



CORE

Public Health Functions for BC

**Model Core Program Papers:
Air Quality**

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**Population Health and Wellness
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TABLE OF CONTENTS

Executive Summary	1
1.0 Overview/Setting the Context.....	3
1.1 An Introduction to This Paper.....	4
1.2 Introduction to Air Quality	4
2.0 Scope And Authority For The Air Quality Program	7
3.0 Principles.....	9
4.0 Goals and Objectives	10
5.0 Main Components and Supporting Evidence	11
5.1 Introduction.....	11
5.2 Surveillance, Assessment and Intervention - Outdoor Air	11
5.3 Surveillance, Assessment and Intervention - Indoor Air	12
5.4 Education and Public Awareness – Outdoor/Indoor Air	13
6.0 Best Practices	14
7.0 Indicators, Benchmarks and Performance Targets	16
7.1 Introduction.....	16
7.2 Surveillance and Assessment – Indoor/Outdoor Air	17
7.3 Additional Indicators for Surveillance and Assessment – Indoor/Outdoor Air.....	18
8.0 External Capacity and Support requirements	21
8.1 Key Success Factors/System Strategies.....	21
8.2 Intersectoral Collaboration and Integration/Coordination.....	22
8.3 Assessment and Evaluation of the Air Quality Program	22
9.0 Conclusion	24
References.....	25

List Of Tables

Table 1: Surveillance and Assessment – Indoor/Outdoor Air	17
Table 2a: Program Indicators for Air Quality Surveillance and Assessment	19
Table 2b: Health Indicators for Air Quality Surveillance and Assessment	19

Appendices

Appendix 1: The Evidence Base for a Model Core Program - Outdoor Air Quality	26
Appendix 2: The Evidence Base for a Model Core Program - Indoor Air Quality	28
Appendix 3: Program Schematic - Model Core Program For Air Quality	30

EXECUTIVE SUMMARY

This paper identifies the core elements that are provided by British Columbia health authorities in the delivery of air quality programs. It is intended, as part of the BC Core Functions in Public Health, to reflect evidence-based practice and support continuous performance improvement.

A Working Group of representatives from the Ministry of Health, British Columbia Centre for Disease Control and the health authorities worked together in the development of this paper. They agreed that the main program components are:

- Contributing to the surveillance and monitoring of air quality, including trend analysis and assessment of public health reports.
- Identifying, with partners as appropriate, key air pollutants and sources (including new products), and assessing/prioritizing their public health impact.
- Identifying and implementing, with partners, effective interventions.
- Educational and awareness initiatives.

Best or “promising” practices focus on air pollutants that constitute a significant health risk, and are practical and possible to control. These practices include:

- Measuring key ambient air pollutants at the local and/or neighbourhood levels, and assessing their health impacts.
- Working collaboratively with other sectors in reducing concentration of ambient air pollutants.
- Assessing key indoor air contaminants in buildings, particularly those that house the most vulnerable, and determining the health impacts.
- Developing proactive, innovative measures to reduce exposure to key indoor air contaminants (e.g., environmental tobacco smoke, ventilation problems, radon gas, mold and so on).
- Providing informational materials to build public awareness and education about air quality.

Indicators and benchmarks for air quality programs are presented for each of the program components to provide a basis for ongoing performance review and evaluation. The indicators considered the most significant in determining overall air quality performance are:

- Level/concentration of pollutants in ambient air.
- Prevalence of environmental tobacco smoke (ETS) in homes with children.
- Level of radon gas (particularly in the north and interior regions).

Key success factors highlight a range of strategies that ensure the successful implementation of an effective air quality program. These include: strong support from the Board and management; allocation of sufficient resources; well-trained and competent staff; a well-developed information

system; high quality and competent management; and clear mechanisms of reporting and accountability. As well, successful advocacy, cooperation and collaboration with other partners such as the Provincial Medical Health Officer, Ministry of Environment, Environment Canada and local authorities such as the Greater Vancouver Regional District (GVRD), are important factors in achieving effective outcomes.

Finally, additional evidence is needed to strengthen the identification of specific indoor air risk factors, in particular appropriate interventions that will be effective in reducing the risks. Also, additional clarity is needed on the roles and responsibilities of the health sector with respect to implementing interventions that will reduce key air pollutants. Specifically the roles and responsibilities of health authorities in relation to the Ministry of Environment, Ministry of Health and Greater Vancouver Regional District need clarification.

1.0 OVERVIEW/SETTING THE CONTEXT

As demonstrated in recent Canadian reports, public health needs to be better structured and resourced, in order to improve the health of the population. The Framework for Core Functions in Public Health is a component of that renewal in British Columbia. It defines and describes the core public health activities of a comprehensive public health system. This policy framework was accepted in 2005 by the Ministry of Health and the health authorities.

Implementation of core functions will establish a performance improvement process for public health developed in collaboration between the Ministry of Health, the health authorities and the public health field. This process will result in greater consistency of public health services across the province, increased capacity and quality of public health services and improved health of the population. To ensure collaboration and feasibility of implementation, the oversight of the development of the performance improvement process is managed by a Provincial Steering Committee with membership representing all health authorities and the ministry.

What are core programs? They are long-term programs representing public health services that health authorities provide in a renewed and modern public health system. Core programs are organized to improve health; they can be assessed ultimately in terms of improved health and well-being and/or reductions in disease, disability and injury. In total 21 programs have been identified as “core programs”, of which air quality is but one. Many of the programs are interconnected and thus require collaboration and coordination between them.

In a “model core program paper”, each program will have clear goals, measurable objectives and an evidentiary base that shows it can improve people’s health and prevent disease disability, and/or injury. Programs will be supported through the identification of best practices and national and international benchmarks (where such benchmarks exist). Each paper will be informed by: an evidence paper; other key documents related to the program area; and by key expert input obtained through a working group with representatives from each health authority and the Ministry of Health.

The Provincial Steering Committee has indicated that an approved model core program paper constitutes a model of good practice, while recognizing it will need to be modified to meet local context and needs. The performance measures identified are appropriate indicators of program performance that could be used in a performance improvement plan. The model core program paper is a resource to health authorities that they can use to develop their core program through a performance improvement planning process. While health authorities must deliver all core programs, how each is provided is the responsibility of the health authority, as are the performance improvement targets they set for themselves.

