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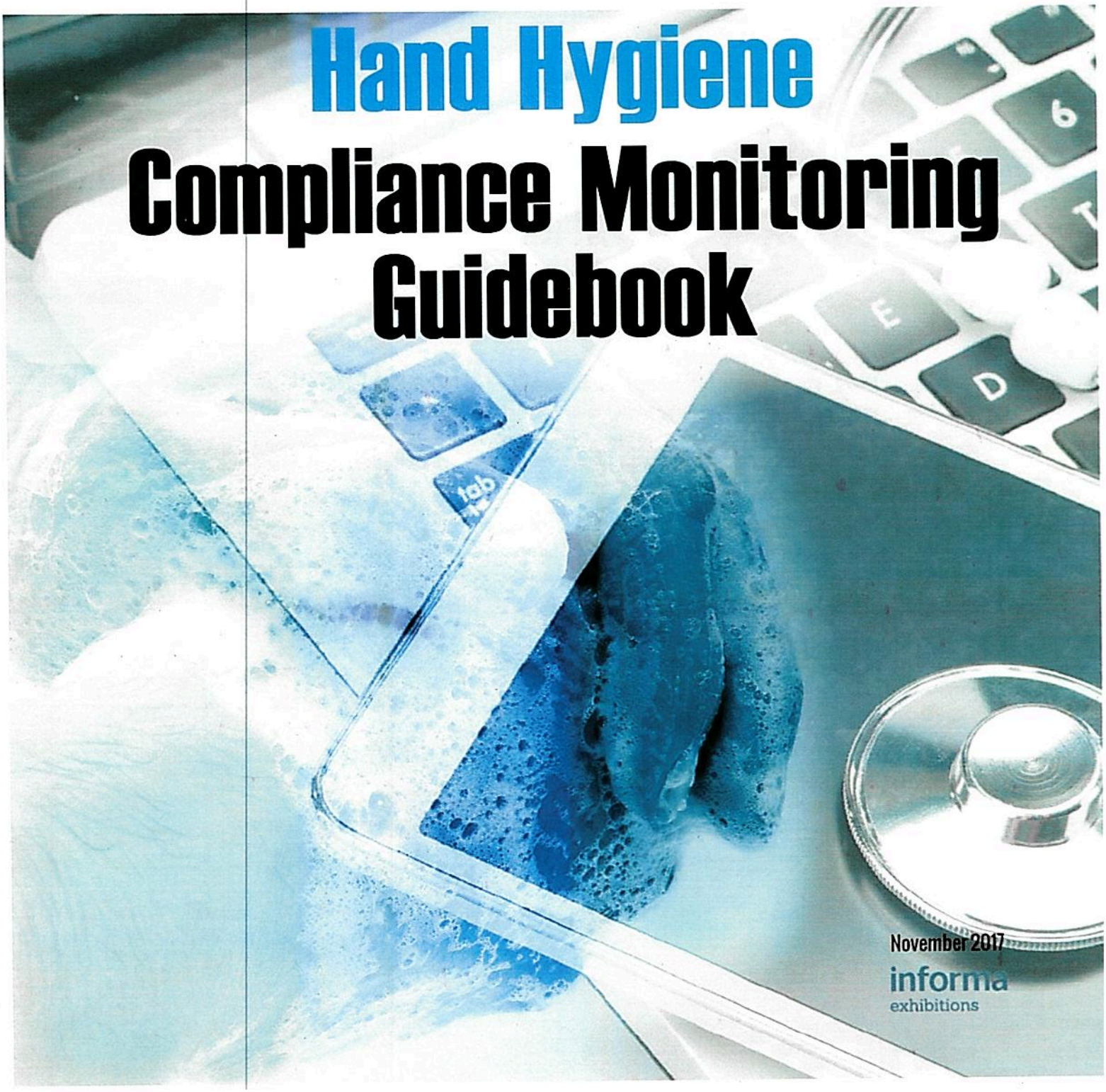
Hand Hygiene Compliance Monitoring Guidebook



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Your Guide to Infection Prevention

While healthcare techniques and technology escalate in complexity, there's a need to return to the basic, foundational practices in infection prevention, to ensure that all practitioners – novice, intermediate and advanced – review these essential best practices that ensure quality and enhance patient and healthcare worker safety. The 2017 Guidebook series provides several installments of expert advice and best practices based on the medical and scientific literature, pertaining to a number of key topics in the infection prevention and control space. Each Guidebook will provide infection prevention-related instruction through the use of educational information, checklists, infographics, and more. This Hand Hygiene Compliance Monitoring Guidebook includes a review of imperatives relating to hand hygiene compliance monitoring, a review of what the literature says, and other practical information that clinicians can implement into practice immediately.

contents

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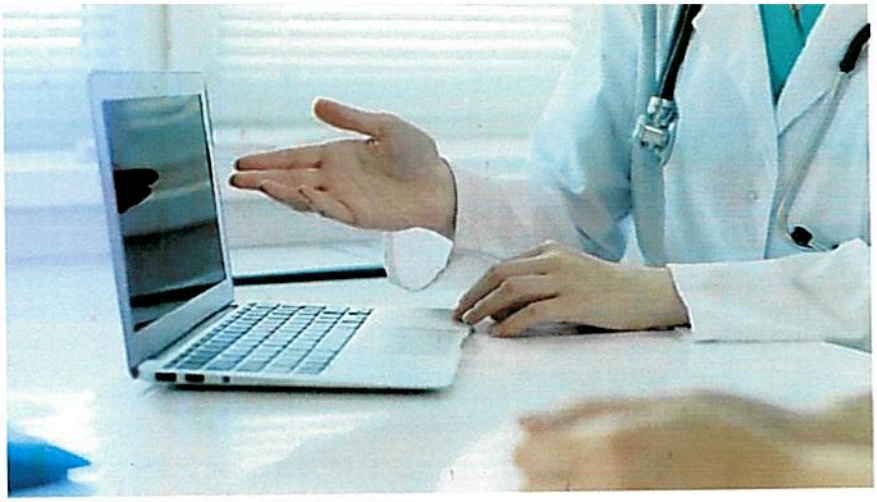

Hand Hygiene Compliance Monitoring Guidebook

By Kelly M. Pyrek

While direct observation has been the standard way to monitor hand hygiene compliance behavior - the drawbacks of small sample size, the Hawthorne Effect and lack of inter-rater reliability can make data highly unreliable. Technologies are emerging that are evidence based and may provide a significantly more reliable way to monitor this essential measure of healthcare quality and patient safety. Additionally, with the 2017 inclusion of MRSA and C. diff rates included in the calculation of a hospital's Hospital-Acquired Condition (HAC) score – the imperative to improve hand hygiene to reduce the risk of these costly infections is that much more critical to avoiding the HAC 1 percent CMS revenue penalty.

As we consider the current healthcare landscape, let's explore several givens relating to hand hygiene compliance:

Healthcare professionals' hand hygiene is subpar at many institutions: The Joint Commission (2009) notes that "Following effective hand hygiene practices has long been recognized as the most important way to reduce the transmission of pathogens in healthcare settings. Many studies, however, have shown that adherence to hand hygiene recommendations remains low and that improvement efforts frequently lack sustainability."

There are many self-reported and observed barriers to hand hygiene practice: Pittet (2000) enumerated a number of these barriers, including: Skin irritation caused by products; inaccessible hand-hygiene supplies; interference with HCW-patient relationship; patient needs take priority; belief that wearing gloves negates the need for hand hygiene; forgetfulness; busyness; lack of knowledge of guidelines; lack of scientific information on effect of hand hygiene on nosocomial infection rates; significant work load or lack of appropriate staffing; lack of hand-hygiene promotion at individual or institutional level; lack of role model for hand hygiene; lack of administrative sanction of non-compliers or rewarding of compliers; and lack of an institutional safety climate.

There are ways to significantly boost hand hygiene compliance: Pittet (2000) outlines the parameters associated with successful hand hygiene promotion, including: Education; routine observation and feedback; engineering controls that make hand hygiene possible, easy and convenient; patient education; reminders in the workplace; administrative sanctions and rewards; promotion and facilitation of healthcare worker skin care; obtaining active participation at the individual and institutional levels; maintaining an

> **Following effective hand hygiene practices has long been recognized as the most important way to reduce the transmission of pathogens in healthcare settings.**

institutional safety climate; enhancing individual and institutional self-efficacy; and avoiding understaffing and excessive workload among healthcare workers.

Many hospitals are adding technology to their arsenal against HAIs and considering electronic hand hygiene compliance monitoring systems as part of their infection prevention protocols. Hospitals are becoming more diligent about monitoring hand hygiene, moving toward electronic compliance monitoring systems over direct observation if they can provide a solid business case for this technology-driven intervention. Electronic systems have the capacity to eliminate inaccuracy and unreliability in hand hygiene compliance monitoring, thus enhancing patient safety and improving outcomes.

Suboptimal hand hygiene by healthcare personnel and problematic direct observation methods necessitates a better solution that can drive a healthcare institution's improvement of handwashing behavior. While it is the technique that many hospitals still use, direct observation is unreliable and has been shown to inflate compliance rates, leading to a false sense of security about hand hygiene performance. Studies have demonstrated the Hawthorne effect—humans acting differently when they know they're being observed--on hand hygiene behavior and found that direct observation results in compliance rates up to 300 percent higher than can be validated using other more accurate and reliable methods. (Srigley, Furness, Baker and Gardam, 2014)

Technology is one way that healthcare facilities can more accurately measure in real-time hand hygiene compliance, capturing handwashing events and providing data soon after capture.

