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Major article

Estimation of hand hygiene opportunities on an adult medical ward using 24-hour camera surveillance: Validation of the HOW2 Benchmark Study

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Background: We previously published a formula to estimate the number of hand hygiene opportunities (HHOs) per patient-day using the World Health Organization's "Five Moments for Hand Hygiene" methodology (HOW2 Benchmark Study). HHOs can be used as a denominator for calculating hand hygiene compliance rates when product utilization data are available. This study validates the previously derived HHO estimate using 24-hour video surveillance of health care worker hand hygiene activity.

Methods: The validation study utilized 24-hour video surveillance recordings of 26 patients' hospital stays to measure the actual number of HHOs per patient-day on a medicine ward in a large teaching hospital. Statistical methods were used to compare these results to those obtained by episodic observation of patient activity in the original derivation study.

Results: Total hours of data collection were 81.3 and 1,510.8, resulting in 1,740 and 4,522 HHOs in the derivation and validation studies, respectively. Comparisons of the mean and median HHOs per 24-hour period did not differ significantly. HHOs were 71.6 (95% confidence interval: 64.9-78.3) and 73.9 (95% confidence interval: 69.1-84.1), respectively.

Conclusion: This study validates the HOW2 Benchmark Study and confirms that expected numbers of HHOs can be estimated from the unit's patient census and patient-to-nurse ratio. These data can be used as denominators in calculations of hand hygiene compliance rates from electronic monitoring using the "Five Moments for Hand Hygiene" methodology.

Substantial efforts are being made to reduce health care-acquired infections (HAIs). A critical component of these efforts is the emphasis on improving hand hygiene (HH) compliance among health care workers (HCWs).[1-4] The Centers for Disease Control and Prevention (CDC) has outlined a method describing multiple opportunities for HH.[5] Similarly, the World Health Organization (WHO) has developed the "Five Moments for Hand Hygiene" (WHO5) method that requires the HCW to clean their hands at various points inside the patient room during the care of the patient.[6-8]

Accurate, reliable, affordable, and timely HH compliance measurement systems are essential to these efforts. The measurement of HH compliance is often difficult to achieve, and various methods (ie, direct observation, product utilization, and survey methods) have fallen short with regard to validity and practicability.[9-11] Direct observation is considered the gold standard for HH monitoring, but it has several drawbacks. It requires substantial resources to train, employ, and monitor observers. Additionally, the data collation and reporting are often delayed significantly from the actual patient care. Finally, it is difficult to perform necessary observations within the patient care environment, and when the observer enters the patient room, compliance may be

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Table 1
Comparison of study characteristics: Derivation study vs validation study

Study characteristic	Derivation study	Validation study
Data collection methodology	Random sampling whereby observer follows HCW involved in patient care activity	24-hour video surveillance of HCW care activity in patient rooms
Type of unit (adult medical)*	Adult medical	Adult medical
Unit average daily census	29.3 Patients	29.1 Patients
Total hours of data collection	81.3	1,510.8
Total number of HHOs	1,740	4,522
Total number of indications	2,879	6,117
Indications: No. (%) of indications		
Before patient contact	607 (21.1)	1,294 (21.2)
Before aseptic technique	178 (6.2)	476 (7.8)
After body-fluid exposure	239 (8.3)	300 (4.9)
After patient contact	767 (26.6)	344 (22.0)
After contact w/pt surroundings	1,088 (37.8)	2,703 (44.2)
HCW HHOs: No. (%) HHOs		
Nurses†	1,367 (78.6)	3,302 (73.0)
Physicians‡	80 (4.6)	259 (5.7)
Auxiliary personnel§	48 (2.8)	312 (6.9)
Therapists‖	120 (6.9)	452 (10.0)
Other¶	125 (7.2)	197 (4.4)

*Derivation study done primarily on an adult nephrology unit and the validation study done on an adult pulmonary unit.
†Nurses, patient care technicians/nursing assistants, and nursing students.
‡Physicians, residents, medical students, and physician assistants.
§Environmental services/housekeeping personnel, dietary aides, and volunteers.
‖Therapists (eg, physical therapists, occupational therapists, audiologists).
¶Other (technicians, dieticians, unit secretaries, transporters, and any other type HCW).

overestimated because of the change in HCW behavior when being observed (ie, the Hawthorne effect).[12,13]

The default method for HH compliance monitoring has become the direct observation of the cleaning of hands by HCWs as they enter or exit a patient room. A commonly observed effect is that the HCWs now only clean their hands at entry and exit. Although this method is relatively easy to understand, it significantly increases the risk of the HCW becoming recontaminated after entry to the room.[14]

Various electronic methods have been developed to measure HH compliance in the attempt to develop less expensive and more accurate, reliable, and timely monitoring systems. These methods typically measure HH compliance upon the entry or exit of a HCW from the patient's room.[10] In most of these methods, the numerator is measured by an electronic signal with the activation of a soap or alcohol dispenser. The denominator is obtained through the electronic recognition of a HCW's badge entering or exiting the room.[11] Once implemented, these systems are usually relatively inexpensive to maintain, are able to collect large amounts of data that can be interpreted in near real time, and likely minimize the Hawthorne effect.

No one has developed a reliable electronic monitoring system for HH compliance using the WHO5 methodology. The present work explored the possibility of developing such a system. Monitoring HH compliance involves accurate assessment of HH events, as well as simultaneous HH opportunities (HHOs). HH events may be electronically measured based on activations of the alcohol or soap dispensers. Measuring HHOs is more difficult because they will vary based on the frequency and intensity of patient care and the work flow of the HCW. In a previous publication, we reported the estimated HHOs per patient-day on various types of hospital units using the WHO5 methodology.[1] We found that 2 readily available unit-specific factors, patient census and the patient-to-nurse ratio, could be used to estimate the expected number of unit-specific HHOs. These estimates were determined using a previously published WHO5 sampling technique.[6] To validate these estimates, a second study was conducted using 24-hour video surveillance of entire patient care episodes.

METHODS

Sample and setting

Both the HOW2 Benchmark Study and the validation study were conducted within an adult medical inpatient unit at Greenville Memorial Hospital, a 746-bed teaching hospital, in Greenville, South Carolina. The adult general medical unit was chosen for the validation study because it is the most commonly occurring unit within most acute care hospitals. Institutional Review Board (IRB) approval was obtained for both studies, and all patients in the validation study provided written informed consent.

In the validation study, video surveillance footage was obtained using cameras (Speco Technologies Model VL648IRVF; Speco Technologies, Amityville, NY) with infrared wide-angle dome 2.8- to 11-mm lenses mounted in 12 of the 32 patient rooms on the study unit. Cameras were motion activated and equipped with infrared capability to allow videotaping in a dark room; however, no audio was recorded. Each camera was positioned to allow a view of the room doorway; the patient's bed; and all sink, soap, and alcohol dispensers. A curtain was attached to each camera so that patients, family members, or HCWs could draw the curtain to block videotaping during any activity requiring privacy (eg, bed baths, bed-pan use, or other).

If a patient was assigned to 1 of the 12 study rooms and provided informed consent, the camera curtain was drawn open to uncover the lens, and videotaping ensued 24 hours a day for the remainder of their unit stay. For participants, a sign was posted on the door informing staff, family, and visitors that there was a camera videotaping in the room. In addition, cameras were in plain view of anyone entering the room.

Data collection

The WHO method of defining HHOs based on the "Five Moments for Hand Hygiene" was used in both studies.[6] The derivation study (HOW2 Benchmark Study) utilized random convenience sampling, whereby observers walking onto the study unit would