Outbreaks of Infections Caused by Water-Related Organisms in Acute Care Hospitals

Part 1. Background

Section 1. Purpose

Infections from water-related organisms are a serious concern in healthcare facilities. Healthcare-associated infections (HAIs) have been caused by a variety of water-related pathogens such as nontuberculous mycobacteria (NTM), gram-negative bacteria, fungi, protozoa, and viruses.[1] Water-related organism outbreaks have been associated with a variety of potential exposures and can be difficult to manage due to the presence of complex premise plumbing systems in healthcare facilities which can lead to stagnation, contamination, biofilm formation, as well as challenges with temperature management and in maintaining appropriate disinfectant levels.[1]

Considerations for Reducing Risk: Water in Healthcare Facilities | HAIs | CDC includes a list of opportunistic pathogens of premise plumbing. These organisms may be natural inhabitants of the plumbing system in a healthcare facility and may not cause infections in healthy individuals.[2] However, healthcare patients may be more susceptible to infection from these organisms due to the presence of invasive and indwelling devices or open wounds, having undergone procedures or surgeries, or by being immunocompromised.[3] A few examples of opportunistic pathogens of premise plumbing frequently encountered during water-related outbreaks in healthcare facilities include:

Burkholderia cepacia complex
Elizabethkingia spp.
Enterobacterales
Nontuberculous mycobacteria (NTM)
Pseudomonas spp.
Ralstonia spp.
Serratia marcescens
Sphingomonas spp.
Stenotrophomonas maltophilia

This document is intended to provide considerations for addressing an outbreak of water-related organism infections in an acute care hospital. These considerations will likely need to be adapted for each outbreak investigation and healthcare facility based on individual outbreak scenarios. While developed to address outbreaks in acute care hospitals, some considerations could be applied to other healthcare settings.

The contents of this tool are intended to complement existing infection prevention and control (IPC) guidelines and practices, including Standard and Transmission-based Precautions and environmental cleaning and disinfection guidelines. Some of the relevant IPC guidelines and recommendations include:

- CDC's Core Infection Prevention and Control Practices for Safe Healthcare Delivery in All Settings | Infection Control | CDC
- Standard Precautions for All Patient Care | Infection Control | CDC
- Transmission-Based Precautions | Infection Control | CDC
- Environmental Infection Control Guidelines | Infection Control | CDC
- Considerations for Reducing Risk: Water in Healthcare Facilities | HAIs | CDC

This tool addresses two aspects of a response for an outbreak of water-related organism infections once the outbreak has been identified: (1) the investigation (i.e., identifying outbreak sources and transmission routes), and (2) response activities, including interventions to stop or mitigate the outbreak's progression. This tool does not address the identification of an outbreak of water-related organisms. The goals of the investigation and response activities are to prevent additional transmission and harm to patients, and to create a safe environment for patient care, while also safeguarding healthcare personnel.[4]

This document is intended to provide considerations to assist in investigating outbreaks of water-related organism infections in acute care hospitals; however, some aspects could be applied to other healthcare settings, such as long-term care facilities or outpatient settings. When available, review guidance for specific healthcare settings.

As with any healthcare outbreak investigation, response steps do not typically need to be completed sequentially or in a specific order but can be done simultaneously and in an order that best fits the circumstances. Frequently, a bundled approach with multiple strategies and interventions implemented concurrently can be used to successfully address healthcare outbreaks.

Consider the patient population when determining the scope of the investigation and to whom these recommendations apply. Depending on the outbreak, the patient population, and the facility or unit layout, investigators can determine whether interventions involve only affected patients, a specific unit or floor in the facility, or the entire facility. Continue the investigation and implementation of interventions, in consultation with IPC staff and other key facility stakeholders, until the outbreak has ended.

Section 2. Groups to engage during your investigation

During an outbreak investigation, several partners might be engaged to assist with prevention and mitigation of a water-related outbreak. These partners include internal healthcare facility staff, public health (local, state, and federal), regulatory agencies and accrediting organizations, and industry professional organizations. Table 1 highlights examples of these various partners and their roles in planning and responding to outbreaks.

