



Water Management - How's it Flowing?

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Division of Healthcare Quality Promotion

North Dakota IPC Conference

April 25, 2024

- Water Risks in Healthcare
 - Why it matters
 - Uses of water in healthcare
 - Risk and hazards associated with water
- Water Management Programs
- Water Infection Control Risk Assessment



AGENDA

Water Matters in Healthcare

- **Water used in healthcare can harbor organisms that can cause disease in patients**
- **Patient susceptibility**
 - Immunosuppressed, cystic fibrosis, pre-existing lung damage
 - Presence of non-intact skin or open wounds
 - Medical devices used in healthcare can serve as vectors



Photo Credit: WCNC

California Healthline Daily Edition

Summaries of health policy coverage from major news organizations

2019

More Families Sue Dental Clinic Over Bacterial Infections Contracted Following Children's Root Canals

The bacterial outbreak, which occurred in 2016, sickened dozens of children, some of whom lost permanent teeth because of the infections. There are now 113 plaintiffs in a series of lawsuits against the Children's Dental Group, and lawyers expect that number to grow.



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Saskia v. Popescu

Saskia v. Popescu, MPH, MA, CIC, is a hospital epidemiologist and infection preventionist with Phoenix Children's Hospital. During her work as an infection preventionist she performed surveillance for infectious diseases, preparedness, and Ebola-response practices. She is currently a PhD candidate in Biodefense at George Mason University where her research focuses on the role of infection prevention in facilitating global health security efforts. She is certified in Infection Control.

Investigating an *Elizabethkingia anophelis* Cluster in a Pediatric ICU

AUG 24, 2018 | SASKIA V. POPESCU



Intensive care units (ICUs) are the last place infection preventionists want to see an outbreak. There is no "good" location for an outbreak, but an ICU is perhaps one of the worst, as the sickest, most vulnerable patients are cared for in such units. Like an oncology unit, an ICU experiencing cases of infection with an unusual organism can represent a canary in the coal mine.

Elizabethkingia bacteria are found in soil, river water, and reservoirs; however, they tend to only cause disease for those with weakened immune systems. The most common manifestations are meningitis and respiratory infections.

4th patient with GHS infection dies

Liv Osby, losby@gannett.com

Published 3:53 p.m. ET July 21, 2014 | Updated 6:59 p.m. ET July 21, 2014

The Post and Courier

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Dozens of Roper Hospital patients developed waterborne bacterial infection after surgery

BY LAUREN SAUSSER LSAUSSER@POSTANDCOURIER.COM
APR 13, 2018



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Health / Picture of Health

Bacterial outbreak closes Prince George's hospital neonatal intensive care unit

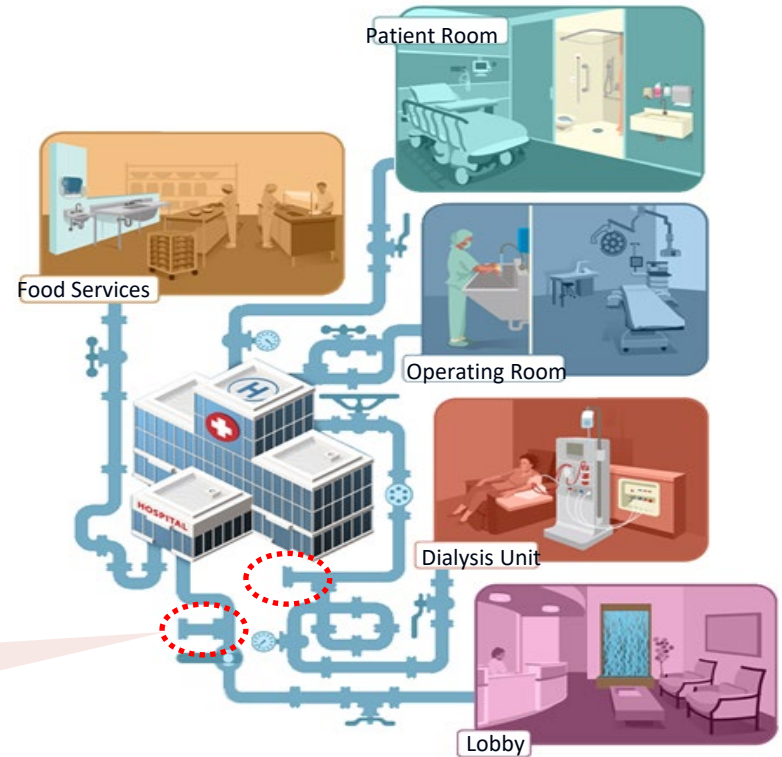
The 7 most reported water-associated healthcare acquired pathogens, CLABSI, VAP, CAUTI, SSI — NHSN, 2011–2014

Organism	Number of reports	%
<i>Klebsiella pneumoniae/oxytoca</i>	31,498	7.7
<i>Pseudomonas aeruginosa</i>	29,636	7.3
<i>Enterobacter</i> spp.	17,235	4.2
Yeast	10,811	2.6
<i>Serratia</i> spp.	5,463	1.3
<i>Acinetobacter baumannii</i>	4,375	1.1
<i>Stenotrophomonas maltophilia</i>	1,758	0.4

Some features of healthcare facility premise plumbing can increase risk of pathogen transmission