It is envisioned that the performance improvement process will be implemented over several years. During that time the process will contribute to and benefit from related initiatives in public health infrastructure, health information and surveillance systems, workforce competence assessment and development and research and evaluation at the regional, provincial and national levels. Over time these improvement processes and related activities will improve the quality and

strengthen the capacity of public health programs, and this in turn will contribute to improving the health of the population.

1.1 An Introduction to This Paper

This model core program paper for air quality is one element in an overall public health performance improvement strategy developed by the Ministry of Health in collaboration with provincial health authorities and experts in the field of public health. It builds on previous work from a number of sources.

In March 2005, the Ministry of Health released a document entitled *A Framework for Core Functions in Public Health*. This document was prepared in consultation with representatives of health authorities and experts in the field of public health. It identifies the core programs that must be provided by health authorities, including air quality, and the public health strategies that can be used to implement these core programs. It provides an overall framework for the development of this document.

Other documents that have informed this paper include:

- *Every Breath You Take: Air Quality in British Columbia, Provincial Health Officer's Annual Report, 2003*, published by the Ministry of Health.
- Two evidence-base papers, prepared by the BC Centre for Disease Control, have documented the effectiveness of existing provincial, national and international programs: *Outdoor Air Pollution Interventions With Health Impacts: A Review* (2004), and *Indoor Air Pollution Interventions: a Review of Published Evidence* (2004).

A Working Group for Air Quality, formed of experts in air quality from the Ministry of Health, BC Centre for Disease Control and the health authorities, was formed in November 2005. The group provided guidance and direction in the development of the model core program paper during meetings in November 2005 and January 2006, as well as through regular telephone and e-mail discussions.

1.2 Introduction to Air Quality

Air quality issues encompass a wide range of air pollutants, created from many different sources. These can have a significant health impact depending upon their characteristics and levels of concentration, the local conditions and the health status of individuals. Some experts have made the point that “there is no safe level of air pollutants.”

Given the limited information available, it is difficult to estimate the total financial burden of ill health from air pollution in British Columbia. The Provincial Health Officer estimated in 2004 that the premature death toll from air pollution was 270 deaths annually (ranging from 140 to 400 deaths), with approximately half due to outdoor air pollution, and the other half to indoor air pollution. The largest single contributor to deaths from indoor air pollution was estimated to be environmental tobacco smoke (ETS). In addition, (not included in the Provincial Health Officer's count) are the estimated 100 lung cancer deaths attributable to radon exposures (Bigham and Copes n.d.). This mortality burden from air pollution is substantially larger than several other

public health challenges, such as AIDS and work-related deaths. Also, the Provincial Health Officer estimated that between 700 and 2,000 hospital admissions, and between 900 and 2,700 emergency room visits, occur annually due to air pollution. Furthermore, annual health care costs of air pollution were conservatively estimated to be \$16.7 million.

Adverse health effects from air pollution include: respiratory diseases such as influenza, asthma, Legionnaire's disease, cardiovascular disease, cancers (especially lung cancer), poisonings such as childhood lead poisoning and carbon monoxide poisoning; as well as minor health problems such as allergies and headaches. In addition, air pollution causes a significant loss in productivity.

From a health perspective, key outdoor pollutants are caused by: burning gas, oil, coal and wood for generating heat or energy; industrial manufacturing and processing plants; smoke from outdoor fires (e.g., agricultural and slash burning, forest fires and so on); and emissions from motor vehicles. Air pollutants are not evenly distributed across the province. Some areas, such as the Interior, North and the Lower Fraser Valley, experience higher levels of ambient air pollutants relative to others. Particulate pollution is more of an issue in the North and Interior, where industrial and domestic sources predominate. Transportation sources are greater contributors to air pollution in the Lower Mainland. Also, significant levels of "naturally" occurring particulate matter and ozone periodically occur at concentrations that can have serious health effects.

An extensive provincial network for monitoring outdoor air quality is in place through the efforts of Environment Canada, the BC Ministry of Environment and the Greater Vancouver Regional District (GVRD). These agencies focus on outdoor air quality in large regional areas and work closely with the Ministry of Health in sharing information and collaborating in decision-making. It should be noted that the Ministry of Environment does not: monitor air quality in smaller geographic areas or on a neighbourhood level; assess the impact of air pollutants on the health of the population; or monitor indoor air quality.

Major indoor air pollutants include: ETS; products of wood combustion; emissions from furniture, building materials and adhesives; bioaerosols such as molds and bacteria; and radon gas. A lack of proper moisture control, and/or inadequate ventilation can be additional contributing factors to the health impact from these pollutants.

Indoor air pollutants are important as the majority of people spend 85-90 per cent of their time indoors. Environmental tobacco smoke is a primary concern because of its serious impact on health. As well, there is a growing body of evidence that indicates that molds can cause respiratory disease (Dales and Miller 1999), particularly in children (Rylander and Etzel 1999). A damp climate is conducive to the growth of molds, and is a major concern in many areas of the province. Other health problems from exposure to indoor air pollutants include: smoke from wood stoves that causes significant health problems, especially among children (Smith et al. 2000); radon gas can cause lung cancer and is of particular concern in the North and Interior health authorities; CO and NO exposures can cause serious poisoning in arenas; and a variety of airborne allergens can cause asthma and other respiratory problems.

Overall, health authorities have had very limited experience in monitoring, assessing and implementing strategies to reduce health risks caused by poor air quality, particularly indoor air quality. There is a lack of clarity and structure with respect to the policies, mandate and authority of the health sector to monitor and enforce safety standards, as well as some questions about capacity, resources and expertise on a regional level. These issues have, together, impacted the ability of health authorities to take a strategic approach in addressing air quality issues. An added challenge results from the limited research evidence on effective intervention strategies for reducing exposure to indoor air pollutants.

Innovative approaches have been taken in several areas. For example, several regional governments (Greater Vancouver Regional District and the Fraser Valley Regional District) have been delegated the air quality responsibilities of the Ministry of Environment. This has enabled them to establish proactive air quality management plans, and to reduce a number of key pollutants in their regions. Elsewhere in BC, there have also been significant declines in levels of ambient particulate matter (PM_{2.5} and PM₁₀) achieved through the efforts of the Ministry of Environment. At times these initiatives have been developed through the assistance of the health authorities.

