Meeting of the Parties to the Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Working Group on Water and Health

Thirteenth meeting
Geneva, 19 and 20 May 2022
Item 5 of the provisional agenda
Prevention and reduction of water-related diseases

INFORMAL DOCUMENT

Training module on water-related disease surveillance and outbreak management
(draft)

Programme area 2 on prevention and reduction of water-related disease aims to strengthen implementation of Article 8 of the Protocol on Water and Health, in particular to support countries in building national and/or local surveillance and early-warning systems and develop preparedness and contingency plans for responses to outbreaks of water-related diseases.

The development of training modules on water-related disease surveillance and outbreak management is a planned activity under the Protocol’s programme of work for 2020-2022. The modules are based on the technical guidance provided by the publication Strengthening surveillance and outbreak management of water-related infectious diseases associated with water-supply systems (WHO Regional Office for Europe, 2019) that was published under the 2017-2019 programme cycle, as well as on the training materials developed and piloted in the previous triennium. The training package was peer-reviewed by technical experts. It consists of two main modules:

1. Part on surveillance of water-related disease: technical presentations with annotations, case studies and a guide for interactive group work. This module provides technical background and details on the key principles and building blocks of surveillance systems with a view on water-related disease and practical considerations on how to set up, improve and maintain effective systems for surveillance of water-related disease.

2. Part on outbreak management: technical presentations with annotations, case studies and a guide for interactive group work. This module provides hands-on, step by step guidance for practitioners involved in outbreak management and emphasize specific aspects related to waterborne outbreak investigation.

The Working Group on Water and Health is requested to review the draft training package and provide feedback on its technical content by 10 June 2022 to Enkhtsetseg Shinee at enkhtsetsegs@who.int.

Note: The draft document is for review by the Working Group on Water and Health only and not for wider distribution at this stage.
Introduction to water-related infectious diseases

Module 1.1

Overview

- The Protocol on Water and Health & requirements relating to water related disease surveillance and outbreak management
- International Health Regulations (IHR) core requirements:
  - Definition of water related infectious disease (WRID)
  - Pathogens transmitted through drinking water
  - Drinking water systems as a source of WRID
  - Burden of WRID in the European Region
  - The need to strengthen WRID surveillance & outbreak management capacity

The Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes

- Article 8:
  - Establishment & maintenance of surveillance & early warning systems
  - Development of national & local contingency plans for responding to outbreaks, incidents & risks
  - Strengthen response capacity
- Article 6.2:
  - Establish & publish targets to reduce WRID outbreaks & incidents
- Article 13:
  - Strengthen transboundary cooperation on early warning and response systems

IHR Core Capacity Requirements

<table>
<thead>
<tr>
<th>Core Capacity</th>
<th>Component</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance</td>
<td>Indicator based surveillance</td>
<td>Early warning function for the early detection of a public health event</td>
</tr>
<tr>
<td>Response</td>
<td>Rapid response capacity</td>
<td>Public health emergency response mechanisms are established &amp; functioning</td>
</tr>
<tr>
<td>Risk communication</td>
<td>Policy &amp; procedures for public communication</td>
<td>Mechanisms for effective risk communication during a public health emergency are established and functioning</td>
</tr>
</tbody>
</table>

2030 Agenda for Sustainable Development

- Ensure healthy lives and promote well-being for all at all ages
  - Target 3.3: By 2030, (…): combat hepatitis, water-borne diseases and other communicable diseases
  - Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from (…): water and soil pollution and contamination

What are water-related infectious diseases?

- Water related disease
  - adverse effect on human health caused by the condition of water
- Infectious or non-infectious

WRID may be transmitted via:

- The person-to-person route by ingestion of undercooked meat or contaminated water
- The respiratory tract by ingestion of aerosolized water or water vapor in breathing
### Classification of WRID

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-borne</td>
<td>Ingestion of pathogens in contaminated water</td>
<td>Typhoid, legionellosis, poliomyelitis</td>
</tr>
<tr>
<td>Water-related vectors</td>
<td>Infection by agents that spend part of their life-cycle in water</td>
<td>Schistosomiasis</td>
</tr>
<tr>
<td>Water-related vectors</td>
<td>Spread by vectors that breed or bite near water</td>
<td>Malaria, West Nile Fever</td>
</tr>
<tr>
<td>Water-washed</td>
<td>Skin &amp; eyes</td>
<td>Poor hygiene / lack of access to safe water</td>
</tr>
<tr>
<td>Water-washed</td>
<td>Diarrhoeal diseases</td>
<td>Scabies, trachoma, bacillary dysentery</td>
</tr>
<tr>
<td>Water-based</td>
<td>Skin penetration</td>
<td></td>
</tr>
<tr>
<td>Water-based</td>
<td>Ingested</td>
<td></td>
</tr>
</tbody>
</table>

### Primary agents of infectious waterborne outbreaks

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Virus</th>
<th>Protozoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campylobacter jejuni</td>
<td>Hepatitis A virus</td>
<td>Balantidium coli</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>Norovirus</td>
<td>Cryptosporidium spec.</td>
</tr>
<tr>
<td>Helicobacter pylori</td>
<td>Rotavirus</td>
<td>Cyclospora cayetanensis</td>
</tr>
<tr>
<td>Legionella spec.</td>
<td>Adenovirus</td>
<td>Entamoeba histolytica</td>
</tr>
<tr>
<td>Leptospira spec.</td>
<td>Enterovirus</td>
<td>Giardia spec.</td>
</tr>
<tr>
<td>Mycobacterium spec.</td>
<td>Astrovirus</td>
<td>Naegleria fowleri</td>
</tr>
<tr>
<td>Salmonella enterica</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Pathogens transmitted through drinking water

#### Campylobacter spp
- Important cause of acute gastroenteritis worldwide and in the European region.
- *C. jejuni*, *C. coli*, *C. laridis* and *C. fetus*
- Incubation period: 2-4 days; illness duration: 3-7 days
- Symptoms: abdominal pain, diarrhea (sometimes bloody), vomiting, chills & fever
- Reactive arthritis, meningitis & Guillain Barre syndrome
- Reservoir: Poultry, wild birds, cattle & pets.
- Waterborne outbreaks
  - Faecal contamination of water storage reservoirs with bird faeces
  - Consumption of inadequately treated surface water

#### Shigella
- *S. dysenteriae*, *S. flexneri*, *S. boydi* and *S. sonnei.*
- Abdominal cramps, fever & water diarrhoea; bacillary dysentery is characterized by bloody diarrhoea.
- Incubation period: 24-72 hours
- Faecaloral transmission through person-to-person contact, contaminated food & water, & flies.
- Waterborne outbreaks are occurring more frequently due to faecally contaminated drinking-water.
- Control of Shigella in drinking water is of special public health importance
- Sensitive to disinfection

#### Legionella
- Heterotrophic bacteria, widely found in water, proliferate at 25°C
- *L. pneumophila*
  - Legionnaires’ disease
  - Pontiac fever
- Biofilms in water distribution systems
- Route of infection – inhalation of aerosols from cooling towers, air conditioning, showers & spas – common sources of infection & outbreaks.
- Control strategies:
  - Disinfection
  - Minimising biofilm growth
  - Temperature control (>20°C & <50°C)
Hepatitis A virus

- Highly infectious with a low infectious dose
- Average incubation period 28-30 days
- Mostly asymptomatic, disease severity increases with age
- Hepatitis A / infectious hepatitis – sudden onset, fever, malaise, nausea, anorexia, abdominal pain, jaundice & liver damage – prolonged illness
- Mortality <1%
- Source: faecally contaminated food & water
- Person to person & faecal oral transmission most common
- Strong evidence of waterborne transmission

Hepatitis E

- Much less widespread and mostly confined to tropical and subtropical areas. It has caused large waterborne outbreaks
  - Recent evidence indicates that HEV might also be prevalent at a low level in Europe.
  - Infection can be more severe than, HAV, increased mortality in pregnant women

Norovirus

- 90% of epidemic nonbacterial outbreaks of gastroenteritis worldwide
- Usually self-limiting: severe illness is rare
- Transmission:
  - Faecally contaminated food or water
  - Person-to-person
  - Aerosolization of vomited virus and subsequent contamination of surfaces
- Outbreaks - often occur in closed communities
  - Long-term care facilities, overnight camps, mass gatherings, hospitals, schools, prisons, dormitories, cruise ships

Cryptosporidium

- 13 species – C. hominis & C. parvum predominant in humans
- Self-limiting abdominal pain and diarrhea (1 week on average); can be prolonged and severe in immunocompromised
- Oocysts shed in faeces can survive for weeks or months in fresh water
- Person to person transmission: consumption of contaminated food & water & transmission from animals.
- Highly infectious – 10 oocysts
  - Resistant to disinfection
  - E. coli or thermotolerant coliforms are not a reliable indicator of their presence/absence.

Giardia

- Giardiasis – G. intestinalis/G. lamblia or G. duodenalis
- Diarrhoea, abdominal cramps & malabsorption deficiencies
- Self-limiting illness, but prolonged illness can occur
- Asymptomatic carriage is common
- Cysts are shed in faeces, prolonged survival of cysts in fresh water
- Infectious dose <10 cysts
- Person to person transmission, contaminated drinking water, recreational water & food
- Well-established source of waterborne outbreaks
  - Resistant to disinfection
  - E. coli or thermotolerant coliforms are not a reliable indicator of their presence/absence.