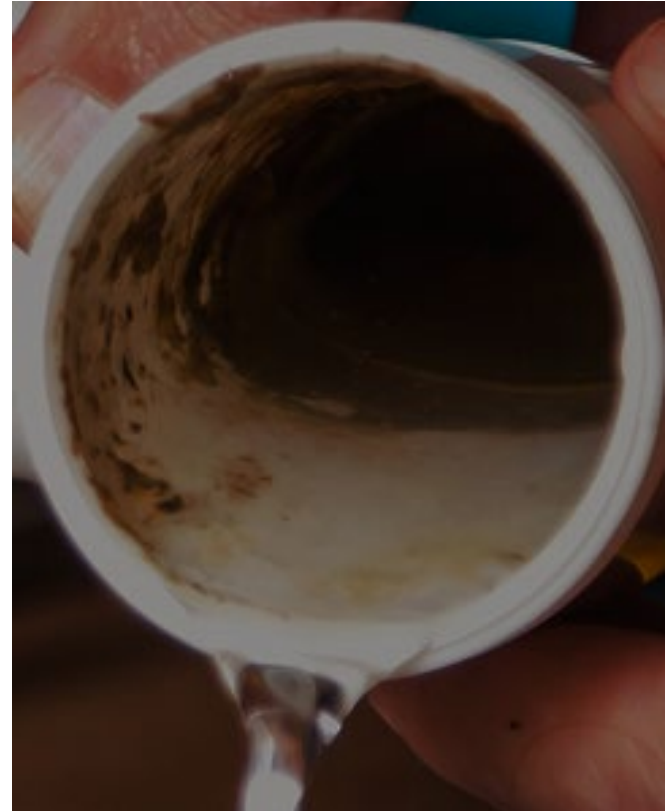
- Large, complex distribution systems
- High surface-to-volume ratio: conducive to biofilm formation
- Intermittent stagnation, low residual disinfectant, and warming cycles
- Building water quality may not meet U.S. Safe Drinking Water Act (SDWA) standards

A **dead leg** is a section of potable water pipe which contains water that has no flow or does not circulate.



Water-associated pathogens in healthcare

- Opportunistic Pathogens of Premise Plumbing (OPPP)
- Microbial residents of drinking water distribution systems and premise plumbing, **NOT contaminants**
- Biofilm formation
- Withstand temperature changes
- Survival and growth at low oxygen
- Resist or tolerant to disinfection
- Slow growth



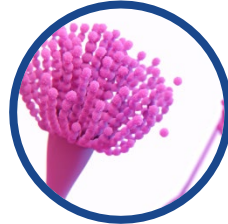
Examples of OPPP in healthcare

Gram-negative bacteria

- *Achromobacter xylosoxidans*
- *Acinetobacter baumannii* complex
- *Burkholderia cepacia* complex
- *Cupriavidus* spp.
- *Delftia* spp.
- *Elizabethkingia* spp.
- *Legionella pneumophila*
- *Methylobacterium mesophilicum*
- *Pseudomonas aeruginosa*, *P. fluorescens*, *P. putida*
- *Sphingomonas paucimobilis*
- *Stenotrophomonas maltophilia*



Legionella pneumophila



Aspergillus fumigatus



Pseudomonas aeruginosa

Non-fecal coliforms:

- *Enterobacter* spp.
- *Klebsiella* spp.
- *Pantoea agglomerans* complex
- *Serratia macescens*, *S. liquefaciens*

Nontuberculous mycobacteria (NTM)

Fungi

- *Aspergillus fumigatus*
- *Fusarium*
- *Phialemonium*

Protozoa

Water uses in healthcare are extensive and varied

- **Facility:** Building systems including HVAC, cooling towers, fire suppression, irrigation
- **Consumption:** water, ice, food and food prep
- **Care:** hygiene (hand washing, patient bathing); aqueous medical products, medications, humidifiers, ventilators, incubators, hydrotherapy, dental unit water uses (DUWLs)
- **Procedures:** dialysis, surgery (e.g., bypass, humidifiers), burn wound debridement, ECMO
- **Cleaning:** medical device reprocessing (AERS, instrument washers), steam generation (autoclaves), environmental cleaning



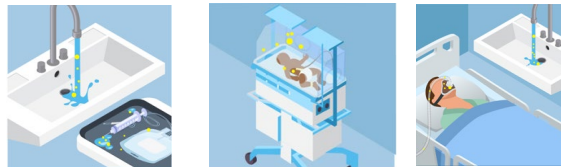
Follow The Flow: Assessing the risk of water

Patient safety depends on:

The “upstream”: Water from the water treatment facility entering a healthcare facility meeting quality standards

The “midstream”: Premise plumbing (i.e. a building’s hot and cold water piping systems) designed and maintained in a way that minimizes growth and spread of waterborne pathogens in both the supply and waste sides

The “downstream”: Exposure to infection risks from water sources during patient care.