A major consideration in implementing effective air quality programs is not only the complexity of the issues, but also, the multiple sectors and levels of government that have a role in preventing and reducing air pollution. The health authorities have a key leadership role in assessing health impacts and collaborating with others in the design and delivery of effective strategies to reduce those health impacts. However, interventions depend on successful advocacy, cooperation and collaboration with other partners.

2.0 SCOPE AND AUTHORITY FOR THE AIR QUALITY PROGRAM

In order to implement air quality programs, there must be clarity on the role of the Ministry of Health, the British Columbia Centre for Disease Control, the health authorities and other ministries and levels of government involved in air quality.

The Ministry of Health has three major roles and responsibilities:

- Providing overall stewardship of the health care system in British Columbia, including conducting strategic interventions with health authorities to ensure continuation of the delivery of efficient, appropriate, equitable and effective health services to British Columbians.
- Working with the health authorities to provide accountability to government, the public and the recipients of health services.
- Providing resources to health authorities to enable them to deliver health-related services to British Columbians.

Specifically in the area of air quality at a provincial level, the Ministry of Health advises the Minister of Health on provincial issues and plans with respect to air quality; and provides advice to assist health authorities regarding strategies to reduce the risk of air pollution.

The Provincial Health Services Authority is responsible for ensuring that high-quality, specialized services and programs are coordinated and delivered within the regional health authorities. With respect to air quality, its role includes surveillance, knowledge transfer and testing of new interventions, particularly in regard to environmental tobacco smoke. The British Columbia Centre for Disease Control provides support and expertise to health authorities with respect to air quality.

The Ministry of Environment and the Environmental Assessment Office play a role in monitoring, regulating and enforcing air quality measures. Industrial sites are regulated through the issuing of permits that limit the level of allowable emissions. The Ministry of Environment has also been instrumental in encouraging and facilitating the development of a number of regional airshed plans (air quality management plans for large geographic areas).

In addition, the federal government has a mandate on the issue of air quality and jointly funds a network of monitoring stations, in partnership with the BC Ministry of Environment. The trans-boundary nature of air quality makes it critical for jurisdictions to work together on air quality management.

Zoning, transportation and land use decisions are usually a local government issue and are regulated through municipal by-laws. Municipal and regional governments have responsibilities for land use planning and the authority to restrict emission-causing activities such as backyard burning and residential use of wood fireplaces. Health authorities are ideally positioned to influence these matters. For example, local decisions on new building sites can potentially impact health if locations are adjacent to major traffic arteries.

Finally, the role of health authorities overall is to identify and assess the health needs in the region, to deliver health services (excluding physician services and BC Pharmacare) to British Columbians in an efficient, appropriate, equitable and effective manner, and to monitor and evaluate the services which it provides. In the area of air quality, health authorities may be involved in some or all of the following:

- Playing a role in the surveillance and monitoring of air quality, including trend analysis and assessment of public health reports.
- Identifying key air pollutants and sources (including new products) and assess/prioritize their public health impact.
- Identifying and implementing, with partners, effective interventions.
- Implementing educational and awareness initiatives.

The overall legislative and policy direction for government air quality programs is derived from:

- The following acts and regulations: *Health Act*; *Environmental Management Act* (2004), *Environmental Assessment Act*; *Workers Compensation Act* and Occupational Health and Safety Regulation; *Social Services Act* (tax concessions for alternative fuel vehicles); *Motor Vehicle Act* (mandatory vehicle inspection and maintenance); *Motor Fuel Tax Act* (preferential tax rates for alternative fuels); and municipal by-laws.
- The Federal/Provincial Accord on Environmental Harmonization and sub-agreement on Canada-wide Standards for air quality.
- The Framework for Core Public Health Functions approved by the Ministry of Health.
- The Performance Agreements currently in place with each health authority.
- The strategic directions of the Ministry of Health.
- The rolling *Health Service Redesign Plans* for each health authority

3.0 PRINCIPLES

The following principles can guide the direction of policies, procedures and operating practices for the air quality program:

- Collaborative working relationships with other provincial ministries and agencies, municipalities, the federal government, non-government organizations and the community at large.
- Priority placed on the most significant public health risks.
- Consistency in practices and messages across jurisdictions as appropriate.
- Focus on prevention, protection and promotion.
- Responsiveness, in a timely manner, to local needs and issues.
- Measurable, achievable and effective strategies.
- Evaluation to support flexibility, innovation and ongoing performance improvement in response to new evidence.

4.0 GOALS AND OBJECTIVES

The goal of the air quality program is to improve the health of British Columbians by reducing the risk to public health from indoor and outdoor air pollution. The specific objectives for achieving this goal are:

- To prevent ill health through surveillance, analysis and planning to address air quality concerns and the adverse health impacts from air contaminants.
- To protect the public by identifying and implementing effective interventions for air pollutants, through pro-active leadership with partners.
- To increase public awareness by educating individuals, families and industry on ways to reduce air pollution.

In addition health authorities also have an objective to reduce the health impacts on persons exposed to air pollution.

5.0 MAIN COMPONENTS AND SUPPORTING EVIDENCE

5.1 Introduction

The major program components for an air quality program are:

- Contributing to the surveillance and monitoring of air quality, including trend analysis and assessment of public health reports.
- Identifying key air pollutants and sources (including new products), and assessing/prioritizing their public health impact.
- Identifying and implementing, with partners and stakeholders, effective interventions.
- Educational and awareness initiatives.

A key consideration in assessing and implementing initiatives is the need to focus on hazards that constitute a major health risk and at the same time, are practical and possible to control. It is important to prioritize pollutants, and target those that can be effectively reduced. This will ensure the efficient use of resources while maximizing potential effectiveness.

In determining priorities, it is also important to consider the long-term implications as air pollutants may ultimately contaminate soil, agricultural products and water supplies and thus lead to indirect health effects, such as lead exposure in children from deposits of airborne lead dust (Provincial Health Officer 2004, p.11).

5.2 Surveillance, Assessment and Intervention – Outdoor Air

National air quality objectives have been established for some common pollutants including: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide and ozone. Canada-wide Standards for PM (2.5) and ozone were established through federal/provincial agreements, and are monitored jointly by federal and provincial ministries of the environment. While these objectives and standards are not entirely protective of human health, they are used as standards or targets across Canada.

