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Tap Water Avoidance Decreases Rates of Hospital-onset Pulmonary Nontuberculous Mycobacteria: A Call for Water Management in Healthcare

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Nontuberculous mycobacteria (NTMs) are among species that considered to be opportunistic pathogens of premise plumbing (OPPP) [1, 2]. In healthcare settings, direct and indirect tap water exposures have been associated with outbreaks of healthcare-associated infections and even deaths [3–9]. Therefore, water management programs are an essential part of both facility management and infection control programs [2].

In this issue, Baker et al. present an intervention to evaluate the impact of a tap water avoidance protocol on the incidence of NTM colonization and infection [10]. Previously, they identified a common source outbreak of *Mycobacterium abscessus* that was present in their premise plumbing system and in water being used by patients [4]. The intervention was implemented during the last 6 months of the previously described outbreak [4]. The intervention consisted of patients in three intensive care units (ICUs) and one intermediate care unit being placed on strict tap water avoidance where commercially obtained, sterile water for irrigation was used for drinking and all routine patient care activities, bathing was performed using either a waterless product or with sterile water [10].

An important facet of both this intervention study and the previous outbreak report is the description of cases [4,10]. While the population effected was at risk of developing severe infections due to *M. abscesssus,* cases were defined on the basis of a first-time positive culture meeting additional conditions (i.e., cultures obtained during first 48 hrs of admission or from the outpatient clinic were excluded unless they were previously hospitalized at their hospital within 30 days of culture collection) [4]. *M. abscessus* colonization occurred in more than 50 patients, including more than 30 lung transplant patients; 24% of the lung transplant patients who were identified as cases died within 60 days of their first positive culture. The intervention of avoiding tap water use for these patients significantly reduced

*The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention colonization with nontuberculous mycobacteria on the high-risk units from 41.0 to 9.9 episodes per 10,000 patient-days [10]. This is just one of any interventions available that can be implemented in response to the potential transmissions of OPPP from building water systems.

This outbreak is another example that highlights the importance of having a water management program in place. The two major objectiveness of a water management program include operating the building water system to prevent hazardous conditions from occurring and preventing OPPP found in building water systems from infecting patients. The degree of intensity in pursuing these two objectives should be stratified across the facility based upon locations of patients who are at greatest risk.

In the facilities-based approach, the building water system is textually described and drawn out with flow diagrams. On the flow diagrams, areas where microbial growth are identified along with locations where control measures can be applied and monitored. The program management team should determine what interventions should be taken when control limits are not met; these are also included in the plan. The program team monitors data to make sure that the program is running as designed and is effective by documenting impact. This process becomes part of continuous maintenance and quality review [11]. The infection control component is important because presence of a pathogen in the environment alone does not necessarily constitute a transmission risk [12]. A water infection control risk assessment (wICRA) should also be included as a component of the water management program that considers patient characteristics and potential water exposures.

Patient exposure to potable water and the microbiota present in that water can occur through any number of ways. The exposure pathways not only include the water for drinking, oral care, and bathing (contact and inhalation of droplets and mists) but may also include splash contamination of medications (including intravenous medications) and clean supplies, contamination of medical devices and equipment [5–9,13–15].

In order minimize risk to patients, well-developed water management plans should be in place that also includes wICRAs. This is why Center for Medicare and Medicaid Services (CMS) requires all hospitals, critical access hospitals, and long-term care facilities to have water management programs in place [11]. Managing water building water systems will involve monitoring different water quality parameters and include programs in place to mitigate stagnation. The water management team should consider developing relationships with the local drinking water provider. Risk reduction measures for some patient populations may need to include a variety of approaches including tap water avoidance [10], removal of sinks from ICUs [16–18], installation of point of use filters [5], or point of entry treatment [9]. Hospitals that choose to add supplemental disinfection to their premise plumbing systems may be subject to their drinking water regulation depending on local, regional or national drinking water regulatory program.

Whether to monitor for microbes is a difficult decision because the presence of microbes does not in and of itself equal to risk and the number of potential pathogens is not small [2]. In addition, drinking water standards are principally targeted to identify enteric pathogens and microbial indicators of potential fecal contamination. Most of the bacterial members OPPP, with some exceptions, emanate from biofilms in the plumbing system and are normal microbiota of soil and water; many of these microorganisms can be detected on a standard heterotrophic plate count (HPC). Monitoring HPC, disinfectant residual, temperature, may be some of the parameters that one selects to monitor. In the United States, drinking water plant and distribution system operators use the heterotrophic plate count (<500 CFU/mL) as a treatment process indicator and it is not a regulatory standard, nor is it associated with health effects [19,20].

Currently, there are no consensus standards for water quality at point of use for healthcare, either minimum standards or standards for special high-risk populations [21]. However, there are published guidelines and standards around a single pathogen, *Legionella pneumophila* [11,22,23]. Another indicator of general water quality to consider is a colony count of ≤500 CFU/mL. Statistical process control analysis of these indicators can be as important as monitoring their absolute value, with out-of-control results prompting reassessment of the building water system and possible interventions. Clinical surveillance is another important component of a water management program. One may see trends in infections or positive clinical cultures with organisms that suggest a problem with water within the facility or with a product being used in the facility that became contaminated following a water exposure elsewhere [24–27]. While the establishment of water management programs in most acute care hospitals in the United States is an important starting point in preventing healthcare infections from water [28,29], it is clear that there is much more work to do requiring the coordinated action of both regulatory and non-regulatory government agencies, professional and patient advocacy organizations, the healthcare industry, and academia.

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