Ohio Department of Health

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Recommendations for Unoccupied to Partially Occupied Buildings for Flushing and Disinfection to Reduce *Legionella* Growth

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Purpose:

Water that has been stagnant in cold and hot-water distribution lines and fixtures can grow harmful bacteria including *Legionella*. Legionellosis is a disease that occurs from inhalation of droplets of water that are aerosolized from splashing, spraying or misting of water from various sources including sinks, showers, hoses, or other manufacturing devices. The following procedures are recommended to ensure stagnant and potentially contaminated water is flushed from a water system, and that water lines and fixtures are disinfected to prevent exposure to bacteria that can cause disease.

Application of the Guidance

When using this guidance, building managers should first attempt to remediate their building water distribution system using flushing. Self-contained recirculating fixtures, water features, dental and medical devices, and attached appliances should always be flushed AND disinfected according to manufacturer or industry standards.

The following types of buildings should consider conducting additional disinfection of the hot and cold-water distribution system when:

- Buildings have complex water systems such as recirculating hot water systems with multiple loops and more than several floors.
- The presence of high- risk conditions that may cause Legionella growth are identified as part of the environmental facility assessment.
- When implementing requirements of a *Legionella* water management plan.
- Healthcare and long-term care facilities.
- Medical and dental facilities.
- Manufacturing facilities using equipment that sprays or mists water where those devices cannot be separated and cleaned.

Stagnant water in complex water systems can require additional disinfection. Disinfection of cold and hot water distribution systems will require the services of a qualified water quality professional/Legionella consultant to assist with handling of chemicals, connection into plumbing systems, proper use of disinfection chemicals, and maintaining proper disinfection levels.

These recommendations are to be used when buildings are being re-started for continuous operations after:

a. Period of non-use (>14 days), unoccupied, or vacated space;
b. Change of intended use or occupancy of space or building;
c. Alternative use or occupancy of building space during emergent response.

Flushing and Disinfection Procedures

1. Obtain the services of a qualified and experienced *Legionella* consultant when flushing **and disinfecting** a building water system to for *Legionella* (https://www.cdc.gov/legionella/wmp/consultant-considerations.html).

2. If a water management program is available for existing building operations, consult the plan to create an informed flushing and disinfection process for the cold and hot water distribution system and selection of appropriate sites for environmental sampling.

3. If there is NO water management program available, or if an assessment has not been conducted in the last 6 months, conduct an environmental facility assessment using the CDC Environmental Assessment tool (https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment.pdf) to:
    a. Characterize and identify cold and hot-water distribution system
    b. If necessary, create basic flow diagrams of the facility's hot and cold-water distribution systems. Refer to the CDC Management Program Toolkit (https://www.cdc.gov/legionella/wmp/toolkit/index.html) for guidance .
    c. Identify and prioritize high hazard areas for correction.
    d. Complete high hazard plumbing and system corrections identified by the environmental assessment if possible, prior to flushing and disinfection. The efficacy of disinfection will be impacted by functionality of the system and the removal of areas where water can stagnate.

4. Create a list of a water fixtures and features. This should include all sinks, showers, drinking fountains, water features, sprayers, misters, hot water spas/tubs, humidifiers, medical or industrial water systems that spray or mist water.

5. Conduct a thorough flushing, cleaning and disinfection in accordance with manufacturer's recommendation's, CDC or industry best practices of:
    a. Terminal fixtures (sink aerators, hoses, shower heads, sprayers).
    b. Fountains and other decorative water features.
    c. Ice machines (empty existing ice, discard at least 2-3 volumes of ice).
    d. Equipment or devices with water reservoirs (sprayers, pressure tanks, water heaters, water softeners, washing machines, medical or dental or manufacturing equipment). Drain reservoirs where present.

6. Make sure appropriate back-flow prevention is in place to separate fire suppression, irrigation, boiler or other water systems that may be present to protect the potable water system.

7. Flush the cold and hot water piping distribution lines in accordance with the Ohio EPA building flushing recommendations (https://epa.ohio.gov/ddagw/covid19#187665334-consumers) and the following:
    a. Preparation for flushing
        i. Remove aerators from faucets;
        ii. Install filters where necessary to protect medical devices or other sensitive equipment from sediment fouling.

iii. Ensure drainage and sewerage can receive maximum flow in the lines during flushing.

