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Major Article

An automated hand hygiene compliance system is associated with improved monitoring of hand hygiene

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Key Words:
Central-line associated bloodstream infections
Catheter-associated urinary tract infections
Multidrug-resistant organisms

Background: Consistent hand hygiene is key to reducing health care-associated infections (HAIs) and assessing compliance with hand hygiene protocols is vital for hospital infection control staff. A new automated hand hygiene compliance system (HHCS) was trialed as an alternative to human observers in an intensive care unit and an intensive care stepdown unit at a hospital facility in the northeastern United States.

Methods: 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. Pearson χ^2 tests were used to assess changes in compliance, and incidence rate ratios were used to test for significant differences in infection rates.

Results: During the study period, the HHCS collected many more hand hygiene events compared with human observers (632,404 vs 480) and ensured that the hospital met its compliance goals (95%+). Although decreases in multidrug-resistant organisms, central line-associated bloodstream infections, and catheter-associated urinary tract infection rates were observed, they represented nonsignificant differences.

Discussion and conclusions: Human hand hygiene observers may not report accurate measures of compliance. The HHCS is a promising new tool for fine-grained assessment of hand hygiene compliance. Further study is needed to examine the association between the HHCS and HAI rate reduction.

Health care-associated infections (HAIs) are a substantial concern in U.S. hospitals. Progress has been made in reducing most categories of HAIs over the years.[1] But roughly 1 in 25 patients in the United States has at least 1 HAI during a hospital stay. An estimated 80,000 people die annually in the United States from an HAI.[2,3] Infections caused by multidrug-resistant organisms (MDROs) are of special concern as hospitals develop antimicrobial stewardship programs. Patients in intensive care units (ICUs) are known to be highly susceptible to infections.

HAIs add substantially to health care costs. The total cost for the 5 major HAIs—central line-associated bloodstream infections (CLABSIs), ventilator-associated pneumonia, surgical site infections, *Clostridium difficile* infection, and catheter-associated urinary tract infections (CAUTIs)—is roughly $10 billion per year.[4]

Many infections are preventable through good hand hygiene, defined as using a disinfecting agent such as alcohol-based hand sanitizers or soap and water to kill microorganisms on the hands. Failure to adhere to proper hand hygiene practice is thought to be the leading cause of HAIs.[5] The Centers for Disease Control and Prevention, The Joint Commission, and the World Health Organization support good hand hygiene to reduce HAIs. Compliance is believed to be low globally and has been notably difficult to measure.[3]

There is a widely recognized need for caregivers to be conscientious about disinfecting their hands at every hand hygiene opportunity (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% 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 (eg, emergency cases).[5]

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Conflicts of interest: The maker of the hand hygiene compliance system provided manuscript writing assistance. The authors are solely responsible for the content and conclusions.

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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.[6]

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 h/d, 7 d/wk health care setting.[6]

Background on study site

In recent years, a community hospital in the northeastern United States believed it had a strong hand hygiene program to combat MDROs and other sources of infection. The hospital, a nursing Magnet facility, is located in a suburban area close to a large metropolitan area and is the tertiary hub for a large health care system. In 2010 and 2011, hand hygiene compliance rates were 84% and 91%, respectively. Although these rates are better than some reported national averages, rates were below the hospital's goal of 95% compliance.

To improve compliance, the hospital undertook re-education of staff about hand hygiene, had staff members sign pledges to comply, empowered staff to intervene when they observed others not complying, increased the availability of hand sanitizer and moisturizer dispensers, and subjected noncompliant staff to the institution's disciplinary process.

Measurement of compliance was performed in 2014 on a part-time basis by human observers. The observers were local college students in a work–study program who were trained to conduct observations and to intervene if they saw clinicians not being compliant. The compliance rate was measured by this limited human observation. Infection control staff members were concerned about how accurate the reports of human observations were. Student observers were only able to cover a small number of clinicians over a relatively few hours each month. The work–study program at the college was also influenced by budget cuts. Turnover among student observers made it difficult to maintain a fully staffed and trained observer team. The hospital had a goal of 40 observations per month per unit, but often could not meet that standard. Moreover, the hospital continued to experience a higher-than-desirable rate of patient infections, despite a purportedly high rate of hand hygiene compliance.

