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Major article

Comparison of human and electronic observation for the measurement of compliance with hand hygiene

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Background: Monitoring of hand hygiene is an important part of the improvement of hospital quality indicators.
Methods: This study was prospectively performed over a 14-week (electronic observer) period from December 3, 2013-March 9, 2014, to evaluate hand hygiene compliance in an adult step-down unit. We compared electronic handwash counters with the application of radiofrequency identification (RFID - ZigBee; i-Healthsys, São Carlos, Brazil) (electronic observer), which counts each activation of the alcohol gel dispenser to direct observation (human observer) using the iScrub application.
Results: For the overall time period of simultaneous electronic and human observation, we found that the electronic observer identified 414 hand hygiene episodes, whereas the human observers identified 448 episodes. Therefore, we found 92% (95% confidence interval [CI], 90%-95%) overall concordance (414/448), with an intraclass correlation coefficient of .87 (95% CI, 0.77-0.92).
Conclusion: Our RFID (ZigBee) system showed good accuracy (92%) and is a useful method to monitor hand hygiene compliance.

Increasingly, hospitals are focusing on the improvement of quality indicators.[1] Monitoring of hand hygiene is part of this quality improvement process.[2,3] Hospitals generally use observers to monitor hand hygiene[2,4] because direct observation is considered the criterion standard for evaluating hand hygiene compliance.[4] However, direct observation is generally able to capture only a very small fraction of hand hygiene opportunities.[5] Moreover, observers typically use relatively short observation periods[4,5]; however, electronic counters record 24 hours per day.[2,3,5]

It has been also demonstrated that directly observed rates of adherence may not be accurate because they do not correlate with other hand hygiene metrics (eg, electronic handwash counters).[2,5] Direct observation could change health care worker (HCW) behavior if the workers knew they are being observed.[2,6] These are reasons to search for other strategies to monitor hand hygiene compliance.[7-9]

The purpose of this study was to prospectively evaluate hand hygiene compliance in an adult step-down unit using electronic handwash counters with the application of radiofrequency identification (RFID) (electronic observer) and compare this to direct observation (human observer).

METHODS

The study was approved by the facility's institutional review board and was conducted in a 20-bed step-down unit of a tertiary care, private hospital in São Paulo, Brazil. All rooms are private, and

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each has dedicated noncritical devices for patient care (eg, stethoscopes, thermometers). There is 1 sink and 2 alcohol gel dispensers in each room; there is 1 alcohol gel dispenser between each room in the corridor. The study was conducted over a 14-week period from December 3, 2013-March 9, 2014.

We compared hand hygiene compliance measurement by 2 different methods: direct observation of practice and electronic counting of alcohol hand rub gel use by an electronic device using ZigBee technology (i-Healthsys, São Carlos, Brazil). Results from both methods were compared for a specified 20-minute period each day.

Direct observations

Prior to the beginning of the study, 3 nurses were trained by an infection preventionist (IP) on hand hygiene observation as per our previous study.[10] In training observers we first addressed the concept of the My 5 Moments for Hand Hygiene. To assess the understanding of these concepts by the observers, we used videos from the World Health Organization, available free on their Web site (http://www.who.int/gpsc/media/training_film/en/). These videos include scenarios in which personnel have opportunities for hand hygiene. Concordance of hand hygiene observations between the 3 nurses and IP was established in the units by having the nurses and IP observe hand hygiene performance in the unit simultaneously and then comparing their measured rates of compliance.

We have performed other hand hygiene studies[5,10] using the same methodology and some of these observers. For this reason it was not possible to see more data and statistics on the concordance of the human observers.

Then the nurses from the unit (while not on clinical duty) were directed to perform hand hygiene observations in the study unit for a 20-minute period daily that varied from day to day for a 14-week period (excluding weekends and holidays). These nurse observers recorded the opportunities for hand hygiene and compliance on a handheld personal digital assistant (iPods or iPads, Apple, Redmond, WA) using an application (iScrub).[11] During these audits, the 3 nurse observers only counted hand hygiene opportunities that represented the points in time within the care process when hand hygiene should be performed, as specified by the World Health Organization's My 5 Moments for Hand Hygiene.[12] The observers did not evaluate the quality of hand hygiene performance. All HCWs, such as doctors, nurses, respiratory therapists, and other HCWs (eg, radiology technicians, laboratory technicians) who provided care in the unit were included in the hand hygiene observations.