b. Flush to achieve the highest velocity possible to make sure that at least 5 volumes of water held in the lines are evacuated (goal is to achieve 2.5 to 5 ft/sec of scour velocity) without damaging piping.
    i. Open and flush all fixtures for a minimum of 10 minutes. This will flush all stagnant water and remove any loose biofilm.
    ii. If the building has more than one floor or multiple hot and cold-water loops, flush the first- floor systems first. Flush each loop individually for each floor, followed by flushing individual loops on higher floors. Flush the cold-water systems first in each flushing sequence.
    iii. Flush all toilets at least twice.
c. During flushing, evaluate if uniform flow is occurring throughout the building to help achieve proper disinfectant levels during disinfection. For those who can measure water quality, measure the concentration of disinfectant (chlorine) in the building supply and the concentration of disinfectant in the cold water of the most distant fixture of each zone after that fixture is fully flushed. By comparing the disinfectant in the distant taps to the disinfectant in the building supply, it can be determined if disinfectants from the public water supply are reaching all sections of the plumbing. This will also help identify areas of water stagnation or low-flow conditions that can cause regrowth of *Legionella* after disinfection is completed.
d. All flushing should be completed within the same day, preferably less than one-half day if possible.

8. Building managers that choose to **disinfect** the water distribution system based on an environmental facility assessment, water management plan, or in response to known or suspected increased Legionella risk, should conduct the following steps with the assistance of a qualified Legionella consultant. Additional disinfection of the water systems should be conducted as follows:
    a. Identify or plumb in an injection port into the cold- water distribution system.
    b. Select the appropriate disinfectant:
        i. Inject and circulate chlorine dioxide at 4 mg/L to achieve a chlorine dioxide residual of at least 1 mg/L at each fixture and outlet. Hold for a one-hour contact time in the hot and cold-water distribution systems. Flush all fixtures and outlets for at least 10 minutes following the 1-hour hold time.
        ii. Inject and circulate chlorine at 50-200 mg/L to achieve a free chlorine residual of at least 20 mg/L at each fixture and outlet. Flush for 20 minutes or until the desired free chlorine residual is achieved at all fixtures. Hold for a minimum of 2 hours.
    c. Completely flush all water lines until free chlorine levels are below 4 mg/L.

<u>Water Sampling Recommendations to Evaluate Flushing or Disinfection</u>

1. Based on the environmental facility assessment or a water management program, identify key sampling locations in the hot water distribution system to periodically measure temperature and disinfectant residual. Record these in a daily log. At a minimum, these should include:
    a. Cold water supply (point of entry to building)
    b. Hot water supply
    c. Hot water return

d. rotating subset of cold and hot distal outlets

2. Based on the environmental facility assessment or water management program, identify key locations to collect environmental samples for Legionella.
    a. Collect at **minimum** of 2-4 samples per hot water loop and per level of the facility depending on the floor shape plan, square footage, and number of risers in the building including distal locations in the water distribution system. Collect sufficient water samples to ensure a thorough evaluation of the hot water distribution system. More sample locations provide a comprehensive assessment of water quality to ensure safety of residents or patients.
    b. Collect samples at the hot water tank and at the hot water return if present.
    c. Collect a sample at the cold water main to the building if possible.

3. Follow the CDC protocols for sample collection including collection of a fixture swab or first draw and a flush sample. https://www.cdc.gov/legionella/downloads/cdc-sampling-procedure.pdf

4. Send samples to a CDC Elite Certified Lab (https://wwwn.cdc.gov/elite/public/elitehome.aspx) for analysis. Ask the lab to provide an immediate PCR analysis (normally available within 1-2 days) as a quick screening tool to determine the presence of Legionella DNA, in addition to standard culture plate methods for the sample (7-10 days) to determine the presence of viable *Legionella.* If Legionella DNA is present, it may indicate that additional flushing, disinfection, or water system corrections are needed prior to use of the water. Follow up with evaluation of the culture sample results and consider the collection of additional *Legionella* samples if additional flushing, disinfection or water system actions are conducted.

Installation of Continuous Disinfection

1. **Continuous disinfection may be needed to protect sensitive populations that visit or stay in a facility.** If the facility had the ability to continuously disinfect before building closure, evaluate if reinstallation of disinfection equipment is feasible. Secure the services of a qualified water management company to install or restart disinfection equipment.

2. If high risk conditions in the hot and cold-water distribution system identified as part of the environmental facility assessment are unable to be corrected, or testing shows that initial or subsequent disinfection is not effective at mitigation, then strongly consider installation of a continuous disinfection system. If continuous disinfection is not possible, consider installation of medical grade point of use filters capable of removing Legionella (less than 0.2 microns).

