Healthcare Water Quality: From Plumbing to Patients

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Why Water Matters

- Wet environments support microbial growth
  - Source for antibiotic resistant pathogens and HAIs
- Tap water meets stringent safety standards in the United States, but it is not sterile
  - Rarely poses risk in community (e.g., for drinking, bathing, food prep)
- In healthcare
  - Vulnerable patient populations
  - Large, complex distribution systems
  - Water uses are varied, leading to unique exposure pathways
Healthcare Outbreaks Associated With a Water Reservoir and Infection Prevention Strategies

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Hospital water may serve as a reservoir of healthcare-associated infections. The clinical features of waterborne outbreaks are reviewed. The common waterborne pathogens were bacillus and mycobacteria, although fungi and viruses were occasionally involved. Waterborne pathogens were often isolated in the settings of healthcare-associated infections. Waterborne outbreaks occurred in hospital water systems, membranes, and water reservoirs and transmission pathways of waterborne pathogens. The authors provide a practical approach for healthcare personnel.

Keywords: waterborne outbreaks; healthcare-associated infections

Table 2. Summary of Key Issues and Infection Prevention Strategies Against Waterborne Outbreaks by Major Water Reservoir in Healthcare Settings

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Key Issues</th>
<th>Infection Prevention Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable water, tap water, and hospital water systems</td>
<td>Potable water is not sterile, and pathogenic waterborne organisms may exist in potable water at acceptable levels of coliform bacteria (&lt;1 coliform bacterial/mL). Healthcare-associated outbreaks have been linked to contaminated potable water.</td>
<td>Follow public health guidelines. Not water temperature at the outlet at the highest temperature allowable, preferably &gt;55°C. Water disruptions: post signs and do not drink tap water. Maintain standards for potable water (&lt;1 coliform bacterial/mL). Rinse semiconductors with potable water, which may lead to contamination of the equipment and subsequent healthcare-associated infections. Common pathogens include non-fermentative gram-negative bacilli (e.g., Pseudomonas aeruginosa, Legionella, NTM).</td>
</tr>
<tr>
<td>Sinks</td>
<td>Colonization of sinks with gram-negative bacilli has been reported. Some studies demonstrate a transmission link between a colonized sink and infected patients. Some studies describe that multi-drug-resistant gram-negative bacilli are associated with contaminated sinks. Gram-negative bacilli can survive wet environments, including sinks, for a long time (&gt;260 d). Transmission can be caused by splashing of water droplets from contaminated sinks to hands of healthcare personnel, followed by transient colonization of hands. Common pathogens include gram-negative bacilli (e.g., Pseudomonas, Acinetobacter, Serratia).</td>
<td>Use separate sinks for handswashing and disposal of contaminated fluids. Decontamine or eliminate sinks as a reservoir if epidemic spread of gram-negative bacteria via sinks is suspected.</td>
</tr>
<tr>
<td>Faucet aerators</td>
<td>Faucet aerators may serve as a platform for accumulation of waterborne pathogens. Potential pathogens include Pseudomonas, Stenotrophomonas, and Legionella.</td>
<td>Routine screening and disinfection or permanent removal of all aerators are not warranted at present. No precautions necessary at present. For Legionella outbreaks, clean and disinfect faucet aerators in...</td>
</tr>
</tbody>
</table>
Original Article

Investigation of healthcare infection risks from water-related organisms: Summary of CDC consultations, 2014—2017

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Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract
Objective: Water exposures in healthcare settings and during healthcare delivery can place patients at risk for infection with water-related organisms and can potentially lead to outbreaks. We aimed to describe Centers for Disease Control and Prevention (CDC) consultations involving water-related organisms leading to healthcare-associated infections (HAIs).

Design: Retrospective observational study.

Methods: We reviewed internal CDC records from January 1, 2014, through December 31, 2017, using water-related terms and organisms, excluding *Legionella*, to identify consultations that involved potential or confirmed transmission of water-related organisms in healthcare. We determined plausible exposure pathways and routes of transmission when possible.

