Retrospective Investigation of Drinking Water-related Illnesses in Canada

1993-2008

The Canadian Institute of Public Health Inspectors (ON Br.)
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An Agency of the Provincial Health Services Authority

Outline

- Introduction to NCCEH and project
- Report of "Retrospective Investigation of Drinking Water-related Illnesses in Canada"
- Next steps: Small Drinking Water Systems Project

The NCCs

- One of six national collaborating centres
- Funded by the Public Health Agency of Canada (PHAC) – at arm's length
- Each is hosted by a different institution
- Each focuses on a different aspect of public health

The NCCs

1. Environmental Health – BCCDC
2. Aboriginal Health – Univ of Northern BC
3. Infectious Diseases – International Centre for Infectious Diseases
4. Methods & Tools – McMaster Univ
5. Healthy Public Policy – Institut national de santé publique du Québec
6. Determinants of Health – St. Francis Xavier Univ

Function of the NCCs

- Synthesizing, translating, & exchanging knowledge
- Identifying gaps in knowledge
- Building networks & capacity

NCCEH

- Environmental health (EH) – initially defined as services/programs currently delivered by regional & local health agencies throughout Canada
- Client group – people who deliver those services/programs or set the policy framework for delivery
- Plan to broaden definition to include environmental hazards with reasonable evidence of significant potential burden of illness

NCCEH Approach

- Defining the audience
- Listening to their needs
- Linking to what's already available
- Partnering with researchers
- Providing quality products
- Getting feedback

Evolution of Drinking Water Project

- Environmental scan in 2005-6
- Drinking water was the highest priority for the majority of interviewees
- Warranted a major project in this area
- Found surveillance information lacking
- Contracted out project over multiple years

The Project

Retrospective Investigation of Drinking Water-related Illnesses in Canada 1993-2008

Background

- Lack of systematic information on characteristics & causes of waterborne disease
- Outbreaks of waterborne disease (WBE) provide a window into sources, health impacts, contributing factors to waterborne illness
- No national surveillance system in Canada for waterborne disease outbreaks; approaches to collection of information on outbreaks are not standardized
- Information collected is often not published, distributed, often incomplete

Background (cont.)

- Investigation was undertaken in order to obtain:
  - Detailed
  - Standardized

  Information on past WBE's, 1993 - 2008

- In-depth interviews of relevant front-line environmental health professionals

Objectives

(i) Characteristics of WBE's

(ii) Water source characteristics pre- and post-WBE

(iii) Water treatment and distribution pre- and post-WBE

(iv) Demographic info & health outcomes for WBE's

Objectives (cont.)

(i) Contributing factors & outbreak control for WBE's

(ii) Prevention programs or policies stemming from the WBE

(iii) Programs in place to detect or prevent WBE's

(iv) Information needs with respect to WBE's

Project Advisory Committee (PAC)

- 12 FPT representatives bringing regional, provincial, federal; urban, and rural, front-line and academic perspectives
- *in the areas of* ….
- water quality management, treatment, waterborne disease surveillance and more....

DCI – Data Collection Instrument

- Event date
- Event location
- Water source description
- Water treatment description
- Water system classification
- Watershed type and status
- Nature of water distribution system
- Microbiologic agents identified
- Water quality parameters
- Number of confirmed cases
- Hospitalizations
- Other clinical syndromes identified
- Deaths
- Age distribution
- Gender distribution
- Strength of evidence of waterborne source of outbreak
- Actions following event
- Investigation methods
- Resulting policy changes
- Gaps and needs in outbreak prevention and control identified
- Advocacy approaches used
- Nature of desired knowledge translation tools

Results

- Contacted all RHA's in:
  - AB ON SK NF QC
- Directed to select contacts
  - BC MB
- Single contact covered entire province or Territory
  - NS NB PEI YK NWT NU

