

Diligence in Environmental Infection Prevention

is Important to Maintaining the Quality of Laundered Healthcare Textiles Prior to Use



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Maintaining both the quality and cleanliness of processed healthcare textiles (HCTs) prior to their use is a shared responsibility. It calls for a collaborative effort between laundry operators and the healthcare professionals in the recipient healthcare facilities. This maintenance phase is the last part of the overall laundry process of preparing reusable fabric items for use in the next clinical setting, and infection prevention is central to its success. Thus, it is useful to understand how efficiently contemporary laundry procedures reduce contamination; a perspective on the outbreaks that have been attributed to laundered HCTs; and an awareness of when and where, and how HCTs can become contaminated prior to use.

Microbial Inactivation/Removal Properties of the Laundry Phase

A review article published in 2015 summarized the published evidence supporting the notion that contemporary laundering procedures excel at both soil/organic matter removal and microbial contamination removal and inactivation.¹ According to the Centers for Disease Control and Prevention (CDC) “hygienically clean laundry carries negligible risk to healthcare personnel and patients, provided that the clean textiles are not inadvertently contaminated before use.”² The laundry process is primarily a soil removal process, but the combination of detergent use, agitation of the textiles during the wash, duration of the wash, use of laundry additives with antimicrobial properties, rinsing, and hot air drying together can achieve significant microbial reductions (i.e., >

8 log10).³ Antimicrobial chemicals for laundry use include but are not limited to quaternary ammonium compounds, chlorine compounds, hydrogen peroxide and other oxygenated formulations (some of which include peracetic acid), and ozone producing systems.¹ Many of these chemicals are registered by the Environmental Protection Agency (EPA) as either laundry sanitizers or laundry disinfectants, and many are designed specifically for use with cooler wash water temperatures.⁴

Infectious Disease Epidemiology and Laundered HCTs

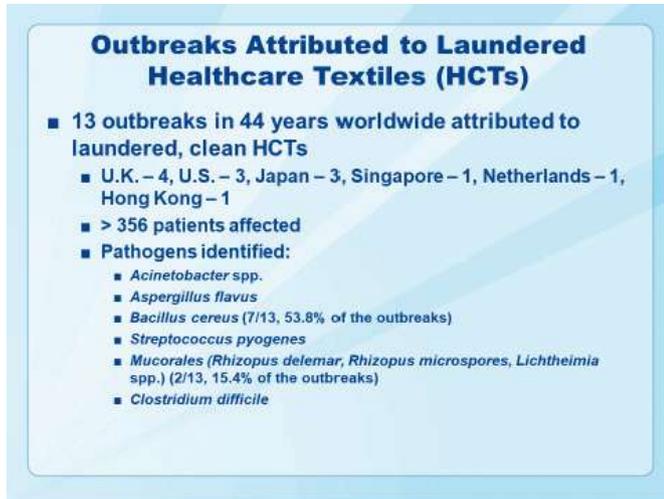
Laundered HCTs are hygienically clean but they are not sterile (the exception being surgical textiles which are sterilized prior to use), and they will accumulate microorganisms from patients, the environment, and anything that touches them while they are in use.⁵ Nevertheless, four decades of experience using laundered, reusable HCTs strongly supports the notion that current industrial laundry processes are effective in interrupting potential patient-to-patient transmission of infectious diseases.¹ The significance of this assessment increases when one notes the annual volume of laundered HCTs produced for U.S. hospitals is estimated to be 4.34 billion pounds; this volume of clean HCTs increases potentially by several billion pounds when the clean HCT demands of non-hospital venues are taken into account.^{1, 6-7}

Immunocompetent patients in general are not adversely affected from contact with hygienically clean, reusable HCTs despite anticipated accumulation of microbes from various sources (e.g., patient skin squames, microbial transfer from hands and other surfaces, microbes settling out from the air).



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A literature search, however, identified 13 outbreaks around the world attributed to laundered HCTs that were ultimately determined to be contaminated prior to use.¹ Box 1 summarizes the main points describing these outbreaks; the earliest of these events was in the late 1970s and the latest outbreak occurred in Hong Kong in 2015.^{1,8}



Adapted from Table 4 in reference 1 and updated

Of these 13 outbreaks, seven occurred in the period 2004 – 2015 (53.8 percent). Five of these outbreaks were clusters of *Bacillus cereus* bloodstream infections (5/7, 71.4 percent) and two outbreaks involved invasive systemic infections due to fungi of the family *Mucoraceae* (2/7, 28.6 percent). The fact that more than half of the reported disease outbreaks attributed to laundered HCTs have occurred in the most recent 12 years in a more than 40-year period begs the question, what has changed in healthcare delivery in recent years? Four things come to mind: 1) significant advances in medical technology and treatment options are now available to treat diseases and conditions deemed incurable or untreatable only a decade or so ago; 2) the proportion of hospitalized patients with either severely compromised immune systems or medical conditions necessitating very lengthy hospital stays has steadily increased; 3) many of these severely immunocompromised patients require care in a protective environment; and 4) routine care for immunocompetent patients continues to move from acute-care hospitals to other healthcare venues (e.g., ambulatory care centers).² In short, more hospitalized patients are at increased risk of acquiring a healthcare-associated opportunistic infection, including infections due to exposure to environmental pathogens.

