

Microbiological Risk Assessment of Drinking Water Contamination

Gander, Newfoundland

March 26 & 27, 2001

Neil Thomas, P.Eng

ADI Limited (www.adi.ca)

Microbiological Risk Assessment of Drinking Water Contamination

INTRODUCTION

BACKGROUND

RISK ASSESSMENT

EXPERIENCE

SOLUTIONS - CHALLENGE

CONCLUSION

Introduction (cont.)

Safety of water supplies is a matter of human health

Provincial jurisdiction to govern drinking water supplies

e.g. N.B. Health Act, General Health Regulation also Clean Water Act and the Potable Water Regulation

Introduction (cont.)

Purveyor's job - primary responsibility for the water system

Comprehensive day to day management of the water system

Relationships with regulator, industry & customers before problems arise

Introduction (cont.)

We all want health risk reduction through well operated and maintained water distribution systems

Prevention can not be done after the fact

Background

Guidelines for Canadian Drinking Water Quality 6th Edition

http://www.hc-sc.gc.ca/ehp/ehd/bch/water_quality.htm

Limits established for inorganic, organic and microbiologic parameters

Background (cont.)

**Microbiological parameters –
immediate threat, non detectable by
taste, odour, visual observation**

**Microbiological guidelines are based
on indicator organisms and effective
treatment to control the presence of
pathogenic or disease-causing
microorganisms**

Background (cont.)

Pathogenic microorganisms that occur in polluted surface water include protozoa, bacteria and enteric viruses

Groundwater (bedrock & gravel) also subject to surface organisms.

Waterborne pathogenic micro-organisms: gastrointestinal illness

Background (cont.)

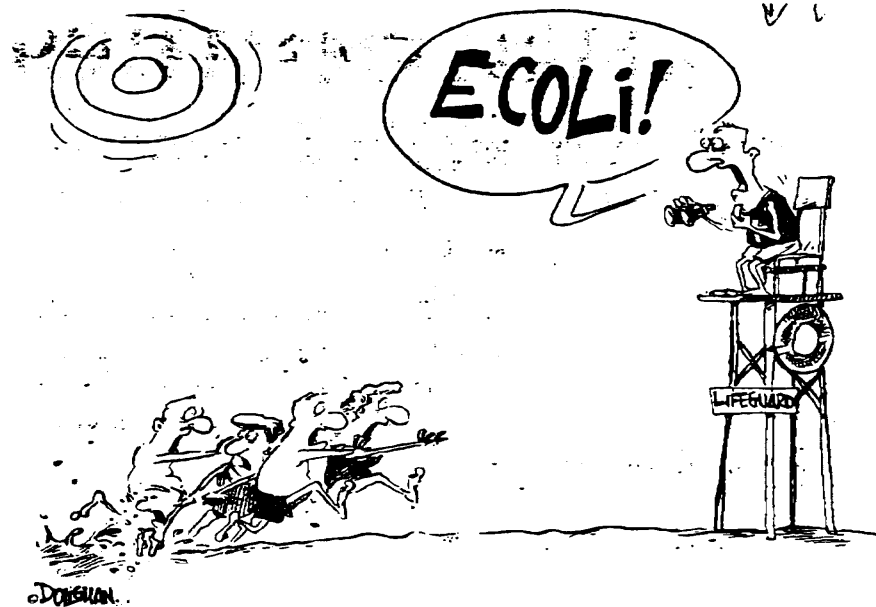
Generally non-life threatening in normal healthy adults, mortality can occur in sensitive sub-populations

- Milwaukee, 1993, approx. 400,000 ill and 100 + people dead
- Walkerton, 2000, approx. 2,000 ill and 6 people dead

E. coli, campylobacter, salmonella

Risk Assessment Process

Trigger mechanisms for greater evaluation – changes in analytical data or events



Risk Assessment Process (cont.)

When events occur how should you assess the situation ?

Purveyor should view the longer-term sustainability of the system, not a quick fix that only addresses the symptoms and ignores the cause(s)

Risk Assessment Process (cont.)

Risk assessment for water distributions systems involves but is not limited to assessing the multiple barriers of protection of drinking water:

Source Area

Treatment

Distribution system

Testing

Training

Risk Assessment Process (cont.)

Source Area

Groundwater, what degree(s) of aquifer protection?

- bedrock vs. gravel, security?
- back flow into wells.

Surface water, what degree(s) of watershed protection?

Risk Assessment Process (cont.)

Treatment

- How do you prevent problems without disinfection ?
- Type of disinfectant utilized
- Source water, re-growth, cross connections, line breaks
- treatment consistent with source water type?
- CT concepts i.e. $0.2 \text{ mg/L} \times 30 \text{ min} = 6 \text{ CT}$

Risk Assessment Process (cont.)

Distribution System

Spare parts, routine system check ?

Reservoir condition, turnover, location

Distribution network, age, condition

Geography – elevation changes

Risk Assessment Process (cont.)

Events

Weather – relevant to surface water and those sources under the influence of surface water

Equipment – failure, malfunction, e.g. chlorinators

Line breaks – induce backflow

Risk Assessment Process (cont.)

Events

Fire fighting demand – induce backflow

Flushing - can induce backflow if not conducted properly

Do corrective actions follow recognized standards, i.e. AWWA?

