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# Environmental Scan Results: Literature and Website Search

## Literature Search

## Website Search

# Needs, Gaps, and Opportunities Assessment

## State of Environmental Health Service/Program Delivery in Canada

### Needs

- Environmental Health Service/Program Delivery
  - Advanced Training in Environmental Health
  - Evaluation of Effectiveness
  - Research Knowledge Base
  - Surveillance of Environmental Exposures and Risk Factors
- Environmental Health KSTE and NCCEH
  - Environmental Health KSTE
  - NCCEH
  - Evaluation of Effectiveness
  - Capacity
  - Research and Practice Knowledge Base
  - Access to Information
  - KSTE Products

## Gaps in KSTE Products and Activities

- Existing KSTE Products
- New KSTE Products

## Opportunities for NCCEH

- Reviews of Evidence/Evidence-Based Practices
- Monitoring and Exchanging Information
- Secondments/Interchanges and Practica
- Courses and Summer Institutes
- Matching Practitioners/Policymakers and Researchers
- Evaluation of NCCEH

# Work Plan

## Major KSTE Project

## Next Steps
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Acknowledgements

We thank the many environmental health practitioners, policymakers, and researchers who took time out of their demanding schedules to share ideas with us. Without their support, this report would not have been possible. Thanks also go to Meaghan Hennessy, Maureen Phillips, and Nina Clark for their important contributions. Any errors or omissions are solely the responsibility of the authors.
Executive Summary
In 2005-06, the National Collaborating Centre for Environmental Health (NCCEH) conducted an assessment of needs, gaps, and opportunities related to synthesizing, translating, and exchanging knowledge (KSTE) for policy and practice in environmental health (EH). The purpose of the study was to facilitate development of a work plan for our first three years of operation.

Key objectives were to:

- identify EH services and programs delivered through public health in Canada;
- identify available EH KSTE products, materials, and activities;
- examine past experience in EH KSTE;
- identify needed EH KSTE products, materials, and activities;
- identify gaps between what is needed and what is available;
- identify opportunities for bridging the gaps; and
- identify potential priorities for the NCCEH.

The study involved an environmental scan, including interviews with key informants, an online survey, and a literature and website search. This was followed by a needs, gaps, and opportunities assessment.

Sixty-five practitioners and policymakers from 38 agencies that deliver EH services and programs were interviewed. Twenty-two researchers active in EH research were also interviewed. Thirty people responded to the survey. In addition, discussions were held with representatives from Canadian organizations that include practitioners and policymakers or provide training for public health inspectors.

Key findings of the study included:

- A wide variety of EH services and programs are delivered, and these vary between and within provinces and territories. Agencies both within and outside the public health system are involved.
- The amount of staff time allocated to delivering services and programs varies between and within provinces and territories.
- A number of additional services and programs for delivery were identified by participants.
- Limited evidence was cited for effectiveness of delivery of current services and programs.
- The research knowledge base for current services and programs was inadequate for most participants.
- There is relatively little KSTE activity in EH. EH lags behind public health, and public health falls behind the acute care sector.

The following two sets of overlapping needs became clear. Those related to EH service and program delivery include:

- a shortage of people with advanced training in EH which prevents delivery of additional services/programs;
- a lack of evaluation which results in scant evidence of effectiveness for current service/program delivery;
- an inadequate research knowledge base for current services and programs; and
- an absence of surveillance of environmental exposures and risk factors which is a more fundamental problem; without it, not only is evaluation of effectiveness compromised, but EH cannot accurately set risk-based priorities or targets.

The needs related to EH KSTE and the NCCEH include:

- evaluation of effectiveness of service/program delivery;
- capacity to access, assess, and review scientific studies;
- scientific studies relevant to policy and practice;
- easily accessible information on current EH research/practice/policy, and on EH KSTE products;
- specific EH KSTE products; and
- the establishment of the NCCEH itself.
In the absence of these, the use of scientific studies in developing EH policy and practice is hindered. Given the needs stated above and what is actually available in EH KSTE, it is clear that significant gaps exist. There are major opportunities for the NCCEH to bridge those gaps, and by doing so, address the overarching need to improve the effectiveness of environmental health service and program delivery in Canada.

In response to recommendations from participants, initial plans for the NCCEH include:

• producing documents such as reviews of evidence and evidence-based practices;
• monitoring and exchanging information about current policy, practice, and research;
• establishing secondments/interchanges and practica;
• developing courses and summer institutes;
• matching practitioners/policymakers and researchers; and
• evaluating the work of the NCCEH.

Based in part on the environmental scan, the NCCEH selected drinking water as a risk factor for human illness as its first major project. We are in the process of selecting other topics for a number of minor projects.

The NCCEH will collaborate with practitioners, policymakers, and researchers throughout its projects. For the major ones, a steering committee including representation from this user group will also be set up.

The plan is intended to reflect the priorities of EH practitioners and policymakers, and to build a national network of practitioners/policymakers and researchers for collaboration. The ultimate goal is to improve public health.
Background and Introduction
NCCEH, the Public Health Agency of Canada, and the Other National Collaborating Centres

The National Collaborating Centre for Environmental Health (NCCEH) is one of six centres recently established by the Public Health Agency of Canada (PHAC) as part of the Government of Canada’s commitment to renew and strengthen public health. Located in Vancouver at the British Columbia Centre for Disease Control (BCCDC), its focus is on environmental health, initially defined as environmental health services and programs currently delivered by regional and local health agencies throughout the country. The NCCEH’s function involves synthesizing, translating, and exchanging knowledge (KSTE) with environmental health practitioners and policymakers; identifying gaps in research and practice knowledge; and building capacity through networks of practitioners, policymakers, and researchers in environmental health. It is expected to serve the needs of practitioners who deliver environmental health services and programs and policymakers who set policy related to the delivery. The scope also includes environmental hazards for which there is reasonable evidence of a potential significant burden of illness in the Canadian population.

The six national collaborating centres were announced by PHAC in May 2004 and include: Aboriginal Health at the University of Northern British Columbia; Environmental Health at the BCCDC; Determinants of Health at St. Francis Xavier University; Infectious Diseases at the International Centre for Infectious Diseases; Methodologies and Tools at McMaster University; and Healthy Public Policy at the Institut national de santé publique du Québec.

These centres are funded by PHAC, but operate at arm’s length. Their mission is to “build on existing strengths and create and foster linkages among researchers, the public health community and other stakeholders to ensure the efficiency and effectiveness of Canada’s public health system.” All centres have a similar function, but in different areas of public health.

In 2005-06, the NCCEH produced a Needs, Gaps, and Opportunities Assessment Report (based on an environmental scan), developed a 2006-09 work plan (which includes collaboration with the other centres and the formation of an evaluation plan), and set up an advisory board.

The national collaborating centres were required to submit a proposal for 2006-09 in September 2005, followed by a preliminary 2006-07 work plan in January 2006, before completing their environmental scans. This document reports on the results of the NCCEH environmental scan.

Working Definitions

**public health system:**
- comprised of those agencies and organizations within Canada concerned with the delivery of services and programs that improve and protect the health of communities through preventive medicine, health education, control of communicable diseases, application of sanitary measures, and monitoring of environmental hazards.

**environmental health:**
- those environmental health services and programs currently delivered by regional and local health agencies throughout the country.

**environmental health practitioners:**
- people who are responsible for delivering environmental health services and programs;
- include public health inspectors/environmental health officers, physicians, nurses, and other public health staff.

**environmental health policymakers:**
- people who are responsible for setting policy related to delivering environmental health services and programs.
knowledge synthesis, translation, and exchange (KSTE):

- a process of incorporating evidence from research and experience into policy and practice;
- involves a formal and systematic search for research, as well as other lines of evidence, and the assessment and synthesis of the gathered evidence for the purpose of developing/improving policy and practice;
- includes working up the evidence base into products and tools that are useful for policymakers and practitioners;
- ideally this will be initiated by a policy/practice question emanating from policymakers and practitioners.

KSTE products, materials, and activities:

- products can take the form of reviews of evidence for policymakers and/or evidence-based practices for practitioners;
- materials are used to develop such products, but are not products themselves;
- activities can include workshops and courses.

### KSTE in Public Health

KSTE is not a new concept. The process has been studied for many years, and a wide variety of studies in a broad range of fields has been conducted, including public health. However, the focus of the studies, as well as the terminology, has changed over time.\(^2\)

The studies generally agree that there is limited use of research evidence in developing policy and practice. A number of theories have been proposed to explain this, with the majority of studies focusing on two explanations. The first is that factors other than research can influence the policy process, and the second is that differences between the worlds of researchers and policymakers can hinder communication. For example, they ask different questions, have different timeframes for results, use different languages for communication, and lack understanding about each other’s worlds.\(^3,4\)

Several strategies have been proposed to increase the use of research in policy and practice. These include increasing dissemination by researchers, increasing acquisition skills of policymakers, using “knowledge brokers” or facilitators, providing systematic reviews of evidence, and developing collaborative relationships.\(^3,4\) This latter strategy reflects the recent shift from what is sometimes referred to as a “producer push” to a “user pull” approach. To date, relatively few studies have been conducted that evaluate the effectiveness of these strategies in Canada.

---

* For Canadian studies, see: Ciliska, Hayward, Dobbins, Brunton, and Underwood; Palauk, Williamson, Milligan and Frankish; Lomas.\(^5-7\)

† For Canadian studies, see: Landry, Amara, and Lamari; Lavis, Robertson, Woodside, McLeod, Abelson, and the Knowledge Transfer Study Group; Lomas; Lavis, Ross, Hurley, Hohenadel, Stoddart, Woodward, and Abelson; Denis and Lomas; Kiefer, Frank, Di Ruggiero, Dobbins, Manuel, Gully, and Mowat.\(^8-9,7,10-11,2\)
Objectives
The purpose of the Needs, Gaps, and Opportunities Assessment was to facilitate development of a work plan for the first three years of operation of the NCCEH. The specific objectives were to:

- identify environmental health practitioners, policymakers, and more generally researchers in Canada;
- identify the environmental health services and programs delivered through the public health system in Canada;
- identify what environmental health KSTE products and materials are available;
- identify what environmental health KSTE activities are underway;
- examine past experience in environmental health KSTE, particularly what works and what does not;
- identify what environmental health KSTE products, materials, and activities are needed;
- identify gaps between what is needed and what is available/underway, understand the reasons for those gaps, and identify potential opportunities for bridging the gaps;
- identify potential priority products and activities for the NCCEH; and
- identify members of the environmental health KSTE networks.
Methodology
Our study involved two major components: an environmental scan and a needs, gaps, and opportunities assessment.

**Environmental Scan**

We conducted an environmental scan which included interviews with key informants, an online survey, and a literature and website search.

**Interviews**

In every province and territory, semi-structured interviews were conducted with practitioners and policymakers responsible for the delivery of environmental health services and programs at the local/regional level. Practitioners and policymakers in the First Nations & Inuit Health Branch of Health Canada were also interviewed. In provincial and territorial jurisdictions, interviewees were identified by asking the chief medical health officers and assistant deputy ministers with responsibilities for environmental health (or their office) for recommendations. Federally, assistant deputy ministers were asked. Interviewees were approached as individuals knowledgeable about environmental health services and programs delivered in their jurisdiction, not as official representatives of specific organizations.

The interview questions were piloted in British Columbia in July 2005, and subsequently revised. Interviews took place from August 2005 to January 2006, and the majority was conducted in person and by two interviewers. The practitioners and policymakers were asked to describe the delivery of environmental health services and programs in their particular province or territory. They were also asked to identify what environmental health KSTE products and activities existed, what products and activities were needed, what forms they should take, and how the NCCEH could help fill the gaps. This included asking the interviewees to rough rank a list of possible project topics, and to add to the list any additional topics. Finally, they were asked to identify whether they would like to actively collaborate with the NCCEH in environmental health KSTE activities, how they would like the NCCEH to communicate with them, and who they would recommend as members of the NCCEH Advisory Board.

In addition, discussions were held with representatives from selected national and provincial organizations that include environmental health practitioners and policymakers. Discussions were also held with the organizations that provide training for public health inspectors. The representatives were asked to comment on the role of and their potential collaboration with the NCCEH.

Interviews were also conducted with researchers active in environmental health during the same time period, after similarly piloting the questions. They were identified in an informal manner through their research in areas relevant to public health practice and policy. Interviewees were intended to be representative of the environmental health research community across Canada. The majority of the interviews were conducted in person and by two interviewers. The researchers were asked to describe the types of environmental health research they carried out, identify what environmental health KSTE products and activities existed, and how the NCCEH could help fill the gaps. They were also asked whether they would like to actively collaborate with the NCCEH in environmental health KSTE activities, how they would like the NCCEH to communicate with them, and who they would recommend as members of the NCCEH Advisory Board.

In addition, brief discussions were held with representatives from selected provincial organizations that include environmental health researchers.

The specific questions, interviewees, and discussants for the two sets of interviews are listed in appendices A and B.

**Survey**

In order to provide an opportunity for broader input to the NCCEH, an online survey was conducted through the British Columbia Centre for Disease Control website from October 2005 until the end of January 2006. The questions were a modified version of the practitioner and policymaker interview questions, but covered some of the same content. The survey was piloted in British Columbia in September and October 2005 and subsequently revised.

Interviewees, discussants, and survey respondents were asked to let anyone with an interest in environmental health know about the survey.

The questions are listed in Appendix C.
Literature Search

An initial scan for peer-review and grey literature was conducted to identify environmental health KSTE materials, specifically systematic reviews and meta-analyses on drinking water, food, waste, and air interventions. This was in anticipation of the need for such evidentiary materials which could be used to develop KSTE products, given there was a known lack of evidence-based policies and practices and the interview/survey process was not expected to identify many. Once topics for NCCEH projects are identified, a thorough literature search will be required including hand searches of key relevant journals and other resources.

Drinking Water, Food, and Waste

During this preliminary scoping of the literature, librarians from the University of British Columbia provided advice on searching databases for the specific subjects.

An inventory of the references found was created and a classification scheme for them was developed (on file with the NCCEH). Although not systematically sought, suggestions on search strategies and leading articles from researchers in relevant fields were followed up on.

Databases and search terms are listed in Appendix D. No date delimiters were used. The food search was limited to pathogen-related risks.

Reports, conference proceedings, and grey literature were included in the inventory if they were found in the databases.

The review articles in the inventory were appraised to identify those that were adequate and could be classified as either a systematic review or meta-analysis. The criteria for appraisal, based on Cochrane and Campbell Collaboration guidelines, were as follows:

- Is the study question clear, i.e. does it clearly state the population, the intervention or treatment, the control group, and the outcome?
- Was there an explicitly stated search strategy?
- Was there an explicit method of evaluating the studies?
- The number and location of studies included. Was there evidence of any publication bias?
- Were the conclusions reached by review or meta-analysis?
- Sources of bias, if any.\textsuperscript{12}

Air

Reviews on indoor and outdoor air were identified through a different process. They were taken from documents produced as part of the core program review on air conducted in British Columbia. (The focus of the review was on intervention studies, and not specifically on identifying systematic reviews or meta-analyses.) This process was supplemented by a recent US Institute of Medicine’s volume on damp spaces and indoor air.

The burden of illness from outdoor air pollutants is well demonstrated in the literature, however, our literature search focused on interventions.

KSTE

A limited search for literature on the process of KSTE, in both environmental health and public health, was also conducted. The results were supplemented by suggestions from others. A list is available on file.

Website Search

A preliminary search for websites providing resources relevant to environmental health KSTE was conducted. Many of the sites were identified by interviewees and survey respondents.
Needs, Gaps, and Opportunities Assessment

Results of the interviews, survey, and literature/website search were analyzed. The existing environmental health KSTE products, materials, and activities were compared with those identified as needs by the practitioners and policymakers. The gaps and potential opportunities to fill them were identified, including priority NCCEH products and activities. Also taken into consideration were the results of the discussions with the organizations mentioned above.

NCCEH Proposal and Work Plan

The emerging findings of the interviews and literature search were used to identify the initial activities of the NCCEH. They were incorporated into the proposal submitted to the Public Health Agency of Canada in September 2005, and especially into the 2006-07 work plan submitted to them in January 2006.
Environmental Scan Results: Interviews and Survey
Participant Profile

Interviews
Sixty-five practitioners and policymakers from 38 agencies were interviewed in 40 sessions. These included the seven who helped pilot the questions.
Twenty-two researchers were interviewed, including the two who helped pilot the questions.

Survey
Thirty people responded to the survey, including the eight who helped pilot it.

Discussions
As stated earlier, discussions were held with a number of organizations, specifically:
- the Canadian Institute of Public Health Inspectors, the Urban Public Health Network, and the Ontario Public Health Association’s Environmental Health Group;
- Cape Breton University, Ryerson University, the First Nations University of Canada, Concordia University College of Alberta, and the British Columbia Institute of Technology; and
- the British Columbia Environmental and Occupational Health Research Network and the Réseau de recherche en santé environnementale in Quebec.

Practitioner and Policymaker Interviews

Delivery of Services and Programs

Services and Programs Delivered and Who Delivered Them
Interviewees interpreted the term public health system in different ways and identified the environmental health services and programs delivered by the system or other agencies in their province or territory. The agencies accountable for delivering those services/programs are shown in Table 1 according to content area and jurisdiction. The areas of zoonoses and disease surveillance were added as prompts partway through the interviews. In all cases, public health was an accountable agency.
<table>
<thead>
<tr>
<th>JURISDICTION</th>
<th>CONTENT AREA</th>
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<tbody>
<tr>
<td>Alberta</td>
<td>food: PH CFIA; drinking water: PH AB Environment; recreational water: PH AB Transportation; wastewater: PH AB Environment</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>food: PH CFIA; drinking water: PH Dept of Environment; recreational water: PH; wastewater: PH Dept of Environment</td>
</tr>
<tr>
<td>Ontario</td>
<td>food: PH CFIA; drinking water: PH Ministry of Environment; recreational water: PH; wastewater: PH Ministry of Environment</td>
</tr>
<tr>
<td>Quebec</td>
<td>content area: PH Ministère de l’Agriculture, des Pêcheries et de l’Alimentation CFIA Ministère de l’Environnement; drinking water: PH Ministère de l’Environnement municipal govt City of Montreal (Public Health is separate); recreational water: PH Ministère de l’Environnement; wastewater: ?</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>food: PH CFIA; drinking water: PH Dept of Environment local govt; recreational water: PH; wastewater: PH Dept of Environment</td>
</tr>
<tr>
<td>Newfoundland &amp; Labrador</td>
<td>food: Dept of Natural Resources Dept of Govt Services &amp; Lands (unless otherwise stated, for PH) CFIA; drinking water: PH Dept of Environment &amp; Conservation; recreational water: Dept of Govt Services &amp; Lands; wastewater: Dept of Govt Services &amp; Lands (for PH and Dept of Environment &amp; Conservation)</td>
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<td>Nunavut</td>
<td>food: PH CFIA; drinking water: PH hamlets NU Water Board; recreational water: PH; wastewater: PH</td>
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<td>Yukon Territory</td>
<td>food: PH CFIA; drinking water: PH; recreational water: not PH; wastewater: PH</td>
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<tr>
<td>FNIHB (responsible for delivery on reserves south of 60)</td>
<td>food: PH CFIA; drinking water: PH; recreational water: PH; wastewater: PH</td>
</tr>
</tbody>
</table>

CFIA = Canadian Food Inspection Agency; Dept = Department; FNIHB = First Nations & Inuit Health Branch; Govt = Government; PH = Public Health system

Note: If PH is accountable for delivering any services or programs, it is listed first; other agencies are listed in no particular order.
<table>
<thead>
<tr>
<th>CONTENT AREA</th>
<th>sewage</th>
<th>indoor air</th>
<th>outdoor air</th>
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<td>PH Ministry of Environment Ministry of Municipal Affairs &amp; Housing</td>
<td>PH Ministry of Environment</td>
<td>PH Ministry of Environment</td>
<td>PH Ministry of Environment</td>
<td>PH Ministry of Environment</td>
</tr>
<tr>
<td>NB</td>
<td>PH Dept of Environment</td>
<td>PH Dept of Education</td>
<td>PH Dept of Environment</td>
<td>PH Dept of Environment</td>
<td>PH</td>
</tr>
<tr>
<td>PE</td>
<td>PH Dept of Environment &amp; Energy</td>
<td>PH</td>
<td>Dept of Environment &amp; Energy</td>
<td>municipal govt Island Waste Management Corporation</td>
<td>PH</td>
</tr>
<tr>
<td>NU</td>
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<td>PH</td>
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<tr>
<td>NT</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH Dept of Municipal &amp; Community Affairs Dept of Environment &amp; Natural Resources</td>
<td>PH</td>
</tr>
<tr>
<td>YT</td>
<td>PH YK Water Board</td>
<td>PH</td>
<td>PH Dept of Environment</td>
<td>PH Dept of Environment</td>
<td>PH</td>
</tr>
<tr>
<td>FNIHB</td>
<td>PH Environment Canada</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>CONTENT AREA</td>
<td>tobacco reduction</td>
<td>odour</td>
<td>animal &amp; nuisance control</td>
<td>noise</td>
<td>injury prevention</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>BC</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>AB</td>
<td>PH municipal govt</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>SK</td>
<td>PH municipal govt</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>MB</td>
<td>PH MB Conservation</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>MB Labour MB Conservation</td>
</tr>
<tr>
<td>ON</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>QC</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>NS</td>
<td>Dept of Agriculture &amp; Fisheries Dept of Environment &amp; Labour RCMP</td>
<td>PH</td>
<td>PH</td>
<td>municipal govt</td>
<td>PH Dept of Education</td>
</tr>
<tr>
<td>PE</td>
<td>Health Canada PE Liquor Control Commission Workers’ Compensation Board of PE</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>NL</td>
<td>Dept of Govt Services &amp; Lands NL Liquor Corporation</td>
<td>Dept of Govt Services &amp; Lands</td>
<td>Dept of Govt Services &amp; Lands</td>
<td>municipal govt in major centres</td>
<td>Dept of Govt Services &amp; Lands</td>
</tr>
<tr>
<td>NU</td>
<td>municipal govt RCMP</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>NT</td>
<td>mostly federal govt</td>
<td>PH</td>
<td>PH</td>
<td>municipal govt mostly RCMP</td>
<td>PH</td>
</tr>
<tr>
<td>YT</td>
<td>federal govt</td>
<td>?</td>
<td>PH</td>
<td>?</td>
<td>not PH</td>
</tr>
<tr>
<td>FNIHB</td>
<td>Health Canada (a different division)</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
</tr>
<tr>
<td>CONTENT AREA</td>
<td>emergency response for disasters</td>
<td>community development &amp; land use planning</td>
<td>personal services establishments</td>
<td>radiation</td>
<td>other</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>BC</td>
<td>PH others</td>
<td>PH the Crown Ministry of Transportation &amp; Highways</td>
<td>PH</td>
<td>PH</td>
<td>housing: PH municipal govt some PH deliver on reserves for FNIsHBN</td>
</tr>
<tr>
<td>AB</td>
<td>AB Municipal Affairs</td>
<td>PH municipal govt AB Environment</td>
<td>PH</td>
<td>PH Health Canada</td>
<td>rental housing: PH fire dept trades</td>
</tr>
<tr>
<td>SK</td>
<td>PH</td>
<td>PH other departments</td>
<td>PH</td>
<td>Dept of Environment SK Labour</td>
<td>Dept of Health provides advice to Northern Intertribal Health Authority housing pilot: PH City of Regina</td>
</tr>
<tr>
<td>ON</td>
<td>PH Ministry of Environment Ministry of Natural Resources everyone</td>
<td>PH Ministry of Environment local govs Toronto Buildings Toronto Works &amp; Emergency Services</td>
<td>PH</td>
<td>PH Ministry of Labour Ministry of Environment</td>
<td></td>
</tr>
<tr>
<td>QC</td>
<td>PH</td>
<td>PH Ministère des Affaires Municipales et des Régions Ministère de l’Environnement City of Montreal</td>
<td>PH</td>
<td>PH</td>
<td></td>
</tr>
<tr>
<td>NB</td>
<td>PH others</td>
<td>PH</td>
<td>PH</td>
<td>PH</td>
<td>housing: PH</td>
</tr>
<tr>
<td>PE</td>
<td>PH Workers’ Compensation Board of PE</td>
<td>Dept of Environment &amp; Energy Dept of Community &amp; Cultural Affairs</td>
<td>PH</td>
<td>PH</td>
<td></td>
</tr>
<tr>
<td>NL</td>
<td>PH Dept of Govt Services &amp; Lands</td>
<td>PH</td>
<td>Dept of Govt Services &amp; Lands</td>
<td>PH Dept of Govt Services &amp; Lands</td>
<td></td>
</tr>
<tr>
<td>NU</td>
<td>PH Dept of Community &amp; Govt Services</td>
<td>PH NU Planning Commission</td>
<td>PH</td>
<td>do not have any</td>
<td></td>
</tr>
<tr>
<td>NT</td>
<td>PH Dept of Municipal &amp; Community Affairs</td>
<td>PH</td>
<td>PH</td>
<td>PH NT &amp; NU Workers’ Compensation Board</td>
<td>housing</td>
</tr>
<tr>
<td>YT</td>
<td>PH Dept of Community Services</td>
<td>PH</td>
<td>PH</td>
<td>federal govt YK Housing Corporation</td>
<td>YK govt delivers for First Nations</td>
</tr>
<tr>
<td>FNIHB</td>
<td>PH</td>
<td>PH Indian &amp; Northern Affairs Canada</td>
<td>PH</td>
<td>PH</td>
<td>public education &amp; awareness, not regulation &amp; enforcement</td>
</tr>
</tbody>
</table>
Interviewees identified a variety of strategies that were used by public health or other agencies to deliver environmental health services and programs, shown in Table 2.

