Reducing Risk to Staff Flushing Buildings

As COVID restrictions are adjusted and regular building use resumes, staff and managers who operate and maintain building water systems might be asked to conduct flushing to address water quality degradation that might have occurred in water that sat stagnant in some buildings. ESPRI – The Environmental Science, Policy and Research Institute – prepared this memo to help educate managers and staff who will flush building water systems about risks that some of them might face and to pass on a suggestion for reducing risks based on an experimental setup in our lab. ESPRI scientists and engineers have decades of combined experience conducting research on drinking water treatment and distribution and are on the forefront of research and policy related to water quality in buildings. We hope you find this memo useful and wish everyone the best during the COVID response and beyond.

When staff flush buildings, they and other people in the buildings might be exposed to aerosol droplets from spraying and splashing water. Those aerosol droplets could contain germs like *Legionella pneumophila* (the germ that causes Legionnaires' disease) that could make them sick if they breathe them. Federal agencies including the Occupational Safety and Health Administration (OSHA) and The National Institute for Occupational Safety and Health (NIOSH) have developed guidances and recommendations for working in environments where *Legionella* bacteria might be present. Reviewing materials from those agencies is the best starting point for developing a strategy for reducing risks during flushing.

According to OSHA (https://www.osha.gov/SLTC/legionnairesdisease/control_prevention.html), "Preventing exposure to *Legionella* in the workplace starts with awareness about water systems in which the bacteria could grow, and continues with water system maintenance to prevent growth and checking for unexpected growth in case preventative measures fail." OSHA continues "When *Legionella* hazards cannot be controlled with engineering and administrative controls and safe work practices, personal protective equipment (PPE) may also be needed to prevent worker exposures and infections. Although there are no OSHA standards specific to *Legionella* or other non-bloodborne, biological hazards, several existing requirements may apply to occupational exposure to *Legionella*." An example of PPE suggested in some cases for use when working with domestic water is N95 respirators. The Food and Drug Administration (FDA) has documented a shortage of N95 and equivalent respirators within the health care community and issued temporary guidances (April 4, 2020) to address this shortage (https://www.fda.gov/media/136449/download). The FDA further notes that "It is important to recognize that the optimal way to prevent airborne transmission [of the novel coronavirus] is to use a combination of interventions from across the hierarchy of controls, not just PPE alone (https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-and-surgical-masks-face-masks)." This statement can also apply to other airborne pathogens.

This memo is intended to promote awareness about water systems, flushing and *Legionella* risk and describes an engineering practice that can be incorporated into flushing when there are concerns that

Legionella risks might be elevated. It is essential that staff who are conducting flushing and their supervisors understand and follow recommendations from agencies like OSHA. This memo is not intended to contradict or supplant recommendations from OSHA or other agencies. Rather, we want to help workers establish multiple barriers to infection while flushing. Think of this as a belt *and* suspenders approach to worker safety.

Figure 1 shows how staff conducting flushing, or other people who enter rooms where flushing is being conducted, might be exposed to harmful bacteria. The bacteria we are concerned about may be present in some (but not all) building water systems. When building water systems are not managed effectively, bacteria including *Legionella* can grow to dangerous numbers as water sits stagnant in both hot and cold building plumbing. Hot water plumbing is considered particularly problematic because the disinfectant in the building water supply decays faster in warmer water and is often absent in hot water plumbing. The bacteria in the hot and cold water may make people sick when small droplets of water containing *Legionella pneumophila* are breathed in. The small droplets are generated from sprays and streams of water as it splashes in the bottoms of sinks, shower stalls, tubs and other places where water drains. Some droplets are small enough to be carried by air and inhaled. The more aerosols and bacteria that are inhaled, the greater the odds that the person who is exposed could become infected **if there are *Legionella* in the water**. Note that not all water in buildings will have *Legionella*, but there is some risk.