Technology is one way that healthcare facilities can more accurately measure in real-time hand hygiene compliance, capturing handwashing events and providing data soon after capture. With accurate data, healthcare organizations will have a clearer picture of current hand hygiene compliance and can address avoidable infections along with associated harm and expense by driving true gains. An increasing number of studies seem to indicate that technology-facilitated hand hygiene compliance monitoring is a viable way to determine compliance, drive change, provide feedback and determine how improved hand hygiene compliance may result in a reduction in rates of healthcare-associated infections (HAIs).

Let's explore the key issues relating to hand hygiene compliance monitoring.

The Scope of the Problem

Hand hygiene is among the critical interventions to help control and eliminate HAIs, however, as we have seen, numerous barriers to compliance exist. It has been well documented that hand hygiene among healthcare workers averages around 40 percent; a review of the literature by Erasmus, et al. (2010) reported compliance rates less than 50 percent in the United States. As the World Health Organization (2009) explains, "Perceived barriers to adherence with hand hygiene practice recommendations include skin irritation caused by hand hygiene agents, inaccessible hand hygiene supplies, interference with healthcare worker/patient relationships, patient needs perceived as a priority over hand hygiene, wearing of gloves, forgetfulness, lack of knowledge of guidelines, insufficient time for hand hygiene, high workload and understaffing, and the lack of scientific information showing a definitive impact of improved hand hygiene on HAI rates." WHO (2009) adds, "Lack of knowledge of guidelines for hand hygiene,

lack of recognition of hand hygiene opportunities during patient care, and lack of awareness of the risk of cross-transmission of pathogens are barriers to good hand hygiene practices. Furthermore, some healthcare workers believed that they washed their hands when necessary even when observations indicated that they did not."

The Joint Commission (2009) outlines some of the specific challenges to measuring hand hygiene adherence:

- Contact with patients or their environment takes place in many locations within organizations.
- Opportunities for hand hygiene occur 24 hours a day, seven days a week, 365 days a year and involve both clinical and nonclinical staff.
- The frequency of hand hygiene opportunities varies by the type of care provided, the unit, and patient factors.
- Monitoring through current methods is often resource intensive; infection preventionists, quality improvement staff, and other healthcare workers face numerous competing demands for their time and expertise.
- Observer bias (for example, the Hawthorne effect) is difficult to eliminate.

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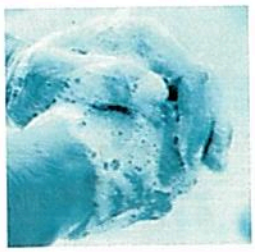
The Joint Commission (2009) advises clinicians that before selecting a measurement method, determine the answers to a few key questions:

- Why do you want to measure hand hygiene practices, and what are your organization's goals?
- What elements of hand hygiene do you want to measure?
- How do you want to measure hand hygiene?



Some healthcare workers struggle with the correlation between hand hygiene and its impact on infection rates, citing a lack of definitive studies documenting this connection. As WHO (2009) states, "The lack of scientific information on the definitive impact of improved hand hygiene compliance on HAI rates has been reported as a possible barrier to appropriate adherence with hand hygiene recommendations. However, there is convincing evidence that improved hand hygiene through multimodal implementation strategies can reduce infection rates. In addition, although not reporting infection rates, several studies showed a sustained decrease of the incidence of multidrug-resistant bacterial isolates and patient colonization following the implementation of hand hygiene improvement strategies. Failure to perform appropriate hand hygiene is considered the leading cause of HAI and spread of multidrug-resistant organisms, and has been recognized as a significant contributor to outbreaks."

Hand hygiene is a common-sense cornerstone of HAI prevention and control, and its importance should not be overlooked. Compliance is essential, and understanding HCP hand hygiene habits is a first step to correcting behavior.

Let's explore the current methods for monitoring hand hygiene compliance.

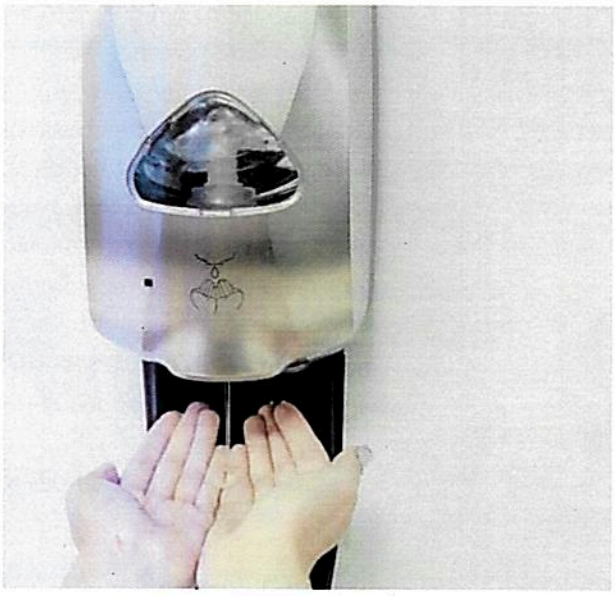
Direct Observation and its Challenges

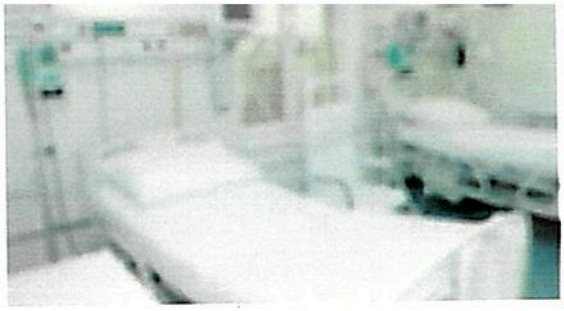
Automated electronic hand hygiene monitoring systems, of course, move hospitals away from using direct observation of healthcare professionals for monitoring and tracking to ensure they clean their hands when required. Proponents of electronic systems emphasize the flaws of direct observation:

- The Hawthorne Effect, which describes how people act differently when they know they are being observed, can artificially increase compliance rates. Technology eliminates human observation completely. Electronic systems are often replacing "secret shoppers"; when using secret shopper sampling methods, hospitals may overestimate their actual hand hygiene compliance rates.
- Direct observation can harbor observer bias. Technology can standardize the data reporting process.
- Direct observation requires additional time for compliance rates to be calculated, thus reducing opportunity for more immediate feedback to healthcare professionals. Technology can capture hand hygiene data in real time and can generate reports on compliance rates immediately.
- Direct observation can be resource-intensive and time-consuming. Technology can be more efficient.
- Direct observation inherently has a smaller sample size because human observers can only observe a portion of the hospital's total work-force. Technology can improve statistical reliability of compliance rate results.

In his literature review of issues relating to monitoring hand hygiene compliance, Boyce (2017) outlines the disadvantages of direct observation, Boyce (2017) notes, "For compliance rates determined by direct observation to be valid, hand hygiene observers require adequate training and periodic validation by experienced individuals, which involves considerable personnel time and expense. To obtain reasonable estimates of hand hygiene compliance rates, auditors must devote hours of observation time in multiple clinical areas on a repeated basis ...Yin, et al. estimated that in a hospital with a 70 percent compliance rate, it would require at least 153 observations per nursing unit per time period (month or quarter) to identify a 10 percent change in compliance with 80 percent power and 5 percent significance level. Many hospitals have had considerable difficulties in finding sufficient time and associated financial resources for auditors to perform an adequate number of observations, especially on night shifts and weekends."

He adds that there is often an insufficient sample size: "Due to the time required for direct observations, it is feasible to observe only a very small fraction of all the HHOs and HHEs that occur. In one study that had HCP in an intensive care unit wear electronic badges to record HHOs, simulated observational models suggested that only 0.5 percent to 1.7 percent of HHOs were detected by observational methods. Similarly, in a study that compared direct observation to the volume of alcohol-based handrub (ABHR) used, it was estimated that only 0.4 percent of HHEs were detected by direct observation. In several studies that used electronic counting devices in dispensers or badges worn by HCP to record the number of HHEs performed, only 0.14 percent to 2.5 percent of HHEs were captured by direct observation. The tremendous number of HHOs that can occur in a facility annually attests to the difficulty in obtaining accurate estimates of hand hygiene compliance using





direct observation. For example, in an acute-care hospital with 1,023 beds, it was estimated that 171,468,240 HHOs occurred per year in inpatient and emergency areas."

An additional challenge with direct observation is the lack of standardized observational practices: "Although recommendations on how to observe hand hygiene compliance are available, many aspects of performing observations vary tremendously, making comparison of compliance rates between healthcare facilities problematic. For example, the methods used to train auditors and the degree to which their performance is validated vary substantially. The role of the individual conducting observations (e.g., unit-based nurse, infection preventionist [IP], student, or volunteer) and the extent to which they are recognized as observers can clearly effect compliance rates. Unintentional observer bias, as well as the Hawthorne effect, is likely when observations on a nursing unit are made by nurses who routinely work on the unit, rather than by non-unit observers. The distance of the observer from the HCP being observed, the location of the observer on the unit, the level of activity on the unit, the duration of each observational session, and even the time of day when observations are made can influence compliance rates. Performance of observers who have received the same training may also vary. Identifying and maintaining an adequate number of trained personnel to perform observations can also represent a significant problem in some institutions.

For example, in an acute-care hospital with 1,023 beds, it was estimated that 171,468,240 HHOs occurred per year in inpatient and emergency areas.

Electronic Hand Hygiene Compliance Monitoring

Gould, et al. (2017) explain that, "Hand hygiene can be monitored with electronic and computerized devices that employ infrared detection and wireless networks. It has been argued that staff become habituated to presence of the device when they are used continuously [overcoming] the Hawthorne effect… Many electronic systems require each health worker to wear a detector...Electronic devices are becoming more sophisticated. Some models can even provide data relating to key moments of the 'five moments of hand hygiene' but they are expensive to purchase and install. It is also important to consider that the real-time data generated is only of value if managers have sufficient time to analyze and interpret."

