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Major article

Challenges in implementing electronic hand hygiene monitoring systems

Laurie J. Conway PhD, CIC *

Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, Toronto, Ontario, Canada

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Review

Electronic hand hygiene (HH) monitoring systems offer the exciting prospect of a more precise, less biased measure of HH performance than direct observation. However, electronic systems are challenging to implement. Selecting a system that minimizes disruption to the physical infrastructure and to clinician workflow, and that fits with the organization's culture and budget, is challenging. Getting front-line workers' buy-in and addressing concerns about the accuracy of the system and how the data will be used are also difficult challenges. Finally, ensuring information from the system reaches front-line workers and is used by them to improve HH practice is a complex challenge. We describe these challenges in detail and suggests ways to overcome them.

Despite substantial evidence that hand hygiene (HH) prevents health care-associated infections, HH performance by nurses, doctors, and other health care personnel (HCP) is suboptimal.[1,2] Research suggests that HH performance can be improved through audit and feedback.[3] Auditing HH compliance and feeding the data back to professionals gives them the information they need to change their practice. HH audits can also provide data needed to determine whether or not a program aimed at increasing HH compliance has succeeded. In addition, audits can determine why HH is not being performed as expected. For these reasons, HH audit and feedback is recommended by the World Health Organization and the Centers for Disease Control and Prevention, and is an accreditation requirement of The Joint Commission.[4-6]

However, auditing HH performance is not easy. Most health care organizations audit HH compliance by directly observing staff interacting with patients, but there is no standard method of observation so it is difficult to make comparisons across organizations or within organizations over time.[7] In addition, direct observation may not give an accurate account of HH compliance for several reasons. First, because direct observation is labor intensive, a very small number of HH opportunities is observed and the results are used to infer HH compliance rates overall. In 1 study, direct observation for 1 hour/day in an 18-bed intensive care unit (ICU) captured only 1.3% of all HH opportunities.[8] Such small samples may not reflect the true level of compliance overall. Second, observers may not receive training or they may not coordinate with other observers, so they may collect data or interpret events differently. For example, observations made from a distance or during a period of high clinical activity tend to be inaccurate.[9] If observers are not trained to be especially vigilant in these situations, they may make mistakes. Also, HH compliance is generally highest in non-ICU wards, on weekends, during periods of low workload, and among nurses versus other professionals.[5] So if an observer monitors these groups and times preferentially, HH compliance will be overestimated. Third, people behave differently when they are being observed. Research has shown that HCP perform nearly 3 times the number of HH actions when they are being overtly observed compared with when they are not.[10] This Hawthorne effect causes HH compliance rates to appear higher overall than they actually are.

Electronic HH monitoring systems reduce these biases by objectively and imperceptibly monitoring HH events 24 hours/day. Also, because they capture all events, electronic systems are more sensitive to detect changes in HH rates arising from HH improvement initiatives.[11] In addition, electronic systems have the potential to generate a standard HH metric that could be used to compare HH performance fairly across organizations or within organizations over time. However, despite their great potential, electronic systems have limitations and challenges to implementation that are rarely described in research reports. The purpose of this article is to summarize the challenges of implementing an electronic HH monitoring system and to suggest ways to overcome the challenges.

* Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, 130 – 155 College St, Toronto, ON M5T 1P8, Canada.
E-mail address: laurie.conway@utoronto.ca.

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Specifically, we will discuss selecting a system appropriate for the organization, getting staff buy-in and trust, and using the data to monitor and effect change.

SYSTEMS

Several different electronic HH monitoring systems are on the market or in development.[12] All include 1 or more of the following 3 components: dispensers for soap (antiseptic or plain) or alcohol-based handrub (ABHR), patient zone indicators in doorways or around beds, and HCP tags (eg, badges, wrist bands, or pager cases) that communicate with the dispensers or the patient zone indicators or both. The 3 components collect and exchange information using a combination of technologies, including infrared, ultrasound, Wi-Fi, ZigBee (ZigBee Alliance; Davis, CA), motes, radiofrequency identification (RFID), remote video monitoring, or alcohol vapor-sensing technologies. The systems differ in their capacity to issue a prompt to perform HH, and to issue immediate feedback in addition to compliance reports. The simplest systems are dispensers that record each time they are activated (called an HH event). The most complex systems sense HCP entry into a patient zone, determine if a HH event has occurred, issue a prompt if needed, and give immediate feedback to HCP that can also be seen by coworkers and patients.

SELECTING A SYSTEM APPROPRIATE FOR THE ORGANIZATION

Implementing an electronic HH monitoring system can disrupt a health care facility's physical infrastructure and interfere with HCP workflow; it also costs money and affects the organizational culture. Selecting a system that minimizes disruption and fits the organization is a challenge.