Table 1. List of potential partners* to engage in prevention or control of a water-related outbreak

Partners	Planning	Response
Internal Healthcare Facility Partners		
Infection Preventionist (IP): Oversees infection prevention program for affected areas of healthcare facility and plays a key role in identifying water-related infectious risks and coordinating with partners for prevention and mitigation	☑	☑
Facility leadership: Establishes internal notification protocols and addresses resource needs related to water management plan or outbreak response	☑	☑
Facilities manager: Has oversight of system engineering, maintenance, and repair of building water systems	☑	☑
Environmental safety manager: Provides industrial hygiene expertise and has responsibility for environmental policies and procedures	☑	☑
Nursing management: Informs water-related procedures and implements updated water-related infection prevention and control practices, where indicated	☑	☑
Staff from affected units: Informs unit-specific water-related policies and infection prevention and control gaps during a water-related outbreak	☑	☑
Public Health		
State, local, or territorial HAI/AR Programs**:** Receive reports of healthcare-associated outbreaks and provide technical assistance related to water-associated issues		☑
Centers for Disease Control and Prevention (CDC) Division of Healthcare Quality Promotion Provides consultation and technical assistance for HAI outbreaks. Access consultation through HAI/AR Program contacts.		☑
Regulatory Agencies and Accrediting Organizations		
Centers for Medicare and Medicaid Services (CMS): Oversees and enforces regulation of applicable guidelines/standards among participating providers/facilities. For example, water management plan requirements can be found here: QSO17-30-18.	☑	☑
Food and Drug Administration (FDA): Provides oversight of drugs and medical devices, including water-based medical products. Adverse events or quality problems experienced with the use of medical products should be reported to FDA's MedWatch Program.		☑
Occupational Safety and Health Administration (OSHA):	☑	☑

Issues standards and regulations that may apply to workplaces with the potential for contamination and water-related occupational exposures (e.g., related to **water management plans** and **routine flushing of eye wash or shower stations**)		
Healthcare facility licensing and survey agencies: Assesses for and ensure adherence to licensing/survey agency requirements, which may include standards from CMS and organizations like The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the Facility Guidelines Institute (FGI) (below)	☑	☑
State & Territorial Drinking Water Programs/Environmental Protection Agency: Implement relevant drinking water standards referent to the Safe Drinking Water Act or other state/local requirements	☑	☑
Accrediting Organizations: Set and enforce standards for healthcare facilities. These agencies may have specific standards related to water management (e.g., The Joint Commission **water** management program standard)	☑	☑
Industry Professional Organizations		
ASHRAE: Develops standards and guidelines related to the built environment, including those related to water management planning (See standards 188, 514)	☑	☑
American National Standards Institute (ANSI)/Association for the Advancement of Medical Instrumentation (AAMI): Develops standards and guidelines, including those related to water-related considerations for the processing of medical devices (See ST108)	☑	☑
Facility Guidelines Institute (FGI): Develops standards for planning, designing, and constructing healthcare facilities	☑	☑

*List may not be exhaustive of all relevant organizations and partners

Section 3. Healthcare facilities: Types of water used in healthcare and healthcare facility premise plumbing systems

Types of water used in healthcare:

There are a variety of different types of water used in healthcare.[5] The most appropriate type of water to use during clinical care, nutrition, wound care, and other patient activities may differ during an outbreak compared to normal operations. Few guidelines exist which outline the specific type of water to be used during patient and clinical care activities. Decisions around the type of water to be used need to consider the vulnerability of the patients and hypotheses of the investigation. The various types of water used in healthcare include:

- **Tap (potable) water:** Potable water is water that is safe for human consumption and meets health standards set by regulatory agencies. It is free from harmful levels of contaminants, pathogens, and pollutants that could pose health risks. Potable water can come from various sources, including treated municipal water supplies, well water, and bottled water.

