National Collaborating Centres for Public Health

Update on the NCCPH Small Drinking Water System Project

Sylvia Struck, Ph.D.
Environmental Health Scientist
National Collaborating Centre for Environmental Health

CIPHI Saskatchewan Branch Seminar
November 4, 2010
Outline

- NCCPH Overview
- Small Drinking Water Systems Project
- Project Update
- Questions/Discussion
National Collaborating Centres for Public Health (NCCPH)

Who are we?

- Six Centres created by the Federal government to strengthen public health in Canada
- Each Centre focuses on a specific area of public health

Mission:

Develop, translate, promote and support the use of existing and new evidence in public health to inform best practices nationally – and beyond
National Collaborating Centres for Public Health (NCCPH)

- National Collaborating Centre for Determinants of Health
- National Collaborating Centre for Infectious Diseases
- National Collaborating Centre for Environmental Health
- National Collaborating Centre for Methods and Tools
NCCPH
NCC Leads & Host Institutions

NCCAH – Margo Greenwood, PhD
University of Northern British Columbia, Prince George, BC

NCCDH – Keith De’Bell, PhD
St. Francis Xavier University, Antigonish, NS

NCCEH – Tom Kosatsky, MD, MPH
British Columbia Centre for Disease Control, Vancouver, BC

NCCHPP – François Benoit, MSc
Institut national de santé publique du Québec, Montreal, QC

NCCID – Margaret Fast, MD
International Centre for Infectious Disease Inc., Winnipeg, MB

NCCMT – Donna Ciliska, RN, PhD
McMaster University, Hamilton, ON
National Collaborating Centres for Public Health (NCCPH)

Goals

- Synthesize, translate, and exchange evidence-based knowledge to support front-line public health practitioners and policy-makers in Canada

- Identify gaps in the use of evidence in public health practice and policy making

- Strengthen national profile with significant contacts and networking across Canada

- Consult with front-line public health practitioners to identify promising practices, policy options and research gaps
Small Drinking Water Systems Project

- Environmental Scan conducted 2005-6
- Drinking water was the highest priority for the majority of interviewees
- Seen as a cross-cutting issue amongst NCCs
- NCCEH commissioned a Retrospective Surveillance of Waterborne Disease Outbreaks/Events
Background

- Lack of systematic information on characteristics and causes of waterborne disease events (WBE)
- Outbreaks provide opportunity to look into sources, health impacts and contributing factors to waterborne illness
- No national surveillance system in Canada for WBE; approaches to collection of information on outbreaks are not standardized
- Information collected is often not published distributed and often incomplete
Retrospective Investigation of Drinking Waterborne Illness Events

- Objectives of Study
  - Determine the characteristics of WBEs
  - Water source characteristics
  - Water Treatment and distribution
  - Demographic information and health outcomes

- Obtain information of direct relevance to prevention policies and programs
Study

- In-depth interviews of relevant front-line environmental health professionals
- 47 WBE were identified
- Most outbreaks happened in small systems (< 5,000 population)
- Most WBEs began in summer
- Most associated with surface water or combination
Study cont.

- About half WBEs were caused by protozoa - giardia and cryptosporidium
- 46% had disinfection only, 40% had no treatment
- Attributed factors to WBE
  - Inadequate treatment
  - Precipitation
  - Lack of source protection
  - Animals in watershed
Study cont.

- Response to WBE
  - Changed water source
  - Upgraded or changed treatment
  - Changed or improved policy, reporting or combination

- Study currently being re-analyzed for SDWS only
Consultations for SDWS Project

Consulted policymakers & practitioners, Aboriginal organizations and communities, and other experts

- CIPHI conference (May 2009)
- CPHA conference (June 2009)
- Toronto forum (June 2009)
- Montreal forum (September 2009)
- Online Survey (ended October 2009)
Results of Consultations

Identified gaps were prioritized within each of these six areas:

- Testing
- Treatment
- Surveillance
- Interventions
- Policy
- Education
Online Survey

Developed using SurveyMonkey™, a web-based survey tool, and was linked from the NCCPH website (www.nccph.ca).

- Invitations sent via e-mail
- 132 participants representing all provinces and the Northwest Territories

Survey participants occupation

- Local or regional health department/authority: 80
- Provincial or territorial health ministry/department/agency: 9
- Federal health department/agency: 5
- Researchers or other representatives from an academic institution: 4
- Local community representatives: 4
- Other occupations: 1
- Water supplier: 1
Small Drinking Water Projects

1. Description of roles and responsibilities
2. Production of a user guide to home water testing
3. Review of applicability of treatment technologies
4. Creation of a database of notifiable waterborne diseases
5. Review of effective strategies for risk communication
6. Review of drinking water and its impact on pregnancy and children’s health
7. Inventory and summary of Canadian and international projects in SDWS
8. First Nations SDWS
1. Roles and Responsibilities

Components:
- Source water protection
- Water treatment and distribution
- Drinking water quality and monitoring
- Waste management
- Surveillance
- Role of community in provision of safe drinking water
Roles and Responsibilities
(partial sample only)

