CDC Role in Federal Response to Biological Contamination of Water

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Outline

- How and when a federal response to a water event activates
- Description of CDC responsibilities during federal water response
- How and when CDC is involved in state/local water response
- Overview of CDC Waterborne Disease Prevention Branch
- CDC water testing laboratory capabilities for waterborne outbreaks
- CDC water response beyond biological contaminants

Response Management

- Most incidents managed at local or tribal level from start to finish
- Local incidents may require a unified response from local agencies, the private sector, and NGOs – some may require additional support from neighboring jurisdictions or state governments using in-state resources
- State may request assistance from other states or the Federal Government through a Stafford Act Declaration

Federal Response Support

- Degree of Federal response support depends on incident severity, authorities invoked, and ability of local and insular area entities to manage the incident and any associated cascading incidents
- The Federal department or agency leading coordination a federal response depends on incident type and magnitude
- and are also supported by other agencies who bring their relevant capabilities to bear to support those affected

Federal Emergency Response

National Response Framework

- Scalable, flexible, and adaptable approach for how the Nation responds to all types of disasters and emergencies
- Describes the principles, roles, responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident
- Outlines how response efforts integrate with those of the other mission areas (Federal Interagency Operations Plans)
  - Example: FEMA Interagency Biological Annex governs biological response coordination

Federal Health-Related Response Declarations

National Declarations

- Public Health Emergency declared by Secretary of HHS
- Pandemic All Hazards Reauthorization Act declared by HHS
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) by EPA
- Presidential declaration under Stafford Act
- Presidential declaration of a National Emergency
- National contingency plan evolves into Stafford Act

Response without a declaration

- Public Health Service Act
- Upon request from SLTT authorities

Role of CDC in Federal Biological Response

Overall

- HHS is the lead agency for all response and recovery activities for human disease
- CDC within HHS is the primary agency for the public health response to a biological incident

Water Associated Response Activities

- Leads initial response through **examining** and **responding** to public health effects from exposure and consumption of contaminated water
- Supports epidemiologic and surveillance activities and helps identify exposures pathways to support implementation of intervention strategies
- Disseminate key public health and risk mitigation messages to the public

Federal Water Testing During a Biological Response

CDC

- Sampling is conducted for different objectives throughout the response
- Initial water sampling/processing by CDC/LRN to determine the agent type, relative concentration, and viability *(within days)*
- National CDC/LRN labs characterize pathogens detected in water
- Water sampling plans designed by CDC to:
  evaluate routes of exposure, dose of exposure, and root cause

EPA

- EPA/ERLN water sampling/processing to determine:
  extent of contamination, strategies for remediation, effectiveness of decontamination, requirements for clearance *(within weeks and months)*
- Sample plans designed by EPA to evaluate contamination clearance

CDC Role in State & Local Outbreak Response

- Majority of outbreak investigations by CDC result from requests for assistance from state and local health departments and abroad
- Requests include assistance with
  - Responding to emergencies
  - Quantifying impact of diseases
  - Investigating infectious disease outbreaks
- Epi-Aids and Lab-Aids are short-term requests for on site CDC assistance

2017 CDC Hurricane Response in Puerto Rico

Waterborne Disease Prevention Branch

Waterborne Disease Outbreaks

- **Definition:** 2 or more persons epi linked after exposure to same water source
- **Illness types:** depends on etiological agent but can include gastrointestinal, respiratory, and/or skin infections
- **Water types**: drinking, recreational, industrial, healthcare, and agricultural

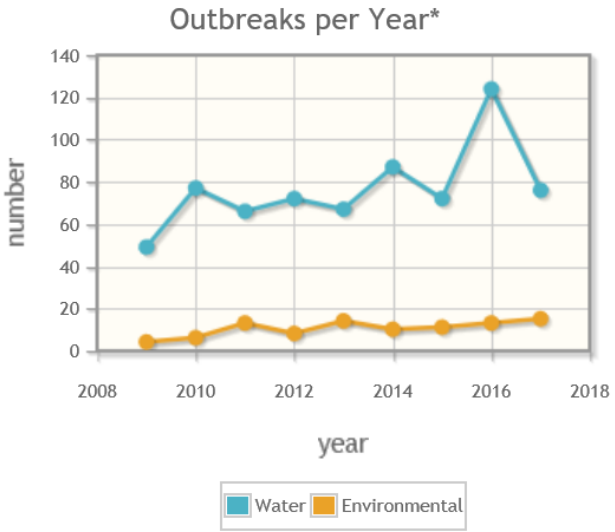
U.S. Reported 2009-2017

784 Outbreaks

18,453 Illnesses

1,428 Hospitalizations

119 Deaths



WDPB Structure

- Global and Domestic Epidemiology
  - Water related disaster and outbreak tracking
  - Prevention strategies for improving health
  - Guidance support: MAHC
- Health Promotion and Communication
  - Develops training and education materials
  - Health education campaigns & observances
    - Safe water, healthy swimming, etc.
- Laboratory
  - Environmental Microbiology, Molecular Epidemiology, FLIA, Serology