Results: Of 620 consultations during the study period, we identified 134 consultations (21.6%), with 1,380 patients, that involved the investigation of potential water-related HAIs or infection control topics with the potential for water-related HAIs. Non-tuberculous mycobacteria were involved in the greatest number of investigations (n = 40, 29.9%). Most frequently, investigations involved medical products (n = 48, 35.8%), and most of these products were medical devices (n = 40, 83.3%). We identified a variety of plausible water-exposure pathways, including medication preparation near water splash zones and water contamination at the manufacturing sites of medications and medical devices.

Conclusions: Water-related investigations represent a substantial proportion of CDC CHAI consultations and likely represent only a fraction of all water-related HAI investigations and outbreaks occurring in US healthcare facilities. Water-related HAI investigations should consider all potential pathways of water exposure. Finally, healthcare facilities should develop and implement water management programs to limit the growth and spread of water-related organisms.
22% (134) of DHQP Consultations Were Water-Related

- 40 (30%) involved NTMs
- 45 (35%) involved MDROs
- 24 (18%) surgery-related
- 40 (30%) involved medical devices
- 13 (10%) involved medication contamination

### Table 3. Possible Exposure Pathways and Routes of Transmission Involved in Water-Related Investigations, Division of Healthcare Quality Promotion, CDC, United States, 2014–2017

<table>
<thead>
<tr>
<th>Exposure Pathway/Route of Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection/medication preparation near sink&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Nutrition (including breast milk and infant formula) preparation near sink&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Patient care supplies stored by sinks and toilets in intensive care unit&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contaminated compounded nasal spray used prior to laryngoscopy</td>
</tr>
<tr>
<td>Contaminated water from neonatal intensive care unit (NICU) sinks&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contaminated water from operating room scrub sinks&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contaminated sink drains&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contaminated dialysis wall boxes&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Use of nonsterile ice for patient care among immunocompromised patients&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Use of contaminated water in dental water lines&lt;sup&gt;10,11,a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Water introduction during respiratory therapy&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Use of tap water during bronchoscopy procedures&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Use of nonsterile water for humidification reservoirs of infant incubators in NICU&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Use of consumer-grade humidifier in operating room during LASIK procedures&lt;sup&gt;12&lt;/sup&gt;</td>
</tr>
<tr>
<td>Use of nonsterile water and inadequate disinfection of heater-cooler devices used during cardiac surgery&lt;sup&gt;13-15,a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Intrinsic contamination of medical products due to water contamination at production site&lt;sup&gt;16,17,a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Poor medical device reprocessing procedures&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contaminated automated endoscope reprocessors</td>
</tr>
<tr>
<td>Poor cleaning and disinfection of hydrotherapy rooms and equipment&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Water from contaminated shower heads&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Improperly cleaned mobile shower trolleys</td>
</tr>
<tr>
<td>Hot tub use by surgical personnel&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Water contamination of specimens/reagents in the laboratory&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Building water leaks in patient care areas</td>
</tr>
</tbody>
</table>

<sup>a</sup>Indicates a potential exposure pathway or route of transmission that was documented as the possible source of infection in two or more investigations.
Water Management Programs (WMPs)

- In 2017, CMS memo reminded hospitals (and nursing homes) of WMP expectations
- Identify and assess risks and minimize risks from legionella and other opportunistic pathogens in water
- Conduct a facility risk assessment
- Implement a water management program that considers the ASHRAE industry standard and the CDC toolkit
Toolkit: Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Buildings

A Practical Guide to Implementing Industry Standards

Many buildings need a water management program to reduce the risk for *Legionella* growing and spreading within their water system and devices. This toolkit is designed to help people understand which buildings and devices need a *Legionella* water management program to reduce the risk for Legionnaires' disease, what makes a good program, and how to develop it.

