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How can emerging disinfection technologies gain a foothold in the current culture of hospitals?

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ABSTRACT. In the United States, more than 90% of hospitals still use only the traditional “spray and wipe” disinfection methods initiated over a century ago to protect patients from their environment; international adoption of new methods is even lower. Innovative approaches like whole room disinfection find an inhospitable reception in spite of clearly superior reductions in health care-acquired infections. Much of the resistance is due to a lack of true accountability for patient safety in hospital organizations and to perverse incentive structures in historical reimbursement policies. But all of that may change in the coming years as hospitals and doctors become more responsible for the health outcomes of their patients.

For well over a century, hospitals around the world have fought against the rise of what are now called “health care-acquired infections” (HAIs) caused by a long list of pathogens like Clostridium difficile and Staphylococcus aureus. Patients entered the hospital and quickly became exposed to disease and infections unrelated to their admitting diagnosis. In recent times, the increased resistance of bacteria like MRSA to standard antibiotics has only complicated the fight against HAIs as patients without a history of heavy antibiotic use are infected by bacteria already hardened by mutagenic processes in other patients. Today, many as 1 in 20 – or a total of 1.7 million hospitalized patients annually – will contract an HAI in United States hospitals; of those cases, approximately 5% will die (1). Approximately 300,000 Clostridium difficile infections (CDIs) occur in the United States each year and they are becoming increasingly resistant to standard treatments.

The battle against pathogenic infections has multiple fronts. One focus, instrument and device sterilization, copes with the potential introduction of pathogens into a patient by the application of heat, UV or harsh chemicals to the devices and instruments. All such processes require a very controlled environment in which to act on the instruments and devices. While there have certainly been advances in sterilization technologies, the most common methods – like the use of autoclaves for surgical instruments – have been around since the 10th century.

The second front has been the advances in treatment of patients already infected with the pathogens. The incredible strides made through the development of increasingly sophisticated antibiotics, for instance, saved – and continue to save – countless lives each year in developed and developing countries worldwide. However, as mentioned, the overuse of these miracle drugs and evolutionary processes have created strains of drug-resistant pathogens and, most alarmingly, some can now pass that resistance on to other types of pathogens. The concurrent lack of a viable drug development pipeline for new antibiotics diminishes the health care system’s ability to protect patients from the ravages of infections already contracted. These circumstances elevate the importance of an effective prevention strategy to a higher level than ever before.

The third area, therefore, has been to try to ensure that vulnerable patients are never exposed to the most virulent pathogens found in health care settings. Those efforts can be easily categorized into hand sanitization and environment disinfection. About 150 years ago, studies in Vienna by Dr Ignaz Semmelweis and in Boston by Dr Oliver Wendell Holmes Jr established that hospital-acquired diseases were often transmitted via the hands of doctors and nurses. Since that time, much has been written and done to try to limit the exposure of one patient to pathogens brought into their room by staff coming from another patient’s bedside. Refinements in scrubbing techniques have emerged, as have new chemicals (mainly alcohol-based gels). In spite of the combination of good intentions, excellent training and implementation of staff motivation policies, hospital staff are still far from perfect in their use of this very basic infection reduction technique. In fact, compliance with hand sanitization policies in the United States, for example, remained effectively below 50% for both intensive care unit (ICU) and non-ICU staff in 2009 (3).

In the face of such odds, how do hospitals keep pathogens from being picked up in one location and carried to another? Environment disinfection is one way to minimize the risk. The vast majority of surface disinfection in hospitals over the past two centuries has been attempted by using the process widely known as “spray and wipe”. The notion of disinfecting an entire room was reduced to trying to routinely disinfect the primary surfaces in the room. In recent years, the focus of the disinfection process was even further diminished to what came to be identified as “high-touch surfaces”. In reality, despite attempts to implement a standardization of training and cleaning techniques, the overall thoroughness of cleaning designated high touch surfaces ranges widely. And a study shows no significant correlation between the thoroughness of cleaning high-touch surfaces and the amount of time required to clean the room, with an average time to clean a...
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standard hospital patient room being 30 minutes (4). It seems clear that just doing more cleaning will not reduce HAIs in significant ways.

There are new technologies for whole-room disinfection in use in the United States, but their market penetration remains quite low. The most prevalent – largely because it is unregulated by either the FDA or the EPA (as are all other disinfection technologies) – is the use of ultraviolet light to destroy pathogens. While some manufacturers of UV light dispensing systems claim to kill 99% of bacteria, viruses and spores, it remains very difficult to verify without the rigorous efficacy testing required by the regulatory agencies. It is commonly recognized that to be effective, UV light must encounter a contaminated surface directly to kill pathogens at an effective rate. Should the light be blocked and the surface be in a shadow, a high percentage of the pathogens will survive (8).

