Water-borne Disease Outbreaks in Canadian Small Drinking Water Systems

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National Collaborating Centre for Environmental Health
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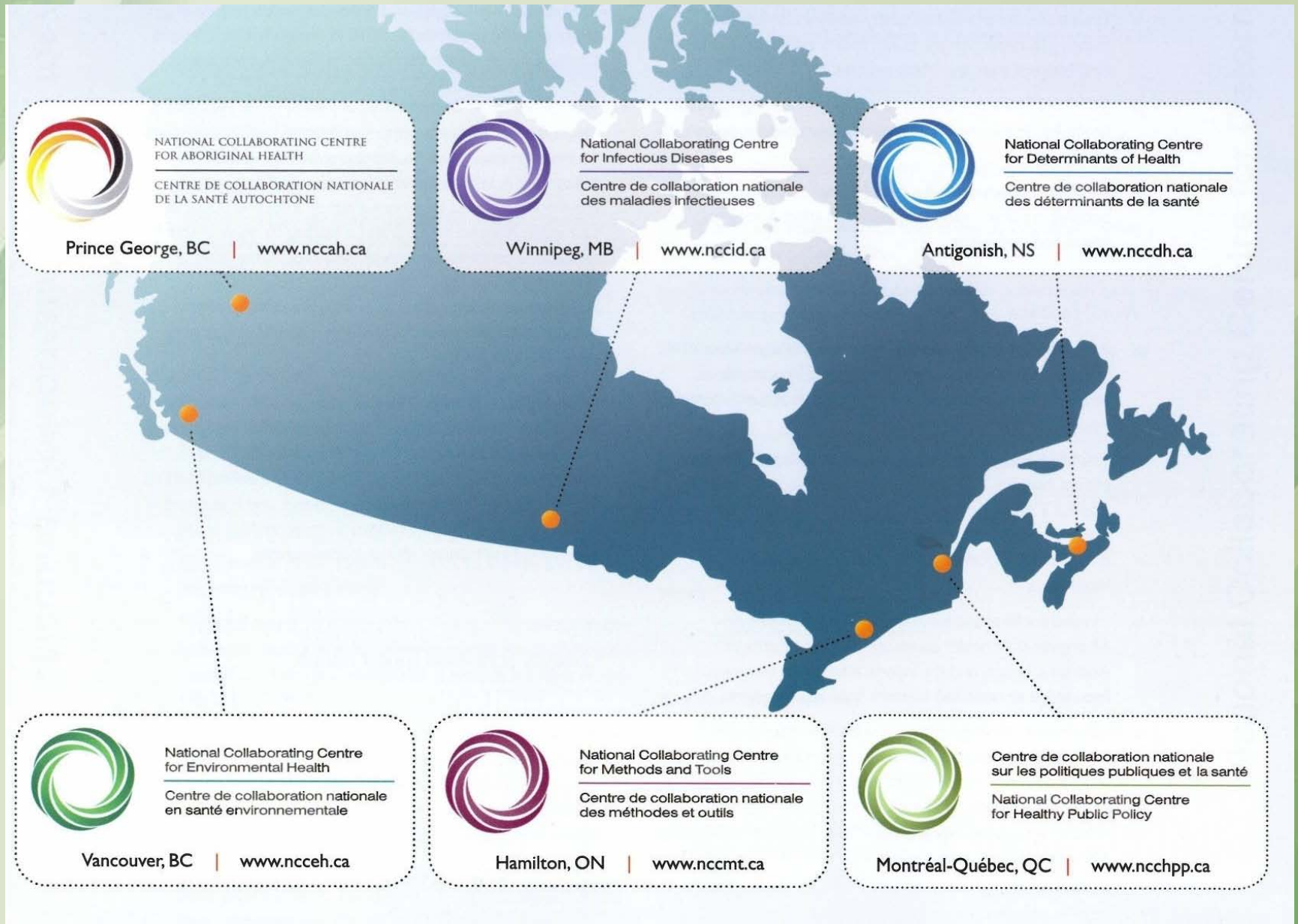