Although there are varied levels of activity within health authorities, they have an essential role in monitoring and assessing current gaps in air quality surveillance, to focus on the health impact of pollutants, as follows:

- Monitoring/assessing the concentrations of key ambient air pollutants that are present on a sub-regional, local and/or neighbourhood level (high concentrations in small geographic areas can be masked in generalized data).
- Assessing to what degree current levels of key air pollutants (documented by the Ministry of Environment and/or the health authority) are impacting the health of the public.
- Assessing air pollution permits that are under consideration by the Ministry of Environment, by ensuring the potential health impact of proposed emission levels are determined, and recommending approval/denial or mitigating measures.

As well, health authorities have a role in intervening to reduce the adverse health impacts from air pollutants, and should be active in:

- Identifying effective interventions to respond proactively to significant health risks, (based on research evidence when possible).
- Working collaboratively, through proactive leadership and advocacy when required, with other sectors to build agreement on strategies, realistic target levels, and implementation mechanisms.
- Providing leadership in advising and informing community coalitions and networks to address priority air quality issues, (i.e. community capacity building and community development).
- Participating in the development of community air quality management plans in collaboration with other sectors, considering key health impacts, technical and economic feasibility, and effectiveness of interventions.

Examples of successful interventions include: government regulation of the phase-out of lead in gasoline which has drastically decreased airborne lead levels; and similarly, a smelter upgrade in Trail, BC, which resulted in significant declines in blood lead levels in children (Provincial Health Officer 2004, p. 42).

5.3 Surveillance, Assessment and Intervention – Indoor Air

Health Canada has developed Canadian Guidelines for Indoor Air Quality, which can be used by health authorities in assessing air quality complaints in public-use buildings and private dwellings. Although not all health authorities have testing instruments or substantial expertise in this area, they may (through a memorandum of understanding) access air testing equipment and expert assistance from the University of British Columbia School of Occupational and Environmental Hygiene.

Health authorities have an important role in the surveillance and testing of indoor air quality, as follows:

- Assessing indoor air quality, particularly in buildings that house the most vulnerable, i.e., hospitals, long-term care homes, schools and childcare centres (in consultation with Ministry of Health authorities responsible for licensing childcare centres, group homes and long-term care facilities).
- Assessing air quality in buildings where there is a suspected risk to public health (based on priorities to reduce exposure to key air contaminants).
- Determining whether key air pollutants are impacting the health of the public.

Effective interventions and strategies to address significant indoor air quality issues should include:

- Supporting intersectoral community-based coalitions to plan, advocate, educate and implement effective initiatives. For example, the Clean Air Coalition to reduce tobacco smoke involved partnerships with many other groups including the WorkSafe BC Board,

Ministry of Environment, the industry, asthma groups, physicians, tourism groups and so on, to develop, implement and monitor the effectiveness of strategies.

- Focusing on key priorities to reduce exposure to toxic and hazardous substances with major health impacts, for example:
 - Identification of interventions that reduce ETS exposures.
 - A proactive program to promote adequate ventilation; and
 - A response capacity, based on the immediacy of risk, to deal with situations where indoor air contaminants appear to present a health hazard to members of the public.

A review of 152 research papers on the health effects of different ventilation systems indicated a strong association between the ventilation rate (amount of outdoor air supplied to indoor air) and health, comfort and productivity. Improving ventilation to the levels recommended by the American Society of Heating, Refrigeration and Air Conditioning Engineers, was shown to decrease the prevalence and intensity of clinical symptoms, reduce absenteeism and increase the productivity of office workers (Wargocki et al. 2000).

5.4 Education and Public Awareness – Outdoor/Indoor Air

Health authorities should establish strategies to improve the level of education and understanding of members of the public. The role of the health authorities should include:

- Providing information, posters and other tools to enhance public awareness about effective interventions to reduce the adverse health effects from air pollution.
- Targeted information and education to members of the public about specific air quality safety issues that are a special concern to a neighbourhood, community or a sector. For example, safety practices regarding sports arenas, childcare centres, backyard burning, indoor fireplaces/woodstoves and so on.
- Targeted information and education for individuals with asthma, allergies and other health challenges that are exacerbated by poor air quality, to assist them in identifying effective measures to reduce the adverse effects of exposure to air pollutants.
- Issuing media releases and public service announcements on health effects of air pollution.

6.0 BEST PRACTICES

Often, there is no one “best practice” which is agreed upon, but rather, there are practices that may have been successful in other settings and should be considered by health authorities. The terms “promising practices” or “better practices” are often preferred to reflect the evolving and developmental nature of performance improvement. As part of this review “promising” practices from other provinces were considered.

With respect to best practices, there is clear evidence supporting the effectiveness of:

- Regulation and enforcement of ETS reduction strategies.
- Radon abatement programs.
- Adequate ventilations systems.

However, there is little hard evidence on the effectiveness of other interventions and strategies. Some “promising” practices recommended consistently by professional experts, which have already been identified in this paper, include:

- Testing air quality and assessing health impacts of key ambient air pollutants at the neighbourhood level.
- Working collaboratively with other sectors in reducing the concentration of ambient air pollutants.
- Participating in the development of community air quality management plans in collaboration with other sectors.
- Testing and assessing the health impacts of key indoor air contaminants in buildings, particularly those that house the most vulnerable.
- Developing proactive measures to reduce exposure to key indoor air contaminants (e.g., ETS, ventilation problems, radon gas, mold and so on).
- Providing informational materials to build public awareness and education about air quality.

Other additional “promising” measures, not previously noted, may prove to be equally effective:

General Measures:

- Establishing annual and long-term plans for improving air quality within the health authority area.
- Prioritizing and responding to complaints from the public, depending on the severity of potential health impacts, available resources and potential for reducing health impacts.
- Working towards upgrading and enhancing health authority staff expertise in the area of health impact assessment.

Air Quality

- Encouraging continuous improvement through active involvement in new research on air quality and the use of research and evaluation results in program planning.