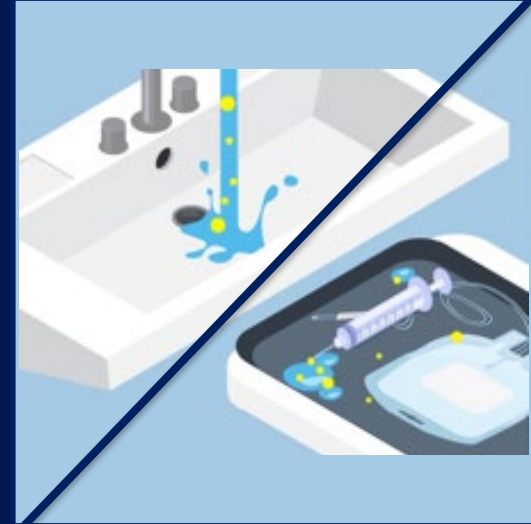
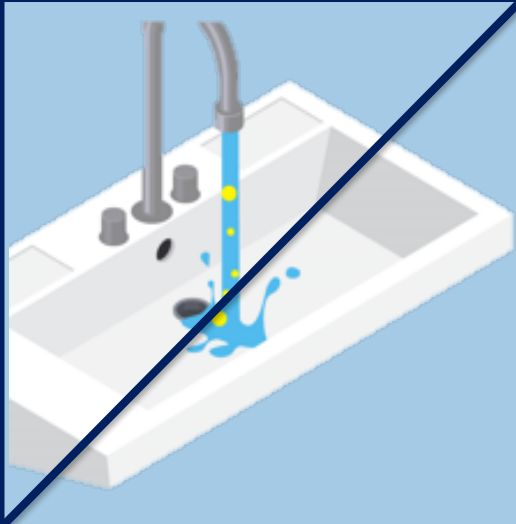


Environmental Assessment

Water Infection Control Assessment

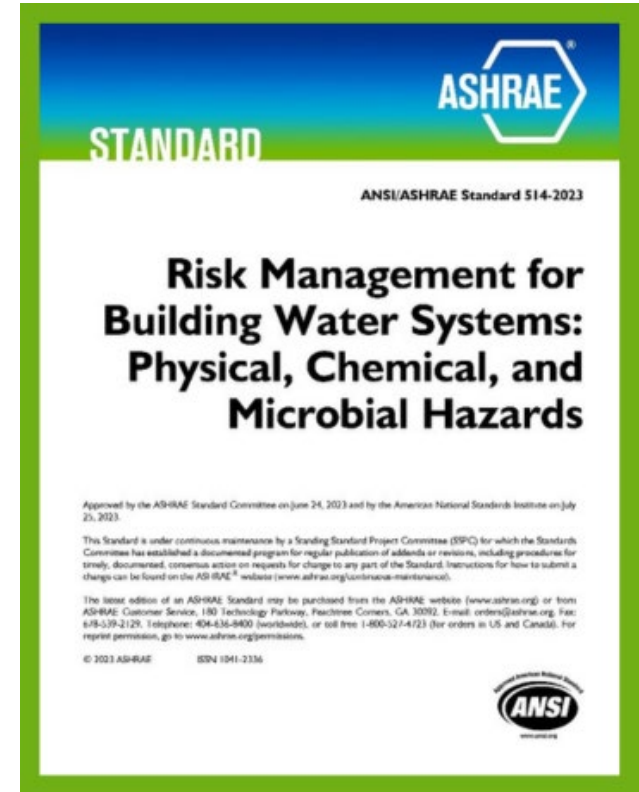
Mitigating Risk of Water-Associated HAIs is a Two-Part Approach

- Reducing OPPP from growing and spreading through water management programs
- Preventing exposure to potentially contaminated water



Water Management Programs (WMPs)

- WMP identifies **hazardous conditions** and take steps to minimize the **growth and transmission** waterborne pathogens in building water systems
- Standards, policy, regulation:
 - American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - US: CMS, VHA, and TJC standards and regulations + states regulations



Elements of a Water Management Program

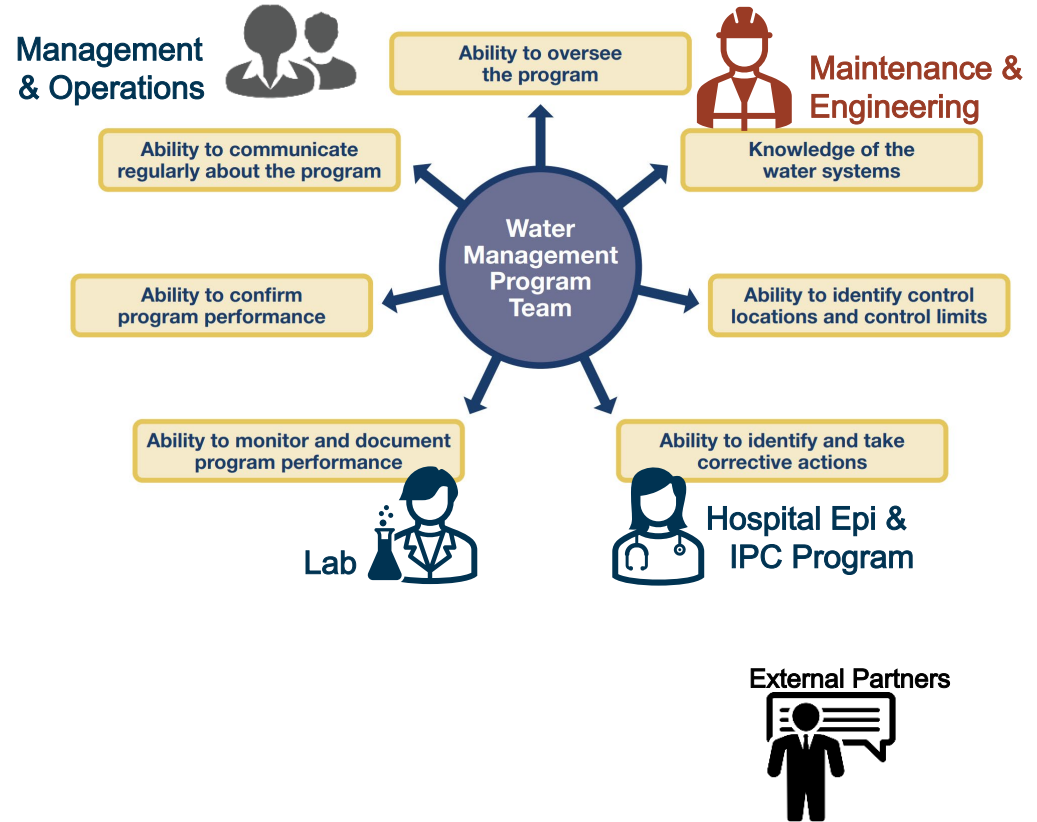
1. Establish a WMP team
2. Describe the building water systems
3. Identify areas where *OPPP* could grow and spread
4. Decide where control measures should be applied and how to monitor them
5. Establish ways to intervene when control limits not met
6. Make sure the program is running as designed and is effective
7. Document and communicate all the activities



