Bacteriological Monitoring

The Public Water Supplies of Newfoundland and Labrador

Newfoundland Labrador
Government Services

Presenter

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Newfoundland Labrador

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AGENDA

- Where does GS fit in the MBSAP?
- Sample Collection Numbers
- Who Collects and Where?
- Sampling Frequency
- Sources of Contamination
- Microbial Contaminants in Water
- Limitations
- Microbiological Guidelines for Drinking Water
- Disinfection of Drinking Water

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Drinking Water Quality

- **Microbiological parameters**
  - Indicator organisms
  - Bacteriological quality
- **Chemical and physical parameters**
  - Chemicals, pesticides, THM
  - Color, turbidity, pH
- **Radiological parameters**

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Numbers of Samples Collected

Fiscal Year	Samples Collected	Total Coliforms	E. coli	BWAs
2007-08	19,757	747	133	229
2006-07	19,149	879	144	215
2005-06	20,993	990	135	222
2004-05	19,410	1208	200	232
2003-04	18,568	1110	164	242
2002-03	15,352	1182	150	267

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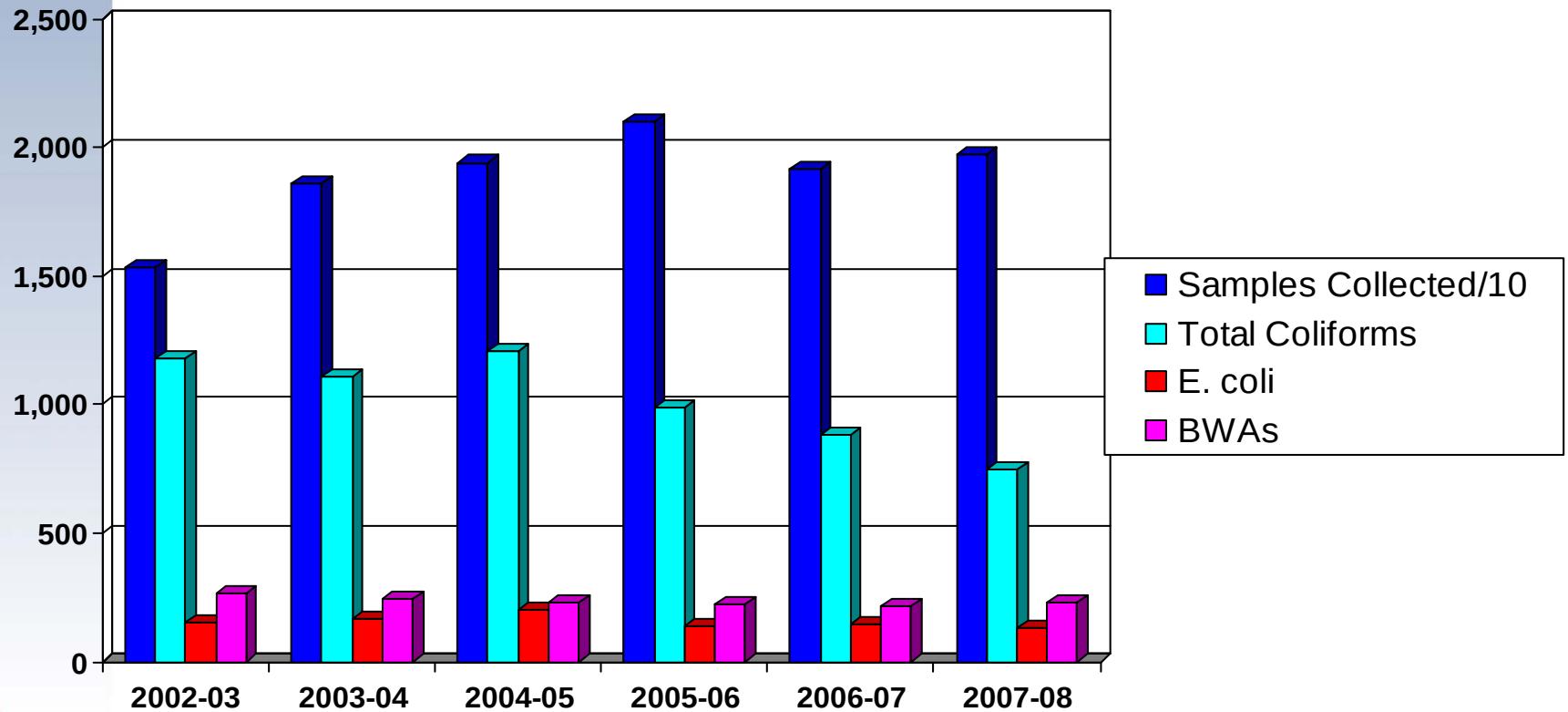
Comparisons Over the Years