### Table 2

<table>
<thead>
<tr>
<th>STRATEGIES FOR SERVICE/PROGRAM DELIVERY</th>
</tr>
</thead>
<tbody>
<tr>
<td>inspection</td>
</tr>
<tr>
<td>monitoring</td>
</tr>
<tr>
<td>sampling</td>
</tr>
<tr>
<td>interpretation</td>
</tr>
<tr>
<td>investigation</td>
</tr>
<tr>
<td>review</td>
</tr>
<tr>
<td>licensing</td>
</tr>
<tr>
<td>enforcement</td>
</tr>
<tr>
<td>interpretation</td>
</tr>
</tbody>
</table>

Those strategies listed on the left are related to mandatory/regulatory activities where the recipient may or may not choose to be the recipient (typically programs). Those on the right are related to voluntary consumption (typically services).

Services and programs were delivered for a variety of places ranging from public to private. While they were delivered for all of the general content areas, the specific content varied both between and within the provinces/territories. For some content areas, a service/program was delivered only when there was a health focus, concern, complaint, problem, hazard, outbreak, or emergency.

In some provinces and territories, certain services/programs were delivered by one or more agencies in the public health system, working either on their own or with other agencies, while other services/programs were delivered by agencies outside that system (see Table 1). In addition to place and content area, who the agencies were depended on a number of factors. These included whether the food was for domestic use or import/export; the drinking water/wastewater/sewage/solid waste systems were being designed, constructed/installed, or operated; the volume of drinking water/wastewater/sewage was large or small; and the indoor air concern was related to students or teachers.

For example, a drinking water service/program was delivered by the public health system in all jurisdictions (on its own or with other agencies). Emergency response for disasters and odour services/programs were also delivered by public health in most jurisdictions. In contrast, a noise service/program was delivered in two-thirds of them.

In British Columbia, Ontario, and New Brunswick, public health delivered services/programs for all content areas (on its own or with other agencies). In Newfoundland & Labrador and Nova Scotia, the system delivered services/programs for only a few areas.

An additional service/program mentioned by some interviewees was housing, which was delivered by public health in about half of the jurisdictions (on its own or with other agencies).

Public health alone delivered a personal services establishment service/program within the majority of jurisdictions. The system also commonly delivered an injury prevention service/program on its own.

In the jurisdictions of the First Nations & Inuit Health Branch, British Columbia, New Brunswick, and the Northwest Territories, public health alone delivered services/programs in two-thirds of the content areas. In contrast, in Newfoundland & Labrador, Nova Scotia, and Manitoba, the system delivered services/programs on its own in only a few areas.

Some interviewees commented that certain aspects of the delivery of their environmental health services/programs were to change, including those in Nova Scotia, Prince Edward Island, and the Yukon Territory.

### Staff Time Allocated to Service/Program Delivery and Determining Factors

In response to the question of what percentage of staff time was allocated to environmental health services and programs, some agencies had the information ready at hand, while others did not. Their comments included: do not know; no tracking system; varies seasonally; depends on region/part of region, time of year, disease.
Staff time was allocated to a range of services/programs and varied between and within provinces/territories. For half of the agencies, food was the content area given the most staff time. For others, the areas were drinking water, housing, sewage, or sanitation. For a third of the agencies, food and drinking water together were given the most staff time.

The amount of staff time allocated also varied within each service/program. For example, food ranged from 15 to 56%, drinking water from 5 to 50%, and tobacco control from 6 to 14%.

Interviewees identified several factors that determined this allocation. These factors and the number of interviewees who mentioned them were as follows:

- legislation, regulations, by-laws, liability (14);
- general public (10);
- risk assessments (9);
- current issues (7);
- unplanned (5);
- political, politicians (4);
- historical (4);
- staff, budget (4);
- outbreaks, death (3);
- other agencies, inside and outside of public health (2);
- internal (2);
- policy (1).

### Desired Additional Service/Program Delivery and Barriers

Interviewees, with the exception of one, identified several additional environmental health services and programs they would like to deliver. These are shown in Table 3 and ranked according to the number of provinces/territories for which there was at least one mention. The services/programs identified varied between and within provinces/territories.
### Table 3
**Desired Additional Service/Program Delivery by Jurisdiction**

<table>
<thead>
<tr>
<th>CONTENT AREA</th>
<th>NUMBER OF JURISDICTIONS</th>
<th>SPECIFIC CONTENT</th>
</tr>
</thead>
</table>
| indoor air                          | 8                       | • indoor air quality  
• indoor air and housing  
• arenas and carbon monoxide  
• mould  
• radon                                                                                           |
| injury prevention                   | 8                       | • injury prevention  
• injuries due to public health system  
• child safety and recreation  
• playgrounds                                                                                     |
| food                               | 6                       | • food safety/food handler training  
• food safety in homes  
• food safety in schools  
• mandatory food handler training  
• health education - food allergies/chemicals in food                                              |
| personal services establishments    | 6                       | • personal services  
• public education re: personal services/tanning  
• ultraviolet light and skin (sun and tanning salons)                                              |
| outdoor air                         | 4                       | • air quality - develop protocols  
• ambient air & oil/gas industry  
• outdoor air                                                                                        |
| contaminants                        | 3                       | • risk assessment & management of chemicals in the environment  
• environmental contaminants  
• pesticide reduction in the home  
• human health implications of toxics/pesticides  
• surveillance of environmental contaminants  
• comprehensive assessment of environmental exposure and health risk                                |
| drinking water                      | 3                       | • private drinking water supplies  
• source water protection - private wells  
• drinking water source protection  
• strengthen regulations and lower thresholds to do with water supplies                              |
| education                           | 3                       | • health promotion (more active – e.g. schools & kids)  
• public education around environmental health  
• rabies education in schools                                                                       |
| environment                         | 3                       | • climate change  
• sustainability                                                                                   |
| assessment of issues & interventions| 2                       | • public health impact assessment  
• underlying burden of illness  
• evaluation - are we making a difference  
• syndrome surveillance  
• environmental health mapping & surveillance                                                        |
| community development & land use planning | 2             | • community development  
• environmental planning - site cleanup, soil risk  
• flood control  
• mining                                                                                           |
| recreational water                  | 2                       | • safe water education  
• swimming pools                                                                                   |
One interviewee commented that environmental health, not another health agency, should deliver injury prevention. Those interviewees also identified several factors that can prevent delivery, as shown in Figure 1.
Evidence for Effectiveness of Service/Program Delivery

Interviewees interpreted each of the terms evidence and effectiveness in different ways. The majority indicated there was some evidence to support the effectiveness of their environmental health service/program delivery. The others stated there was (5) or there was not (4). Comments included:

- not much evaluation done, bits and pieces, depends on the program;
- more done in large vs small regions, southern vs northern;
- some done, but not for their region;
- some done, but dated.

Interviewees stated that a number of health agencies were in the process of evaluating their services/programs, including Quebec, Health Canada’s First Nations & Inuit Health Branch, British Columbia, Alberta Health & Wellness, and Capital Health (Edmonton). Toronto Public Health had recently evaluated their food inspection system. Nova Scotia Environment & Labour was also in the process of evaluating its services/programs.

Types of Evidence Identified

Interviewees identified the following environmental health services and programs for which they had some kind of evidence of effectiveness: food safety (9), drinking water (6), sewage (3), swimming pools (2), recreational water (2), community sanitation (1), forest fires (1), drunk driving (1), injury prevention (1), tobacco reduction (1), communicable diseases (1), indoor air (1), outdoor air (1), community development (1), radiation (1), and rabies (1).

A number of interviewees further identified one or more of the types of evidence they had for certain services/programs, shown in Table 4.

Table 4
Types of Evidence Identified

| public opinion survey/poll, staff surveys, owner/operator survey |
| inspection results, observe change in some operations, seeing fewer examples |
| media support |
| few food poisonings in restaurants, less community illness, health outcome data, data evaluation |
| more training, certified operator |
| protection/good treatment, decreased number of boil water advisories, number of vaccinations, reduction in the number of rabid dogs, air quality |
| monitoring system |
**Types of Indicators Suggested**

Interviewees more generally identified the types of indicators that could be used for evaluation of effectiveness of environmental health services and programs, either alone or in groups, shown in Table 5.

### Table 5
**Types of Indicators Suggested**

<table>
<thead>
<tr>
<th>Types of Indicators Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive feedback from community, people consult and participate, lack or reduction of complaints from the public, most people support in general, consumer confidence reports (6)</td>
</tr>
<tr>
<td>permit, compliance, better compliance, utilities report, report more often, look at failures (5)</td>
</tr>
<tr>
<td>absence or presence of reports of illness, lack of major disease outbreak, decrease in infectious communicable diseases, age of onset (9)</td>
</tr>
<tr>
<td>effectiveness of chlorine, lower number of positives, a lower number of mis-samples (3)</td>
</tr>
<tr>
<td>number of times inspected, maintenance of inspection schedule, annual inspection, monitoring, regulatory oversight, efficiency of inspection (7)</td>
</tr>
<tr>
<td>number of FTEs, management plan (2)</td>
</tr>
<tr>
<td>cause and effect (1)</td>
</tr>
</tbody>
</table>

The indicators in the first five rows were similar to those identified as evidence; the ones in the last two rows were new mentions.

Some interviewees commented on the barriers to evaluation, shown in Figure 2.

![Figure 2](image-url)
Use of Scientific Studies by Practitioners and Policymakers

Who Used Scientific Studies and Why

With one exception, interviewees indicated they used scientific studies to develop environmental health policy and practice. Of those, nine interviewees always used them, 16 used them most of the time, 11 used them some of the time, and two did not use them often.

The reasons interviewees use scientific studies included:

- to justify, defend, support decisions/actions (14);
- committed to the use of science, is a call for, is expected, in the business of (9);
- to improve and protect public health, respond to real issues, the right way to think, to give good advice to the public, make logical decisions, validate, confirm (8);
- to persuade, make changes (3);
- to be credible (1);
- the scientific model is our paradigm (1).

Barriers to Increased Use of Scientific Studies

Interviewees identified several factors that prevented them from using more often the results of scientific studies to develop environmental health policy and practice:

- lack of time (11), staff (9), money (2);
- lack of resources/capacity to review/study (13);
- lack of staff skills, expertise (4);
- lack of relevant studies, including for a specific issue, province/territory, practice (13);
- lack of ease of access to studies or network (11);
- lack of quality studies (9);
- results do not translate easily, conflicting science (4);
- studies not available when needed (2);
- inertia (for change, to bring forward), results not recognized (2);
- complications due to split jurisdiction (inertia, money transfer) (2);
- an overwhelming amount of information (1);
- studies not in a form that can be used (reviews) (1).

One interviewee commented that their advanced training was supported by their agency.

Gaps in Research Knowledge Base and Areas of Greatest Need

Interviewees’ responses to the question of whether the research knowledge base for their environmental health services and programs was adequate were split between yes, depends on the area, do not know, and no.

Their areas of greatest need included:

- assessment of issues/interventions (15): national surveillance, environmental health impact assessment, greater attention to risk assessment including cumulative risk, healthy environments, rationalize and find optimum levels for inspection, best practices for programs, tools for measuring effectiveness of interventions and technologies (e.g. assess others’ experiences);
- food (13): general food standards, baseline data for contaminants in food, effective interventions, risk-based evidence for frequency of inspection, health risks associated with Aboriginal foods (e.g. salmon), understanding of proper cooking methods and sanitizing methods, consumption advisories;
- water (13): application of standards for drinking and recreational water (monitoring levels, evaluating effects, and planning timely intervention), review approaches to small water systems, alternatives to chlorine disinfection, boil water advisories;
• outdoor air (9): sources (e.g., traffic, crop residue burning, independent operators such as power plants), application of standards, health effects (e.g., asthma), zoning, evaluation of interventions;
• contaminants (8): more rigorous environmental investigation of air and water, exposure monitoring (including estimate of time spent indoors and outdoors), effects of chronic low dose exposure and multimedia exposure, new toxins, carcinogenicity, arsenic standards and interventions, specific information for children’s exposure to environmental contaminants (e.g., exposure route, parameters to measure);
• indoor air (6): assessment of quality, current standards, requirements for inspections (e.g., mould), outcomes;
• sewage (6): disposal, use, and effectiveness of holding tanks, disposal information specific to northern and arctic area, lagoon setbacks, lack of central collection for research;
• radiation (5): e.g., new electromagnetic fields, standards for electromagnetic fields;
• public facilities (3): children and seniors’ facilities (e.g., playgrounds and daycare, appropriate care for seniors), personal care vs school care for children;
• education (1): tools for public education;
• other: quick access to literature/experts on emerging issues, more concentrated research in basic areas, link research into practice.

Types of KSTE Products
Interviewees indicated that the results of scientific studies could be put into forms that would allow for their increased use in developing policy and practice for environmental health. Preferred formats included reviews of evidence (3), best practice guidelines (2), case studies (3), bulletins/factsheets (3), and newsletters (2) which include information about who does/is doing what (in practice/policy/research) (2).

Further, interviewees suggested that formats such as reviews and guidelines should be written in plain language (10), based on evidence/science (8), summarized in one to four pages with a link to a central source (8), up-to-date/evolving (6), and practical (5). They should also include a literature review (2), identify what is known and what is not (1), be peer reviewed (1), be neutral (1), relate to policy demands (1), relate to people and their health (1), and include links to additional sources of information (1).

A majority of interviewees preferred a website as a means for disseminating information (one-stop shopping with links to a variety of other sources) (21), followed by networking with others (4), and dialogue with the general public (2).

Best Practices
In response to the question of what the term best practices meant to them, interviewees identified a range of criteria. Notably, some of these were contradictory, in particular whether a best practice should be a minimum (7), a maximum or an ideal (2), or specific to context (28). Context could be related to the area, site, institution, regulation or policy, and economic or technical feasibility. Two other opposing criteria were whether a best practice should be based on scientific evidence (10) or common sense (14). Interviewees also mentioned that best practices should be comparative, identifying practices that are better than before/elsewhere/alternatives (11); up-to-date and evolving (7); and publicly/politically accepted and imitated by others (6). Further, they should include a proper outcome measure (4), be transparent (2), and identify research gaps (1).

Several interviewees suggested using a term other than best practices, including better practice, leading practice, quality improvement, gold standard, or promising practice. Some stated that the related document should only identify best practices (4), while others stated that it should endorse them (2).

KSTE Products, Producers, and Users
Most of the interviewees indicated they or others in their organization had taken the results of scientific studies and put them into a form that facilitated their use by policymakers and practitioners who deliver environmental health services and programs (55), while some had not (9). Those who had, identified a wide variety of examples.

The majority of interviewees indicated they knew of others who had taken the results of scientific studies and put them into such a form (62), but a few did not (3). Those who did, identified a wide variety of examples.

In addition to documents, interviewees identified courses (on food safety, health impact assessment of development projects, and risk communication) and presentations, including webcasts.
Comments included:

- do not have the people or time;
- tend to use other people’s work;
- usually look at other jurisdictions, useful most of the time;
- do not know too much about others’ work.

A complete listing of the example documents and organizations’ websites is on file with the NCCEH. Appendix E lists the documents located that included a literature review and recommendations for policymakers and practitioners.

**How NCCEH Could Help Increase Use of Scientific Studies**

Prior to being asked about the role of the NCCEH in increasing the use of the results of scientific studies in developing policy and practice for environmental health, several interviewees had already made suggestions. These included helping evaluate intervention programs (2), comparing and benchmarking different approaches to evaluation across the country (1), and making evidence for effectiveness more understandable to others (1). Some interviewees suggested that the NCCEH should take the lead and persuade the research community to address the practical questions from front-line practitioners. One person suggested that the NCCEH should strive to endorse best practices.

When they were specifically asked about the role, interviewees gave a wide variety of responses. Generally, they supported the function of the NCCEH, i.e. to synthesize, translate, and exchange knowledge; identify gaps in research and practice knowledge; and develop networks in environmental health. They reiterated many of the interviewees’ responses to the earlier general question asking if the results of scientific studies could be put into forms that would allow for their increased use, and if so, what kinds of forms. Additional responses included:

- be neutral vs political;
- do projects that practitioners/policymakers do not regularly do;
- the list of projects must be fluid;
- add weight to projects relevant to those provinces/territories that lack expertise;
- respond to emergencies;
- coordinate or provide funding/staff for projects;
- provide means for environment agencies to bring forward issues;
- use the Cochrane approach;
- provide document review service;
- be timely with products;
- provide link to experimental interventions;
- monitor current events/trends related to environmental health;
- participate in scientific meetings/conferences;
- organize/co-organize workshops/conferences of practitioners/policymakers/researchers;
- provide training, train the trainers, work in partnership;
- help build a national environmental health surveillance/tracking system;
- provide website discussion board;
- make website content inclusive vs vetted;
- decide how to deal with general public.
**Possible KSTE Product Topics**

Thirty-nine interviewees rough rated a list of possible topics for NCCEH projects. Those rated high by one or more interviewees are shown in Table 6.

**Table 6**

NCCEH Project Topics Rated High by Practitioners/Policymakers

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>PERCENT OF RESPONDENTS RATING TOPIC AS “HIGH” IMPORTANCE</th>
<th>TOTAL NUMBER OF RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>methods &amp; techniques for risk communication with the public</td>
<td>69</td>
<td>13</td>
</tr>
<tr>
<td>approaches to developing air pollution advisories</td>
<td>47</td>
<td>36</td>
</tr>
<tr>
<td>procedures for dealing with mould in schools*, **</td>
<td>43</td>
<td>35</td>
</tr>
<tr>
<td>procedures for dealing with mould in public buildings*, **</td>
<td>42</td>
<td>36</td>
</tr>
<tr>
<td>investigation of exposure to environmental contaminants, e.g. lead, arsenic</td>
<td>41</td>
<td>22</td>
</tr>
<tr>
<td>ethnic food preparation (safety of)**, ****</td>
<td>39</td>
<td>38</td>
</tr>
<tr>
<td>procedures for dealing with mould in single family homes</td>
<td>37</td>
<td>19</td>
</tr>
<tr>
<td>radon abatement*</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td>investigation &amp; follow-up protocols for elevated blood levels of metals, e.g. lead, manganese</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>approaches to developing fish contaminant advisories</td>
<td>26</td>
<td>34</td>
</tr>
<tr>
<td>procedures for cleanup of illegal drug labs</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>disinfectants for various personal services**</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>serving un-inspected wild meat at special events</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>risks from secondary contact recreational water</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>procedures for dealing with mercury spills in schools/public buildings/ apartments/condos*, **</td>
<td>9</td>
<td>35</td>
</tr>
<tr>
<td>emergency response for white powder incidents**, **, ***</td>
<td>3</td>
<td>38</td>
</tr>
</tbody>
</table>

* guidelines available; ** Alberta (Capital Health) has documents; *** Quebec has documents; **** some interviewees included Aboriginal with ethnic food
<table>
<thead>
<tr>
<th>TOPIC</th>
<th>PERCENT OF RESPONDENTS RATING TOPIC AS &quot;HIGH&quot; IMPORTANCE</th>
<th>TOTAL NUMBER OF RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>risk assessment of drinking water systems*,**</td>
<td>84</td>
<td>38</td>
</tr>
<tr>
<td>evaluating the outcome of environmental health programs &amp; interventions</td>
<td>67</td>
<td>24</td>
</tr>
<tr>
<td>estimated burden of illness from environmental hazards in Canada</td>
<td>64</td>
<td>33</td>
</tr>
<tr>
<td>housing as a determinant of health</td>
<td>63</td>
<td>35</td>
</tr>
<tr>
<td>surveillance of environmental hazards</td>
<td>58</td>
<td>33</td>
</tr>
<tr>
<td>emergency planning for environmental disasters</td>
<td>56</td>
<td>25</td>
</tr>
<tr>
<td>outcome-based food safety inspection evaluations</td>
<td>56</td>
<td>16</td>
</tr>
<tr>
<td>risk assessment of food establishments</td>
<td>55</td>
<td>33</td>
</tr>
<tr>
<td>communicable disease/infection control (super bugs) as it relates to care facilities**</td>
<td>44</td>
<td>34</td>
</tr>
<tr>
<td>assessment of source water protection</td>
<td>44</td>
<td>36</td>
</tr>
<tr>
<td>zoonoses (diseases transmitted from animals to humans)</td>
<td>43</td>
<td>35</td>
</tr>
<tr>
<td>environmental impact assessment (human health)</td>
<td>42</td>
<td>24</td>
</tr>
<tr>
<td>indoor air and wood burning stoves</td>
<td>36</td>
<td>14</td>
</tr>
<tr>
<td>impacts of large-scale intensive agriculture</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>use of home &amp; garden pesticides</td>
<td>34</td>
<td>35</td>
</tr>
<tr>
<td>methods of engaging the public &amp; other stakeholders in designing &amp; delivering environmental health programs</td>
<td>31</td>
<td>13</td>
</tr>
<tr>
<td>body modification/tanning risks &amp; risk reduction</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>land use planning/management</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>review public policies, including international, related to reducing impacts of transportation on public health</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>wastewater reuse</td>
<td>29</td>
<td>24</td>
</tr>
<tr>
<td>human health impacts of climate change</td>
<td>29</td>
<td>24</td>
</tr>
<tr>
<td>injury prevention (e.g. skateboards, playground safety)</td>
<td>27</td>
<td>15</td>
</tr>
<tr>
<td>burning of wood [&amp; agriculture] residue</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td>radon detection &amp; abatement measures***</td>
<td>24</td>
<td>29</td>
</tr>
<tr>
<td>domestic wastewater disposal to marine environment</td>
<td>23</td>
<td>26</td>
</tr>
<tr>
<td>secondhand smoke outdoor risk</td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>health impact of pine beetle infestation (through water turbidity, harvesting, denim pine production, wood waste disposal)</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>effectiveness of licensing interventions (e.g. daycare)</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>new opportunities for health protection through licensing</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

* First Nations & Inuit Health Branch has documents; ** Alberta (Capital Health) has documents; *** guidelines available
Interviewees rated some topics low because they already had such a document, they knew of others who had such a document, or it was not their responsibility.

**Collaboration with NCCEH**

All interviewees responded yes to the question of whether they were interested in collaborating with the NCCEH on knowledge translation, knowledge gap identification, and networking. Comments included: especially on gap identification (5), NCCEH must be in concert with the Ontario and Canadian public health agencies (2), on issues related to remote areas/small provinces/First Nations (3), in partnership for staff training (1), small provinces may not be able to contribute much (2).

**Communication**

In response to the question of how they would like to communicate with the NCCEH, interviewees generally suggested:

- email *(the preferred method)*: concise; periodic updates on what is new, with links to further information;
- face-to-face: e.g. regular meetings, workshops, conferences;
- phone: for important communication; conference calls;
- mail: for documents needing immediate attention;
- newsletter: concise; periodic; main points only, with links to further information; consistent format.