There has to date been limited published data about the effectiveness of one alternative: automated hand hygiene systems intended to improve compliance and reduce MDROs.[7] Related data have been promising. A level-1 trauma center in India improved hand hygiene compliance and infection rates for CLABSIs, CAUTIs, and ventilator-associated pneumonia after implementing a hand hygiene compliance system (HHCS).[8]

METHODS

This study did not meet requirements for institutional review board application and approval, and was thus exempt from institutional review board review and informed consent protocols.

Study design and setting

The present study was a single-site, observational, retrospective cohort study of hand hygiene and HAIs in a 292-bed community hospital in the northeastern United States. The study goals were to determine whether implementation of the automated HHCS is associated with improved hand hygiene compliance and a significant reduction in MDROs, CLABSIs, and CAUTIs in the hospital's ICU and ICU stepdown unit compared with the use of human observers. The study was conducted using data from the HHCS, human hand hygiene observer records, routine hospital infection surveillance data, and de-identified electronic medical records over a 2-year period. Data were collected during the full calendar year 2014, when human hand hygiene observers were deployed, and partial year 2015 when the HHCS was in-use (February 16-December 31). The hospital implemented the HHCS in its 8-bed ICU and 25-bed ICU stepdown unit.

Participants

During the first study period in 2014, ICU and ICU stepdown unit caregivers and their compliance with hand hygiene protocols were assessed when human observers were present. During the second study period in 2015, all ICU and ICU stepdown unit caregivers with direct patient contact (nurses, nurse technicians, respiratory therapists, care managers, dietary aides, and housekeeping staff) were required to participate in the HHCS implementation. No caregivers were excluded from the handwashing observations during the first study period, except for those not directly observed by the student workers, and only those caregivers without direct patient contact were excluded from the HHCS implementation during the second study period.

For the purposes of calculating infection rates and rate ratios, all patients in the hospital's ICU and ICU stepdown unit 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.

Data collection and measurement

Hand hygiene compliance

During the 2014 study period, hand hygiene compliance was recorded manually by human observers on a sporadic, part-time basis. A hand hygiene monitoring protocol was developed by hospital infection control staff, and observers, students in a local work–study program, were recruited. Observers received a brief training and were then asked to demonstrate adherence to the protocol with infection control staff. New observers participated in weekly debriefings for the first month and then monthly debriefings thereafter. During observation sessions, student workers were required to record the hand hygiene compliance of all health care personnel within the observed unit, including foodservice and housekeeping staff. Hand hygiene compliance was evaluated on the following activities: upon entering and exiting patient rooms, before patient content, after patient contact, before donning and after removing gloves, and after touching equipment or elements in the environment. Compliance or noncompliance was only recorded on complete patient or health care worker encounters.

Evaluation of hand hygiene compliance was recorded on paper survey forms that included the date, time, location, and job classification of observed health care workers, and compliance or noncompliance of the hand hygiene opportunity. Data from the paper forms were entered into the Midas + electronic hospital quality reporting database (Midas + Solutions, Franklin, TN) and compliance reports were generated quarterly.

In 2015, the HHCS was implemented. The system selected for the automated HHCS, Biovigil (Biovigil Healthcare Systems, Inc, Ann Arbor, MI), has a wearable device designed to remind caregivers to sanitize their hands while also assuring patients and anyone at bedside that hand hygiene has been performed. All ICU and ICU stepdown unit caregivers with direct patient contact were required to participate in the HHCS trial. Electronic badges that caregivers wore throughout their shift had a light that glowed yellow then red until hand hygiene was performed and validated by the caregiver. The light then turned green, providing visual confirmation of compliance. The badge also emitted an audible tone to prompt the caregiver to perform hand hygiene. Each badge was individually set to "know" the name of the caregiver wearing it as well as the worker's job classification and his or her unit or department.

