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Measuring hand hygiene compliance rates in different special care settings: a comparative study of methodologies

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SUMMARY

Objectives: The purpose of this study was to compare methods for assessing compliance with hand hygiene in an intensive care unit (ICU), a step-down unit (SDU), and a hematology–oncology unit.
Methods: Over a 20-week period, we compared hand hygiene compliance measurements by three different methods: direct observation, electronic handwash counter for alcohol gel, and measuring the volume of product used (alcohol gel) in an ICU, an SDU, and a hematology–oncology unit of a tertiary care, private hospital.
Results: By direct observation we evaluated 1078 opportunities in the ICU, 1075 in the SDU, and 517 in the hematology–oncology unit, with compliance rates of 70.7%, 75.4%, and 73.3%, respectively. A total of 342 299, 235 914, and 248 698 hand hygiene episodes were recorded by the electronic devices in the ICU, SDU, and hematology–oncology unit, respectively. There were also 127.2 ml, 85.3 ml, and 67.6 ml of alcohol gel used per patient-day in these units. We could find no correlation between the three methods.
Conclusions: Hand hygiene compliance was reasonably high in these units, as measured by direct observation. However, a lack of correlation with results obtained by other methodologies brings into question the validity of direct observation results, and suggests that periodic audits using other methods may be needed.

1. Introduction

Healthcare-associated infections remain a major cause of morbidity and mortality. One of the principal mechanisms responsible for the transmission of microorganisms in the hospital is contact with the contaminated hands of healthcare workers (HCWs).[1]

The intensive care unit (ICU), the step-down unit (SDU), and the hematology–oncology unit accommodate complex, critically ill patients, many of whom have alterations in their immune systems. Many of these patients also have central venous access devices, which are frequently essential for antimicrobial therapy, parenteral nutrition, vasopressors, chemotherapy, and other intravenous medications. In the daily care of these patients, there are a large number of opportunities for hand hygiene, many of which are not realized.[2–4]

Given the great need to effectively measure hand hygiene compliance by staff, different methods have emerged.[5–7] Direct observation is generally considered the gold standard among the various methods. However, the data derived are typically from a very limited time of observation of HCWs during their routine activities.[5–7] Another method to assess hand hygiene compliance is the measurement of the consumption of hand hygiene products (alcohol gel and chlorhexidine, for example).[5–7]

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Electronic handwash counters quantify the use of alcohol gel by HCWs and serve as a surrogate for direct observation. With these devices, it is possible to express dispensing episodes per 24 h of patient care. This is a practical method with good acceptance.[5–8]

Since the overall goal of measuring hand hygiene compliance is to change HCW behavior and improve the quality of care, it is necessary to give timely feedback to HCWs. This remains the biggest challenge for improving hand hygiene compliance.[9–12]

The purpose of this study was to compare methods for assessing compliance with hand hygiene in an ICU, an SDU, and a hematology–oncology unit. We used direct observation of practice, electronic counters for dispensers of alcohol-based hand-rub (ABHR), and measurement of the volume of ABHR product used.

2. Methods

This study was approved by the institutional review board (IRB) of Hospital Israelita Albert Einstein. The requirements for informed consent were waived by the IRB in accordance with the Code of Federal Regulation and of the Privacy Rule. This study was conducted in three different units (ICU, SDU, and hematology–oncology) of a tertiary care, private hospital in São Paulo, Brazil. For the purpose of this study, we evaluated 20 beds in each unit. All rooms are private, and each has dedicated non-critical devices for patient care (e.g., stethoscopes and thermometers). There is one sink (with a bottle of chlorhexidine) and one alcohol gel dispenser in each room, and one alcohol gel dispenser between each room in the corridor. The study was conducted over a 20-week period from February 11 to June 31, 2013.

We compared the measurement of hand hygiene compliance by three different methods: direct observation of practice, electronic counting for alcohol gel, and measurement of the volume of alcohol gel used.