Water Management Program Teams

Collaboration between Management & Operations, Maintenance and Engineering, Environmental Services, IPC Program, and other partners

- Each team member has a role
- All should understand risks of water to patients

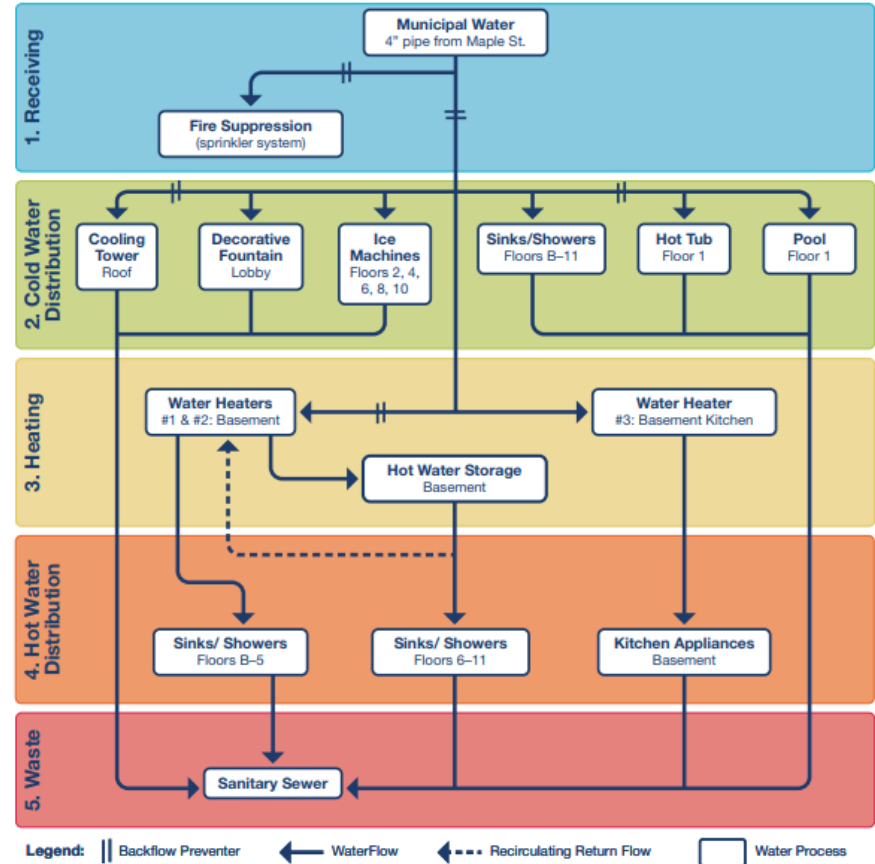


WMP: Describe the Building Water Systems

(WMP elements 2)

Identify and describe the potable and non-potable building water systems using text, charts, or process flow diagram

- Water quality entering the building
 - [EPA Drinking Water Information System](#)
- How water is received and processed
 - screened, filtered, conditioned, stored, heated, tempered, cooled, recirculated, and delivered
- Water use end points
 - **INCLUDING** medical/patient care devices