Download the Toolkit


Use the toolkit’s quick [print worksheet](#) to find out if your building or certain devices in your building need a water management program.
Does your facility have a WMP to prevent the growth and transmission of *Legionella* and other opportunistic waterborne pathogens? (n = 4,929)

3,821 (77.5%) reported YES

If you reported HAVING a WMP, have you ever conducted a facility risk assessment to identify where *Legionella* and other opportunistic waterborne pathogens (e.g. *Pseudomonas*, *Acinetobacter*, *Burkholderia*, *Stenotrophomonas*, nontuberculous mycobacteria, and fungi) could grow and spread in the facility water system (e.g., piping infrastructure)? (n = 3,821)

3,348 (87.6%) reported YES
Does your facility have a WMP to prevent the growth and transmission of *Legionella* and other opportunistic waterborne pathogens? (n = 4,929)

- General: 82.9%
- Critical Access: 60.7%
- Surgical: 70.8%
- Psychiatric: 65.0%
- Children’s: 87.4%
- Veteran’s Affairs: 98.8%
- Military: 71.1%
- Orthopaedic: 72.4%
- Oncology: 94.1%
- Women’s & Children’s: 84.6%
- Women’s: 91.7%
If you reported HAVING a WMP, are these staff represented on your water management team? (n = 3,821)

- Administrative: 61.8%
- Epidemiology & Infection Control: 83.4%
- Environmental & Facilities: 98.6%
NHSN Survey Results

If you reported HAVING a WMP, do you regularly monitor these parameters in your building water system? (n = 3,821)

- Disinfectant: 66.2%
- Temperature: 86.9%
- Heterotrophic Plate Counts: 35.6%
- Legionella: 63.1%

If you reported NOT having a WMP, do you regularly monitor these parameters in your building water system? (n = 1,108)

- Disinfectant: 19.8%
- Temperature: 52.6%
- Heterotrophic Plate Counts: 5.5%
- Legionella: 14.4%
From Plumbing to Patient: Comprehensive Prevention-Minded Water Management

- Decrease potable water contamination
  - Traditional water management program activities

- Decrease vector/device contamination
  - Appropriate use, cleaning, disinfection

- Decrease patient exposure to contaminated water
  - Considerations of host susceptibility
## Table 1. Risk Characterization of Areas in the Facilities

<table>
<thead>
<tr>
<th>Risk classification</th>
<th>Rationale for risk characterization</th>
<th>Hospital inpatient areas (Rochester Methodist and St. Marys Hospitals)</th>
<th>Outpatient areas (Gonda and Mayo buildings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest-risk area</td>
<td>Immunosuppressed hosts reside or cared for in these areas</td>
<td>BMT unit, solid-organ transplant, hematology, medical oncology</td>
<td>Hematology and medical oncology (pediatrics or adult), transplantation, chemotherapy, HIV/AIDS</td>
</tr>
<tr>
<td>Higher-risk area</td>
<td>Patients with multiple severe comorbidity diseases reside or procedures in areas with water usage and exposure</td>
<td>Nontransplant ICUs, ORs</td>
<td>Endoscopy, bronchoscopy, outpatient surgery</td>
</tr>
<tr>
<td>Medium-risk area</td>
<td>General medical/surgery patients with no or few comorbidity disease reside, general patient areas, surgical areas, public areas</td>
<td>General medicine and surgery</td>
<td>General patient areas, surgical areas, public areas</td>
</tr>
<tr>
<td>Low-risk area</td>
<td>Nonpatient areas</td>
<td>Waiting rooms, etc.</td>
<td>Secretarial and administrative areas</td>
</tr>
</tbody>
</table>

Note. BMT: bone marrow transplantation; HIV/AIDS: human immunodeficiency virus/acquired immunodeficiency syndrome; ICUs: intensive care units; ORs: operating rooms.
CDC From Plumbing to Patients Website