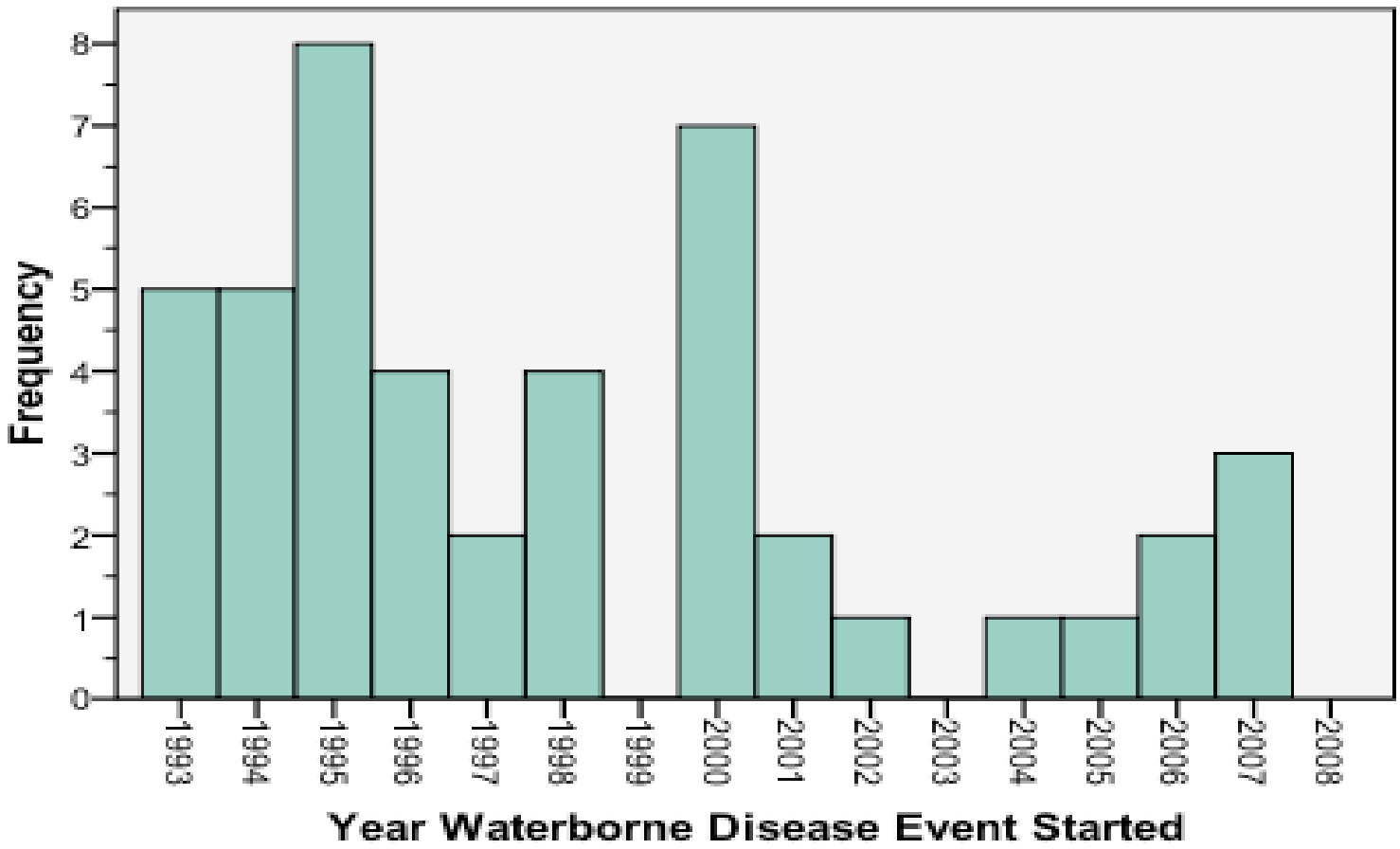
Compliance

Provinces	Successful Contacts	Attempted Contacts	Success (%)
Alberta	9	9	100.0%
British Columbia	13	14	92.9%
Manitoba	2	3	66.7%
New Brunswick	0	1	0.0%
Newfoundland	4	4	100.0%
Northwest Territories	1	1	100.0%
Nova Scotia	1	1	100.0%
Nunavut	1	1	100.0%
Ontario	22	36	61.1%
Prince Edward Island	1	1	100.0%
Quebec	8	17	47.1%
Saskatchewan	8	11	72.7%
Yukon	1	1	100.0%
TOTAL	71	100	71.0%