Outdoor Air:

- Obtaining baseline data, and, combined with information on community levels of particulate matter, identifying ‘hot spots’ within the health authorities for priority attention.
- Evaluating Air Quality Health Alerts that inform the public about air pollution health hazards (i.e., AirPlay is a Ministry of Environment pilot project based on an Internet-based Air Quality Health Index which is expected to be tested in all health authorities in 2006).
- Evaluating the effectiveness of interventions to reduce ambient pollution, by tracking pollutant levels to assess the effectiveness of risk reduction measures.
- Identifying buildings with existing air conditioning that may serve as refuge centres during periods of high air pollution (e.g. during forest fires).

Indoor Air:

- Introducing a risk-management system by establishing BC indoor air quality guidelines and associated compliance strategies for schools, childcare centres, long-term care facilities and hospitals.
- Introducing indoor air quality guidelines and compliance strategies for bingo halls, shopping malls, restaurants and other key public-use buildings.
- Providing consultation/advice on achieving guidelines and implementing strategies.
- Conducting program evaluation to determine the effectiveness of indoor air quality interventions.
- In parts of BC with high radon levels, make the public aware of radon risks and effective measures to reduce this risk.

7.0 INDICATORS, BENCHMARKS AND PERFORMANCE TARGETS

7.1 Introduction

This section presents a range of indicators, benchmarks and performance targets to provide a basis for the assessment of the core program on air quality.

It is recognized that health-related air quality programs are a relatively new public health area, and that the development of benchmarks and standards is in the early stages. It is expected that additional health-related standards and risk-management systems will be developed over time and along with increased research evidence, particularly for indoor air issues, will provide a more substantive basis for measuring effective program performance in the future. In the meantime, the indicators of necessity will need to focus on inputs, activities and outputs, rather than on specific outcomes.

However, the indicators taken together can provide a broad context for understanding the overall functioning of the program. Therefore, it is not necessary to have only outcome-related indicators. In general, it is best to consider a number of indicators together in forming a view about a given air quality program. It is recognized that air quality programs are complex and that it may be difficult to link interventions with direct health outcomes, particularly as initiatives involve multiple factors and multiple sectors, which all play a role in determining outcomes. In these cases, reduction in exposure to air pollutants is a reasonable surrogate. Where reduction to exposure cannot be demonstrated, it is unlikely the intervention will be of any benefit in reducing adverse effects on health. Given the relatively limited evidence related to effective interventions, it is important that health authorities evaluate the effectiveness of their programs and interventions dealing with indoor and outdoor air quality.

Some of the suggested indicators may apply across the province, while others may need to be modified to account for key variables such as different air quality priorities and challenges in the different geographic areas. Once there is a set of agreed-upon benchmarks, health authorities can use the indicators, benchmarks and their own performance targets to monitor their performance and to address any gaps which may exist between the indicators for their regions and the agreed-upon benchmarks. It is anticipated that the Ministry of Health will work with health authorities to, over time, develop a greater consensus on key indicators and benchmarks for the air quality programs. As well, one or two key performance indicators could in the future be selected to represent overall functioning of the air quality program in the Performance Agreements between the Ministry of Health and the health authorities.

When no provincial benchmarks are available for a certain program indicator, it would be reasonable for a health authority to determine its own performance target. A health authority could do so by assessing its current (and perhaps historical) level of performance and then, based on a consideration of local factors (e.g., capacity resources, staff training and so on), could establish realistic performance targets. Initially, health authorities will set performance targets for a number of indicators. However, over time, and particularly if consistent data collection methods and definitions are applied, it would be realistic for health authorities to share information related to their performance targets and then develop a consensus to determine

provincial benchmarks for these indicators. In other words, locally developed performance targets, over time, could lead to the development of additional provincial benchmarks.

7.2 Surveillance and Assessment – Indoor/Outdoor Air

It is understood that some of the indicators listed below may not be under the control or influence of health authorities, but it is nevertheless, important information for the health authorities to collect. Where this information is collected by other organizations, health officials should be consulted in planning data collection and monitoring, as well as in the preparation of related studies, reports and other initiatives.

Indicators and benchmarks for air quality programs (which are under the control and influence of health authorities) provide a basis for ongoing performance review and evaluation. The indicators considered the most significant in determining overall air quality performance are listed below. In many cases, the baseline data will need to be established in the program’s first year to provide a basis for comparative analysis in future years. In these cases, benchmarks are currently not available but will be determined over time between the Ministry of Health and the health authorities. In other instances, it may be more appropriate to establish local or regional performance targets.

Table 1: Surveillance and Assessment – Indoor/Outdoor Air

Collecting indicators, such as those listed below, may assist a health authority in monitoring air quality. It is recognized that health authorities may not be currently collecting this information, and each health authority will make its own decisions around which of these indicators (if any) might be collected.

Indicator	Definition/Description	Benchmark
1.1 Level/concentration of pollutants in ambient air.	a) Annual average, and 90 percentile, levels of pollutants: carbon monoxide, lead, nitrogen dioxide, particulate matter (2.5), sulfur dioxide and ozone. b) List of hotspots and their annual levels of major air pollutants.	No benchmarks available* No benchmark available**
1.2 Proportion of homes with environmental tobacco smoke, especially homes with children.	a) Percentage of children in regional health authorities living in homes where smoking occurs. b) Percentage of households with adult smokers.	No benchmarks available*** (Note: data available in CCHS)
1.3 Level of radon gas (Northern and Interior health authorities) in buildings/homes.	a) Communities are categorized according to high, medium and low risk of radon pollution (yes/no). b) Number of high-risk communities in which houses have been tested.	No benchmark available* No benchmark available*

Indicator	Definition/Description	Benchmark
1.4 Proportion of public-use buildings that serve the most vulnerable and that have acceptable levels of air quality.	Percentage of the following public-use buildings that meet Canadian Guidelines for Indoor Air Quality (or acceptable levels based on professional opinion): a) Percentage of hospitals. b) Percentage of schools. c) Percentage of long-term care homes. d) Percentage of childcare centres. e) Percentage of residential centres, provincial jails and other public institutions.	Canadian Guidelines for Indoor Air Quality could be considered as benchmarks, or BC indoor air quality guidelines may be established by the Ministry of Health with the advice of the British Columbia Centre for Disease Control.
1.5 Health authority surveillance reports to the public.	Public reports on air quality trends and health impacts of indoor and outdoor air pollution: <ul style="list-style-type: none"> • Annual reports (yes/no). • Quarterly reports (yes/no). • Media alerts on air health hazards (yes/no). 	Yes Yes Yes

* No benchmarks available: health authorities could gather these statistics in the first year/s to establish baseline data, and in subsequent years, use the data for comparative purposes. Where appropriate health authorities will also want to determine performance targets to establish desired goals in the short and long term.