Goals of all NCCs

- Synthesize and translate evidence-based knowledge
- Identify gaps in the use of evidence in public health practice and policy making
- Strengthen national profile and networking across Canada
- Consult with front-line public health practitioners to identify promising practices, policy options and research

National Collaborating Centre for Environmental Health (NCCEH)

- Focus on the health risks associated with the *physical environment* (natural and built) and identify evidence-based interventions to reduce those risks
- Act as a resource for environmental health practitioners and policy-makers across Canada

Major Project Areas

- Built environment
- Drinking water
- Heat advice
- Outdoor air
- Personal service establishments





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Small Drinking Water Systems Project

- Collaborative effort among the NCCs
- The purpose is to improve small drinking water systems by identifying gaps and providing the necessary evidence to inform policy and practice
- SDWS defined as serving a population of < 5,000
- Forums, workshops and an online survey to gather input from front line practitioners, policy-makers, local drinking water officials and other experts in water safety

NCCEH Water-borne Events Retrospective Study

- Lack of systematic information on characteristics and causes of water-borne disease events (WBE)
- Outbreaks provide opportunity to look into sources, health impacts and contributing factors to water-borne 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 or distributed and often incomplete

NCCEH Water-borne Events Retrospective Study

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

- Obtain information of direct relevance to prevention policies and programs

http://www.ncceh.ca/en/practice_policy/ncceh_reviews/dw_illnesses_surveillance

Retrospective WBE Study

- 1993-2008, 48 events, based on interview data with relevant front-line environmental health professionals
- Most outbreaks happened in small systems (< 5,000 population)
- Data reanalysed to focus on SDWS and combined with other studies
  - Schuster et. al. (2005)
  - Hrudey and Hrudey (2004)

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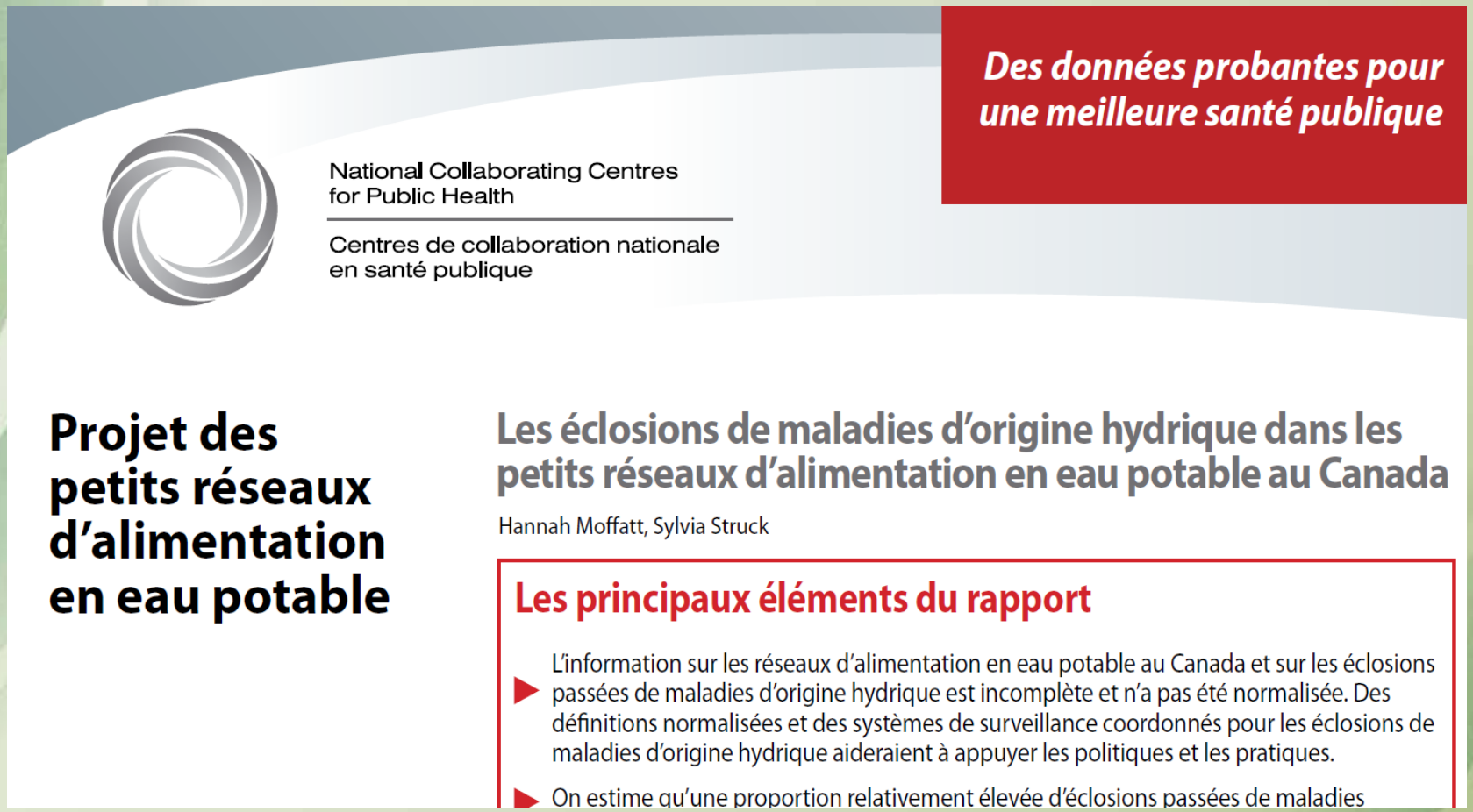