Drinking water systems as a source of WRID
Hazardous events at different points of the water supply system

<table>
<thead>
<tr>
<th>Point of occurrence</th>
<th>Examples of hazardous events</th>
</tr>
</thead>
</table>
| Source water (groundwater) | - Runoff of animal and human waste and sewage during wet weather  
- Leakage of faecal matter from on-site sanitation or damaged sewers |
| Treatment system | - Incursion of filtration beds with contaminated water during flooding  
- Failures in treatment (e.g. coagulation, filtration and/or disinfection processes) |
| Distribution system | - Ingress of contaminated water from the environment through cracked or eroded pipes, especially during pressure drops  
- Cross-contamination of drinking water systems with wastewater, rainwater etc  
- Unhygienic conditions of containers carrying water from source to home |
| Storage system | - Faecal contamination of water stored in reservoirs and storage tanks |

The water treatment and distribution process

Drinking-water systems as cause of WRID outbreaks

Number of published outbreaks between 2000 and 2014 categorized by cause (Moreira & Bondelind 2017)

<table>
<thead>
<tr>
<th>Water safety plans</th>
</tr>
</thead>
</table>
| • Best way to ensure a safe drinking-water supply  
• Identify hazards and events (e.g. technical defects, malpractices, accidents, natural causes) that pose a risk to the supply system or fail to remove them  
• Multi-barriers to contamination  
  - Preventing hazards entering to water system (catchment)  
  - Removing hazards from the water (treatment)  
  - Preventing re-occurrence (storage and distribution) |

Burden of WRID in the European Region

Waterborne outbreaks in Europe

Outbreaks reported to GIDEON, 2000 - 2013

Viral gastroenteritis, hepatitis A, E. coli & Legionellosis – most frequently reported cause of outbreaks

18% of outbreaks linked to water – most caused by contaminated drinking water supplies
Viral gastroenteritis

Example: Prague experienced large waterborne outbreak of norovirus infection (estimated 11,000 to 12,000 cases) caused by cross contamination resulting from breakages of water and sewage pipes (2015).

Burden of mortality

• Burden of disease ≠ burden of mortality
  – the burden of disease caused by pathogens transmitted by the faecal oral route is greatest, BUT
  – the burden of mortality may be caused by pathogens transmitted by other routes is greatest

• Legionella, pseudomonas & non-tuberculous mycobacteria
  – Caused 91% of WRID deaths in the USA between 2003 and 2009
  • Germany: >3 deaths every day due to legionellosis

Surveillance of Water Related Infectious Diseases

Module 1.2

Overview

• What is disease surveillance?
• WRID surveillance objectives
• Core activities & building blocks of surveillance
• The epidemic intelligence framework & different types of surveillance
• Surveillance attributes
• How to strengthen WRID surveillance?

What is disease surveillance?

• Ongoing systematic collection, analysis and interpretation of health-related data
  ➢ for use in planning, implementing and evaluating public health policies and practices

• Right information at the right time to inform public health decision making

WRID SURVEILLANCE OBJECTIVES

• Monitor trends over time
• Detect outbreaks
• Identify new, emerging or re-emerging pathogens
• Estimate WRID burden
• Identify at-risk groups, populations and areas → target control & prevention measures
• Identify priorities for drinking water supply system improvement
• Assess effectiveness of control measures
• Inform water quality and WRID policies & regulations
Ideally WRID surveillance will:

- Integrate monitoring of health outcomes with monitoring of drinking water quality & environmental contamination events
- Involve strong co-ordination & collaboration between:
  - Public health surveillance agencies
  - Drinking water service providers
  - Regulators
  - Environmental agencies
- Timely sharing of information on water supply incidents & water-related outbreaks
- Operate at the national and sub-national (regional and local) level

Core activities & building blocks of surveillance

- Core surveillance activities:
  - Case detection
  - Case reporting
  - Investigation and confirmation
  - Analysis and interpretation
  - Communication
  - Action – public health response, policy development & feedback to stakeholders
- Support processes enable the core activities
- Integrated disease surveillance
- Indicator based surveillance
- Event based surveillance

Indicator based surveillance

- Notifiable disease – urgent reporting of serious diseases requiring an immediate public health response
- Syndromic – Cases that comply with a specified syndromic case definition
- Laboratory – number of isolates or positive tests for specific organisms
- Sentinel – health facilities representing high risk areas or groups
- Environmental monitoring – indicator based or event based – legally mandated monitoring of key environmental indicators at set time periods
- Other types
- Prescriptions,
- Calls to medical helplines,
- Health insurance claims etc.

Event based surveillance

- Notifications of events related to water supply
  - Water providers, municipal authorities
- Media monitoring
  - Mass media (TV, newspapers), social media reports

EBS can be a sensitive and rapid way to detect outbreaks, but may lead to false alarms.
Outbreak Surveillance

Event based
- Notifications of clusters of cases or suspected outbreaks
  - Health facilities, the public
  Prevent and control outbreaks

Indicator based
- Number of confirmed outbreaks related to water
  - Disease burden
  - Causal agents
  - Risk factors
  - Geographical distribution

Inform on the need for investments in the water supply system & public health action

Other types of surveillance & studies

- Seroprevalence surveys
  - Public health agencies, laboratories, research institutes
  - Estimate the burden of WRID

- Environmental surveys
  - Environmental agencies, research institutes
  - Detect outbreaks, risk assessment, monitoring emerging & re-emerging pathogens, estimate burden

- Case control studies using surveillance data
  - Identify water sources as risk factor for infection
  - Estimate burden of disease associated with waterborne transmission

Surveillance attributes

- Completeness
- Timeliness
- Usefulness
- Sensitivity
- Specificity
- Positive predictive value
- Representativeness
- Simplicity
- Flexibility
- Acceptability
- Stability

Table 4 of the guidance document

Timeliness & sensitivity

- Sensitivity – how well the system detects cases
  - % of symptomatic cases
  - % of cases seeking care
  - Sampling practices
  - Sensitivity & specificity of laboratory assays
  - Completeness of reporting of cases

Source: K. Nygard

How to strengthen WRID surveillance?

- Build on or expand existing surveillance systems to include WRID
  - Include additional waterborne pathogens in the existing notifiable or laboratory based surveillance system
  - Reported using the existing surveillance procedures

- What are the surveillance objectives?
- How well will this type of surveillance meet the surveillance objectives?
  - timeliness, sensitivity, specificity, completeness, representativeness etc.

- Feasibility??
  - Human & laboratory capacity for collection, transportation, detection
  - Funding for surveillance
  - Reporting and database
  - Sustainability and participation by health care workers

Timeliness of outbreak detection varies by surveillance type.

- Event based surveillance is usually the fastest
- Surveillance based on clinical or laboratory diagnoses are much slower and are less suitable for outbreak detection
- Surveillance based on clinical diagnosis – risk of incorrect diagnosis → delayed or missed outbreak detection

Source: Procter et al, Epidemiology & Infection, 1998
Module 1.3
Setting up, improving & maintaining national systems for WRID surveillance

Overview
• Approach to WRID surveillance system strengthening
• Overview of main activities
• Enabling factors for surveillance

We will work through a case study in parallel to this session

Approach to WRID surveillance system strengthening
• Appoint public health specialist to lead & coordinate
• Develop overall strategy
• Support local level to develop procedures & implement
• Surveillance protocol
• Working group or advisory group

Main activities in WRID surveillance system strengthening
• Stakeholder engagement
• Situation analysis & priority setting
• Purpose, scope & objectives
• Surveillance outcomes, scope & system design
• Methodology for data collection, management & analysis
• Monitoring & evaluation

1. Engage stakeholders & agree their roles

1. Establish an advisory / working group
• Establish advisory group to provide oversight & expertise
  ▶ Do this early
  ▶ Include decision makers, focal points & technical experts from participating organizations
  ▶ Include those who will be responsible for running the system and acting on the results of surveillance (front line staff)
  ▶ Include those working at the national & local level
• National advisory group
  ▶ Overall system design & development
  ▶ Priority setting for surveillance
• Local advisory group
  ▶ Operate/monitor the system
Advisory groups could include:

At the national level:
• MoH/National public health agency
• Epidemiologist
• Water regulator
• Environmental agency
• Environmental health specialists
• Laboratory specialist
• Legal & data protection expert
• IT specialist
• Data manager
• Event-based surveillance specialist

At the local level:
• Local public health specialist
• Local epidemiologist
• Local water provider
• Representative from health facilities
• Representatives from local laboratories
• Local environmental health specialists

Case study 1

2. Characterise the public health problem through a situation analysis & agree priorities for surveillance

Situation analysis

• Data sources: surveillance & laboratory reports & datasets, outbreak investigation reports, published & unpublished research studies, data from environmental studies, water providers & environment agencies

• Describe the epidemiology of WRIDs in the country
  ➢ Burden of disease & trends over time
  ➢ Economic cost, societal cost/humanistic burden
  ➢ Outbreak potential
  ➢ Reservoirs & sources
  ➢ High-risk groups & areas
  ➢ Political and social context

Situation analysis cont.