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Who Collects the Samples and Monitors the Bacteriological Quality

- 6 Environmental Technicians (ETs) and 35 Environmental Health Officers (EHO's) with Government Services
  - 5 Regions and 14 Offices
  - Responsible for Bacteriological Water Quality Monitoring
  - Linkage with the Medical Officer of Health
- some municipalities (e.g. St. John's, Mount Pearl, CBS, Paradise, Labrador)

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Who Monitors Bacteriological Water Quality?

GS Regional and Satellite Offices

Happy Valley - Goose Bay

Corner Brook

- **Stephenville**
- **Port aux Basques**
- **St. Anthony**

St. John's

- **Harbour Grace**

Gander

- **Grand Falls - Windsor**
- **Lewisporte**
- **Springdale**

Clarenville

- **Grand Bank**
- **Marystown**

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Sampling Frequency

Sampling frequency depends on:

- Quality and number of water sources
- History of unsatisfactory samples
- Method of disinfection and adequacy of treatment
- Size and complexity of the distribution system
- Size of the population served

http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index-eng.php

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How Often Are Samples Collected?

- **Samples are collected monthly. The provincial sample frequency standard is based on the *Guidelines for Canadian Drinking Water Quality,* 6th Edition. Chlorine residual testing is done in conjunction with sample collection.**

Population Served	# of Samples per month
No distribution system or very small system serving less than 100 people	1 sample
< 5,000	4 samples
5000 - 90,000	1 per 1000
> 90,000	90 + 1/ 10,000

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*** (2 x 2)**

http://www.env.gov.nl.ca/Env/env/waterres/Policies/PolicyList.asp

Drinking Water Contamination

Surface water:

- Source of most drinking water
- Constantly under threat from environmental contamination (e.g. runoff)
- Requires treatment prior to consumption

Groundwater:

- Tends to be purer, lesser potential for surface contamination
- Lesser need for treatment
- Subject to natural contamination
- Contamination longer lasting and more difficult to correct

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Distribution System Contamination

- Sewage leaks or improper connections
- Growth of microbes within the distribution system
- Accumulation of disinfection by-products

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Potential for Microbiological Contamination

- Significant source water quality deterioration (e.g., flooding, Badger disaster)
- Inadequate disinfection or disinfection residuals
- Unacceptable turbidities or particle counts (based on local conditions and experience)

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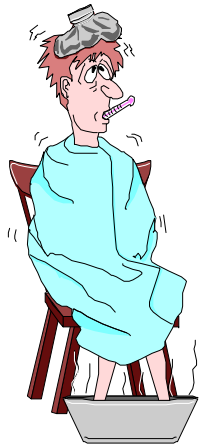
Microbial Contamination

- Examples of Disease Causing Microorganisms Include:
  - Giardia
  - Campylobacter
  - Enterohemorrhagic E. coli (e.g., E. coli O157:H7)
- Examples of symptoms include:
  - diarrhea, bloody diarrhea, vomiting, stomach cramps, chills
  - more severe symptoms(or illnesses) may develop such as kidney problems (e.g., HUS)
- Most at Risk: Young, Elderly and Sick People



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Key Microbial Contaminants in Drinking Water

Bacteria	**Viruses**	**Enteric Protozoa**
Shigella spp.	Norwalk-like virus	**Giardia lamblia**
Campylobacter spp.	Rotavirus	Cryptosporidium parvum
E.coli 0157:H7	Caliciviruses	Microsporidium
Mycobacterium avium complex	Adenoviruses	
Legionella pneumophila	Hepatitis A	