- **Filtered tap water:** Filtered tap water is potable water that has gone through filtration to remove bacteria and other microbes. Point-of-use (POU) filters (≤0.2 µm) may be installed in patient rooms (e.g., showers and sink faucets) as a mitigation measure following an outbreak linked to potable water from the facility plumbing or based on a Water Infection Control Risk Assessment (WICRA) in high-risk units. These filters may also be used with ice machines.
- **Purified water:** Purified water is water that has been mechanically filtered or processed to remove impurities and contaminants, including chemicals, minerals, and microorganisms. It is typically produced through methods such as distillation, deionization, reverse osmosis, or filtration. Purified water meets specific standards for purity set by regulatory agencies and is often used in pharmaceuticals, laboratories, device reprocessing, food production, and for hemodialysis applications. Three types of purified water are distilled water, deionized water, and reverse osmosis (RO) water. Distilled water is produced by boiling water and then condensing the steam, leaving behind impurities including microorganisms and contaminants. Distilled water is sterile at the moment of purification but can become contaminated during packaging and storage. Deionized water is created by removing mineral ions through an ion exchange process, often requiring additional filtration for complete purification, including removal of microorganisms or organics. RO is a water purification process that uses pressure to force water through a semi-permeable membrane, leaving contaminants behind.
- **Bottled water:** Bottled water is water that is packaged in bottles for consumption or for clinical or laboratory uses (e.g., reagent water, water for injection and water for irrigation). It can be sourced from various places, including springs, wells, or municipal supplies, and may undergo various purification processes. The FDA requires bottled water producers to meet specific safety and labeling requirements, including protecting water sources from bacteria, chemicals, and other contaminants, and conducting sampling and testing of the source water and final product for contaminants.[6]
- **Sterile water:** Sterile water is water that has been treated to eliminate all viable microorganisms, including bacteria, viruses, fungi, and spores. It is commonly used in medical and laboratory settings, including for medication preparation, rinsing of surgical equipment, or in laboratory experiments; sterile water is typically packaged in bottles and is labeled as sterile.

Healthcare facility premise plumbing can harbor water-related organisms.

- While tap water meets safety standards, it is not sterile and can contain microorganisms that may cause HAIs. Some of these microorganisms may be normal inhabitants of water or plumbing systems (e.g., nontuberculous mycobacteria, *Pseudomonas* spp.) but do not usually cause infections in otherwise healthy individuals. Some other microorganisms, however, are considered contaminants (e.g., *Escherichia coli* and other enteric pathogens) and typically should not be found in tap water. Premise plumbing systems of healthcare facilities, however, may have conditions that encourage microbial growth (e.g., dead legs), leading to high levels of these potential pathogens.[1]
- Water is used in a variety of ways in healthcare facilities such that patients can be exposed to water through direct (e.g., bathing, handwashing) or indirect contact (e.g., improperly reprocessed medical device or equipment contaminated via splash from a sink), ingestion of

water or ice, inhalation of aerosols dispersed from water sources (e.g., toilets), or aspiration of contaminated water.[7]

Part 2. Investigating an Outbreak of Water-Related Organisms (Identifying the Source of the Outbreak)

Tools to investigate outbreaks of water-related organisms are similar to those used to investigate other HAI outbreaks but have an added focus on patient exposures to water in the healthcare facility. Important epidemiologic considerations, such as timing of the infections, location of case-patients within the facility, and types of infections are still critical components of the investigation.