WATER-BORNE DISEASE OUTBREAKS IN CANADIAN SMALL DRINKING WATER SYSTEMS

S. Struck, 2012

Water-borne Disease Events

- Preventable
- However limited knowledge of factors
- Investigations difficult
  - Rare
  - Can be transmitted via multiple routes
  - GI illness frequently under-reported

WBE Report Objectives

- Provide a brief overview of Canadian drinking water systems
- Describe trends of past water-borne disease outbreaks
- Describe characteristics and factors contributing to outbreaks in small drinking water systems
- Discuss practices for preventing water-borne disease outbreaks in small drinking water systems

Overview of Canadian DWS

- Classification
  - Ownership
    - Private
    - Semi-private
    - Public
  - Number of connections
  - Population served
- Approximately 5 million served by SDWS

Overview of Canadian DWS

- Source water
  - Majority (92%) of Canadians with *private* water supply from groundwater sources
  - Majority (85%) of Canadians with *public* water supply from surface water sources
- Treatment practices
  - 55% of treated water from conventional or direct filtration serving about half the population (Stats Can 2007)
  - 8.7% of drinking water systems serving communities of 300 or more do not utilize any treatment process (Stats Can 2007)

Recent Investigations of WBE

- Novometrix, 2009
  - 1993-2008, collected through standardized questionnaire and interviews with public health representatives
  - 48 events identified
  - Limitations: retrospective, recall bias, incomplete records, biased towards larger events?, non-response rate was 29%

Recent investigations of WBE

- Hrudey and Hrudey, 2004
  - In-depth case studies of water-borne disease outbreaks in Canada and industrialised countries
  - Summary of important themes and broader context of themes