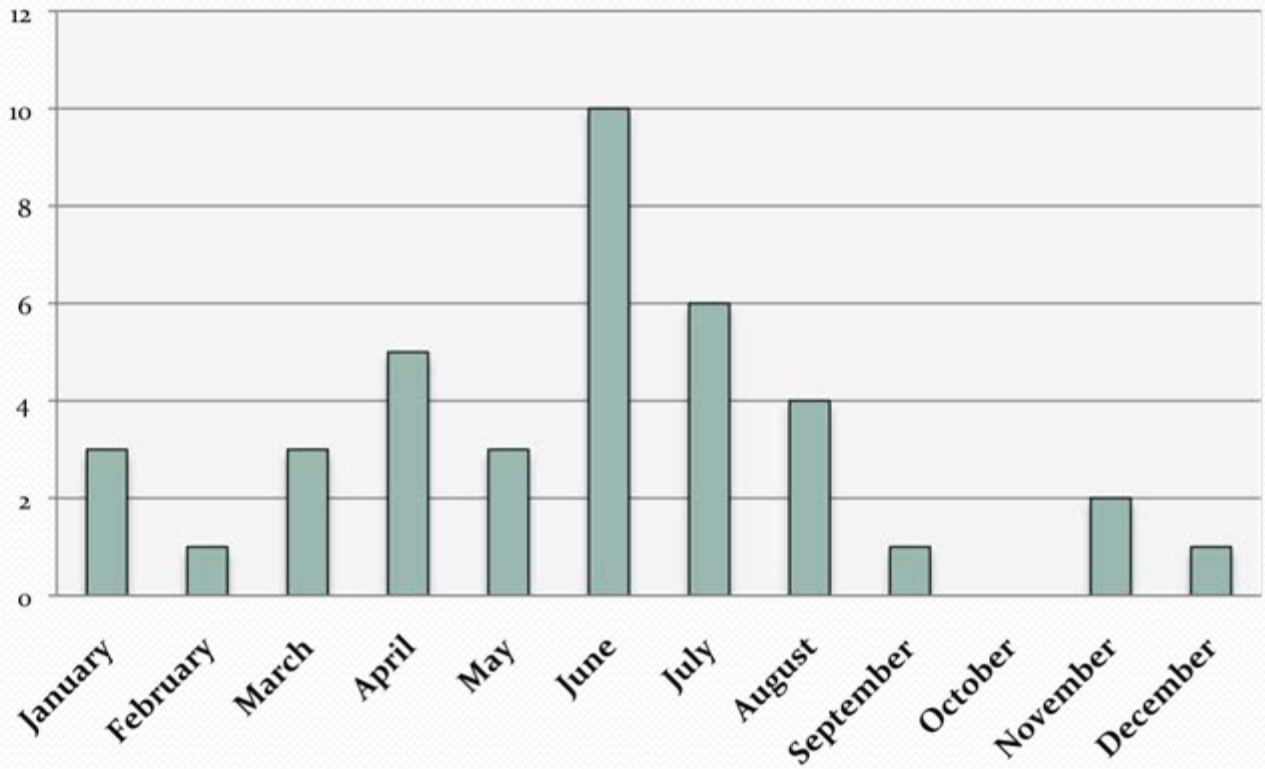
Interviews

Outbreaks:	47	
Non-Outbreaks:		41
Total:	88	

Year of WBE Started



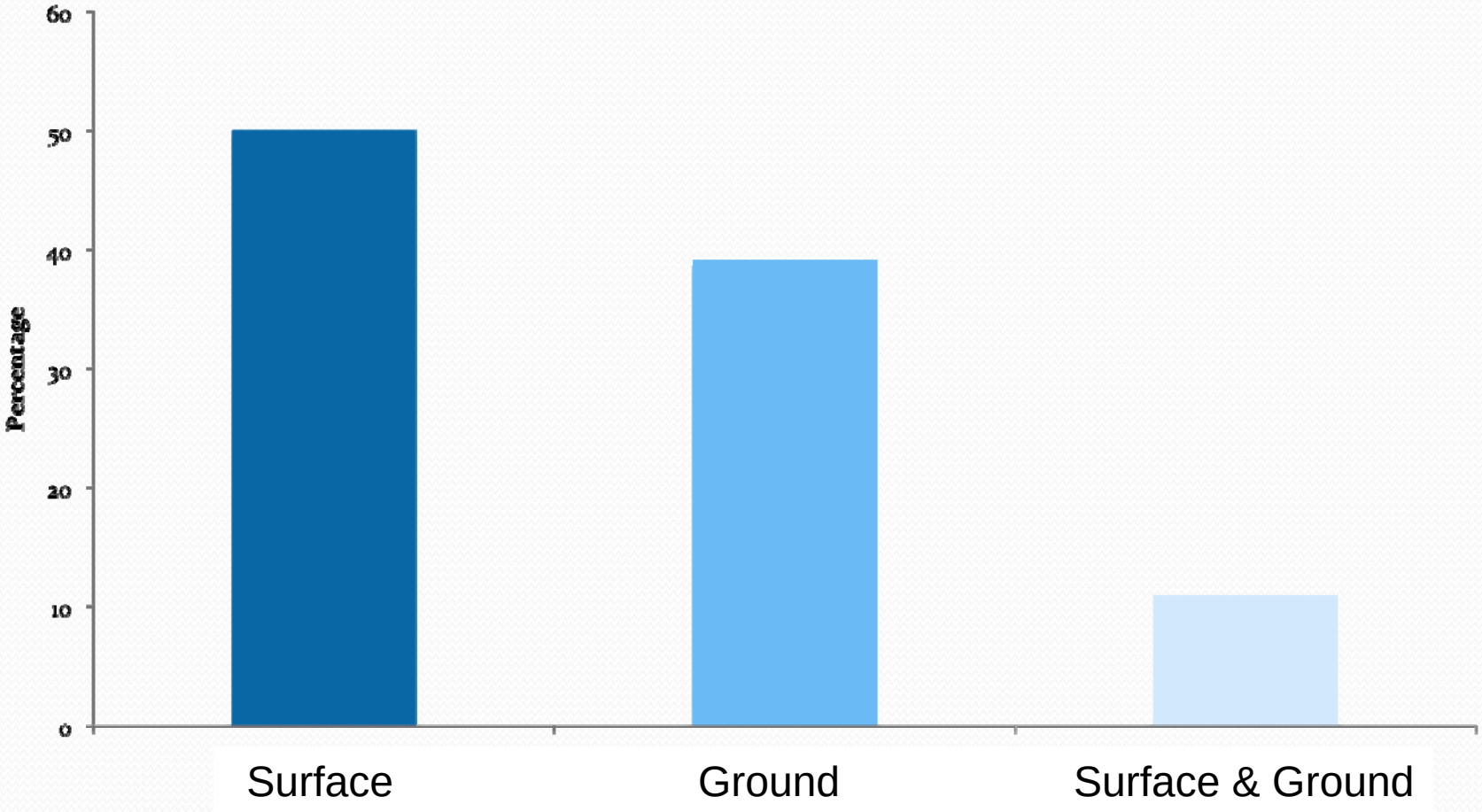
Season Events Began



Etiologic Agent

WBE Agent	Frequency (%)	
Giardia	10	(21.3)
Cryptosporidium	7	(14.9)
Cryptosporidium & Giardia	2	(4.3)
Toxoplasma	1	(2.1)
Campylobacter	3	(6.4)
E. coli	3	(6.4)
E. coli & Campylobacter	1	(2.1)
Legionella	1	(2.1)
Salmonella	1	(2.1)
S. aureus	1	(2.1)
Total coliform	1	(2.1)
Norovirus	4	(8.5)
Hepatitis A	3	(6.4)
Chemical	2	(4.3)
Not identified	7	(14.9)
Total	**47**	**(100.0)**

Water Source



WBE Agent by Water Source Type

- Protozoal outbreaks occurred most frequently in association with surface water sources