Section 1. Patient-level Information

- Determining possible water exposures, exposure window, and time of onset.[8]
    - Consider the various clinical activities during which water or ice is used and possible modes of transmission of water-related organisms to patients.
        - Examples include:
            - Bathing, showering, hand washing
            - Consumption of ice or water
            - Oral care
            - Swallow evaluations
            - Use of tap water to flush enteral feedings or to dissolve oral medications
            - Wound care (e.g., wound irrigation)
            - Use of ice in ice packs or bags
            - Use of water to thaw or warm products or liquids (e.g., bottle warmer in pediatric settings)
            - Respiratory therapy, including use of ice to chill saline bullets for respiratory treatments
            - Use of ice or water in the operating room
            - Hydrotherapy
            - Dialysis
    - Consider other routes of exposure to ice or water
        - Examples include:
            - Rinsing of devices (e.g., scopes, nebulizers) and other medical equipment or storage of equipment and devices that were not completely dry after reprocessing
            - Splashes from sinks and drains onto patient care or personal care items
            - Medication preparation areas not protected from splashing
            - Medical devices and equipment
            - Water intrusion or leaks in patient rooms
            - Aerosols from flushing toilets or hoppers
            - Decorative water elements (e.g., flower vases, fountains, or aquariums)
            - Contamination from rarely used sinks or eye washing stations
- Retrospective and prospective laboratory-based surveillance can identify affected patients; constructing an epidemic curve of the outbreak can be useful for visualization of the cases over time. Having a well-defined case definition can help standardization of case-finding.

- Additional case-finding: active surveillance testing for colonization might be of use in the unit or facility to identify additional affected patients, if appropriate. Ongoing case finding and surveillance efforts based on the case definition can help define the outbreak.

Section 2. Facility-level Information

- An on-site assessment can be used to review infection prevention and control practices and identify lapses. Assessing adherence to control measures can identify gaps and determine whether control measures need to be further enhanced or can be relaxed.[9]
- A Water Infection Control Risk Assessment (WICRA)[10] and an environmental assessment can be used to assess water and premise plumbing systems.
- CDC's Infection Control Assessment and Response (ICAR) tool for water exposures[11] includes modules and observation forms that were designed to assess IPC policies and practices and their implementation within a healthcare facility and guide quality improvement activities by addressing identified gaps. While not created for use during an outbreak, these modules and forms can be used as a foundation to begin assessing potential exposures and IPC gaps. This information can help guide further investigation of the outbreak.
- Assessing the facility/unit layout and identifying common exposures to particular facility locations (e.g., patient rooms, procedure rooms, waiting areas) can help pinpoint areas of interest.
- Reviewing environmental cleaning policies and procedures can help determine if additional interventions are needed or if there are opportunities for improvement of current practices.
- Facility water management program
    - A general review of the facility's water management program can be valuable. In particular:
        - Note whether ice machines are included within the plan.
        - Review water flow rates, temperature gradients, supplemental disinfection, disinfectant levels, routine testing for residual chlorine and heterotrophic plate counts (HPCs), water temperatures, total organic carbon (TOC), total dissolved solids (TDS), and frequency of monitoring.[12,13]
    - When assessing the facility's water system, consider reviewing:
        - The potable water provider and cooling towers
        - The number of entry points
        - Any moisture visible around pipes or insulation
        - Use of disinfectants in the water supply entering the building
        - The residual disinfectant concentration at the facility
        - Information regarding the premise plumbing system, especially presence of low-flow states, stagnant water, dead ends, and reduced temperature within the hot water distribution system[14]
        - The use of aerators
            - The frequency of cleaning and disinfection of aerators and the program in place to ensure this is done regularly
            - The schedule, if one exists, for routine replacement of aerators

Section 3. Laboratory

- If environmental sampling is appropriate and would be useful for identifying a source(s):
    - Develop an environmental sampling strategy based on epidemiologic findings, including where and what to sample.
- Water sampling during an outbreak investigation may help determine transmission routes and help guide appropriate infection control measures.[15] If done:
    - Determine the locations from which water will be collected.
    - Determine which laboratory can perform testing.
    - For water and ice samples, 1-liter samples are preferred to increase the likelihood of isolating the organisms of interest.
        - Add sodium thiosulfate to neutralize any residual disinfectant that may be present in the sample.
    - Determine how the water collection happens depending on the question(s) being asked.
        - An immediate "first catch" involves no flushing of the water line and is intended to maximize recovery of the target organism from water that has been sitting stagnant in the faucet.
        - A more in-depth water sampling procedure involves the use of both first catch and post-flush (after running the water for 2–5-minutes) samples from the same faucet.
    - Determine type of test methods to perform. Options include:
        - Presence/absence of target organism(s)
        - Total microbial burden testing (i.e., heterotrophic plate counts [HPC]) to provide information about relative water quality conditions for that particular water faucet tested and for water residing deeper within the facility's plumbing
- Consider sampling ice machines.
    - Ice can be dispensed or scooped into the same type of 1-liter bottles used for water collection. The ice will melt during storage and transport to the testing laboratory.
    - Swabs can be used to collect samples from ice machine chutes, drains, bins, or other areas where biofilm is observed.
- Consider sampling of other objects and surfaces, including sink drain and basin faucets, surfaces within the splash zone, and medical devices.
- Consider whole genome sequencing (WGS) of isolates to assess the genetic relatedness of isolates from clinical and environmental sources.
- If and when possible, save all clinical isolates associated with the outbreak for potential testing.

