ANNALS OF CLINICAL AND ANALYTICAL MEDICINE

INFECTION CONTROL OF BACTERIA IN HOSPITAL DRINKING WATER

Shuwayl Mahdi Almuhamidh[1*], Mohammed Ali M Al Mutlaq[2], Mohammad Mani H Alsagoor[3], Mohammed Hussien Ali Binhamim[4], Hezam Saleh Mana Alzamanan[5], Abdullah Hamad Ali Alsuliman[6], Saleh Mana Saleh Almorshed[7], Amer Mohammed Al Aba Latihy[8]

Abstract

Introduction: Cooling towers were originally believed to be the main source of Legionella bacteria, as the US Centers for Disease Control (CDC) found that a cooling tower near a hospital with cases of Legionnaires' disease was contaminated with the bacteria. However, since this discovery, there have been few reported cases of hospital-acquired Legionnaires' disease linked to cooling towers. This review aimed to explore the interventions to control infections transmitted through drinking water in hospitals.

Methods: The review searched for published peer-reviewed literature in English from 2000 to 2022 in the Medline Embase, Aqualine, and National Guidelines Clearing House databases. The review focused on critical care units, such as neonatal, pediatric, adult intensive care, burns, organ transplant, oncology, hematology, cystic fibrosis, and renal units. The review included experimental and epidemiological study designs such as non-clinical experiments, randomized controlled trials, non- randomized controlled trials, quasi-experimental studies, before-and-after studies, prospective and retrospective cohort studies, case-control studies, and analytical cross-sectional studies.

Results: Out of 196 potentially relevant studies identified in the search, 21 were assessed for this review. Of these, 11 provided plausible evidence, while the remaining 10 provided descriptive evidence of low plausibility. The majority of the studies focused on understanding the occurrence of Pseudomonas aeruginosa outbreaks in critical care units. Most of these studies were retrospective analyses of outbreaks or short-term prospective follow-up studies in intensive care or hematology-oncology units. Only two of the studies included comparison groups.

Conclusions: the research suggests that the water and plumbing systems in healthcare units can be a source of Pseudomonas aeruginosa and legionella, a bacteria that can cause colonization or infection in patients. This is especially likely if the bacteria is able to form biofilms, which may be facilitated by certain types of plumbing materials and locations.

Keywords: Infection, Prevention, Drinking water, Bacteria, Legionella.

[1*]Health Informatics.
[2]nursing
[3]dental Technology
[4]x-Ray Technician
[5]pharmcist
[6]pharmacy Technician
[7]dental Assistant Technician
[8]emergency Medicine

***Corresponding Author:** Shuwayl Mahdi Almuhamidh[1]
*Health Informatics.

DOI: 10.53555/ecb/2023.12.5.536

Introduction

Several investigations into outbreaks have found that environmental contamination in healthcare settings, such as ICUs and endoscopy suites, can be a significant source of antibiotic-resistant and antibiotic- susceptible P. aeruginosa infections. During these investigations, certain environmental surfaces were identified as sources of antibiotic-resistant P. aeruginosa, including tap water, sinks, plumbing systems, shower drains, faucets, wash basins, bronchoscopes, and automated endoscope preprocessors [1,2].

In the early 1980s, Tobin and Stout found a connection between the presence of Legionella pneumophila in hospital drinking water and hospital-acquired legionellosis. The first published study on disinfecting hospital drinking water using the "superheat-and- flush" method was conducted in 1983. In 1990, the first comprehensive review of disinfection methods was published, but it did not recommend a specific methodology as the best option. At that time, the drawbacks of hyperchlorination and ultraviolet light had become apparent, and copper-silver ionization was being tested as a new technology. Copper and silver have been shown to be bactericidal against Legionella and other waterborne pathogens, including Pseudomonas aeruginosa, Stenotrophomonas maltophilia, Acinetobacter baumannii, and mycobacteria [3]. Copper-silver ionization is the only disinfection method for which multiple field evaluations of effectiveness have been published in the peer-reviewed literature, and its effectiveness in eradicating Legionella has been documented in hospitals worldwide [4].

More than 300 hospitals worldwide have adopted ionization as the primary method for controlling Legionella in their water systems. The ions are typically only added to the hot water recirculation lines, so oral consumption is limited [4,5]. However, some hospitals have reported failures with ionization systems, such as in Germany and France, where a phosphate compound was added to the water system to control corrosion, which may have hindered mainly effectiveness of the ionization. There have also been a few documented cases of Legionella pneumophila developing resistance to copper-silver ions in hospitals several years after installing ionization systems, though the prevalence of this resistance is unknown. Many vendors now offer ionization systems. Chlorine dioxide has been used for water treatment in Europe since the 1940s and has also been installed in some hospitals in the United States for Legionella disinfection [6]. Chlorine dioxide is a gas in solution that is typically generated on site at the facility using chemical precursors or electrochemical generation.

A limited number of controlled studies have been conducted on the effectiveness of chlorine dioxide disinfection, such as a 30-month study in a New York hospital and the implementation of chlorine dioxide disinfection in a hospital in the UK where hospital- acquired Legionnaires' disease had occurred due to repeated failures with hyperchlorination. Additionally, cases of Legionnaires' disease caused by L. anisa are very rare [7]. Third, reactions with organic material and corrosion scale in pipes can cause the rapid conversion of chlorine dioxide to its byproducts, chlorite and chlorate, which may be harmful to consumers. Fourth, the corrosion of galvanized pipes can lead to the loss of chlorine dioxide due to its reaction with magnetite (Fe_3O_4), which may affect its effectiveness. One major challenge with using chlorine dioxide is maintaining an effective residual concentration (0.3-0.5 mg/L) throughout the drinking water system. Chlorite can cause congenital heart defects and hemolytic anemia, while chlorate is not currently regulated due to a lack of health data for setting a maximum contaminant level. The UK Drinking Water Inspectorate specifies a maximum value of 0.5 mg/L for all oxidants in drinking water, which includes the combined concentration of chlorine dioxide, chlorite, and chlorate [8]. In 2004, the US Environmental Protection Agency (EPA) mandated that any healthcare facility that adds a disinfectant to a water system serving at least 25 people is considered a public water system and must comply with the Safe Drinking Water Act and Stage in