** Ambient air pollutants in neighbourhood “hot spots” will need to be measured to establish a baseline level for comparison in future years. Health authorities will need to establish performance targets to establish annual goals for reducing the key air pollutants over time.

*** No data currently available: the Canadian Community Health Survey (CCHS) instrument collects this information and can be used to establish baseline data, and in the future, to measure and compare changes over time.

7.3 Additional Indicators for Surveillance and Assessment – Indoor/Outdoor Air

Additional supplemental indicators are included to provide further potential information for assessing progress in improving air quality within the health authorities. Table 2a focuses on the activities and impact of health authority programs, while Table 2b considers health outcomes that may be attributed, to some extent, to the presence of major air pollutants.

Table 2a: Program Indicators for Air Quality Surveillance and Assessment

Indicator	Definition/Description	Benchmark
2a.1 Health authority programs that address hazardous or toxic substances in ambient air.	a) Regional health authority has local monitoring of key ambient air pollutants (yes/no). b) Percentage of communities, over 5,000 population, that have implemented an air quality management plan. c) Percentage of population in communities over 5,000 that are protected by an airshed management plan.	Yes No benchmarks available*
2a.2 Health authority programs to assess hazardous or toxic substances in indoor air.	a) Number of indoor air complaints from the public. b) Number of buildings inspected in response to complaints per year. c) Number of consultations regarding indoor air quality per year. d) Percentage of dwellings inspected with visible mold and dampness.	No benchmark available* No benchmark available* No benchmark available* No benchmark available**
2a.3 Policies pertaining to increasing indoor air quality.	Percentage of communities over 5,000 population that have by-laws requiring an entirely smoke-free environment.	No benchmark available*
2a.4 Level of knowledge about air quality among the public.	Percentage of the public indicating a moderate or high knowledge about air quality (a scale score from a regularly conducted survey).	No benchmarks available***

* No benchmarks available: it will be necessary to gather this data to establish baseline data to use as a basis for comparison in future years, and for determining performance targets within a health authority.

** A survey will be required to estimate the percentage of dwellings with visible mold and dampness, in order to establish baseline data, and to use as a basis for comparative purpose in future surveys. It will also provide health authorities with a basis for determining performance targets.

*** No data currently available: a survey instrument will be required to gather baseline data and health authorities will need to determine reasonable performance targets to increase public knowledge over time.

Table 2b: Health Indicators for Air Quality Surveillance and Assessment

Listed below are examples of potential indicators that may assist a health authority in carrying out its overall air quality surveillance role.

Indicator	Definition/Description	Benchmark
2b.1 Patterns of asthma events.	a) Number of physician consultations for asthma events per 10,000 population, semi-annually (MSP data). b) Prevalence of asthma by health service delivery area (data from CCHS). c) Number of people filling prescriptions for asthma medication** per 10,000 population, semi-annually.	No benchmarks available*
2b.2 Patterns of respiratory events.	Number of physician consultations for respiratory disease per 10,000 population, semi-annually (MSP data).	No benchmark available*

Core Public Health Functions in BC: Model Core Program Papers
Air Quality

Indicator	Definition/Description	Benchmark
2b.3 Level of carbon monoxide poisoning (not fire-related).	a) Number of deaths from CO poisoning per 100,000 population per year. b) Number of hospitalizations and emergency department visits attributed to CO exposure, per 10,000 population, per year.	No benchmark available*

* No benchmarks available: it will be necessary to gather this data on a quarterly basis to establish baseline data (incorporating retrospective information if available), which can then be used as a basis for comparison in assessing whether unusual patterns are occurring in subsequent quarters of each year.

** Data available through Pharmacare and the Pharmacists databases.

8.0 EXTERNAL CAPACITY AND SUPPORT REQUIREMENTS

8.1 Key Success Factors/System Strategies

The previous sections outlined the main components and best practices that health authorities could include in their air quality programs. However, it must be emphasized that successful implementation of an effective air quality program will also depend on having in place key success factors/system strategies. These are:

- Strong support from the Board and management of the health authorities regarding the importance of the air quality program in their regions and the role it plays in protecting the health of the population.
- Clarification of the policies, mandate and powers of health authorities with respect to assessing and implementing interventions to reduce air contaminants which have a significant health impact on the population, particularly in relation to the mandate of Ministry of Environment. Although the *Health Act* does not have specific regulations governing air quality measurement and enforcement, it could, through its overall mandate for the health and wellness of British Columbians, provide a sufficiently strong mandate to confirm and clarify this role.
- Allocation, by the health authorities, of sufficient resources to deliver high-quality programs.
- Well-trained and competent staff with the necessary policies and equipment to carry out their work efficiently.
- An information system that provides staff with appropriate support, and provides management with the information it needs to drive good policy and decisions.
- High-quality and competent management of the air quality program, including monitoring of performance measures.
- Clear mechanisms of reporting and accountability to the health authority and external bodies.

A strengthened provincial air quality role for the British Columbia Centre for Disease Control would further support the commitment to effective air quality programs throughout the province. This would provide the necessary expertise, advice and support to health authorities in the field, including:

- Surveillance of provincial air quality and analysis of trends.
- Conducting health impact assessments and background research, to address priorities and emerging air quality issues.
- Identifying effective air quality interventions and evaluating promising interventions.
- Advising Ministry of Health on indoor air quality guidelines and compliance strategies to support health authorities in improving indoor air.

- Encouraging the Building Policy Branch (within the Ministry of Forests and Range) to include adequate indoor air quality guidelines and standards in the BC Building Code.
- Developing an education/information plan and strategy to assist health authorities in addressing air quality and ventilation problems in large public-use buildings.
- Ensuring that members of the public have access to reliable information on preventing and reducing air pollution in their homes, communities and workplaces.