CDC Water Laboratory Capabilities

Laboratory Response Network (LRN)

- National network of local, state and federal public health and environmental testing laboratories that provide the laboratory infrastructure and capacity to respond to biological and chemical terrorism, and other public health emergencies
  - 3 Tiers: CDC serves as a National Laboratory with highest capabilities
- Partnership involving key stakeholders in the preparation and response to biological and chemical threats – Founding partners: CDC, FBI, APHL

LRN Water Processing Protocol

- In large volumes of water, low concentrations of BT agents may be undetectable by traditional methods
- LRN Method 1114 developed by CDC in 2007, recently updated, for use in a drinking water incident associated with bio-terrorism or biothreat agents
- Protocol concentrates the biological agents using a series of filters so that low concentrations may be more effectively captured from water

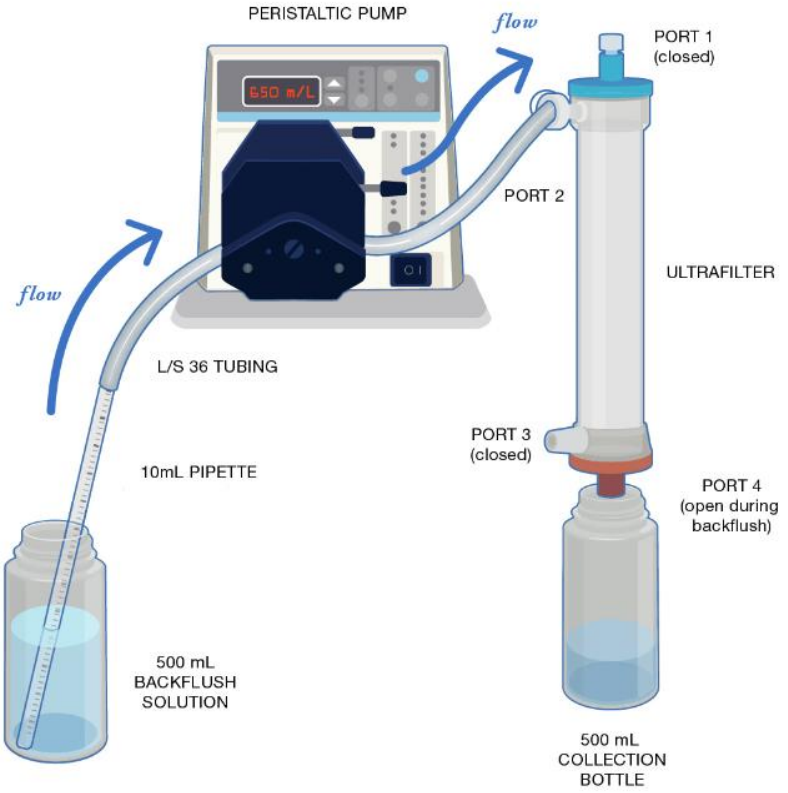
LRN Water Processing Protocol

Accepts 3 types of samples:

1. **Ultrafilter:** 10-100 L of potable water ultrafiltered and treated with sodium thiosulfate.

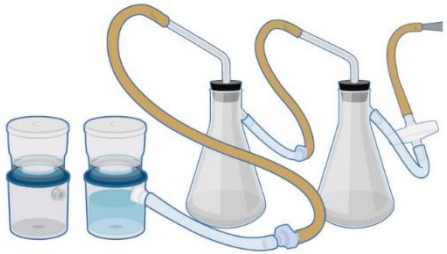
2. **UF concentrate/backflush:** 500 ml of ultrafilter eluent in 1 L bottle with sodium thiosulfate