2.1. Direct observations

Prior to the beginning of the study, six nurses (two nurses for each study unit) were trained by an infection preventionist (IP) on hand hygiene observation, as per our previous study.[13] In training the observers, we first addressed the concept of the 'five moments for hand hygiene'. To assess the observers' understanding of these concepts, we used videos from the World Health Organization (WHO), which are available free of charge on the website (http://www.who.int/gpsc/media/training_film/en/). These videos include scenarios in which personnel have opportunities for hand hygiene assessment. Concordance in hand hygiene observations between the six nurses and the IP was established in each of the units (ICU, SDU, and hematology–oncology unit) by having the two nurses and the IP observe hand hygiene performance in the same unit, at the same time, and comparing their measured rates of compliance. Then the nurses from each unit (while not on clinical duty) were directed to perform hand hygiene observations in the study unit for a 20-min period daily, which varied in the time of day (8 a.m. to 8 p.m.). The hand hygiene observations were done from Monday to Friday, except holidays, for 20 weeks. These nurse observers recorded the opportunities for hand hygiene and compliance on a handheld personal digital assistant (iPod or iPad; Apple Inc.) using an application (iScrub).[8] During these audits, the six nurses counted only hand hygiene opportunities that represented the points in time within the care process when hand hygiene should be performed, as specified by predefined indications (the World Health Organization Five Moments for Hand Hygiene).[7] The observers did not evaluate the quality of hand hygiene performance. All HCWs (doctors, nurses, respiratory therapists, and other HCWs, such as radiology technicians and laboratory technicians) who provided care in the unit were included in the hand hygiene observations.

If questioned by a 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.

Direct observation data were calculated as a percentage (number of instances of hand hygiene performed/number of hand hygiene opportunities).

2.2. Electronic counting device and the measurement of products

Hand hygiene episodes were recorded by electronic handwash counters for alcohol gel (PURELL Hand Instant Sanitizer; 62% ethyl alcohol + 4% isopropyl alcohol, 1 liter bag). The alcohol gel dispenser (NXT 1 liter model) records only one episode in any 2-s period even if more than one aliquot of alcohol is dispensed. Alcohol gel dispensers dispense an approximately 1.3-ml volume of product per use and are located inside the patient rooms and outside the patient rooms in the corridor. The location of the dispenser inside each patient room is near the entrance, to promote compliance prior to patient contact. Each dispenser was checked twice weekly to ensure the nozzle was not obstructed. Electronic counter data were recorded as the mean number of dispensed hand hygiene episodes per patient-day, since product use can be measured across all shifts, 24 h per day, 7 days per week.

The total volume of product (alcohol gel) used in milliliters and the number of alcohol gel aliquots were expressed per patient-day. The volume of product was measured by storing empty dispenser bags in a box that was collected weekly. In the hematology–oncology unit there were also loose bottles of the same alcohol gel (350 ml) in the patient rooms. These bottles do not have electronic handwash counters. This was implemented so that hematology–oncology patients have easy access to alcohol gel in their rooms, and this gel was used by both patients and HCWs.

Patient-days were calculated as the total number of days for all patients who were admitted for an episode of care and discharged during the study period.

2.3. Statistical analysis

The comparison of hand hygiene compliance by direct observation in the different units was performed using the Pearson Chi-square test. For product volume usage and electronic dispenser counts, we compared average volume consumption and average number of dispenser uses by normal linear mixed models, considering the dependence between observations in the same site under the autoregressive correlation matrix of order 1. Multiple comparisons between the three units (comparison unit by unit: ICU vs. SDU, ICU vs. hematology–oncology, and SDU vs. hematology–oncology unit) were corrected by the Bonferroni method. The correlation between metrics was assessed by Pearson correlation coefficients. The analyses were performed using SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA). All tests of statistical significance were two-sided, with the level of significance set at 0.05.