8.2 Intersectoral Collaboration and Integration/Coordination

An air quality program does not exist in isolation and will not achieve optimum efficiency or effectiveness unless it works collaboratively with other key partners involved with air quality. Intersectoral collaboration and coordination on the local and regional levels is essential to ensure the active participation of those that can contribute to air quality.

On the provincial level, the key linkages are the Ministry of Health and the British Columbia Centre for Disease Control. Other important linkages are with the Ministry of Environment, the Workers Compensation Board, the Ministry of Education, the Ministry of Children and Family Development, and the BC Assessment Authority. At the regional and local level, it is essential to link with municipalities, school districts, local networks and agencies involved in environmental issues and health concerns such as asthma and allergies.

It is also important to coordinate good air quality practices into the management of health authority buildings and surrounding areas. In particular, the control of ETS and effective ventilation systems are necessary in hospitals, nursing homes and other facilities operated by the health authorities.

8.3 Assessment and Evaluation of the Air Quality Program

It will be important for health authorities to review their existing information and monitoring systems with respect to their ability to measure and monitor performance indicators. As a relatively new area, it will be necessary to:

- Establish new policies and procedures for some activities to ensure that the necessary records are kept.
- Acquire additional software to facilitate the process of recording and monitoring data (consistency and compatibility among the health authorities with respect to reporting systems is desirable).
- Plan regular survey or sampling projects, either individually or in partnership with other health authorities, or with the Ministry of Health, to assess performance on certain indicators. For example, the level of knowledge about air quality among the public will likely only be available by conducting a survey to gather baseline data, and repeating the survey at a later date to determine any differences over time. Such surveys may be conducted by each region or developed as joint projects.

Health authorities will also need to consider the impact of program monitoring and evaluation on their staffing resources. Expertise will be needed in the fields of program monitoring, program analysis and program evaluation to ensure effective implementation and assessment of the Core Functions improvement process.

9.0 CONCLUSION

There is strong evidence of the health impact of a number of major indoor and outdoor air pollutants and some early progress has been made in dealing with a number of these (such as reductions in lead levels in automobile tailpipe emissions and requirements for industrial emission permits). However, there is less evidence on potential interventions that would be helpful. Except for ETS, the lack of evidence on indoor air quality is, in large part, due to the difficulty in performing practical, valid exposure assessments for large populations of the type used in studies on outdoor air pollution.

It is clear that in air quality, more work needs to be done in developing research on specific indoor air risk factors, and in developing evidence on appropriate interventions that are effective in reducing the risk to public health. It is a complex issue and some further effort is needed to clarify the most appropriate roles and responsibilities for the British Columbia health sector in this important field.

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APPENDIX 1: THE EVIDENCE BASE FOR A MODEL CORE PROGRAM - OUTDOOR AIR QUALITY

Taken from: *Outdoor Air Pollution Interventions and Health Impacts: A Review*, by Kit Shan Lee, Dr. Reka Gustafson, Dr. Ray Copes, and Dr. Michael Brauer.

Exposure to outdoor air pollution can have a negative human health impact. Air pollution can have wide ranging detrimental effects on health, from irritation of the respiratory tract to premature mortality. For this reason, government has allocated many resources to the improvement of outdoor air quality. Several interventions to reduce outdoor air pollution have been successfully implemented. Despite the effectiveness of these interventions in decreasing air pollution, the health gains as a result of air quality improvements have not been well clarified.

The goal of this report was to review the studies that evaluated the health benefits from outdoor air pollution interventions in order to recommend steps that could be taken by public health to effectively address outdoor air pollution concerns. A literature search was conducted on MEDLINE using the following criteria: 1) the intervention was done at the regional or community level; and 2) health impacts as a result of the intervention were studied.

A total of 11 studies were retrieved. The interventions evaluated in these studies included closures or upgrades of industrial emission sources and government-implemented policy interventions such as the restriction or banning of the use of toxic substances. The studies were reviewed according to the category of pollutant affected by the intervention.

Several interventions that succeeded in decreasing levels of particulate matter have resulted in a beneficial health impact. The closing of a steel mill during a labour dispute resulted in lower PM₁₀ levels and was linked to a reduction in average deaths per day. The reduction of industrial and motor vehicle emission in East Germany led to a drop in total suspended particulate. An incremental decrease in total suspended particulate was associated with a positive change in pulmonary function tests in children. A study on the efficacy of intervention methods utilized during the Hoopa Valley, California wildfires reported that two methods appeared effective in decreasing respiratory symptoms. The two intervention methods included the greater duration of using high efficiency particulate air cleaners and the recalling (i.e., remembering) of public service announcements.

The reduction of airborne lead is an example of a successful intervention strategy. Government regulation on the phase-out of lead in gasoline drastically reduced airborne lead levels. The health benefits resulting from this intervention strategy are not discussed in this report. The interventions that were reviewed focused on reducing lead exposure from nearby point sources. The upgrading of a lead-zinc smelter in Trail, BC, was followed by a significant decrease in blood lead levels. Additional community interventions may have contributed slightly to the reduction in blood lead. The reduction in blood lead levels following the closure of a metals smelter was also evident in North Lake Mcquarie, Australia.

The third category of pollutant reviewed was the restriction of sulphur content in fuel in Hong Kong. Several studies examined the effect of this intervention on respiratory symptoms in

children. Collected data from one study showed a reduction in bronchial responsiveness following implementation of the sulphur restriction. The results from the other study reviewed were difficult to interpret due to the common presence of environmental tobacco smoke in the homes of the children studied. This intervention was also reported to have resulted in a significant decline in annual trend deaths from all causes.

The implementation of alternative transportation strategies during the Atlanta Olympics resulted in a decrease in peak daily ozone, carbon monoxide and PM₁₀ levels, and an increase in sulphur dioxide levels. During this time, the number of acute asthma events, including hospitalizations, emergency department visits and urgent care centre visits was determined and compared to previous time periods. An overall decrease in asthma-related visits to emergency care clinics was reported while the transportation alternatives were in place.

All of the outdoor air interventions presented resulted in positive health gains. There were several pre-conditions that were common to all intervention strategies prior to initiation. It is recommended that public health departments involved with outdoor air pollution in BC focus their efforts either on interventions that meet these pre-conditions, or on establishing these pre-conditions. The pre-conditions included: 1) officials could conclude that the levels present in their community were negatively impacting health as a result of monitoring ambient air pollutants; and 2) pollutants were at concentrations significantly above background levels. It is also recommended that sources of outdoor air pollution amenable to an intervention be identified.