The system differentiated between different types of HHOs—in particular, sanitizer versus soap and water. A chemical sensor in the badge detected the presence of alcohol, confirming that the badge wearer recently sanitized her or his hands. When soap and water were used, the badge recorded the proximity of and time spent at a sink.

When caregivers finished their shifts, they removed their badges for recharging at a base station. The station sent data, individualized per badge, to cloud computing-based applications where reports on compliance were generated and stored. Per unpublished internal testing, the HHCS system captures more than 97% of HHOs (based on room entry or exit) and 100% of hand hygiene events performed provided that the user registers the event with the badge. For alcohol-based sanitizer hand hygiene events, the badge captures compliance with more than 99% specificity.

To ensure a comparable measure in both study periods, hand hygiene compliance was calculated as a proportion, using the number of compliance events over the total number of observations.

Infections and infection rates

Data on infection by MDROs, CLABSIs, and CAUTIs in the ICU and ICU stepdown unit patient populations were collected via routine hospital surveillance per Centers for Disease Control and Prevention National Healthcare Safety Network protocols. Definitions for the infection categories of interest are reproduced below along with the formulas used to calculate relevant infection rates and the patient population at risk.

MDROs

For hospital infection control purposes, MDROs were defined as microorganisms that are resistant to 1 or more classes of antimicrobial agents.[9] Common examples of MDROs collected under routine surveillance include methicillin or oxacillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, extended-spectrum β-lactamases, and resistant *Pseudomonas aeruginosa*. MDRO determination was made via LabID Event reporting with laboratory testing data. Health care facility-onset HAI was defined as a laboratory-identified event specimen collected >3 days after admission to the facility (ie, on or after day 4). Infection rates were calculated as number of MDROs divided by patient days multiplied by 1,000, with the population at risk comprising all admitted patients within the unit.

CLABSIs

A CLABSI was defined as a laboratory-confirmed bloodstream infection where a central line or umbilical catheter was in place for >2 calendar days on the date of event, with day of device placement being day 1, and the line also in place on the date of event or the day before. If a central line or umbilical catheter was in place for >2 calendar days and then removed, the date of event of the laboratory-confirmed bloodstream infection was the day of discontinuation or the next day, to be defined as a CLABSI. If the patient was admitted or transferred into a facility with an implanted central line (port) in place, and that was the patient's only central line, day of first access in the inpatient location was considered day 1. Access was defined as line placement, infusion, or withdrawal through the line. Infection rates were calculated as number of CLABSIs divided by central line or umbilical catheter days multiplied by 1,000, with the population at risk comprising all patients with central line or umbilical catheters.

CAUTIs

A CAUTI was defined as a urinary tract infection where an indwelling urinary catheter was in place for >2 calendar days on the date of event, with day of device placement being day 1, and an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for >2 calendar days and then removed, the date of event for the urinary tract infection was the day of discontinuation or the next day. Infection rates were calculated as number of CAUTIs divided by catheter days multiplied by 1,000, with the population at risk comprising all patients with catheters.

Patient data

De-identified patient demographic and diagnostic data were collected from the hospital's electronic medical record system for all patients who were admitted to the ICU and ICU stepdown units during the 2014-2015 study periods. Data examined included patient admit and discharge dates, age, gender, primary diagnosis, major diagnostic category, days in unit, total hospital length of stay, and patient days. Days in unit and total hospital length of stay were reported as proportion of full days and rounded to the nearest hundredth of a day. Patient days, used for the calculation of infection rates, were defined as total hospital length of stay rounded to the nearest whole number.