1. Source Water Protection:
   - Who has stewardship role related to water source protection?
   - Who overseas liquid waste?
   - Who is responsible for land use planning activities?
   - Who is responsible for ensuring activities such as construction, infrastructure, mining, etc do not degrade source water?
   - Who delivers permits to draw water?
   - Who has control over watershed?
   - Who is responsible for watershed management plan?
   - Any source vulnerability assessment?
Example Gaps

British Columbia

Source Water Protection:
- Source vulnerability assessment & ranking (in progress) Min. of Health Services currently revising

Water Treatment & Distribution:
- Fee for water distribution

Drinking Water Quality & Monitoring:
- Chemical testing (not required but DWO can order)

Surveillance:
- No overall policy; guided regionally
# Roles and Responsibilities
*(partial sample only)*

<table>
<thead>
<tr>
<th>Location</th>
<th>Organization/Personnel</th>
<th>Source</th>
<th>Treatment</th>
<th>Quality</th>
<th>Waste</th>
<th>Surveillance</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>Lieutenant Governor in Council</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ministry of Healthy Living &amp; Sport</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minister - Healthy Living &amp; Sport</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provincial Health Officer/Authority</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Regional Health Authorities</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medical Health Officer</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Provincial Drinking Water Officer</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional Drinking Water Officers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water System Owner</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Supplier</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PH Engineer</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Home Water Testing

- Extensive search for home test kits
- Contact with producers

Findings:

- 12 kits reviewed
- Only 2 had independent EPA testing
  - Nitrate: false positives 0-14%
    - false negative 32-38%
  - Atrazine, Simazien: false positive 14%
    - false negative 0%

Fact Sheet up on website
3. Treatment Technologies

Treatment Preferences:

- Low construction & operating costs
- Simple operation
- Low maintenance & low labour requirements
- No serious residual disposal
- Specific to the water characteristics
- Pilot plant testing is essential, even for packaged plants!
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Level of operational skills</th>
<th>Level of maintenance</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Coagulation-filtration package plants         | • Coagulation chemistry must be managed properly | • Cleaning or backwash required | • Ready to operate  
• Little flexibility  
• Alternative to large scale coagulation-filtration which is complicated |
| Slow sand filtration                          | • Basic                      | • 2 to 5 hours per month | • No access to electrical power needed  
• Low turbidity water  
• Does not remove all microorganisms |
| Diatomaceous earth filtration                 | • Basic                      | • Cleaning filter every 1-4 days | • Removes *Giardia* and *Cryptosporidium* (oo)cysts  
• Fine grade can remove bacteria, however use of coagulant chemical required for virus removal  
• If no chemical used, residue can be discarded to landfill  
• Does not remove all microorganisms |
| Precipitative softening                       | • Can require advanced operator skills  
• Knowledge in water chemistry needed        | • Require regular attention | • Due to complexity of fluctuation of water characteristics, used only for well water  
• Removes a wide range of contaminants including nitrate and arsenic  
• Lime sludge can usually be suitable for application to farmland |
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Level of operational skills</th>
<th>Level of maintenance</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Reverse Osmosis                                | •Low level                  | •Low level           | •Expensive waste removal  
•Potential issue with fouling, may require pH reduction to 5-6  
•Expensive technology when compared to other systems  
•More appropriate for treatment of groundwater than surface water  
•Very effective removal of microbial, inorganic chemicals, metals, radium, minerals and some organic chemicals |
| Granulated activated carbon                    | •Low level                  | •Backwash required   | •Organic chemicals  
•For groundwater or filtered surface water  
•Absorbs aromatic compounds, chlorinated aliphatics, pesticides and herbicides  
•Disposal of radioactive decay product of radon may be a problem |
| Ceramic membrane filtration without chemical pre-treatment | •Low level                  |                      | •Eliminating the use of coagulants reduces complexity and cost of treatment operation  
•Work best for low turbidity waters |
Water Treatment Database

- Types of treatment applicable to SDWS
- Advantages, Disadvantages, Issues where known
- Level of skill, ease of operation, maintenance
- Other, feedback on how information should be presented
## Example Database

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Use</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disinfection Chlorine Gas</td>
<td>Appropriate as primary or secondary disinfectant for microbial pathogens</td>
<td>Effective….</td>
<td>Dangerous….</td>
<td>Adequate mixing and contact time must be provided to ensure complete disinfection of pathogens</td>
</tr>
<tr>
<td>UV</td>
<td>Effective bacteria and virus</td>
<td>No known toxic residual, easy to operate and maintain….</td>
<td>Not suitable for water with high suspended solids, turbidity….</td>
<td>Use for GW not directly influenced by SW where no risk of protozoan cysts</td>
</tr>
<tr>
<td>Filtration Slow Sand Filtration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Disinfection Chlorine Gas**: Appropriate as primary or secondary disinfectant for microbial pathogens. Effective disinfection of pathogens requires adequate mixing and contact time. Disadvantages include being dangerous, necessitating proper handling and use to prevent accidents.

- **UV**: Effective against bacteria and virus. Known for its non-toxic residual and ease of operation, making it efficient for disinfection. However, it is not suitable for water with high suspended solids or turbidity due to operational limitations. Useful for groundwater where no risk of protozoan cysts is present.