- Bacterial and viral more commonly with ground water

Surface Water Protection

84% of surface watersheds were unprotected

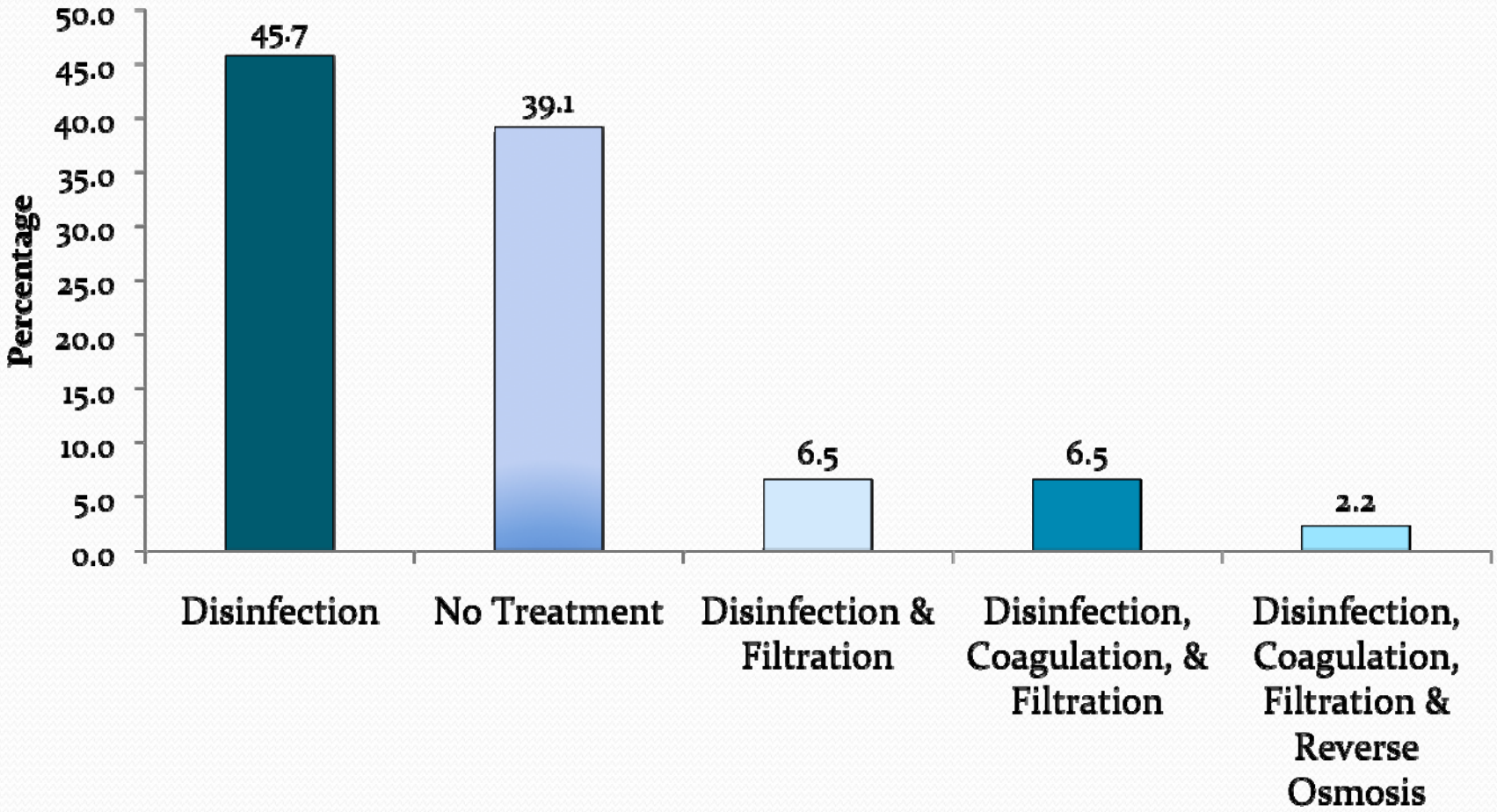
Nature of Ground Water Source

- 53% of WBE's involving ground water reported to be under the direct influence of surface water
- 66.6% of WBE's involving ground water reported a protected well-head
- 37.5% of WBE's reported a change in integrity of the well or aquifer