Boyce (2017) notes that, "Monitoring hand hygiene compliance among HCP is an essential element of hand hygiene promotion programs. Observation by trained auditors is considered the gold standard method for establishing hand hygiene compliance rates. Advantages of observational surveys include the ability to establish compliance with all of the World Health Organization My 5 Moments for Hand Hygiene initiative Moments and to provide just-in-time coaching. Disadvantages include the resources required for observational surveys, insufficient sample sizes, and non-standardized methods of conducting observations. Electronic and camera-based systems can monitor hand hygiene performance on all work shifts without a Hawthorne effect and provide significantly more data regarding hand hygiene performance. Disadvantages include the cost of installation, variable accuracy in estimating compliance rates, issues related to acceptance by HCP, insufficient data regarding their cost-effectiveness and influence on health care-related infection rates, and the ability of most systems to monitor only surrogates for Moments 1, 4 and 5. Increasing evidence suggests that monitoring

only Moments 1, 4 and 5 provides reasonable estimates of compliance with all 5 Moments. Although there is substantial evidence that monitoring of all 5 Moments as part of interventions based on the WHO multimodal strategy has improved compliance rates, not much is known about how compliance with a single Moment might influence compliance with other Moments and how compliance with Moments 1, 4 and 5 might change if Moments 2 and 3 are no longer monitored. As a consequence, continued efforts to further develop electronic monitoring systems that can also detect compliance with Moments 2 and 3 are desirable. With continued improvement of electronic monitoring systems, combining electronic monitoring with observational methods may provide the best information as part of a multimodal strategy to improve and sustain hand hygiene compliance rates among HCP."

Experiences With Electronic Monitoring from the Medical Literature

When reviewing studies conducted of electronic compliance monitoring systems, healthcare professionals should look for the type of system used -- whether the technology monitors room entry/exit or all moments in the room -- as the metrics reported from the research will be dependent upon the technology and type of system. This context is essential for comparing systems and results.

McCalla (2017) reports the experience of a community hospital that decided to trial an electronic hand hygiene compliance system (HHCS) in its ICU and ICU stepdown units as an alternative to human observers. Using a retrospective cohort design, researchers investigated whether implementation of the HHCS resulted in improved hand hygiene compliance and a reduction in common HAI rates. In 2010 and 2011 before the study, hand hygiene compliance rates were 84 percent and 91 percent, respectively. Although these rates are better than some reported national averages, rates were below the hospital's goal of 95 percent compliance. For the purposes of calculating infection rates and rate ratios, all patients in the hospital's ICU and ICU stepdown unit

Essential Moments to Perform Hand Hygiene

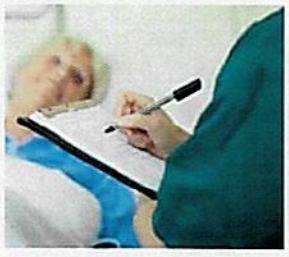
1 Clean your hands before touching a patient. When hands are visibly soiled, wash with soap and water. Otherwise, use an alcohol-based sanitizer or rub that contains at least 60 percent alcohol to decrease transient bacteria and reduce the risk of cross-contamination between patient rooms.

2 Clean hands before performing any type of aseptic procedure to protect the patient against harmful pathogens, including germs carried by healthcare professionals or ones living on the patient's own body.

3 Clean hands after exposure to, or the threat of exposure to, bodily fluids. This will protect the healthcare worker from the patient's germs and limit the spread of infection-causing pathogens.

4 Clean hands after touching a patient and any of the patient's immediate surroundings, such as the patient's clothes or gown, hospital bed or exam chair.

5 Clean hands after touching any object in the patient's room, including high-touch surfaces such as door handles, bed railings, chairs, countertops, etc.



Based on the World Health Organization's (WHO) "My 5 Moments for Hand Hygiene"

To improve compliance, a hospital must be able to improve reinforcement of the desired behavior. It must also be able to measure compliance accurately. The conventional approach is to employ a team of observers who can record HHOs and the number of times caregivers comply with protocol.

during the data collection periods were included in the study. This consisted of 2,174 patients in 2014 and 1,896 patients in 2015, for a total of 4,070 patients across the full study period.

The hand hygiene compliance system used, which includes a wearable device designed to remind caregivers to sanitizer their hands, captures HHOs (hand hygiene opportunities) based on room entry or exit. During the study period, the HHCS collected many more hand hygiene events compared to human observers (632,404 vs 480). The detailed data collected indicated total compliance for the year was lower than the year human observers were used, but ensured that the hospital met its compliance goal of 95 percent. Decreases in MDRO, CLABSI, and CAUTI infection rates were observed during the study period, but because the differences were not significant, further study is needed to examine the association between the HHCS and HAI rate reduction. McCalla concluded the systems provided a successful alternative to human observers.

As McCalla (2017) observe, "There is a widely recognized need for caregivers to be conscientious about disinfecting their hands at every HHO; that is, when hand hygiene is indicated by guidelines or institution protocol. There is also a need for a reliable means of assessing compliance, which would allow facilities to measure their progress and move toward 100 percent compliance. Caregivers in ICUs are reported to be less compliant than caregivers in other units. Wearing gowns and/or gloves is associated with lower compliance. Factors contributing to lower compliance include poor knowledge of guidelines and protocols, and circumstances where hand hygiene is a lower priority than the urgent needs of the patient. To improve compliance, a hospital must be able to improve reinforcement of the desired behavior. It must also be able to measure compliance accurately. The conventional approach is to employ a team of observers who can record HHOs and the number of times caregivers comply with protocol. The World Health Organization considers observation the gold standard for measuring compliance. However, relying on human observation has limitations. Observers must have received thorough, similar training. Being observed can change a caregiver's behavior. Workers are more likely to be compliant when they know they are being watched (the so-called Hawthorne effect). Therefore, it may be impossible to obtain a true measure of compliance through human observation. Observation alone does not provide a real-time reminder when the caregiver is in a patient room that it is important to practice good hand hygiene. Because observers are unlikely to be utilized during the hospital's full hours of operation, no institution can determine whether results from limited human observation will accurately reflect actual handwashing compliance in the 24 hours a day, seven days a week healthcare setting."

The researchers add, "The significant reduction in hand hygiene compliance during implementation of the HHCS may have been influenced by a documented lack of precision inherent to human observation of hand hygiene events. Factors, including observer distance from healthcare workers and business of the ward, attenuate the accuracy of hand hygiene event observation, whereas automated systems capture these events with greater precision. In that regard, the HHCS record of several hundred thousand HHOs during its implementation is promising and suggests that it may provide an accurate, detailed assessment of hand hygiene compliance,

with a resolution far greater than human observers. There is some concern that limited implementation of automated HHCSs (i.e., a short-term deployment meant to boost compliance rates) may result in rates that rebound to preintervention levels. Similarly, interventions that provide immediate, automated feedback—as in the case of the HHCS trialed in this study—have been shown to help sustain high compliance rates in an ICU setting. To ensure hospitals sustain their stated compliance goals, long-term—or permanent—deployment of the HHCS may be necessary ... The ability of the HHCS to record a substantial number of HHOs and compliance events is solely dependent on the implementation of the system (e.g., the number of electronic badges and monitoring sensors deployed) and is unlikely to be influenced by geographic location, ward of installation, or type of healthcare personnel utilizing the system. However, reproducibility of the observed compliance rate itself may be influenced by the healthcare worker's job title, time of day, and performance of hand hygiene before patient contact, among other hypothesized factors. Future studies of the HHCS would benefit from collection and inclusion of those variables in the analysis. Although the tentative decrease in HAI rates is promising, these results may be highly dependent on location, hospital, and ward under surveillance, as well as existing infection control and hand hygiene protocols. Further study is required to reproduce the observed reduction in infection rates, ideally using a more robust study design that controls for possible confounders."

Michael, et al. (2017) report that an automated observation system with immediate feedback was associated with a rapid and durable improvement in hand hygiene compliance.

Michael, et al. (2017) report that an automated observation (AO) system with immediate feedback was associated with a rapid and durable improvement in hand hygiene compliance. Two pilot studies were conducted at a large tertiary medical center with 1,400 beds; the first was conducted for 12 weeks on a nursing unit for solid organ transplant patients with 34 beds (unit 1) and the second was conducted for eight weeks on a cardiothoracic surgery intensive care unit with 14 beds (unit 2). Preexisting isolation procedures included contact precautions for patients with a history of carbapenem-resistant Enterobacteriaceae in clinical culture and for those with Clostridium difficile infection. Standard precautions applied to patients colonized or infected with vancomycin-resistant enterococci or methicillin-resistant Staphylococcus aureus. During the pilot studies, unit all HCWs were provided with electronic badges that measured compliance before room entry and after room exit using a mechanism for sensing volatile alcohol. HCWs were instructed to wear the badge on their chest pocket and to hold their cleansed hand to the badge after an HH opportunity. Detection of alcohol by the badge would elicit a visible color change from red to yellow to green. Visualization of the color green provided visual confirmation that HH had been performed. The badge also provided an audible beep if alcohol was not detected within 30 seconds of an entry or exit event. Unit rooms were equipped with entry and exit sensors that interacted with badges to define room entry and exit. Compliance was predefined by manufacturer as achieving the green light 60 seconds before or 30 seconds after room entry for an entry HH opportunity, and 60 seconds before or after room exit for an exit HH opportunity. Unit and individual HCW compliance was amassed by a software program. Unit supervisors reviewed HCW performance and gave verbal feedback on a weekly basis.