**Other Advice on KSTE**

Interviewees’ general responses to the question of whether they had any other advice to offer the NCCEH about knowledge translation included:

- listen carefully;
- keep it simple;
- consider that this could generate a lot of controversy;
- do not come into health authorities with own agenda; be very sensitive to the local culture; need buy-in of chief medical officer and director of health protection;
- preserve your independence;
- approach senior management in other institutions, make institutional arrangements;
- do not make it too bureaucratic;
- build a fan base;
- be sensitive to degree of participation possible;
- pick some winners to start; start small, build in evaluation; take on national not regional issues initially; get going, baby steps;
- keep advisory board small, not 30;
- clarify the NCCEH’s roles and responsibilities vs provincial/federal health agencies;
- be considerate when doing knowledge translation related to First Nations and Inuit.
Researcher Interviews

Types of Research and Relevance to Practitioners and Policymakers

Interviewees responded that they carried out a variety of types of environmental health-related research including:

- surveillance and biomonitoring;
- toxicology;
- epidemiology;
- modeling;
- methods development;
- risk assessment, impact assessment;
- guidelines and standards;
- policy-related research, evaluation of effectiveness;
- socio-economic, cost-benefit analysis;
- risk construction, risk perception;
- risk communication, knowledge translation.

Their research topics included:

- indoor air;
- outdoor air;
- zoonoses, e.g. cryptococcus, West Nile virus;
- food;
- drinking water;
- noise (occupational health);
- methylmercury; pesticides; organochlorines, persistent organic pollutants, polychlorinated biphenyls, polybrominated diphenyl ethers; arsenic; lead; sulphur; ozone; nitrogen dioxide; malachite green; multiple chemicals;
- microbial;
- mould (occupational health);
- fine particulates, grain dust;
- radiation, radon;
- climate change, extreme weather;
- emergency preparedness;
- sustainable development and energy policy;
- smoking;
- injury prevention, road safety (occupational health);
- diabetes, cancer, immune systems, respiratory disease, endocrine disruptors, blood;
- First Nations/Aboriginal health; northern; farm, rural; other communities.

The overwhelming majority of researchers indicated their results were relevant to policymakers and practitioners who deliver environmental health services and programs (yes (10), hopefully (10), no (1)).
Use of Scientific Studies by Practitioners and Policymakers

Who Used Scientific Studies

Interviewees’ responses to the question of whether their research was used by policymakers and practitioners who deliver environmental health services and programs included: no (1), not clear (1), hope so (1), and yes (16). Those who said yes generally identified a range of organizations as users, including national, federal, provincial/territorial, Aboriginal, regional, local, international, multiple stakeholders, and professional. Some interviewees also identified communities and non-governmental organizations as users.

Barriers to Increased Use of Scientific Studies

Two interviewees responded that there were no barriers to the increased use of their research by policymakers and practitioners who deliver environmental health services and programs; one responded that they had no idea if there were; and 16 responded that there were barriers. Barriers identified included:

- practitioners/policymakers/researchers live in separate worlds; networks/avenues for sharing information in many topic areas are relatively underdeveloped; environmental health in Canada is fragmented (4);
- researchers lack resources; finite capacity to fully engage with partners; finite capacity to translate knowledge (3);
- researchers/educators do not have the proper staff to train future researchers (2);
- researchers are out of the official loop (1);
- variability in data collection/data standards between jurisdictions (1);
- lack of good pilots, case studies (1);
- researchers should collaborate with practitioners, not tell them what to do (1);
- knowledge translation is province-specific (1);
- difficult to fund knowledge translation (1);
- health agencies do not have the proper staff (1);
- lack of understanding of risk construction, otherwise health units could negotiate with communities (1);
- not a lot of leadership in public health (1);
- policymakers, because the solutions are difficult (1);
- competing priorities due to wide range and multiplicity of issues handled by partners/stakeholders at any one time (1);
- solidly entrenched lobbies, difficult to keep air quality issues on government agenda (1);
- people do not hear the same thing from many sources (1).

KSTE Products, Producers, and Users

The majority of interviewees indicated they or their colleagues had taken the results of scientific studies and put them into a form that facilitated their use by policymakers and practitioners who deliver environmental health services and programs (20). They identified a wide variety of examples.

The majority of interviewees indicated they knew of others who had taken the results of scientific studies and put them into such a form (19). They also identified a wide variety of examples.

In addition to documents and organizations, interviewees mentioned courses and presentations.

One interviewee specifically commented on the types of strategies that facilitated the use of scientific studies by policymakers and practitioners. These included interacting with them in person frequently, asking what topics were of interest to them as often as informing them about potential new ones, and identifying and working with the people who others approach for advice on practice and policy.

Also, many interviewees indicated that their involvement in projects had been initiated by policymaker/practitioner organizations that often sponsored the work and in some cases co-authored it.

A complete listing of the example documents and organizations’ websites is on file with the NCCEH. Appendix E lists the documents located that included a literature review and recommendations for policymakers and practitioners.
How NCCEH Could Help Increase Use of Scientific Studies

Interviewees gave a wide variety of responses to the question of how the NCCEH could help increase the use of the results of scientific studies in developing policy and practice for environmental health. Generally, they supported the function of the NCCEH and further responded:

- address use of Cochrane approach vs “precautionary principle” when evidence is limited;
- identify and work with the people that others go to for information;
- track major issues;
- contract a series of case studies;
- interaction across disciplines is crucial, all national collaborating centres could play an important role;
- ensure support for cross-disciplinary environmental programs at universities;
- provide link to training/fieldwork for students;
- fund research;
- provide letters of support for funding applications;
- bring the few environmental epidemiologists in Canada together on issues;
- link researchers to practitioners/policymakers, including researcher support (not funding, but staff);
- provide a place to disseminate research;
- help identify who needs to know research results;
- encourage researchers to share results with practitioners/policymakers;
- participate in scientific conferences;
- organize conferences of practitioners/policymakers/researchers;
- organize courses/summer institutes of researchers/practitioners/policymakers/graduate students;
- train researchers to do knowledge translation, train the trainers;
- include the general public in your mandate.

Collaboration with NCCEH

All researchers, like the practitioners and policymakers interviewed, generally responded yes to the question of whether they were interested in collaborating with the NCCEH on knowledge translation, knowledge gap identification, and networking.

In response to the question of what would be needed in return for their collaboration, interviewees suggested the following: exchange of in-kind services, schedule/locate meetings around conferences of interest, letter of recognition, cover expenses, teaching relief, guest lecture by the NCCEH, honorarium for assistant, provide funding, cover conference expenses, small fellowship to support graduate student, financial support for a literature review. A third of the interviewees needed essentially nothing in return.

Communication

In response to the question of how they would like to communicate with the NCCEH, the researchers, like the practitioners and policymakers interviewed, generally suggested:

- email (the preferred method): concise; periodic updates on what is new, with links to further information;
- face-to-face: e.g. meetings, conferences;
- phone: periodic calls; for important communication; conference calls;
- newsletter: periodic; with links to further information;
- website discussion board;
- fax.
Other Advice on KSTE

Interviewees’ responses to the question of whether they had any other advice to offer the NCCEH about knowledge translation included:

- do not be superficial;
- do a few things, do them well;
- be careful of easy wins;
- in the first year or two, build a website, contact international groups;
- have a champion in each level of government;
- need to educate/pressure the person at the top, and have resources;
- be considerate when doing knowledge translation related to First Nations and Inuit;
- maintain the integrity of your message;
- identify gaps, push the Canadian Institutes for Health Research to move money into environmental research;
- should also value basic research, not just policy-relevant research and knowledge translation, innovation could lead to a breakthrough.

Survey

Evidence for Effectiveness of Service/Program Delivery

Survey respondents interpreted each of the terms evidence and effectiveness in different ways. Their answers to the question of whether there was evidence to support the effectiveness of the environmental health services and programs delivered in their community ranged from no (8) to some (13) to yes (5). One respondent stated that the First Nations & Inuit Health Branch was in the process of evaluating their services/programs.

Respondents identified the following services/programs for which there was some kind of evidence of effectiveness: food safety (5), drinking water (5), tobacco reduction (3), outdoor air (1), communicable diseases (1), and indoor air (1).

A number of respondents further identified one or more types of evidence they had for certain services/programs, including:

- community survey, survey of students over time;
- number of stool samples submitted;
- enteric disease statistics each year, lack of major food borne outbreaks.

Respondents more generally identified the following types of indicators that could be used for evaluation, either alone or in groups:

- number of inquiries from the public (1);
- number of inspections (1);
- low numbers of reports of enteric illness, lack of major disease outbreak (2).

Some respondents commented on the barriers to evaluation:

- difficult to measure prevention (2).
Use of Scientific Studies by Practitioners and Policymakers

**Types of KSTE Products**

The survey respondents, like the policymakers and practitioners interviewed, indicated that the results of scientific studies could be put into forms that would allow for their increased use in developing policy and practice for environmental health. Preferred formats included reviews of evidence (4), best practice guidelines (3), and bulletins/newsletters (3).

Further, they suggested that formats such as reviews and guidelines should be written in plain language (3), useful to decision-making (3), short (1), based on a literature review (1), interpret uncertainty (1), and be peer reviewed (1).

Means for disseminating information included a website (with a search engine and links to a variety of other sources) (4); networking with others, including some face-to-face meetings (3); and an electronic mailing list (1).

**KSTE Products, Producers, and Users**

Half of the respondents indicated that they or others in their organization had taken the results of scientific studies and put them into a form that facilitated their use by policymakers and practitioners who deliver environmental health services and programs (11), while the other half had not (10). Those who had, identified a few examples.

More than half indicated that they knew of others who had taken the results of scientific studies and put them into such a form (13), and less than half did not (8). Those who did, also identified a few examples.

Two respondents commented that lack of support from management was a barrier.

In addition to documents and organizations, respondents identified a course (on health impact assessment of development projects).

A complete listing of the example documents and organizations’ websites is on file with the NCCEH. Appendix E lists the documents located that included a literature review and recommendations for policymakers and practitioners.

**Possible KSTE Product Topics**

Table 7 shows the topics that respondents suggested for NCCEH projects related to food, drinking water, indoor air, outdoor air, and other environmental health services and programs.
<table>
<thead>
<tr>
<th>AREA</th>
<th>TOPIC</th>
</tr>
</thead>
</table>
| **production and distribution** | • pros and cons of encouraging private, regional, and home food production. Possibly subsidized  
• global food distribution  
• the effect of climate change on food networks  
• environmental and health impact of food transportation  
• farm practices affecting food safety  
• ensuring that food is produced safely and healthfully from an ecosystem health and human health viewpoint  |
| **processing** | • food safety controls, or lack of, for imported and Canadian products  
• federal/provincial overlap on food processing facilities. Critical processing, storage, control issues, labelling, imported food products, and issues of potential problem that maybe we should be monitoring  
• food processing from gate to plate  
• meat in general. BC has new meat legislation taking effect September 2006. Health inspectors will be involved in meat processing. This is a huge topic from slaughter through to sausage making.  |
| **handling** | • raw food safety  
• food safety (home)  
• handling raw/ready-to-eat foods with limited facilities  
• hand washing  
• hand washing/hygiene  
• temperature/time abuse  
• minimizing risk for food storage  
• temperature control  |
| **food borne illnesses** | • food safety issues related to bacterial  
• zoonoses, information on various in-the-news issues, Mad Cow Disease, Bird Flu  
• analysis of BC/Canadian food-related disease outbreaks, to identify leading causes of failure in food safety  
• cost-effectiveness of Hepatitis A vaccination for all food-handlers  
• irradiation and alternatives  
• how can environmental health programs be most efficient in food borne illness prevention  |
| **contamination and additives** | • ingredients  
• preservatives  
• organic or not  
• nutritional qualities and pollutants in industrial vs organic agriculture  
• impacts of food contaminants (chemical residues, antibiotics, etc.) on human health  
• cross-contamination control  
• container toxicity and associated food contamination  |
| **inspections** | • Hazard Analysis and Critical Control Point (HACCP)  
• use of field tests  
• assessing food safety without fancy gadgets  
• quality assurance in inspections of food premises  
• quality determinants in foods  
• standardization of inspections and approaches between different health units/regions  
• food inspection standards provincially and regionally as well as international perspectives - i.e. what are the safeguards  
• results of recall notices (how much product is recovered, etc.)  
• provincial comparisons in requirements for establishments, professional catering and non-profit organizations (e.g. church suppers)  
• safety determinants in foods. These should be translated in the younger years.  |
| **training** | • practices in food handling training across Canada (related to food borne illness)  
• training manuals for staff especially with high turnovers  
• life-long learning for environmental health officers/public health inspectors in order that they stay on top of new information and approaches  |
| **assessment of issues/interventions** | • what are emerging issues  
• what program designs are the most effective  |
<p>| <strong>other</strong> | • having expert support in applied/legalistic enforcement  |</p>
<table>
<thead>
<tr>
<th>AREA</th>
<th>TOPIC</th>
</tr>
</thead>
</table>
| training and updates        | • training for environmental health officers/public health inspectors  
• training specific to micro water system operators  
• what are emerging drinking water issues  
• dissemination on latest information on drinking water science and issues  
• more training for environmental health officers                                                                                                                                                           |
| contaminants                | • literature on contamination issues, biological, minerals and chemicals  
• understanding the ‘fecal’ in ‘fecal coliform’  
• bacteriological standards (application of them)  
• waterborne diseases  
• total coliforms  
• parasite control  
• microbiological updates/information  
• health impact of microbiological contamination vs chemical contamination  
• the sources and health implications of chemical contamination of drinking water  
• pollutants  
• the new Canadian drinking water arsenic guideline  
• the practical interpretation of chemical parameters  
• testing to include much more than the current coliform and aesthetics guideline information (i.e. chlorinated compounds, trace elements, all pathogens, etc.)  
• substandard results                                                                                                                                                                                     |
| treatment methods           | • smaller scale treatment  
• the economics of mass water treatment  
• treatment by-products, pros and cons of various treatment methods  
• disinfection by-products  
• disinfection  
• develop treatment system information packages  
• disinfection of well water                                                                                                                                                                               |
| distribution                | • availability  
• shortages in the future  
• proper use of  
• distribution problems  
• private and community water                                                                                                                                                                               |
| source protection           | • the practical value of source water protection with respect to the provision of safe drinking water  
• land use controls around drinking water catchment zones                                                                                                                                                                                                            |
| communicating with the general public | • boil water advisories  
• update the recommendations for well users that used to come from the MOH  
• make sense of the literature on disinfection by-products and the risk/benefits for consumers  
• all major sources tested and results publicly posted in media                                                                                                                                                                                                       |
| assessment of interventions | • cost-benefit analysis of attempting to regulate small water systems                                                                                                                                                                                                                                                                         |
| other                       | • ecology of water  
• quality                                                                                                                                                                                                                                                                                                                                 |
<table>
<thead>
<tr>
<th>AREA</th>
<th>TOPIC</th>
</tr>
</thead>
</table>
| contaminants | • contaminants, what’s there and at what concentration, bacteria, viruses, mould spores, toxins, off-gassing, etc.  
               | • contaminants of                                                                                                                        
               | • what contaminants are of concern                                                                                                        
               | • effects of outdoor pollutants in indoor environments                                                                                   
               | • description and health implications of non-bacterial, non-mould contaminants. Also strategies to respond to them.                     
               | • mould                                                                                                                               
               | • damp indoor spaces and mould issues - set the record straight                                                                           
               | • mould and mildew                                                                                                                     
               | • basic course on moulds and spores and the health problems related to them                                                             
               | • the importance of moisture control in housing                                                                                         
               | • moulds                                                                                                                              
               | • moulds - long-term and short-term exposure                                                                                           
               | • connections between the use of wood and gas heating, indoor air quality, and illnesses                                               
               | • how heating types affect indoor air quality                                                                                          |
| building     | • information on indoor air quality building planning, the process, approvals, standards, etc.                                           
               | planning                                                                                                                              
               | • recommendations for number of building air exchanges per hour, in what circumstances                                                 
               | • where best to locate air intakes for varying environments                                                                            
               | • ventilation and air conditioning                                                                                                     
               | • ventilation                                                                                                                          
               | • practical, effective filtering, and where and when required                                                                         |
| public       | • an evidence-based approach to deal with ‘off-gassing’ in newly constructed or renovated public buildings (e.g. schools)               
               | buildings                                                                                                                              
               | • indoor air quality in daycare facilities and schools                                                                                
               | • daycares                                                                                                                             
               | • schools                                                                                                                             |
| private       | • what are the top three priority areas that significantly impact the health of occupants in the home                               
               | residences                                                                                                                             
               | • private homes                                                                                                                        |
| mitigation    | • evidence-based procedures for responding to complaints of illness related to indoor air quality                                       
               |                                                                                                                                       
               | • ways to economically improve indoor air quality                                                                                      
               | • remediation of                                                                                                                        
               | • mediation of                                                                                                                         
               | • need a standardized assessment form                                                                                                  
               |                                                                                                                                       
               | • training                                                                                                                             |
| agency roles | • how can environmental health programs best work in this area                                                                          
               |                                                                                                                                       
               | • management support allowing us to do this work                                                                                       
               |                                                                                                                                       
               | • need to develop support agencies to assist clients with real needs                                                                 |
| other         | • breathing problems                                                                                                                   
<pre><code>           |                                                                                                                                       
           | • quality                                                                                                                             |
</code></pre>
<table>
<thead>
<tr>
<th>AREA</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>monitoring and standards</td>
<td>• increase monitoring</td>
</tr>
<tr>
<td></td>
<td>• hazardous material detection, measurement, monitoring, etc., in the event of local or global disaster such as a nuclear explosion</td>
</tr>
<tr>
<td></td>
<td>• standards, and background on how the standards were established, scientific evidence</td>
</tr>
<tr>
<td>contaminants</td>
<td>• smog</td>
</tr>
<tr>
<td></td>
<td>• particulates</td>
</tr>
<tr>
<td></td>
<td>• sulphur dioxide</td>
</tr>
<tr>
<td></td>
<td>• nitrous oxide</td>
</tr>
<tr>
<td></td>
<td>• information on what counts, is it wood smoke, industrial pollution, vehicles, combination of</td>
</tr>
<tr>
<td></td>
<td>• contribution of agricultural emissions to fine particulates</td>
</tr>
<tr>
<td></td>
<td>• identify all sources possible (i.e. airport, harbour contributions) and how they factor in</td>
</tr>
<tr>
<td>health</td>
<td>• connections between winter smog and respiratory illnesses</td>
</tr>
<tr>
<td></td>
<td>• breathing</td>
</tr>
<tr>
<td></td>
<td>• allergies and asthma</td>
</tr>
<tr>
<td></td>
<td>• how to monitor and mitigate the impact of living close to sources of pollution (e.g. major highways)</td>
</tr>
<tr>
<td></td>
<td>• quality</td>
</tr>
<tr>
<td></td>
<td>• relative importance of air pollution vs other determinants of respiratory and cardiovascular disease</td>
</tr>
<tr>
<td>effect of population density</td>
<td>• urban vs rural issues review is needed</td>
</tr>
<tr>
<td></td>
<td>• comparing rural air quality to urban air quality</td>
</tr>
<tr>
<td></td>
<td>• how crowd density affects outdoor air quality</td>
</tr>
<tr>
<td></td>
<td>• impact of urban growth (i.e. more houses, more people) on air quality</td>
</tr>
<tr>
<td>training</td>
<td>• education/training</td>
</tr>
<tr>
<td></td>
<td>• training in this science is needed with a focus on practical application of the knowledge to protect public health</td>
</tr>
<tr>
<td>mitigation</td>
<td>• increase awareness about advocacy role that can be taken by environmental health programs</td>
</tr>
<tr>
<td></td>
<td>• how can a local health authority get involved in outdoor air issues</td>
</tr>
<tr>
<td></td>
<td>• review of evidence for effective interventions to mitigate impact of poor air quality events on people</td>
</tr>
<tr>
<td></td>
<td>• domestic reduction</td>
</tr>
<tr>
<td></td>
<td>• publish localized information</td>
</tr>
<tr>
<td>environment</td>
<td>• global warming</td>
</tr>
<tr>
<td></td>
<td>• impact of ozone depletion</td>
</tr>
<tr>
<td>AREA</td>
<td>TOPIC</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| training and updates                      | • develop leadership skills and other core competencies in environmental health programs  
   | • help us interpret the issues most pressing in environmental health protection and how we can measure it  
   | • general public health, information on disease transmission, upcoming issues, exposure routes, intervention methods, etc.  
   | • update environmental health practitioners on emerging issues  
   | • up-to-date, local, regional, epidemiological information published in media (not just the sensational news bites)  
   | • better publication of resource contact information  
   | • evaluation of the quality of the training of health inspectors in relation to ability to deal with modern environmental health issues |
| community development and land use planning | • community planning for healthier communities  
   | • developing safer streets  
   | • improve the roads for alternate transportation - walking, biking, alternative fuel vehicles, scooters, etc.  
   | • mass transit’s role in disease transmission |
| injury prevention                          | • injury prevention - residence and child care  
   | • injury risk and prevention  
   | • playground safety |
| climate change                             | • current situation regarding climate change and health  
   | • possible public health adaptations for climate change  
   | • surveillance methods for climate change |
| education                                  | • education  
   | • food safety training for employees |
| emergency response for disasters           | • disaster planning, both short term (terrorism or accidental), and long term (things creeping up on us that we may not be aware of)  
   | • emergency preparedness |
| housing                                    | • housing standards/guidelines are needed. Why do we not have a safety program incorporated into what we do elsewhere. Let’s get less insular about the profession and expand it  
   | • housing complaints |
| contaminants                               | • environmental lead studies (soil especially)  
   | • handling of toxic substances |
| waste                                      | • landfill reduction - reduce, reuse, recycle |
| radiation                                  | • evaluation of the health impact of electromagnetic field exposure inside the home, and mitigation if necessary |
| tobacco reduction                          | • tobacco smoke - in the home and the workplace |
| environment                                | • stewardship  
   | • proper use of our ecosystem |
| assessment of issues/ interventions        | • population health. Information on where we would be best placing our effort - environmental, public safety, housing, education  
   | • myth, superstition, and misinformation 'busting'  
   | • help us determine what is the dead wood in program delivery... based on the evidence related to best practice and health outcomes  
   | • comparison of effectiveness of self-regulation (including accreditation) and regulation by legally mandated inspection |
| other                                      | • empower public health inspectors to be more active, more leadership, etc.  
   | • how the aging population will affect client-based service demand  
   | • practical asepsis vs disease phobia  
   | • entomology |
Other Advice on KSTE

Interviewees’ responses to the question of whether they had any other advice to offer the NCCEH about knowledge translation included:

• ensure your mandate is clear and your response time is reasonable;
• brainstorm with selected and creative environmental health officers;
• must have resources to produce useful materials in a timely manner;
• needs to expand quickly;
• avoid becoming another academic department;
• look for champions, node/gateway people;
• do not use the phrase “knowledge translation product,” it is jargon;
• need to develop an evaluation plan, little baseline data to track environmental health trends;
• establish formal task groups with equal geographic representation;
• do not leave out the Atlantic region;
• very important to work in French rather than just provide translation.
Environmental Scan Results: Literature and Website Search
Literature Search

There are a number of review articles on environmental health topics, but relatively few are systematic reviews or meta-analyses. Also, there are many more systematic reviews/meta-analyses on topics related to clinical patient care than on public health. Within public health, relatively few are within environmental health.

The results of the appraisal of reviews on drinking water, food, and waste are summarized in appendices F, G, and H.

Thirty systematic reviews/meta-analyses on drinking water were found in the literature. As shown in Appendix F, none of them pertain to Canadian systems. The majority of them examine the health effects of chlorinated drinking water and its by-products. The first six systematic reviews are included because of their possible relevance to small communities in Canada with untreated or under-treated water supplies.

For food, 28 systematic reviews/meta-analyses were found. As shown in Appendix G, one of them pertains to the Canadian context and synthesizes the evidence relating to collective kitchens, and four of them evaluate the effectiveness of different food safety interventions relating to inspections and food handling within Canada. With respect to the relationship between public health impacts of the microbiological quality of food, and hazard analysis and critical control point (HACCP), the United Kingdom has taken a lead role in evidence synthesis. Further, the UK and European Union countries are leading in research and intervention studies linking HACCP to food from gate to plate, based on published research. However, the extent to which there is an actual impact on risk or illness has yet to be demonstrated.

