Across the United States, aging water infrastructure, severe weather, contamination events, and accidents cause community-wide water emergencies, including an estimated 240,000 water main breaks a year. These emergencies result in loss of service and boil water advisories, affecting public health and causing community-wide disruptions. With climate change-related surges in severe weather, as well as aging infrastructure, the frequency and severity of water, sanitation, and hygiene- (WASH-) related emergencies are expected to increase.

Local health departments (LHDs) are often called to respond to WASH emergencies in their communities, so they need to have access to the appropriate tools to prepare and respond timely. Recent WASH emergencies have demonstrated the importance of preparedness, and these examples can be used as learning opportunities to prepare water utility companies, public health departments, and emergency managers for future water emergencies.

This compendium features stories from three LHDs that have prepared for and responded to complex water emergencies in their communities:

- City of Milwaukee Health Department, Wisconsin;
- Washington County Public Health, Oregon; and
- Public Health – Seattle and King County, Washington.
Legionella Outbreak in the City of Milwaukee
City of Milwaukee Health Department, Wisconsin

By Paul Biedrzycki, City of Milwaukee Health Department (former)

During the summer and fall of 2013, the City of Milwaukee Health Department (MHD) responded to a Legionella outbreak that resulted in 58 clinically diagnosed cases in Milwaukee County. In previous years, approximately 12 to 20 cases were reported annually in Milwaukee County, eight to 10 of which were reported in the City of Milwaukee. The health department led the investigation, identifying improperly maintained cooling tower units as the likely source of the outbreak. The MHD worked closely with other local health departments, private healthcare providers, and the Wisconsin Department of Health Services (WDHS), as well as local building owner maintenance associations; heating, ventilation, and air conditioning (HVAC) contractors; and the City of Milwaukee Department of Neighborhood Services during the response. HVAC contractors, responsible for maintaining commercial building cooling tower units, helped the MHD identify poorly maintained units within the city.

The outbreak primarily affected middle-aged and older adults with underlying chronic health problems or a history of smoking. One hospitalization was documented, and there were no deaths. Most of the confirmed and suspected cases were identified in the City of Milwaukee within a defined radius of buildings with cooling towers that were sampled by the MHD and found to have Legionella bacteria contamination.

Timeline

An initial uptick in cases of Legionellosis within Milwaukee County was reported in late June 2013 by the WDHS after a period of unseasonably cool weather and rain during the two previous months. The WDHS then notified the 13 LHDs within Milwaukee County of the increase in reported cases. The MHD conducted an environmental epidemiologic investigation, including enhancing surveillance for additional cases, identifying any potential common environmental exposures, and crafting public health risk messaging. In addition, the MHD conducted case interviews and began to test hypotheses associated with commercial building water cooling tower involvement as cases in the county increased through September 2013.

Eventually, approximately 58 clinically diagnosed cases of Legionellosis were identified in Milwaukee County between June and September 2013, representing a three-fold increase in reported Legionellosis cases in Milwaukee County as compared to a similar timeframe in previous years. Case reporting gradually decreased as cooler weather prevailed in early October through November.

Challenges

The MHD encountered many challenges while responding to the outbreak. It was difficult to pinpoint any common source of exposure or location between reported cases. Many of the cases were reported by people suffering from underlying health conditions, making them potentially susceptible to opportunistic bacteria and viruses that are ubiquitous in the environment. The environmental assessment and sampling expertise and capacity were not readily available to mobilize in testing of indoor and outdoor building environments. In addition, engaging the media effectively quickly became time consuming in terms of building public awareness and launching effective risk communication to avoid public panic.

Partnerships

To overcome the challenges, the MHD used a combination of approaches, including leveraging existing and new partnerships and implementing a modified Incident Command System to organize resources, collect and analyze data, and manage operational logistics. The utilization of technology such as GIS mapping helped visualize cooling tower locations and report cases geospatially. To engage the media, routine media press briefings were arranged to update the community on outbreak response and progress.