During the two pilot studies, the AO system resulted in substantial increase in hand hygiene compliance compared with baseline. For both pilots, unit compliance rapidly achieved 98 percent during week 1 and remained stable.

A total of 267,566 AOs were generated. The median number of AOs per HCW was 242 (range, 1-2,097). The majority of AOs were ascribed to nurses (83 percent), followed by respiratory therapists (12.3 percent), mid-level providers (2.4 percent), secretaries (1.3 percent), and physicians (1 percent). On unit 1, baseline HH compliance was 54% based on 88 DOs made over 12 months. During the 12-week pilot, 75 HCWs participated and HH compliance averaged 98 percent based on 140,000 AOs. Compliance based on DO during pilot 1 was 93 percent based on 27 observations. Post-pilot compliance by DO was 100% (44 DOs) at 6 months and 87 percent (150 DOs) at one year. On unit 2, pre-pilot HH compliance was 52 percent of 104 DOs in 12 months. During the eight-week pilot study 45 HCWs participated, and compliance by AO was 97 percent based on 27,566 measurements. Compliance by DO during the pilot study 2 was 99 percent based on 68 observations. Post-pilot compliance based on DO was 92 percent (185 DOs), and 86 percent (290 DOs) at 6 and 12 months, respectively.

Kelly, et al. (2016) sought to determine if implementation and use of an electronic hand hygiene monitoring system delivering WHO 5 Moments data was effective in reducing incidence of healthcare-associated MRSA infections. Kelly analyzed existing data from 23 inpatient units over a 33-month period and found a significant correlation between unit-specific improvements in electronic monitoring compliance and reductions in methicillin-resistant Staphylococcus aureus infection rates. The health system at which the study was conducted transitioned from monitoring hand hygiene compliance (HHC) using entry-exit to the WHO 5 methodology in 2009, with implementation of electronic monitoring on most units in July 2012. Unit leaders and staff were educated on the new system, and unit leaders were encouraged to report and discuss the real-time HHC reports in monthly and quarterly staff-quality meetings. Frontline staff were asked to identify barriers to HHC, and unit-specific ideas for improvement were implemented (e.g., adding or relocating alcohol dispensers, designating unit champions, posting WHO5 diagrams above dispensers). In addition, the hospital continued to perform spot-checking of HHC through direct observation and immediate feedback to staff regarding missed HHC opportunities.

We believe the monitoring system was associated with decreased rates of healthcare-associated MRSA infections. -- Kelly, et al. (2016)

Electronic HHC data and MRSA surveillance data were available for 23 of the 28 inpatient units (representing 87 percent of hospital beds) of the 746-bed teaching hospital. Unit-specific HHC data were obtained from the electronic system and converted to HHC rates (0-100 percent). Data were aggregated into quarterly averages and covered a 33-month time frame (July 1, 2012-March 31, 2015). The baseline quarter for each unit was defined as the first quarter of electronic HHC implementation; each quarter thereafter was used to calculate an absolute difference in HHC from the baseline quarter. These differences were then correlated with the unit's quarterly average MRSA rate using Pearson correlation coefficient. A statistically significant negative correlation was found between unit-specific change in HHC and the corresponding MRSA rate. Increased HHC resulted in lower rates of MRSA infection. Of the 225 unit quarters analyzed, 111 (49.3 percent) showed improvement in HHC; the median difference was -0.11 (interquartile range, -7.5 to 7.4). Overall, 21 of the 23 units (91.3 percent) showed improvement from the baseline quarter to the most recent quarter; the median absolute improvement was 9.7 percent.

Tips for Improving Hand Hygiene Compliance in Healthcare Facilities

To improve hand hygiene compliance and help to reduce the prevalence of HAIs, consider the following:

1. Reminders. Reinforce hand hygiene education efforts with hospital staff by posting reminders in staff break rooms breakrooms, restrooms, locker rooms and other high-visibility locations. Reminder discussions should also take place during every meeting whether individual or all-staff.

2. Top-down Commitment. Employees are more likely to comply with hand hygiene protocols if they witness hospital leaders doing the same. Encouraging leadership to demonstrate commitment by practicing good hand hygiene, as well as communicating its importance to staff, can help foster a culture of compliance.

3. Track and Report. Electronic monitoring programs provide powerful information that healthcare professionals can use to understand, track and improve their hand hygiene performance. The data can complement the use of observations for real-time coaching and feedback. Consider implementing an electronic hand hygiene compliance system that has been clinically proven to improve hand hygiene performance and reduce HAIs.

4. Share Results. Share consistent and reliable data correlating HAI rates to hand hygiene compliance rates with employees so they can visualize the direct impact of hand hygiene on lower incidences of infection. Clinically validated data lends credibility to the message and has been shown to lead to higher performance.

Kelly, et al. (2016) add, "Our study showed that improved HHC after the introduction of an electronic monitoring system was associated with decreased rates of healthcare-associated MRSA infections. Across the entire hospital, periods of improved HHC led to lower infection rates. We believe the monitoring system aided nursing leadership's ability to drive change and improve staff performance, by providing real-time reliable HHC data. Continuing feedback allowed for ongoing conversation with frontline nursing staff, and unit-level data allowed for unit-level solutions because staff engagement with the data led to strategic decisions, which resulted in consistent, sustained improvement in hand hygiene performance." The study found hospital-wide a 25.5 percent increase in HHC over the study period; the rate of healthcare-associated MRSA decreased 42 percent from baseline; and an estimated $434,000 in hospital cost savings over the study timeframe.

Edmisten, et al. (2017) shared lessons learned from implementation of an electronic system at three community hospitals. The monitoring system consisted of RFID badges with lights indicating compliance status, which resulted from beacons on patient beds that monitored hand hygiene opportunities before and after patient contact. To get the most from an electronic hand hygiene monitoring system, Edmisten suggests that facilities identify any implementation challenges at the facility level during pilot implementation and recommends active participation by stakeholders: "Before full facility rollout, each hospital worked jointly with the technology product vendor to identify the root cause of implementation challenges and to implement solutions that optimized system accuracy and acceptance. Feedback was captured by soliciting direct input from users, direct observation, and analysis of system-generated data. Best practices were shared between facilities as the deployment progressed. After implementation, the project teams at each facility regularly reviewed compliance reports and system status and collaborated with department and facility leadership to discuss ongoing challenges and potential solutions. Best practices were identified through existing analysis mechanisms for process improvement projects. These best practices were shared between facilities through regular telephone calls with the shared regional project management team."

Edmisten, et al. (2017) concluded: "As our experienced showed, a collaborative environment featuring a multidisciplinary team and clear leadership support is necessary for successful implementation. Presenting the data in a meaningful way can help empower and inspire staff to achieve high levels of HH compliance for their own

protection and the protection of their patients. Careful consideration of these issues and planning for ongoing support and maintenance could help facilities realize the full benefit of their investment in electronic HH monitoring systems." Edmisten added, "The implementation of an electronic HH monitoring system is a complicated and lengthy process. The successful implementation and acceptance of these systems requires cooperation and coordination among departments within a facility and between the system vendor and the healthcare facility. With careful planning, promotion of a collaborative environment, and steadfast support from leadership, each facility was able to implement and sustain the use of an electronic HH system for monitoring HH compliance."

The Technology

A number of researchers advocate the use of technology to improve healthcare personnel compliance. For example, Ellingson, et al. (2014) says that advanced technologies for electronic adherence monitoring should be explored as a viable adjunct to or replacement of direct observation-related methods.

Boyce (2017) explains that electronic compliance monitoring (ECM) systems currently fall into three major categories: door minder or activity monitoring systems, systems that include the wearing of electronic badges by HCP, and camera-based: "Activity monitoring systems utilize sensors that detect entry and exit of individuals into a patient room or their proximity to the patient's bed and the use of ABHR (and sometimes soap dispensers). The number of dispenser actuations divided by the number of HHOs (i.e., room entries and exits) is used to estimate hand hygiene compliance rates. Entry and exit of individuals into a patient's room are considered proxies for Moments 1, 4 and 5. Badge-based systems also utilize sensors to detect entry and exit of individuals into a patient's room or bed space and can attribute use of hand hygiene product dispensers by individual personnel who are wearing a specialized badge. Camera-based systems can monitor room entry and exit and use of ABHR or soap dispensers by HCP and determine compliance rates by visual review of videos by auditors."

There are various technological solutions for how to electronically monitor hand hygiene compliance. The key is that they are capable of capturing 100 percent of hand hygiene events.

Additionally, Kelly (2016) and Azim (2016) described the use of a badgeless electronic monitoring system that captured hand hygiene events from dispensers and transmitted data via a radio frequency network to a cloud-based database, which calculated WHO 5 Moment compliance rates based upon daily bed occupancy and nursing staff.