Bias

During the 2014 study period, there were concerns regarding potential bias in the assessment of hand hygiene compliance. With human hand hygiene observers, it is possible that the presence of the observers may influence health care personnel to demonstrate compliance at a higher rate than when unobserved. Recording bias, in the form of careless data recording or inappropriately entered data from the paper forms into the Midas + database, may have also been present. The hospital and infection control staff members attempted to minimize these biases through the use of a well-defined protocol for the monitoring of hand hygiene in addition to regular debriefings to ensure observers were appropriately recording hand hygiene compliance. Misclassification bias—incorrectly recording compliance in the event of noncompliance or vice versa—was limited by recording compliance only when the full encounter between health care worker and patient was observed.

With the implementation in 2015 of the HHCS to record compliance, many of the bias concerns that arose during the 2014 study period were alleviated, particularly those relating to recording or misclassification bias. There were minimal opportunities for incorrect data entry or misclassification of compliance because the HHCS badge electronically recorded and stored all data, and also required caregivers to validate each detected hand hygiene event. Red lights and audible tones emitted by the badge acted as incentives to validate the hand hygiene event with the badge, limiting the influence of misrecorded or unrecorded events.

Assessing the overall influence of both the human observers and the HHCS on the MDRO, CAUTI, and CLABSI infection rates is difficult because this study did not utilize a randomized, controlled trial designed to control for possible confounders. However, no other handwashing interventions were undertaken during the study period, eliminating the effect of another intervention. In addition, the full patient population within the ICU and ICU stepdown units was included in the calculation of infection rates, minimizing possible selection bias.

As with any retrospective study design, there is the potential for chronology bias in the infection rates. The present study was undertaken in 2 consecutive years to minimize the influence of this bias.

Statistical analysis

Frequency distributions and descriptive statistics of patient demographic characteristics were examined and calculated. Comparison of hand hygiene compliance during 2014 and 2015 in each unit was assessed using Pearson χ^2 tests, with a 2-sided P value ≤ .05 considered significant. To test the change in infection rates, incidence rate ratios (IRRs) were calculated with 95% confidence intervals. IRRs with 95% confidence intervals that did not include 1 were considered significant. All data management and statistical analyses were completed in SAS Studio Enterprise Edition version 3.5 (SAS Institute Inc, Cary, NC).

RESULTS

De-identified electronic medical records of 4,070 patients over a 2-year period were examined. In 2014 and 2015, the patient populations were demographically alike (Table 1), with a similar composition of men and women and a nearly identical median average age (72 years in 2014 and 71 years in 2015). Ninety percent of patients spent <10 days in the ICU and ICU stepdown unit during both study periods, with a similar median stay (2.88 days in 2014 and 3.06 days in 2015). The distribution of major diagnoses between the 2 years was stable, with a majority of patients being cared for by the infectious disease, cardiology, and pulmonology departments.

Examination of hand hygiene compliance data is striking (Table 2). The electronic compliance system captured substantially more data and hand hygiene opportunities than human observers could. During 2014, the year human observers were active, a total of only 480 observations between the ICU and ICU stepdown unit were recorded. In comparison, the HHCS captured 632,404 hand hygiene events, more than an order of magnitude greater than human observers.

In the ICU, hand hygiene compliance was measured at 100% by human observers during the first 3 quarters of 2014, dropping to 96.5% during the fourth quarter. The number of hand hygiene

Table 1
Characteristics of patient population, intensive care unit and intensive care stepdown unit, 2014-2015

Characteristic	Study period	
	2014 (Jan-Dec)	2015 (Feb-Dec)
Total patients	2,174	1,896
Gender		
Male	1121 (51.6)	914 (48.2)
Female	1053 (48.4)	982 (51.8)
Age	72 (17-103)	71 (17-101)
Days in unit	3.06 (0.0-69.3)	2.88 (0.0-73.9)
Major diagnostic category*		
Arterial disease	115 (5.3)	82 (4.3)
Gastroenterology	168 (7.7)	126 (6.6)
Infectious disease	263 (12.1)	210 (11.1)
Cardiology	356 (16.4)	321 (16.9)
Pulmonology	236 (10.9)	185 (9.8)

NOTE. Values are presented as n (%) or median (range).
*Only categories with >100 patients reported.