Risk Assessment Process (cont.)

AWWA Standards

C651-92 Disinfecting Water Mains

**C652-92 Disinfecting Water Storage
Facilities**

**C653-97 Disinfecting Water Treatment
Plant**

C654-87 Disinfecting Wells

Risk Assessment Process (cont.)

Back pressure or Back siphonage can introduce elevated concentrations of inorganic, organic compounds and biological organisms in the drinking water supply

Results

- metal toxicity**
- chemical poisoning/burns**
- disease outbreak**

CSA B64.10 – Manual for the Selection, Installation, Maintenance and Field Testing of Backflow Prevention Devices



- lawn care chemicals
- soap dispensers

Direct Cross Connection

sewage to drinking water



Risk Assessment Process (cont.)

Customers

What are your customers doing to the water system ?

Back flow - methods to prevent or remove

- premise isolation and zone isolation

Risk Assessment Process (cont.)

Customers

- mixture of building types/zones in community
- risk increases with greater number of businesses

Risk Assessment Process (cont.)

Communication

Lines of communication to water consumers, regulator and others e.g. pharmacists

Informed Customers – recent USEPA legislation

USEPA - Consumer Confidence Report, July 1, 2000

- source type
- water quality
- contaminants detected
- corrective actions taken

Risk Assessment Process (cont.)

Routine Testing

- The analytical results, (TC/FC/E.Coli/HPC) parameter types, counts, acceptability of site, distribution both temporal and spatial
- Don't test for the sake of testing !!

Risk Assessment Process (cont.)

Training

- Adequate training of operators, adequate number of operators
- Dedication of properly trained operators is a fundamental key to delivering safe water

Experience

- 1997 to 2000 identified a number of purveyors that were fixated on analytical data
- Safe water remains undervalued
- Loss of purveyor credibility, very important to recognize long term effects (i.e. avoiding the public supply)

Experience (cont.)

- **Communities with boil orders do not have cross connection control**
- **Front line staff – limited access to decision making process**
- **Time frame - catch up more expensive and time consuming**

Experience (cont.)

- Lack of operation & maintenance plans, record keeping, customer complaints, analytical data
- Purveyors reluctance to recognize and to accept role & responsibility
- Application of recognized standards – disinfection, cross connection, etc

Experience (cont.)

- **Public distaste for chlorine – breakpoint chlorination**
- **Lines of communication not defined - at risk users not identified or notified**
 - **expanding cooperation between municipalities, AWWA and regulator**
 - **importance of a remediation Plan**

Experience (cont.)

A remediation plan is to ensure that procedures and materials used meet recognized standards and is an appropriate solution to the problem.

Framework for comprehensive system management is established.

Address immediate issues and longer term management

Experience (cont.)

Flushing program – be careful !

**Before disinfect complete
calculations/trials**

Confirmation.

Solutions - Challenges

- **sensible regulatory environment**
- **knowledge transfer ability of AWWA to communities and regulatory staff**
- **prevention cannot be done in the future**
- **Multibarrier approach**

Solutions - Challenges (cont.)

Quality Control - water treatment plant & system approvals, training, record keeping, backflow program, treatment and break point chlorination

Future – Concentration x Time (CT) concepts.

Future - greater education requirements for purveyors and regulators.

Sharing resources

Solutions - Challenges

How should the regulator intervene?

cooperative approach is preferable

- **establish contacts/relationships**
- **risk elimination is impossible – we have to live with some degree of risk but must be low and an informed risk**

Conclusion

Roles and responsibilities:

**Regulator is restricted to
confirmation/review**

Purveyor has primary responsibility

Conclusion (cont.)

Risk assessment: Not constrained to analytical data and risk elimination not possible

Conclusion (cont.)

Solutions: Due Diligence.

Pro-active and cooperative approach required

Develop and implement a cross connection control by-law and program



Need for continual training.

Reference information

1) Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, Standards and Guidelines Branch, Alberta Environmental Protection

Regulatory Approval Center
Alberta Environmental Protection
Main Floor, 9820 – 106th Street
Edmonton, Alberta
T5K 2J6
Phone 403-427-6311

2) AWWA Guidance Manual for Compliance with Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources

American Water Works Association
6666 West Quincy Ave
Denver, Colorado, USA
80235
phone 1-800-926-7337 or
<http://www.acwwa.ns.ca/awwa/index.html>

Internet based resources for drinking water issues.

Health Canada - Guidelines for Canadian Drinking Water Quality - Supporting Documents., web site http://www.hc-sc.gc.ca/ehp/ehd/bch/water_quality.htm

USEPA - United States Environmental Protection Agency – Water Issues
<http://www.epa.gov/water/>

Cross Connection Control and Water Borne Disease,
<http://home.sprynet.com/~geraldf/XCBASIC.HTM>

ACWWA – Atlantic Canada Water Works Association, web site
<http://www.acwwa.ns.ca/awwa/index.html>

Canadian Chlorine Coordinating Committee, web site: <http://www.cfour.org/>

Groundwater – discussion, resources, web site <http://www.groundwater.com/>

University of West Virginia, drinking water, on-site sewage, environmental health
<http://www.estd.wvu.edu/>

Water And Waste Water Links Page, <http://members.aol.com/ronwater1/index.htm>