A unique partnership with local HVAC contractors and consultants familiar with commercial building water cooling tower location and maintenance throughout the Milwaukee metropolitan area greatly enhanced the success of the MHD’s response to the outbreak. The contractors helped the MHD identify potential rooftop and ground-level water cooling towers of interest based on location; size; proximity to identified, confirmed, and suspected cases; and maintenance history. The HVAC contractors
and consultants also had relationships with building and property management owners that facilitated MHD field assessment and environmental sampling strategy implementation. The collaboration between the MHD and the HVAC contractors served as a great example of public-private partnership in the context of public health emergency preparedness.

Other important partnerships that were essential to the effectiveness of the overall outbreak response, along with MHD epidemiology, lab, and environmental health support, included the following:

- Wisconsin Department of Health Services and Wisconsin State Laboratory;
- Milwaukee County Office of Emergency Management;
- Region 7 Healthcare Coalition;
- Milwaukee County LHDs; and
- Local media.

The MHD practices a “whole of community” approach in public health emergency preparedness, response, and recovery to engage diverse stakeholders, assure accountability in decision-making and action, and strengthen population resiliency.

While the MHD had a longstanding and productive relationship with the Milwaukee Water Works (MWW), the relationship was not leveraged extensively during response to the 2013 Legionellosis outbreak in Milwaukee. The MHD and MWW did not collaborate primarily due to epidemiological evidence collected early in the response suggesting that water cooling towers were the likely reservoir and source of exposure within the community.

**Lessons Learned**

- Surveillance for cases by the epidemiology team and collection of environmental samples from cooling towers should start early in the investigation.
- Good risk communication with the public and coordination with building owners on maintenance protocols are important.
- Building owners need a better understanding of how climate change will affect how cooling towers are operated on a seasonal basis, with potential problems from biofilm growth on units if they are not properly maintained immediately after starting up for the season.
- Environmental epidemiology capacity and capability are generally lacking at the LHD level.
- Use of GIS geospatial software is an invaluable tool in LHD investigations of environmentally related disease and injury.
- Organizing LHD outbreak response using a modified Incident Command System is imperative to organize resources, develop strategies, and oversee operational implementation.
Health Department
City of Milwaukee Health Department
https://city.milwaukee.gov/Health

Additional Resources

Articles on Legionnaires Disease
http://legionella.org/about-the-disease/articles-on-legionnaires-disease/

Legionella and Legionnaires’ Disease: 25 Years of Investigation
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC118082/

Prevention of Legionnaires’ Disease in the 21st Century by Advancing Science and Public Health Practice

ASHRAE 188: Legionellosis: Risk Management for Building Water Systems
https://www.cdc.gov/legionella/health-depts/ashrae-faqs.html

Guidance on Reducing the Risk of Legionella
Preparing for Disaster Sanitation Following a Cascadia Subduction Zone Earthquake in the Pacific Northwest
Washington County Public Health, Oregon

By Sue Mohnkern, Washington County Public Health (former)

The Pacific Northwest is sited in the Cascadia subduction zone (CSZ). A CSZ earthquake can produce a magnitude 9.0, minutes-long earthquake that would result in significant destruction along the almost 700 miles of impact. This type of earthquake has an estimated 20% chance of occurring in the next 50 years. The Oregon Resilience Plan anticipates that one of the results of this subduction zone earthquake will be catastrophic impacts to wastewater systems, with anticipated loss of wastewater systems for six months to a year. The areas affected include the Portland metro area, which has approximately 2.4 million residents. This loss will pose a significant public health threat in the aftermath of the earthquake, as adequate sanitation is a cornerstone of protecting the public’s health.

Challenges

No clear guidance is available on how a large modern metropolitan area such as Portland would handle long-term disaster sanitation needs following a significant earthquake. The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response is focused on humanitarian responses to sanitation needs in developing countries. The websites of the Federal Emergency Management Agency (FEMA) and the Centers for Disease Control and Prevention (CDC) only address temporary sanitation needs, with a focus on flooding, and recommendations for use in developing nations.

Partnerships

The Regional Disaster Preparedness Organization (RDPO) is a partnership of government agencies, non-governmental organizations, and private-sector stakeholders in the Portland metropolitan region collaborating to increase the region’s resiliency to disasters. The metropolitan region spans Clackamas, Columbia, Multnomah, and Washington Counties in Oregon and Clark County in Washington. Under the auspices of the RDPO, a regional disaster sanitation task force of multi-disciplinary professionals from the five counties in the area was convened to develop recommendations to assist the public to safely handle their sanitation needs in the absence of a functional wastewater system for an extended period. Participants represented the disciplines of public health (including environmental health), emergency management, public works, wastewater treatment professionals, waste haulers, and the Oregon Department of Environmental Quality.

