Material Incompatibility – Disinfectants for Environmental Surfaces in Healthcare

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Improving patient safety is one of the five strategic objectives of the WHO Global Action Plan for tackling Antimicrobial Resistance. Reducing microbial burden from clinical surfaces is fundamental and should be considered collaboratively with any infection prevention efforts.

Healthcare providers are increasingly under pressure to improve efficiency, resilience to seasonal challenges and reduce antibiotic prescriptions. To cope with this challenge, healthcare facilities are cleaning medical equipment and healthcare environment surfaces more frequently and with more powerful disinfectants than ever before. This often led to surface damage and inefficient decontamination, leading to further spread of Healthcare Associated Infections (HCAIs). Consequently, hygiene product manufacturers are also under continuous pressure to develop innovative disinfectant that kills most pathogens but gentle on everything else!

The importance of healthcare disinfectants and the material compatibility of healthcare equipment and environmental surfaces will continue to be an issue if both manufacturers don't partner more closely. A sustainable integrated approach to infection prevention and hygiene management, that takes into account all participating factors, need to be developed collaboratively among all parties involved.

The role of healthcare equipment and environmental surfaces on transmission of HCAIs

In May 2015, the World Health Organisation (WHO) developed a Global Action Plan to tackle the Antimicrobial Resistance crisis with five strategic objectives, one of which is to reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures.

Ineffective sanitisation leads to increased incidence of HCAIs (Klevens *et al*, 2007). Various factors contribute to HCAIs among patients, including antibiotic therapy (Aldeyab *et al*, 2012), inadequate hand hygiene by healthcare workers (Pitet *et al*, 2003), venous or urinary catheter use and length of hospital stay (Swaminathan *et al*, 2013). Environmental surface contamination in the health care setting is one of the major contributing factors in the transfer of infectious agents that contributes to HACIs in patients, and these same agents may cause infections in health care workers (Morgan *et al*, 2012). Pathogens transmitted to environmental surfaces via the hands of patients or healthcare workers can persist on these surfaces for hours (enveloped virus), days or weeks (vegetative bacteria, fungi) or months (bacterial or fungal spores) if the disinfectant or sanitisation measure is not effective (Weber *et al*, 2013). Environmental surfaces in the room of an infected patient colonised with

methicillin resistant Staphylococcus aureus (MRSA) or vancomycin-resistant enterococci (VRE) can remain contaminated long after it has been vacated if the decontamination procedure is not done properly; this in turn increases the risk of colonising or infecting the next occupant (Shaughnessy *et al*, 2011).

According to NICE in 2014, around 300,000 patients a year in England are estimated to acquire a healthcare-associated infection as a result of care within the NHS (NICE, QS61, 2014), the most common types being respiratory infections (including pneumonia and infections of the lower respiratory tract) (22.8%), urinary tract infections (17.2%) and surgical site infections (15.7%). An updated report of the NICE Clinical Guideline 139 in 2018 estimated that healthcare-associated infections could cost the NHS approximately £1 billion a year, and £56 million of this is estimated to be incurred after patients are discharged from hospital. Each of these infections drain the NHS resources, cause greater patient discomfort and decrease patient safety (Clinical Guidance NICE, CG139 2018).
In Wales, 5.5% of patients in the acute hospital sector had a healthcare-associated infection as per a 2017 survey, up from 4.3% in 2011 and again the most common infections were pneumonia, urinary tract infections, and surgical site infections. A report from the Department of Health stated E.coli infections to be the most common cause of death, killing more than 5,500 NHS patients in 2015 and are estimated to cost the NHS £2.3 billion by 2018 (Commons Library Briefing, 2017).