Section 4. Other Considerations

- Medical product considerations[16]
    - Consider contamination of medical products and devices, whether extrinsic or intrinsic, with water-related organisms. Specifically consider aqueous medical products which serve as an environment for water-associated organisms to proliferate (e.g., ultrasound gel, soaps, lotions, antiseptics) or devices that use water (e.g., heater-cooler devices).

    - Consider using a standardized chart abstraction form for water-related outbreaks to help ensure the appropriate questions are asked and that all needed information is collected.
- If a facility is experiencing an outbreak of water-related organisms, consider a retrospective review for infections or positive microbiology from other water-related organisms in the unit or facility.

Part 3. Response Activities: Interventions to stop transmission

Section 1. Sterile water protocol

One intervention that has been used by some facilities during a healthcare outbreak of water-related organisms is to stop the use of tap water for patient care and restrict water use to sterile water. Data on the effectiveness of these protocols are limited; however, a large tertiary care hospital showed significant reductions in hospital-onset pulmonary NTM in high-risk units after implementation of a tap water avoidance protocol.[17,18] The protocols adopted by facilities that have implemented sterile water practices and described them in the literature vary. Considerations for implementing a sterile water protocol include:

- Patient population: Identifying the patients to whom the sterile water protocol will be applicable, considering the outbreak, hypotheses, and facility context (e.g., only among those affected, the entire unit, or the whole facility).
- Duration of sterile water protocol: Continuing to implement the protocol until the outbreak has ended (i.e., lack of new cases during a defined period of careful monitoring) or until appropriate interventions have been implemented, in consultation with facility IPC staff.

Of note, some institutions have removed sinks and implemented water-free activities in intensive care units to reduce outbreaks of water-related organisms. Although studies evaluating this practice are limited, a variety of water-free interventions have been used to address these outbreaks.[19] Some of these interventions include the use of waterless bath products, and sterile or bottled water for consumption, oral care, shaving, and dissolving medications.

In the context of an outbreak, sterile water may be used for clinical care activities. An example of considerations for the use of sterile water for clinical care activities include:

- Avoid the use of tap water and ice for all patient care activities and procedures.
    - Avoid using ice from ice machines for patient care activities.
    - Consider the use of sterile ice in certain situations. Making sterile ice requires the use of medical devices that are designed to make sterile ice for certain sterile procedures, such as those that take place in an operating room.
    - Use sterile water for wound care.
        - Note: During non-outbreak activities, cleaning and irrigation of wounds is generally recommended to be done with normal saline; however, sterile water may also be used and may be recommended based on the anatomical location of the wound, the cleanliness of the environment, and if the wound enters a sterile cavity.[20-22] When neither saline nor sterile water are

available, tap water is sometimes used. Commercially prepared wound cleansers may also be recommended.

- When making decisions about water for patient bathing and showering, consider the patient populations affected and those at-risk and the context of the outbreak. Options for patient bathing/showering include the use of sterile water for bathing, installation of POU filters for showerheads, bathing with chlorhexidine gluconate (CHG), or the use of non-medicated cloths if a patient has a CHG allergy.