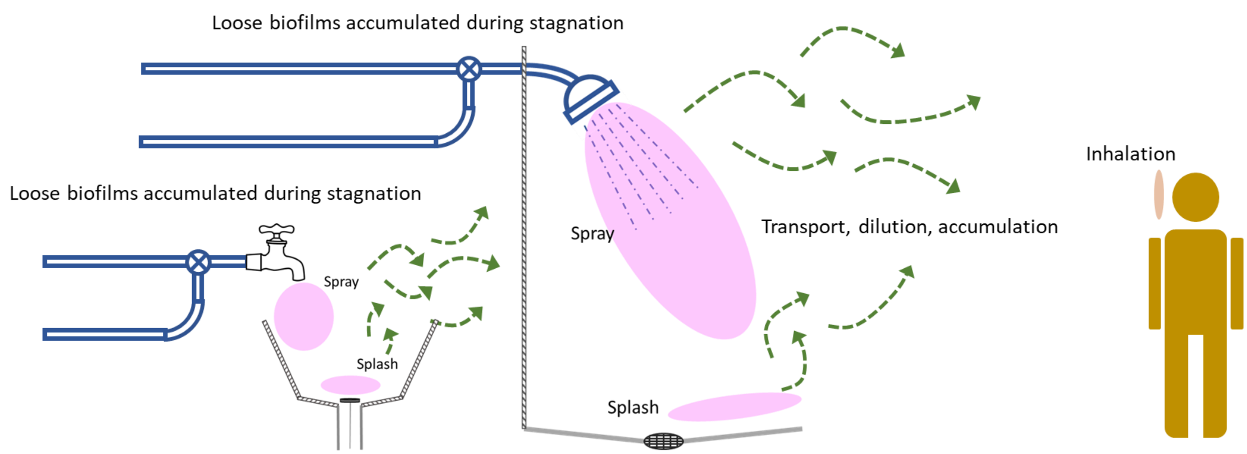

Figure 1. Legionella exposure route

Drinking water treatment and distribution uses a "multiple barrier" approach for risk reduction. The multiple barriers approach entails understanding the chain of events required (exposure route) for a pathogen such as *Legionella* to reach a person using the water, then adding barriers to the pathogen at multiple key parts of the exposure route. An ideal way to interfere with the chain of events that could lead to infection during flushing of building water systems is to reduce the production of small water droplets.

There are currently no reliable estimates of whether risks are greater after water has been stagnant in some buildings for a long time, compared with under normal conditions. While researchers get a better idea of the risk to staff who flush buildings and approaches for mitigating risk, we would like to share a suggestion based on a simple design we used in water heater experiments conducted in an ESPRI lab. The concept is straightforward, and the apparatus can be made using materials widely available to staff who operate and maintain building water systems. If you are concerned about risk, we hope you will take advantage of all the practical means for reducing risk and wanted to let you know about an option you might not have thought of to minimize aerosols.

In ESPRI's lab, we studied the microorganisms that were able to grow in experimental systems including water heaters and showers. We devised a system for collecting shower sprays and directing them to drains when we were not sampling the sprays. Although we did not devise or test the system specifically for aerosol elimination, it reduced aerosols in the vicinity of the test apparatuses. A much simpler arrangement – a shower curtain that tightly hugs the shower head and provides a no-splash discharge – could provide an extra barrier to exposure during flushing.

Two versions were devised using materials available in an ESPRI researcher's residence. The first is shown in Figure 2 on the following page. A tarp was cut to 4 ft × 8 ft, eyelets were punched into the top for a draw string, and Velcro squares were affixed roughly each 2 ft along the height of the curtain. When secured around the shower head and shower hose, the curtain captured the spray and discharged into the bottom of the tub with no splash. An even simpler version (Figure 3, on the following page) was devised using an 8 ft section of 4 ft wide plastic and secured to the shower head with a cable tie. Installing the simpler version such that it fully eliminated spray was slightly more difficult than the more complex version. Similar spray capture for sinks is easy to envision and is shown schematically in Figure 4. Many other devices for capturing sprays can be conceived and used. ***All versions must be designed and installed such that they cannot backflow into the building water distribution system, e.g. air gap.*** Directly connecting a hose to a tap and running the hose to a drain poses a back-siphoning risk and must be avoided. Both versions of spray catchers shown in this memo are no more difficult to maintain than a shower curtain. We recommend wiping the plastic curtain down with a dry towel or a squeegee after using rather than shaking it. Wiping rather than shaking reduces the chances that water on the surface becomes breathable droplets.