• Describe current surveillance capacity at national & subnational levels
  ➢ Main actors & stakeholders & their roles in surveillance & disease control
  ➢ Current data sources & potential new sources
  ➢ Data gaps & limitations
  ➢ International surveillance requirements

• At the local level:
  ➢ Describe the local water supply – sources, providers, geographical distribution & population served
  ➢ Review water quality data & condition of water system (WSP if available)
  ➢ Review potential sources of Legionella
  ➢ Identify local vulnerable populations & settings

Identifying priorities for surveillance

• Target surveillance at areas where WRIDs are endemic or where outbreaks occur:
  ➢ Vulnerable water sources
  ➢ Water supply is vulnerable to contamination – livestock
  ➢ Areas subject to drought, drops in water pressure & intermittent supplies
  ➢ Areas prone to flooding
  ➢ Small-scale community supplies
  ➢ Industrial areas

• Seasonal pathogens - enhance surveillance at certain times of year?
Criteria for selecting candidate surveillance outcomes

<table>
<thead>
<tr>
<th>Criteria for selecting candidate surveillance outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease burden – size of the problem &amp; severity of the clinical outcomes</td>
</tr>
<tr>
<td>- Percentage of cases attributable to waterborne transmission</td>
</tr>
<tr>
<td>- Annual incidence rate</td>
</tr>
<tr>
<td>- Vulnerability of exposed population groups (by age, sex, ethnicity)</td>
</tr>
<tr>
<td>- Case-fatality rate</td>
</tr>
<tr>
<td>- Hospitalisation rate</td>
</tr>
<tr>
<td>- Frequency &amp; nature of long-term sequelae of infection</td>
</tr>
<tr>
<td>Information about the hazard - Water monitoring data for microbial pathogens</td>
</tr>
<tr>
<td>Epidemiological features – Outbreak potential &amp; number &amp; size of outbreaks attributable to the pathogen</td>
</tr>
<tr>
<td>Trends in disease incidence over time</td>
</tr>
<tr>
<td>Societal burden – Economic cost</td>
</tr>
<tr>
<td>Public perceptions of risk</td>
</tr>
<tr>
<td>Political context</td>
</tr>
<tr>
<td>Feasibility – Diagnostic capacity</td>
</tr>
<tr>
<td>Capacity to conduct surveillance</td>
</tr>
</tbody>
</table>

How to select the priority diseases

- Desktop exercise - Use the results of the situation analysis to identify priority pathogens, syndromes & diseases
- Strategy grids (next slide)
- Delphi panels
  - Form a panel of experts
  - Define criteria & score diseases against these
  - Weight & sum the results for each participant
  - Rank diseases & ask experts to assess ranking
  - Finalise results
- Decide what type of surveillance to conduct on each priority disease

Strategy Grids

- Used if resources are limited
- Focus on identifying those WRID for which surveillance will have the biggest impact.
- Use two of the five criteria listed previously to rank diseases

For instance, the grid could use:
- Disease burden + feasibility (example on next slide)
- Disease burden + epidemiological features
- Epidemiological features + availability of treatment & control

Example of a strategy grid based on disease burden & feasibility

Case study 1 continued.

3. Define the overall purpose, scope & objectives of surveillance
Purpose & scope
• Situation analysis & prioritization exercise → the purpose & scope of surveillance
• Purpose – the high level reason for conducting surveillance
   → “To strengthen our understanding of the burden and epidemiology of WRID in order to inform WRID prevention & control measures”
• Scope
  - What types of WRID to include in the system
  - Geographic coverage
  - Target population

Surveillance Objectives
• Can have multiple objectives
  “The objectives are to:
  – Detect outbreaks
  – Estimate the burden & impact of WRID
  – Identify high-risk areas & populations to target with control measures”
• Design the system to meet the objectives
  – Will the system be sufficiently timely, representative, sensitive & specific to meet the objectives?

Case study 1 continued.

Define the surveillance outcomes, the core dataset & design the system

Define outcomes for surveillance
• Informed by results of situation analysis & by purpose, scope & objectives of system
• List priority outcomes (pathogens, notifiable diseases & syndromes) to monitor
• Additional surrogate outcomes for event-based surveillance - water complaints, exceedances of water quality limits
• Link the outcomes to specific surveillance objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detect outbreaks</td>
<td>1. Physician notifications of acute gastroenteritis</td>
</tr>
<tr>
<td></td>
<td>2. Laboratory detections of cryptosporidum, giardia, campylobacter</td>
</tr>
<tr>
<td></td>
<td>3. Complaints to the water provider</td>
</tr>
<tr>
<td></td>
<td>4. Over the counter sales of anti-diarrhoeal medicines</td>
</tr>
</tbody>
</table>

Identify sources of data
• Laboratory databases → data on lab confirmed cases
• Medical insurance databases / sales databases → data on prescriptions or over-the-counter sales for anti-diarrhoeal medications
• Water providers → breech in water quality limits

What needs to be actively reported?
Can you automate the capture of data from any of these sources?
Schematic diagram of the elements of the surveillance system

**Case definitions**
- Define a case definition for each surveillance outcome
- Different to clinical case definitions & those used during outbreaks
- Publicly available case definitions – ECDC, CDC

**Define what to collect & how often**
- Notifiable disease & laboratory confirmed cases = case based
- Syndromic surveillance = case based or aggregated data
- Only collect as much data as you need to
- All data must have a specific purpose & help to fulfil a specific surveillance objective
- Frequency of data reporting = depends on purpose of the data
  - Data for outbreak detection → report immediately
  - Data to monitor trends → ongoing reporting e.g. weekly
  - Data for burden of disease → less frequent e.g. monthly or annually

**Box 1. European Union surveillance case definition for cryptosporidiosis**
- Clinical criteria: any person with at least one of the following two:
  - diarrhoea
  - abdominal pain
- Laboratory criteria: at least one of the following four:
  - isolation or demonstration of Cryptosporidium in faecal or faecal-oral specimens
  - detection of Cryptosporidium antigen in stool
  - detection of Cryptosporidium antigen in stool
- Epidemiological criteria: one of the following five epidemiological links:
  - human to human transmission
  - exposure to a common source
  - contamination of food or drinking water
  - contamination of food or drinking water
  - environmental reservoirs

**Case classification**:
- A. Probable case if any person meeting the clinical criteria
- B. Suspect case if any person meeting the clinical criteria & epidemiological link
- C. Confirmed case if any person meeting the clinical and the laboratory criteria

**Example of what to report & how often**

<table>
<thead>
<tr>
<th>Surveillance outcome</th>
<th>Type of data</th>
<th>Suggested core data set</th>
<th>Example reporting frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notifiable cases of WRID</td>
<td>Case-based</td>
<td>Name, age, date of birth, sex, address, occupation, work address, date of onset of illness, case outcome (alive, died), recent travel history</td>
<td>Within 24 hours</td>
</tr>
<tr>
<td>WRID outbreaks</td>
<td>Aggregate</td>
<td>Location and date of outbreak, total cases, number hospitalized and died, causative agent, source of outbreak (public or private water supply, cooling tower etc.), water quality, main risks of water-supply system contamination, contributory factors</td>
<td>Quarterly</td>
</tr>
</tbody>
</table>

**Syndromic surveillance data (AGI, diarrhoea)**
- Case-based
  - Name, age, date of birth, sex, address, occupation, work address, date of onset of illness, case outcome (alive, died), recent travel history
  - Total weekly cases by age group, sex and place
  - Weekly
Strengths & limitations of the system

• Who is not covered by the system & how might that impact on WRID control measures?
• Sources of bias in the data?
• Potential to miss cases?
• Potential to misclassify cases as non-cases?
• Timeliness of the system for outbreak detection?
• Flexibility / adaptability?
• Simplicity?
• Redundancies & duplication of efforts?

5. Develop a methodology for collecting, managing and analysing the surveillance data

Methodology

• Surveillance protocol & standard operating procedures
• Roles & responsibilities
• Case identification & investigation
• Data reporting / data flows
• What data will be collected?
• Reporting forms
• Data management
• Data analysis, interpretation & reporting
• Alert thresholds

Surveillance Thresholds

• Used to identify outbreaks & monitor seasonal epidemics
• Vary from simple calculations of historical surveillance data to complex statistical models
• Require several years of stable reliable surveillance data on a pathogen or outcome
• Can be defined in different ways:
  a) A defined number of cases that will prompt an investigation to verify existence of an outbreak → 5 cases of shigellosis or bloody diarrhoea
  b) An increase in the number of cases compared to the background rate for a specific disease over the same time-period and place → Doubling of cryptosporidium cases above the baseline surveillance rates for the previous 5 years

Monitoring and Evaluation

• Ongoing automated monitoring of surveillance data quality:
  – Data entry checks
  – Range and consistency checks
  – Cross check data between different data tables & databases
  – Completeness and timeliness of data reporting
• Periodic evaluations of the system (surveillance attributes):
  – How well is the system meeting its objectives
Monitoring and Evaluation Resources

Enabling factors I

- Set targets
  - For the prevention & reduction of WRID burden
  - For the strengthening of WRID surveillance, early warning and response systems
- Legal framework for surveillance
  - Update national legislation & guidelines
  - Establish formal requirements for WRID surveillance
  - Ethical & data protection requirements

Enabling factors II

- Budget – local & national
- Laboratory capacity
- Transportation (specimens)
- Standard operating procedures
- Training
- Information technology
- Electronic data management system / web-based reporting system

Case study 1 continued

Analysis, interpretation, reporting & use of data

Module 1.4

Overview

- Analysis & interpretation of data
- Surveillance bulletins
- Using surveillance data for advocacy
General approach to data analysis