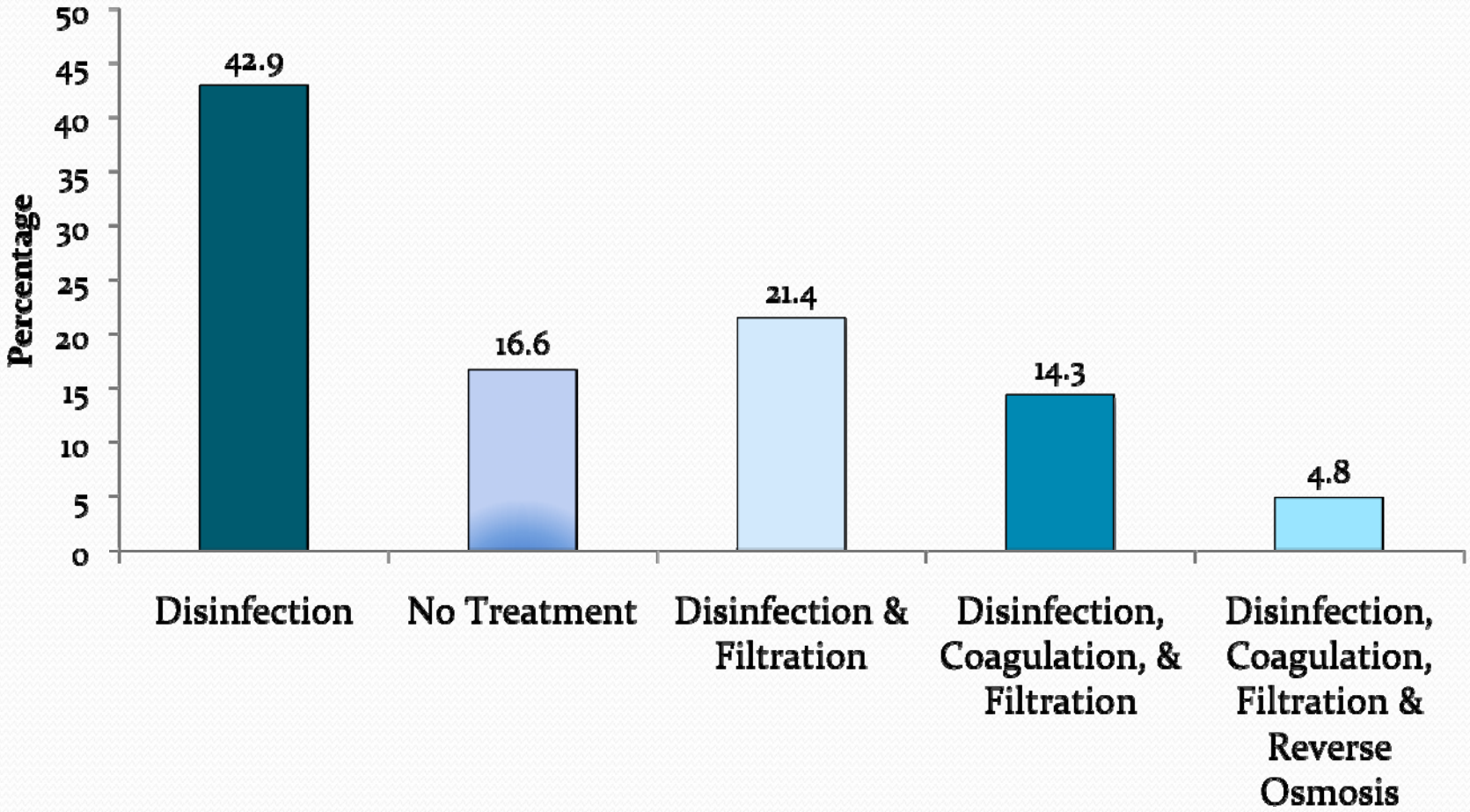
Comparison of Water Source During WBE and at Time of Interview

Water Source During WBE	Number (%)	
Surface Water	23	(50.0)
Ground Water	18	(39.1)
Mix of Surface & Ground	5	(10.9)
Total	46	(100)
Water Source at Time of Interview	**Number (%)**	
Surface Water	16	(34.8)
Ground Water	23	(50.0)
Mix of Surface & Ground	5	(10.9)
Closed Facility	2	(4.3)
Total	46	(100.0)