Sterile water may be used for consumption. An example of considerations for the use of sterile water for consumption include:

- Avoid the use of tap water and ice for patient consumption and all nutrition orders.
- Use sterile water for:
    - Oral care, including brushing teeth, cleaning dentures, and mouth swabbing
    - Nasogastric (NG)/orogastric (OG) and feeding tube flushes
    - Dissolving oral medication
- When determining the type of water for patients to consume during an outbreak of water-related organisms, consider the specific circumstances of the outbreak, the types of patients affected, and other at-risk populations.

Current recommendations from the American Society for Parenteral and Enteral Nutrition (ASPEN) during non-outbreak activities highlight the use of various types of water for enteral nutrition, including the use of tap or bottled water (depending on the degree of contaminants), purified water for medication preparation, and sterile water for reconstituting powdered formula. In addition, they recommend the use of sterile water as best practice for immunocompromised patients for all of the procedures mentioned above.[23]

Section 2. Water management interventions for source water or drains

- Consider the installation of POU filters (≤0.2 µm) on sinks and shower faucets and whether this will be temporary or long-term.
    - Use of these devices requires a rigorous maintenance program. Change the filters according to the manufacturer's instructions for use (mIFU), either at the recommended interval or when they become fouled. Fouling occurs when contaminants such as suspended solids, organic matter, or biological organisms block pores leading to reduced permeate flux and potential damage to the membrane. Fouling may occur less than the number of days specified by the mIFU depending on the facility water quality.[24] Fouled filters will often have a visually evident slower flow of water.
    - Use of POU filters on sink and shower faucets is usually considered until the premise plumbing system is remediated, if the outbreak is linked to tap water.
- Consider enhanced routine cleaning and disinfection of sinks. At a minimum, clean and disinfect surfaces daily near the drain such as the sink basin, faucet, faucet handles, and

surrounding countertop. Consider providing additional education to environmental services (EVS) staff and ongoing audits of cleaning processes.

- When spread from sink drains is suspected, consider the use of an EPA-registered disinfectant with a label claim for the disinfection of biofilms in wastewater drains.[1,24] No evidence has determined how frequently to use disinfectants for biofilm eradication.
- To decrease the risk of aerosols of water-related organisms spreading to patients, consider closing lids to toilets or hoppers in patient care areas during flushing. Consult local regulations to determine if toilet cover use is specified.

Section 3. Ice machines

Cleaning, disinfection, and sanitization

- Clean, disinfect, and maintain ice machines on a regular basis per the manufacturer's instructions. Ice machine sanitizers should be food-safe and contain a quaternary ammonium compound and at least 40% of either isopropyl or ethyl alcohol**.** Use an EPA-registered disinfectant suitable for use on ice machines, dispensers, or storage chests in accordance with label instructions. If instructions and EPA-registered disinfectants suitable for use on ice machines are not available, use a general cleaning/disinfecting regimen.[25]
    - Cleaning considerations of ice machines based on previous published guidance include regular monthly to quarterly cleaning of the machine and all removable parts that come in contact with water.[26] The cleaning process should include: ensuring the presence of an air space in the tubing that leads from the potable water inlet into the water distribution system of the ice machine, circulating a chlorine solution throughout the entire ice-making and storage systems of the machine according to the manufacturer's recommended cleaning and sanitizing procedures, and letting the solution remain in the ice-making and storage system of the machine for 4 hours.[26]
    - If the mIFU calls for mixing cleaners, sanitizers, or descalers with water, use filtered water for preparation of solutions and for final rinsing of the ice machine to avoid recontamination of the ice machine. Follow the mIFU to ensure that the water used for mixing is at the appropriate temperature.
- Consider increasing the frequency of cleaning and sanitization of ice machines during an outbreak.
- Before anticipated lengthy water disruptions, flush and clean the ice machines and dispensers.[25]
- For ice machines that appear to be visibly contaminated within the fluid pathways, consider replacing the fluid pathways. Current food grade sanitizers and sanitization schedules may not remove biofilms.
- Consider sampling ice and water from the machine before and after sanitization and sending for microbial analysis. Analyses to consider should include at a minimum, total viable counts and total HPCs. While these metrics may not detect all pathogens, they serve as general indicators of effectiveness of treatment processes.