- Analyse the surveillance data on a continuous basis – plan to analyse on at least a weekly basis.
- Typically report:
  - Total number of cases
  - Incidence or notification rates – adjust for size of underlying population
  - Proportions
- Core descriptive analyses:
  - Time (day, week, month, year)
  - Place (district, region, country)
  - Person (age, sex, occupation, race, ethnicity)
- Present results in tables, graphs & maps

Target analyses to address surveillance objectives & questions

<table>
<thead>
<tr>
<th>Surveillance objective</th>
<th>Analytical output that can address these objectives</th>
<th>Frequency of analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify temporal trends and detect possible outbreaks</td>
<td>Line graph of incidence over time</td>
<td>Weekly</td>
</tr>
<tr>
<td>Identify groups who are at higher risk of WRID</td>
<td>Table of total number of cases and incidence or prevalence rate by age, sex and geographic area</td>
<td>Weekly</td>
</tr>
<tr>
<td>Detect possible outbreaks or clusters of cases; identify areas associated with higher rates of disease</td>
<td>Table or map of the number of cases or the incidence rate by geographical area</td>
<td>Weekly</td>
</tr>
<tr>
<td>Estimate disease burden</td>
<td>Table of frequency of cases</td>
<td>Quarterly or annually</td>
</tr>
<tr>
<td>Evaluate the impact of control measures, such as implementing a new water-treatment step</td>
<td>Incidence of disease before and after changes in the water treatment</td>
<td>Based on needs</td>
</tr>
</tbody>
</table>

Calculating an incidence or notification rate

Notification rate per 100,000 persons = \( \frac{\text{Number of cases (notifications)} \times 100,000}{\text{Total population}} \)

<table>
<thead>
<tr>
<th>Surveillance week</th>
<th>Number of notifications</th>
<th>Population estimate</th>
<th>Notification rate / 100,000 persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>525</td>
<td>1,291,850</td>
<td>40.6</td>
</tr>
<tr>
<td>13</td>
<td>489</td>
<td>1,291,850</td>
<td>37.9</td>
</tr>
<tr>
<td>14</td>
<td>501</td>
<td>1,291,850</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>579</td>
<td>1,291,850</td>
<td></td>
</tr>
</tbody>
</table>

Example: Using the formula, calculate the notification rates for weeks 14 and 15

Analysis by time – monitoring trends

- Different ways of presenting the data over time will illustrate different information and will convey different messages:
  - Is the rate or burden of disease increasing or decreasing?
  - How does this year compare to previous years?
  - Is there any seasonality in the incidence of disease?
- Can apply alert thresholds to detect outbreaks or identify the start of seasonal epidemics
Alert thresholds & moving averages

- Alert thresholds provide a signal that the number of cases exceeds a defined level
  - Possible outbreak or start of seasonal epidemic → sign that action may be needed
- Threshold depends on severity and epidemic potential of a pathogen & the local epidemiology
- Defined based on number of cases or by comparing number of cases in current surveillance period to historical data over previously defined time periods:
  - 5 year moving average

Example Alert Thresholds

<table>
<thead>
<tr>
<th>Surveillance outcome</th>
<th>Alert threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloody diarrhoea</td>
<td>5 or more cases in one place in one day</td>
</tr>
<tr>
<td>Acute gastroenteritis</td>
<td>Increase above the five-year average for that reporting period or two standard deviations above the five-year average for that reporting period</td>
</tr>
</tbody>
</table>

Calculating a – 5 year weekly moving average

\[
\text{5-year moving average of weekly cases} = \frac{\text{Total Yr 1} + \text{total Yr 2} + \text{total Yr 3} + \text{total Yr 4} + \text{total Yr 5}}{5}
\]

<table>
<thead>
<tr>
<th>Surveillance week</th>
<th>Weekly notifications per year</th>
<th>5-year total</th>
<th>5-year average</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>10 10 10 10 10</td>
<td>50 10</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>53 49 61 43 57</td>
<td>263 53</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>48 37 45 54 51</td>
<td>?   ?</td>
<td></td>
</tr>
</tbody>
</table>

Number of cases and crude incidence rate (CIR) over time

Discussion: What is your interpretation of this graph?

Weekly notifications (or incidence) compared to average notifications (or incidence) for the previous 5 years

Discussion: What is your interpretation of this graph?

Source: Public Health England

Interpretation: The temporal distribution of Cryptosporidium in 2017 is similar to the previous 5 years, with cases peaking at a similar time. The overall number of cases for 2017 appears to be lower than the average for the previous 5 years.

Monthly notifications compared to mean, minimum and maximum notifications for the previous 5 years

Discussion: What is your interpretation of this graph?


Interpretation: The number of monthly notifications of cryptosporidiosis are higher than the 5-year average and are at the higher limit of notifications observed over the past 5 years. There is a higher burden of cryptosporidiosis this year compared to previous years.

Monthly notifications over time

Discussion: What is your interpretation of this graph?

Source: The Institute of Environmental Science and Research Ltd. Notifiable Diseases in New Zealand: Annual Report 2017

Interpretation: Cryptosporidium shows a seasonal pattern, with most notifications occurring in October and November. There has been an upward trend in notifications over the past 4 years.
Analysis by place

Spatial analyses

- Identify high-risk areas for WRID
- Simple analyses using tables and graphs.
- Use geographic information systems to map the distribution of surveillance indicators by geographical area or water supply zone
  - Number of cases
  - Incidence rates
  - Complaints to water companies
- Need a geographical marker
  - Postcode
  - Place of residence
  - Location of medical facility

Simple tables of cases & rates

- Compare number of cases & notification rates by region
- Discussion: What is your interpretation of this table?

Source: Public Health England

Simple tables of cases & rates

- Interpretation: The highest number of cases and the highest notification rate was reported from the South West region. The burden of Cryptosporidium is highest in the South West

Source: Public Health England

Graph of rates by place over time

Discussion:
What is your interpretation of this graph?

What are the possible explanations for the different distribution of cryptosporidiosis by region and over time?


Graph of rates by place over time

Interpretation: The highest notification rate was reported from the midlands. Consistently over the past 5 years, and particularly in the last two years, the burden of cryptosporidiosis has been highest in the midlands. The eastern region has the lowest burden of disease.
Over the past 5 years the incidence of cryptosporidium in Ireland has been increasing.
### Analysis by person

Maps of cases & rates

**Source:** The Institute of Environmental Science and Research Ltd.

**Notifiable Diseases in New Zealand: Annual Report 2017**

### Analysis by age and sex – number of notifications

**Discussion:**
What is your interpretation of this graph?

### Analysis by age and sex - interpretation

**Interpretation:** The highest number of laboratory reports of cryptosporidium occurs in children aged 0-4 years old. In this age-group, the burden is highest in males. The burden of cryptosporidium is also high among women aged between 20 and 39.

**What are the possible explanations for the different distribution of cryptosporidium by age and sex?**

<table>
<thead>
<tr>
<th>Young children:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Environmental exposure including exposure to animals</td>
</tr>
<tr>
<td>• Greater susceptibility</td>
</tr>
<tr>
<td>• More severe disease &amp; greater care seeking</td>
</tr>
<tr>
<td>Women aged 20-40:</td>
</tr>
<tr>
<td>• Drink more water?</td>
</tr>
<tr>
<td>• Eat more salad &amp; raw vegetables?</td>
</tr>
<tr>
<td>• More likely to seek care?</td>
</tr>
</tbody>
</table>

### Analysis by age and sex - explanation

### Analysis by age and sex

**Discussion:**
What is your interpretation of this graph?

What is the advantage of this type of graph compared to the previous graph?

5/9/2022
Analysis by age and sex

Interpretation: The notification rate is highest in those aged 0-4 years old, and particularly in males aged 0 to 4 years. Higher notification rates are also observed in women aged 15 to 24 and 25 to 44.

Advantages:
Adjust for size of underlying population in each age & sex group

Analysis by person – risk factors for infection

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>% of known</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel outside of Ireland</td>
<td>43</td>
<td>63%</td>
<td>15%</td>
</tr>
<tr>
<td>Contact with other diseases</td>
<td>127</td>
<td>386</td>
<td>76</td>
</tr>
<tr>
<td>Contact with farm</td>
<td>314</td>
<td>339</td>
<td>136</td>
</tr>
<tr>
<td>Contact with on or off farm</td>
<td>206</td>
<td>233</td>
<td>120</td>
</tr>
<tr>
<td>Swimming pool visit</td>
<td>306</td>
<td>865</td>
<td>76</td>
</tr>
<tr>
<td>Other water related activities</td>
<td>45</td>
<td>97</td>
<td>187</td>
</tr>
<tr>
<td>Contact with known cases</td>
<td>307</td>
<td>160</td>
<td>200</td>
</tr>
</tbody>
</table>

Data source: CÍB

Discussion: What is your interpretation of this table?

Analysis by person & time – risk factors for infection

Interpretation: Cryptosporidiosis notifications peak in the spring. Travel associated cases are most frequently reported between July and October. The percentage of travel associated cases peaks in October.

Explanation:
Most rate falls in spring – increase in environmental exposure (water & farm exposure) & domestic notifications. Lambing & calving in spring. Most people travel overseas in the summer – higher numbers of travel associated cases.

Discussion: What is your interpretation of this graph?

What are the possible explanations for the varying distribution of cryptosporidiosis in this graph?