Twenty-one systematic reviews/meta-analyses on waste were found. As shown in Appendix H, they relate mostly to hazardous substances in US Superfund sites, health effects of working or living near waste incinerators/landfills, or different methods of waste management practices. The majority of them focus on the health impacts of exposure to different waste systems.

For indoor air, nine systematic reviews/meta-analyses were identified from the study by Ouellette et al. which focuses on evidence for positive health gains from indoor air interventions (see Table 9). They do not pertain to the Canadian context. Their focus was on evaluating dust-mite control for allergies/asthma or reduced exposure to environmental tobacco smoke.

The US Institute of Medicine’s volume on damp spaces and indoor air is a first-rate review of the literature and should contain much information that is useful for practitioners (see Table 9).

For outdoor air, no systematic reviews/meta-analyses were identified from the study by Lee et al. which evaluates the health benefits from outdoor air pollution interventions.

Website Search

Table 8 lists a selection of organizations with websites that provide resources relevant to environmental health KSTE. Suggested by interviewees and survey respondents, the websites include KSTE products, as well as materials that could be used to develop such products.
Table 8
Organizations and Their Websites with Environmental Health KSTE Resources

<table>
<thead>
<tr>
<th>ORGANIZATION AND URL</th>
<th>TYPE OF RESOURCE AND AUDIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• American College of Occupational and Environmental Medicine</td>
<td>EH KSTE product – practitioners/policymakers</td>
</tr>
<tr>
<td>• American Water Works Association</td>
<td>EH KSTE materials – all audiences</td>
</tr>
<tr>
<td><a href="http://www.awwa.org/">http://www.awwa.org/</a></td>
<td></td>
</tr>
<tr>
<td>• Association of Public Health Observatories (UK)</td>
<td>OPH &amp; EH KSTE materials – practitioners/policymakers</td>
</tr>
<tr>
<td><a href="http://www.apho.org.uk/apho/">http://www.apho.org.uk/apho/</a></td>
<td></td>
</tr>
<tr>
<td>• BC Centre for Disease Control</td>
<td>EH KSTE materials – general public and practitioners/policymakers</td>
</tr>
<tr>
<td>• BC Injury Research and Prevention Unit</td>
<td>some EH KSTE products, mostly OPH KSTE materials – practitioners/policymakers</td>
</tr>
<tr>
<td><a href="http://www.injuryresearch.bc.ca/">http://www.injuryresearch.bc.ca/</a></td>
<td></td>
</tr>
<tr>
<td>• BC Lung Association</td>
<td>EH KSTE product – practitioners/policymakers</td>
</tr>
<tr>
<td>Health and air quality 2002 report <a href="http://www.bc.lung.ca/airquality/airquality_publications.html">http://www.bc.lung.ca/airquality/airquality_publications.html</a></td>
<td></td>
</tr>
<tr>
<td>• BC Ministry of Environment</td>
<td>EH KSTE products – practitioners/policymakers</td>
</tr>
<tr>
<td>• BC Ministry of Forests</td>
<td>EH KSTE materials – general public and practitioners/policymakers</td>
</tr>
<tr>
<td><a href="http://www.gov.bc.ca/bvprd/bc/channel.do?action=ministry&amp;channelID=-8385&amp;navid=NAV_ID_province">http://www.gov.bc.ca/bvprd/bc/channel.do?action=ministry&amp;channelID=-8385&amp;navid=NAV_ID_province</a></td>
<td></td>
</tr>
<tr>
<td>• Canadian Council of Ministers of the Environment</td>
<td>EH KSTE materials and products – all audiences</td>
</tr>
<tr>
<td>• Canadian Water Resources Association</td>
<td>EH KSTE materials – practitioners/policymakers</td>
</tr>
<tr>
<td><a href="http://www.cwra.org/index.html">http://www.cwra.org/index.html</a></td>
<td></td>
</tr>
<tr>
<td>• Cancer Care Ontario</td>
<td>EH KSTE product – practitioners/policymakers</td>
</tr>
<tr>
<td>• enHealth Council (Australia)</td>
<td>EH KSTE products and materials – practitioners/policymakers</td>
</tr>
<tr>
<td>• EURêKAPRO.info, Portal of Environmental Health</td>
<td>EH KSTE materials – practitioners/policymakers</td>
</tr>
<tr>
<td><a href="http://www.eurekapro.info/EurekaPro/Anglais/index.asp">http://www.eurekapro.info/EurekaPro/Anglais/index.asp</a></td>
<td></td>
</tr>
<tr>
<td>• Food Safety Network</td>
<td>EH KSTE materials – all audiences</td>
</tr>
<tr>
<td><a href="http://www.foodsafetynetwork.ca/en/page.php?a=7&amp;s=1">http://www.foodsafetynetwork.ca/en/page.php?a=7&amp;s=1</a></td>
<td></td>
</tr>
<tr>
<td>• Fraser Health (BC)</td>
<td>EH KSTE product – practitioners/policymakers</td>
</tr>
<tr>
<td>ORGANIZATION AND URL</td>
<td>TYPE OF RESOURCE AND AUDIENCE</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------</td>
</tr>
</tbody>
</table>
| Indian & Northern Affairs Canada  
National assessment of water and wastewater systems in First Nations communities  
Northern Contaminants Program  
http://www.ainc-inac.gc.ca/ncp/pub/pub_e.html | EH KSTE products and materials – all audiences |
| Institute for Public Health Practice  
Food council news  
Environmental public health clearinghouse  
Environmental public health monitor  
http://www.ciphp.ca/resources.htm | EH KSTE materials – practitioners/policymakers |
| Institut national de santé publique du Québec  
| Malaspina University-College, Center for Coastal Health  
http://www.mala.ca/cch/aboutcch.asp  
http://www.mala.ca/cch/publications.asp | EH KSTE materials – practitioners/policymakers |
| McGill University  
Centre for Indigenous Peoples’ Nutrition and Environment  
http://www.mcgill.ca/cine/ | EH KSTE materials – general public and practitioners/policymakers |
| Montreal Public Health  
Prévention en pratique médicale  
http://www.santeпублиq.mtl.qc.ca/english/index.html  
http://www.santepub-mtl.qc.ca/Publication/telecharg_ppm.html | EH KSTE products and materials – all audiences |
| National Institute for Health and Clinical Excellence (UK)  
Evidence base  
| Northern Health (BC)  
http://www.northernhealth.ca | EH & OPH KSTE materials – all audiences |
| Nova Scotia Department of Health  
Policy watch  
http://www.gov.ns.ca/health/policywatch/ | EH & OPH KSTE materials – all audiences |
| Ontario College of Family Physicians  
Pesticides literature review  
http://www.cfpc.ca/English/CFPC/CLFM/environmental/default.asp?%s=1%20 | EH KSTE product – practitioners/policymakers |
| Ontario Ministry of Health & Long-Term Care  
http://www.health.gov.on.ca/english/providers/providers_mn.html#public | EH & OPH KSTE products and materials – practitioners/policymakers |
| Ontario Public Health Association  
http://www.opha.on.ca/resources/e-h.html#environmental  
http://www.opha.on.ca/advocacy/list.html | EH KSTE products and materials – all audiences |
| The Ontario Tobacco Research Unit  
http://www.otru.org/reports_index.html | OPH & EH KSTE materials and some products – general public and practitioners/policymakers |
| Partners in Information Access for the Public Health Workforce (US)  
http://phppartners.org/hp/eh.html | EH KSTE materials – practitioners/policymakers |
| Pest Management Regulatory Agency  
| Public Health Research, Education and Development (Ontario)  
http://www.phred-redsp.on.ca/  
http://www.myhamilton.ca/myhamilton/CityandGovernment/HealthandSocialServices/Research/EPHPP | EH & OPH KSTE materials – practitioners/policymakers |
### Sample Table Content

<table>
<thead>
<tr>
<th>Organization and URL</th>
<th>Type of Resource and Audience</th>
</tr>
</thead>
</table>
| Saskatchewan Coalition for Tobacco Reduction  
Best practices in tobacco control: a vision for Saskatchewan  
| Toronto Public Health  
http://www.toronto.ca/health/hphe/index.htm  
http://www.toronto.ca/health/az_index.htm  
http://www.toronto.ca/health/hphe/pubs.htm  
http://www.toronto.ca/health/hphe/pdf/boh_hot_weather.pdf | EH & OPH KSTE products and materials – all audiences |
| University of British Columbia, Centre for Health and Environment Research  
Border air quality study  
Wildfire smoke study  
http://www.cher.ubc.ca/  
http://www.cher.ubc.ca/UBCBAQS/welcome.htm  
http://www.fresmoke.ubc.ca | EH KSTE materials – practitioners/policymakers and general public |
| University of Ottawa, McLaughlin Centre for Population Health Risk Assessment  
EMCOM, the information site on endocrine disruption  
http://www.emcom.ca/ | EH KSTE materials – practitioners/policymakers and general public |
| US Agency for Toxic Substances & Disease Registry  
http://www.atsdr.cdc.gov/  
http://www.atsdr.cdc.gov/HEC/CSEM/csem.html | EH KSTE material and products – practitioners/policymakers and general public |
| US Centers for Disease Control and Prevention  
http://www.cdc.gov/node/id/0900f3ec8000e04d44  
http://www.cdc.gov/nccdphp/exemplary/index.htm  
http://www.cdc.gov/nceh/ | EH KSTE products and materials – practitioners/policymakers and general public |
| US Department of Energy, Office of Environment, Safety, and Health  
http://www.eh.doe.gov/ | EH KSTE materials – practitioners/policymakers |
| US Environmental Protection Agency  
Mercury information for health care providers  
http://www.epa.gov/  
http://www.epa.gov/mercury/healthcare.htm | EH KSTE products and materials – all audiences |
| US Food and Drug Administration  
http://www.fda.gov/ | EH and OPH KSTE materials – all audiences |
| US National Academy of Sciences, Institute of Medicine  
Damp indoor spaces and health  
http://www.iom.edu/  
http://www.iom.edu/CMS/3731.aspx  
http://www.iom.edu/CMS/3793/4703/20223.aspx | EH & OPH KSTE materials and products – all audiences |
| Vancouver Coastal Health  
http://www.vch.ca/environmental/index.htm | EH KSTE materials – mainly general public |
| Walkerton Reports (Ontario)  
http://www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/ | EH KSTE products – practitioners/policymakers |
| World Health Organization  
http://www.who.int/topics/en/ | EH KSTE products and materials – practitioners/policymakers and general public |
| WHO Regional Office for Europe, Health Evidence Network  
Evidence reports  
http://www.euro.who.int/HEN/syntheses/questiontopage | EH KSTE products – practitioners/policymakers |

**EH** = environmental health  
**OPH** = other public health

For specific examples of EH KSTE products, see also Appendix E.
Needs, Gaps, and Opportunities Assessment
As stated earlier in this report, the function of the NCCEH is to synthesize, translate, and exchange knowledge; identify gaps in research and practice knowledge; and build capacity through networks in environmental health. Our client group includes practitioners who are responsible for delivering environmental health services and programs, and policymakers who are responsible for setting policy related to delivery. The scope of the NCCEH includes environmental health services/programs currently delivered by regional and local health agencies throughout Canada and environmental hazards for which there is reasonable evidence of a potential significant burden of illness in the Canadian population.

Based on the results of the environmental scan, we identified the following current needs, gaps, and opportunities for the NCCEH.

### State of Environmental Health Service/Program Delivery in Canada

A wide variety of environmental health services and programs are delivered through the public health system (see Table 1). These vary between and within provinces and territories, and agencies both within and outside the public health system are involved. For example, drinking water was delivered in all jurisdictions, while noise was delivered in two-thirds of them. Certain aspects of the delivery change over time.

The amount of staff time allocated to delivering services and programs varies between and within provinces and territories as well. For example, for half of the agencies, the time allocated for food or for food and drinking water combined was highest. Still, the amount of time allocated by agencies for each service/program could differ by up to 45%. Several factors determine this allocation, with the most significant being legal mandates, the general public, risk assessments, current issues, and unplanned events.

A number of additional services and programs were identified for delivery within provinces and territories (see Table 3). The top mentions were indoor air, injury prevention, food, and personal services establishments. At the same time, however, limited evidence was cited for effectiveness of delivery of current services and programs (see Table 4). Further, the research knowledge base for current services and programs was not adequate for most participants.

### Needs

Two sets of needs emerged, the first related to environmental health service/program delivery and the second to environmental health KSTE and the NCCEH. Addressing these overlapping needs has the potential to improve the effectiveness of delivery of environmental health services and programs overall.

#### Environmental Health Service/Program Delivery

- **Advanced Training in Environmental Health**
  A scarcity of people with advanced training in environmental health was identified as a factor preventing delivery of additional environmental health services and programs.

- **Evaluation of Effectiveness**
  Due to a lack of evaluation, there is little evidence of effectiveness for environmental health services/programs.
● Research Knowledge Base
As already stated, the research knowledge base for current services and programs was inadequate for most participants. The top mentioned areas of greatest need were: assessments of issues/interventions, food, water, outdoor air, and contaminants.

● Surveillance of Environmental Exposures and Risk Factors
Lack of a comprehensive tracking system was a major barrier to evaluation. More fundamentally, without it risk-based priorities or targets cannot be accurately set.

Environmental Health KSTE and NCCEH

● Environmental Health KSTE
Participants supported the use of scientific studies to develop environmental health policy and practice. They see it as a way to justify decisions and actions, meet a commitment/expectation, and to improve and protect public health.
Participants agreed that the results of the scientific studies could be put into forms that would allow for their increased use in developing policy and practice. These include reviews of evidence for policymakers and evidence-based practices for practitioners.
Many participants had actually taken the results of scientific studies and put them into forms that facilitated their use in policy and practice, while others had not. Similarly, many knew of others who had done this, while others did not.

● NCCEH
All participants agreed with the function of the NCCEH and supported its establishment.

● Evaluation of Effectiveness
A need for the NCCEH to help evaluate intervention programs, compare and benchmark different approaches to evaluation across the country, and make evidence for effectiveness more understandable to others was identified. This was also identified as an environmental health service/program delivery need.

● Capacity
Lack of capacity (especially staff, time, and expertise) to access, assess, and review scientific studies was a factor that hindered their use in developing policy and practice. Again, this was also identified as an environmental health service/program delivery need. Some agencies support the advanced training of their staff, while others do not. The Public Health Agency of Canada and the Canadian Institute of Public Health Inspectors are currently working on core competencies for public health inspectors/environmental health officers, but the initial focus is on entry-level skills.
Not only is there a lack of people with advanced training in environmental health, there are insufficient links between the researchers and those who deliver services/programs at the local, regional, and provincial levels.

● Research and Practice Knowledge Base
Lack of studies relevant to policy and practice and lack of quality studies were additional factors that hindered their use in developing policy and practice. This need was also identified for environmental health service/program delivery. It was further recommended that the NCCEH take the lead in developing strategies that result in the research community addressing the practical questions from front-line practitioners. One preferred strategy may be to make funds available for certain types of research.

● Access to Information
Lack of easy access to studies was another factor that hindered their use. Further, improving access to and sharing information on current research/researchers, practice/practitioners, and policy/policymakers; and facilitating the distribution and production of KSTE products were identified as important.
KSTE Products

A need for documents such as reviews of evidence and evidence-based practices that are written in clear, concise language and useful, relevant, and up-to-date was identified.

Participants recommended a variety of possible KSTE product topics for NCCEH projects (see Table 6). The top ones primarily for use by practitioners include:

- methods and techniques for risk communication with the public;
- approaches to developing air pollution advisories;
- procedures for dealing with mould in schools, and in public buildings;
- investigation of exposure to environmental contaminants;
- safety of ethnic food preparation.

The top topics primarily for use by policymakers include:

- risk assessment of drinking water systems;
- evaluation of the outcome of environmental health programs and interventions;
- estimation of the burden of illness from environmental hazards in Canada;
- housing as a determinant of health;
- surveillance of environmental hazards;
- emergency planning for environmental disasters.

As shown by all of the topics, environmental health professionals are interested in playing a role that goes beyond the traditional areas of policy and practice, and further, would like the NCCEH to support this. It is recognized that multidisciplinary teams of professionals will be required, as well as the involvement of other national collaborating centres.

Gaps in KSTE Products and Activities

Given the needs stated above and what is actually available, we identified the following gaps in KSTE activity.

Generally, there is relatively little KSTE activity in environmental health. Not only does it lag behind public health, public health in turn falls behind the acute care sector in KSTE.

Existing KSTE Products

Although participants identified a variety of examples of documents, only a limited number of those located included both a literature review and recommendations for policy or practice, i.e. were actual KSTE products.

New KSTE Products

In Table 9, the systematic reviews and meta-analyses found in the literature search (evidentiary materials) are matched to those topics that were recommended by participants such as drinking water, food, and air. The systematic reviews/meta-analyses that pertain to Canada were only for food, and they are highlighted in the table.

For drinking water, most of the systematic reviews/meta-analyses examine health effects of chlorinated drinking water and its by-products.

The five systematic reviews/meta-analyses for food that pertain to Canada focus on collective kitchens and evaluating effectiveness of food safety interventions.

For waste, the systematic reviews/meta-analyses pertain to hazardous substances in US Superfund sites, health effects of working/living near incinerators/landfills, and different waste management practices. The majority of them focus on health impacts of exposure to waste systems.

The indoor air systematic reviews/meta-analyses focus on evaluating interventions on dust-mite control for allergies/asthma, and reducing exposure to environmental tobacco smoke. The review by the US Institute of Medicine focuses on damp spaces. No systematic reviews/meta-analyses were found for outdoor air.
### Table 9
KSTE Project Topics and Related Systematic Reviews/Meta-Analyses

<table>
<thead>
<tr>
<th>TOPIC FROM INTERVIEWS</th>
<th>AREA/TOPIC FROM SURVEY</th>
<th>SYSTEMATIC REVIEWS/META-ANALYSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>risk assessment of drinking water systems</td>
<td>literature on contamination issues, biological, minerals and chemicals</td>
<td>• Manganese – Appendix F (reference g)</td>
</tr>
</tbody>
</table>
| assessment of source water protection              | waterborne diseases                                                                    | • Relationship between microbial indicators of recreational water quality and gastrointestinal illness – F (s)  
• Consumption of water from North American backcountry and risk for giardiasis – F (t)  
• Tap water vs bottled mineral water for immunocompromised people – F (u)  
• Prevalence & incidence of Giardia spp. & Cryptosporidium spp. infection in asymptomatic populations in Nordic countries – F (y)  
• Estimation of global illness caused by rotavirus – F (cc) |
| zoonoses                                           |                                                                                         |                                                                                                 |
|                                                   | microbiological updates/information                                                     | • Interventions to improve microbiological quality of drinking water and prevention of diarrhea among children & adults – F (bb) |
|                                                   |                                                                                         |                                                                                                 |
|                                                   | the sources and health implications of chemical contamination of drinking water         | • Chromium (IV) exposure and health hazards – F (x)                                             |
|                                                   |                                                                                         |                                                                                                 |
|                                                   | the new Canadian drinking water arsenic guideline                                       | • US Environmental Protection Agency maximum contaminant level (arsenic) in drinking water evaluation – F (aa)  
• Safety of current water fluoridation standard – F (v) |
|                                                   | testing to include much more than the current coliform and aesthetics guideline info. (i.e. chlorinated compounds, trace elements, all pathogens, etc.) | • Dose of ultraviolet light to inactivate Giardia spp. cysts & Cryptosporidium spp. cysts – F (m) |
|                                                   |                                                                                         |                                                                                                 |
| treatment methods:                                | treatment by-products, pros and cons of various treatment methods                      | • Fluoridation and Down’s syndrome – F (h)  
• Fluoridation and decreased birth rates – F (i)  
• Tap water and spontaneous abortion – F (j)  
• Fluoridation and fracture risk – F (l)  
• Chlorinated drinking water & chlorinated by-products and birth defects – F (n)  
• Drinking water chlorinated by-products and cancer – F (o)  
• Trihalomethanes and bladder cancer – F (p)  
• Chlorinated drinking water and bladder cancer – F (q)  
• 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone in drinking water and cancer – F (dd) |
|                                                   | disinfection                                                                           | • Evaluation of drinking water interventions and diarrheal disease in developing countries – F (a)  
• Interventions at point-of-use and diarrhea or cholera incidence in developing countries – F (d) |
<p>|                                                   | disinfection of well water                                                             | • Drinking well water and risk of Parkinson’s disease – F (w)                                   |
|                                                   | communicating with the general public:                                                 | • Systematic reviews and health risk assessment of exposure to chlorinated by-products – F (z) |
|                                                   | make sense of the literature on disinfection by-products and the risk/benefits for consumers |                                                                                                 |</p>
<table>
<thead>
<tr>
<th>TOPIC FROM INTERVIEWS</th>
<th>AREA/TOPIC FROM SURVEY</th>
<th>SYSTEMATIC REVIEWS/META-ANALYSES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>production and distribution:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pros and cons of encouraging private, regional and home food production. Possibly subsidized</td>
<td></td>
<td>• To improve understanding of current information &amp; continuing gaps in knowledge of collective kitchens in Canada – Appendix G (reference w)*</td>
</tr>
<tr>
<td><strong>handling:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>food safety (home)</td>
<td>• Estimation of % of consumers engaging in risky behaviour relating to consumer food safety knowledge &amp; practice – G (e) • To evaluate research methods used in consumer food safety studies – G (m) • To assess the number of cases of foodborne illnesses (Salmonella, E. coli, Campylobacter) prevented; and to evaluate the cost effectiveness of a disinfection program targeting high-risk food preparation activities in household kitchens – G (u)</td>
<td></td>
</tr>
<tr>
<td>hand washing/hygiene</td>
<td>• Evaluation of hand washing with soap and risk of diarrheal disease in the community – G (a)</td>
<td></td>
</tr>
<tr>
<td><strong>contamination and additives:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ingredients</td>
<td>• Relationship between saccharin use &amp; bladder cancer – G (n) • Relationship between any type &amp; specific types of allergy and risk of pancreatic cancer – G (o), (p) • Relationship between fish &amp; shellfish consumption and thyroid cancer risk – G (q)</td>
<td></td>
</tr>
<tr>
<td>preservatives</td>
<td>• Relationship between maternal intake of cured meats during pregnancy and risk of pediatric brain cancer – G (p)</td>
<td></td>
</tr>
<tr>
<td>nutritional qualities and pollutants in industrial vs organic agriculture</td>
<td>• To assess consumer willingness-to-pay &amp; willingness-to-accept values for genetically modified foods; and to determine effects of characteristics of consumers, methods of value elicitation, &amp; food product characteristics on valuation estimates – G (t)</td>
<td></td>
</tr>
<tr>
<td>impacts of food contaminants (chemical residues, antibiotics, etc.) on human health</td>
<td>• What are likely sources of ochratoxin A present in more than 50% of human blood &amp; serum samples in Germany – G (i) • Are artificial food colorings a risk factor for hyperactivity in children with attention-deficit/hyperactivity disorder – G (j) • To develop the composite benefit-harm curve of fish consumption and a dose-response curve that elucidates the benefit-harm paradox – G (k) • Relationship between cadmium levels in sheep livers &amp; kidneys and cadmium in the food chain – G (l)</td>
<td></td>
</tr>
<tr>
<td><strong>inspections:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HACCP (Hazard Analysis and Critical Control Point)</td>
<td>• Microbiological quality of food in the UK catering &amp; retail premises and relationship to HACCP &amp; hygiene training – G (d)</td>
<td></td>
</tr>
<tr>
<td>standardization of inspections and approaches between different health units/regions</td>
<td>• Prediction of growth kinetics of pathogenic microorganisms in the event of contamination &amp; growth initiation using a relational database associated with quantitative microbiology models – G (f)</td>
<td></td>
</tr>
<tr>
<td>food inspection standards provincially and regionally as well as international perspectives - i.e. what are the safeguards</td>
<td>• Evidence on effectiveness of public health interventions relating to food safety at restaurants, institutions, homes &amp; other community settings – G (b)* • Effectiveness of food safety interventions applicable to public health practice – G (c)* • Effectiveness of food safety interventions in Canada – G (y)* • Recommendations based on critical appraisal of the literature and survey of Canadian jurisdictions on restaurant inspections &amp; education of food handlers – G (2)* • Evaluation of effectiveness of routine restaurant inspections &amp; education of food handlers – G (a)*</td>
<td></td>
</tr>
<tr>
<td><strong>assessment of issues/interventions:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>what are emerging issues</td>
<td>• Critique of Cochrane methodology relating to knowledge synthesis about diet and disease – G (y)</td>
<td></td>
</tr>
<tr>
<td>Topic from Interviews</td>
<td>Area/Topic from Survey</td>
<td>Systematic Reviews/Meta-Analyses</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Procedures for dealing with mould</td>
<td>Indoor air contaminants:</td>
<td>• Evaluation of interventions (acaricides, physical, and combination of the two) for house dustmite control measures for asthma¹</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evaluation of intervention studies on dust-mite allergen and asthma²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do air cleaners have health benefits in allergic disease³</td>
</tr>
<tr>
<td></td>
<td>The importance of moisture control in housing</td>
<td>• Efficacy of humidity control in treatment of chronic asthmatics⁴</td>
</tr>
<tr>
<td></td>
<td>Damp indoor spaces and mould issues</td>
<td>• Discusses the health impact of exposure to damp indoor environments, how &amp; where buildings get wet, how dampness influences microbial growth &amp; chemical emissions, ways to prevent &amp; remediate dampness, and elements of a public health response to the issues. Finds sufficient evidence of an association between damp indoor environments and some upper respiratory tract symptoms – coughing, wheezing, &amp; asthma symptoms in sensitized persons⁵</td>
</tr>
<tr>
<td>Building planning:</td>
<td>Ventilation</td>
<td>• Impact of ventilation on health in non-industrial indoor environments⁶</td>
</tr>
<tr>
<td>Other:</td>
<td>Quality</td>
<td>• The effectiveness of interventions to reduce tobacco consumption in public places⁷</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To identify which intervention strategies were most effective at reducing exposures to ETS⁸</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evaluating interventions directed at people caring for their children and its impact on reducing exposure of children to ETS⁹</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evaluating impact of interventions to modify smoking patterns of smoking mothers and exposure of children in the same household as smoking mothers to ETS¹⁰</td>
</tr>
</tbody>
</table>

