



IMPROVING PATIENT SAFETY: THE IMPLICATIONS OF INTERNET OF THINGS, IT DEVICES, AND WEARABLES ON INFECTION CONTROL STRATEGIES

Healthcare-associated infections (HAIs) are a significant problem that cause costly and deadly impacts to patients, their families and care providers interacting with infected patients. In the U.S., HAIs infect one in 31 patients, account for 1.7 million infections, and lead to approximately 99,000 deaths each year — meaning HAIs cause more fatalities than car accidents, according to the CDC.¹ Based on PICNet data, Canadian healthcare systems see more than 220,000 HAIs each year.² Many providers are increasingly turning to prevention strategies that target overlooked infectious vectors such as technology devices like PCs, displays, mice and keyboards — and Internet of Things (IoT) devices like smart watches, smart phones and multi-function printers, ID badges, and other inanimate objects used in everyday patient interactions.

The reality is that alcohol and other cleaning agents are ineffective at removing dangerous pathogens on IT and IoT devices — and other shared devices clinicians use for patient care — without using medical-grade germicidal wipes designed to eliminate super-resistant bacteria and fungi, or Ultraviolet-C disinfection (UV-C).

To reduce infection rates and control hospitalization costs, healthcare providers and institutions should address the neglected risks lurking in every hospital, clinic, and long-term nursing facility, which need new solutions that fit clinical realities.

Widespread infection and HAI dangers

HAIs are enormously expensive for healthcare systems. According to a 2018 study published in *Clinical Infectious*

Diseases, treatment of *Clostridioides difficile* infections (also known as C. diff), for instance, costs the U.S. \$5.4 billion annually mostly due to hospitalization.³ Adding these costs to public and private insurance programs could ultimately result in patients and taxpayers shouldering even more of the financial burden of healthcare.

Island Health on Vancouver Island, Canada, wanted to investigate the technology-device-as-vector problem. But before it introduced full-scale interventions throughout every clinical site, a healthcare provider decided to research the issue.

Dr. Sean Spina, PharmD, Coordinator of Clinical Pharmacy Services at Royal Jubilee Hospital in Victoria BC, designed and led the research study along with principal investigator Stephanie Huffman and other clinicians from Island Health. The *Investigation into the Cleaning Methods of Smartphones and Wearables from Infectious Contamination in a Patient Care Environment trial*, (dubbed the I-SWIPE trial) emphasized real-world clinical settings in some of Island Health's hospitals and clinics.⁴

The team quickly discovered at baseline, only 45% of clinicians cleaned their smartphones at least weekly. For watches and hospital ID badges, the percentages were 61% and 29%, respectively.⁴

Consequently, Spina wanted to know if there was an opportunity to reduce this potential infectious vector. Since wearable-consumer IoT devices are not designed to withstand caustic germicidal wipes for disinfection, Ultraviolet-C disinfection (UV-C) devices (CleanSlate), which use light frequen-



"We know that here in Canada, healthcare-associated infections affect about 1 in 10 patients. And the evidence shows bacterial contaminants can live on inanimate surfaces for many, many months."

DR. SEAN SPINA, PHARM D | COORDINATOR OF CLINICAL PHARMACY SERVICES | ROYAL JUBILEE HOSPITAL, VICTORIA BC

cies to safely neutralize bacteria from personal items, were studied for effectiveness in a clinical setting.

Tackling healthcare's superinfections

In 2010, Spina realized that the still-ubiquitous pagers used in clinical settings were becoming woefully obsolete. En route to a flight at the airport, he recalls, a security guard noticed he was carrying a pager, and asked if he worked in healthcare. "She told me: 'No one would page a lawyer or accountant, but if someone's sick, you'd page a doctor.'" Every other industry phased out pagers years ago but healthcare personnel were still carrying them for essential communication.

After raising the matter with Island Health (comprised of 12 hospitals on Vancouver Island), Spina was approved to provide his staff with smartphones — as long as he studied the value of upgrading to newer communications technology, instead of relying on pagers to reach clinicians. During the process, he noticed that smartphones (and wearables) would prove difficult to keep clean.

The infection risks didn't stop there, he noted. Providers, forbidden from wearing neckties, still wore name badges on lanyards. In fact, though name badges are required, they are not specifically considered a potential vector for cross-contamination of microbial pathogens.

"I realized very quickly that our hand hygiene policies and some of the practices within healthcare institutions were going to limit our ability to benefit from upcoming new technologies," Spina said. "We're relying more heavily on our smartphones and wearables for essential communication. And there is no real efficacious way to actually clean these devices."