Analysis by person & time – risk factors for infection

Interpretation:
Cryptosporidiosis notifications peak in the spring. Travel associated cases are most frequently reported between July and October. The percentage of travel associated cases peaks in October.

Explanation:
Most rate falls in spring – increase in environmental exposure (water & farm exposure) & domestic notifications. Lambing & calving in spring. Most people travel overseas in the summer – higher numbers of travel associated cases.

Surveillance Bulletins

- Regularly communicate results of surveillance to stakeholders (weekly, monthly, quarterly)
  - Inform decision making for public health action
  - Demonstrate the purpose and usefulness of surveillance to those working on surveillance
- Incorporate into existing surveillance bulletins (enteric pathogens, food and waterborne illness bulletin, or communicable diseases bulletin)
- Disseminate to stakeholders (water providers, regulators etc)
- Make publicly available (public health agency website)
Outline for a surveillance bulletin

• Key messages / summary
• Introduction (brief)
• Methods (brief)
• Epidemiology
  – Time (trends in notifications or rates)
  – Person (age, sex, other risk factors (travel))
  – Place
• Outbreaks
• Discussion / conclusions

Key messages

• Summarise the main findings and take home messages of the report
  – What is the ONE message you want the audience to take away from this report?
  – What is the ONE message the reader needs to understand?

• Focus the key messages on:
  – The most important conclusions arising from the analyses
  – The most important facts you want to communicate to the reader (3 or 4 facts)

Using surveillance data for advocacy

• Inform development of policy, regulations and guidelines
• Identify priorities & where to target resources for improving the water system
• Estimate impact of WRID—disability adjusted life years, quality adjusted life years, direct costs (healthcare utilisation) & indirect costs (work absenteeism & productivity losses)
• Evaluate impact of control measures
  – impact on incidence after the introduction of the control measure
  – cost benefit analyses

Principles and steps of an outbreak investigation

Module 2.1

What is an outbreak?
✓ Unexpected increase in cases in a specific place and time
✓ Exceedance of a predefined alert threshold
✓ Two or more cases of disease linked to the same source

What is a waterborne outbreak? - WHO definition

At least two people experience a similar illness after exposure to water and the evidence suggests a probable water source
(Large water supply) waterborne outbreaks

- Associated with watershed events:
  - Defects in the water-treatment process or distribution system
  - Exceedance of water-quality parameters
- Sudden, rapid and widespread occurrence of consultations
- Clustering of cases in a particular water-supply zone

When to investigate a waterborne outbreak?

- The outbreak is likely to continue if no intervention
- Unknown source
- Unknown cause
- Severe and/or unusual disease
- Large number of cases

When to investigate a waterborne outbreak?

- Unknown source
- Unknown cause
- Severe and/or unusual disease
- Large number of cases

Outbreak investigation objectives

- Confirm the outbreak
- Identify the source and contributing factors
- Implement control measures

Outbreak investigation steps

- Differ from outbreak to outbreak
- Simultaneous and in parallel
- Control measures as early as possible
- Communication on an ongoing basis

10 step approach

1. Detect and confirm the outbreak and agent
2. Rapid Response Team (RRT)
3. Define cases
4. Identify cases and obtain information
5. Descriptive epidemiological investigation (time, place, person)
6. Additional studies (environmental, risk assessments, laboratory)
7. Interview cases and generate hypotheses
8. Evaluate the hypotheses
9. Inform risk managers and implement control measures
10. Communicate findings, make recommendations and evaluate the outbreak response
Step 1. Detect and confirm the outbreak and agent

Health-care systems
✓ Detection by surveillance systems
▪ Indicator and event based surveillance
▪ Epidemiological
▪ Microbiological
✓ Health-care facilities reports

Other signals
✓ Absenteeism from work, schools
✓ Increased sales of certain medications
✓ Media reports

Water quality
✓ Routine samples with faecal bacteria
✓ Water treatment or distribution failures
✓ User complaints

Is the outbreak real? → More cases than expected?
Seasonal variations?
Notification artefacts?
New surveillance system?
Diagnostic bias?

Identifying the microorganism helps to:
✓ develop a hypothesis about the source (previous events)
✓ identify time of exposure (incubation period)
✓ choose control measures

✓ Not wait lab results to start the investigation
✓ Confirm a proportion of cases.

Country example

Large waterborne *Campylobacter* outbreak: use of multiple approaches to investigate contamination of the drinking water supply system, Norway, June 2019
Step 1. Detect and confirm the existence of the outbreak and confirm the causative agent

6 June 2019, Askøy, Norway.

- In 24 h, 10 people hospitalised with fever, abdominal pain and diarrhoea, and 30 consultations from out-of-hours primary healthcare services.
- Many patients presenting with gastroenteritis had home addresses near each other → drinking water?
- One person tested positive for *Campylobacter*
- Medical Officer in Askøy reports the outbreak to the Norwegian Institute of Public Health.

Outbreak context

- Three different water supply systems in Askøy: A, B, C
- Water Supply System A (WSSA) from the 1950s, serves ca 12,000 people in the south of the island.
- WSS-A has 9 reservoirs, including 3 built as unlined mountain caverns.
- One of these reservoirs was reservoir X

Immediate precautionary control measures

- 6 June: Boil Water Advice issued
- 7 June: Reservoir X taken out of service

Step 2. Form the Rapid Response Team

Outbreak confirmed

Investigation needed

Form the Rapid Response team

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local/regional public Health agency</td>
<td>Overall coordination</td>
</tr>
<tr>
<td>Food/water authority</td>
<td>Environmental investigation</td>
</tr>
<tr>
<td>Water supplier</td>
<td>Control measures implementation</td>
</tr>
<tr>
<td>Health-care providers</td>
<td>Case management</td>
</tr>
<tr>
<td>Laboratory</td>
<td>Microbiological investigation</td>
</tr>
</tbody>
</table>

Communication experts!
Step 2. Form the rapid response team

Coordinating activities across agencies can be difficult

- Clear roles and responsibilities
- Teams before an outbreak occurs
- Contact meetings and exercises between crisis

Step 2. Form the Rapid Response Team (RRT)

- Complete investigation planned
  - Epidemiological
  - Microbiological
  - Environmental
- Municipal services
- Norwegian Food Safety Authority
- Norwegian Institute of Public Health

Step 3: Define cases

Case definition components
- Time
- Place
- Person

Case Classification
- Possible
- Probable
- Confirmed

“A person (who?) living in town XXXX (where?) with diarrhoea (≥ 3 loose stools in 24 hours) and any one of the following symptoms – abdominal pain, nausea and vomiting (who?) – and date of onset of symptoms from 1 August 2020 (when?) and not travel history (who?, where?).”

Step 4: Identify cases and obtain information

In order to:
- Estimate the size of the outbreak and its distribution
- Determine the population at risk
- Enroll patients
  - Hypothesis-generating pilot interviews
  - Descriptive and analytical epidemiology
- Identify patients who need treatment

How?
- Passive case finding → Existing surveillance system.
- Active case finding
  - Additional laboratories, not part of national surveillance systems
  - Public and private hospitals or primary healthcare centers
  - People at risk: school children, nursing homes, mass gatherings
  - Invitation lists, reservation lists, guest lists
Step 4: Identify cases and obtain information

Line List
- Basic information on each case
  - Id, age, type of case, sex, phone number, residence, clinical information...
  - One line per case
  - Spreadsheet
  - Updated as the investigation develops

- Facilitates systematization of the information
- Provides an overall picture

Pilot interviews
- Standardized questionnaire:
  - Clinical information, risk factors and demographics
- Comprehensive: all relevant exposures
- Few interviewers
- Sample of cases

- Obvious common exposures?
- Exclude exposures?

Guidelines for investigation of outbreaks, of food and waterborne diseases, Norwegian Institute of Public Health

Questionnaires distribution
- Email
- Web questionnaires
- Telephone interviews
- Paper questionnaires by mail
- Social media

Step 5: Descriptive epidemiological investigation

What do cases have in common? ➔ Generate hypothesis

- Time
  - When were they infected?

- Place
  - Where were they infected? Where do they live?

- Person
  - What are the symptoms and etiology? Who was infected?
• Outbreak monitoring ➔ Determine the extent of the outbreak
  - Case finding: gastroenteritis consultations
  - Map gastroenteritis consultations
  - Trawling questionnaires to first campylobacteriosis cases

• Survey childcare centres ➔ Ascertain start and distribution of the outbreak and document absence for illness.

Step 3: Define cases
Step 4: Identify cases and obtain information
Step 5: Descriptive epidemiological investigation

Outbreak monitoring ➔ Determine the extent of the outbreak
  • Case finding: Gastroenteritis consultations (who?) at primary care in Askøy (where?) between 3 June and 15 June (when?)
  • Map consultations by household address and water supply
  • Trawling questionnaires to first campylobacteriosis cases
    – Food consumption
    – Animal contact
    – Environmental exposures
    – Clinical and demographical information

Estimated incidence rates for gastroenteritis consultations linked to reservoir supply zones
Water supply zones of water supply system WSS A defined by different reservoirs Zones 6, 7 and 8 served by Reservoir X.

Number of gastroenteritis consultations at general practitioner and out-of-hours primary healthcare services

Sharp increase in gastroenteritis consultations (from 12 to 182 consultations) on Thursday 6 June
Consultations evenly distributed among all age groups, although in-person consultations were primarily for children
Step 3: Define cases

Outbreak monitoring

Gastroenteritis patients’ residences were coincided with three water supply zones served by Reservoir X.