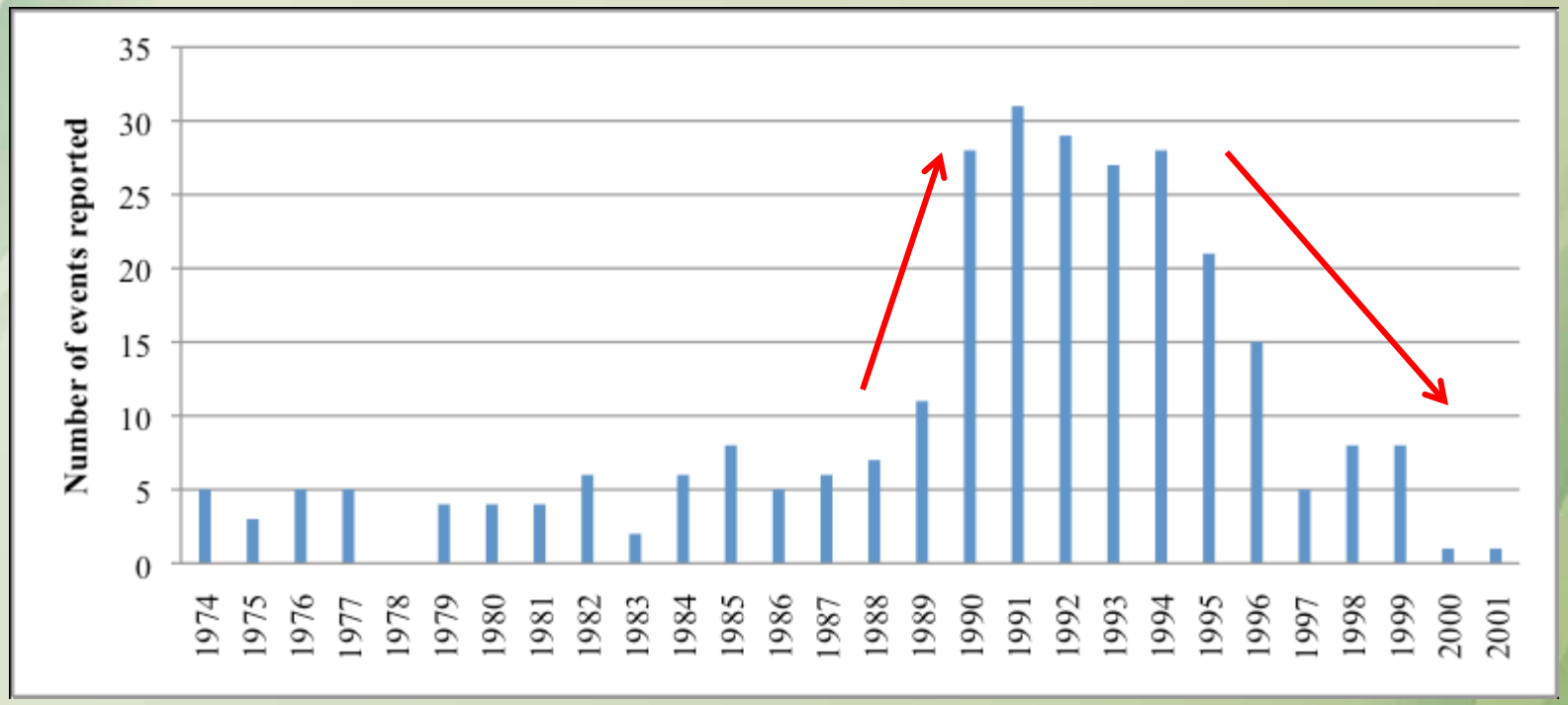
Recent investigations of WBE

- Schuster et. al, 2005
  - 1974-2001, collected through outbreak summary reports (HC, Quebec), academic and grey lit
  - 288 *definite*, *probable*, and *possible* water-borne disease outbreaks
  - Greater number of events but not all maybe water-borne and less specific information about event and size of population

Defining WBE

- Schuster – incident in which more than 2 cases of illness occurred after ingestion from the same water source
- Novometrix – suspected or confirmed acute illness involving 2 or more and included events involving individual where clear point source
- Both Novometrix and Schuster report a high proportion of outbreaks in Quebec due to enhanced surveillance

“Definitely”, “probably” and “possibly” WBE from 1974 - 2001



Source: Schuster C, Aramini J, Ellis A, Marshall B, Robertson W, Medeiros D, et al. Infectious disease outbreaks related to drinking water in Canada, 1974-2001. Can J Public Health. 2005 Jul-Aug;96(4):254-8. Available from: http://journal.cpha.ca/index.php/cjph/article/viewFile/634/634.