Risk Assessment: Environmental/Facility

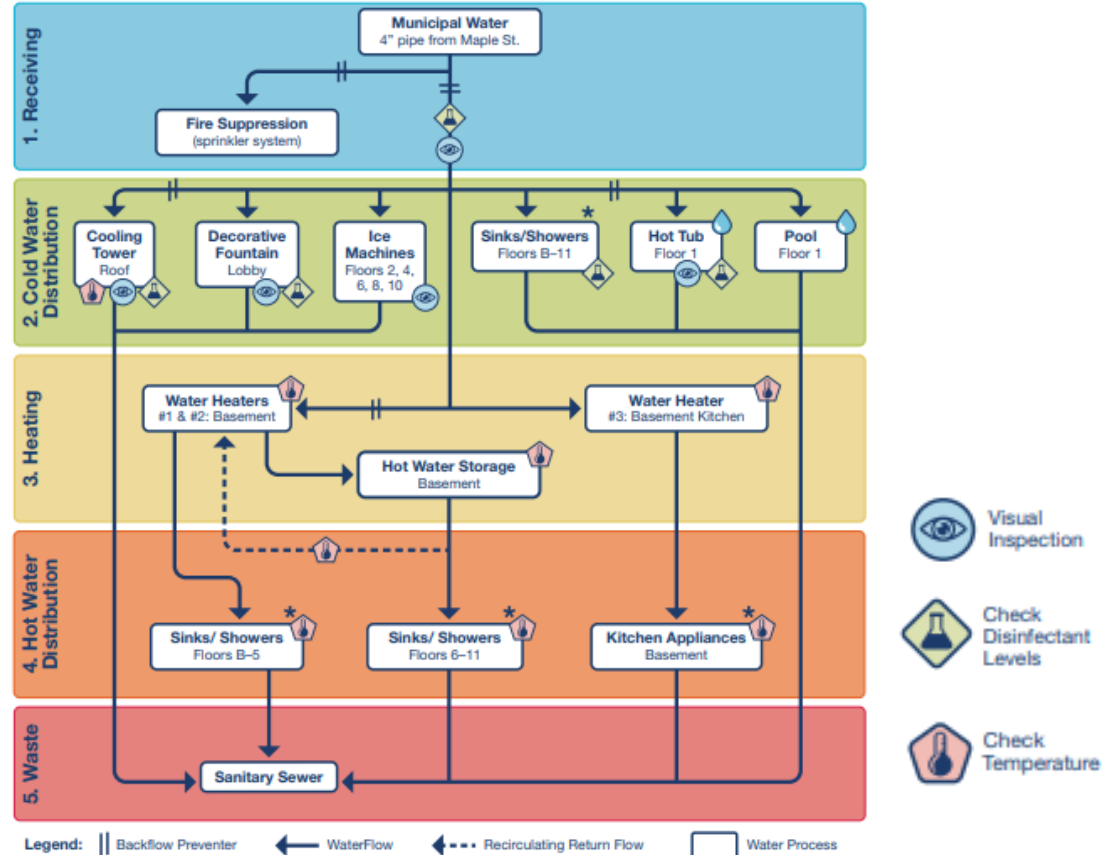
(WMP elements 3-5)

4 key factors that contribute to OPPP growth/spread:

1. Accumulation of sediment
2. Water temperatures between 77°F and 120°F
3. Excessive water age
4. Absence of a disinfectant residual

Each hazard addressed with a control point, measure, and limit

Interventions if control limits are not met



How Are Microbial Hazards Controlled

Table 1. *Legionella* Control Measures for Potable Water Systems

Water Parameter	Control Measure	Recommendations
Sediment and Biofilm	Flushing, cleaning, and maintenance	<ul style="list-style-type: none">• Flush after an intrusion event (e.g., water main break).• Clean and maintain water system components such as water heaters, mixing valves, aerators, showerheads, hoses, and filters regularly as indicated by water quality measurements.
Temperature	Control limits	<ul style="list-style-type: none">• Store hot water above 140°F (60°C) and maintain circulating hot water above 120°F (49°C).• Store and maintain circulating cold water below the growth range most favorable to <i>Legionella</i> (77–113°F, 25–45°C). Note that <i>Legionella</i> may grow at temperatures as low as 68°F (20°C).
Water Age	Flushing	<ul style="list-style-type: none">• Flush low-flow pipe runs and dead legs at least weekly.• Flush infrequently used fixtures regularly.
Disinfectant Residual*	Control limits	<ul style="list-style-type: none">• Chlorine: Detectable residual as directed by WMP.• Monochloramine: Detectable residual as directed by WMP.

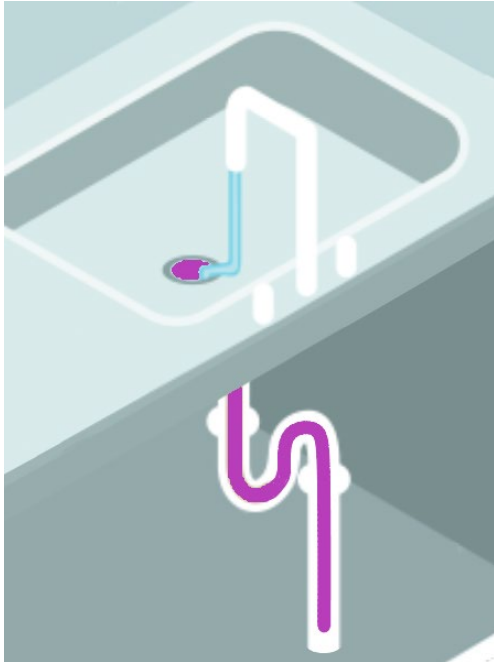
* Disinfectant residual recommendations apply to disinfectant delivered by the municipal water authority. Supplemental disinfection system control limits are not prescribed here and must be dictated by the water treatment professional and water management program.