ETS = environmental tobacco smoke

<table>
<thead>
<tr>
<th>TOPIC FROM INTERVIEWS</th>
<th>AREA/TOPIC FROM SURVEY</th>
<th>SYSTEMATIC REVIEWS/META-ANALYSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>emergency planning for environmental disasters</td>
<td>emergency response for disasters:</td>
<td>• What are direct &amp; indirect disaster-associated releases; and what are the environmental and adverse human health effects resulting from natural disaster-related hazardous material incidences – Appendix H (reference m)</td>
</tr>
<tr>
<td>Investigation of exposure to environmental contaminants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation &amp; follow-up protocols for elevated blood levels of metals</td>
<td></td>
<td></td>
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<tr>
<td>procedures for dealing with mercury spills in schools/public buildings/apartments</td>
<td></td>
<td></td>
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<tr>
<td>emergency response for white powder incidents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>use of home &amp; garden pesticides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wastewater reuse</td>
<td>waste:</td>
<td>• What are some of the key problem areas that have de-valued the role of health risk assessment in the environmental planning process for waste incinerators – H (f)</td>
</tr>
<tr>
<td>domestic wastewater disposal to marine environment</td>
<td></td>
<td>• Health impacts in populations living in the neighbourhood of waste incinerators – H (a)</td>
</tr>
<tr>
<td>risks from secondary contact recreational water</td>
<td></td>
<td>• Association between residence near hazardous waste landfill sites and adverse health effects – H (b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Health risks associated with municipal waste incinerators – H (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Health effects of waste landfill sites – H (d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Are solid waste management (SWM) workers at an increased risk of contracting vaccine-preventable diseases compared to workers who do not work in SWM – H (e)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Is exposure to sewage associated with a higher risk of Hepatitis A – H (f)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Who are groups at risk of Hepatitis A infection – H (g)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Are sewage/wastewater workers at risk of Hepatitis A – H (h)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Health risks of employees working in sewage treatment plants – H (l)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Health impacts of different methods of waste management systems in England &amp; Wales – H (n)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What are the effects of the Great Lakes environment on human health – H (p)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To draw together scientific findings on incinerator emissions and their impacts on human health – H (f)</td>
</tr>
<tr>
<td>tobacco reduction:</td>
<td></td>
<td>• see Indoor air above</td>
</tr>
</tbody>
</table>

Other topics mentioned include:
- Contaminants: environmental lead studies (soil especially)
- Handling of toxic substances
- Waste: landfill reduction – reduce, reuse, recycle
- Tobacco reduction: tobacco smoke - in the home and the workplace
Opportunities for NCCEH

It is clear that gaps in KSTE products and activities exist. As discussed below, there are exciting opportunities for the NCCEH to bridge those gaps, and by doing so, address the overarching need to improve the effectiveness of environmental health service and program delivery in Canada. The ultimate goal of course is to improve public health.

In response to recommendations from participants, initial plans for the NCCEH include: producing documents such as reviews of evidence and evidence-based practices; monitoring and exchanging information about current policy, practice, and research; establishing secondments/interchanges and practica; developing courses and summer institutes; matching practitioners/policymakers and researchers; and evaluating the work of the NCCEH. Further, the intention of the NCCEH is to avoid duplicating the work of others.

Reviews of Evidence/Evidence-Based Practices

The NCCEH will use the following process to select topics for projects recommended by participants. For some topics, KSTE products may already exist and those who need them could simply be informed. For others, existing KSTE products such as guidelines may not be relevant because, for example, they were developed for a different location or are now out-of-date. Then the evidence synthesis on which the product is based could be adapted. For still other topics, no KSTE products will exist, but related evidentiary material will, and the evidence could be synthesized. And for even more topics, evidentiary material will not exist, and researchers could be informed. The NCCEH could develop the products itself, or facilitate the development by others.

Based in part on the preliminary results of the environmental scan, the NCCEH selected drinking water as a risk factor for human illness as the topic for its first major project. The topic was being rough-rated high by participants and the few systematic reviews that were found were of limited relevance. The NCCEH is in the process of selecting other topics for a number of minor projects from those recommended by participants.

The NCCEH will continue to collaborate with practitioners, policymakers, and researchers throughout its projects. For the major ones, a steering committee including representation from this user group will also be set up. In addition, linkages will continue to be developed and maintained with the Public Health Agency of Canada, the other national collaborating centres, and the NCCEH Advisory Board (see Appendix I).

The following URL links to an example of one type of KSTE product that the NCCEH is considering developing:
http://www.publichealth.nice.org.uk/page.aspx?o=526671.23

Monitoring and Exchanging Information

To facilitate its work, the NCCEH will monitor the activities of other organizations, including those delivering environmental health services and programs (since things can change) and those producing materials and products relevant to environmental health KSTE.

Participants identified the web as a preferred vehicle for exchanging information related to KSTE, for example, topics for research projects. The NCCEH is in the process of developing its website.

Secondments/Interchanges and Practica

The NCCEH plans to offer secondments and interchanges to practitioners/policymakers and researchers. This type of collaboration would allow for mutual learning. In addition, practica will be offered to students enrolled in training and professional programs.

Courses and Summer Institutes

The NCCEH also plans to offer courses and summer institutes to refresh and enhance skills in specific areas for practitioners and policymakers. Researchers and graduate students could also be involved.
Matching Practitioners/Policymakers and Researchers

Service demands can conflict with the research interests of practitioners/policymakers, and some researchers want to do policy/practice relevant research. A national matching service could be set up by the NCCEH to facilitate partnerships between them.

Evaluation of NCCEH

Given our knowledge about effective KSTE, ongoing evaluation and adjustment of the activities of the NCCEH will be critical to its success. In addition to obtaining advice from the Advisory Board and incorporating opportunities for feedback on the website, an environmental scan will be regularly conducted.
Work Plan
We submitted our preliminary 2006-07 work plan to the Public Health Agency of Canada in January 2006, and an updated version based on the final results of our environmental scan follows.

Our work plan includes a major KSTE pilot project on drinking water, a few smaller ones, monitoring/exchanging information, establishing secondments and practica, developing a summer course, matching practitioners/policymakers with researchers, and evaluating the work of the NCCEH.

**Major KSTE Project**

Small water systems have been identified as a problem and a priority across Canada in terms of waterborne illness. The purpose of this project is to improve our understanding of drinking water as a risk factor for human illness in Canada. Our approach essentially involves “retrospective surveillance,” i.e., to enumerate identified water borne illness in Canada for the past 35 years and identify water system risk factors associated with those illnesses. We will strive for completeness, including a “systematic review” of experience so that we can learn from experience. A project steering committee comprised of practitioners/policymakers and researchers will be set up and will be involved throughout the project. We are discussing with the other national collaborating centres opportunities for collaboration.

Our overall goal is to determine how we can use evidence to improve the effectiveness of policy and practice in managing Canadian drinking water. Our approach involves: engaging the relevant practitioners/policymakers from start to finish in KSTE; involving researchers; identifying gaps in knowledge and priorities for further research; building networks; and generally increasing capacity.

**Next Steps**

The next steps include: revising and developing a detailed work plan for the NCCEH, developing an organizational structure, and beginning/moving forward on our projects. The plan is intended to reflect the priorities of environmental health practitioners/policymakers, and to build a national network of practitioners/policymakers and researchers. Collaboration is fundamental to success.
References


See also appendices F-H and tables 8-9 (Indoor air).
Appendices
Appendix A: Interview Questions

Policymaker and Practitioner Interviews

Instructions for interviewers are in italics.

Briefly describe the NCCEH and the NCCEH Development Project.

1. What environmental health services and programs does the public health system in [province/territory/your jurisdiction] deliver? Keep track of services/programs mentioned. For example:
   - food, drinking water, recreational water, wastewater; indoor air, outdoor air; solid waste, sewage, public buildings [e.g. schools], tobacco reduction, odour, animal & nuisance control, noise, injury prevention, emergency response for disasters, community development & land use planning, radiation, personal services establishments, zoonosis, and disease surveillance.

See appendix for information found on the web about the programs/services that are delivered in each province/territory/jurisdiction.

2. What percentage of staff time is allocated to each of these services and programs? What are the factors that determine this allocation?

   For each service/program not mentioned in question 1, ask:

3. You didn’t mention [service/program]. Who delivers it in [province/territory/your jurisdiction]?

4. Are there other environmental health services or programs that you would like to deliver but can’t? If so, which ones? What prevents you?

5. Is there evidence supporting the effectiveness of the delivery of your environmental health services and programs? If so, for which ones? What kinds of evidence?

6. Do you use the results of scientific studies in developing policy and practice for environmental health? How often (never, some of the time, most of the time, always)? If so, why? What prevents you from using the results more often?

Prompt/probe: studies could include those from the natural, applied, social sciences.

7. Is there an adequate base of research knowledge for your current programs and services? What are the areas of greatest need?

8. Could the results of scientific studies be put into forms that would allow for their increased use in developing policy and practice for environmental health? If so, what kinds of forms? For what services and programs? If not, why not?

Prompt/probe: forms could include so-called reviews of evidence for policy-makers, best practice guidelines for front-line practitioners.

After the interviewee answers the above questions, ask:

What does the term “best practices” mean to you?

9. Have you or others in your organization put the results of scientific studies into a form that allowed for their increased use in developing policy and practice for environmental health? If so, what type of form? For what purpose? Could the documents be made available with credit through the NCCEH?

10. Do you know of others who have put the results of scientific studies into such forms? If so, who? For what purpose?

11. How could the NCCEH help increase the use of the results of scientific studies in developing policies and practice for environmental health?

Give list of possible NCCEH projects to interviewee and ask:

12. Based on our interviews to date, we’ve compiled a list of possible NCCEH projects. How would you rate them in terms of high, medium, or low priority? Why?

If the interviewee says a project has already been done, then ask:

Do you recall the title of the related document and when it was drafted?


14. How would you like to communicate with the NCCEH? About what kinds of things?

15. Are there any other organizations or individuals we should contact for input?

16. Do you have any other advice to offer the NCCEH about knowledge translation?

17. The NCCEH will have an advisory board of policy-makers, practitioners, and researchers in various disciplines from across Canada. Is there anyone you would recommend as a member?
Researcher Interviews

Instructions for interviewers are in italics.

Briefly describe the NCCEH and the NCCEH Development Project.

1. What types of environmental health-related research do you carry out? Are your results relevant to policymakers and practitioners who deliver environmental health services and programs?

2. Is your research used by environmental health policymakers and practitioners who deliver environmental health services and programs? If so, who uses it? And how?

3. Are there barriers to the increased use of your research by environmental health policymakers and practitioners who deliver environmental health services and programs?

4. Have you or your colleagues taken the results of scientific studies and put them into a form that facilitated their use by environmental health policymakers and practitioners who deliver environmental health services and programs? If so, for what purpose? Could the results be made available with credit through the NCCEH?

5. Do you know of others who have taken the results of scientific studies and put them into a form that facilitated their use by environmental health policymakers and practitioners who deliver environmental health services and programs? If so, who? For what purpose?

6. How could the NCCEH help increase the use of the results of scientific studies by environmental health policymakers and practitioners who deliver environmental health services and programs?


8. How would you like to communicate with the NCCEH? About what kinds of things?

9. Are there any other organizations or individuals we should contact for input?

10. Do you have any other advice to offer the NCCEH about knowledge translation?

11. The NCCEH will have an advisory board of policymakers, practitioners, and researchers in various disciplines from across Canada. Is there anyone you would recommend as a member?
Appendix B: Interviewees and Discussants

Jodi Abbott
Mark Allen
Pierre Ayotte
Pierre Band
Nicholas Bayliss
Lucy Beck
Michele Belanger
Christine Bender
John Blatherwick
Daniel Bolduc
Joe Bradley
Mike Brauer
Jerry Capko
Michel Charbonneau
Ken Christian
Donald Cole
Larry Copeland
Louis Corkery
Ron de Burger
Jim Dosman
Jim Drew
Louis Drouin
Ron Duffell
Grace Egeland
Don Feldman
Nelson Fok
John Frank
Gary Gallivan
Paul Glover
Mark Goldberg
Pierre Gosselin
Richard Gould
Yvonne Graff
Judy Guernsey
Paul Hasselback
Teresa Hennebery
Patricia Hoes
Bill Hohn
Mike Horwich
Steve Hruday
Shauna Hudson
Robert Jin
Darryl Johnson
Kersteen Johnston
Kami Kandola
Susan Kennedy
Joel Kettner
Claudia Kurzac
Jamie Lafontaine
Richard Lawrence
Roger Ledrew
Bill Leiss
Nic Losito
Linda Lusby
Tim Macaulay
Mike Macfarlane
Alex MacKenzie
Jack MacKinnon
David MacLean
Jim Mattison
Steve McColl
Heather McCormack
Paul McCue
Karen McDonald
Kevin McLeod
John Millar
Gordon Mowat
Cameron Mustard
Craig Nowakowski
Gary O’Toole
Andrew Papadopoulos
Paula Pasquali
David Pengelly
Ian Pike
Jim Popplow
Doug Powell
Gerry Predy
Gloria Rachamin
Marc Rhaiands
Lynn Richards
Ann Roberts
Don Rocan
Mike Routledge
Fred Ruf
Theresa Schumilas
Klaus Seeger
Tim Shum
Isaac Sobal
Rick Sokolowski
Ralph Stanley
Craig Stephen
Doris Stus
Manju Su
Tim Takaro
Ann Thomas
Claude Tremblay
Bruce Trotter
Hu Wallis
Lorraine Woolsey
Huiming Yang
Appendix C: Survey

Introduction

Please complete this survey by January 31, 2006.
Click "Next" to get started. If you want to leave at any time, click "Exit this survey." Your answers will be saved.

Definition

Examples of environmental health programs and services delivered by Public Health include:
Food, Drinking Water, Recreational Water, Wastewater, Indoor Air, Outdoor Air, Solid Waste, Sewage, Public Buildings (e.g. schools), Tobacco Reduction, Odour, Animal & Nuisance Control, Noise, Injury Prevention, Emergency Response for Disasters, Community Development & Land Use Planning, Radiation, Personal Services Establishments, Zoonosis (diseases transmitted from animals to humans), and Disease Surveillance.

Demographic

1. Are you affiliated with any organization? If so, which one?
2. What are the first three letters/numbers of your postal code?

Effectiveness of Services and Programs

3. Is there evidence supporting the effectiveness of environmental health programs and services delivered in the community where you live? If so, for which ones? What kinds of evidence?

Knowledge Translation

4. Could the results of scientific studies be put into forms that would allow for their increased use in developing policy and practice for environmental health? If so, in what form? For what purpose? Could the documents be made available with credit through the NCC-Environmental Health?
5. Have you or others in your organization put the results of scientific studies into a form that allowed for their increased use in developing policy and practice for environmental health? If so, in what form? For what purpose? Could the documents be made available with credit through the NCC-Environmental Health?
6. Do you know of others who have put the results of scientific studies into such forms? If so, who? For what purpose?

Possible Knowledge Translation Products

We are looking for subjects or topics for knowledge translation products.
7. What are your top 3 suggestions related to Food?
8. What are your top 3 suggestions related to Drinking Water?
9. What are your top 3 suggestions related to Indoor Air?
10. What are your top 3 suggestions related to Outdoor Air?
11. What are your top 3 suggestions related to other environmental program/service areas?

Other Comments

12. Do you have any other advice for the NCC-Environmental Health?

Thank you

Thank you for completing our survey.
If you know of anyone with an interest in environmental health programs and services, please tell them about our website and survey.

Ray Copes, MD
Christina Chociolko, PhD
Jo Rekart, PhD
Brian Copley
Appendix D: Literature Search

The following databases were searched:

- PubMed
- Medline
- Embase
- CINAHL
- AGRICOLA
- Biosis
- Cochrane & Campbell Collaboration
- Database of Abstracts of Reviews and Effects
- ERIC
- EBSCO databases
- Environmental Science and Pollution Management
- EnvironetBase
- Food Science and Technology
- Web of Science

The following MeSH® (Medical Subject Headings) and keyword search terms were used:

- for drinking water: (1) tap water (explode), (2) household water (explode), (3) public or municipal water (explode), (4) water supply (explode), (5) #1 or #2 or #3 or #4 or #5, (6) gastrointestinal illness or disease (explode), (7) diarrhoea or diarrhoea (explode), (8) gastroenteritis (explode), (9) #6 or #7 or #8, and (10) #5 and #9
- for food: (1) food (explode), (2) foodborne disease (explode), (3) food preparation (explode), (4) food manufacturing (explode), (5) food catering (explode) (6) food microbiology (explode), (7) food contamination (explode), (8) food contaminant (explode) #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8, (9) health effects (explode), (10) food poison (explode), (11) foodborne illness or disease (explode), (12) #9 or #10 or #11, (13) #8 and #11
- for waste: (1) incineration (explode), (2) landfills (explode), (3) waste incineration (explode), (4) refuse or waste disposal (explode), (5) waste (explode), (6) solid waste (explode), (7) liquid waste (explode), (7) sewage (explode), (8) medical or infectious waste (explode), (9) hazardous waste (explode), (10) chemical waste (explode), (11) waste emissions (explode), (12) wastewater (explode), (13) #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12, (14) health effects (explode), (15) exposure (explode), (16) #14 or #15, (16) #13 and #16
Each of the following documents identified by interviewees and survey respondents includes a literature review and recommendations for policymakers and practitioners.

- Ardel J. An evidence paper: the core components of a recreational water management program for British Columbia (undated).
- Durocher J. Your patients are exposed to second-hand smoke... Direction de santé publique de Montréal in collaboration with the Association des médecins omnipraticiens de Montréal; 2003 Apr. Available from: URL: http://www.santepub-mtl.qc.ca/Publication/pdf/ppm/ppmmay2005.pdf
- Health professionals update: sodium in communal well water supplies, town of Caledon (draft). Region of Peel (undated).


• Wilcott L, Cooper K, Taki R, Kerr A, Beck L, Shum T. The evidence base for a core program in food safety (undated).


