Ministry of Labour. Ontario to invest \$2 million to make workplaces safer. News release 00-34. <http://www.gov.on.ca/lab/ann00-34e.htm>.