The three zones with Incidence Rate > 1 are the ones served by Reservoir X.

Large waterborne Campylobacter outbreak: use of multiple approaches to investigate contamination of the drinking water supply system, Norway, June 2019

Step 4: Identify cases and obtain information

Step 5: Descriptive epidemiological investigation

Outbreak monitoring

- Trawling questionnaires to five campylobacteria cases.
  - Diarrhoea, stomach pain and fever (onset 4-5 June)
  - Tap water at home in the week before symptom onset
  - Attendance to events, food items, contact with animals or recreational water not common to all five cases.

Step 6: Additional studies (environmental, laboratory)

Environmental investigation

1) Description of the water supply system

- Water source
- Abstraction points and distribution network
- Treatment processess
- Storage tanks
- Distribution network
- Location of potential contamination sources
Step 6: Additional studies

Environmental investigation

2) Rapid system assessment → Hazardous events? Control measures in place?

- Interview water-supply system personnel
- Review outcomes of sanitary surveys
- Assess water quality information and weather records
- Operational records and procedures: any problems compromising control measures?
- Customer complaint reports
- Non-piped systems: Review water collection, transport and handling
- Map potential exposures of interest

Laboratory investigation of the water-supply system

- Provides strong evidence on the link between the source and cases
- Still possible to demonstrate that water is the source of an outbreak even if the agent is not isolated from the water-supply system

Microorganisms may not be detected in the water-supply system due to:

- Time between the contamination event, exposure and sampling.
- Transient contamination
- Disinfection of the system as a preliminary measure
- Special sampling needed to isolate enteric viruses or protozoa

Step 6: Additional studies (environmental, laboratory)

Environmental investigation – Description of the water supply network

- Under normal conditions, Reservoir X supplies Zone 6 (1,350 residents).
- Before the outbreak, a valve opened from Reservoir X to ensure replacement of water in response to customer complaints about the water quality.
- This led to a connection between Zone 6 and Zones 7 and 8 (3,558 residents), with drinking water from both Reservoir X and others.
- The valve was closed on 6 June.

Laboratory investigation of the water-supply system

- Consultations indicated a higher IR in these zones.
- No unusual malfunctions reported before the outbreak.
Environmental investigation – Weather records.
Weather data from a nearby weather station indicated heavy rainfall. This coincided with registered consultations of gastroenteritis in the Norwegian Syndromic Surveillance System.

Analysis of water in WSS-A or in Reservoir X.
• Routine samples prior to the outbreak did not detect any faecal indicator bacteria. After the outbreak, extra sampling in WSS-A was conducted.
• Routine samples for WSS-A on 3 June were also negative.
• On 6 June, samples collected from Reservoir X and areas supplied by Reservoir X were contaminated.
• Several samples positive for Campylobacter (7 June).

Step 7: Generate hypotheses
- Descriptive epidemiology
  - Age
  - Sex
  - Residence
  - Work place
  - Routines
- Microbiology
  - Incubation period
  - Mode of transmission
  - Previous outbreaks
- Environment
  - Risk assessments
  - Inspections

Step 8: Evaluate the hypotheses
- Analytical studies
- Assessing the strength of evidence

- Analytical studies may generate stronger evidence to support the hypothesis and to quantify the strength of the association.
- Compare exposure between cases and non-cases and identify risk factors.

Cohort studies
Case-control studies

Step 8 Analytical studies- Considerations
Challenges when collecting water usage exposure:
- Time elapsed between the exposure and the investigation.
- Respondents may have changed water use as part of control measures.
- Exposure to different water sources: home, workplace, sport center...
- Household members may be exposed to different water sources.

Measure Dose response
Risk increases with increasing amounts of water
Step 8: Evaluate the hypotheses
Assessing the strength of evidence

A. Pathogen identified in clinical cases also found in water
B. Water quality failure and/or water-treatment problems of relevance, but outbreak pathogen is not detected in water
C. Evidence from an analytical (case-control or cohort) study demonstrates an association between water and illness
D. Descriptive epidemiology suggests that the outbreak is water-related and excludes obvious alternative explanations

Source: Tillet et al

Cohort study of households
All residents who received water from WSS-A were included
Exposed: people in households receiving water from Reservoir X
Case definition: person with gastroenteritis with symptom onset between 1 and 19 June 2019.

Analytical studies
Cohort study of households
SMS with link to a questionnaire sent to all households served by WSSA
One person should respond on behalf of all household members.
The questionnaire included items on illness and tap water consumption

Information available from 2,526 persons who responded on behalf of 6,108 household members
Coverage of 51% (6,108/11,995) of the residents supplied by WSSA

Mean age: 34 years (0-93)
50% were female
1,573 respondents met the case definition
Attack rate: 26%
Number of cases peaked on 6 June and decreased gradually thereafter

Attack rates and risk ratios for areas supplied by Reservoir X and other areas

<table>
<thead>
<tr>
<th>Area</th>
<th>Attack rate</th>
<th>Risk ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>26%</td>
<td>Reference</td>
</tr>
<tr>
<td>Other areas</td>
<td>11%</td>
<td>0.6 (0.4-1.0)</td>
</tr>
</tbody>
</table>
Step 8: Evaluate the hypothesis
Analytical studies
Assessing the strength of evidence

Cohort study of households
Risk of gastrointestinal illness by consumption of tap water

<table>
<thead>
<tr>
<th>Group</th>
<th>Tap water consumption</th>
<th>Cases</th>
<th>Controls</th>
<th>Relative risk</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td>12</td>
<td>10</td>
<td>1.2</td>
<td>0.95-1.5</td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td>18</td>
<td>15</td>
<td>1.2</td>
<td>0.95-1.5</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td>24</td>
<td>20</td>
<td>1.2</td>
<td>0.95-1.5</td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td>30</td>
<td>25</td>
<td>1.2</td>
<td>0.95-1.5</td>
</tr>
</tbody>
</table>

Step 9: Implement control measures

Immediate precautionary control measures
- Boil water advisory
- Reservoir X taken out of service
- Emergency water supply distribution from water tanks located in public areas
- Infection control measures in public services were strengthened

Final considerations
- Water contamination through cracks in a mountain reservoir, because of heavy rainfall
- Water supply systems, in particular ageing infrastructure, are generally vulnerable to contamination especially as external risks such as climate factors are changing.
- Importance of conducting water safety planning, updating the infrastructure and performing risk-based surveillance to mitigate risks.

Step 10: Communicate findings, make recommendations and evaluate the outbreak response

Communication should begin early
- What is already known?
- What is being done?
- Control measures should be communicated continuously to relevant stakeholders
- The public should receive regular updates
- Detailed outbreak report

• The outbreak may prompt policy changes
- Insufficient policy or tools?
- Inadequate training of waterworks personnel?
- Inadequate maintenance of the water distribution system?

Final considerations
- The triangulation of epidemiological, genomic, geographical and water systems data was essential for confirming the role of Reservoir X.
- Rationale for the early decisions was based on local knowledge and mapping of cases rather than epidemiological studies.
- The use of mixed methods allowed to identify contributing factors, such as inclement weather conditions.

Final considerations
- Water contamination through cracks in a mountain reservoir, because of heavy rainfall
- Water supply systems, in particular ageing infrastructure, are generally vulnerable to contamination especially as external risks such as climate factors are changing.
- Importance of conducting water safety planning, updating the infrastructure and performing risk-based surveillance to mitigate risks.

• The outbreak may prompt policy changes
- Insufficient policy or tools?
- Inadequate training of waterworks personnel?
- Inadequate maintenance of the water distribution system?

Final considerations
- The triangulation of epidemiological, genomic, geographical and water systems data was essential for confirming the role of Reservoir X.
- Rationale for the early decisions was based on local knowledge and mapping of cases rather than epidemiological studies.
- The use of mixed methods allowed to identify contributing factors, such as inclement weather conditions.

Step 10: Communicate findings, make recommendations and evaluate the outbreak response

Communication should begin early
- What is already known?
- What is being done?
- Control measures should be communicated continuously to relevant stakeholders
- The public should receive regular updates
- Detailed outbreak report

• The outbreak may prompt policy changes
- Insufficient policy or tools?
- Inadequate training of waterworks personnel?
- Inadequate maintenance of the water distribution system?

Final considerations
- The triangulation of epidemiological, genomic, geographical and water systems data was essential for confirming the role of Reservoir X.
- Rationale for the early decisions was based on local knowledge and mapping of cases rather than epidemiological studies.
- The use of mixed methods allowed to identify contributing factors, such as inclement weather conditions.

Step 10: Communicate findings, make recommendations and evaluate the outbreak response

Communication should begin early
- What is already known?
- What is being done?
- Control measures should be communicated continuously to relevant stakeholders
- The public should receive regular updates
- Detailed outbreak report

• The outbreak may prompt policy changes
- Insufficient policy or tools?
- Inadequate training of waterworks personnel?
- Inadequate maintenance of the water distribution system?

Final considerations
- The triangulation of epidemiological, genomic, geographical and water systems data was essential for confirming the role of Reservoir X.
- Rationale for the early decisions was based on local knowledge and mapping of cases rather than epidemiological studies.
- The use of mixed methods allowed to identify contributing factors, such as inclement weather conditions.