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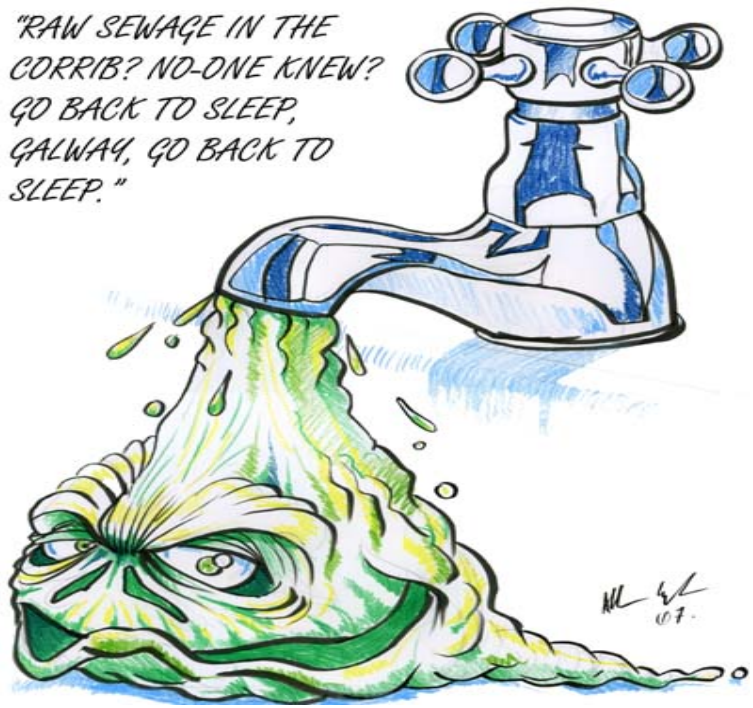
Cryptosporidium Outbreak in Galway, Ireland



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Waterborne Enteric Infections
Contamination from human/animal wastes

- Salmonella
- Shigella
- E. coli
- Campylobacter
- Hepatitis A
- Enteroviruses
- Norwalk virus
- Giardia
- Cryptosporidium

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Waterborne Non-Enteric Infections
Organisms indigenous to the environment

- Pseudomonas
- Staphylococci
- Legionella
- Mycobacterium
- Vibrio

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Waterborne Parasitic Infections

GIARDIA
CRYPTOSPONDICUM
CYCLOSPORA

- Common in communities which use unfiltered surface water
- Cysts are highly resistant to disinfection
- Testing methodologies are cumbersome, costly, inconsistent and lack specificity and sensitivity

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Table 2 Waterborne Illness Outbreak Summary – Newfoundland and Labrador

Month / Year	April 1983	August 1991	March 1992	August 1993	August – Sept. 1993	July 1994	August 1994	July–August 1999	April 2000	May 2002
Town	Harbour Grace	Botwood	Corner Brook	Robert's Arm	Bird Cove[3]	Springdale	Deer Lake	Appleton / Glenwood	Pasadena	Botwood
Population[1]	2520	4200	24870	895	500	3555	6320	1425	4130	4200
Source	Unknown	*Giardia*	*Giardia*	*Giardia*	*Giardia*	*Giardia*	*Giardia*	*Unknown*	*Giardia*	*Giardia*
Cases of Illness	5 (confirmed)	136 (confirmed); 1,200 (suspected)	72 (confirmed)	16 (confirmed):	8 (confirmed) 242 (suspected)	5 (confirmed)	7 (confirmed)	4 (suspected)	13 (confirmed)	4 (confirmed)
Cause of Outbreak	Well not protected; broken well cap	Beaver population near supply intake; infective *Giardia* cysts were detected in raw water samples; disinfection residuals and contact time were inadequate to inactivate *Giardia* cysts.	Beaver population near supply intake: specimens from trapped beaver confirmed presence of *Giardia; d*isinfection residuals and contact time were inadequate to inactivate *Giardia* cysts.	Substandard chlorination facility; beaver population near supply intake; infective *Giardia* cysts were detected in raw water samples.	Muskrats were suspected however two captured muskrats tested negative; no beavers were noted. Water supply was from a pond that was in close proximity to housing development with sub-standard sewage disposal systems. Chlorination of the supply was sporadic.	Insufficient chlorination; beaver population in raw water supply; outdated chlorination equipment.	Animal population up stream of water intake; pesence of *Giardia* cysts were confirmed by water sampling; chlorine disinfection levels and contact times were insufficient to inactivate *Giardia* cysts.	Under certain wind conditions & low water levels, discharge from Town of Appleton's sewage system in the Gander River has traversed upstream & impacted in the general area of the drinking water intake for these communities.	Animal population up stream of water intake; presence of *Giardia* cysts were confirmed by water sampling; chlorine disinfection levels and contact times were insufficient to inactivate *Giardia* cysts.	Low chlorine residuals in town at time of outbreak which were inadequate to inactivate *Giardia* cysts.
Other Information			A boil water advisory was issued and remained into effect until adequate CT values maintained to inactivate *Giardia* cysts.	A beaver lodge located directly in the mouth of a stream feeding into the intake was removed early in August.			A boil water advisory was issued and remained in effect until a municipal water treatment system was installed.		A boil water advisory was issued and remained in effect until a municipal water treatment system was installed.	
Current Water Treatment	Gas Chlorination	Water treatment and Gas Chlorination	Gas Chlorination	Gas Chlorination	Liquid Chlorination	Gas Chlorination	Membrane Filtration, Liquid Chlorination	Infiltration Gallery, Gas Chlorination	Filtration, UV, Gas Chlorination	Water treatment and Gas Chlorination
Protected Water Supply[2]	Yes (2000)	Yes (1996)	Yes	Yes (1996)	No	Yes (1996)	Yes (1999)	Yes (2000)	Yes (1997)	Yes (1996)