## Appendix F: Summary and Appraisal of Systematic Reviews/Meta-Analyses on Drinking Water

<table>
<thead>
<tr>
<th>REVIEW QUESTION</th>
<th>METHODS</th>
<th>AUTHORS CONCLUSIONS</th>
<th>CONTEXT OF STUDIES REVIEWED</th>
<th>EVIDENCE OF BIAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do improvements in drinking water, sanitation facilities and hygiene practices reduce the risk of diarrhoeal illness? (a)</td>
<td>Reviewed 46 articles with specific measurement of diarrhoea morbidity as a health outcome in non-outbreak conditions.</td>
<td>All interventions studied found to significantly reduce the risk of diarrhoeal illness. Water quality interventions (point-of-use water treatment) found to be more effective than previously thought. Multiple interventions (combined water, sanitation, and hygiene measures) were not more effective than interventions with a single focus.</td>
<td>Focus on developing countries.</td>
<td>Publication bias in the findings from the hygiene and water treatment interventions.</td>
</tr>
<tr>
<td>Do point-of-use water quality interventions affect health outcomes? 2 health outcomes of interest: general diarrhoea and cholera. (b)</td>
<td>2 categories of studies included: (i) 16 observational studies relating microbiological indicators of water quality at point-of-use to health outcomes (general diarrhoea and/or cholera); (ii) 12 intervention studies assessing the effect of changes in water storage and/or treatment on health outcomes.</td>
<td>Observational studies relating microbiological indicators of water quality at point-of-use to health outcomes showed: (i) no significant association between the indicator bacteria (E. coli &amp; thermo-tolerant coliforms) and general diarrhoea; (ii) significant association between V. cholerae in point-of-use drinking water and cholera among subjects. Intervention studies showed that interventions involving water treatment or improved storage have successfully prevented cholera.</td>
<td>Studies included in the review were undertaken in 16 countries. SE Asia showed the greatest number of studies.</td>
<td>Neither study participants nor field workers were blinded in the intervention studies reviewed.</td>
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<td>To assess the extent and causes of microbiological contamination of household drinking water between source and point-of-use in developing countries. (c)</td>
<td>57 observational studies reviewed. Studies were restricted to: (i) field studies; (ii) where water is transported from a source outside the home and stored within the household; and (iii) microbiological measures of contamination (total coliform, faecal coliform &amp; E. coli).</td>
<td>Significant variation between settings but approx half of the observational studies identified significant contamination after collection. There were no instances where microbiological quality improved significantly after collection. The decline in water quality between source and point-of-use is proportionately greater where source water is largely uncontaminated, indicating the need for safer household storage intervention. Covering of water containers lowered the risk of water contamination at point-of-use.</td>
<td>Focus on developing countries.</td>
<td>2 types of systematic bias – subjects changing their behaviour according to where they took their source water and subjects being unwilling to admit if they were using waters from unprotected sources.</td>
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<td>REVIEW QUESTION</td>
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| What are the causes of deaths in children aged < 5 years in developing countries (sub-Saharan Africa and South Asia) without adequate vital registration systems? (d) | 46 studies reviewed.  
Outcome measure: proportion of deaths in children under-5 in national populations of known size and characteristics. | Proportional under-5 deaths were significantly associated with region, mortality level, and exposure to malaria; coverage of measles vaccination, safe delivery care, and safe water; study year, age of children under surveillance, and method used to establish definitive cause of death. Predicted distribution of death by cause in sub-Saharan Africa and South Asia was: pneumonia (23% and 23%), malaria (24% and < 1%), diarrhea (22% and 23%), neonatal and other (29% and 52%), measles (2% and 1%). | Sub-Saharan Africa and South Asia. | Misclassification bias resulting from causes of death established using verbal autopsy methods not being consistent with diagnosis-based/clinical data.  
Coefficients in regression model biased from characteristics of the study population or study design not being included and causing confounding.  
External validation was not possible. |
| To evaluate the effects of interventions that promote hand washing on diarrhoeal episodes in children and adults. (e) | Protocol | | | |
| To assess interventions to improve the microbiological quality of drinking water on preventing diarrhea among children and adults. (f) | Protocol | | | |
| To quantify potential human central nervous system (CNS) exposure to manganese (Mn) from showering. (g) | 99 articles referenced – animal experimental investigations, human epidemiological studies, & consensus & governmental reports considered. Extrapolation to humans from 1 animal dose-response study, 355 websites reviewed. | During a decade of showering in Mn-contaminated water, models for children & adults (extrapolating from animal studies) show higher doses of aerosolized Mn (3-fold & 112-fold greater, respectively) than doses reported to cause Mn brain deposition in rats.  
Conclusions: Long-term shower exposure to Mn-laden water may pose a significant risk for CNS neurotoxicity via olfactory uptake in up to 8.7 million Americans. If results are confirmed, regulatory agencies must rethink existing Mn drinking water standards. | Note: Exposure via inhalation not considered in US EPA standard for Mn.  
Extrapolation to humans from 1 animal dose response study.  
Limitations inherent in cross-species extrapolation. |
| Is water fluoride a risk factor for Down’s syndrome? (h) | All study designs which compared the incidence of Down’s syndrome with different levels of fluoride in their water supply included. 6 studies – ecological in design – were included. | The evidence of an association between water fluoride level and Down’s syndrome incidence is inconclusive.  
1 study – UK-based.  
5 studies – US-based. | Insufficient data was available to investigate publication bias using funnel plots. |
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<tr>
<td>Is exposure to high fluoride concentrations in drinking water associated with decreased birth rates? (i)</td>
<td>US database of drinking water systems used to identify index counties with fluoride levels of at least 3 ppm. Outcome measure: annual total fertility rate (TFR) for women aged 10-49 for the period 1970-1988.</td>
<td>Data confirmed that exposure to high fluoride concentration in drinking water is associated with decreased birth rates.</td>
<td>US-based.</td>
<td>No evidence that outcome resulted from selection bias, inaccurate data, or improper analytical methods. Exposure and TFR based on population means rather than data on individual women.</td>
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<td>Is drinking tap water related to spontaneous abortion? (j)</td>
<td>5 retrospective studies conducted 1982-1988 using databases from the California Dept of Health Services (that included questions on prenatal water consumption). Outcome measure: spontaneous abortion during 1st trimester.</td>
<td>Women abstaining from tap water during the 1st trimester of pregnancy may be at reduced risk of spontaneous abortion.</td>
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<td>To review the safety and efficacy of drinking water fluoridation. (k)</td>
<td>214 studies from published and unpublished sources reviewed. (45 controlled before and after studies, 102 cross-sectional studies, 47 ecological studies, 13 prospective and retrospective cohort studies, 7 case-control studies) Main outcome measures: Caries - decayed, missing, and filled primary/ permanent teeth &amp; proportion of children without caries. Measure of effect was the difference in change in prevalence of caries from baseline to final examination in the fluoridated area compared with control areas in children of the same age. Other health effects: dental fluorosis (88 studies); cancer (26 studies) other health effects such as Down’s syndrome, mortality, senile dementia, goitre, &amp; IQ (32 studies).</td>
<td>Water fluoridation was associated with an increased proportion of children without caries and a reduction in the number of teeth affected by caries. The range (median) of mean differences in the proportion of children without caries was -5.0% to 64% (14.6%). The range (median) of mean change in decayed, missing, and filled primary/permanent teeth was 0.5 to 4.4 (2.25) teeth. A dose dependent increase in dental fluorosis was found. 12.5% (95% CI = 7% to 21.5%) of people exposed to a fluoride level of 1 ppm would have fluorosis that they would find aesthetically concerning. Conclusions: The evidence of a beneficial reduction in caries should be considered together with the increased prevalence of dental fluorosis. There was no clear evidence of other potential adverse effects.</td>
<td></td>
<td>Observer bias in studies that assessed fluorosis. Prevalence of fluorosis likely overestimated because enamel opacities not caused by fluoride may be included. All study areas had at least a small amount of fluoride in the water, in addition to fluoride from other sources.</td>
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<td>Is water fluoridation associated with altered fracture risk at a population level? Are the differences between studies consistent with confounding or chance variation between studies? (l)</td>
<td>18 studies reviewed. 2 outcome measures: (a) Fracture incidence - (relative risk (RR) with 95% confidence) was the primary outcome measure. (b) Bone mass was based on (i) difference in bone mass between the exposed and unexposed groups expressed in either percentage difference or number of standard deviations difference or (ii) odds of osteoporosis diagnosis in the 2 groups.</td>
<td>Water fluoridation had no evident effect on fracture risk (RR=1.02, 95% CI = 0.96-1.09). There was marked heterogeneity between studies which could be explained, in part, by the combination of gender, urbanicity, and study quality. Conclusions: Water fluoridation at levels aimed at preventing dental caries, and possibly at higher naturally occurring levels, appears to have little effect on fracture risk, either protective or deleterious, at a population level. The small effect on bone mass seen in studies performed at the individual level is consistent with this finding. Variation between studies is also likely to be due to differences in the distribution of other recognized fracture risk factors between different populations. Confirmation of these findings is required in large studies performed at the individual level.</td>
<td>US (12 studies), Finland (3), Taiwan (1), France (1), Canada (1).</td>
<td>Studies were generally of poor quality regarding comparability of exposed vs non-exposed subjects. Misclassification bias inherent in ecological studies (of exposure and covariates).</td>
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<td>What dose of ultraviolet (UV) light is needed to inactivate Giardia spp. cysts and Cryptosporidium spp. oocysts? (m)</td>
<td>5 studies with Giardia data and 9 with Cryptosporidium data reviewed. Studies used bench-scale experimental design and included low pressure (LP) mercury lamps as the UV source to ensure the data were comparable. Outcome measure: log inactivation or 3 log inactivation.</td>
<td>Bayesian hierarchical model comparison and model averaging showed that at a risk level of 5%, a UV dose between 8 and 14 mJ/cm² is needed to inactivate at least 99.9% Cryptosporidium spp oocysts, and a UV dose between 12 and 20 mJ/cm² is necessary to achieve at least 3 log inactivation of Giardia spp. cysts.</td>
<td>Work was supported by US EPA.</td>
<td>Results presented were derived from laboratory experimental studies. UV light for drinking water disinfection is not common in the US – therefore bias resulting from small number of studies.</td>
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<td>Does exposure to chlorinated drinking water and chlorinated by-products have an affect on birth defects? (n)</td>
<td>5 studies reviewed. Outcome measures: any birth defect, neural tube defects, cardiac defects, respiratory system defects, oral cleft defects, and urinary system defects.</td>
<td>Consistent evidence indicating that exposure to chlorination by-products has an effect on any birth defect – in particular neural tube and urinary system defects. Effect estimates for cardiac, respiratory system &amp; oral cleft defects were inconsistent (heterogeneous) although some indication of increased risk was present.</td>
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<td>Relatively small number of studies reviewed. Exposure assessment based on routine monitoring of water quality by waterworks and on mother’s place of residence rather than information on complex mixture of by-products consumed during pregnancy.</td>
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<td>Is there a relation between chlorination by-products in drinking water and cancer? (o)</td>
<td>10 case-control and 2 cohort studies reviewed. Outcome measure: bladder and rectal cancer.</td>
<td>Meta-analysis demonstrated a positive association between consumption of chlorination by-products in drinking water and bladder and rectal cancer. Estimates of relative risk did not change substantially when studies that adjusted for potential confounders were pooled separately.</td>
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<td>Is there a relation between chlorination by-products (using trihalomethanes as a marker) in drinking water and bladder cancer risk? (p)</td>
<td>6 case-control studies reviewed.</td>
<td>There was an adjusted odds ratio (OR) of 1.24 in men exposed to an average of more than 1 µg/L (ppb) trihalomethanes compared with those who had lower or no exposure (95% CI = 1.09 – 1.41). Estimated relative risk also increased with increasing exposure, with an OR of 1.44 (1.20 – 1.73) for exposure higher than 50 µg/L (ppb). Trihalomethane exposure was not associated with increased cancer risk among women (OR=0.95, 95% CI = 0.76 – 1.20).</td>
<td>US (2 studies), Canada (1), Italy (1), Finland (1).</td>
<td>Publication bias was not formally tested because of the small number of studies reviewed.</td>
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<td>Is there a relation between individual consumption of chlorinated drinking water and bladder cancer? (q)</td>
<td>6 case-control and 2 cohort studies reviewed.</td>
<td>Consumption of chlorinated drinking water is associated with a moderate excess risk for bladder cancer for both men and women. For both sexes there was a clear excess risk observed among subjects consuming chlorinated drinking water for more than 40 years. Risk estimate for the intermediate exposure category (20 years) was only slightly increased but statistically significant.</td>
<td>Of the 6 case control studies, 1 was Finnish and 5 were US-based. Both cohort studies were US-based.</td>
<td>No evidence of publication bias tested using Egger’s graph. Publication bias in the models stratified by sex could not be tested because of the small number of studies.</td>
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<td>To assess the effects of water compared to other solutions for wound cleansing. (r)</td>
<td>3 studies reviewed.</td>
<td>Lack of standardized criteria for assessment of wound infection across studies prevented pooling of data. Wound cleansing with tap water associated with a lower rate of infection than saline. No statistically significant differences in infection rates when wounds were cleansed with tap water or not cleansed at all. No difference in the infection rate in wounds cleansed with water or procaine and those cleansed with isotonic saline, distilled, and boiled water. Tap water should be considered for use. Boiled, cooled and distilled water can be used in the absence of potable tap water.</td>
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<td>Is there a relation between microbial indicators of recreational water quality and gastrointestinal illness (GI)? What is the potential for GI illness when microbial indicators are below current guidelines? (s)</td>
<td>27 studies reviewed.</td>
<td>Trend toward increasing relative risk for GI illness for all indicators with the strongest trend associated with enterocci, supporting US EPA enterocci guidelines in marine water. In fresh water, E. coli are a more consistent predictor of GI illness than are enterocci and other bacterial indicators; fecal coliforms are not. Risk of GI illness considerably lower in studies with indicator densities below guidelines proposed by US EPA.</td>
<td>Study carried out jointly by EPA and School of Public Health, U of California - Berkeley.</td>
<td>Considerable heterogeneity between studies reported. Begg and Madachhanda statistical test indicate publication bias and likely overestimate of summary relative risks.</td>
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### Needs, Gaps, and Opportunities Assessment for the National Collaborating Centre for Environmental Health

**Appendices**

**Review Question Methods Authors Conclusions Context of Studies Reviewed Evidence of Bias**

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<td>Does consumption of water from North American backcountry sources pose a statistically significant risk for giardiasis? (t)</td>
<td>9 studies reviewed. Outcome measure: waterborne disease.</td>
<td>The association between drinking backcountry water and giardiasis is not statistically significant. This result, together with the high incidence of giardiasis among outdoor recreationalists, suggests that further studies should separate drinking water risk factors from other risk factors contributing to giardiasis in this population.</td>
<td>North American-based. English language.</td>
<td>Publication bias not discussed. Heterogeneity among studies not discussed.</td>
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<td>Should immunocompromised patients drink tap water rather than bottled mineral water? (u)</td>
<td>35 articles reviewed. Outcome measure: gastroenteritis.</td>
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<td>Germany, Central &amp; NW Europe, US, and Canada.</td>
<td>Article not accessed to examine publication and other bias.</td>
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<td>Is the current standard on water fluoridation (1 ppm) safe? (v)</td>
<td>33 studies reviewed, including animal studies. Outcome measure: effects on bone.</td>
<td>Animal studies showed adverse effects at doses much greater than those currently used in artificial water fluoridation. Human studies showed that fluoride at up to 1 ppm does not have an adverse effect on bone strength, bone mineral density, or fracture incidence.</td>
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<td>Is there a relation between Parkinson’s disease and exposure to environmental factors (living in a rural area, well water use, farming, exposure to farm animals, living on a farm, pesticides)? (w)</td>
<td>58 case-control studies reviewed: 16 (living in a rural area), 18 (drinking well water), 11 (farming), &amp; 14 (pesticides exposure). Outcome measure: Parkinson’s disease.</td>
<td>For all studies performed in the US: Combined odds ratio (OR) for rural residence was 1.56 (95% CI = 1.18-2.07) and 2.17 (1.54-3.06); Combined OR for well water use was 1.26 (0.97-1.64) and 1.44 (0.92-2.24); Combined OR for farming, exposure to farm animals, or living on a farm was 1.42 (1.05-1.91) and 1.72 (1.20-2.46); Combined OR for pesticide exposure was 1.85 (1.31-2.60) and 2.16 (1.95-2.39). Findings suggested a small but significant elevation in the risk of Parkinson’s disease in individuals living in a rural area, exposed to farm animals/farming or living on a farm, and exposure to pesticides.</td>
<td>US (9 studies), Spain (2), Canada (2), Italy (3), China (2), Taiwan (1), Hong Kong (1), Australia (1).</td>
<td>Reports no evidence of publication bias. Combined estimates by place were significant for studies conducted in the US. Rural living, farming, drinking well water, and pesticide exposure are closely linked and inter-related – this is not dealt with in the analysis. Significant heterogeneity detected among studies.</td>
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<td><strong>What is the possible health hazard associated with exposure to chromium (VI) (Cr(VI)) in tap water via ingestion, inhalation, and dermal exposure?</strong> (x)</td>
<td>9 studies reviewed including 7 dose reconstruction or simulation studies (quantitatively characterizing the absorbed dose of Cr(VI) following exposure via all routes) involving human volunteers. Outcome measure: red blood cell uptake and sequestration of chromium as an in vivo metric of Cr(VI) absorption.</td>
<td>Oral exposure to concentrations of Cr(VI) in water up to 10 mg/L (ppm) does not overwhelm the reductive capacity of the stomach and blood. Inhaled dose of Cr(VI) associated with showering, at concentrations up to 10 mg/L is so small as to pose a de minimis cancer hazard. Dermal exposure to Cr(VI) in water at concentrations as high as 22 mg/L does not overwhelm the reductive capacity of the skin or blood. Physiologically based pharmacokinetics, coupled with the dose reconstruction studies, indicate that Cr(VI) ingested in tap water at concentrations &lt; 2 mg/L is rapidly reduced to Cr(III), and that even trace amounts of Cr(VI) are not systematically circulated. Exposure to Cr(VI) via all routes of exposure, at concentrations &gt; US EPA MCL of 100 µg/L (ppb) should not pose an acute or chronic hazard to humans – the US EPA MCL of 100 µg/L (ppb) clearly contains a significant margin of safety for preventing both acute and chronic health effects. These conclusions are consistent with those recently reached by a panel of experts convened by the State of California.</td>
<td>US-based.</td>
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<td><strong>What is the prevalence and annual incidence of Giardia spp and Cryptosporidium spp. infections in asymptomatic and symptomatic human populations in Nordic countries?</strong> (y)</td>
<td>13 studies reviewed. Outcome measure: Giardia spp. and Cryptosporidium spp. prevalence (% prevalence: 95% confidence limits).</td>
<td>Giardia cases in the asymptomatic general population estimated at 2.97% (2.64: 3.31); symptomatic population at 5.81% (5.34: 6.30). The prevalence for Cryptosporidium was 0.99% (0.81: 1.19) and 2.91% (2.71: 3.12) respectively. There will be 4670 (4300; 5060) symptomatic cases of Giardia and 3340 (3110; 3580) symptomatic cases of Cryptosporidium annually per 100,000 general population in the Nordic countries. The vast majority will remain unregistered in the national registers of infectious diseases – for each registered case there will be 254-867 cases of Giardia undetected/registered and 4072 to 15,181 cases of Cryptosporidium undetected/registered.</td>
<td>Denmark, Finland, Norway, and Sweden.</td>
<td>Fundamental differences in surveillance and reporting systems used in these countries. Similarities and differences between them not dealt with in the analysis.</td>
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<td>Are systematic review methods useful for combining human and animal data in human health risk assessment of exposure to environmental chemicals (using low birth weight and exposure to chlorinated by-products [trihalomethanes as an example])? (2)</td>
<td>13 studies reviewed (5 epidemiological, 8 toxicological). Outcome measure: low birth weight.</td>
<td>Bayesian meta-analysis to synthesize dose–response slope estimates allows for expert judgment on the relevance of toxicological data to epidemiological data. Bayesian meta-analysis allows for sensitivity analysis, and forces and facilitates explicit acknowledgement and description of assumptions incorporated in the chosen model. Systematic review incorporating sensitivity analyses should be used in synthesis of evidence for chemical risk assessment and environmental standard setting.</td>
<td>Focus on using a systematic review and Bayesian meta-analysis to assess human health risk.</td>
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<td>To evaluate the former US EPA MCL of arsenic (0.05 mg/l) in drinking water using systematic review/meta-analysis methods. (aa)</td>
<td>4 studies reviewed. Outcome measure: occurrence of skin cancer in Taiwan.</td>
<td>Likelihood ratio approach shows that the previous EPA cancer risk assessment model for ingested arsenic is not applicable even in Taiwan – the source country that provided the data for the risk assessment. Previous EPA cancer risk assessment model cannot generate accurate risk estimates for low-dose exposures, and tended to overestimate risk in the low-dose region. New MCL of 0.01 mg/l (0.01 ppm) should be validated using meta-analysis and power calculation methods.</td>
<td>EPA MCL for arsenic–focused.</td>
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<td>To assess the effect of antibiotics on the duration of diarrhea as a result of cryptosporidiosis among immunocompromised patients. (bb)</td>
<td>Protocol</td>
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<td>To estimate the global illness and deaths caused by rotavirus disease. (cc)</td>
<td>154 studies reviewed. Outcome measure: rotavirus-associated illness in 3 clinical settings: mild cases requiring home care alone, moderate cases requiring a clinic visit, and severe cases requiring hospitalization; and death rates in countries in different World Bank income groups.</td>
<td>Each year, rotavirus causes approx 111 million episodes of gastroenteritis requiring only home care. 25 million clinic visits, 2 million hospitalizations, and 352,000-592,000 deaths (median 440,000 deaths) in children &lt; 5 years of age. By age 5 nearly every child will have an episode of rotavirus gastroenteritis, 1 in 5 will visit a clinic; 1 in 65 will be hospitalized, and approx 1 in 293 will die. The incidence of rotavirus disease is similar in children in both developed and developing nations. However, children in developing nations die more frequently, accounting for 82% of rotavirus deaths.</td>
<td>English language studies 1986-2000. Study locations include Central and South America, US, Europe, Australia, Pacific Islands, Africa, Asia, Israel, Arab nations.</td>
<td>Limitations stem from a compilation of studies varying in design, time and place. Diarrhoea mortality studies used verbal autopsy to determine cause of death – variable sensitivity and specificity likely affected estimates. Assumptions made regarding mortality patterns.</td>
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To discuss the evidence of the carcinogenicity of 3-Chloror-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (or mutagen X (MX)).

Covers the following topics:

a) identity of MX & its occurrence in drinking water
b) reviews data on carcinogenicity studies in traditional & transgenic animal models
c) pharmacokinetics & metabolism of MX & structure-activity relationships
d) mechanisms of genotoxic & carcinogenic action
e) cancer potency estimates for MX and health effects.

Review of carcinogenicity studies of MX in traditional & transgenic animal models, MX-induced DNA damage observed in in-vitro & in-vivo tests, epidemiological studies.

Identity & occurrence
MX forms as a by-product from reactions of chlorine & humic acid material present in raw water.

MX concentrations significantly decreased by use of chloramination instead of chlorination, significantly increased with increasing dose of chlorine and increasing levels of total organic carbon. Factors that did not affect MX concentrations included use of activated carbon, aluminum sulfate, residual chlorine concentration, turbidity and pH.

MX carcinogenicity
More potent than other chlorination by-products in causing cancer in animals – induced cancer at multiple sites in male & female rats, acted as a tumour initiator and promoter, enhanced tumour yields in genetically modified rodents, induced a myriad of genotoxic effects in numerous in vitro & in vivo test systems, and was a potent inhibitor of gap junction intercellular communication.

Precise mechanism of MX-induced DNA damage is not known but it is thought to cause DNA damage through an unusual mechanism of ionizing DNA bases due to its extremely high reductive potential. MX may also cause mutations through DNA adduction.

A mean cancer potency estimate of MX of 2.3 (mg/kg-d)^{-1} and an upper 95 percentile estimate of 4.5 (mg/kg-d)^{-1}. Additional data needed to better characterize the risks posed by MX and other halogenated hyroxyfuranes.