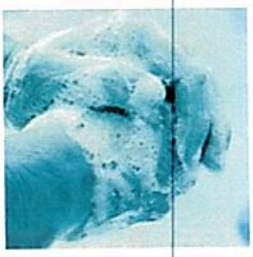
As Alper (2016) explains, "There are various technological solutions for how to electronically monitor hand hygiene compliance. The key is that they are capable of capturing 100 percent of hand hygiene events, not a statistically insignificant sample, as is the case with direct observation. Observer bias and the Hawthorne effect are thus eliminated. There are two major approaches for electronic monitoring. One approach uses systems that monitor and give feedback at the group, unit, ward, or department level. They do not identify individual performance but rather capture all the hand hygiene events on the unit (think "numerator") and compare it to how many there should have been (think "denominator") based on various standards of care, such as before and after patient contact, upon room entry and exit, or the WHO 5 Moments for Hand Hygiene. Research has shown that accurate and reliable denominators can be pre-determined (Steed et al., 2011; Diller et al., 2014) and that empowering the group or unit with the responsibility to identify their own obstacles and barriers to proper hand hygiene, create action plans to remove them, and establish their own goals can lead to sustainable improvement over time (Son et al., 2011). The second approach is individual monitoring. These

systems can either stand alone or be integrated with a real-time location system. In these systems, individuals typically wear badges that communicate with the soap and sanitizer dispensers to identify whether hand hygiene occurred when it should have (for example, on room entry and exit). Some of these badge-based systems have 'gentle reminders' such as a vibration or light that reminds healthcare workers to clean their hands if they have not followed the system's rules. They allow for tracking and reporting on an individual healthcare worker's performance so they can receive personal feedback. Both types of systems provide data, reports, and dashboards generated automatically in real time or very close to it to enable actionable feedback. There is no need to compile direct observation data and create graphs, which can take 30 days or more. Feedback must be timely to effectively change behavior. Most importantly, electronic monitoring systems tell the truth, better enable accountability, and can drive real performance improvement from an honest baseline. Accurate, reliable, timely, and actionable data is the key benefit. Hospitals considering adoption of electronic monitoring should consider which approach and technology best suits their culture, philosophy and budget."

Hospitals considering adoption of electronic monitoring should consider which approach and technology best suits their culture, philosophy and budget.

In his review, Boyce (2017) outlines the advantages and disadvantages of electronic compliance monitoring systems (ECM). Regarding the advantages, he remarks: "Unlike observational surveys, ECM systems require only limited personnel resources once they have been installed. Such systems can continuously provide estimates of the number of HHOs, HHEs, and estimated compliance rates during all shifts and all days of the week. The amount of data that ECM systems can collect on the number of HHOs is orders of magnitude greater than is feasible with direct observation. Based on published data, studies that varied in the types of hospital wards involved and the number of rooms equipped with ECM (and number of HCP with badges if used) have reported the equivalent of from 5,000 to >150,000 HHOs/month. For example, one ECM study recorded HHOs during a 10-day period, equivalent to approximately 143,000 HHOs/month in one medical intensive care unit. Fortunately, ECM systems have integrated data analysis tools that can summarize large amounts of data quickly and provide rapid feedback regarding estimated compliance rates by shift, by ward, and by individual HCP in the case of badge-based systems. Systems that utilize HCP-specific badges can also identify peripatetic personnel who can act as super-spreaders if poorly compliant with recommended hand hygiene practices. ECM software can generate customizable reports, which can reduce the amount of time that hand hygiene program personnel spend on generating monthly reports. Such systems have also facilitated analysis of the effect on estimated compliance rates of various interventions such as different forms of immediate reminders, other feedback strategies, and positive deviance programs, as well as the effects of the duration of auditor observation periods and room location on compliance rates, and the extent of the Hawthorne effect. ECM systems are not affected by observer bias and the type of Hawthorne effect that occurs during the presence of an auditor performing direct observations. Some, but not all, ECM systems can provide HCP with immediate feedback in the form of audible, visual, or vibration reminders, depending on whether or not the individual performed hand hygiene upon entering or exiting the patient's room. ECM systems that can give HCP timely and individual data on their performance, if nonpunitive, may be among the most effective means of providing feedback on hand hygiene practices. A few systems have the capability of notifying hospital personnel when hand hygiene product dispensers need to be refilled."

It is important to note that not all electronic systems require a capital expenditure. Different manufacturers may provide different types of financial models.



In terms of the disadvantages, for most but not all systems Boyce (2017) notes, " Installation of these systems requires capital equipment expenditures that do not occur with direct observation. The costs of the door minder or activity monitoring systems are greater than installing only electronic counting devices in dispensers, but are less expensive than most badge-based systems. For example, Sahud, et al. (2012) estimated that a badge-based system would cost $500/room for fixed sensors and $150 per wearable sensor. Another study estimated that installing a badge-based system in a 20-bed stepdown unit cost $50,000. In addition to the hardware and wireless networks required by ECM systems, support from information technology experts may be routinely necessary. Maintenance costs might include replacement of batteries and any defective sensors. Effective validation of an ECM system and achieving high levels of sensitivity and specificity is very important, because HCP who doubt the accuracy of ECM systems will disregard the compliance results reported by the system, or may refuse to wear a badge if they believe the system does not accurately reflect their use of ABHR. Acceptance of ECM systems by HCP are also influenced by concerns over HCP privacy and how compliance data will be handled by administrators. Attitudes of patients regarding the use of badge-based ECMs is another issue to consider. Technical issues that may affect the accuracy of ECM systems include exclusive use of line-of-sight technologies for dispenser-badge communication, suboptimal location granularity, attribution of dispenser use to >1 individual near a dispenser, and interference with the hospital's existing wireless network.

It is important to note that not all electronic systems require a capital expenditure. Different manufacturers may provide different types of financial models.

Overcoming Healthcare Personnel Resistance

Al Salmana, et al. (2015) found that technology can be used effectively in promoting and improving hand hygiene compliance in hospitals. The researchers report that a number of interventions were used to improve hand hygiene by healthcare personnel, including adoption of skin-friendly and pleasant-smelling alcohol-based handrubs in the dispensers to encourage their use; adoption of skin-friendly and pleasant-smelling liquid soap next to the sinks; training and education of HCWs regarding the importance of proper hand hygiene; highly visible WHO posters and brochures were made available as reminders for the "Five Moments" of hand hygiene and the hand rubbing procedure; as well as the official decision by the upper management to comply with the WHO guidelines. However, the 1,000-bed hospital in the study also decided to trial an electronic hand hygiene monitoring system. The system monitors the HCW before entry into a patient's zone and after exiting the patient's environment, corresponding to specific moments 1 and 4 of hand hygiene, as defined by the WHO. The average hand hygiene compliance started at approximately 60 percent on the first day of the 28-day trial and ended at an average of 82 percent on the last day of the trial, with an overall compliance rate of approximately 71 percent; averages were calculated automatically by the software based on the ratio of positive opportunities/total number of opportunities. Regarding the breakdown of opportunities, Al Salmana, et al. (2015) found that Moment 1 (before patient contact) had a 65 percent average compliance rate, while Moment 4 (after patient contact) showed a 74 percent average compliance rate. Of a total of 10,700 hand hygiene actions, 2,247 (21 percent) were performed with soap and 8,453 (79 percent) were performed with

alcohol-based sanitizer. In recorded cases of exposure to bodily fluid, it was observed that both soap and water and an alcohol-based handrub were used by some HCWs.

Al Salmana, et al. (2015) emphasize that they were specifically examining the impact of technology on healthcare professionals' behavior and its implementation in a medical unit, and not trying to evaluate its impact on diminishing HAIs. The researchers acknowledged that resistance to change is a significant concern in a healthcare environment when introducing a new technology and is difficult to overcome. As Al Salmana, et al. (2015) say, "It is clear that the use of this particular technology in this specific case seems promising and advantageous to the overall healthcare environment and that it is a step toward the establishment of a strong safety culture within the hospital organization. There were many errors and loops in this trial, but it seems that the installation of such a system, after taking care of the errors, should give positive results, especially if implemented for a period of longer than one month. Overall, the experience has proven that despite the strong resistance to change from some of the HCWs, the technology was well received by most HCWs, patients and even visitors. Management's efforts are crucial in the implementation of a new technology, and additional efforts from that front would be important. However, a small dilemma remains: as observed in one emergency case, all HCWs directly or indirectly involved in interacting with this patient took off their badges. This makes us wonder whether the use of technology in this particular case should be a way to improve the quality of care or whether it should be imposed as a crucial method that is indispensable to proper healthcare techniques. As a general finding, this study shows that resistance to technology, although significant at first, might be countered and thus reduced. Adaptation and customized methods must be followed to ensure the best acceptability and reduced reluctance of professionals toward the use of an innovation."

Conway (2016) reminds us that healthcare organizations have unique cultures that must be taken into consideration when evaluating and installing ECM systems.

Conway (2016) reminds us that healthcare organizations have unique cultures that must be taken into consideration when evaluating and installing ECM systems: "One aspect of culture is the degree to which individuals are held personally accountable for processes and outcomes. Electronic HH systems can monitor either groups or individuals. If the organization's primary goal is to support a 'just culture' that balances the need to openly acknowledge and learn from mistakes with the need to take disciplinary action, then an HH system that monitors individuals is needed. Conversely, if the organization's primary goal is to support a team culture in which the entire work group or unit owns HH, then individual identification is not needed. Obviously, HCP themselves have preferences for individual versus group accountability for HH."

Experts say that securing staff buy-in and trust is essential to the ECM system installation process. As Conway (2016) emphasizes, "An electronic monitoring and feedback system cannot fulfill its purpose if the professionals it is designed to serve do not accept it. The purpose of HH monitoring is to gather information and give it back to HCP so they can use it to change their practice. If HCP are distrustful of how others will use the information or if they doubt the accuracy of the system, it is unlikely they will respond to the data it yields ... Boscart, et al. tested a prototype system in a simulation lab. Fourteen HCP wore personal ABHR dispensers and small tags that sensed when the HCP was near a patient zone, issued a prompt to perform HH, and recorded compliance.

The main concern of HCP was about the availability and confidentiality of the data collected. They suggested that policies and procedures be put in place delineating what data would be collected, who would have access to the data, and how it would be used. The degree of concern for privacy and confidentiality varied among HCP. In a follow-up feasibility study of the same system, none of the 11 participants expressed concerns about being monitored. In an implementation study of the same system, 14 nurses did not raise any privacy or data confidentiality issues."