Healthcare-associated Infections

From Plumbing to Patients

Water Management Programs for Healthcare Facilities

Patient safety depends on assuring that:

- Water entering a healthcare facility meets all applicable quality standards
- The premise plumbing within the healthcare facility is designed and maintained in a way that minimizes growth and spread of waterborne pathogens
- Exposure to infection risks from water is minimized

Water can harbor germs that threaten the safety of patients. Waterborne healthcare-associated infections (HAI) may occur during the many uses of potable water (i.e., water suitable for drinking) in the healthcare environment. Water management programs are an important way to help reduce the risk of transmission infection of these organisms among vulnerable patient populations, staff, and visitors.

Additional Resources

- CMS Legionella and Other Waterborne Pathogens Webinar [PDF - 5 pages]
- Tap Water Quality and Infrastructure Discussion Guide for Investigation of Potential Water-Associated Infections in Healthcare Facilities (print only) [PDF - 4 pages]
- Healthcare Facility Water Management Program Checklist (print only) [PDF - 4 pages]
CDC From Plumbing to Patients: NEW RESOURCES

Tap Water Quality and Infrastructure Discussion Guide for Investigation of Potential Water-Associated Infections in Healthcare Facilities

Available from: www.cdc.gov/hai/prevent/water-management.html

**Purpose:** For CDC and health department to use as a discussion guide when consulting with healthcare facilities in situations where there is concern for transmission of waterborne pathogens. Patient exposures may either be direct (aerosols, splash, bathing, ingestion, ice use, contaminated devices with water reservoirs, etc.) or indirect (contaminated surfaces, reprocessed medical devices, drugs, healthcare personnel, etc.). Examples of infections might include surgical site, injection site, or bloodstream infections due to nontuberculous mycobacteria; *Pseudomonas aeruginosa* infections among NICU or burn patients; Legionnaires’ disease.

1. Drinking Water System Name (Public or Private): ___________________________

2. If Public Water System, EPA ID Number: ___________________________
   - To find your EPA ID Number, use [SDWIS Search](https://www.epa.gov/enviro/sdwis-search).

3. Water Source (check):
   - a. ☐ Surface water

Healthcare Facility Water Management Program Checklist

Available from: www.cdc.gov/hai/prevent/water-management.html

This checklist is intended to assist in the development of an all-hazards approach to water management in a healthcare facility, and may be used to:
- Evaluate a comprehensive water management program.
- Identify individuals to participate in the water management program.
- Assist in conducting assessments, including hazard analyses, environmental risk assessments, and infection control risk assessments.
- Inform water monitoring practices guided by the management program.

Depending on complexity of the building plumbing systems, a comprehensive program may include several water management plans. These plans should include areas within the system where control points are identified as well as monitoring methods and procedures.

**Establish a Water Management Program Team**

For all facility types, establish clear lines of communication to facilitate dialogue with representatives from the water utility/drinking water provider, as well as the local health department, on an as needed basis.

- ☐ Define membership (at a minimum, the following ‘roles’ should be represented; may include others depending on facility size, type)
  - facility administration/ownership or C-Suite
  - facilities management
  - facilities engineer
  - infection prevention

- ☐ Develop a charter that defines roles and responsibilities of members, chair, meeting schedule, etc.

- ☐ Have you identified team members who should:
  - Y ☐ ☐ N be familiar with the facility water system(s)
  - Y ☐ ☐ N identify control locations and control limits
  - Y ☐ ☐ N identify and take corrective actions
  - Y ☐ ☐ N monitor and document program performance

For nursing homes, the group may consist of those or more individuals representing management, nursing (someone filling the role of infection control), and the facility engineer; all members with subject matter expertise (to provide advice) may be water consultants.