3. Assess the different types of continuous disinfection with a water management quality professional/Legionella consultant and review recommendations against the *US EPA's Technologies for Legionella Control in Premise Plumbing Systems: Scientific Literature Review.* Acceptable continuous disinfection methods and recommended disinfectant residuals include:
    a. Monochloramine – maintain minimum disinfection levels of 2.5 mg/L of total free chlorine in all fixtures/outlets.
    b. Chlorine Dioxide – maintain minimum disinfectant levels of 0.3 mg/L chlorine dioxide in all fixtures/outlets.

c. Chlorine – maintain minimum disinfectant levels of 1.0 mg/L free chlorine in all fixtures/outlets.

4. Monitor disinfectant levels at least twice weekly to ensure a uniform distribution of disinfectant on all floors, loops and distal locations in the hot water distribution system. If on-going testing demonstrates the absence of any culturable *Legionella*, disinfectant levels may be adjusted. Continued detection of *Legionella* may require the use of more effective disinfectants such as monochloramine and/or chlorine dioxide.

5. Disinfection by-products and maximum residual disinfectant levels as applicable to the disinfection method should be monitored in the water to meet all federal safe drinking water standards. Consult with Ohio EPA, Division of Drinking and Ground Waters (https://epa.ohio.gov/ddagw/).

6. Establish appropriate monitoring and maintenance actions for the disinfection system, and the person(s) responsible for implementing these actions and incorporate into your water management program.

7. Facilities should consult with Ohio EPA, Division of Drinking and Ground Waters (for licensing as a public water system) if a disinfection system will operate for greater than 60 days in a calendar year.

On-Going Maintenance and Monitoring

1. If a *Legionella* Water Management Program has not been established for the facility, the responsible party should create a plan in accordance with ASHRAE 188 (https://www.ashrae.org/technical-resources/bookstore/ansi-ashrae-standard-188-2018-legionellosis-risk-management-for-building-water-systems) and the CDC guidance (https://www.cdc.gov/legionella/wmp/index.html), with the assistance of a qualified *Legionella* consultant and implement the plan.

2. Review ODH/Ohio EPA Guidance for Premise Plumbing Water Service Restoration. This document contains additional best practices for maintaining water quality in building water systems including flushing, testing, and disinfection for contaminants.

3. In accordance with a water management plan, or until a plan is fully developed for a building, assign responsibility to an individual or group for monitoring, recording, and reporting of temperature, disinfectant residual, and environmental sampling.
    a. Hold temperatures at a minimum of 140 degrees F in hot water storage tanks.
    b. Water circulating in the hot water distribution system, or distributed from the storage tank should be maintained above 120 degrees F. Water can be tempered at the point of delivery from the fixture if necessary.
    c. Ensure proper dedicated equipment is available to measure both temperature and disinfectant residual. Ensure equipment can measure disinfectant residual to 0.1 mg/L units and is calibrated in accordance with the manufacturer's recommendations.
    d. Monitor water temperatures and disinfectant residuals to help ensure uniform flow is occurring in the cold and hot water distribution system to prevent water aging and creating conditions conducive to Legionella growth. Maintain a log of all measurements.

4. Identify a person in charge who can quickly communicate and respond to low temperature or disinfectant residuals or detections of *Legionella*.

5. All hot and cold -water fixtures located in any unoccupied rooms or areas in the building should be flushed at least twice weekly for a minimum of 10 minutes (or until cold and hot water temperatures stabilize and reach maximum low or high temperature) to reduce water aging in primary distribution lines, drop legs and fixtures.

6. If at any time, any *Legionella* species is detected by the laboratory culture, repeat disinfection of the system per Step 8 of **Flushing and Disinfection Procedures** as described above and resample for *Legionella* requesting standard culture analysis. Consider installation of continuous disinfection system or medical grade point of use (0.2 micron) filters if any *Legionella* species are detected at any concentration in more than one sample set.

Other References:

ODH/Ohio EPA Guidance for Premise Plumbing Water Service Restoration
https://epa.ohio.gov/ddagw/covid19#187665334-consumers

CDC Guidance for Building Water Systems: https://www.cdc.gov/coronavirus/2019-ncov/php/building-water-system.html

AWWA Building Recommission Guidelines: https://www.awwa.org/Resources-Tools/Resource-Topics/Coronavirus?_ga=2.93333661.1628454629.1586875253-166290618.1586875253#10681543-shutoffs-and-return-to-service-guidance

ESCMID Study Group for Legionella Infections, 2019, ESGLI Guidance for managing Legionella in building water systems during the COVID-19 pandemic.
https://www.escmid.org/research_projects/study_groups/legionella_infections/

ODH Legionella Information: https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/Legionella-Environmental/welcome/

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https://doi.org/10.31219/osf.io/qvj3b

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