Accuracy of Monitoring and the WHO My 5 Moments for Hand Hygiene

One of the most debated aspects of ECM systems is the ability to capture all hand hygiene opportunities, as opposed to just WHO Moments 1 and 4 -- room entry and exit. Conway (2016) points to the top concern of HCP in Ellingson, et al.'s focus groups -- the accuracy of the system, in particular its ability to identify all valid hand hygiene opportunities: "HCP were concerned that without contextual information, automated systems that measured proxy HH opportunities such as room entry and exit would mistakenly count noncontact room entries as opportunities. Their concern is warranted because all electronic systems have limitations. The systems compute HH compliance by dividing the number of HH events by the number of HH opportunities that occur during a given time frame. Both the numerator and denominator present challenges. Dispensers in most systems are designed so that repeat depressions of the lever within 2 seconds are counted as a single HH event, preventing inflation of the compliance rate by people who double-dispense. Systems that rely on alcohol sensors do not count HH events using soap and water, so in settings where Clostridium difficile or norovirus infections are frequent, HH may be underestimated. Some systems count HH events from personal pocket-sized containers of ABHR, whereas others do not. Conversely, HCP compliance can appear higher than it is in simple systems where dispensers count all HH events, including those by visitors and the patients themselves. However, the amount of distortion this cause is unknown."

HH opportunities occur in 5 moments (M) described by the World Health Organization: M1 is before touching a patient, M2 is before an aseptic procedure, M3 is after body fluid exposure risk, M4 is after touching a patient, and M5 is after touching a patient's environment.

A significant challenge, as we have seen, is collecting accurate numerator data. Initial tests of RFID systems by Filho, et al. showed that they occasionally discredited two HCP with the same HH action if both were within range of the dispenser, or discredited an HH event performed by a person who was not wearing a badge to the nearest badge-wearing HCP. These technical problems were successfully resolved in a subsequent study by the same group. In a test of an RFID badge system by Pineles, et al. in the clinical setting, badges only credited HCP with about half of their HH events. This was believed to be because HCP did not position themselves directly in front of the reader-dispenser, or performed HH on the fly.

Conway (2016) says that getting the denominator right is even more challenging: "HH opportunities occur in 5 moments (M) described by the World Health Organization: M1 is before touching a patient, M2

is before an aseptic procedure, M3 is after body fluid exposure risk, M4 is after touching a patient, and M5 is after touching a patient's environment.4 Systems that monitor room entry and exit capture M1, M4, and M5. Systems that monitor the immediate patient zone captures M1 and M4. At least one system uses a formula to estimate the total number of HH opportunities based on all 5 moments. The formula arose from direct observations of HH opportunities done by Steed, et al (2011), who found that the number of HH opportunities on a unit correlated with the patient census and the patient-to-nurse ratio, after accounting for the type of unit. The same group subsequently implemented a system that used the formula, and compared the system-generated compliance rates to the gold standard (direct observation). Trained observers directly monitored HH compliance by viewing video of 26 patients on a medical unit for 1,511 hours of the patients' total 1,671 hours of stay. Quarterly compliance rates by direct video observation ranged from 66 percent to 75 percent and compliance computed by the electronic system ranged from 65 percent to 71 percent over the same 5 quarters. The results are encouraging in that they suggest it may be possible to accurately measure all 5 moments using electronic systems. However, further validation studies are needed." Diller et al (2014) validated the previously derived hand hygiene opportunities per patient day developed by Steed. Azim (2016) conducted a subsequent study at an 850-bed teaching hospital in Australia to test the data collection system and found no significant differences in the average hand hygiene opportunities reported by Steed.

It is essential to discuss with HCP ahead of implementation how the data will be collected and used. It is worthwhile to buy the most accurate system the organization can afford, and to take time to get the inputs right.

Conway (2016) continues, "The importance of monitoring all five moments for HH is not certain. Most electronic systems only measure compliance on room entry and exit, missing opportunities that occur inside the room; however, most direct observation is also conducted this way. Research has shown that monitoring only entry and exit to/from the patient zone captures 80 percent to 85 percent of HH opportunities. [Other research has indicated room entry and exit represents a lower percentage of total opportunities, ranging from 43 percent (Diller, 2014), 48 percent (Steed, 2011) to 61 percent (Azim, 2016)]. Further, Stewardson, et al. found that in non-ICU hospital wards, estimated compliance rates based on M1 and M4 were very similar to rates based on recording all five moments. Electronic monitoring of only entry and exit compliance has its own challenges. In an early attempt to monitor compliance electronically, Swoboda, et al. counted every room entry and exit as opportunities for HH, including instances when HCP did not touch the patient or his environment. The electronic compliance rates were consistently 20 percent lower than simultaneously observed compliance rates, and the authors attributed the difference to an overestimation of HH opportunities by the electronic system. Complicating matters is the fact that HH opportunities often overlap, such as when a nurse exits one patient zone (M4 and M5) and immediately enters another patient zone (M1). In a study by Boscart, et al., more than 5 percent of entry opportunities overlapped with exit opportunities. In such cases, HH compliance was miscalculated by the electronic system. A subsequent system rectified this problem by combining exit–entry opportunities occurring within 2 minutes as a single opportunity... staff are more likely to buy-in to a system if they know and are willing to work with its limitations. It is essential to discuss with HCP ahead of implementation how the data

will be collected and used. It is worthwhile to buy the most accurate system the organization can afford, and to take time to get the inputs right."

Boyce (2017) alludes to the unresolved issues of capturing data: "Although there is substantial evidence that monitoring of all 5 Moments as part of interventions based on the WHO multimodal hand hygiene improvement strategy has improved hand hygiene compliance rates, not much is known about how compliance with a single Moment might influence compliance with other Moments, and how compliance with Moments 1, 4 and 5 might change if Moments 2 and 3 are no longer monitored. As a consequence, continued efforts to further develop electronic monitoring systems that can also detect compliance with Moments 2 and 3 are desirable."

Pires and Pittet (2017) issue caution when electronic systems available use surrogate markers of hand hygiene opportunities "that are, for the most part, quite distant from the meaningful 5 moments proposed by WHO. In addition, if there are fewer attempts to monitor moments 2 and 3, we might depart from the initial objective of hand hygiene monitoring. The risk is to accumulate large amounts of data of questionable relevance. Even if, as mentioned by Boyce, monitoring moments 1, 4, and 5 provides reasonable estimates of compliance with all the 5 moments, this does not mean that we may safely stop monitoring moments 2 and 3. Monitoring, training, and education go hand in hand. Discontinuing the monitoring of moments 2 and 3 could result in a dangerous decrease in compliance, especially with moment 2. In addition, this would go unnoticed because of the very fact that they would no longer be monitored. We respectfully disagree with the idea that monitoring moments 1, 4 and 5 is enough for a successful hand hygiene improvement strategy. Monitoring systems should aim to reflect the 5 moments, which implies taking into account concepts such as patient zone and healthcare zone and detecting aseptic procedures, potentially contaminated sites, and use of gloves. Electronic monitoring systems have other great potential as providing constant reminders and immediate feedback to HCWs at the point of care. These can be of great added value in promoting and maintaining behavior change. Additionally, electronic systems can also play a role in monitoring and improving the quality of the hand hygiene action. ABHR dispensers can record and set the volume used by HCWs, and other systems are available for training the hand hygiene technique that could also be used at the bedside."

Today's quality leaders and patient safety professionals must find new evidence-based ways to improve practices and standards of care, choosing methods that are both effective and relatively easy to implement in their organization's culture

The Fiscal Imperative and Overcoming Cost Objections

There is a considerable fiscal imperative associated with hand hygiene compliance monitoring; As Alper (2016) states, "As the Centers for Medicare and Medicaid Services (CMS) levies penalties that demand hospitals improve quality or lose revenue. With the new penalty for hospital-associated conditions, including HAIs, imposed under the Affordable Care Act (ACA), hospitals can lose 1 percent of their total CMS revenue if they fall into the lowest-performing quartile of U.S. hospitals, so there are serious dollars at stake. In 2015, 724 hospitals were penalized, and 758 are being penalized in 2016, 54 percent of which are in the penalty zone for the second time (Evans, 2015). Today's quality leaders and patient safety professionals must find new evidence-based ways to improve practices and standards of care, choosing methods that are both effective and relatively easy to implement in their organization's culture."

Conway (2016) asserts that cost information in the literature can be a challenge to secure: "To our knowledge, no cost-effectiveness study of an electronic HH monitoring system has been published. In a recent survey of automated or semi-automated HH monitoring systems by McGuckin and Govednik, 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 costs ... It is impossible to compare costs among the systems in these reports because their configurations differed and not all costs were accounted for. However, the costs for most systems appear to be substantial. Infrastructure costs may be more acceptable to facility administrators if the system monitors more than just HH compliance (i.e., whether it can also be used for asset tracking, patient tracking, or nurse call)."

As we have seen, Edmisten, et al. (2017) acknowledges that the implementation of an electronic HH monitoring system requires "an investment of capital, resources and time." In their study, the healthcare facilities reported many months of planning before any implementation activities: "One facility piloted the system in a single unit before moving house-wide; this allowed for workflow issues to be discovered on a small scale but substantially increased the overall length of implementation. Delays in implementation should be expected; for one facility, the installation of dispensers and dispenser beacons took four weeks instead of the planned two because of hospital workflow conflicts, personnel availability, and other confounding factors."