Larger facility representation may include a designer from the C-Suite, risk management, infection prevention, facilities engineer, central services, laboratory, and all key members from clinical departments or water consultants.
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   a. ☐ Surface water
   b. ☐ Ground water
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Define membership (at a minimum, the following ‘roles’ should be represented; may include others depending on facility needs):

- For nursing homes, the group may consist of three or more individuals representing...
- For hospitals, the group may consist of...
- For....
## Legionella (Legionnaires' Disease and Pontiac Fever)

### Monitoring Your Building Water

#### Monitoring Water Quality Parameters

The water management program team should regularly monitor water quality parameters, such as disinfectant and temperature levels. By monitoring these parameters, the team can ensure that building water systems are operating in a way to minimize hazardous conditions that could encourage *Legionella* and other waterborne pathogens to grow.

If the team finds that a control limit (e.g., temperature, disinfectant level) is not being met, their next step will be to take corrective actions to get conditions back to within an acceptable range. Examples of chemical and physical control limits to reduce the risk of *Legionella* growth include:

- Maintain hot water temperature at the highest temperature allowable by state regulations or codes (see [guidance for healthcare-specific recommendations](#)).
- Ensure disinfectant levels are detectable where water enters the building and at points of use.
- Measure the pH of the water to determine whether the disinfectant used in the building will be effective. Disinfectants work best within a narrow pH range (see [parameter conditions indicating operational effectiveness](#)).
• Incoming water continuously monitored: pressure, temp, pH, solids, oxidant
  – Specific cold and hot water temperature requirements
• Quarterly testing of tap water for growth of *Legionella pneumophila*, residual disinfectant, and pH
  – In general, the following minimum detected oxidant residual levels at hot and cold water outlets are suggested as guidance: 0.5 milligrams (mg) per liter (L) for chlorine (as free chlorine), 0.5 mg/L for monochloramine, and 0.3 mg/L for chlorine dioxide
• Water samples from at least 10 outlets on the hot water distribution system and at least 10 outlets on the cold water distribution system must be tested from each building for each quarterly testing cycle

VA Directive 1061.
https://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=3033
Putting It All Together

- On the “upstream” side, make your water utility a WMP partner
  - System disruptions or pressure drops, loss of disinfection residual, and main breaks can impact the quality of water within healthcare system
- Moving “midstream,” carefully assess premise plumbing (traditional WMP focus area) to assure water quality and mitigate legionella and other water-related infection risks
  - Informed by monitoring and testing
- Finally, by focusing “downstream,” water management programs can work with infection control and clinical partners to examine exposure pathways
  - Ingestion, diet, hygiene, or clinical care
  - Higher risk patient populations
  - Surgery and the medical device use
Water Monitoring Implementation Framework for Healthcare Settings
Context for a Water Monitoring Framework

- Guideline extractions led by DHQP HICPAC Management Team
  - International, national, and prominent organization products
  - Monitoring for all-hazards infection risk, focus in healthcare
    - Prominent U.S. *Legionella*-focused healthcare guidance
- Extractions: baseline and intervention-related
  - Monitoring and interventions
- What, where, when and how (primarily potable water-related)
- Thresholds or action limits and corrective actions if limits not met
Guidelines Included (DRAFT)

