CHAPTER 2
DISINFECTION TECHNOLOGIES

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2.1 INTRODUCTION

Among hospitalised patients, healthcare-associated infections (HAI) are a significant contributor to morbidity and mortality. Recent studies indicate that environmental contamination is a significant factor in the nosocomial transmission of mycobacteria, fungi, viruses, and multidrug-resistant organisms (MDRO). Numerous nosocomial pathogens have been demonstrated to linger in the environment for a considerable amount of time, including *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Clostridium difficile*, *Methicillin-resistant Staphylococcus aureus* (MRSA), and *Vancomycin-resistant Enterococci* (VRE) (Sheikh et al., 2024).

The current epidemiology of common HAI linked to environmental contamination will be reviewed in this chapter, along with a discussion of the most recent developments in UV technologies employed to address surface contamination, which may act as potential reservoirs for common nosocomial pathogens linked to HAI.

2.2 ENVIRONMENTAL CONTAMINATION

The environment of care comprises three key elements: The facility or area where patient care is provided, the people involved (including staff,

patients, and visitors), and the equipment used to support patient care or ensure safe facility operations. The patient environment refers to the immediate surroundings a healthcare worker (HCW) may contact while delivering care (MohammadiGorji et al., 2021). In acute care settings, this includes the space within the patient enclosure, which houses personal belongings, medical devices, phones, and restroom facilities.

Microorganisms shed by patients can persist in the air, water, and on surfaces, often surviving for extended periods in the hospital environment. The concentration and types of microbes present are influenced by multiple factors, including the number of people in the area, their activity levels, humidity, the presence of materials that promote microbial growth, air circulation efficiency, and the type and orientation of surfaces (horizontal or vertical). In dry conditions, gram-positive (GP) bacteria tend to survive on dust and dry surfaces, whereas gram-negative (GN) organisms flourish in moist, contaminated settings. Fungi, though capable of surviving dust, preferentially colonise damp, fibrous materials.

Renovation, repair, and remediation activities, such as swapping out outdated sinks for new ones, fixing lift shafts, and installing wiring for new information systems, disturb the surrounding environment and put vulnerable patients in danger of surface, water, and airborne microbe contamination. Natural disasters, ageing equipment, and neglected maintenance are other ways that environmental infections can enter high-risk patient settings.

Further research has identified numerous high-touch surfaces (Table 2.1), including bed rails, bedside tables, faucets, and doorknobs in hospital wards, as common reservoirs for pathogens that facilitate infection transmission. Notably, studies have also linked microbial spread to low-touch surfaces such as oxygen humidifiers, medical staff laptops, and radiologists lead jackets, which points to the infection risks faced by healthcare workers. Additionally, investigations have revealed the remarkable environmental persistence of *Acinetobacter baumannii*, a bacterium exhibiting greater resistance to desiccation than *Escherichia coli*. This pathogen can survive on dry surfaces for over four months and remains viable on glass for more than 20 days at room temperature.

Table 2.1 Represents the most encountered bacterium and associated surfaces

Bacteria	Surface
Escherichia coli	High-touch surface, Low-touch surface
Staphylococcus aureus *Klebsiella pneumoniae*	Infusion stands, Patient beds
Acinetobacter baumannii RNA viruses *Staphylococcus aureus* *Escherichia coli*	Mobile phones
Pseudomonas aeruginosa *Enterobacter cloacae* *Klebsiella pneumoniae*	High-touch surface, Cross contamination
Methicillin-resistant Staphylococcus aureus *Vancomycin-resistant Enterococci*	Mobile equipment in acute care, Intensive care, Transplant units
Klebsiella pneumoniae *Acinetobacter baumannii* *Staphylococcus aureus* *Enterococcus faecium*	Antibacterial cotton textile
Escherichia coli *Staphylococcus aureus*	Medical devices
Specie of *Bacillus* *Staphylococcus aureus*	Mobile phones, Computer keyboards

This demonstrates *Acinetobacter baumannii* resilience and capacity to endure longer on inanimate surfaces. Healthcare facilities have been found to have multiple high-touch surfaces and gadgets that harbour *Clostridium difficile*, a type of bacteria known to cause healthcare-associated infections. Furthermore, various microorganisms can spread through the superficial skin of medical personnel, phones, laptops, doorknobs, and medical equipment like electronic rectal thermometers and finger probes for pulse oximeters, as well as chairs, carts, mop pads, portable bedding, and taps. It has also been observed that high-risk situations for contamination include critical care and newborn facilities. Studies conducted over the past 20 years indicate that *Candida parapsilosis* is to blame for this contamination. *Candida*