Filters

- Determine if a disinfectant residual is present in water entering the ice machine by checking the levels post filter.
- Ensure that there are no carbon filters (Granular activated carbon or GAC or Carbon Block) in the machines as these remove residual disinfectant in the tap water supply.
- Note that a filter labeled for use of 30 days, 60 days, or 90 days may not be effective for the length of time on the label. A drop in water flow or change in transmembrane pressure as a filter fouls can change the function and effectiveness of the filter prior to the time noted on the label. Filter fouling, bacterial breakthrough, and contamination of the filtrate are serious issues in water treatment and filtration processes, potentially leading to reduced filtration efficiency and compromised water quality.
- For ice machines which have been taken off-line, change filters. In general, filters should be $\leq$ 0.2 µm validated by the manufacturer using ASTM 838-20.[27]

Part 4. Special considerations for Neonatal Intensive Care Units (NICUs)

Neonatal intensive care units (NICUs) are unique environments that care for a patient population at significant risk for infections. This necessitates special considerations for this setting, including:

- Bathing
    - There is no standard bathing practice for NICUs and practices can vary depending on the infant's estimated gestational age at birth, current age, weight, and presence of indwelling devices. Some infants may be bathed with warm sterile water with or without a mild soap, while others may be bathed using a CHG-based product.
    - Consider using warm sterile water in favor of CHG-based products if there is skin breakdown.
    - Consider the universal use of sterile water for bathing,[28] and the use of CHG wipes/soap based on hospital policies and procedures (Note: CHG use is commonly restricted in neonates by age or weight due to systemic absorption and toxicity concerns, though the clinical impact of absorption is unknown. Restrictions may vary among institutions.[29,30])
    - Determine if wash basins are being used during bathing. If wash basins are disposable, ensure they are not reused. If wash basins are reusable, ensure they are appropriately disinfected, dried, and stored in a manner to prevent contamination between uses.[31,32]
- Nutrition
    - Review the process and location for storage of formula and maternal breast milk, warming, and administration.
    - Review the process for cleaning and disinfection of lactation equipment (e.g., breast pump, breast pump parts), including who is responsible for this process (e.g., parents, clinical team), where it occurs, where supplies are kept, if cleaning and disinfection occur near a sink, and where equipment is left to dry and be stored. Ensure that breast pump equipment is appropriately cleaned and disinfected, dried thoroughly, and kept away from sink splash zones.

- Assess the area where nutrition preparation is taking place, noting the presence of sinks. Precautions, such as relocating nutrition preparation away from the sink or installation of splash guards can prevent inadvertent contamination of supplies.
- Assess how expressed breast milk and formula are warmed prior to feeding/administration. Waterless systems for warming may be considered to avoid the potential for water contamination.
- Determine if oral syringes are used for small volumes of colostrum or oral medication and ensure that these are stored away from water sources.

- Isolettes
  - Assess the location of the isolette, noting distance from sinks and splash zones. Determine if isolette and patient care supplies are stored away from water sources.
  - Review protocols and practices for cleaning and disinfection of isolettes and cribs and ensure they align with mIFU. An appropriate EPA-registered disinfectant should be used for cleaning of environmental surfaces and isolettes/cribs based on the specific pathogen (e.g., List N for SARS-CoV-2 or List P for *Candida auris*).
    - Note in the mIFU the steps, if any, to remove residual disinfectant and if these include rinsing with water or cloths dampened with water. Determine the type of water being used (e.g., tap, sterile), where this occurs (e.g., near a sink), if there is a potential for isolette parts to touch a sink during rinsing, and how and where parts are dried to prevent contamination. During an outbreak of a water-related organism, consider the option of sterile or filtered water to rinse isolettes and associated parts (e.g., reusable mattresses).
  - Determine how frequently isolette humidifiers are cleaned and disinfected and what type of water (e.g., sterile water, tap water, or other source) is used in the humidifiers. Humidification systems generally use sterile water in a heated chamber on the underside of an isolette. These chambers need to be routinely cleaned and disinfected according to the mIFU.