3. **Grab sample:** Up to 10 x 1 L bottles treated with sodium thiosulfate



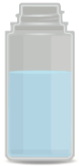
LRN Procedure Overview

Backflush filter

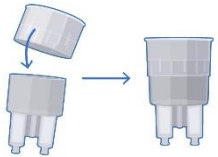


Sequential filtration

Culture



Grab or ultrafilter eluate



Centricon filtration

PCR

PROCESS FILTER | **SECONDARY CONCENTRATION** | **DETECTION**

CDC/EPA Joint Field Sampling Protocol

- CDC is working with EPA to create a joint agency protocol for sampling large volumes of water containing biological contaminants and pathogens
- Protocol will provide steps for collecting the 3 new sample types accepted by LRN labs
- Dead-end ultrafiltration allows sampling from pressurized and non-pressurized sources
- Protocol will also cover sampling designs, packaging and shipping samples, and laboratory network capabilities

WDPB Environmental Microbiology Lab

- **Laboratory research**
  - Develop **methods for recovering** low concentration microbes from environment
  - Investigate pathogen **prevalence, ecology, and risk factors** associated with waterborne disease
  - Understand **transport, survival, and disinfection susceptibility** of microbes in environment
- **Outbreak and emergency response**
  - Investigate **the cause and source** of waterborne disease and outbreaks
  - Conduct sampling to link suspected **etiologic agents** between case and water exposure
  - Assay for **water quality** parameters, **microbial indicators**, and **fecal source markers**

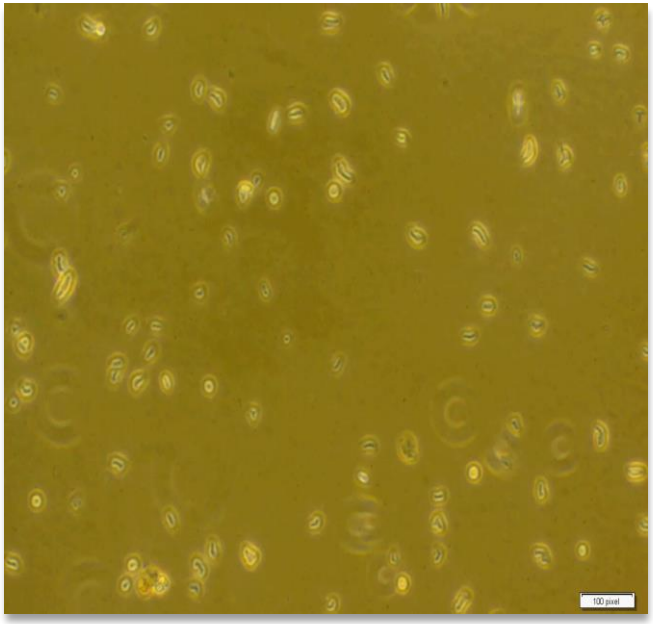
Environmental Investigations in Waterborne Outbreaks

- Complement epi data suggesting water/environmental exposure route
- Link water samples and ill persons to confirm water as transmission vehicle
- Design environmental mitigation and remediation strategies
- CDC EM lab actively involved in >120 outbreak responses domestically and abroad over last 10 years

2018 Atlanta Water Main Break

Types of Water Sources Investigated

- **WDPB EM labs focuses on the environment**
  - Drinking water
  - Surface water (rivers, lakes, storm water runoff)
  - Recreational water (swimming pools, spas, lakes)
  - Wastewater, reclaimed water, and gray water
  - Filter media and backflush (e.g., carbon and sand filters)
  - Soil, sediment, and biosolids
  - “Other”
- **Environments addressed by other CDC labs**
  - Surface sampling and survival on surfaces
  - Air sampling and aerosol biology
  - Biofilm analysis in manufactured systems (e.g., distribution systems, premise plumbing)



Ameba in collected water sample

WDPB Outbreak Response Pathogens & Sources

Waterborne pathogens

- *Cryptosporidium*
- *Salmonella*
- *Escherichia coli* - shiga toxin producing
- Norovirus
- *Shigella*
- *Giardia*
- *Legionella*
- Hepatitis A and E
- *Campylobacter*
- *Naegleria fowleri*
- *Cyclospora*
- *Acanthamoeba*
- *Elizabethkingia*

Pathogen sources in outbreaks

- Human: feces, sewage, septage
- Mammals: dogs, deer, rat, hedgehogs, mouse, beaver
- Birds: goose, gull, ducks
- Livestock: cow, goat, llama, chickens, pigs
- Reptiles: turtles, frog, geckos, dragons
- Naturally present