<https://www.cdc.gov/legionella/wmp/control-toolkit/potable-water-systems.html>

[ASHRAE 12-2023](#)

Multidrug-Resistant Organisms (MDROs) & Premise Plumbing

Many MDRO outbreaks have been linked to premise plumbing, including urgent public health threats



- Sinks, toilets, and hoppers can become contaminated with MDROs
 - Pathogens stick to pipes and form biofilms
- Different bacteria may contaminate the same drain and transfer their antimicrobial resistance genes to other bacterial species

Urgent Threats

- Carbapenem-resistant *Acinetobacter*
- Carbapenem-resistant *Enterobacteriaceae*

Serious Threats

- Multidrug-resistant *Pseudomonas aeruginosa*

Possible exposure pathways and routes of transmission

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

Injection/medication preparation near sink ^a
Nutrition (including breast milk and infant formula) preparation near sink ^a
Patient care supplies stored by sinks and toilets in intensive care unit ^a
Contaminated compounded nasal spray used prior to laryngoscopy
Contaminated water from neonatal intensive care unit (NICU) sinks ^a
Contaminated water from operating room scrub sinks ^a
Contaminated sink drains ^a
Contaminated dialysis wall boxes ^a
Use of nonsterile ice for patient care among immunocompromised patients ^a
Use of contaminated water in dental water lines ^{10,11,a}
Water introduction during respiratory therapy ^a
Use of tap water during bronchoscopy procedures ^a
Use of nonsterile water for humidification reservoirs of infant incubators in NICU ^a

Use of consumer-grade humidifier in operating room during LASIK procedures ¹²
Use of nonsterile water and inadequate disinfection of heater-cooler devices used during cardiac surgery ^{13–15,a}
Intrinsic contamination of medical products due to water contamination at production site ^{16,17,a}
Poor medical device reprocessing procedures ^a
Contaminated automated endoscope reprocessors
Poor cleaning and disinfection of hydrotherapy rooms and equipment ^a
Water from contaminated shower heads ^a
Improperly cleaned mobile shower trolleys
Hot tub use by surgical personnel ^a
Water contamination of specimens/reagents in the laboratory ^a
Building water leaks in patient care areas

^aIndicates a potential exposure pathway or route of transmission that was documented as the possible source of infection in two or more investigations.

Water Infection Control Risk Assessment (WICRA)

WMP team can use a Water infection control risk assessment (WICRA), during the initial development of a WMP and over time, to evaluate:



WATER SOURCES

Patients are potentially exposed to water via the healthcare environment, equipment, or procedures. Water sources include, but are not limited to:

- ◆ Sinks
- ◆ Water source
- ◆ Sinks
- ◆ Drains
- ◆ Showers
- ◆ Toilets
- ◆ Hoppers
- ◆ Humidification devices
- ◆ Mechanical ventilators
- ◆ Endoscopes
- ◆ Heater cooler devices
- ◆ Ice machines
- ◆ Indoor decorative fountains
- ◆ Lactation equipment
- ◆ Enteral feeding
- ◆ Bathing procedures
- ◆ Oral care



MODES OF TRANSMISSION

When assessing risk of healthcare-associated infections caused by waterborne pathogens, consider the diverse modes of transmission, including:

- ◆ **Direct contact**
(e.g., bathing, showering)
- ◆ **Ingestion of water**
(e.g., consumption of contaminated ice)
- ◆ **Indirect contact**
(e.g., from an improperly reprocessed medical device)
- ◆ **Inhalation of aerosols dispersed from water sources**
(e.g., faucets with aerators)
- ◆ **Aspiration of contaminated water**
(e.g. use of tap water to flush enteral feedings)



PATIENT SUSCEPTIBILITY

Patient populations with compromised immune status, comorbidities, and exposure to certain procedures are more vulnerable to infections caused by waterborne pathogens. Units/wards/wings can be classified according to those patients treated in these areas:

- ◆ **Highest**
(e.g., BMT, solid-organ transplant, hematology, medical oncology, burn unit, NICU)
- ◆ **High**
(e.g., non-transplant ICUs, ORs)
- ◆ **Moderate**
(e.g., general inpatient units)
- ◆ **Low**
(e.g., waiting rooms, administrative office areas)



PATIENT EXPOSURE

In order to characterize patient exposure to water sources, consider a categorization scheme that encompasses factors such as the frequency (how often), magnitude (how much), and duration (how long) of exposure:

- ◆ **High**
(e.g., high frequency, magnitude, and duration)
- ◆ **Moderate**
(e.g., combination of high and low frequency, magnitude, and duration)
- ◆ **Low**
(e.g., low frequency, magnitude, and duration)
- ◆ **None**
(e.g., patients are not exposed to the water source)



CURRENT PREPAREDNESS

Consider how your WMP addresses different water sources, as determined by factors such as policies and procedures already in place, relevant staff practice, and implemented mitigation strategies.

- ◆ **Poor**
(e.g., limited policies and procedures, staff practice, and mitigation strategies)
- ◆ **Fair**
(e.g., some policies and procedures, staff practice, and mitigation strategies)
- ◆ **Good**
(e.g., robust policies and procedures, staff practice, and mitigation strategies)