3. Results

During the 20-week study period there were a total of 2493 patient-days in the ICU. There were 1078 opportunities for hand hygiene assessed by direct observation, and the overall rate of hand hygiene compliance was 70.7% (762/1078). Alcohol gel was used in 93.3% (711/762) of opportunities and liquid soap was used in 6.7% (51/762). Via electronic counters, a total of 342 299 hand hygiene episodes were recorded in the unit; the mean number of

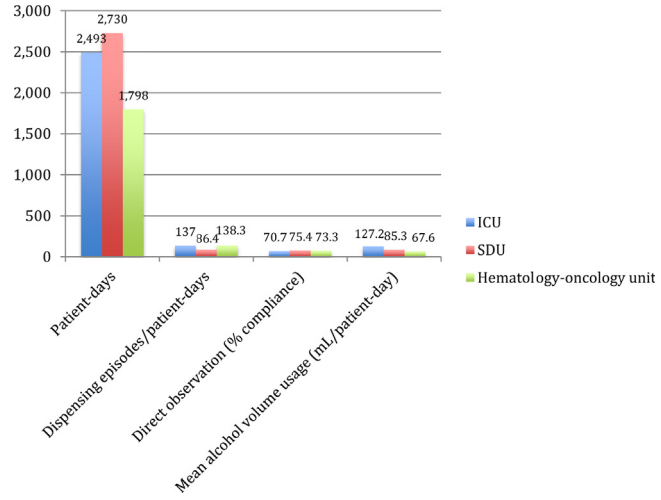

Figure 1. Hand hygiene compliance using the three different hand hygiene metrics in different hospital settings.

episodes per patient-day was 137.3. There were 127.2 ml of alcohol gel used per patient-day in the ICU (Figure 1).

In the SDU, there were a total of 2730 patient-days. There were 1075 opportunities for hand hygiene assessed by direct observation (Table 1), and the overall rate of hand hygiene compliance was 75.4% (811/1075). Alcohol gel was used in 87.3% (708/811) of opportunities and liquid soap was used in 12.7% (103/811). Via electronic counters, a total of 235 914 hand hygiene episodes were recorded in the unit. The mean number of hand hygiene episodes per patient-day was 86.4. There were 85.3 ml of alcohol gel used per patient-day in the SDU (Figure 1).

In the hematology–oncology unit, there were a total of 1798 patient-days. There were 517 opportunities for hand hygiene obtained by direct observation (Table 1) and the overall rate of hand hygiene compliance was 73.3% (379/517). Alcohol gel was used in 98.9% (375/379) of opportunities and liquid soap was used in 1.1% (4/379). Via electronic counters, a total of 248 698 hand hygiene episodes were recorded in the unit. The mean number of hand hygiene episodes per patient-day was 138.3. There were 67.6 ml of alcohol gel used per patient-day in the hematology–oncology unit (Figure 1).

Considering all the units together, the correlation (ρ) between the percentage of hand hygiene compliance and hand hygiene episodes per patient-day was ρ = −0.122 (p = 0.358) (Table 1). The correlation between hand hygiene episodes per patient-day and alcohol gel consumption in milliliters per patient-day was ρ = 0.239 (p = 0.066). The correlation between the percentage of hand hygiene compliance and alcohol gel consumption in milliliters per patient-day was ρ = −0.100 (p = 0.449). Considering each unit individually, only the SDU had a correlation between hand hygiene episodes per patient-day and alcohol gel consumption in milliliters per patient-day (ρ = 0.689, p = 0.001), and between the percentage of hand hygiene compliance and alcohol gel consumption (ρ = 0.524, p = 0.018).

4. Discussion

Recently, we have worked to improve hand hygiene compliance as an important intervention for infection prevention.[13,14] In a previous study performed in a hematology–oncology unit, we were not able to detect a correlation between the three different methods for hand hygiene compliance.[14] We then decided to perform another study in three different hospital settings (ICU, SDU, and hematology–oncology unit) to determine whether there would be different behaviors impacting hand hygiene compliance as measured by the three different methods (observers, electronic handwash counters, and ABHR consumption). In all three units in our study (ICU, SDU, and hematology–oncology unit), positive deviance has been used to encourage HCWs to improve compliance with hand hygiene.[13] Our results suggest that it is necessary to utilize more than one form of assessment before drawing conclusions about HCW hand hygiene performance.