## Appendix G: Summary and Appraisal of Systematic Reviews/Meta-Analyses on Food

* = Canadian studies

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<td>To evaluate the effects of hand washing with soap on the risk of diarrhoeal diseases in the community. (a)</td>
<td>17 studies reviewed (7 intervention studies, 6 case-control, 2 cross-sectional, 2 cohort studies). Outcome measure: reduction in diarrhoeal disease risk.</td>
<td>On current evidence, washing hands with soap can reduce the risk of diarrhoeal diseases by 42-47% and interventions to promote hand washing might save a million lives. More and better-designed trials are needed to measure the impact of hand washing on diarrhoea and acute respiratory infections in developing countries.</td>
<td>Asia (10), Africa (3), Latin America (2), US (1), Australia (1). Nine studies were done in urban settings, 1 in a refugee camp, 1 did not specify location, 3 were set in childcare facilities, whilst others reported on domestic hand washing.</td>
<td>2 of 7 intervention studies were effectively randomized. All studies had methodological flaws and were of poor quality. Used different methods to record data on hand washing (observation, oral reports, etc.). Sensitivity analysis performed. Results may be inflated by publication bias and misclassification bias.</td>
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<td>To summarize evidence on the effectiveness of public health interventions regarding food safety at restaurants, institutions, homes, and other community-based settings. (b)*</td>
<td>15 studies (3 categories: inspections, food handler training &amp; community-based education) reviewed. Outcome measure: foodborne illness, knowledge and training of food handlers, and public knowledge of food safety.</td>
<td>Routine inspections (at least once per year) are effective in reducing the risk of foodborne illness. Food handler training can improve the knowledge &amp; practices of food handlers. Selected community-based education can increase public knowledge of food safety. Multiple public health interventions are effective for food safety at restaurants, institutions, homes, and other community-based settings.</td>
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<td>To investigate the effectiveness of food safety interventions applicable to public health practice. (c)*</td>
<td>34 studies reviewed. Outcome measure: change in inspection scores of food service premises, knowledge of food safety practices and food handling operations on the food service premises, and violations of inspection criteria.</td>
<td>Multiple public health interventions are effective to ensure food safety. Inspections (at least once per year) reduce the risk of foodborne illness. Food handler training programmes, in conjunction with certification, improves the knowledge and practices of food handlers. The effectiveness of most community-based educational programmes has not been formally evaluated.</td>
<td>English language-based. Qualitative analysis presented due to heterogeneity in study design, interventions, and outcome assessed. Majority of studies reviewed were rated poor and moderate quality, and therefore not useful in establishing guidelines.</td>
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<td>Is the microbiological quality of food in UK catering and retail premises related to hazard analysis systems and food hygiene training? (d)</td>
<td>8 UK food studies carried out 1997-2002. Outcome measure: microbiological quality of food samples compared to Public Health Laboratory Service microbiological guidelines.</td>
<td>Significantly more ready-to-eat food samples from catering premises were of unsatisfactory or unacceptable microbiological quality. Fewer catering premises had hazard analysis systems in place. A manager receiving food hygiene training was associated with a documented hazard analysis system being in place. Lower microbiological quality of ready-to-eat foods from catering premises compared with those from retail premises may reflect differences in management food hygiene training and the hazard analysis system being in place.</td>
<td>UK-based.</td>
<td>Publication bias.</td>
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<td>To estimate the percentages of consumers (by demographic categories) engaging in risky behaviour in relation to consumer food safety knowledge and practices. (e)</td>
<td>20 studies reviewed. Outcome measure: % consumers engaging in risky behaviours defined as consumption of raw food, poor hygiene, and cross contamination.</td>
<td>Compared with females, males reported greater consumption of raw or undercooked foods, poor hygiene, poorer practices to prevent cross contamination, and less safe defrosting practices. Mid-age adults consumed more raw foods (except milk) than young adults &amp; seniors. High income individuals reported greater consumption of raw foods, less knowledge of hygiene, and poorer cross contamination practices. The highest raw ground beef and egg consumption and the poorest hygiene and cross contamination practices were found in the US mountain region.</td>
<td>US-based.</td>
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<td>To predict growth kinetics of pathogenic microorganisms in the event of contamination and growth initiation using a relational database associated with quantitative microbiology models. (f)</td>
<td>Used a relational database and predictive model to simulate growth. Outcome measure: behaviour of a given microorganism.</td>
<td>Methodology is illustrated with the effect of temperature on pathogenic E. coli and Listeria monocytogenes growing in a culture medium, beef meat, and milk products. The above results can be compared to the behaviour of bacteria in a given foodstuff and assist in decisions about food safety.</td>
<td>Laboratory-based.</td>
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<td>To quantify the long term renal prognosis of patients (children) with diarrhea-associated hemolytic uremic syndrome (HUS). To identify reasons for different estimates provided in the literature. (g)</td>
<td>49 studies reviewed. Outcome measure: death or permanent end-stage renal disease (ESRD).</td>
<td>A higher severity of acute illness was strongly associated with worse long-term prognosis. Studies with a higher proportion of patients with central nervous system symptoms (coma, seizures, or stroke) had a higher proportion of patients who died or developed permanent ESRD at follow-up. 1 or more years after diarrhea-associated HUS patients with a predicted creatinine clearance higher than 80 mL/ min per 1.73 m², no overt proteinuria and no hypertension, appeared to have excellent prognosis. The severity of acute illness, particularly central nervous system symptoms and the need for initial dialysis, is strongly associated with a worse long-term prognosis. Death or ESRD occurs in about 12% of patients with diarrhea-associated HUS. &amp; 25% of survivors demonstrate long-term renal sequelae.</td>
<td>52% of patients were female and mean age was 2.4 years (range 0.1-18 yrs).</td>
<td>Patients lost to follow-up contributed to worse estimates because these patients were generally healthier than those followed up. No indication of testing for publication bias.</td>
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<td>Is there a relation between infecting dose and severity of disease for salmonella outbreaks among humans? (h)</td>
<td>Re-analysis of data within epidemics for 32 outbreaks, and comparing data between outbreaks for 68 typhoid epidemics, and 49 food-poisoning outbreaks due to salmonellas. Outcome measure: case fatality rate for typhoid and hospitalization for other salmonellas.</td>
<td>There is no evidence for a dose-severity relationship for Salmonella typhi. Attack rate and incubation period are both related to dose, but there is no evidence that they are, in turn, related to severity. The results for the other salmonella are different. The evidence suggests that there is a dose-severity relationship for S. Enteritidis, S. Infantis, S. Newport, and S. Thompson. Message for public health If there is a dose-severity relationship then interventions to lower the dose can have greater impact on the number of severe cases than on the total number of cases. Where there is no dose-severity relationship, the case incidence would suffice as assessment.</td>
<td>US and Britain. Detailed explanation of inclusion and exclusion criteria for studies.</td>
<td>Publication bias – epidemics included only if there was sufficient recorded information.</td>
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<td>What are the likely sources of Ochratoxin A (a carcinogen) present in more than 50% of human blood and serum samples collected in Germany? (i)</td>
<td>Random samples of cereals (other than maize) and cereal products and sausages in Germany 1973-1988 and 1989-1990 (excluding those derived from foodstuff suspected of being contaminated). Outcome measure: uptake of ochratoxin A (µg/kg) based on information about the consumption of various foods.</td>
<td>Based on information about consumption of various foods that make up the German diet, the study estimated that the daily uptake of ochratoxin A = 1 ng/kg body weight per day (higher for children &amp; adolescents consuming maize &amp; cereal products daily). The half-life of ochratoxin A in humans is not known but it is 510 hours in monkeys. This likely explains its presence in 50% of human blood samples. The negative findings in people on a normal diet can be assumed to be below the analytical detection limit rather than corresponding to zero. World Health Organization proposed limit = 16 ng/kg per day. Extrapolation from animal studies = 0.2 - 4.2 ng/kg body weight /per day or 1.2 ng/kg.</td>
<td>German study.</td>
<td>Data pertaining to a typical German diet. Systematically collected data not available as ochratoxin A limit is not regulated.</td>
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<td>Are artificial food colorings (AFCs) a risk factor for hyperactivity in children with attention-deficit/hyperactivity disorder? (j)</td>
<td>15 RCTs reviewed. Outcome measure: hyperactivity measured on behavioural rating scales.</td>
<td>AFCs promote hyperactivity in hyperactive children, as measured on behavioural rating scales.</td>
<td>Unlike previous publications, this meta-analysis focused on AFCs in particular rather than the Feingold Diet (which eliminates a variety of AFCs, naturally occurring salicylates, artificial flavours, and particular preservatives) as a whole.</td>
<td>Publication bias. Results did not change when sensitivity analysis was performed by removing trials of questionable validity. Power enhanced by employing statistical techniques that acknowledge reduction of statistical variance in crossover trials.</td>
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<td>To develop the composite benefit-harm curve of fish consumption and present a dose-response curve that elucidates the benefit-harm paradox. (k)</td>
<td>9 studies reviewed: 7 cohort studies and 2 meta-analyses yielding threshold data and asymptote. Outcome measure: allowable daily intakes (µg/kg day) derived from various international and national agencies.</td>
<td>Based on estimated weighted average methylmercury concentration 0.23 µg/g (ppm wet weight) of the 9 most common fish in New Jersey markets: The duration of pregnancy &amp; birth weight improve at a benefit threshold of about 8-13 g/day maternal fish intake, cardiovascular benefits around 7.5-22.5 g/day. Benefit asymptote are above 45 g/day and exceed 100 g/day in some studies (8 oz = 227 g). Using the US EPA Reference Dose for methylmercury the fish intake threshold for harm converts to 27 g/day (for common commercial fish averaging 0.23 ppm MeHg) to 65 g/day (for fish low in MeHg).</td>
<td>Small number of studies included in review.</td>
<td>Publication bias. Better data needed to estimate thresholds and asymptotes. Great disparities in the amount and distribution of polyunsaturated fatty acids and contaminants in different fish species and locations.</td>
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<td>Is there a relation between sheep fed diets with elevated cadmium levels and cadmium concentrations in their livers and kidneys (which allows for examination of cadmium in the food chain)? (l)</td>
<td>21 RCTs reviewed. Outcome measure: cadmium concentrations in livers and kidneys after slaughter.</td>
<td>The product of the cadmium concentration in the feed and the duration of exposure to that feed were significant predictors of the cadmium concentration in the livers and kidneys. The predominantly organic form of cadmium in the feed further increased accumulation. Prime measures to decrease the risk of human exposure to cadmium from animal sources should include: restricting the animals’ cumulative cadmium intake, preventing the livers and kidneys of older animals from entering the human food chain.</td>
<td>Chronic cadmium toxicity from dietary sources investigated. Sheep exposed to a fixed cadmium concentration throughout the experimental period.</td>
<td>Study showed that other variables (dry matter intake, the vehicle of the elevated cadmium in the diet, animal age, weight, and sex) were not significant predictors of cadmium concentration in the livers and kidneys. Sensitivity analysis for influence of individual studies. Assumes no publication bias but does not provide funnel plot, etc.</td>
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<td>To compare and evaluate research methods used in consumer food safety studies. (m)</td>
<td>87 consumer food safety studies reviewed. Outcome measure: consumers’ knowledge, attitudes, beliefs, intentions, self-reported practices, and actual hygiene behaviours related specifically to food preparation in the domestic kitchen.</td>
<td>The majority of consumer food safety studies have been carried out in the UK and Northern Ireland (48% of studies) and US (42%). Surveys (questionnaires &amp; interviews) were used in data collection in 75% of reviewed studies. Discrepancies are evident when comparing the results from quantitative survey methods with observational findings. Survey data demonstrate a more positive picture of consumer food safety than data obtained from observations of actual food preparation. Unsafe food handling practices are prevalent. For example, 100% of consumers failed to wash/dry their hands adequately after handling raw chicken. &gt; 50% consumers fail to use separate (or adequately washed and dried) utensils between raw meat/poultry and ready-to-eat foods. Observation provides the most reliable consumer food safety behaviour. Focus groups can provide detailed qualitative data relating to perceptions of food safety, barriers and benefits to implementing food behaviours, and perceptions of food safety education.</td>
<td>48% of studies from UK and Northern Ireland; 42% from the US.</td>
<td>48% of studies used interviews to obtain consumer food safety information. 27% used self-completed questionnaires, 8% used focus groups, and 17% of the studies used direct observation techniques. Paper discusses the reliability and validity of the different methods used for data collection. Does not discuss heterogeneity or publication bias.</td>
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<td>Is there an association between saccharin use and bladder cancer? (n)</td>
<td>15 case-control studies reviewed. Outcome measure: bladder cancer.</td>
<td>There is no detectable association between bladder cancer and saccharin consumption in humans. New evidence for a unique mechanism of saccharin carcinogenicity in the male rat leads to the conclusion that saccharin is not related to bladder cancer in humans. An update in light of new data.</td>
<td>Relative risks presented separately for males, females, and both sexes combined.</td>
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<td>Is there a relation between any type, and specific types, of allergy and the risk of pancreatic cancer? (o)</td>
<td>14 studies reviewed: 4 cohort studies and 10 case-control studies. Outcome measure: pancreatic cancer.</td>
<td>A history of allergy was associated with a reduced risk of pancreatic cancer, and the risk reduction was stronger for allergies related to atopy, but not for asthma. There was no association between allergies related to food or drugs and pancreatic cancer.</td>
<td>No evidence of publication bias. Possible confounding by magnesium and potassium, both of which may increase as a result of fibre supplementation.</td>
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<td>Is there a relation between maternal intake of cured meat during pregnancy and the risk of pediatric brain tumours? (p)</td>
<td>7 case-control studies reviewed. Outcome measure: risk of childhood brain tumour (CBT).</td>
<td>Analyzing CBT risk by type of cured meat ingested showed that hot dog consumption increased CBT risk by 33% and frequent ingestion of sausages increased the risk of CBT by 44%. The limited data supports a causal link between N-nitroso from cured meats consumed during pregnancy and subsequent CBT in offspring.</td>
<td>US &amp; Canada (4), France (1), Netherlands (1), Australia (1).</td>
<td>No statistical heterogeneity. Sensitively analysis performed to explain any observed statistical heterogeneity. Analysis of cured meat intake by quartiles (not quantitatively defined) precluded a rigorous meta-analytic evaluation of dose-response. Case-control studies subject to recall bias which may influence effect size.</td>
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<td>Is there a relation between fish and shellfish consumption and thyroid cancer risk? (p)</td>
<td>13 case-control studies reviewed. Outcome measure: thyroid tumour.</td>
<td>Elevated levels of fish consumption (3 or more times per week) does not appreciably increase thyroid cancer risk. This pattern of risk for salt water fish and shellfish was not substantially different from that of total fish. There was a suggestion of a protective effect in endemic goiter areas.</td>
<td>US (3), Japan (1), China (1), Sweden (3), Norway (2), Italy (1), Switzerland (1), Greece (1).</td>
<td>Dietary assessment questionnaires varied among the studies. Validity and reliability also varied. Studies adjusted for age and sex and best recognized determinants of thyroid cancer, such as history of goiter &amp; thyroid nodules or adenomas, and history of radiation.</td>
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<td>To review the clinical relevance and epidemiology of E. coli 0157:H7 infection in humans. (r)</td>
<td>217 references. Outcome measure: clinical manifestation of E. coli 0157:H7 infection and routes of transmission.</td>
<td>Infection with E. coli 0157:H7 presents with a wide spectrum of clinical manifestations including asymptomatic carriage, non-bloody diarrhea, hemorrhagic colitis, hemolytic-uremic syndrome, and thrombotic thrombocytopenic purpura. It is an important agent for hemorrhagic colitis and one of the leading causes of bacterial diarrhea. Transmission is primarily foodborne, undercooked meat is the most common culprit and secondary person-to-person spread is also important. The infection is usually diagnosed from a positive stool culture and/or the presence of Shiga-like toxins. Timely collection (within 7 days of illness onset) of a stool sample for culture is imperative for a high recovery rate. Treatment is primarily supportive and includes the management of complications as necessary. Antibiotic therapy has not proved beneficial. Important public health measures include educating the public, increasing physician awareness of E.Coli 0157: H7 infection, and mandating case reporting.</td>
<td>Includes case reports.</td>
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<td>What is the risk of bovine encephalopathy (BSE) transmission in the US? (s)</td>
<td>111 references. Outcome measure: risk of transmission of BSE in the US. Legislation and regulations implemented based on a risk management approach.</td>
<td>Circumstances in the UK that caused the emergence and propagation of BSE in cattle: widespread use of meat and bonemeal cattle feed derived from scrapie-infected sheep, adoption of new type of processing that did not reduce the amount of infectious prions prior to feeding. The human form, Creutzfeldt-Jacob (nvCJD), probably arose from BSE-contaminated beef ingestion. Current risk of transmission of BSE in the US is minimal because: - BSE has not been shown to exist; - regulations exist to prevent entry of foreign sources; - regulations exist to prevent undetected cases of BSE from uncontrolled amplification within the US cattle population. Preventive guidelines exist to prevent high-risk bovine materials from contaminating products intended for human consumption.</td>
<td>Literature review for 1975 through 1997.</td>
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To assess consumer willingness-to-pay (WTP) and willingness-to-accept (WTA) values for genetically modified (GM) foods. To determine the effects of the characteristics of the consumers, methods of value elicitation, and food product characteristics on valuation estimates. (1)

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<td>25 studies reviewed. Outcome measures: characteristics of the sample of consumers, method for eliciting consumer’s valuation of GM foods, characteristics of food being valued.</td>
<td>Across all studies, consumers on average placed a 42% (unweighted average - all data) to 23% (weighted average) higher value for non-GM food relative to GM food, with European consumers placing a higher value on non-GM food than US consumers. Student sample valuations were on par with studies using more representative samples. Real-money-on-the line valuations were lower than hypothetical valuations. WTA valuations were higher than WTP value measures. Consumers placed the lowest values on GM meat products &amp; highest value on GM oil. Consumer WTP is not sufficiently high to make a mandatory labelling policy a “win-win” outcome in the US. Europeans are willing to pay, on average, 29% more for non-GM food than US consumers – making labelling policies and non-tariff trade barriers more likely in the EU than in the US.</td>
<td>49% of valuation obtained from US participants, 9% Asian, 33% Europe, 9% Canada &amp; Australia. English language-based.</td>
<td>Valuations were made either with a researcher face-to-face with a consumer (58%) or hypothetical – results were pooled. Sensitivity analysis using the jack-knife method.</td>
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<td>To assess the number of cases of foodborne illnesses (number of Salmonella, Campylobacter, &amp; E. coli infections) prevented.</td>
<td>Supplementation of available literature with expert opinion. Outcome measure: number of foodborne illnesses potentially avoided with targeted disinfection practices, the extent to which decreased total annual costs of illness offset the annual costs of implementing targeted disinfection practices, cost effectiveness of targeted disinfection practices relative to current cleaning practices, economic and quality-of-life outcomes measured in quality-adjusted life years (QALY).</td>
<td>80,000 infections could be prevented annually in US households, resulting in $138 million medical cost savings (physician visits and hospitalization), 15,845 QALYs gained, &amp; $788 million in program costs and a favourable cost-effectiveness ratio of $41,021/QALY gained. Results were similar for households in Canada and UK (Can $21,950/QALY gained and £86,341/QALY gained respectively). Cost effectiveness ratio was more favourable when implementation was evaluated for households with high risk members (&lt; 5yrs of age, &gt; 65 years) in the US, UK, and Canada. Implementing a targeted disinfection program in household kitchens in the US, Canada, and UK appears to be a cost-effective strategy.</td>
<td>US, Canada, and UK.</td>
<td>Country-specific costs were assessed using direct medical costs and costs associated with lost productivity. Different data levels available from different countries – assumptions underpinning estimates. Sensitivity analysis performed on foodborne illness incidence rates, utilities estimation. Data ignored institutional settings such as restaurants, schools, hospitals, etc.</td>
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<td>To describe the epidemiology of foodborne disease outbreaks in nursing homes and to identify where preventive efforts might be focused.</td>
<td>Epidemiologist or statistician review of foodborne disease outbreaks reported to US Centers for Disease Control and Prevention on standard investigation forms 1975-1987. Food related pathogen confirmed by laboratory test.</td>
<td>26 states reported 115 outbreaks of foodborne disease in nursing homes, causing illness in 4944 persons and 51 deaths – representing 2% of all reported foodborne disease outbreaks and 19% of outbreak-associated deaths. Of 52 outbreaks with a known cause Salmonella was the most frequently reported pathogen, accounting for 52% of outbreaks and 81% of deaths. The implicated food vehicle in S. enteritidis outbreaks was made with eggs or equipment contaminated with eggs. Staphylococcal foodborne disease was the next most commonly identified cause, accounting for 23% of outbreaks. Nursing homes should practice careful food handling, preparation and storage procedures, provide education for food handlers, and have active infection control programs to rapidly detect and control outbreaks of foodborne disease.</td>
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<td>To synthesize research evidence on collective kitchens in Canada. (w)*</td>
<td>4 research papers, 2 Masters’ theses, and 3 reports reviewed.</td>
<td>Social and learning benefits associated with participation. Foods cooked of high quality, culturally acceptable, and acquired in a manner that maintains personal dignity. Policy implications: unique opportunity for dieticians and nutritionists to facilitate the health promotion and food security benefits of collective kitchens. Need more research.</td>
<td>Canadian-focused published and gray literature.</td>
<td>Limited number of studies.</td>
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<td>To critique Cochrane reviews of diet and chronic disease. (x)</td>
<td>Critique of Cochrane reviews based on RCT studies.</td>
<td>Critique of Cochrane reviews and the potential of Cochrane methodology to the reliability of knowledge about diet and disease.</td>
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<td>To summarize evidence on the effectiveness of food safety interventions. (y)*</td>
<td>7 studies reviewed</td>
<td>Some public health infection control interventions (4/7) are effective in food safety interventions. Food handler training/certification (3 studies) is effective in enhancing food safety knowledge and behaviour among food handlers. Routine inspection (1 study) is effective in enhancing inspection compliance. Conclusion: Evidence was found that some public health food safety interventions are effective.</td>
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<td>Effectiveness of inspection of restaurants and education of food handlers used by regulatory agencies to ensure food safety in restaurants. (z)*</td>
<td>Review of implementation data and a critical review of the literature.</td>
<td>Variation which exists in implementation of these two strategies suggests that the program’s effectiveness is lacking or is not clear. Recommendations include continuation of routine inspections of a frequency of 1 to 2 inspections per year per restaurant, and the continuation of education programs. Evidence on which these recommendations are based is scant and more research is needed to ensure programs are needed, effective, and efficient.</td>
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<td>Evaluation of the effectiveness of routine restaurant inspections and education of food handlers. (aa)*</td>
<td>8 papers relating to food handler education, 4 papers relating to restaurant inspection.</td>
<td>Effectiveness of food handler training in improving food establishment sanitation was weak. Some training resulted in improved inspection scores. Inspections were beneficial, but it was not clear whether 3+ inspections were better than 2. No inspections associated with worse inspection scores.</td>
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EPA = Environmental Protection Agency  
RCT = randomized controlled trials


(i) Frank HK. Food contamination by ochratoxin A in Germany. IARC Sci Publ 1991; 115: 77-81.


# Appendix H: Summary and Appraisal of Systematic Reviews/Meta-Analyses on Waste

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<th>REVIEW QUESTION</th>
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<tr>
<td>What are the health effects in populations living in the neighbourhood of waste incinerators? (a)</td>
<td>46 epidemiological papers reviewed – published 1987-2003.</td>
<td>Significant exposure-disease associations reported in two-thirds of papers focusing on cancer (lung, larynx, non-Hodgkin’s lymphoma). Positive association for congenital malformation and residence near incinerators. Exposure to polychlorinated biphenyls and heavy metals associated with reduction of thyroid hormones and consequent delay in neurologic and sexual development. Findings on non-carcinogenic pathologies were inconclusive.</td>
<td>US, Italy, Spain, Japan, Germany, UK, Finland, Sweden, Belgium, Netherlands, Scotland, Ireland, France. Published studies reviewed only.</td>
<td>Difficulties in defining unequivocally levels of exposure for individuals. Incineration facilities tend to be co-located with other kinds of plants. Misclassification – based on residence being used as proxy for exposure and chronic and acute health endpoints. Confounders – SES.</td>
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<td>Is there an association between residence near hazardous waste landfill sites and adverse health effects? (b)</td>
<td>50 papers and reports reviewed. Outcome measure: low birth weight, birth defects, certain types of cancers.</td>
<td>An increased prevalence of self-reported health symptoms (fatigue, sleepiness, headaches) consistently reported in 10 of reviewed papers. Difficult to conclude whether these symptoms are an effect of direct toxicologic action of chemicals present in waste sites, an effect of stress and fears related to the waste site, or an effect of reporting bias. Risks to health from landfills are hard to quantify due to insufficient exposure information, low-level environmental exposure difficult to establish. Evidence for causal relationship between landfill exposure and cancers weak. More interdisciplinary research required – include epidemiologic and toxicologic studies on individual chemicals, mixtures and well designed single &amp; multi-site landfill studies, development of biomarkers, risk perception, and sociological determinants of ill health. Need to link technical aspects (i.e. what renders them hazardous) of waste disposal to health effects.</td>
<td>Lack of direct exposure measurement – misclassification limits power to detect health risks. Possible publication bias in that negative studies were likely not submitted for publication. Confounding.</td>
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<td>What are the health risks associated with municipal waste incineration? (c)</td>
<td>[abstract in Polish]</td>
<td>Residence in the vicinity of municipal waste incinerators is associated with a slightly increased cancer risk, respiratory symptoms, multiple pregnancy, congenital abnormalities, and disturbances in thyroid hormone levels.</td>
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<td>What are the health effects of waste landfill sites? (d)</td>
<td>11 studies reviewed.</td>
<td>Evidence inconclusive for association between landfill sites and excess risk for cancer, mortality, and congenital malformations. Low birth weight consistently shown in studies.</td>
<td>None or very poor exposure data in studies – misclassification – decreased power to detect effect.</td>
<td>Small number of studies.</td>
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<td>Are solid waste management (SWM) workers at an increased risk of contracting vaccine-preventable diseases (Hepatitis A, Hepatitis B, and tetanus) compared with others who do not work in SWM? (e)</td>
<td>44 studies included – 20 (Hepatitis A), 11 (Hepatitis B), and 13 (tetanus). Outcome measure: health endpoints in the literature. 1 paper studied the prevalence of antibodies to Hepatitis A and Hepatitis B in SWM workers compared with sewage plant workers and office workers – no differences found between these groups. No studies found of the risk of these diseases in SWM workers. No single cases of these diseases being acquired occupationally identified.</td>
<td>No indication of an increased risk of clinical Hepatitis A could be found. Sero-prevalence – studies with the strongest design suggested a slightly increased risk of sub-clinical Hepatitis A (odds ratio &lt; 2.5). Policy Implication: Systematic Hepatitis A vaccination of every worker exposed to sewage will have little effect on the incidence of clinical Hepatitis A. Vaccination of the heavily exposed workers may be of value, but this has not been demonstrated.</td>
<td>Studies based in Europe and North America. Publication bias. Confounders. Significant heterogeneity among studies precluded meta-analysis.</td>
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<td>Is exposure to sewage associated with a higher risk of Hepatitis A? (f)</td>
<td>17 studies reviewed. Outcome measure: definition of type of immunoglobulins determined to assess sero-prevalence and definition of “clinical” Hepatitis A.</td>
<td>No indication of an increased risk of clinical Hepatitis A could be found. Sero-prevalence – studies with the strongest design suggested a slightly increased risk of sub-clinical Hepatitis A (odds ratio &lt; 2.5). Policy Implication: Systematic Hepatitis A vaccination of every worker exposed to sewage will have little effect on the incidence of clinical Hepatitis A. Vaccination of the heavily exposed workers may be of value, but this has not been demonstrated.</td>
<td>Studies based in Europe and North America. Publication bias. Confounders. Significant heterogeneity among studies precluded meta-analysis.</td>
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<td>Who are the risk groups for Hepatitis A infection? (g)</td>
<td>Reviewed 9 studies relating to sewage workers.</td>
<td>7 of 9 studies found an increased risk of antibodies to Hepatitis A in sewage workers. In countries where the sero-prevalence of Hepatitis A in the community is high, occupational risk is low, as most workers have already been exposed to Hepatitis A prior to starting work.</td>
<td>Studies based in Singapore, England, France, Canada, Israel, US, Italy.</td>
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<td>Are sewage/wastewater workers at risk of Hepatitis A? (h)</td>
<td>6 studies reviewed.</td>
<td>Some studies found that sewage exposure carries an increased risk of anti-Hepatitis A sero-prevalence, but others did not. Additionally, other non-occupational risk factors (age, siblings, and children) were more likely or just as likely to contribute to anti-Hepatitis A sero-positivity.</td>
<td>A low overall anti-Hepatitis A sero-prevalence among sewage workers, particularly younger workers, and the risk of fecal exposure, suggest that sewage workers are at risk for occupational exposure to Hepatitis A.</td>
<td>Many assumptions underpin ATSDR model. Reliance on biomedical opinion.</td>
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| What are the health implications of exposure to hazardous substances? (i)      | Weight of evidence approach based on US ATSDR overview of hazardous waste (Office of Technology Assessment assessment); US EPA inventory of uncontrolled waste sites (40,000 approx) of which approx 5,500 were placed on the National Priorities List (NPL) as posing the most significant threats to public health; ATSDR HazDat database. | Most frequent contaminants (of assessments up to Sept 1994): volatile organic compounds (VOCs) (74%), inorganic substances (71%), halogenated pesticides (37%), polycyclic aromatic hydrocarbons (25%), phenols/phenox acids (23%), phthalates (22%), nitrosamines/ethers/ethanol (15%), organophosphates (14%). | Priority hazardous substances: a prioritized list developed for 275 hazardous substances of the 2000 unique substances found in hazardous waste sites in the US. Heavy metals, some organochlorines & VOCs heavily represented. | Chemical mixtures: 100+ chemicals can be found at a single waste site. Some combinations are more hazardous than any of the individual chemicals.  
Populations at risk: 41 million people live within a 4-mile radius of 1134 NPL sites, 3300 within a 1-mile radius, 2000 people with potential exposures at a typical waste site. Disadvantaged & persons of color are disproportionately located in areas near hazardous waste sites.  
Public health assessment of chemical mixtures: ATSDR developed an approach to categorize waste sites according to hazard categories (assumption that exposures to multiple toxic compounds are more common than exposures to single compounds).                                                                 |
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| What are the health hazards of waste and waste management processes? (i) | 48 references listed. Outcome measure: low birth weight, congenital malformations, cancers of different sites. | Waste management practices & health impact
Raised incidence of low birth weight and various congenital malformations shown to be associated with residence near landfill sites.
Evidence is mixed with respect to cancer with varying results for different cancer sites.
Self reported symptoms include respiratory symptoms, gastrointestinal problems, fatigue, headaches, and allergies.

