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Rethinking Water Safety:

THE UNDERESTIMATED RISK OF NONTUBERCULOUS MYCOBACTERIA AND THE CRITICAL ROLE OF POINT-OF-USE FILTERS

This white paper was written by PACE Lab, an independent laboratory specializing in the testing of waterborne pathogens and the evaluation of water safety solutions. Our aim is to provide objective, evidence-based insights to support healthcare facilities and other organizations in managing water-related infection risks.

INTRODUCTION

Nontuberculous mycobacteria (NTM) are a significant source of nosocomial infections and among the most common and costly sources of water-associated infections. Despite their prevalence in US drinking water, NTM are often overlooked in water management. This piece highlights the growing recognition of NTM risk and the role of point-of-use (POU) filters in infection control.

THE RISING THREAT OF NTM INFECTIONS

NTM infections are often diagnosed long after exposure due to vague symptoms and the slow-growing nature of mycobacteria [1], [2]. Even after NTM infection is suspected, identification can take 6–8 weeks, and faster-growing organisms can obscure detection unless selective media or decontamination steps are used [2]. Because NTM infection is not universally reportable [3], [4], [5], proactive surveillance measures for potable water systems are not required by regulations, leaving the decision to monitor NTM up to the building owners.

Despite underreporting and detection challenges, global NTM disease rates have steadily increased in recent decades [3], [5], [6], [7], [8]. In the United States, a 2017 study found a rise in antibodies against NTM, suggesting widespread exposure to NTM [9]. This is consistent with an EPA study showing U.S. prevalence increased from 8.7 to 13.9 per 100,000 between 2008 and 2013 [5]. Pulmonary infection is the most common form of NTM disease, with water as the dominant source of infection [3]. Individuals at highest risk of pulmonary

NTM disease are those >65 yrs old in age, women and individuals with comorbidities such as cystic fibrosis [6], [7], [10].

A 2020 Danish study found higher prevalence in older adults was due not only to increased incidence but also to prolonged symptomatic periods [10]. Treatment is lengthy—averaging 12–18 months with 3–4 antimycobacterial drugs—and often aimed at control rather than cure [1], [2]. Individuals with detectable NTM in their sputum after 6 months of treatment have lower chances of being cured of infection [11]

NTM Disease Burden: Percent Change in US Longitudinal Studies
Grouped by Region and Citation



and reinfection is common. Up to 50% of patients with *Mycobacterium avium* complex experience relapse. Others never achieve remission and may develop chronic infection or die [1].

This rise in prevalence and the associated long treatment timelines are an increasing burden on healthcare systems. A 2021 CDC study found NTM had the highest hospitalization and mortality rates among waterborne diseases — including *Legionella* — and the highest associated healthcare costs, totaling \$1.53 billion annually [12]. Hospitalization periods associated with initial diagnosis or before-death care have the highest cost among medical encounters across a patient's NTM infection timeline [13]. Of all the costs associated with NTM disease care, medications contribute 76% of the cost, and individuals greater than 65 years of age, one of the groups at greatest risk of infection by NTM, incur twice the cost per medical encounter compared to those under 65 years of age [4].

NTM IN DRINKING WATER

Given these outcomes, it is essential to prevent nosocomial NTM infections. Most exposures stem from potable water systems. NTM enter through source water and survive disinfection in small numbers [14]. In premise plumbing, they thrive due to low competition, resistance to disinfectants, and their ability to form stable biofilms. These biofilms are complex layers of microorganisms that adhere to pipe surfaces and create a protective environment, shielding NTM from disinfectants and enabling long-term colonization of water systems. NTM's waxy, hydrophobic surfaces further support biofilm formation [14]. Warm, suboptimal water temperatures in recirculating systems or tanks further promote growth. Faucet aerators

and showerheads offer biofilm surfaces and enable droplet transmission, during which NTM readily aerosolize. Risk is higher with municipal water, and NTM have been found with 'ubiquity' in showerhead biofilms [15] — highlighting daily exposure for vulnerable individuals.

POINT-OF-USE (POU) FILTRATION AS A SOLUTION

POU filters are increasingly seen as a critical component of infection risk management for patient safety [16]. These filters use membranes small enough to physically block bacteria, removing them from water reaching patients. Because most fail by clogging rather than bacterial breakthrough, they offer a uniquely fail-secure method of protection against a broad range of pathogens, including NTM.

Secondary disinfection systems, which add low doses of disinfectants like chlorine or monochloramine, also help reduce pathogen occurrence. However, they must be paired with robust water management practices and often fail to fully eliminate opportunistic pathogens, making sporadic detections expected [17], [18], [19]. No single disinfectant works well against all pathogens; for instance, monochloramine is effective against *Legionella* but less so NTM [20]. It is proposed to even promote NTM growth, with its disinfection byproducts acting as nutrients for NTM [21] or by selecting for the more resistant species [22]. Therefore, comprehensive risk control requires integration of disinfection, flushing, water management, and POU filtration. Here, POU filtration serves as the final barrier at the point of use, ensuring protection precisely where patients are most vulnerable.

Choosing the right POU filter is essential. For example, carbon filters

may actually serve as a reservoir for NTM [23].

For pathogen control, use filters with an absolute pore size of 0.22 µm or smaller and relevant certifications (e.g., FDA 510(k), ASTM F-838, ASSE 2011-2022) to ensure bacterial retention. POU filters offer the highest level of protection where installed, making them ideal for areas with highly vulnerable patients, including:

- Solid organ and bone marrow transplant units
- Hematology-oncology units
- ICUs and NICUs
- Burn units

For protection in these areas, POU filters should be installed at all outlets where patients would be exposed to water or aerosols.

KEY POINTS AND CONCLUSION

1. NTM are an underappreciated source of hospital-acquired infections.
2. NTM, like *Legionella*, are both common in drinking water and a major source of water-associated infections.
3. No secondary disinfectant is practically effective for all waterborne pathogens. Thus, they work best in tandem with other control measures.
4. POU filters are a critical tool in waterborne pathogen risk mitigation, as they provide the highest barrier to infection for the most immunocompromised patients.
5. Healthcare facilities should consider how POU filters can work in tandem with other control measures to provide necessary infection prevention.

Table 1: Hospitalizations and Direct Healthcare Costs Associated with Waterborne Diseases in the U.S.

Disease or syndrome	Domestic waterborne hospitalizations	Direct healthcare cost, millions [12]
Legionnaires' disease	10,800	\$402
<i>Pseudomonas pneumonia</i>	15,500	\$453
NTM Infections	51,400	\$1,530

→ NTM: The Costliest Waterborne Threat

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About PACE

PACE (Pace® Analytical Services) is a leading provider of environmental and water safety services, including water management planning, risk assessments, and laboratory analysis for waterborne pathogens such as Legionella and nontuberculous mycobacteria. PACE supports healthcare and other organizations in developing and implementing water safety and management plans, ensuring compliance with industry standards and regulations, and providing expertise in infection control risk assessment and emergency response.

About AQUATOOLS

AQUATOOLS is a manufacturer and supplier specializing in advanced point-of-use (POU) water filtration solutions, including medical-grade filters designed to control waterborne pathogens in healthcare and other high-risk environments. AQUATOOLS products are used globally to reduce the risk of healthcare associated infections by providing a final barrier against bacteria, including nontuberculous mycobacteria, at the point-of-use.