Water Infection Control Risk Assessment (WICRA) for Healthcare Settings						
Facility Name: Hospital A		Assessment Location: Burn ICU		Assessment Date: 10/01/2020		
Performed By (names): Jane Smith and John Doe						
WMP Team Role(s) (check all that apply): <input type="checkbox"/> Hospital Epidemiology/Infection Preventionist <input type="checkbox"/> Facilities Manager/Engineer <input type="checkbox"/> Environmental Services <input type="checkbox"/> Compliance/Safety Officer <input type="checkbox"/> Risk/Quality Management Staff <input type="checkbox"/> Infectious Disease Clinician <input type="checkbox"/> Consultant <input type="checkbox"/> Equipment/Chemical Acquisition/Supplier <input type="checkbox"/> Other (please specify):						
Location	Water Source	Modes of Transmission	Patient Susceptibility Highest = 4 High = 3 Moderate = 2 Low = 1	Patient Exposure Highest = 4 High = 3 Moderate = 2 Low = 1 None = 0	Current Preparedness Poor = 3 Fair = 2 Good = 1	Total Risk Score = Patient Susceptibility x Patient Exposure x Preparedness
BICU Inpatient Rooms	Sink counter storage of patient care supplies	Indirect contact; splashing onto supplies	4	3	3	36
BICU Inpatient Rooms	Toilets without lid	Direct contact	4	3	2	24
BICU Soiled Utility	Hopper, no lid, behind closed door	Indirect contact	4	2	1	8
BICU Medication Preparation Room	Sink with aerator, no splash guard	Aerosolization, and potential for splashing	4	2	3	24
BICU Hydrotherapy Room	Debrisment showers	Direct contact	4	3	1	12

<https://www.cdc.gov/hai/pdfs/prevent/water-assessment-tool-508.pdf>

Infection Control Assessment and Response (ICAR): Water Exposure

Water Exposure Observations:

This portion of the tool is intended for the direct observation of water exposure practices. Ideally at least three patient care areas are observed.

Location/Unit 1: _____

- Ice machine Ice chest room

1. Is the ice dispenser area uncluttered, clean, and free of signs of rodents or insects?
- Yes
 - No
 - Not observed but endorsed by frontline staff
 - Not observed and not endorsed by frontline staff

Medication Preparation area

2. Are patient care supplies protected from splashing (e.g., via splashguards or distance)?
- Yes
 - No
 - Not observed but endorsed by frontline staff
 - Not observed and not endorsed by frontline staff
3. When taps are running, do countertops and care supplies remain free from splashing?
- Yes
 - No
 - Not observed but endorsed by frontline staff
 - Not observed and not endorsed by frontline staff
4. Are faucets offset from drains?
- Yes
 - No
 - Not observed but endorsed by frontline staff
 - Not observed and not endorsed by frontline staff

Soiled Utility Room

5. Do all hoppers have a cover that can be closed before flushing?
- Yes
 - No
 - Not observed but endorsed by frontline staff
 - Not observed and not endorsed by frontline staff
6. Does the door to the soiled utility remain closed when hoppers are flushed?
- Yes
 - No
 - Not observed but endorsed by frontline staff
 - Not observed and not endorsed by frontline staff

<https://www.cdc.gov/infectioncontrol/pdf/icar/ipc-obs-form-water-exposure-508.pdf>

Infection Control Assessment and Response (ICAR) Tool for General Infection Prevention and Control (IPC) Across Settings

Module 11: Water Exposure Facilitator Guide

Water Exposure: This form is intended to aid an ICAR facilitator in the review of a healthcare facility's infection risks posed by water exposures and related policies (Part A) and guide observations about water exposure risks (Part B). The form is intended for use in acute care facilities, long-term care facilities, and outpatient healthcare facilities. It is not intended for use in hemodialysis facilities; if conducting an assessment of a hemodialysis facility, refer to the resources at: [Audit Tools and Checklists | Dialysis Safety | CDC](#)

NOTE: This module does not apply to assessment of dental water lines.

Part A. Water Exposure Interview Questions

This interview should include the person in charge of Plant Operations or Facility Management

1. Does your facility have a water management program (WMP) to reduce the growth and transmission of *Legionella* and other waterborne pathogens (e.g., *Pseudomonas*, *Acinetobacter*, *Burkholderia*, *Elizabethkingia*, *Stenotrophomonas*, nontuberculous mycobacteria, and fungi)?
- Yes
 - No
 - Unknown
 - Not Assessed

A water management plan should address additional topics not addressed in this ICAR, including the assessment and assurance of the microbial safety of water within a facility's premise plumbing. Information regarding water management including tools for developing a WMP to ensure the safety of patients, staff and visitors is available at [Reduce Risk from Water | HAI | CDC](#) and includes the following tools and other resources:

- [Healthcare Facility Water Management Program Checklist \(cdc.gov\)](#)
- [Water Infection Control Risk Assessment \(WICRA\) for Healthcare Settings \(cdc.gov\)](#) which may be performed during the initial development of a WMP, and which can be used to evaluate water sources, modes of transmission, patient susceptibility, patient exposure and program preparedness. It may be updated over time and subsequently reused.
- CDC Toolkit: [Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings](#).

NOTE: The Centers for Medicare and Medicaid Services (CMS) considers it essential that healthcare facilities have a Water Management Plan, and provides information at [§C17-30.Legionella_Risks in Healthcare Revised 6-09-17 | cms.gov](#)

NOTE: CDC guidelines recommend to evaluate possible environmental sources of specimen contamination (e.g., water, laboratory solutions, or reagents) when microbiologic test results (e.g., cultures) appear to be inconsistent with the given clinical context. For more information, see Box 1 of <https://www.cdc.gov/infectioncontrol/guidelines/environmental/index.html>

NOTE: An essential part of a water management plan includes monitoring water coming into the building (e.g., municipal water line). CDC recommends that healthcare facilities develop an ongoing dialogue with their drinking water provider so that they are aware of changes that may affect the building's water supply.