Table 2
Hand hygiene compliance, intensive care unit (ICU) and intensive care stepdown unit (ICU stepdown), 2014-2015

Unit	Study period		P value
	Human observers	Hand hygiene compliance system	
	2014 (Jan-Dec)	2015 (Feb-Dec)	
	Compliant/hand hygiene opportunities (%)		
ICU	167/169 (98.8)	210,648/221,396 (95.2)	.03*
ICU stepdown	308/311 (99.0)	397,476/411,008 (96.7)	.02*

*Statistically significant at the $P \le .05$ level.

observation sessions varied across the year, with the hospital's goal being 40 sessions per month. There were 60 sessions (an average of 20 per month) in quarter 1; 39 sessions in quarter 2 (an average of 13 per month); 13 sessions in quarter 3 (<5 per month), and 57 sessions in quarter 4 (19 per month). During the same time period in the ICU stepdown unit, there was 100% observed compliance for quarters 1-3 and 97.2% compliance for quarter 4. There were 113 observations of hand hygiene opportunities in quarter 1 (about 38 per month); 68 observations in quarter 2 (roughly 23 per month); 21 observations in quarter 3 (7 per month); and 109 observations in quarter 4 (approximately 36 per month).

Compared with the limited number of observations made by human monitors during 2014, the design of the HHCS allowed for continual data collection and observation from the mid-February 2015 implementation onward. However, the detailed data collected by the HHCS indicated that compared with human observers, total compliance for the year was significantly lower in both the ICU (98.8% vs 95.2%; $P = .03$) and ICU stepdown unit (99.0% vs 96.7%; $P = .02$). Although lower than the year human observers were present, the HHCS did ensure, with confidence, that the hospital met its 95% hand hygiene compliance goal.

IRRs could not be calculated for CLABSI infections due to lack of incident infections during the 2015 study period, and there may be overlap in these rates resulting from MDROs causing some of the CAUTIs and CLABSIs.

Overall, HAIs dropped substantially during the period that the HHCS was in use (Table 3). Although none of the reductions were statistically significant, there was a decrease in MDROs (2.0 per 1,000 patient days vs 0.4 per 1,000 patient days; IRR, 0.22; 95% CI, 0.03-1.92) and an elimination of CLABSI infections in the ICU. In the ICU stepdown unit, there was a similar elimination of CLABSI infections, and a reduction in the MDRO infection rate, down from 1.3 to 0.8 per 1,000 patient days (IRR, 0.68; 95% CI, 0.03-1.79) after the implementation of the HHCS.

DISCUSSION

Key results

- The HHCS was able to capture substantially more hand hygiene events, providing a fine-grained assessment of compliance within the ICU and ICU stepdown units.
- Measured compliance was significantly lower during the year the HHCS was active compared with the human observers.
- Further study is needed to investigate the association between the HHCS and infection rates in the ICU and ICU stepdown unit.

During the study period, the HHCS recorded significantly lower compliance than human observers did during the year prior, but it also recorded far more hand hygiene events and ensured that the hospital reached its 95% hand hygiene compliance goal. In the assessment of infection rates, this study focused on ICU and ICU

Table 3
Hospital-acquired infections, intensive care unit and intensive care stepdown unit, 2014-2015

Unit and infection type	Study period: Human observers 2014 (Jan-Dec) Infection rate*	Study period: Hand hygiene compliance system 2015 (Feb-Dec) Infection rate*	Incidence rate ratio (95% CI)
Intensive care unit			
Multidrug-resistant organism	2.0	0.4	0.22 (0.03-1.92)
Central line-associated bloodstream infection	0.7	0.0	–
Catheter-associated urinary tract infection	1.5	1.7	1.02 (0.21-5.04)
ICU stepdown			
Multidrug-resistant organism	1.3	0.8	0.68 (0.03-1.79)
Central line-associated bloodstream infection	2.7	0.0	–
Catheter-associated urinary tract infection	3.1	0.6	0.22 (0.25-1.86)