APPENDIX 2: THE EVIDENCE BASE FOR A MODEL CORE PROGRAM - INDOOR AIR QUALITY

Taken from: *Indoor Air Pollution Interventions: A Review of Published Evidence*, by Dr. Veronic Ouellette, Kit Shan Lee, Dr. Ray Copes, and Dr. Michael Brauer.

Most Canadians spend over 85-90 per cent of their time indoors. Although some outdoor air pollutants can move into buildings, indoor sources of pollutants can have a major impact. For many pollutants, concentrations are higher indoors than outdoors. This review was conducted to assess the evidence behind public health indoor air interventions.

A literature search on indoor air pollution was conducted using several online databases. The items retrieved included systematic reviews, evidence-based medicine databases and interventions studies. To be included in the review, the studies had to focus on interventions and their effects on health. Several exclusion criteria were identified. The exclusion criteria included: 1) intervention studies on topics addressed by systematic reviews unless they were published after the systematic review and led to conclusions different than the systematic review; 2) studies with specific focus on occupational indoor pollution exposure; 3) smoking cessation intervention if not related to environmental tobacco smoke; and 4) studies or reviews about the association between exposure to air pollution and health effects that did not refer to any interventions. Any papers that did not meet the inclusion or exclusion criteria with certainty were assessed by a second reviewer. All systematic reviews related to indoor air interventions were compiled into tables.

A total of 257 studies were retrieved, of which 19 were reviewed for this report. The studies were grouped by intervention type. The interventions types identified involved humidity control, ventilation, particulate matter/dust, indoor allergens and environmental tobacco smoke.

Only two studies were included that examined the health benefits following interventions on humidity. There was very little evidence that showed the efficacy of humidity control on the reduction of health effects.

Four papers were included that looked at the impacts of ventilation and health. There was sufficient evidence that improving inadequate ventilation can decrease the prevalence of sick building syndrome as well as self-reported symptoms. It is recognized that many building ventilation systems are not functioning up to design specifications. Debate continues on appropriate ventilation standards.

Four studies were reviewed that investigated the health impacts of interventions on particulate matter or dust. The small number and poor quality of the reviewed studies made it difficult to determine the beneficial effects of particle filtration on health.

Five review articles investigated the impacts of controlling indoor allergens on health. Limited evidence was found that avoidance of dust mite in allergic people might provide them with benefit. However, the current available evidence is not strong enough to recommend those interventions to asthmatics.

The intervention studies on environmental tobacco smoke (ETS) only looked at the reduction of exposure to ETS and did not evaluate health impacts. These studies did indicate that programs aimed at decreasing children's exposure to ETS could be effective. There was sufficient evidence to recommend bans and regulations of smoking in public and work places.

Based on the available evidence, banning or restricting smoking in indoor environments and provision of adequate ventilation are measures that are effective in reducing the burden of illness from pollutants in indoor air. Other interventions may also be effective but do not have a large body of evidence to support them.

APPENDIX 3: PROGRAM SCHEMATIC - MODEL CORE PROGRAM FOR AIR QUALITY

Objective: To reduce the risk to public health from indoor and outdoor air pollution.

Main Components	Implementation Objectives (Best Practices)	Outputs	Linking Constructs	Short-term Outcomes	Long-term Outcomes
Surveillance, Assessment and Intervention – Outdoor Air	<p>Surveillance and Health Impact Assessment</p> <ul style="list-style-type: none"> Assess concentrations of key ambient air pollutants on a local and/or neighborhood level. Assess whether current levels of key air pollutants are impacting public health. Assess air pollution permits under consideration by Ministry of Environment. <p>Interventions</p> <ul style="list-style-type: none"> Identify effective interventions to respond to significant health risks. Work collaboratively with other sectors to build agreement on strategies, realistic target levels and implementation mechanisms. Provide leadership in advising/informing community air quality coalitions. Participate in community air quality management planning, with other sectors. 	<ul style="list-style-type: none"> Number of local air monitoring projects. Number of community air quality management plans. 	<ul style="list-style-type: none"> Reduced levels of ambient air pollution at the local level. 	<ul style="list-style-type: none"> Reduced incidence of asthma, respiratory disease, poisoning, and cancer. 	
Surveillance, Assessment and Intervention – Indoor Air	<p>Surveillance and Health Impact Assessment</p> <ul style="list-style-type: none"> Assess indoor air quality in buildings that house the most vulnerable (i.e., hospitals, long-term care homes, schools, and child care centres). Assess air quality in buildings where there is a suspected risk to public health (based on priorities for reducing exposure to key contaminants). Determine whether key air pollutants are impacting the health of the public. <p>Interventions</p> <ul style="list-style-type: none"> Support intersectoral community-based coalitions to implement strategies. Focus on key priorities to reduce exposure to toxic and hazardous substances with major health impacts, for example: <ul style="list-style-type: none"> Interventions to reduce environmental tobacco smoke exposures. A proactive program to promote adequate ventilation. A response capacity to deal with situations where indoor air contaminants appear to present a health hazard to members of the public. 	<ul style="list-style-type: none"> Number of buildings inspected (i.e., buildings that house the vulnerable, dwellings). Number of consultations. Number homes tested for radon pollution in high-risk communities. 	<ul style="list-style-type: none"> Reduced exposure to indoor air contaminants. Increased knowledge about strategies to reduce contaminants. 	<ul style="list-style-type: none"> Reduced incidence of asthma, respiratory disease, poisoning, and cancer. 	<p>Reduced incidence of disease from air pollutants.</p> <p>Improved population health.</p>
Education and Awareness – Indoor/Outdoor Air	<ul style="list-style-type: none"> Provide information to enhance public awareness about effective interventions. Target information to the public about specific air quality issues of concern at a local level. Target information to individuals with specific health challenges such as asthma, allergies and so on. Issue media releases and public announcements on air quality health effects. 	<ul style="list-style-type: none"> Number of informational materials provided to public. Number of media and public announcements. 	<ul style="list-style-type: none"> Increased public knowledge about how to reduce contaminants. 	<ul style="list-style-type: none"> Improved air quality practices among the public and industry. 	