The mission of the group was to develop recommendations for the handling of human waste by residents of the Portland metropolitan region following a catastrophic earthquake. Those recommendations are framed by the following assumptions:

- Sewage collection and treatment systems will be out of service for many months following a CSZ earthquake.
- Although outside assistance will be forthcoming to the area, it may not arrive for some time, estimated as two weeks to a month.
- Methods for handling human waste must be simple, cheap, and effective, and they must protect the public’s health by limiting exposure to the waste.
- No single sanitation method is right for every situation; there must be a variety of recommendations to handle a variety of needs (high to low density, urban vs. rural, congregate living, etc.).
- While portable toilets work well in small events, the number required for this scenario far outreaches the initial availability. Additionally, these units require frequent cleaning and emptying, which would be very challenging in this catastrophic earthquake scenario.
- Within 30 days of the event, local sewage and solid waste agencies, acting in concert with federal and state responders, will be positioned to provide more specific guidelines.
Results and Recommendations

The final three recommendations that met the stated requirements are the following:

1. **Septic Systems (to be used if not compromised):** A flyer was developed by the septic subject matter experts with recommendations for making septic systems more resilient as well as information on determining if septic systems are functional post CSZ earthquake. If septic systems were functional, they could still be used post-earthquake.

2. **Pit toilets and trench latrines:** The group developed information on how deep and where to locate pit toilets, with special recommendations on safety (using the buddy system) when congregate toilets are necessary. The sites of these pits should be noted after filling for treatment at a later date.

3. **Twin bucket system:** This system would entail double bagging of solid waste with on-site storage and eventual haul-away of bags. The no-mix twin bucket system was developed in Christchurch, New Zealand after their devastating earthquake in 2011. It was adapted by a local volunteer agency, Public Hygiene Lets Us Stay Human (PHLUSH), and is based on the principle that urine and feces are more safely and easily dealt with if separated by using two separate buckets.

The second phase of this project was to take the recommendations developed by the task force and work with a marketing company to develop materials that can be used in a public education campaign both before the disaster for preparedness and after the disaster in response. Those materials were translated into the top seven languages in the region and are all available for non-commercial use at the EmergencyToilet.org website.

Lessons Learned

- Addressing failed sewage systems was not an issue that was “owned” by any single discipline; it required buy-in and participation by multiple disciplines and stakeholders across the jurisdictions.
- The strength of the relationships that were developed through the RDPO made the work possible.
- A diverse group of stakeholders from all different jurisdictions and disciplines were able to participate and contribute to the process.

**References**


**Additional Resources**

A series of frequently asked questions, instructions and directions, and social media spots are available at EmergencyToilet.org.
Boil-water Advisories at Mercer Island, Washington
Public Health — Seattle and King County, Washington

By Christopher Skilton, Public Health — Seattle and King County

Mercer Island is a city of 25,000 in King County, Washington that occupies a six square mile island of the same name, with its own municipal water utility, Mercer Island Utility Services (MIUS). That utility contracts routine surveillance testing to a much larger neighboring entity, Seattle Public Utilities. In October 2014, high levels of coliform bacteria were detected in the water supply. This prompted two back-to-back boil-water notices and on-site response from Public Health — Seattle & King County (PHSKC) Environmental Health Division. The PHSKC role included monitoring of food services establishments, public education, and facilitation of testing. Environmental health field personnel visited the nearly 90 food service establishments, including grocery stores, schools, nursing facilities, and restaurants, to ensure precautions were taken and food service operations were suspended as required by code. In addition, PHSKC provided guidance to residents on precautionary measures for the duration of the boil-water incident and surveillance for potential resultant illnesses.

Timeline

Sept. 26, 2014: Drinking water supplies were shown to be positive for total coliforms, specifically, *E. coli*. MIUS issued a boil-water advisory to commercial and residential customers. Concurrently, PHSKC required all food services to cease and desist operations, and, where appropriate, ordered the discard of potentially contaminated produce.