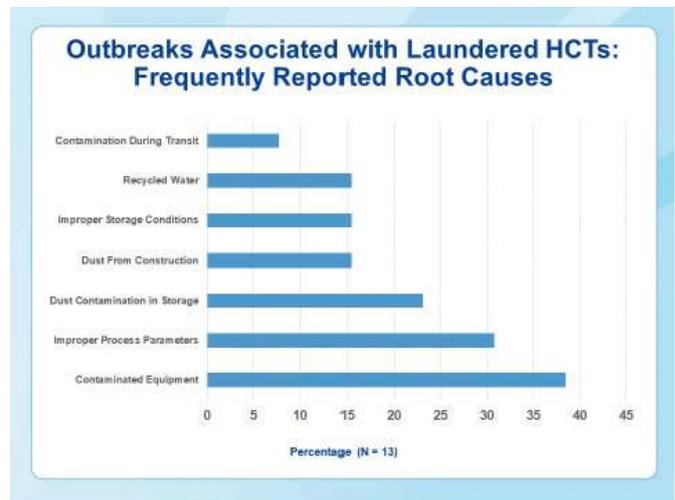
The outbreak of infection due to *Rhizopus delemar*, an environmental fungus that was linked to contaminated HCTs in a New Orleans children’s hospital in 2009 provides insight into the epidemiology of this infection and the risk factors at work here.⁹ Five case-patients with different clinical conditions in three different critical care areas of the hospital were identified, each with an extended length of stay. All five patients died. An epidemiologic investigation to identify possible exposure risk factors found HCTs as the only item in common with the care for these patients. Applying the chain of infection to the analysis of the outbreak information provides some clarity. In its original presentation, the five links in the chain are: 1) presence of a pathogen; 2) an infectious dose of that pathogen; 3) a mode of transmission; 4) a susceptible host; and 5) a portal of entry.¹⁰

“Laundry A” provided laundered HCTs to all departments in this hospital, but only five patients were clinically susceptible to this opportunistic pathogen and became infected. All the other patients in the hospital during this period were presumably immunocompetent

to prevent this pathogen from initiating infection. A medical chart review revealed that all five patients had significant clinical risk factors (i.e., immunocompromised, acidosis, hyperglycemic) for opportunistic *Rhizopus* infection.^{9, 11} All of the case patients developed cutaneous lesions on their skin at some location (e.g., face, neck, upper back, etc.), which suggests the mode of transmission was cutaneous via direct contact and the lesions became the portal of entry. In this outbreak, each of the case-patients had extensive exposure to laundered HCTs that were inadvertently contaminated with *R. delemar*.⁹ In the investigation of this outbreak, *R. delemar* was isolated from laundered HCTs, hospital areas where the HCTs were stored, and in clean HCTs and clean linen delivery carts at Laundry A.⁹ Sterilization of HCTs used by at-risk patients helped to stop this outbreak.

Inadvertent Environmental Contamination Compromises HCT Quality and Cleanliness

Referring back to Box 1, the majority of pathogens implicated in the outbreak investigations of infections associated with laundered HCTs are environmental microbes that are present in both indoor and outdoor environments. In each of the investigations efforts were made to identify the root cause leading to the inadvertent environmental contamination of the HCTs. A summary of these root causes is presented in Box 2.



Compiled from Table 4 in reference 1

Three of these root causes are associated with laundry equipment maintenance and operation issues, which suggests that routine facility and equipment maintenance and process inspection should be priorities. Improper wash process parameter settings can affect all aspects of the wash cycle and reduce the overall level of microbial inactivation of the wash process. Three other root causes are related to improper HCT storage settings and control of dust from construction or other sources. It is well known that dust can serve as a carrier of organic matter contamination, bacteria, and fungal spores. Dust and lint control measures such as regular blow-downs and keeping a regular surface cleaning schedule are necessary to minimize the deposition of dust on clean HCTs as they move toward the packaging/bundling stage of the overall process. Once these packages/bundles are in either a holding stage or in storage, the storage units and/or carts should be designed to minimize any additional contact with dust. Strategies to help with dust control in the healthcare facility storage rooms include: 1) regular cleaning and disinfection of surfaces; 2) setting the area’s ventilation at positive pressure relative to adjoining spaces; 3) installing self-closing doors; and 4) storage rooms should not be near the loading dock. Additionally, HCT storage rooms should not be designed as pass-through areas,