The nurse observers recorded observations in patient rooms. If questioned by an HCW, the nurse observers (not on clinical duty but dressed as if on clinical duty) explained that they were observing problems that needed to be corrected in the unit.

Electronic counting device

Hand hygiene episodes were recorded by electronic handwash counters for alcohol gel (PURELL Hand Instant Sanitizer; 62% ethyl alcohol and 4% isopropyl alcohol 1-L bag; Purell, GOJO Industries, Inc., Akron, OH). The alcohol gel dispenser (NXT 1-L model) records only 1 episode in any 2-second period, even if >1 aliquot of alcohol is dispensed. Each unit was checked twice weekly to ensure the nozzle was not obstructed. The alcohol gel aliquots were expressed per patient day.

FEEDBACK TECHNOLOGY

Real-time feedback technology has been used in this hospital unit since June 2013.[13] This technology uses a wireless identification device (badge) worn by the HCW to sense when an HCW performs hand hygiene with alcohol hand rub using electronic dispensers inside the patient's room. The identification devices use ZigBee technology (a wireless communication protocol using the 2.4 GHz based on Institute of Electrical and Electronics Engineers 802.15.3 standards approved for medical applications).[13,14] A red light flashes above the patient bed when an HCW approaches the patient bed if hand hygiene has not been performed. A green light flashes if hand hygiene has been performed. Therefore, the HCW is provided real-time feedback on hand hygiene compliance. Software integrated with a database allows reports to be generated showing how many HCWs entered the rooms, how many performed hand hygiene, and how many patients were provided care by individual HCWs. The maximum distance for detection of the badge dispenser is approximately 1 m (the patient zone). The electronic handwash sensor records the hand hygiene episode for HCWs with and without badges. However, a badge is required to trigger the feedback (red or green) light above the patient bed. The ZigBee system uses 16-bit microcontrollers for the badge, electronic module of the dispenser, and bedside sensor. There is a flash memory of 8 megabits for the bedside sensor and dispenser electronic module. The bedside sensor and electronic module of the dispenser have an internal clock to detect the date and time of each event. The badge uses 2 button batteries lasting 40 days; the dispenser uses 3 AA batteries lasting 3 years; and the bedside sensor is plugged to the alternating current source, with no batteries.

This ZigBee system is able to monitor in real time the signal strength of the radio, and through statistical analysis it determines whether the person with the badge is within the limits of the physical space of the bed.

Compliance with hand hygiene was registered if it occurred within 1 minute of entering the patient zone. This arbitrary time was established based on prestudy observations of staff work habits.[15] Noncompliance was registered when an opportunity was not linked to a registered hand hygiene event.

The bedside sensor has an internal flash memory to store all the data it acquires (eg, badge identification number, date, time) for each hand hygiene episode performed. Also, the sensors stored the time and date for each event of hand hygiene that occurred when the device did not detect an HCW badge. Therefore, the system has the capability to monitor how many times the dispenser was pressed, and this information is stored in the flash memory of the bedside sensor. We are then able to wirelessly download the data stored in the bedside flash memory to a laptop computer and to the cloud computing network element.

After the data is downloaded, the bedside sensor clears the internal flash memory to avoid memory overload. The bedside memory has a capacity of 100,000 events. This allows the data to be safely downloaded every 2-3 months. The mean number of uses per hour of professional in the room was calculated by dividing the number of uses with badge by the total number of hours of professional in the bed.

Data validation

Validation was performed in 2 stages. We used software to compare the events recorded by the human observer (iScrub) and electronic observer (i-Healthsys). We decided to exclude hand hygiene observations of the unit physician (who did not wear the badge in the unit) because the step-down unit doctor was the only physician among the 77 HCWs. We gave badges only to the unit-based HCWs. We did not have enough badges to offer to consulting physicians from our institution during the time of this study.

To evaluate the Hawthorne effect, the number of HCW visits and number of alcohol gel aliquots dispensing episodes recorded by the