Source: <https://www.cdc.gov/legionella/wmp/toolkit/index.html>

Additional resources for facilities that receive water from private sources (e.g., ground water wells) are available at [Private Water Systems | Private Water Systems | Drinking Water | Healthy Water | CDC](#).

<https://www.cdc.gov/infectioncontrol/pdf/icar/ipc-mod11-water-exposure-508.pdf>

Infection Control Considerations for Reducing Exposure from Sinks and Sink Drains

Engineering controls

Consider splash guards and sink designs to reduce splashing.



Clean and Disinfect

Always clean surfaces near the drain at least daily

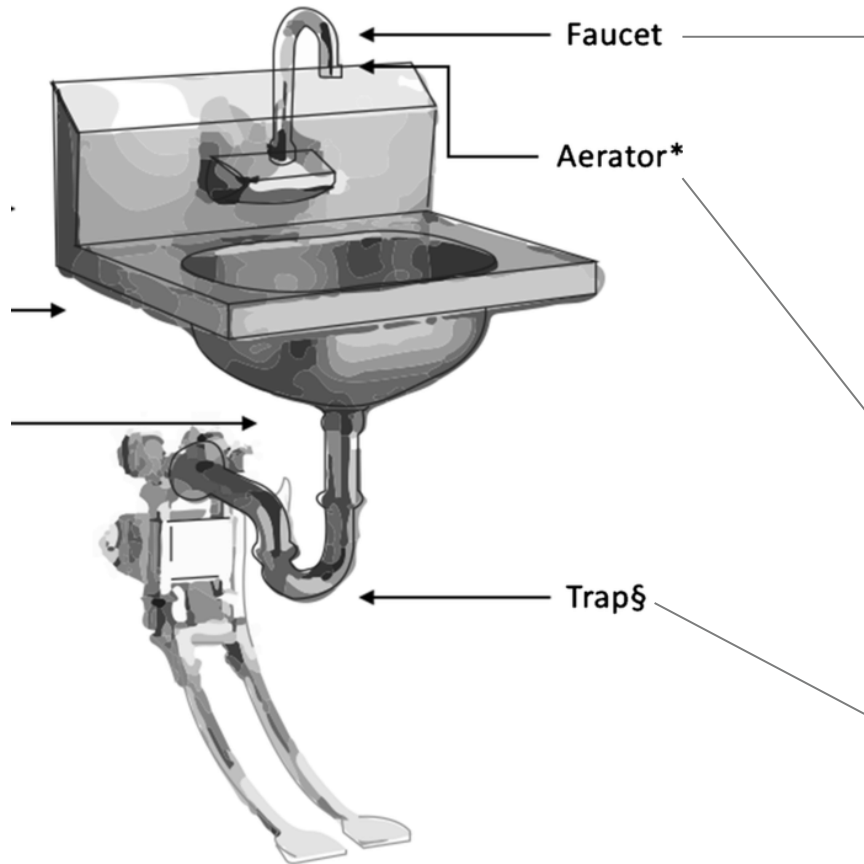


Sink hygiene

No patient waste or beverages. Keep care supplies & personal items away.



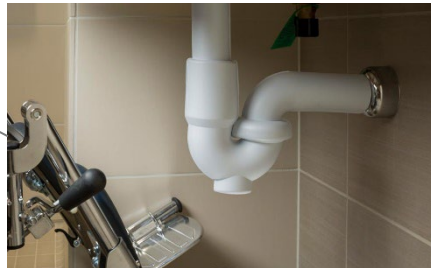
Other Sink Considerations



Point of Use Filters for faucets/showerheads in patient care-care and medication prep rooms



Clean or replace aerators



Replace P-Traps or other plumbing components

Verification, Validation, Documentation

Verification- Program is running as designed. Confirmation that control measures are:

- Being applied at control locations
- Being maintained within the control limits.
- When outside of limits, correction actions are taken

Validation- Program is effective in controlling for microbial hazards

- Clinical surveillance
- Environmental sampling*

Documentation

- Team Roster
- Building and water system description
- Monitoring data, **corrective actions events**
- **Revisions to the water management plan**
- Notifications of water-related illness or injury
- If conducted, environmental testing results

General tips for non-water SMEs during prevention and response-based activities



- Assess potential opportunities for water exposures during or in relation to patient care



- Discuss practices with the IPC program and other members of the WMP team



- Look for opportunities to provide resources and training and education to HCP



- Reach out to health department SMEs (e.g., water, laboratory) and contact CDC for technical assistance if needed



- Sterile water protocol/tap water avoidance could be considered for outbreaks

KEY TAKE AWAYS

- Water has a wide range of uses in healthcare and can be a source of HAIs
- Mitigating the risk of water-associated HAIs is a **two-part approach**:
 - Reducing OPPP from growing and spreading through water management programs
 - Preventing exposure to potentially contaminated water
- A diverse WMP team is needed to address water-related challenges in healthcare
- Communication and collaboration is key to success

Thank you!

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APIC Annual Conference & Expo 2024
WMP Workshop
Tuesday, June 4 at 4:00 – 5:30 PM

For more information, contact CDC
1-800-CDC-INFO (232-4636)
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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.

Environmental
Infection Control
Guidelines



<https://www.cdc.gov/infectioncontrol/guidelines/environmental/index.html#d>

Reduce Risk from
Water– From
Plumbing to
Patients



<https://www.cdc.gov/hai/prevent/environment/water.html>