*Reported as infections per 1,000 patient days for multidrug-resistant organisms, infections per 1,000 umbilical or central line catheter days for central line-associated bloodstream infections, and infections per 1,000 catheter days for catheter-associated urinary tract infection.

stepdown units where infections can be especially dangerous. Rates of the studied infections—CAUTI, CLABSI, and those caused by MDROs—generally declined during the nearly 1-year period when the HHCS was in use. The single exception was in the ICU, where CAUTI rates rose slightly. The differences in HAI rates between 2014 and 2015 were not statistically significant, but are interesting nonetheless, potentially clinically relevant, and warrant further study.

Limitations

Because this is a retrospective observational study of an intervention, not a randomized controlled trial, interpretations of the influence of the HHCS on both compliance and infection rates must be made cautiously. Results were not stratified by age group or gender, a limitation that may hide confounding or interacting effects in the patient population. Data were also not collected on confounding or interacting variables (beyond age, gender, unit, or infection type), a limitation that could modify or obfuscate the association between the HHCS and infection rates.

Although recorded compliance did reach 100% for several quarters when human observers were used, there are reasons to regard that data skeptically. The observers could only cover a very limited number of HHOs. The Hawthorne effect suggests that the high numbers accomplished when observers were overseeing caregivers may partially reflect caregivers' desire to please the observers, rather than reflect actual rates of compliance when an observer was not present, thus artificially inflating overall compliance. Previous research has shown a quantifiable increase in hand hygiene events while under direct observation compared with electronic observation.[10]

Interpretation

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.[11] Factors, including observer distance from health care workers and business of the ward, attenuate the accuracy of hand hygiene event observation, whereas automated systems are able to capture these events with greater precision.[11] 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 (ie, a short-term deployment meant to boost compliance rates) may result in rates that rebound to preintervention levels.[12] 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.[13] To ensure hospitals sustain their stated compliance goals, long-term—or permanent—deployment of the HHCS may be necessary.

As noted, the HHCS did not result in a statistically significant decline in any of the measured infections in this study; in particular, a lack of incident CLABSIs during the 2015 data collection period made comparison to the previous year difficult using IRRs. A longer follow-up trial may provide the necessary data to clarify any association and allow for the calculation of IRRs for all infections. Nonetheless, isolating the effect of the HHCS on, and establishing a temporal relationship with, nosocomial infections remains a challenge. Difficulty has been noted in assessing this kind of causal relationship, for reasons that may include a nonlinear relationship between hand hygiene compliance and infection rates, as may be the case with methicillin-resistant *S aureus*.[14]

Generalizability

The ability of the HHCS to record a substantial number of HHOs and compliance events is solely dependent on the implementation of the system (eg, the number of electronic badges and monitoring sensors deployed) and is unlikely to be influenced by geographic location, ward of installation, or type of health care personnel utilizing the system. However, reproducibility of the observed compliance rate itself may be influenced by the health care worker's job title, time of day, and performance of hand hygiene before patient contact, among other hypothesized factors.[15] 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.

CONCLUSIONS

Previously, there has been insufficient evidence to accurately measure the effectiveness of automated HHCSs, and there is a recognized need for more information about, and better assessments of, such systems.[7] This study adds to what is known about the potential value of one such compliance system compared with human observation to encourage and measure compliance. The system provided a successful alternative to a limited team of human observers, supplying much more extensive information about hand hygiene compliance. It yielded detailed compliance results that met the hospital's 95% compliance goal. In addition, it replaced the logistical problems of sustaining a full team of human observers. The hospital has decided to continue long-term use of the automated HHCS.

These findings suggest that further study of the potential advantages of using this automated system to improve hand hygiene compliance is warranted, as is additional evaluation of its association with a reduction in MDROs, CLABSIs, and CAUTIs.

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