Inversion
Little evidence found linking modern waste incinerators and reproductive or developmental effects.
Little evidence of increased prevalence of respiratory illness near incinerators using either self reported symptoms or psychological measures.
Evidence is mixed for association of specific cancers and residential proximity to incinerators used for disposal of solvents and oil.

Future Research
Studies based on individuals rather than communities are the way forward.
Biomarkers allow possibility of measuring low level exposure to specific contaminants or hazardous materials.
Wider emphasis on recycling and waste site remediation – health impacts need to be assessed and monitored. | Lack of technical data relating to what is released from waste sites – i.e. precise substance(s) implicated.
Lack of individual exposure data leading to possibility of misclassification.
Analysis for latency lacking in many studies. Migration in and out of areas also ignored in studies reviewed.
Lack of data on confounders – e.g. SES. |

| To determine the knowledge and attitudes of dental health care workers (DHCWs) towards infection control procedures, to examine DHCWs’ practice in respect of infection control, and to determine whether a relationship exists between knowledge, attitudes and behaviour. (k) | Qualitative analysis of 71 studies reviewed. Outcome measures: glove use, mask use, use of eye protection, and other personal protective equipment (PPE), sterilization of instruments & hand pieces, disinfection of surfaces, Hepatitis B vaccination of staff, waste disposal, training of staff on all principles of infection control, knowledge of blood borne infections, willingness to treat HIV patients, infection control policy in place, occupational health & safety policies & practice. | Knowledge and attitudes of infection control – general level of knowledge of dentists appears to be adequate. Problems related to serving high risk patients.
PPE – compliance has increased over the years as guidelines have been extended and made more explicit.
Immunization – Hepatitis B vaccine has shown continued rise since the 1980s in Britain.
Sterilization and disinfection – a consistently high rate of autoclaving for sterilizing hand instruments. Disinfection of impressions is often overlooked.
Waste disposal & occupationally acquired injuries – inadequate compliance with universal infection control guidelines with respect to sharps, leading to effective management of needlestick injuries being problematic.
Conclusions: more rigorously designed studies required to assess accurately dental team members’ adherence to infection control guidelines. | Quality of the studies reviewed was poor. Many studies presented research several years prior to date of publication. |
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<td>What are the health risks of employees working in the sewage treatment plants? (1)</td>
<td>32 non-cancer studies. Outcome measure: gastrointestinal symptoms (7 studies), fatigue (5), headache (4), symptoms of the airways (9), skin symptoms (4), dizziness (3), fever (1), central nervous system (2), laboratory findings relating to increased clinical and immunological symptoms (4), decreased forced expiratory vital capacity (FVC1) and forced expiratory volume in one second (FEV1) (3).</td>
<td>Non-cancer and infections: These exist a risk for infection, especially of hepatitis A. Gastrointestinal tract symptoms are more common among employees at sewage treatment plants than among controls. Respiratory symptoms, fatigue and headache have also been reported in several investigations. The cause of the symptoms is unknown, although certain data suggest that they are caused by inflammation. The results suggest that endotoxin in gram-negative bacteria may be one of the causative agents. Cancer: Some studies report an increased risk of stomach cancer, and a few studies report an increased risk of cancer in the larynx, liver or prostate or leukemia. The spread of cancers over a multitude of organs does not support a hypothesis of causality with agents commonly found in sewage treatment plants. Conclusions: Further investigations are needed to determine the work-related effects and ascertain the causal agents.</td>
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<td>Narrative review.</td>
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<td>12 infection studies (5 already included in 32 non-cancer studies).</td>
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<td>What are direct and indirect disaster-associated releases?</td>
<td>Summarizes past incidents on chemical, radiologic, and biologic releases associated with natural disasters. Outcome measures: nature of release and human health effects.</td>
<td>1. <strong>Flood &amp; wind-related storms</strong>&lt;br&gt;Of greatest concern – large scale releases from industrial (heavy metals as well as multiple organic compounds such as pesticides and polyaromatic hydrocarbons), US Superfund (possibly containing benzene, toluene, lead &amp; chromium) and agricultural sites (agrochemicals such as organophosphate pesticides, carbamates, polychlorinated biphenyls, etc.) located near streams, rivers and coastlines. Can uproot petroleum tanks, rupture underground oil, dislodge storage tanks stored at ground level, and disrupt water purification &amp; sewage disposal systems.&lt;br&gt;<strong>Associated health effects</strong>&lt;br&gt;Stress &amp; respiratory problems. Increased leukemia &amp; lymphoma. Fire casualties from burst oil &amp; gasoline tanks.</td>
<td>Earthquakes&lt;br&gt;Mexico (1 study), Japan (1), Turkey (1), US (3).&lt;br&gt;Floods&lt;br&gt;Netherlands, France &amp; Belgium (2), US (3).&lt;br&gt;Hurricanes&lt;br&gt;US (3), Honduras (1), France (1).&lt;br&gt;Landslides&lt;br&gt;US (1).&lt;br&gt;Volcanic eruptions&lt;br&gt;US (1), Iceland (1), Cameroon (1).</td>
<td>Includes only those events documented by academic journals, national or local news reports. Public health impacts potentially underestimated – studies examining disaster-related hazardous material releases &amp; health are rare and complicated. Symptoms may also be subtle, nonspecific and have long latencies.</td>
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<td>What are the environmental and adverse human health effects resulting from natural and technologic (na-tech) disaster-related hazardous material incidences during and after natural disasters?</td>
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Stress & respiratory problems. Increased leukemia & lymphoma. Fire casualties from burst oil & gasoline tanks.
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<td>Associated health effects</td>
<td>Volcanic ash associated with severe tracheal injury, pulmonary edema, bronchial obstruction which at high concentrations leads to suffocation. Deaths from hydrogen sulfide &amp; carbon monoxide exposure. Upper &amp; lower airway inflammation, decreased lung capacity, cough &amp; bronchospasm and exacerbation of chronic obstructive pulmonary disease (COPD). Eye irritation, connective tissue disorders &amp; cutaneous bullae.</td>
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<td>4. Wildfires, droughts &amp; other disasters</td>
<td>Biomass burning produces carbon monoxide, aldehydes, organic acids, semivolatile &amp; volatile organic compounds, free radicals &amp; ozone – many consisting of irritant respirable particles that are carcinogenic (e.g. polychlorinated dibenzo-p-dioxin, polychlorinated dibenzofuran). Airborne silt and clay, fungus spread through dust storms. Associated health effects Increase in respiratory &amp; cardiovascular mortality &amp; morbidity. Increased cancer incidence. Skin, eye, &amp; membrane irritation. Drowsiness, nausea, coughing, sneezing, shortness of breath, and death. Increase hospital admissions due to asthma and COPD. Fatalities due to carbon monoxide exposure.</td>
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<td>Conclusions</td>
<td>Disaster-related hazardous material releases can affect large geographic areas and large numbers of people. Land use planning to avoid hazard zones should be used in locating landfills, Superfund sites, waste lagoons &amp; industrial facilities. Implementing risk reduction strategies in new buildings, retrofitting weak edifices &amp; special designs for tanks &amp; pipelines. Educating public, emergency response teams. Co-operation among researchers &amp; government, industry groups to more accurately assess risk.</td>
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<td>To provide an overview of the health impacts of different methods of waste management systems in England and Wales. (n)</td>
<td>101 landfill studies. <strong>Health outcome:</strong> reproductive outcomes/developmental effects on children (22), cancer (22), symptoms (27), psychosocial impacts (18), biomarkers (12), health problems not specified in abstract (9), mortality (4), injuries/poisoning (2). 51 incineration studies. <strong>Health outcome:</strong> occupational health (17), cancer (15), health problems/diseases/unspecific health effects (12), biomarkers (10), reproductive/developmental effects on children (9), symptoms (8), mortality (5), injuries/poisoning (3), psychosocial impacts (2), economic (1). 70 sewage discharge studies. <strong>Health outcome:</strong> health problems/disease/unspecific health effects (44), occupational health studies (36), symptoms (24), unknown (4), mortality (4), cancer (3), injuries/poisoning (2), psychosocial impacts (2), reproductive outcomes/developmental effects on children (1). Landspreading sewage sludge. 21 studies about health hazards and 1 primary study of health impacts.</td>
<td>Landfills: Evidence was insufficient to link exposure to landfill and any health outcomes. Incineration: Composting and occupational health effects – probable. Composting and health effects to residents – insufficient. Sewage discharges: Gastrointestinal symptoms and bathing in sewage contaminated recreational waters – convincing evidence. Gastrointestinal tract problems, headache, fatigue &amp; airways symptoms &amp; working in sewage treatment plants – probable evidence. Working in sewage treatment plant facilities and cancer – insufficient evidence. Landspreading sewage sludge: Sewage sludge landspreading and health impacts – evidence insufficient.</td>
<td>Studies based in England.</td>
<td>Data do not provide detailed information about the composition of the waste collected or of off-site emissions from waste management operations. Accurate exposure assessments are not possible without such data. Existing epidemiological data useful for generating hypotheses but are unable to test the hypotheses or provide convincing evidence of an association between exposure and a health impact.</td>
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| What is known about the number and types of toxic chemical waste disposal sites in the US, the risks they pose to public health and the gaps in pertinent information that call for further research? (o) | US EPA database for number, types of waste sites, and substances most commonly detected.  
16 epidemiological studies (6 retrospective follow up, 2 case control, & 8 cross-sectional).  
Outcome measure: leukemia & Hodgkin's, cancer, chromosomal aberrations, low birth weight, health problems (seizures, learning problems, hyperactivity, eye irritation, abdominal pain, incontinence), liver function, bladder cancer, self reported health problems, congenital heart defects, pregnancy outcomes, childhood leukemia. | As of May 6, 1988 EPA listed 29,307 sites as containing potentially hazardous materials, 26,997 had undergone preliminary assessment and 8947 more detailed investigation.  
951 sites on National Priority List are widely distributed throughout US.  
Many have been operated by local, state or federal agencies in conjunction with industrial operations producing hazardous wastes.  
Pathways of exposure: air, water, food & soil.  
Substances detected most commonly at NPL sites: halogenated hydrocarbons, aromatic hydrocarbons, metals.  
Epidemiological studies: Few have been sufficiently well-designed and well conducted to yield meaningful results. Reasons include (a) methodologic & logistic difficulties, (b) litigation at various sites, (c) absence of clear government responsibility or authority, and (d) presence of other inhibitory factors. 2 studies suggest prenatal exposure may be linked to decreased weight at birth, 2 others suggest prenatal exposure linked to congenital malformations & spontaneous aborations. Fifth study suggests that children living near waste sites were of shorter stature than controls. Evidence is inconclusive with respect to types of cancer. Suggestions of increased prevalence of other health symptoms call for further investigation. | Type, amount, and mode of contamination at a particular site not clear from studies.  
Lack of adequate exposure assessment with virtually all studies using surrogate measures of exposure usually based on proximity to site – which are not adequately informative about individual exposure.  
Misclassification may thus be extensive.  
Sample sizes in reviewed studies too small to provide statistical power needed to test the hypotheses in question. |
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<td>What are the effects of the Great Lakes environment on human health? (p)</td>
<td>International conference held in Montreal, Quebec, sponsored by agencies in US &amp; Canada. More than 120 platform &amp; poster presentations.</td>
<td><strong>Persistent toxic substances</strong>&lt;br&gt;Researchers have confirmed quantifiable amounts of 362 contaminants in the waters, sediments, &amp; biota of the Great Lakes basin. In 1985 eleven of the most persistent &amp; widespread substances identified as “critical Great Lakes pollutants” – polychlorinated biphenyls (PCBs), dichlorodiphenyl trichloroethane, dieldrin, toxaphene, mirex, methylmercury, benzo(a)pyrene, hexachlorobenzene, furans, dioxins, &amp; alkylated lead. <strong>Weight of evidence – human health effects</strong>&lt;br&gt;PCBs and dichlorodiphenyldichloroethylene blood serum levels statistically correlated with amount of Great Lakes fish consumed. Adverse developmental health outcomes in newborn infants of mothers who consumed more than 12 kg of contaminated Great Lakes fish – statistically significant decreases in infants’ birth weight, gestational age, head circumference compared with controls. Infants also exhibited neuro-developmental &amp; behavioural deficits based on visual recognition &amp; memory at 7 months &amp; 4 years of age. Many persisted at follow-up at 11 years of age. Children exposed to PCBs in utero – exhibited neurological deficiencies such as hyperreflexia &amp; hypotonicity, growth retardation, neuro-developmental &amp; behavioral deficits &amp; autonomic disturbances. Whether related to exposure to PCBs or polychlorinated dibenzofurans (CDFs) is unclear. Newborns exposed to high levels of PCBs, CDFs, and chlorinated dibenzo-dioxins in breast milk exhibited reduced neurological functions. Increased hypotonia associated with high levels of coplanar PCBs in breast milk. Additionally prenatal exposure to PCBs or dioxins produced alterations in their immune system &amp; thyroid hormone status. Changes in human sex ratio in children born to persons exposed to high concentrations of dioxins. <strong>Policy implications</strong>&lt;br&gt;Partnerships among US and Canadian agencies – ecosystem approach to human health, its partnership with community and public groups, federal &amp; local agencies and emphasis on combining the latest science with informed action. Fish advisories of limited effectiveness and needs to be combined with companion programs to reduce ecosystem health effects.</td>
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<td>Do contaminants from hazardous waste sites cause adverse health effects?</td>
<td>11 case control studies, 1 cross sectional, and 2 retrospective cohort studies were reviewed.</td>
<td>Studies reviewed did not provide convincing evidence of causal relationships between hazardous waste site exposure and adverse human health effects, in particular because of poor exposure measurement.</td>
<td>US (10 studies), Canada (2), France (1), Saudi Arabia (1).</td>
<td>2 of 14 studies were satisfactorily rated for exposure measures – 12 were poorly rated. None had access to individual exposure level data – likelihood of non-differential misclassification which tends to attenuate the risk effects.</td>
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<td>Environmental exposures: (i) point sources of contamination, (ii) hazardous waste sites near or within residential areas. (q)</td>
<td>Health endpoints: various cancers, various reproductive outcomes, and a variety of nonspecific health conditions and symptoms.</td>
<td>Substantially better exposure assessment methodology is needed to establish the harmful effects caused by hazardous waste exposures.</td>
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<td>Risk assessment</td>
<td>Review of databases, undertaken in May 1998, revealing a total population of 110 environmental statements (ESs) (containing environmental impact statements (EIS)) - broadly representative of the total population of EIS submitted since the UK Environment Impact Assessment regulations were introduced in 1988.</td>
<td>Only 19 (31%) of 61 reviewed ESs included a health risk assessment. The maximum extent of assessment in the remaining ESs was either emission referencing (23%) or air quality impact assessment (46%). All 19 ESs failed to acknowledge that different risks are calculated with different models, &amp; different models vary considerably in terms of their inherent assumptions and uncertainties. Getting the science right implies: (a) making better exposure assessment and taking into account direct as well as indirect pathways of how a source moves through the environment and makes contact with a human being. (b) risk characterization – components include hazard identification, exposure assessment and dose-response assessment – is integrated &amp; synthesized in order to determine and communicate the likelihood of an emission causing harm to an individual – most significant failings were in relation to characterization of cancer risks and characterizing uncertainty.</td>
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<td>A sample of 61 ESs were reviewed. This sample contained a slightly lower proportion of clinical waste incinerators and a slightly higher proportion of municipal waste incinerators, but broadly representative of the total population.</td>
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<td>What are the key activities in evaluating environmental health effects of environmental contaminants? (s)</td>
<td>Review of US ATSDR studies.</td>
<td>US National Research Council has suggested a hierarchy of exposure data &amp; surrogates – ranking from best to poorest: quantified personal measurements, quantified ambient or area measurements in the vicinity of the residence or other sites of activity, quantified surrogates of exposure (e.g. estimates of drinking water use), distance from site and duration of residence, distance or duration of residence, residence or employment in reasonable proximity to site where exposure can be assumed, residence or employment in defined geographical area (e.g. a county) of the site. ATSDR has identified 7 priority health conditions: birth defects &amp; reproductive disorders, cancers (selected anatomic sites), immune function disorders, kidney dysfunction, liver dysfunction, lung and respiratory diseases, neurotoxic disorders. Of the studies reviewed by ATSDR only 4 environmental epidemiologic studies were supportive of adverse health effects from contamination of the ambient environment – methylmercury &amp; neurologic effects, Love Canal &amp; low birth weigh and short stature, polychlorinated biphenyls, and neuro-developmental effects, &amp; hepatotoxicity associated with chlorinated organic compounds. <strong>Key issues:</strong> For populations to be affected, an exposure pathway is required. A completed exposure pathway exists when a contaminant can be traced through 5 elements of an exposure pathway: identified source of contamination; environmental media &amp; transport pathways; geographic point of exposure or contact; biologic route of exposure; presence of a receptor population.</td>
<td>Misclassification of outcome a strong possibility from reporting bias for symptoms between target and comparison communities – tend to overemphasize potential health effects. Exposure misclassification – for studies that use exposure surrogates evidence of at least potential pathways of exposure is needed.</td>
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<td>To summarize the data and information that shape US ATSDR’s view that hazardous waste represents a significant concern as an environmental hazard to humans:</td>
<td>Data specific to the nature and extent of releases of substances from uncontrolled hazardous waste sites. Summarize ATSDR surveillance data bearing on frequency of occurrence, nature, &amp; health impact of substances released under emergency situations. ATSDR’s Hazardous Substance Release/Health Database (HazDat) data system.</td>
<td>In 1997, 1296 sites on US EPA’s National Priority List (NPL). 43% of current NPL sites are waste storage/treatment facilities or landfills, 31% are abandoned manufacturing facilities, 8% are waste recycling facilities, 5% mining sites, 4% government properties, and the rest miscellaneous. Classes of contaminants most frequently reported in ATSDR’s public health assessment (n=1719) – volatile organic compounds (75%), inorganic substances (71%), halogenated pesticides (37%), polyaromatic hydrocarbons (25%), phenols/phenoxy acids (23%), phthalates (22%), nitrosamines/ethers/alcohols (15%).</td>
<td>US Superfund top 10 priority substances: lead; arsenic; mercury, metallic; benzene; vinyl chloride; cadmium; polychlorinated biphenyls; benzo(a)pyrene; chloroform; benzo(a)fluoranthene. Superfund 10 substances found most often in completed pathways: trichloroethylene (45 studies), lead (42), tetrachloroethylene (34), arsenic (29), benzene (27), 1,1,1-trichloroethane (24), cadmium (23), chromium (23), chloroform (19), manganese (18).</td>
<td>5 elements of a completed exposure pathway: source of contamination, environmental medium, point of exposure, route(s) of exposure, receptor population. Top binary combination of contaminants in groundwater &amp; surface water (n=1188 studies): tetrachloroethylene &amp; trichloroethylene (279); chromium &amp; lead (225); 1,1,1-trichloroethane &amp; trichloroethylene (213); lead &amp; trichloroethylene (206); cadmium &amp; lead (204); benzene &amp; trichloroethylene (202); arsenic &amp; lead (194); 1,2-dichloroethene, trans &amp; trichloroethylene (172); toluene &amp; trichloroethylene (161); benzene &amp; lead (160). Health Effects Approx 41 million persons lived within 4-mile radius of the 1134 NPL sites. SES disadvantaged &amp; some minority groups disproportionately located in areas near hazardous waste sites (HWS). 23% of 1719 public health assessments for more than 1300 Superfund sites represented health hazards. Epidemiologic studies of cancer rates &amp; prevalence of adverse reproductive outcomes associate a small to medium increased risk to HWS when considered in the aggregate. However these studies have severe limitations in terms of human exposure information. Site remediation is consistent with reducing or preventing human exposure.</td>
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<td>To draw together scientific findings on incinerator emissions and their impacts on human health. (u)</td>
<td>Review of published research including human exposure studies, epidemiological studies, and risk assessment studies.</td>
<td>Occupational health studies: Studies on workers at incinerator plants, and populations living near to incinerators, have identified a wide range of associated health effects – elevated mutagens in urine, elevated levels of hydroxypyrene in urine, increased quantity of thioethers in urine, 3.5 fold increased probability of mortality from lung cancer, 2.79 fold increase in gastric cancer, excess hyperlipidemia – a significant association between blood dioxin levels &amp; natural killer cell activity (immune system effect), excess of proteinuria (urine abnormality) &amp; hypertension. Possible increased incidence of small airway obstruction (unconfirmed diagnosis), chloracne (skin condition due to dioxin-exposure). Health effects of living in vicinity of incinerators: cancer, respiratory effects, effects on sex ratio (increase in female births), congenital abnormalities, multiple pregnancy. Other health effects – increased allergies, incidence of common colds, complaints about health in general, increased use of medication.</td>
<td>Emission data to fully characterize environmental concentrations not readily available for most incineration facilities. Data usually based on a few stack samples rather than during full operations – adequacy of data to fully characterize the contribution of incinerators to ambient pollutant for health effects uncertain.</td>
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ATSDR = Agency for Toxic Substances & Disease Registry  
EPA = Environmental Protection Agency  
SES = socioeconomic status


(p) Johnson BL, Hicks HE, De Rosa CT. Key environmental human health issues in the Great Lakes and St Lawrence River Basins. Environ Res 1999;80(Sec A):S2-S12.


Appendix I: Advisory Board Members

Ron de Burger
Monica Campbell
Laurie Chan
Louis Corkery
Eric Dewailly
Jim Dosman
Louis Drouin
Nelson Fok
Judy Guernsey
Andy Hazlewood
Steve Hrudey
Susan Kennedy
Jack MacKinnon
Steve McColl
Andrew Papadopoulos