- CDC Guidelines for Environmental Infection Control in Health-Care Facilities (2003)
- WHO Water safety in buildings
- UK National Health Service/Department of Health: Water sources and potential Pseudomonas aeruginosa contamination of taps and water systems
- UK Department of Health: Health Technical Memorandum 04-01: Safe water in healthcare premises. Part B: Operational management
- VHA Directive 2061 (2014)
- Microbiological standards for water and their relationship to health risk
- International Society for Infectious Diseases, ISID Infection Guide 2018
- HACCP Plan for Prevention of Legionellosis Associated with Building Water Systems
- Health Protection Surveillance Centre: Guidelines for the Prevention and Control of Infection from Water Systems in Healthcare Facilities
- Experimental based experiences with the introduction of a water safety plan for a multi-located university clinic and its efficacy according to WHO recommendations (Dyck 2007)
- Technologies for Legionella Control in Premise Plumbing Systems: Scientific Literature Review
- Overview and Comparison of Legionella Regulations Worldwide (Kenhove 2018)
<table>
<thead>
<tr>
<th>Document</th>
<th>Intervention</th>
<th>Location of testing</th>
<th>Frequency of testing</th>
<th>How to test or monitor</th>
<th>Threshold or action limit</th>
<th>Corrective Actions if limits are exceeded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title: Water sources and potential Pseudomonas aeruginosa (P. aeruginosa) Infection of tap and water systems</td>
<td>Routine water sampling for P. aeruginosa</td>
<td>Outlets that have direct contact with patients, used to wash staff hands, or used to clean equipment that will have contact with patients as determined by the local risk assessment (p. 12/n. 31 and HTM Part B, p. 68/n. D12)</td>
<td>Every 6 months if initial assessment of contamination levels is satisfactory (0 cfu/100 ml) (p. 12/n. 31 and HTM Part B, p. 68/n. D13) Water sampling could be undertaken earlier than at 6 months if there are clinical suspicions that the water may be linked with patient colonization of infection (p. 12/n. 31 and HTM Part B, p. 68/n. D14-D15, and HTM Part B, p. 68/n/D13)</td>
<td>All outlets should be tested during initial assessment (p. 12/n. 31) Sample of outlets can be taken in batches on separate occasions on subsequent sampling (p. 12/n. 31 and HTM Part B, p. 68/n. D13)</td>
<td>0 cfu/100 ml: Satisfactory 1-10 cfu/100ml: Not satisfactory Interpretation of Pre-Post Flush: High bacterial count in pre-flush but low count in post-flush suggests local outlet problem (p. 12/n. 47 and Table 2, p. 18/n. 110 and HTM Part B, p. 68/n. D19) High bacterial count in both pre-flush and post-flush suggests systemic problem (p. 13/n. 48 and Table 2, p. 18/n. 110 and HTM Part B, p. 68/n. D19)</td>
<td>0 cfu/100 ml (Satisfactory): No action, or there are changes in the water distribution and delivery systems components or system configuration (e.g., reflux, cross connections) until the next sampling (p. 12/n. 42 and HTM Part B, p. 68/n. D14) &gt;1-10 cfu/100ml in pre-flush: Pulsed Post-Flush: Retest with paired set of samples including post-flush sample taken as before plus post-flush sample (p. 18/n. 110, HTM Part B, p. 68/n. D16 and HTM Part B, p. 68/n. D19) If sample shows satisfactory results, return to routine sampling; if sample shows unsatisfactory results, then follow remediation measures below (p. 15/n. 45 and HTM Part B, p. 68/n. D19) &gt;10 cfu/100ml (Not Satisfactory): Risk-assess by removing outlet from service and retesting using paired post-flush sample method, followed by remediation measures (below) and retesting (HTM Part B, p. 68/n. D1)</td>
</tr>
</tbody>
</table>
DRAFT Water Monitoring Implementation Framework for Healthcare Settings

- Water management programs (WMP) identify hazardous conditions and take steps to minimize the growth and spread of waterborne pathogens in building water systems. In healthcare settings, WMP functions contribute to the prevention of healthcare-associated infections (HAIs) caused by water-related organisms.

- The Centers for Medicare & Medicaid Services (CMS) defines WMP expectations for Medicare-certified hospitals, critical access hospitals, and long-term care facilities. This includes testing protocols and acceptable ranges for control measures that maintain compliance with other applicable Federal, State, and local requirements.

- The water monitoring implementation framework presented here provides considerations for the "what, where and when" of water monitoring and associated control limits. This should be informed by facility environmental assessments to identify where waterborne pathogens could grow and spread, and water infection control risk assessments (WICRA) to recognize modes of transmission for specific pathogens, identify patient groups at increased risk, and consider the likelihood of water exposures resulting in HAIs.