WDPB Outbreak Response Environmental Sampling

Water

- **Grab sample** of 100 mL – 1 L for general fecal indicators (e.g., *E. coli*), physical/chemical water quality
- **Large-volume** via ultrafiltration of 10 L – 100+ L for pathogens

Soil/sediment/biosolids "grab sample" into sterile container or bag

Surface swabs/wipes shower head, water tap aerator

Other filters, water meter, pipe, garden hose, "slip 'n' slide," nasal rinsing device, contact lens case - *Collection procedures vary and are often improvised.*

Example WDPB Environmental Investigations

2018 Romaine Lettuce

- **Yuma**
- **Santa Maria**

***Naegleria fowleri* in NC whitewater rafting park**

Water park did not contain sufficient free chlorine residual for disinfection

Norovirus in PA camp ground water well

Norovirus contamination of drinking water well and recreational creek, likely due to sewage contamination

Sewage in drinking water of TN zip line facility

Untreated well water used to fill coolers at stations along course, leaking septic tank contaminated ground water

CDC Water Response Capacity Beyond WDPB

- Environmental Chemicals in Water- NCEH
  - Monitors health outcomes and environmental water related exposures from chemicals and toxins (lead, PFAS, etc.)
  - Manages the National Environmental Public Health Tracking Network that can track regulated and unregulated drinking water chemical indicators in community water systems (arsenic, nitrates, radium, etc.)

CDC Water Response Capacity Beyond WDPB

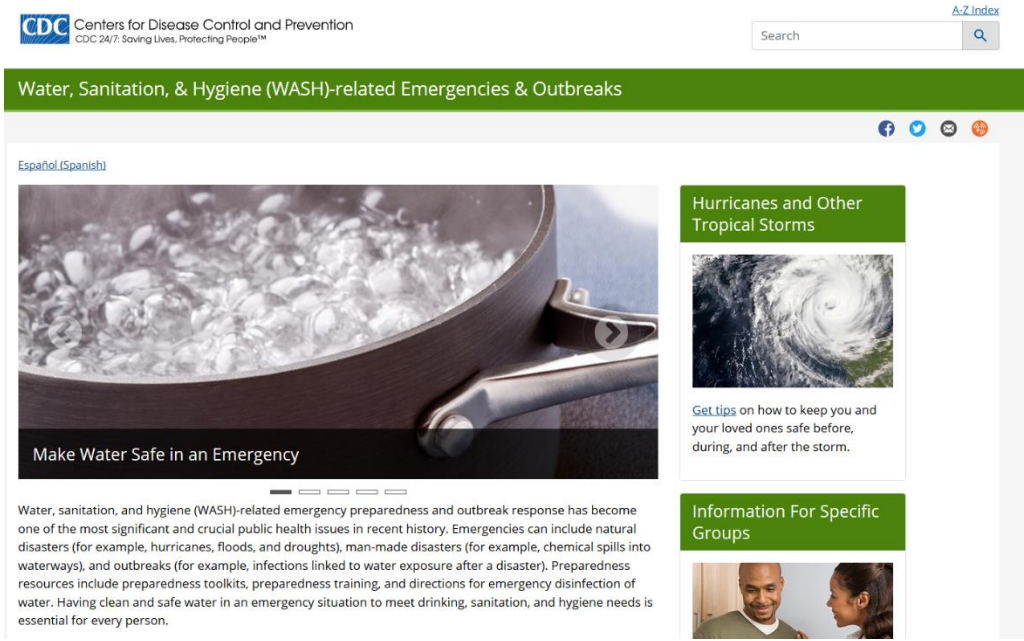
- Healthcare Facilities Water Quality- DHQP
  - Conducting water quality research and investigating water-related disease outbreaks in healthcare settings
- Water Access for School Nutrition- NCCDPHP
  - Provides schools with information on increasing access to drinking water
- Health Studies Promoting Clean Water- NCEH
  - Conducts rapid epidemiologic investigations in response to outbreaks that may be associated with exposure to water contaminated with non-infectious toxic agents
  - Conducts water-borne exposure studies to protect the public health and public water supplies

CDC Water Response Capacity Beyond WDPB

- Legionella-NCIRD
  - Investigating and providing consultation on waterborne disease outbreaks of Legionnaires' Disease and Pontiac Fever
  - Provides toolkits that assist with developing water management plans to reduce infections for buildings and healthcare facilities
  - Health departments can request assistance from CDC for epidemiologic assistance and laboratory testing

Thank you!

www.cdc.gov/healthywater
www.cdc.gov/healthywater/emergency



For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Questions?