Deleterious effect of cleaning and disinfectants on healthcare equipment and environmental surfaces

Chemical disinfectants or Biocides are the most common method of decontamination of healthcare environment and medical equipment surfaces. However, these products are not simple cleaning and disinfecting formulations but a complex mixture of chemical ingredients, some of which are associated with adverse human health effects such as dermal and respiratory sensitization or irritation, work-related asthma, chronic bronchitis, sensitization, discolouration and damage to equipment and devices. There is also a growing concern with medical devices made of polymer, such as those used for housings for electrical equipment used in the healthcare environment. It has been reported that cracking can sometimes occur within three to four months of initial use in a healthcare environment (PolyOne, 2014). This issue can lead to several problems for patients, healthcare providers, and medical equipment manufacturers. In severe cases medical equipment can also malfunction, leading to patient injury or even death. Frequent use of cleaners and disinfectants can also lead to equipment damage (Hoffman *et al*, 2013)

Some common reusable medical equipment and devices that are likely to require chemical disinfection include diagnostic and therapeutic equipment such as pumps, feeding pumps, suction pumps, resuscitation equipment, patient monitors, nebulisers etc., patient monitoring devices such as blood pressure monitors and bedside electrocardiogram

monitors; infusion devices such as insulin pumps, infusion pumps, and injection pens; dialysis equipment, defibrillators and handheld devices (eg. barcode scanners).

Plastics are now the most common materials used in our hospitals – especially touch surfaces in clinical settings. More and more manufacturers trend away from the use of metal towards newer, cheaper polymers because they give product designers greater freedom to design complex shapes or consolidate components (PolyOne, 2014). Increased focus on patient safety resulted in higher performance expectations with regards to aesthetics and functionality. Increased portability and constant handling require increased use of aggressive disinfectants by healthcare practitioners. Changes in infection prevention techniques has led to more rigorous cleaning of items including those that were not designed for healthcare use such as light switches, plug sockets and phone handsets, adding to more chances of cracks and damages within a given vicinity.

In 2010, MHRA issued a warning (MDA/2010/001) that detergents and disinfectant wipes used on plastic surfaces of reusable medical devices have significant risk of degrading the surface and that only those recommended by the manufacturers and supplied by employers should be used. A further alert in 2013 (MDA/2013/019) reported similar incidents with regards to detergent and disinfectant wipes that have degraded plastic surfaces of medical devices such as tympanic thermometers, patient monitors, infusion pumps, dialysis fluid filters, peritoneal dialysis transfer sets and infant warmer, and affected their performance and integrity. Consequently, damaged surfaces may compromise the ability to decontaminate medical devices adequately and / or may interfere with device functionality. Finally, equipment discard due to damage or failures generate extra costs and resource time for the hospital and the device manufacturers.

What do we do about it?

Material – Compatibility should be a shared vision between the device manufacturers and disinfectant producers to provide healthcare professionals a product and equipment that is fit for purpose and easy to clean. Cleaning personnel need to be informed about the crucial link they play in the infection chain and be trained to also protect themselves from being infected or being the carrier. There is a need for device manufacturers to design equipment and devices that can withstand several frequencies of disinfection and sanitisation procedures during device design and product development stages. Similarly, disinfectant manufacturers need to have done Material Compatibility test, such as ISO 21530 or ASTM D543, against some of the common materials used on device or environmental surfaces, as part of product development. A ‘one size fits all’ approach does not work with cleaners and disinfectants; those that claim to do several other functions generally tend to have unwanted hazards compared with a simple straightforward formulation that is highly efficient and less corrosive.

Different areas of hospitals and healthcare setting are often classified by the level of infection risk and accordingly the cleaning and disinfecting methods are differentiated to

reflect these requirements. A purposeful evaluation is needed to determine the optimum frequency with which cleaning and disinfecting should be performed with the objective to reduce chemical exposure while not reducing effectiveness of infection prevention. The best cleaning and disinfecting practices for each area in a health care facility need to be identified, in particular, whether nonclinical public spaces are suitable for cleaning only (ie, do not need disinfecting). If disinfection is not necessary in all areas, guidelines specifying cleaning only could reduce the exposure of workers, patients and environmental surfaces to disinfectants. Simple and efficient formulation using 'green' chemicals and newer technologies for cleaning and disinfecting could be an alternative to reduce toxic exposures and may be effective for infection prevention in areas that are low risk.

A sustainable approach to overcome material incompatibility of healthcare equipment and environmental surfaces with healthcare disinfectants would require collaboration of both manufacturers and infection control and hygiene management teams.

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