Another relatively new and fully regulated technology available to accomplish whole-room disinfection uses hydrogen peroxide-based chemistries. This wholeroom disinfection technique dispenses the H2O2 solution using a machine to form either a Hydrogen Peroxide Vapour (HPV) that is dispersed throughout the environment, touching all surfaces. Disinfection with these methods of application reduces the labour and skill required and is very effective in reducing the number of infectious organisms in a given room (8). These approaches have been proven to have a 6-log kill on pathogens like C. difficile spores, one of the hardest micromonsters to eradicate. While the difference between an assumed 99% kill rate and a proven 99.9999% kill rate might seem small, the former allows 10,000 times more spores to survive than the latter!

One of the first HPV systems was developed by Bioquell and uses a hazardous 35% H2O2 solution dispensed from a large vaporizer that requires significant operator training. Like the system from Steris, use of the Bioquell HPV system is very effective and has been approved as a sterilizing process. Given their expense and the size of the units, both systems are generally recognized as more appropriate for sterilization of pharmaceutical manufacturing environments than for normal health care facilities.

Pennsylvania Hospital, a 496-bed teaching hospital in Philadelphia, Pennsylvania, began using the Halo Disinfection System in 2011 to reduce their hospital-acquired C. difficile rate as demonstrated in Figure 1. This compares favorably to the CDC’s recently reported reduction in C. difficile infection rates of only 2% nationally for the same time period.

The Halo Disinfection System (HDS) from Sanosil International is an H2O2 fogging system that aerosolizes a non-hazardous H2O2 solution (5%) containing a small amount of stabilized ionic silver (0.01%). The HDS application process requires little operator training and is a small fraction of the capital cost of either the UV or HPV systems. Yet it achieves the same 99.9999% kill rate against spores.

Given the proven efficacy of the whole-room disinfection systems and the clear failure of traditional spray and wipe disinfection approaches to significantly lower the rate of HAIs, why are the new technologies not being more rapidly adopted? And in an environment where governments and private insurers are beginning to refuse to pay for preventable errors, a category into which many HAIs will fall, how long will it be before hospitals will change their focus? The prevailing sentiment is that hospitals are simply large, complex organizations that are slow to change habits formed over many decades of reinforcement, including full reimbursement for treating infections contracted while in their care. If medical advances in the United States are thought to take 17 years to spread in the physician community, why expect a different result in a hospital?

One key to understanding the problem is the lack of clear accountability for reducing HAIs in hospitals today. While the infection prevention professionals are passionate defenders of patients, their families and hospital staff, they seldom have control over budgets and resources to truly affect outcomes. The physician Head of Infectious Diseases consults with the Infection Prevention Department, but sees patients and has responsibilities well beyond minimizing HAIs. Housekeeping (called environmental services, or EVS, in the United States) has the responsibility for managing the enormous task of maintaining and cleaning a large, complex facility that operates 24 hours a day. 7 days a week utilizing a workforce with generally very high turnover rates. Typically, no individual is given the charter, the budget and the authority to change the way hospitals deal with the full range of processes to improve the safety of their patients.
Consequently, improvement efforts are often made on a piecemeal basis, with each element of an overall plan subject to being attacked by vested interests with more power and more authority. The Marketing Department introduces new, comfortable upholstered chairs into patient rooms – and the C. difficile infection rate skyrockets. EVS is given a dictum by the CFO to ensure that all rooms are turned around in under 30 minutes, so patients are exposed to potentially deadly pathogens because insufficient time was allotted for disinfection to keep them safe.

There are legitimate challenges to the use of the new technologies, but these challenges can be mitigated by careful planning. The first is capital cost – HPV and UV systems costs between about US$ 60,000 and US$ 120,000 each. As the only EPA-validated fogging system, the Halo Disinfection System costs well under US$ 10,000. And while the cost of spray and wipe room treatment is initially cheaper, the cost of treating unnecessary infections and patient deaths resulting from incomplete disinfection is far more expensive. True – patient room turnaround times are delayed by UV treatment, and indeed extended even further for a complete HPV or fogging intervention. But by focusing on isolation rooms and on rooms where infectious patients have been treated, the average turnaround time for rooms need not increase by much. And is it worth an extra hour to truly protect the staff and the next patient to be in that room? Whole-room disinfection systems and processes consume resources, but they reduce the costs of treating patients with HAIs by a far greater amount. Pennsylvania Hospital, for example, saved about US$ 10 for every US$ 1 they spent on the Halo Disinfection System – and, in 2013, about three patients who might have died of complications from hospital-acquired C. difficile never even caught the disease.

Accountability is key – someone needs to be provided the resources and the authority to be directly accountable for patient safety in hospitals. In too many hospitals, that is simply not the case today.

David St Clair is a successful entrepreneur who has founded or invested in a number of companies seeking to transform services and information technology in the health care market over the past 30 years. In every instance these companies focused on improving the quality of care while reducing the cost of that care. His interest in Sanofi International was sparked by the company’s ability to dramatically reduce the incidence of hospital-acquired infections at a remarkably low cost.

Mr St Clair was raised in the Caribbean, received his Bachelor of Applied Science from the University of Pennsylvania and an MBA from the Harvard Graduate School of Business.

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