- **Filtration Slow Sand Filtration**: While filtration is a common method, specific advantages and disadvantages are not detailed in this table.
4. Waterborne Disease Outbreaks

Review of surveillance systems for waterborne disease outbreaks in Canada and internationally

- No formal surveillance conducted nationally
- Scattered informal surveillance conducted at provincial, local, and university levels
- Reporting only done through journal articles, case studies, etc.

GAP: National Surveillance system for waterborne disease outbreaks
Notifiable Disease Database

Reporting of notifiable diseases is conducted at the provincial level

- Different requirements in each jurisdiction
- Includes various diseases/conditions (both waterborne and other)

Reporting at the federal level is voluntary

http://www.flickr.com/photos/bjarkih/2538316297/
Notifiable Disease Database

**STEP 1:** Compile and compare *notifiable disease reporting requirements* in all Canadian jurisdictions

- What is reported: pathogen, disease, case definition
- Who reports: physician, laboratory, veterinarian
- Classifications: *waterborne*, foodborne, STBBI, zoonotic, respiratory
- Stored online and accessible to PH practitioners
- Includes search and comparison capabilities

**STEP 2:** Use results from database to inform NCC SDWS projects and further work, make recommendation on reporting of waterborne disease outbreaks
5. Risk Communication – Systematic Review

Environmental Health Risk Communication incl. Boil Water Advisories

Questions:

- Which strategies are most effective for communicating environmental health risks?
- Which factors relate to environmental risk communication uptake?
Risk Communication – Systematic Review

Literature suggests:

- From a trusted source
- Tailored to the audience
- Multi-media approach is more effective than any single
- Incorporate text with visuals (pictures, diagrams) with qualitative and quantitative data for print materials
- Disseminate through multiple sources and channels
Risk Communication

- Deliver warning system notices on a regular and on-going basis.
- Develop communication strategies with the awareness that people make choices based on personal past experience.
- Ensure the public have an opportunity to address questions and concerns.

*Fact Sheet available on website*
6. Drinking Water and Impact on Pregnancy and Children’s Health

- Trihalomethanes—possible increase in reproductive and developmental effects
- Nitrate—health risk for infants under 6 months, blue baby syndrome
- Arsenic—need more data to confirm neg. effects, reproductive outcomes
- Lead exposure—may lead to physical and mental developmental delays
- Microbial—GI problems
Drinking Water and Impact on Pregnancy and Children’s Health

Recommendations identified by the Canadian Partnership for Children’s Health and Environment:

- Support research, monitoring and publications of health impact of contaminants on foetuses and children
- Evaluate Government policies in terms of foetal and childhood exposures to drinking water contaminants
- Publish performance measures of children’s environmental health including water quality indicators
7. Links to Other Small Drinking Water Projects

Summarized and linked to information on water related projects across Canada and internationally

- Walkerton Clean Water Centre
- Canadian Network for Public Health Intelligence (CNPHI) drinking water modules
- Environmental Operators’ Certification Program (BC)
- Small Community Water Supplies Task Group
- RES’EAU Water Network
- C-EnterNet
- Small Water Users Association of British Columbia
- Circuit Rider programs

http://www.nccph.ca/182/Other_Initiatives_and_Projects_in_Canada.ccnsp
External Resources Link


- Definitions
- Background
- Aboriginal Issues
- Education
- Directories
- Interventions
  - Boil water advisories
  - General
- Monitoring
  - Risk Assessment
- Procedural Manuals or Guidelines
- Testing
- Treatment
- Waterborne Illness (Surveillance)
- Websites
Circuit Rider Training Programs (CRTP)

- National training program began in Canada mid-1990s
- Customized training program for water and wastewater operators in remote locations
- CRTP takes into consideration:
  - Educational background of trainees
  - Remote location of the communities
  - Unique culture of First Nations peoples
- Circuit riders (trainers) are experts in the field with years of experience; personally oversee training of operators in several communities (the circuit)
CRTP continued

- One-on-one hands-on training on-site:
  - water and sewage treatment
  - health and safety guidelines
  - community awareness promotion
  - water testing

- Pass on important skills, answer questions, aid in licensing certifications, and offer troubleshooting and problem-solving for typical water treatment problems

- Now in every province and territory (except Nunavut) with plans for more expansion over the next 5 years
8. First Nations SDWS

- Collaborative project with Assembly of First Nations (AFN)
- Evidence Reviews
  - State of Knowledge on SDWS in First Nations communities across Canada
  - Regulatory Issues
    On-Reserve

http://www.flickr.com/photos/peupleloup/2626448826/
NCCPH link to SDWS Project

Next Steps

- Develop a quarterly e-magazine describing current and promising practices

- Put together a repository of SDWS information

- Continuing consulting with users of this information and experts
Questions for You/ Discussion

- What do valuable tools and products look like?
- What types of informational material are necessary to fill the gaps?
Thank you!

Contact:

E-mail:  info@nccph.ca
Sylvia.Struck@bccdc.ca
Website:  www.nccph.ca

Funded by the Public Health Agency of Canada