Water Treatment at Time of WBE



Water Treatment at Time of Interview



Type and Frequency of Water Quality Monitoring

	Chlorine Number (%)		Turbidity Number (%)		Coliform/E. coli/Chemicals Number (%)		Giardia/ Cryptosporidium Number (%)	
Daily	1	(4.0)	1	(4.8)	1	(2.9)		
Weekly					4	(11.4)		
Biweekly	1	(4.0)	1	(4.8)				
Monthly					3	(8.6)	2	(9.1)
Sometimes	4	(16.0)			7	(20.0)	1	(4.5)
Yearly	2	(8.0)	2	(9.5)	2	(5.7)	2	(9.1)
Acc. to Standards	5	(20.0)	5	(23.8)	6	(17.1)	5	(22.7)
Not at all	12	(48.0)	12	(57.1)	12	(34.3)	12	(54.5)
Total	25	(100.0)	21	(100.0)	35	(100.0)	22	(100.0)

Demographic Characteristics of WBE

	Number of People Served by Water Supply	Number of People Who Became Ill	Number of Lab-Confirmed Cases
Mean	26,969.9	654.4	40.6
Median	437.5	20.0	13.0
Minimum	4	0	0
Maximum	390,000	15,000	283
Number of WBE	42	39	37

Demographic Information

- Giardia outbreaks
  - Affected smaller populated communities (mean 2,212.6)
  - Fewer clinical cases (mean 20.6)
- Cryptosporidium outbreaks
  - Tended to affect larger communities (mean 138,642.9)
  - Caused more cases (mean 3,173.3)

Demographic Information

- Surface water (vs ground water)
  - WBE involved larger populations
  - More cases
- Age and sex of cases
  - Mean age of 38.1 (29-65)
  - 50% female

Hospitalizations

Hospitalizations	Frequency (%)	
Yes	9	(37.5)
No	13	(54.2)
In seniors home	2	(8.3)
Total	24	(100.0)

- 1 WBE had fatalities

Contributing factors in WBE

Contributing Factors		Frequency (%)	
Contamination at Water Source	Precipitation	14	(31.8)
	Spring thaw / run-off	7	(15.9)
	Flooding	3	(6.8)
	Lack of source water protection	17	(38.6)
	Animals in the watershed	16	(36.4)
	Other	7	(15.9)
Water Treatment Deficiencies	Treatment failure	7	(15.9)
	Inadequate treatment	28	(63.6)
	Other	5	(11.4)
Cross Contamination in Water Distribution	Broken pipe(s)	3	(6.8)
	Post-treatment contamination	5	(11.4)
	Cross connection	0	(0.0)
Other	Turbidity	10	(22.7)

Evidence Implicating Outbreak Waterborne

Type of Evidence	Frequency (%)	
Pathogen Identified in Cases and Water	26	(63.4)
Water Quality Failure	17	(41.5)
Descriptive Epidemiology	17	(41.5)
Water Treatment Problem But No Pathogen Found	4	(9.8)
Analytical Epidemiologic Study	2	(4.9)

Actions to Prevent Future WBE

Actions	Frequency (%)	
Upgrade/change treatment system	24	(55.8%)
Education/study/assessment	12	(27.9%)
Changed water source	28	(65.1%)
Changed/improved policy, reporting, monitoring	13	(30.2%)

Effectiveness of actions to prevent WBE

Effectiveness	Frequency (%)	
Yes	29	(90.6)
No - had BWA since	2	(6.3)
No - had outbreak since	1	(3.1)
Total	32	(100)

Policies and Procedures to Prevent WBE

Developed Policies and Procedures	Frequency (%)	
Yes	30	88.2
No	4	11.8
Total	34	100.0

Policies and Procedures to Prevent WBE

Policies & procedures developed	Frequency (%)	
Water source	5	(18.5)
Boil water advisory/notice	2	(7.4)
Surveillance	2	(7.4)
Inspection/water quality monitoring	7	(25.9)
Treatment	11	(40.7)
Response to outbreak	2	(7.4)
Other initiative	5	(18.5)

Policies and Procedures to Investigate and Manage Future WBE

Policies and Procedures for Investigation	Frequency (%)	
Yes	20	(71.4)
No	8	(28.6)
Total	28	(100.0)

Risks Predisposing Regions to WBE

Risks	Frequency (%)	
Yes	37	(88.1)
No	5	(11.9)
Total	42	(100.0)

Risks

- Environmental & Cultural
  - Human activity
  - Agricultural activity
  - Wildlife activity
  - Industry
  - Spring run-off
  - Cultural disbelief in safety of treatment
- Monitoring
  - Lots of small systems
  - Large geographic area with small population to monitor
  - Budgets inadequate

Risks (cont.)