Although many existing prevention methods prove to be effective in laboratory settings, clinicians are seeing many real-world obstacles that may prevent these methods from accomplishing their purpose.

Sanitizing away risks — or hiding the problem?

Unfortunately, HAIs spread in part because so many vectors exist within healthcare. Inanimate vectors such as smartphones, IT and IoT devices, wearables, and other electronics are often underrated as infection risks in healthcare environments.

During its investigation, Spina's team swabbed smartphones and other personal items for pathogenic bacteria. It established a baseline inoculation level for these items and also tested devices with known inoculations for comparison testing the efficacy of the UV-C CleanSlate device. Additionally, smartphones and wearables were deliberately inoculated with MRSA, ESBL, VRE, pseudomonas, and other pathogens before sanitizing them with a UV-C CleanSlate device.

The results showed that UV-C works in a clinical setting to decrease bacterial load on smartphones and wearable devices in a clinical setting, but still at a 100% success rate. At baseline, 22% of smartphones and wearable devices grew pathogenic bacteria. Unfortunately, there was no significant reduction in bacterial growth when the UV-C sanitizer was used twice daily (self-reported by participants), as 20% of devices still grew pathogenic bacteria.

CleanSlate demonstrated efficacy in this setting *immediately after the use* of the UV-C device, with only 4% of devices growing pathogenic bacteria. The percentage isn't at 0% in part because cell phone owners were using a variety of cases and other accessories that could still harbor bacteria due to the inability of the UV-C light to reach into all of the crevices.

Based on these findings, UV-C sanitizers seem to be a lot like handwashing — potentially highly effective when done often and correctly. Although research has yet to reveal the optimal number times that smartphones and wearables should undergo UV-C disinfection per day, it's entirely possible that the technology will soon be as common as hand sanitizer already is within clinical settings.

Since clinicians wash their hands between each patient interaction, it makes sense that using UV-C between encounters would be necessary, too. Unfortunately, this may limit the value of UV-C for many, if not most, healthcare applications. More research — and more solutions — are urgently needed.

HP fights infection challenges around the globe

Recognizing the value in doing more for HAI prevention, HP is working hard to lead in promoting smart infection-control practices. HP Healthcare Edition products such as PCs, notebooks, monitors and multi-function printers are safe to clean and can withstand caustic germicidal wipes required for sanitization of super-resistant bacteria and fungi that typically, if used on commercial IT or IoT devices, would result in plastic fatigue and degrade.

“With our healthcare focus, portfolio and practice, we are very serious about combating healthcare-associated infections at both a local and a global level,” said Daniel Colling, Global Leader of HP Healthcare Industry Solutions. “We’ve partnered with, for example, APIC Consulting Services, a wholly owned subsidiary of the Association for Professionals in Infection Control and Epidemiology (APIC). We’ve also been able to work with them to write a whitepaper with recommendations and cleaning protocols.”



“Leading germicidal wipes that are common in your hospital, like CaviWipes or Sani-Cloth, can be safely used with our Healthcare Edition products.”

DANIEL COLLING, BSC, RN | GLOBAL LEAD FOR HEALTHCARE INDUSTRY SOLUTIONS | HP INC.

computers, and displays that generate less electromagnetic interference with medical devices, HP is implementing higher standards to enable its own equipment to withstand germicidal wipes and other sanitizing methodology used in healthcare settings.

Although many of the sanitization methods used today pose significant potential harm for electronics and plastic components, better technology may hold the answers to effective infection prevention and may allow organizations to overcome the surge of HAIs that now plague healthcare.

1 Centers for Disease Control. “Health Topics - Healthcare-associated Infections (HAI).” January 22, 2019. <https://www.cdc.gov/policy/polaris/healthtopics/hai.html>.

2 Provincial Infection Control Network of British Columbia, (PICNet). “About Healthcare-associated Infections.” <https://www.picnet.ca/surveillance/about-hai/>.

3 Zhang D, Prabhu VS, Marcella SW. “Attributable Healthcare Resource Utilization and Costs for Patients with Primary and Recurrent Clostridium difficile Infection in the United States.” Clinical Infectious Diseases, Vol. 66, Issue 9, May 1, 2018. <https://academic.oup.com/cid/article/66/9/1326/4817900/>.

4 Huffman S, Webb C, Spina S. “Investigation into the cleaning methods of smartphones and wearables from infectious contamination in a patient care environment” (I-SWIPE). American Journal of Infection Control. 2019. [https://www.ajicjournal.org/article/S0196-6553\(19\)30845-4/abstract](https://www.ajicjournal.org/article/S0196-6553(19)30845-4/abstract).



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