Physical infrastructure

Some systems require that existing dispensers be replaced, others do not.[13] If new dispensers are required, it should be noted that HCP prefer touch-free dispensers to manual dispensers.[14] If new dispensers are not required, it is still an opportune time to consider moving or adding dispensers. Dispensers are needed inside patient rooms, not just in hallways. In an evaluation of an electronic monitoring system by Boyce et al[15] in which dispensers were placed inside and outside patient rooms, 36%-47% of all HH events occurred at dispensers located inside patient rooms. Positioning dispensers so that they are visible and accessible is also important. Using workflow observations, interviews, and dispenser counts, Boog et al[16] found that the optimal placement of ABHR dispensers in their ICU were at room entrances and sinks, rather than on the wall beside patient beds. However, as the authors note, there is no single ideal location and HCP are likely to habituate to whatever location is most common in the rooms on their unit. Electronic systems that monitor freestanding and personal dispensers in addition to wall-mounted dispensers are available, and may encourage HH compliance. In a feasibility study of 1 such system by 11 nurses, in which ABHR was available in personal wearable dispensers and in wall mounted dispensers in the hallways near the doorways to patient rooms but not inside patient rooms, the nurses used the personal dispensers about half the time.[17] In a subsequent study by the same researchers,[18] when dispensers were made available at each patient bed, in hallways, and in patient bathrooms, the nurses considered wearable ABHR dispensers redundant and declined to use them.

Some systems require fixed hard wiring, which necessitates removing ceiling tiles and/or drilling into walls to mount sensors in the patient zone. Some systems require that data stored in devices be uploaded manually to a computer through a universal serial bus cable,[16,18,19] other systems automatically and wirelessly upload data to a central server. Wireless systems have the potential to interfere with medical equipment or to overload existing wireless networks;[20] however, in a recent test of a propriety RFID system at 2 large academic centers by Pineles et al,[13] there were no electronic conflicts or interference between the HH system and medical devices.

Workflow

Implementing an electronic system may interrupt workflow or require a change in HCP behavior. Monitoring tags can be heavy.[21] Fisher et al[22] surveyed HCP who wore wireless tags as part of a randomized controlled trial assessing the influence of prompts and feedback on HH compliance. Some participants reported that the tags were bulky, not durable, difficult to use, or had frequent battery failures. When asked reasons for not wearing the tags, 7 of 46 said they were inconvenient, 3 cited problems with the tag receivers, and 2 disagreed with being monitored.[22] RFID tags do not need batteries but tags using Wi-Fi or ZigBee do. In 1 study using ZigBee technology, 2 button batteries in each tag needed to be replaced every 40 days.[23,24] RFID systems require staff to wear the badge high on the body, be within the field of detection of the reader, and face the badge to the reader to be credited with an HH event.[13] Alcohol-sensing technologies require HCP to pass a disinfected hand within 2-10 cm of a sensor to be recognized as compliant.[25,26] This is most challenging if the alcohol sensor is wall-mounted rather than wearable.[21] These behavior changes, which are required to ensure the system works properly, may be a burden to HCP.

HCP tags that deliver prompts come with unique challenges. In a trial by Fisher et al,[22] HCP wore a wireless HH monitoring tag. Those in the intervention group received a 5-second reminder beep if they did not perform HH within 6 seconds of entering or 60 seconds of exiting a patient zone. In a poststudy survey, a minority of respondents (28 of 62) believed that the reminder beeps served a helpful function, and only 56% believed the beeps correlated well with HH opportunities. A similarly mixed response was noted by Al Salman et al[27] when they trialed an electronic system that included badges that vibrated if the person was within a patient zone and had not performed HH. Some of the HCP complained that the vibrations were too strong, and others were concerned about the effects of the vibrations on their health. Occasionally the badges vibrated when no HH was indicated, but this problem was resolved when the patient zone beacons were recalibrated.

If the prompt is audible or visible to others, it has the added benefit of eliciting peer pressure and/or patient reminders if HH has not been performed. In a study by Levchenko et al,[18] HCP indicated that the flashing green light on the monitoring tag was useful for checking their own HH status and that of other HCP. However, peers may be more willing than patients to speak up. Storey et al[21] trialed a system that included alcohol-sensing badges with red and green lights. HCP in the study indicated that they would be receptive to patient reminders, but only 3 of 30 patients reported that they would challenge HCP wearing a red light badge. The fact that one-quarter of HCP in the study reported being unaware of the color while wearing the badge underlines the need for peers and patients to be involved. One negative consideration of audible prompts or flashing lights is that they could disturb patients and add to HCP "alert fatigue."[17]

Cost

To our knowledge, no cost-effectiveness study of an electronic HH monitoring system has been published. In a recent survey of automated or semiautomated HH monitoring systems by McGuckin and Govednik,[12] to which 18 of 38 manufacturers responded, capital and consumable costs were queried but not reported. In fact, only a handful of studies of electronic HH monitoring systems mention