[1] Populations presented are from the 2001 Census. [3] Currently on a boil water advisory due to unsatisfactory bacteriological sample results

[2] For more information on protected water supplies in NL visit http://www.env.gov.nl.ca/env/Env/waterres/Surfacewater/Watershed_Protection/Designation_Process_Booklet_Mar26_2004.pdf

Sampling Limitations

Problem in depending on water sampling to determine safety of system:

- Small sample size
- Microorganisms not evenly distributed, with clustering and adherence to suspended solids
- 0/100 mL samples is the detection limit

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Testing Limitations

- Not practical or technically feasible to monitor for all microbial pathogens
- Microbiological safety of water and microbiological guidelines are based on indicator organisms and effective treatment

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Microbiological Guidelines for Drinking Water

- Need to control the presence of microbial pathogens
- Water-borne infectious diseases cause GI symptoms
- Generally, most pathogens are non-life threatening in healthy adults
- However, infants, the elderly and immuno-suppressed at increased risk

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Reasons for Disinfection Application

- Must assume water source contains pathogens because of testing limitations
- Unacceptable microbiological quality (based on local conditions and experience)

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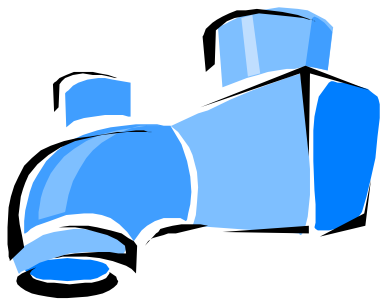
Disinfection of Drinking Water

- Water from public drinking water sources should be disinfected
- Includes sources such as rivers, ponds, streams, lakes and groundwater wells
- Most common method of disinfection is chlorination



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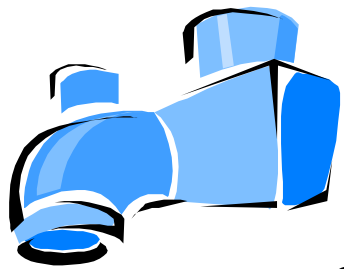
Disinfection of Drinking Water

- Disinfection will kill/destroy/inactivate many of the disease causing micro-organisms in water sources
- Provide protection in the piping system should there be a leak, cross contamination, etc… (residual chlorine)



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World Health Organization

The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses.

WHO General Comment No. 15 (2002): The Right to Water

We shall not finally defeat AIDS, tuberculosis, malaria, or any of the other infectious diseases that plague the developing world until we have also won the battle for safe drinking water, sanitation and basic health care.

Kofi Annan, United Nations Secretary-General (1997-2006)

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Questions?

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