5 Reasons Why You Should Automate Hand Hygiene Compliance

Washing your hands is a simple yet effective way to prevent the spread of infection. But according to the CDC, healthcare workers clean their hands less than half of the times they should, facilitating the spread of new infections. Manual direct observation of hand hygiene events is simply an outdated method to monitor or improve compliance within healthcare facilities. Electronic hand hygiene compliance is an innovative approach that has been proven to improve compliance, reduce infections and their associated costs and enhancing the patient safety environment. Here are 5 reasons why you should automate hand hygiene compliance:

1. Manual observation is painfully inaccurate, accounting for a mere 1.2 percent to 3.5 percent or less of all hand hygiene events that take place within a healthcare facility. Observation of such a small sample does not provide an accurate representation of hand hygiene compliance within a hospital. In addition, manual observation allows for the Hawthorne Effect, which is the potential to influence the behavior of those who know they are being observed. In a hospital setting, this phenomenon translates to inflated rates of hand hygiene compliance. It is a proven fact that the Hawthorne Effect has caused hand hygiene compliance rates to be overstated by up to 300%. Electronic hand hygiene systems are capable of recording 100 percent of hand hygiene events creating a true picture of healthcare workers' hand washing habits.

2. It holds healthcare workers accountable. With data corresponding to 100 percent of all hand hygiene events, hospital staff are held accountable for washing their hands all the time, not just the times they are being physically watched for compliance. Notifications and alerts serve as friendly reminders to staff to keep in accordance with hospital standards for clean hands.

3. It prevents infection. While receiving medical treatment at a hospital, patients are at risk of contracting healthcare-associated infections (HAI). In fact, according to the CDC, about 1 in 25 hospital patients contracts at least one healthcare-associated infection during their stay. HAI accounts for more than 700,000 unnecessary infections annually, while an average of 75,000 of those patients die during their hospital stay. Utilizing an electronic monitoring solution promotes hand hygiene compliance and has been proven to reduce infections and their associated costs. Upon implementation, electronic monitoring data can deliver an objective, consistent, and long-term means of collecting and reporting data to improve patient safety.

4. It saves money. Healthcare-associated infections mean more time spent in the hospital, and higher costs to healthcare facilities. According to the CDC in a 2009 report on HAI related costs, the average annual per patient cost to a hospital for all HAI was $18,581. The report also indicates that if just 20 percent of infections were prevented, the cost savings would be between $5.7 and $6.8 billion. Electronic monitoring has been associated with a savings of more than $433,000 in the first year on a 647-bed implementation.

5. It improves clinical workflow. Unlike other types of monitoring, an electronic hand hygiene monitoring system may not interfere with workflow to the degree that it does not require any effort on the healthcare workers' part. There are no distractions and no manual recording of information. In fact, electronic monitoring can potentially improve workflow because of its ability to be seamlessly integrated into a healthcare worker's routine.

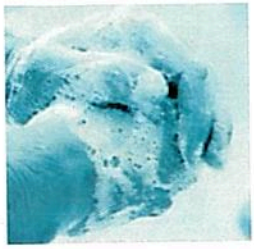
Source: EHCO, Electronic Hand Hygiene Compliance Organization

Edmisten, et al. (2017) continue, "These systems also require a defined plan for maintenance to ensure system continuity. System maintenance faces two major challenges. First, the presence of the beacons adds new processes to standard bed and dispenser maintenance that require additional technical skills. Facilities considering these systems should plan for regular education and training of maintenance staff and/or contracted maintenance services with the system vendor. Second, maintenance activities often occur in short, high-demand bursts due to system characteristics, such as the annual replacement of batteries for system components (badges, beacons, and hubs). Coordination of these high-demand maintenance activities can be challenging due to inadequate staffing levels to support the temporary increase in workload and a lack of opportunities for staff to refresh their technical skills for these tasks. For these reasons, the facilities profiled here have expressed a preference for contracted services for all known annual scheduled maintenance events. Overall, the maintenance of the system is paramount to program functionality. Without regular upkeep, the system can capture inaccurate data. If left unaddressed, this problem can escalate and will require a larger-scale remediation effort requiring analysis of data exports in consultation with vendor experts to determine the sources of inaccurate data and the corrective actions required to return the system to full functionality."

Healthcare facilities considering electronic monitoring also must understand whether maintenance is included in the cost of adopting the system.

Healthcare facilities considering electronic monitoring also must understand whether maintenance is included in the cost of adopting the system.

Technology Evaluation and Purchasing



Technology can improve statistical reliability of compliance rate results. An electronic system may provide more constant and consistent results, because they are designed for 24/7 active monitoring. Unlike human observers, electronic systems capture most patient room entry and exit episodes. However, according to the WHO's Systematic literature review of automated/electronic systems for hand hygiene monitoring whitepaper, most of these systems fail to identify standard indications for hand hygiene. In addition, most systems also fail to distinguish between a hand hygiene indication and opportunity. "Thus, the electronic/automated systems currently available are not able to detect moments when microbial transmission most likely occurs. These systems are also usually unable to identify HCWs and individual hand hygiene opportunities and actions, and to evaluate glove use or the appropriateness of the hand hygiene technique. Finally, cost-effectiveness remains unknown and suitability for use in settings with limited resources is quite unlikely."

In terms of electronic systems' benefits, the same WHO whitepaper notes, "Several advantages of automated monitoring systems are recognized: the possibility of continuous monitoring, a lower Hawthorne effect, saving in terms of human resources and the possibility of down-loading and analyzing data automatically for repeated measurement. Apart from monitoring, the implementation of these systems has also been studied as an intervention to improve hand hygiene with successful results." The whitepaper adds, "... these new technologies are promising and could be part of the future approach to hand hygiene compliance monitoring when available resources permit it and provided they reflect the WHO Five Moments for hand hygiene indications. Additional research is needed to support their adoption as a standard. However, direct observation of hand

hygiene compliance and performance technique, [for] continuing education at periodic intervals are still needed."

To facilitate their technology-related product evaluation and purchasing decision-making, healthcare institutions must seek as much information as possible. One source is the Electronic Hand Hygiene Compliance Organization (EHCO), formed in 2015 and comprised of companies that offer electronic monitoring technologies. The alliance's purpose is to increase safety, reduce avoidable harm, and eliminate unnecessary costs at hospitals nationwide. It promotes changes in hand hygiene measurement policy and guidelines at accreditation organizations, government agencies, health insurers, and hospitals. According to the organization, EHCO's goals align with those of hospital leadership: to reduce the risk of HAIs along with associated costs and potential penalties. EHCO says it invites patient safety and quality leaders to consider the real cost of using antiquated methods of measuring hand hygiene compliance and suggests that now is the time for hospitals to change how they measure this key performance indicator of patient safety and quality.

So, while electronic hand hygiene monitoring systems can boost objectivity, they can be expensive, require a learning curve among staff, and may in some cases require information technology-related infrastructure. Additionally, there is a wide range of systems in the marketplace with differing levels of features. Considerations to bear in mind when evaluating systems are:

- How the system fits into the existing clinical workflow
- Is it easy to implement and work with existing dispensers?
- Can it track individual compliance?
- Will there be support for the behavior change after installation of the technology?

When evaluating a system, consider the following questions:

- What are our hospital's goals for hand hygiene and infection prevention?
- How will the system impact staff workflow and culture?
- What resources are required to install and roll out the system?
- What are implications for staff time? How is the system maintained?
- What data is generated and how can my hospital use it?

Additional clinical questions to consider are as follows:

- Does the system add steps to the healthcare worker workflow?
- Does the system provide real-time data?
- What compliance data is important to you?

Additional technical questions to consider are as follows

- What are the power requirements (wires, outlets, batteries, etc.)?

- Does the system work with your existing soap/ sanitizer dispensers or products?
- Can the company support a system-wide implementation?
- What clinical reports and maintenance support are provided after installation?
- What will IT need to understand?

Leaders must be committed to actively guiding the organization through the implementation process. To ensure that data generated by the system are used to make improvements, feedback should be delivered directly to HCP in a format that is meaningful to them.

Conway (2016) says that electronic hand hygiene monitoring systems "offer the exciting prospect of a more precise, less biased measure of HH performance than direct observation," but acknowledges that these systems require thoughtful installation and demand proper implementation and use: "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 frontline 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." Conway (2016) continues, "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. 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."

These challenges can be overcome, Conway (2016) says, especially if a healthcare organization selects an appropriate system. Conway (2016) advises that facilities ponder several key considerations:

1 Physical infrastructure

Determine if the electronic system under consideration requires existing hand hygiene-product dispensers be replaced, and whether it provides either touch-free dispensers or manual dispensers in locations inside patient rooms as well as in hallways. Electronic systems that monitor freestanding and personal dispensers in addition to wall-mounted dispensers are available. Some systems require fixed hard wiring, which necessitates changes to existing infrastructure such as walls and ceilings to mount sensors in the patient zone. Some systems require that data stored in devices be uploaded manually to a computer while other systems automatically and wirelessly upload data to a central server. Some wireless systems have the potential to interfere with medical equipment or to overload existing wireless networks.

2 Workflow

Determine if implementing an electronic system may interrupt workflow or require a change in HCP behavior, if badges or monitoring tags are involved.

3 Using the data to monitor and effect change

Ensuring workers use outputs from the system to improve their practice is an ongoing challenge.

4 Providing feedback

Workers who do not receive feedback, or who receive feedback that is meaningless to them, will be unable to act on the data. Also, consider that individuals have different feedback needs.