Step 10: Communicate findings, make recommendations and evaluate the outbreak response

Communication should begin early
- What is already known?
- What is being done?
- Control measures should be communicated continuously to relevant stakeholders
- The public should receive regular updates
- Detailed outbreak report

• The outbreak may prompt policy changes
- Insufficient policy or tools?
- Inadequate training of waterworks personnel?
- Inadequate maintenance of the water distribution system?

Final considerations
- The triangulation of epidemiological, genomic, geographical and water systems data was essential for confirming the role of Reservoir X.
- Rationale for the early decisions was based on local knowledge and mapping of cases rather than epidemiological studies.
- The use of mixed methods allowed to identify contributing factors, such as inclement weather conditions.

Step 10: Communicate findings, make recommendations and evaluate the outbreak response

Communication should begin early
- What is already known?
- What is being done?
- Control measures should be communicated continuously to relevant stakeholders
- The public should receive regular updates
- Detailed outbreak report

• The outbreak may prompt policy changes
- Insufficient policy or tools?
- Inadequate training of waterworks personnel?
- Inadequate maintenance of the water distribution system?

Final considerations
- The triangulation of epidemiological, genomic, geographical and water systems data was essential for confirming the role of Reservoir X.
- Rationale for the early decisions was based on local knowledge and mapping of cases rather than epidemiological studies.
- The use of mixed methods allowed to identify contributing factors, such as inclement weather conditions.
Step 10
Communicate findings, make recommendations and evaluate the outbreak response

After-action review:
• Outbreak detection and alert
• Suitability and speed of implementation of control measures
• Outbreak reporting and communication
• What worked well
• What could be improved

References
• This module is based on the document: Surveillance and outbreak management of water-related infectious diseases associated with water supply system. Copenhagen: WHO Regional Office for Europe; 2019. Licence: CC BY-NC-SA 3.0 IGO.
• Additional references are:
  - Additional references were materials used in pilot national training workshops on water-related disease surveillance previously run by the World Health Organization Regional Office for Europe under the framework of the Protocol of Water and Health and training materials from the European Programme for Intervention Epidemiology Training (EPIET) Epidemiological studies Module 2.2

Steps in outbreak management
1. Detect and confirm the outbreak and agent
2. Rapid Response Team (RRT)
3. Define cases
4. Identify cases and obtain information
5. Descriptive epidemiological investigation (time, place, person)
6. Additional studies (environmental, risk assessments, laboratory)
7. Interview cases and generate hypotheses
8. Evaluate the hypotheses
9. Inform risk managers and implement control measures
10. Communicate findings, make recommendations and evaluate the outbreak response

Epidemiological studies

• Descriptive
• Ecological
• Analytical
• Cohort studies
• Case-control studies

Descriptive analysis
They answer the question “What’s going on?”

<table>
<thead>
<tr>
<th>Person</th>
<th>Place</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Who?</td>
<td>• Where?</td>
<td>• When?</td>
</tr>
</tbody>
</table>
Descriptive analysis

- Generate hypotheses on the possible source, etiology and modes of transmission
- Identify the population at risk
- Estimate when the initial exposure to the causative pathogen occurred
- Identify opportunities for control

Descriptive analysis

- Results visualized in tables and maps or curves
- Not possible to identify causality or risk factors

Time - when?

The epidemic curve indicates
1) Type of source: point source, continuous, intermittent.
2) Mode of transmission

Cases of gastroenteritis in a sample of Røros (Grey) and Holtalen (Plum) household members by date of illness onset (n = 105), from April 30 to May 14, 2007 and the timeline of events, which may be relevant to the water contamination.

B.J. Gilpin et al., A large scale waterborne Campylobacteriosis outbreak, Havelock North, New Zealand, Journal of Infection, https://doi.org/10.1016/j.jinf.2020.06.065
Place - where?

- Cases mapped to assess the geographical extent of the outbreak
- Visualize and explore the spatial distribution of cases
- A cluster of cases might suggest exposure to a particular source
- Attack rates by exposure to particular water sources and by place
- Visualize and explore the spatial distribution of cases

Person - who?

- Age
- Sex
- Number of cases
- Attack rate
- Symptoms
- Hospital admission
- Deaths
- Case fatality rate
- Other?: Occupation

Demographic characteristics and clinical outcomes of confirmed and probable campylobacteriosis cases.

Descriptive análise, in conclusion

The W's of descriptive epidemiology:
- **What** → health issue of concern
- **Who** → person
- **Where** → place
- **When** → time

Descriptive analysis, in conclusion

- Analyse by person:
  - calculate attack rates by exposure to particular water sources
- Analyse by place:
  - calculate attack rates by place
  - map cases distribution to assess the geographical extent of the outbreak
  - Undertake spatial analyses to visualize the spatial distribution of cases in relation to suspect sources.
- Analyse by time:
  - if the causative agent is known, use the epidemic curve to estimate the likely time period of exposure
  - Assess if the epidemic curve correlates with events in the water-supply system and implementation of control measures.

Water supply zones of a water supply system defined by different reservoirs, Zones 6, 7 and 8 were served by Reservoir X.

Estimated incidence rates for gastroenteritis consultations linked to reservoir supply zones, The three zones with incidence rate >1 are served by Reservoir X.


John Snow and Cholera outbreak in London

Source: CDC
Ecological studies
• Quite useful for outbreaks associated with public water supplies
• They relate to population level, not individual level
• Rates of disease and their association with exposures are compared among defined populations.

Analytical studies
"Are there any differences between what sick and not sick people did?"
• They help to identify exposures associated with disease
• Generate evidence to support the hypothesis under investigation
• Estimate the strength of the association between an exposure and an outcome.
• In outbreak investigations: retrospective cohort studies, case-control studies

Analytical studies
• (retrospective) cohort studies
• case-control studies

Cohort studies
• Comparison of risk of disease over a defined time period among those exposed to factor X, versus those not exposed
  – Two cohorts: exposed and not exposed
• If those exposed have a higher rate of disease, this provides evidence that the factor is the cause of the disease.
• This assumes that both groups are the same, except in terms of their exposure to the factor.
Analytical studies - Cohort studies

<table>
<thead>
<tr>
<th>Disease</th>
<th>No disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed</td>
<td>a</td>
</tr>
<tr>
<td>Not Exposed</td>
<td>c</td>
</tr>
</tbody>
</table>

\[ a+c = b+d \]

- Attack rate (incidence) in exposed: \( \frac{a}{a+b} \)
- Attack rate (incidence) in not exposed: \( \frac{c}{c+d} \)

Relative Risk (RR): Incidence in exposed / Incidence in not exposed

- RR = 1; no association
- RR > 1; the exposure is a risk factor
- RR < 1; the exposure is a “protective” factor

Cohort study - example

Waterborne Outbreak of Norwalk-Like Virus Gastroenteritis at a Tourist Resort, Italy

Epidemiological investigation

Case definition: Guest/employee at the resort during July 1–31 and who had diarrhea (≥3 loose stools in 24-hour period) or vomiting (at least 1 episode) in the same period.

Retrospective Cohort study: Because of the high number of cases in staff members, performed to assess risk factors in this group.

- Inclusion criteria: staff members employed from July 1 to 31.
- Questionnaires sent to all 224 staff members in the first week of August.
- A month had elapsed between onset of symptoms and distribution of the questionnaires.

Outbreak context

- July 2000, outbreak of gastroenteritis at a tourist resort in southern Italy.
- Illness in 344 people, 69 staff members.
- Norwalk-like virus was found in stool specimens.
- The source was likely contaminated drinking water.

Epidemiological investigation

- 181 questionnaires from 224 staff members were analyzed.
- Attack rate = 38.1% (69/181)
Cohort study- example

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cases</th>
<th>Controls</th>
<th>X²</th>
<th>P</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>20</td>
<td>25</td>
<td>3.3</td>
<td>0.04</td>
<td>2.7</td>
<td>0.04</td>
</tr>
<tr>
<td>Drinking</td>
<td>30</td>
<td>35</td>
<td>1.2</td>
<td>0.21</td>
<td>1.5</td>
<td>0.21</td>
</tr>
<tr>
<td>Obesity</td>
<td>40</td>
<td>45</td>
<td>0.5</td>
<td>0.47</td>
<td>0.6</td>
<td>0.47</td>
</tr>
<tr>
<td>Diabetes</td>
<td>50</td>
<td>55</td>
<td>0.3</td>
<td>0.57</td>
<td>0.4</td>
<td>0.57</td>
</tr>
<tr>
<td>Hypertension</td>
<td>60</td>
<td>65</td>
<td>0.1</td>
<td>0.75</td>
<td>0.1</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Analytical studies

- (retrospective) cohort studies

- case-control studies

Most frequent analytical approach in waterborne outbreaks
Cases are compared to individuals unaffected by the disease in question to find out whether there is a difference in their exposures.
These unaffected individuals are called “controls”

Example of control selection

135 cases of Cryptosporidium hominis

- Where? City XX (population 350,000)
- When? Second week September 2020-first week October 2020
- Who? 47% Women; mean age 37 years old. Range: 19-91

Analytical studies- Case-control studies

- Who are right controls? That is crucial for success
- Controls must represent the population at risk of disease and must not have the disease under investigation at the time of their recruitment.
- Controls represent the background level of exposure in the population.
- If the level of exposure is greater among cases than controls, this provides evidence that the exposure is associated with disease.