- When control limits are not met, the specific corrective actions that a facility should take are highly situation dependent, require multi-disciplinary input (sometimes including that of the municipal water utility), and are therefore beyond the scope of this document.

### Basic Monitoring

- All WMPs in healthcare facilities should incorporate basic monitoring practices.

- If infection control risk assessments determine that all patients receiving medical care in your facility are at a minimal or moderate risk for waterborne pathogens, basic monitoring practices alone may be sufficient for your program.

- When ensuring that your WMP is running as designed and is effective, clinical surveillance of HAIs caused by waterborne organisms should be used to validate your program.

### Enhanced Monitoring

- Some healthcare facilities should incorporate enhanced monitoring in addition to basic monitoring practices. This may be performed:
  - Across a facility or within specific locations
  - Routinely or during limited time periods

- Enhanced monitoring practices may be appropriate for circumstances including but not limited to:
  - A WICRA determines that medical care is provided to patients with compromised immune status, comorbidities, and exposure to certain procedures who are more vulnerable to infections caused by waterborne pathogens
  - Clinical surveillance identifies an increase in or cluster of infections in patients caused by water-associated pathogens
  - Water monitoring identifies that control limits are not maintained
  - A water supply event occurs, such as a water main break, boil water advisory, or do not drink advisory
  - Construction, renovation, or facility maintenance occurs

- If your WMP includes enhanced monitoring practices, additional validation steps (e.g., environmental pathogen testing) may be appropriate.
### DRAFT Water Monitoring Implementation Framework for Healthcare Settings

#### Basic Monitoring Practices
- **Water temperature**
  - Control limit in cold water distribution system: ≤60°F (<20°C)
  - Control limit in hot water distribution system: ≥124°F (≥51°C)
  - Monitoring practices should consider state regulations or codes for water temperature
- **Residual water disinfectant**
  - Control limit at point of facility entry:
    - Chlorine: 0.2 mg/L to 4.0 mg/L free chlorine
    - Monochloramine: 0.5 mg/L to 4.0 mg/L total chlorine
    - Chlorine Dioxide: 0.2 mg/L to 0.8 mg/L free chlorine
  - Control limit at point of use: ≥ trace/detectable
- **Water pH**
  - Control limit: 6.5–8.5
- **Cases of HAIs caused by water-related organisms (e.g., Legionella, Pseudomonas, Acinetobacter, Burkholderia, Stenotrophomonas, nontuberculous mycobacteria)**
  - Control limit: As defined in your WMP

#### Enhanced Monitoring Practices
- In addition to those physical and chemical characteristics of water monitored under basic practices, enhanced monitoring may incorporate other parameters, potentially including but not limited to:
  - **Heterotrophic plate count (HPC) testing**
    - Control limit: <500 CFU/mL, or as defined in your WMP
    - HPCs may be considered as an indicator of water quality and interpretation of laboratory results should be appropriate for testing methodologies
  - **Environmental pathogen testing**
    - Control limit: As defined in your WMP
    - Interpretation of laboratory results should be appropriate for testing methodologies

#### When to Monitor
- Quarterly
  - Basic monitoring practices may be performed more frequently for all or some parameters as defined in your WMP

#### Where to Monitor
- **Point of entry to facility**
  - ≥ 10 outlets on both the hot and cold water distribution systems
  - Sample locations should be informed by environmental assessments (e.g., sites where stagnation and biofilm are more likely to occur)
  - Monitoring at representative fixtures close to and far from the central distribution point is recommended
- **Monitoring additional locations may be warranted**
  - This may be appropriate across a healthcare facility or within specific locations
Water Monitoring Framework: Introduction

- Should be informed by facility environmental assessments to identify where waterborne pathogens could grow and spread, and water infection control risk assessments (WICRA) to recognize modes of transmission for specific pathogens, identify patient groups at increased risk, and consider the likelihood of water exposures resulting in HAIs.
Basic Monitoring Practices