5 Engagement with the data

Leaders are responsible for ensuring that quality and safety data are acted upon, including electronic HH compliance data. Developing action plans based on electronic HH data is challenging because some systems do not provide contextual information. Unlike direct observation of practice, current electronic systems cannot evaluate HH technique or uncover reasons for noncompliance, nor can they identify which of the 5 moments for HH are being missed or whether HH is being performed without any indication. As Conway (2016) notes, "For this reason, direct observation of HH is needed to supplement electronic data and provide a fuller picture of HH compliance. In addition, some systems allow users to generate custom reports by dispenser, by shift, by assigned rooms, or by individual. Examining the data in this way can provide the specific information needed to develop action plans."

Conway (2016) emphasizes that, "Leaders must be committed to actively guiding the organization through the implementation process. To ensure that data generated by the system are used to make improvements, feedback should be delivered directly to HCP in a format that is meaningful to them. Targeted direct observations of HH compliance may be needed to supplement information from the electronic system."

Electronic systems are no magic bullet, but constitute a promising tool to further improve hand hygiene and patient safety when integrated in a wider multimodal approach. -- Pires and Pittet (2017)

The Future

In terms of a direction for the future, Pires and Pittet (2017) observe, "Electronic monitoring systems have other great potential as providing constant reminders and immediate feedback to HCWs at the point of care. These can be of great added value in promoting and maintaining behavior change...Some questions remain unanswered. Although a few single-center, uncontrolled studies show a trend toward hand hygiene improvement, no robust study has definitively demonstrated the added value of electronic monitoring systems in improving hand hygiene and reducing HAI. In addition, the costs —and thus the cost-effectiveness—of these systems remain to be determined. Further research is needed to demonstrate the possible benefit of the use of direct observation combined with electronic monitoring to change HCWs' behavior and reduce HAI. To conclude, electronic monitoring devices could provide continuous monitoring, real-time reminders and feedback, and automatic analysis of data and may ultimately save human resources. However, hand hygiene monitoring is not an end in itself but one element of a multimodal strategy. It provides an outcome indicator that reflects HCWs' behavior and improves the understanding and practices of hand hygiene. To fulfill these criteria, the My 5 Moments for Hand Hygiene concept needs to be reflected by the monitoring systems. Electronic systems are no magic bullet, but constitute a promising tool to further improve hand hygiene and patient safety when integrated in a wider multimodal approach."

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A Q&A with DebMed

This educational Guidebook, authored by ICT and underwritten by DebMed, is provided at no cost to users. DebMed shares its clinical expertise in this Q&A, designed to educate infection preventionists regarding smart product evaluation and purchasing in the hand hygiene category.

Q: What are the primary considerations decision-makers should keep in mind when evaluating and purchasing an electronic hand hygiene compliance monitoring system?

A: The most important consideration when evaluating electronic monitoring is to realize the time is now. Hospitals pioneering this technology years ago now have demonstrated clinically significant MRSA and C. difficile reductions proving the power of electronic monitoring to improve patient safety.[1-2] We've long known hand hygiene is the most important way to reduce healthcare-associated infections. What was missing was a truly effective, proven tool for measuring performance – which is fundamental to improving it. Today's electronic monitoring systems are capable of capturing 100 percent of hand hygiene events to accurately and reliably report compliance – proven in numerous studies to enable sustained improvement.

While electronic monitoring may seem complex, it doesn't need to be. Considerations:

- Are there clinical and cost reduction studies supporting the technology? System providers should provide this data.
- What is the IT impact? There are systems that require no integration with the hospital's IT infrastructure.
- What hardware is needed? Some systems use employee badges and track movements, others do not.
- What is the cost to implement and maintain the system? Healthcare executives need to know what ROI to expect.

The DebMed® System doesn't require badges or complicated equipment and can be set up on a unit in just a couple of hours. It has been clinically proven in a peer-reviewed published study to reduce HAIs.[1] Users have seen sustained increases in hand hygiene compliance in as little as 90 days. With patient outcomes and financial outcomes at stake, healthcare executives who are ready to elevate their patient safety culture now have an empowering, proven tool to help reach their goals.

Q: Why is it critical to base a hand hygiene compliance monitoring system on the World Health Organization (WHO) Five Moments for Hand Hygiene and CDC guidelines?

A: Hospitals educate and train staff on hand hygiene in accordance with CDC guidelines[3] and/or WHO 5 Moments guidelines, which are largely consistent. WHO 5 Moments is an education model that visualizes the indications for hand hygiene in the Patient Zone: 1) Before Patient Contact, 2) Before Aseptic Task, 3) After Fluid Exposure, 4) After Patient Contact and 5) After Contact With Patient Surroundings.[4]

In monitoring and tracking performance, a serious limitation of the historical direct observation method was the inability to effectively monitor hand hygiene activity inside the patient room, where Moments 2, 3 and 5 take place. Yet, as Diller et al (2014) pointed out, a commonly observed effect is that healthcare workers only clean their hands at entry and exit, which increases the risk of being recontaminated after entering the room.5 Similarly, many electronic monitoring systems primarily track room entry and room exit, capturing only Moments 1 and 4.

While tracking compliance upon room entry and exit has historically been considered a marker for hand hygiene compliance, this was because it was the only method available, not because it was an evidence-based practice.

Now many healthcare facilities are seeking a system to evaluate compliance on all 5 Moments to measure against the same practices actually in use – an important element to significantly improve performance. The DebMed® system captures 100 percent of hand hygiene events, even those at the point-of-care, and measure performance on WHO 5 Moment as well as Canada 4 Moment guidelines.

Q: What are the key aspects of the user experience that are essential to a successful system?

A: Key criteria for evaluating an electronic hand hygiene monitoring system:

System Fundamentals

How does the system monitor, track and report compliance?

What does it actually measure? Does it monitor room entry and exit primarily, or 5 Moments?

Does the system report at the group level or on individuals?

Evidence-Based

What clinical studies, papers or other outcomes data does the company provide?

System Reporting

Does the system provide real-time feedback?

Are reports timely and easy to interpret?

How will we use this data to drive performance improvement?

Impact to Workflow

In what ways does the system impact clinical workflow? For example, with badges or alerts.

Vendor Approval Requirements

What is the corporate structure and stability of the manufacturer?

Does the company have a history of successful installations?

Are references provided?

Support for Education, Training, and Culture Change

What support does the vendor provide for initial and ongoing training?

Does the company support the multimodal strategy with educational, reminder, corporate culture, and other tools?

Is the system compatible with a blame-free culture fostering collaboration for identifying obstacles and improving performance?

Installation requirements

What type of hardware and equipment is required?

How long does it take to install?

Does the system work with existing soap and sanitizer dispensers?

Can point-of-care pump bottles be monitored?

What resources and steps are required to implement the system?

What maintenance and upgrades are included after installation?

What support is required from IT?

What is the impact, if any, to the hospital's IT infrastructure?

Q: Which studies point to the efficacy of electronic hand hygiene compliance monitoring systems?

A: Years ago, when electronic monitoring was in its infancy, there were few, if any studies that demonstrated results from use of these systems. That's no longer the case. There are different types of electronic systems available, and there are now published clinical studies and clinical papers that show the ability to effect sustained performance improvement, including increases in compliance, reductions in infections, and even cost reductions.

Kelly, et al. (2016) in a published, peer-reviewed study demonstrated that use of the DebMed System, measuring hand hygiene compliance based on WHO 5 Moments, enabled a 746-bed teaching hospital to improve hand hygiene compliance by 25.5 percent; reduce hospital onset MRSA infections by 42 percent; and reduce costs by $434,000 over the study period.[1]

Robinson et al (2014) evaluated use of the DebMed System in addressing C. difficile transmission on a hematopoietic stem cell transplant unit. Use of electronic compliance data enabled the unit to improve hand hygiene compliance from 77.4 percent to 93.9 percent, ensure adherence to soap and water protocols, and reduce C. difficile infection rate from 7.03 to 2.38/10,000 patient days.[2]

Bouk, et al. (2016) determined that use of the DebMed® System as part of a multimodal strategy of training, leadership engagement and daily feedback resulted in an increase in hand hygiene compliance from 57 percent to 79 percent; a reduction in hospital-onset MRSA rate from 3.94 to 1.98/10,000 patient days; and avoidance of a repeat readmission penalty.[6]

Q: What are some suggestions for how to effectively introduce and educate on a hand hygiene compliance monitoring system to healthcare workers?

A: The guidance on hand hygiene education identifies specific strategies for promoting hand hygiene, including training, motivation, and system change (CDC).[3] WHO provides an evidence-based model for a multimodal hand hygiene improvement strategy.[4]

Evaluation and feedback is a critical component of the multimodal strategy. A meta-analysis of 41 studies, including 19 outcomes studies, provided evidence that the strategy is effective at increasing hand hygiene compliance.[7] In fact, the Joint Commission National Patient Safety Goal 7, to reduce the risk of healthcare-associated infections, requires an accredited hospital to "assess its compliance with the CDC and/or WHO guidelines through a comprehensive program that provides a hand hygiene policy, fosters a culture of hand hygiene, and monitors compliance and provides feedback."[8]

Electronic compliance monitoring, in particular, fits well with the strategy, because of its capability to deliver objective, regular and reliable performance feedback.

Hospitals embracing electronic monitoring have used these practices successfully to introduce and leverage electronic measurement to drive sustainable change in performance:

- Setting goals and engaging staff in identifying barriers to hand hygiene compliance[1]
- Use of a problem-solving tool such as the Joint Commission Targeted Solutions Tool[9]
- Implementing unit-specific ideas and solutions for improvement[1]
- Improving access to dispensers [1,6]
- Designating unit champions [1,6]
- Regular sharing of unit level data and/or patient room level data in daily huddles[10]
- Posting educational and reminder materials[1,6]
- Frequent communication from facility executive leadership reinforcement hand hygiene[6]
- Use of direct observation for real-time coaching and feedback of individuals (not measurement)[1]

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