- Source
  - Surface water
  - Turbidity
  - Shallow wells
  - Old or damaged wells
  - Poorly located wells (i.e. in barnyard)
  - Chemical naturally present in water
- Treatment facilities
  - Water treatment
  - Sewage treatment
  - Placement of septic systems close to source
  - Old treatment facilities/equipment
  - Inexperienced operator

Information, Tools, Training

Format of the information	Frequency (%)	
Training sessions, on- or off-site	22	(57.9)
Online	25	(65.8)
Fact sheet/written information	18	(47.4)
NCCEH retrospective WBE report	11	(28.9)
Information, tools, training	Frequency (%)	
WBE investigation	17	(42.5)
WBE illness	11	(27.5)
Water treatment, technologies	26	(65.0)
Water quality monitoring	11	(27.5)
Education	19	(47.5)
Legal process	1	(2.5)
No further information	4	(10.0)

Summary

- About ½ of interviews reported WBE
- Trend is a decrease in WBE over time
- Most WBEs began in summer
- About ½ of WBEs were caused by protozoa
  - Most associated with surface water
  - Giardia affected smaller communities (i.e., mean ~2200)
  - Cryptosporidium affected larger communities (i.e., mean ~139,000)
- Viral and bacterial WBEs were more often associated with ground water

Summary Cont'd

- More than ½ of WBEs were from areas that used surface water (or mix of surface and ground, or under direct influence of surface)
- 46% used disinfection only and 39% had no treatment at all
- Largest contributing factor was contamination of source water (i.e., precipitation, lack of surface water protection, animals)
- 2/3 of local units took action to prevent WBEs in future (32/47)
  - Most indicate the actions were effective

Small Drinking Water Systems Project

NCCPH Collaborative Effort

- All 6 NCCs are collaborating on a small drinking water systems project this year
- Plan to have a one-day workshop in May or June with up to 20 policymakers and practitioners from agencies responsible for drinking water
  - First Nations Groups (FNEHIN, FNIHB, INAC) (N~7)
  - Those with responsibility for policy for small drinking water systems (N~4-6)
  - Local drinking water officers responsible for small drinking water systems (N~6)
  - Purveyors (N~3)
  - Scientific content experts (N~2-3)

One Day Workshop

- Objective: Share what has been completed in the NCCEH drinking water project to date, determine what needs/gaps exist in Canada with regards to small drinking water systems, and outline what steps the NCCPH can take to fill these needs/gaps.

Proposed Plan

NCCEH

- Lead on project
- Coordinate workshop(s)
- Provide results from our drinking water project and contracted reviews
- Produce summary documents
  - Risk factors that contribute most to waterborne illness and factors that are most successful for mitigation/prevention

Other NCC's

- NCCAH – identify useful examples of solutions in specific First Nations, Inuit, and Métis communities to improve other systems
- NCCDH – identify inequities associated with access to clean drinking water and impact on infant nutrition
- NCCHPP – identify how to assess safety of water systems, identify tools such as ethical analysis, deliberative process or governance models
- NCCID – develop leading practice methods for surveillance and detection of waterborne illness
- NCCMT – assist drinking water practitioners in developing system-specific tools, assist with workshop, dissemination and evaluation

Questions for you

1. What is the best way to solicit input from policymakers and frontline practitioners responsible for small drinking water systems across Canada?
2. What are the gaps in policy or practice in small drinking water systems that the NCCPH can help fill?
3. What types of informational material are necessary to help fill the gaps?
4. What do valuable tools and products look like?

Contact us

- E-mail: contact@ncceh.ca
- Website: www.ncceh.ca