- All WMPs in healthcare facilities should incorporate basic monitoring practices.
- If infection control risk assessments determine that all patients receiving medical care in your facility are at a minimal or moderate risk for waterborne pathogens, basic monitoring practices alone may be sufficient for your program.
Basic Monitoring Practices: The What

- Water temperature
  - Control limit in cold water distribution system: $<60^\circ F$ ($<20^\circ C$)
  - Control limit in hot water distribution system: $\geq 124^\circ F$ ($\geq 51^\circ C$)
  - Monitoring practices should consider state regulations or codes for water temperature
Basic Monitoring Practices: The What

- Residual water disinfectant
  - Control limit at point of facility entry:
    - Chlorine: 0.2 mg/L–4.0 mg/L free chlorine
    - Monochloramine: 0.5 mg/L–4.0 mg/L total chlorine
    - Chlorine Dioxide: 0.2 mg/L–0.8 mg/L free chlorine
  - Control limit at point of use: ≥ trace/detectable

- Water pH
  - Control limit: 6.5–8.5
Basic Monitoring Practices: The What

- Cases of HAIs caused by water-related organisms (e.g., Legionella, Pseudomonas, Acinetobacter, Burkholderia, Stenotrophomonas, nontuberculous mycobacteria)
  - Control limit: As defined in your WMP
  - When ensuring that your WMP is running as designed and is effective, clinical surveillance of HAIs caused by waterborne organisms should be used to validate your program
Basic Monitoring Practices: The When

- Quarterly
  - Basic monitoring practices may be performed more frequently for all or some parameters as defined in your WMP
- Point of entry to facility
- $\geq 10$ outlets on both the hot and cold water distribution systems
  - Sample locations should be informed by environmental assessments (e.g., sites where stagnation and biofilm are more likely to occur)
  - Monitoring at representative fixtures close to and far from the central distribution point is recommended
Some healthcare facilities should incorporate enhanced monitoring in addition to basic monitoring practices.

This may be performed:
- Across a facility or within specific locations
- Routinely or during limited time periods
Enhanced Monitoring Practices

May be appropriate for circumstances including but not limited to:

- A WICRA determines that medical care is provided to patients with compromised immune status, comorbidities, and exposure to certain procedures who are more vulnerable to infections caused by waterborne pathogens
- Clinical surveillance identifies an increase in or cluster of infections in patients caused by water-associated pathogens
- Water monitoring identifies that control limits are not maintained
- A water supply event occurs, such as a water main break
- Construction, renovation, or facility maintenance occurs
In addition to those physical and chemical characteristics of water monitored under basic practices, enhanced monitoring may incorporate other parameters, potentially including but not limited to:

- Heterotrophic plate count (HPC) testing
  - Control limit: <500 CFU/mL, or as defined in your WMP
  - HPCs may be considered as an indicator of water quality and interpretation of laboratory results should be appropriate for testing methodologies

- Environmental pathogen testing
  - Control limit: As defined in your WMP
  - Interpretation of laboratory results should be appropriate for testing methodologies

- If your WMP includes enhanced monitoring practices, additional validation steps (e.g., environmental pathogen testing) may be appropriate
Enhanced Monitoring Practices: The When

- As defined in your WMP
  - If a WICRA identifies vulnerable patients in your facility, increasing frequency of monitoring may be warranted
  - If circumstances require corrective actions, increasing frequency of monitoring may be warranted
  - Appropriate frequency of environmental testing (e.g., specific pathogens) should be defined in your WMP
Enhanced Monitoring Practices: The Where

- Monitoring additional locations may be warranted
  - This may be appropriate across a healthcare facility or within specific locations
Next Steps

- Present–Summer 2019
  - Incorporate internal and external feedback
  - Post water monitoring framework and WICRA to CDC website

- Ongoing activities
  - Develop and pilot new practical water tools
  - Publish NHSN Annual Survey data on WMPs
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.