Example of control selection

135 cases of Cryptosporidium hominis

- Where? City XX (population 350,000)
- When? Second week September 2020-first week October 2020
- Who? 47% Women; mean age 37 years old. Range: 19-91

Who are the right controls for a case-control study?
135 cases of Cryptosporidium hominis
•Where? City XX (population 350,000)
•When? Second week September 2020-first week October 2020
•Who? 47% Women; mean age 37 years old. Range: 19-91

They have to be representative of the population where cases belong

Source population:
People living at City XX > 18 years
Not travelled outside the city in the relevant period

How to select controls
•Random sample for population registry or list
  -Complete
  -Accessible
  -Feasible to stratify (sex, age, district....)

How to select controls- Challenges
•Disease with high rate of asymptomatic
•Immune people
•100% exposure

How to select controls
•Telephone / mobile register
•Challenges:
  –Who has a mobile?
  –Who will answer?

How to select controls
•Friends, family, neighbours
  –Can be efficient.
  –Similar to cases
  –Low cooperation
How to select controls
• Never perfect
• Balance strengths and weaknesses
• Balance urgency, resources
• Defend your choices
• Take into account how limitations may affect results

Analytical studies - Case-control studies
Calculation of OR

Odds ratio - Interpretation
• An OR = 1; no association
• An OR > 1; the study factor is a risk factor
• An OR < 1; the study factor is a “protective” factor

Case-Control study example
Outbreak context
• October 2004: Municipal medical officer in Bergen (Norway) alerted by the university hospital to an increase of patients with giardiasis.
• During two weeks: 27 cases with unknown or no travel history
• Mainly young adults from the central part of the city
• 1–2 domestic cases of giardiasis are normally reported annually in Bergen

Case-Control study example
The epidemiological investigation included:
• Active case-finding, descriptive and ecological analysis
  - Cases identified through the laboratory conducting giardia diagnostics in the area.
  - All laboratory-confirmed cases mapped based on address of residence
  - Attack rates and relative risks were calculated for each water supply zone.
• Case control study
  - Among people living in the central area of Bergen
  - Age- and sex-matched controls randomly selected from the population register.
Selection of controls and information collection

• Potential controls contacted by telephone (two controls per case)

• Cases and controls were asked about exposures two weeks before symptom onset for the case.

• Cases and controls that had travelled to a highly endemic country for giardiasis were excluded.

• Information was collected by telephone interviews
  - Structured questionnaire: food and drinks consumed, different activities, clinical illness, use of health services.
  - Additional analysis to assess risk associated with quantity of water consumed
    - Group matched analysis, including interviewed cases for whom we did not interview individually matched controls.
    - Group matching was based on gender and 10-year age groups.

Matched univariate conditional logistic regression analysis of selected dichotomous risk factors among cases of giardiasis and matched controls, water-supply zone A, Bergen municipality 1/9 – 15/11 2004.

In summary...

Descriptive epidemiology
What is happening?

Ecological epidemiology
Explore associations

Analytical epidemiology
Test hypothesis

Case-control study example

<table>
<thead>
<tr>
<th>Water supply zone</th>
<th>Cases</th>
<th>% Cases</th>
<th>% Controls</th>
<th>OR*</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>water zone 1</td>
<td>0</td>
<td>0%</td>
<td>3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water zone 2</td>
<td>12</td>
<td>4%</td>
<td>1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water zone 3</td>
<td>25</td>
<td>8%</td>
<td>3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water zone 4</td>
<td>30</td>
<td>10%</td>
<td>1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water zone 5</td>
<td>50</td>
<td>16%</td>
<td>1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Case-control study - Risk of giardiasis associated with quantity of water consumed among residents in water supply zone A, Bergen municipality 1/9 – 15/11 2004. Group matched analysis by sex and 10-year age groups (83 cases, 54 controls).

Analytical studies

Small defined populations
• Meetings, courses, restaurants, parties, weddings

Large open populations
• Cities, countries

• Retrospective cohort study
• Relative risk

• Case control study
• Odds ratio

This module is based on the document: Surveillance and outbreak management of water-related infectious diseases associated with water supply system. Copenhagen: WHO Regional Office for Europe; 2019. License: CC BY-NC-SA 3.0 IGO.

Additional used references are
- Additional references were materials used in pilot national training workshops on water-related disease surveillance previously run by the World Health Organization Regional Office for Europe under the framework of the Protocol of Water and Health and training materials from the the European Programme for Intervention Epidemiology Training (EPIT).

References for the country examples are embedded in the presentation.
10 step approach

1. Detect and confirm the outbreak and agent
2. Rapid Response Team (RRT)
3. Define cases
4. Identify cases and obtain information
5. Descriptive epidemiological investigation (time, place, person)
6. Additional studies (environmental, risk assessments, laboratory)
7. Interview cases and generate hypotheses
8. Evaluate the hypotheses
9. Inform risk managers and implement control measures
10. Communicate findings, make recommendations and evaluate the outbreak response

Key points

• Crucial component of risk management
• Should be guided by risk communication planning
• Used to guide public participation to support outbreak’s control
• Communication opportunities exist throughout the investigation ➔ skilled communication is critical

Risk communication under the Protocol and IHR

• Article 8 of the Protocol of Water and Health stipulates that Parties give prompt and clear notification about outbreaks, incidents or threats in the event of any imminent threat to public health from water-related disease

Parties shall “disseminate to members of the public who may be affected all information that is held by a public authority and that could help the public to prevent or mitigate harm.”

• Core requirement for countries within the framework of the International Health Regulations (IHR)

Effective risk communication and planning can mitigate complications during outbreaks

• Outbreaks are unpredictable and alarming to the public and attract media attention
• Public health authorities communicate through the media
• Official information has to be rapid to meet the increasingly rapid media cycle, mitigating rumors
• Communication failures can impede outbreak control measures, undermine public trust and engagement and prolong social, economic and political turmoil

Key elements of risk communication

• Trust
• Announce early
• Transparency
• Understand the public
• Integration in contingency planning
Key elements- Trust

- Communicate in ways that build, maintain or restore trust
- Acknowledge uncertainty
- Trust is hard to win and easy to lose
- No trust → fear and lack of compliance
- Build trust between those leading on communication
- Trust public’s ability to tolerate incomplete or alarming information
- Ensure accountability and transparency
- Listen to and be aware of public concerns

Key elements- Announce early

It helps to build public trust and prevent rumors and misinformation spreading

- Those responsible for risk communication should:
  - avoid withholding information to “protect” the public
  - acknowledge that the announcement is based on preliminary information, so the situation may change as further information emerges
  - ensure clear communication channels between key stakeholders so they are aware in advance of the announcement
  - The way the initial announcement is done may impact on the reception to all subsequent communication

Key elements- Transparency

It leads to greater trust

- Those responsible for risk communication should:
  - Communication should be frank, easily understood, complete and accurate
  - keep the public informed about the activities of the investigation, including the information-gathering, risk assessment and decision-making process of outbreak management
  - focus on what is being done and the next steps
  - Explain the unknowns
  - be aware that pride, embarrassment, fear of revealing weaknesses and fear of being blamed can lead to a lack of trust

Key elements- Understand the public

- Knowing who the public is, and what they think, is essential in developing effective public health messages

- Those responsible for risk communication should:
  - understand the public’s beliefs, opinions and knowledge about specific risks
  - involve representatives of the public in the decision-making process
  - respect the public’s concern, regardless of its validity
  - address the concern in any policies developed
  - publicly acknowledge and correct mistaken concerns
  - include information in risk-communication messages on how the public can protect themselves

Key elements- Integration in contingency planning

- Risk communication should be integrated into contingency planning for major events and outbreak response

- Those responsible for risk communication should:
  - develop the risk-communication plan as part of the outbreak-management plan from the start of the outbreak
  - ensure media training for relevant members of the response team
  - develop partnerships with the media
  - organise press conferences to answer multiple media enquiries in an organised way
  - prepare pre-approved public health messages that can be adapted for the outbreak

Preparing public Health messages

Important to provide clear information and advice to the public during the outbreak. Best done through prepared communication messages with clear public health advice.
**Example messaging: “boil water advisory”**

- Explain current risk: e.g. potential microbial contamination in specific area
- Stipulate under what circumstances: e.g. water for drinking and food preparation
- Describe action to be taken: e.g. bring the water to a rolling boil and allow to cool naturally.

**Preventing public Health messages**

The target audience can absorb only a limited amount of information, so the single overarching communication outcome and the key message that needs to be understood by the audience should be determined.

- simple, accurate, credible, relevant, consistent and timely
- should not contain technical language
- should describe clearly what needs to be done, by whom, when it needs to be done, how it needs to be done and for how long
- should be capable of being understood by, and be accessible to, different groups

**Communication channels**

- Institutional website
- Social media
  - important tool for directly and immediately communicating with the public
  - enables those who use it to become involved in the response to the outbreak through commentary
  - useful for monitoring response and public concerns including community resistance, and can be used to monitor and counter rumors about the outbreak.
- Traditional media
  - Television, radio, printed press
- Partners and stakeholders (internal & external)

**Additional references**

This module is based on the document: Surveillance and outbreak management of water-related infectious disease associated with water supply system. Copenhagen: WHO Regional Office for Europe; 2010. Licence: CC BY-NC-SA 3.0 IGO.

Additional references were materials used in pilot national training workshops on water-related disease surveillance previously run by the World Health Organization Regional Office for Europe under the framework of the Protocol of Water and Health.