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Number of water-borne disease events (1993-2007)

Year	Number of water-borne disease events
1993	5
1994	5
1995	8
1996	5
1997	2
1998	5
1999	0
2000	7
2001	2
2002	1
2003	0
2004	1
2005	1
2006	2
2007	2
No date reported	2
Total	**48**

Source data: Wilson J, Aramini J, Clarke S, Novotny M, Quist M, Keegan V. Retrospective surveillance for drinking water-related illnesses in Canada, 1993-2008: Final report. Moffat, ON: Novometrix Research Inc2009 Aug. Available from: http://www.ncceh.ca/practice_policy/ncceh_reviews/dw_illnesses_surveillance.

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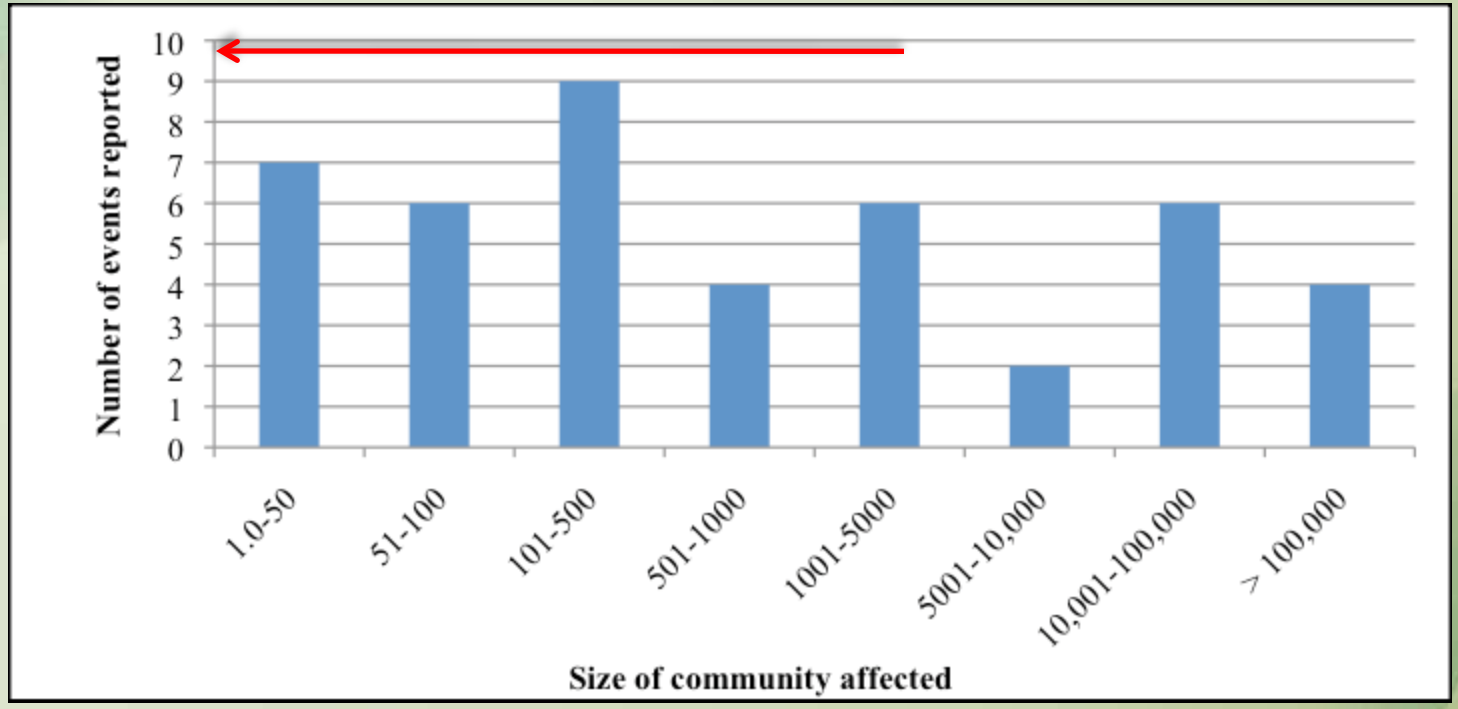
Distribution of WBE investigated by according to size of population served



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Number of infectious disease outbreaks (1974-2001)

Source	Public	Semi-public	Private	Total
Definitely water-borne	59	28	12	99
Probably water-borne	17	25	19	61
Possibly water-borne	23	85	20	128
Total	**99**	**138**	**51**	**288**

Source: Schuster C, Aramini J, Ellis A, Marshall B, Robertson W, Medeiros D, et al. Infectious disease outbreaks related to drinking water in Canada, 1974-2001. Can J Public Health. 2005 Jul-Aug;96(4):254-8. Available from:

http://journal.cpha.ca/index.php/cjph/article/viewFile/634/634.