Sept. 29, 2014: Advisories were lifted, and food service operations could resume after sequential testing indicated no coliforms.

Oct. 2, 2014: Tests again showed the presence of *E. coli*. A second advisory went out, and PHSKC suspended food service operations. Detection and mitigation efforts were ramped up, but positive tests persisted.

Oct. 8, 2014: Although no contamination source was identified, tests showed that the contamination had cleared. Advisories and suspensions of operations were again lifted.

Partnerships

Partnerships were vital to the successful intervention during this incident. Key partners and their roles included the following:

- The Washington State Department of Health (WDOH) is tasked with regulating municipal water utilities and providing support and advice to local health jurisdictions. In turn, PHSKC’s environmental health field staff were asked to expand contact to facilities ordinarily inspected and regulated by WDOH, such as daycare and assisted living facilities.

- The City of Mercer Island Office of Emergency Management has broad direct communication capabilities to the population but relied on PHSKC to assist in providing appropriate messaging in several languages.

- Seattle Public Utilities contracts to routinely test samples from Mercer Island’s water utility. Seattle Public Utilities has a long history of close cooperation and open communication with PHSKC.

- MIUS maintains the potable water supply for Mercer Island. In Washington State, the responsibility to issue boil-water notices rests solely with the water utility. All other involved agencies may support that activity, while pursuing their own specific mandates and functions. PHSKC also regulates many of this utility’s commercial customers. PHSKC also has a duty to protect the health of all their customers, both commercial and residential. The utility’s knowledge of their system allowed for targeted testing to attempt to locate the contamination source. PHSKC’s partnership with the utility was not direct, but rather, to support notification and communications.

- The media played a critical role in getting out the word to both Mercer Island residents, as well as to adjacent communities, calming fears and raising awareness. The media looked to PHSKC to assist in crafting appropriate messaging content.
Lessons Learned

- In retrospect, the front-line response was developed “on the fly.” Fortunately, good rapport with partners, clients, and communities allowed for timely and effective response absent a formal plan in advance.

- The Incident Command System (ICS) is appropriate to every water emergency response. During this and smaller boil-water incidents, the environmental health division had to activate on very short notice. The use of ICS has made for rapid and efficient deployment of personnel and resources. Since that time, there has been a sustained effort to make basic ICS training and awareness a required skillset for every member of field and management staff. ICS is scalable, assuring that response is scalable. PHSKC’s Health & Medical Area Command is in the process of strengthening the training and leadership roles and the visibility of the environmental health division’s emergency response team.

- Communication is integral to response. In the absence of a formalized ICS structure at the “boots-on-the-ground” level, well established communication channels made for rapid deployment and efficient operation.

- Preparedness is multilingual since the jurisdiction of PHSKC encompasses an extremely diverse population with over 20 primary languages spoken. Standardized informational materials for boil-water and similar emergencies, in as many languages as possible, would be a huge asset. Currently, King County is working to build a library of public health documents in many languages. This task is prioritized into three tiers for the top 20 languages. Tier one is Spanish, and tier two includes Vietnamese, Russian, Somali, Chinese, Korean, Amharic, and Punjabi. The third tier is made up of Tagalog, Khmer, Lao, Japanese, Hindi, Arabic, Farsi, Tigrinya, Oromo, French, and Samoan. The environmental health division places a premium on targeted language fluency in every hiring cycle.

Additional Resources

Acknowledgments

This publication was made possible through the support from the Centers for Disease Control and Prevention, Cooperative Agreement CDC-RFA-OT18-1802. NACCHO is grateful for this support. Its contents are solely the views of the authors and do not necessarily represent the official views of the sponsor.

For more information, please contact:

Deise Galan Leonel
Senior Program Analyst, Preparedness
202.640.4923
dgleonel@naccho.org

Tiara Smith
Program Analyst, Environmental Health
202.507.4249
tsmith@naccho.org

The mission of the National Association of County and City Health Officials (NACCHO) is to improve the health of communities by strengthening and advocating for local health departments.

1201 Eye Street, NW, Fourth Floor • Washington, DC 20005
Phone: 202-783-5550 • Fax: 202-783-1583