Part 5. References and additional resources

Water-related organisms, assessment tools, and strategies to address:

- ICAR Tool for General Infection and Control (IPC) Across Settings - Module 11: Water Exposure Facilitator Guide (cdc.gov)
- ICAR Tool for General Infection Prevention and Control (IPC) Across Settings - Section 3: Observation Form - Water Exposure (cdc.gov)
- Tap Water Quality and Infrastructure Discussion Guide for Investigation of Potential Water-Associated Infections in Healthcare Facilities
- Toolkit: Developing a Legionella Water Management Program | Control Legionella | CDC
- Requirement to Reduce Legionella Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD) Memo 17-30-Hospitals/CAHs/NHs
- Healthcare Outbreaks Associated With a Water Reservoir and Infection Prevention Strategies - PubMed (nih.gov)
- Outbreaks of healthcare-associated infections linked to water-containing hospital equipment: a literature review - PMC (nih.gov)
- Preventing Waterborne Pathogen Transmission (infectioncontroltoday.com)

Water management programs:

- Considerations for Reducing Risk: Water in Healthcare Facilities | HAIs | CDC
- Water Infection Control Risk Assessment (WICRA) for Healthcare Settings (cdc.gov)
- The Joint Commission: New Standard for Water Management Program

NTM resources:

- Public Health Strategies for Preventing NTM Outbreaks | Nontuberculous Mycobacteria (NTM) | CDC
- Council of State and Territorial Epidemiologists (ymaws.com) (CSTE Standardized Case Definition for Extrapulmonary Nontuberculous Mycobacteria Infections)
- CORHA-Proposed-NTM-Thresholds-and-Definition-08-19.pdf (naccho.org)
- Treatment of Nontuberculous Mycobacterial Pulmonary Disease: An Official ATS/ERS/ESCMID/IDSA Clinical Practice Guideline (idsociety.org)
- From Oregon
    - Oregon Health Authority : Nontuberculous Mycobacterial Disease (NTM) - Extrapulmonary : Diseases A to Z : State of Oregon
    - ntm.pdf (oregon.gov) (investigative guidelines, December 2017)
    - ntm-orpheus.pdf (oregon.gov) (case report form)
    - Extrapulmonary Nontuberculous Mycobacterial Disease Surveillance — Oregon, 2014–2016 | MMWR (cdc.gov)

- From Tennessee
    - Non-tuberculous Mycobacteria infection extra-pulmonary (tn.gov)
    - https://www.tn.gov/content/dam/tn/health/documents/reportable-diseases/mycobacterium-nontuberculous-species-extra-pulmonary-only/TDH-NTM-Surveillance-Form.docx (Extrapulmonary Non-tuberculous Mycobacterial Infection Surveillance Form)
- From Minnesota
    - ENTM Information for Health Professionals: Sentinel Surveillance and Reporting - MN Dept. of Health (state.mn.us)
    - Proposal for Conducting Sentinel Surveillance for Extrapulmonary Nontuberculous Mycobacteria (ENTM) under the Minnesota Communicable Disease Rule (4605.7046) (state.mn.us)

Tap water avoidance:

- Two-Phase Hospital-Associated Outbreak of *Mycobacterium abscessus*: Investigation and Mitigation - PMC
- Tap Water Avoidance Decreases Rates of Hospital-onset Pulmonary Nontuberculous Mycobacteria - PMC (nih.gov)
- Tap Water Avoidance Decreases Rates of Hospital-onset Pulmonary Nontuberculous Mycobacteria: A Call for Water Management in Healthcare - PMC (nih.gov) (commentary by Matt Arduino)
- The impact of sink removal and other water-free interventions in intensive care units on water-borne healthcare-associated infections: a systematic review - PubMed (nih.gov)
- *Mycobacteroides abscessus* outbreak and mitigation in a cardiothoracic transplant population: the problem with tap water - PubMed

Water quality

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- Water Safety in Buildings - WHO
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