Distribution of infectious disease outbreaks in *public* water systems by size of population served

Population size	Number of outbreaks
100 – 999	6
1,000 – 1,999	15
2,000 – 2,999	9
3,000 – 3,999	7
4,000 – 5,000	6
5,001 or more	44
Total	**87**

50%

Source: Schuster C, Aramini J, Ellis A, Marshall B, Robertson W, Medeiros D, et al. Infectious disease outbreaks related to drinking water in Canada, 1974-2001. Can J Public Health. 2005 Jul-Aug;96(4):254-8. Available from:

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Type of water treatment by water source at time of SDWS infectious disease outbreaks

Type of treatment	Groundwater	Surface water	Mixed	Total
None	10	5	0	15
Disinfection only	5	8	1	14
Disinfection and filtration	0	1*	1	2
Total	**15**	**14**	**2**	**31**

*Failure of Filtration

Source: Wilson J, Aramini J, Clarke S, Novotny M, Quist M, Keegan V. Retrospective surveillance for drinking water-related illnesses in Canada, 1993-2008: Final report. Moffat, ON: Novometrix Research Inc2009 Aug. Available from: http://www.ncceh.ca/practice_policy/ncceh_reviews/dw_illnesses_surveillance.

Factors contributing to outbreaks

- Lack of source water protection
- Precipitation, spring thaw and high turbidity
- Inadequacy or failure of water treatment
- Malfunctioning distribution system
- Other..

Current event detection and prevention practices

- Event detection
  - Patients, physician and lab, water quality monitoring, epidemiological investigations…
- Advisories
  - Issued as response to outbreak but not always effective
- Changes to system management
  - Improvements, change water source
- Monitoring water quality

Monitoring program in SDWS reported by Novometrix (1993-2007)

	Number of events reported			
Water monitoring program in place?	**Private responsibility (alone)**	**Governement responsibility (alone or in combination with private)**	**Unknow responsibility**	**Total**
Yes	5	11	0	16
No	11	0	1	12
Unknown	1	3	1	5
Total	**17**	**14**	**2**	**33**

Source: Wilson J, Aramini J, Clarke S, Novotny M, Quist M, Keegan V. Retrospective surveillance for drinking water-related illnesses in Canada, 1993-2008: Final report. Moffat, ON: Novometrix Research Inc2009 Aug. Available from: http://www.ncceh.ca/practice_policy/ncceh_reviews/dw_illnesses_surveillance.

Monitoring

- System owners responsible
  - Many private owners not monitoring
  - Only 35% of HH testing drinking water (Stats Can)
  - 21% had never tested (Jones et al 2006)
  - Only 8% tested as prescribed by guidelines
  - Inconvenience, lack of problems
- Programs more likely to be implemented and maintained when governmental bodies involved

Themes of drinking water provision

- Pathogens pose greatest risk to drinking water safety
- Robust, effective, multiple barriers to drinking water contamination are needed
- Trouble is usually preceded by change
- Operators must be capable and responsive
- Drinking water professionals must be accountable to consumers
- Ensuring safety is an exercise in risk management

Conclusions

- Small and private drinking water systems may be more vulnerable
- Novometrix: (75%) of water-borne disease outbreaks SDWS
- Schuster et al., a high proportion of events occurred in SDWS classified as semi-public (48%) and private (18%) water systems
- Approximately 34% of the enteric disease outbreaks occurred in public water systems ~ 50% in systems serving populations of < 5,000 people

Unanswered questions

- Resistance, adaptation and tolerance to enteric pathogens
- How many water-borne outbreaks are under-reported?
- What role does public opinion play in inadequate treatment practices?
- How does the collaborative management of systems affect system operations?

Thank you!

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