We note that in a peer-reviewed study, researchers reported that *Legionella* bacteria were detected in the path through which steam exited from shower stalls, but not when the sampling device was placed in the room only a short distance (3 ft) from the shower. The simple designs shown in this note are likely to promote more complete capture of aerosols than was observed in the peer-reviewed study because they block the flow of aerosols in updrafts of heated air, they completely envelop the spray and they prevent splash.

Figure 4

Figure 2. Spray catcher, first version

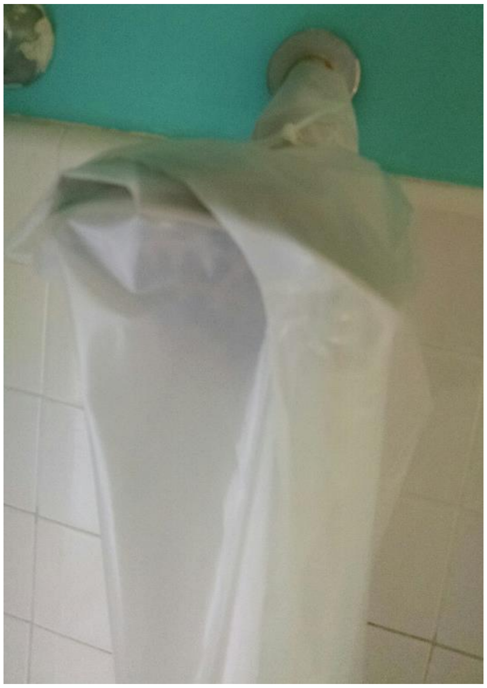

Figure 3. Simpler version of a spray catcher

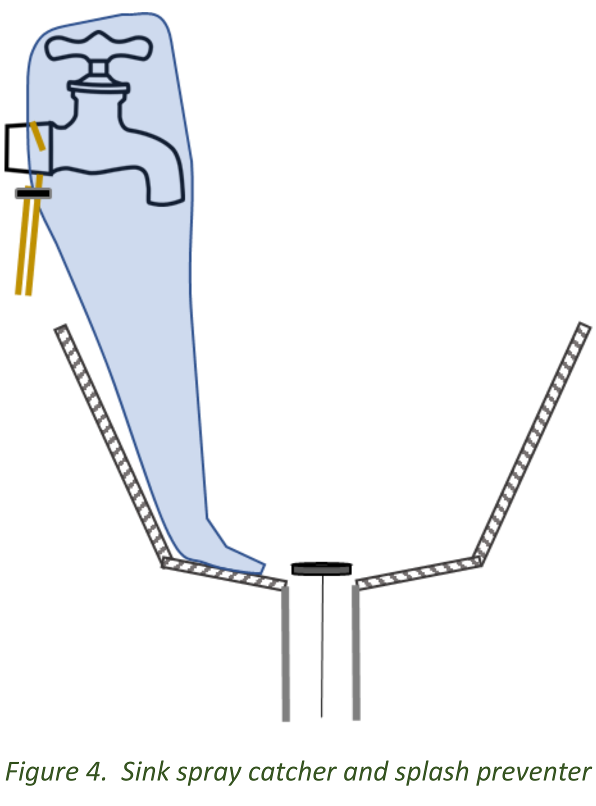

Figure 4. Sink spray catcher and splash preventer