The observational method is considered by many authors to be the gold standard for assessing hand hygiene compliance.[15] Problems with this method include the Hawthorne effect, and the fact that only a small fraction of hand hygiene opportunities are typically captured.[6,16] However, the advantages of direct observation include identification of the specific WHO moment for hand hygiene[7] and the ability to record the job category of the HCW, as well as the product being used (alcohol gel or chlorhexidine).[1] The majority of hand hygiene compliance studies have used the observational method, with daily observations occurring over a period of 20 min to 2 h.[1,2]

Table 1
Relationship between weekly hand hygiene compliance (%), mean alcohol gel consumption (ml/patient-day), and mean hand hygiene episodes per patient-day over the 20 weeks of the study in the three different units

Unit	Compliance[a,*]	Mean episodes/patient-day[b,**]	Mean alcohol-volume, ml/patient-day[b,***]	Relationship between weekly HH compliance (%) and mean HH episodes per patient-day[c]	Relationship between weekly HH compliance (%) and mean alcohol gel consumption (ml/patient-day)[c]	Relationship between mean alcohol gel consumption (ml/patient-day) and mean HH episodes per patient-day[c]
ICU	762/1078 (70.7%)	138.5 (27.3)	128.1 (30.7)	0.035 (0.886)	0.010 (0.966)	0.227 (0.337)
SDU	811/1075 (75.4%)	86.6 (11.2)	85.5 (13.9)	0.190 (0.421)	0.689 (0.001)	0.524 (0.018)
Hematology–oncology	379/517 (73.3%)	140.6 (25.8)	68.3 (21.1)	−0.239 (0.310)	−0.451 (0.046)	0.313 (0.179)
All				−0.122 (0.358)	−0.100 (0.449)	0.239 (0.066)

HH, hand hygiene; ICU, intensive care unit; SDU, step-down unit.
[a] Data described as the number and percentage and compared between sites by Chi-square test.
[b] Data reported as the mean and standard deviation and compared with mixed regression models.
[c] Pearson correlation coefficient (p-value for the test of equality of the correlation 0).
[*] p = 0.045 for comparison between the three units. Comparison unit by unit: ICU vs. SDU, p = 0.013; ICU vs. hematology–oncology unit, p = 0.278; SDU vs. hematology–oncology unit, p = 0.359.
[**] $p < 0.001$ for comparison between the three units. Comparison unit by unit: ICU vs. SDU, $p < 0.001$; ICU vs. hematology–oncology unit, $p > 0.99$; SDU vs. hematology–oncology unit, $p < 0.001$.
[***] $p < 0.001$ for comparison between the three units. Comparison unit by unit: ICU vs. SDU, $p < 0.001$; ICU vs. hematology–oncology unit, $p < 0.001$; SDU vs. hematology–oncology unit, p = 0.001.

Electronic handwash counters have the advantages of quick installation and no requirement for training, but data capture requires manually opening the dispensers, and it is not possible to delineate the WHO five moments of hand hygiene; it is also not possible to determine the quality of hand hygiene episodes. It is questionable if electronic hand hygiene counters could be used as a baseline assessment for hand disinfection compliance given the potential for under- or over-reporting.[17,18] However, these devices can deliver rapid results without requiring the expenditure of many hours to obtain a small sample of observations, and since electronic handwash counters are not visible to the HCW, there is no Hawthorne effect. Results can be assessed at short intervals and feedback used to further encourage compliance among HCWs while trending results over time.[19] Similar to our study, other investigators have concluded that passive electronic monitoring of hand hygiene dispenser counts does not correlate with the results from direct human observation.[9]

Using consumption of alcohol gel as a proxy for hand hygiene compliance requires controlling the delivery of product and ensuring that product is not removed or redistributed. In our study[14] we observed that in the ICU, SDU, and hematology–oncology units, there were no relationships between the other hand hygiene methods and the volume of alcohol gel consumed, except for the SDU, which showed significant correlations between alcohol gel consumption and the other two hand hygiene methods. Both hand hygiene methods (the electronic counters and the total volume of alcohol gel used) are recorded 24 h per day, and it is expected that there would be a relationship between them. However, the relationship between alcohol gel consumption and direct human observation is much more difficult to explain.

Consumption in liters has its limitations compared to other methods. Although measuring product use is less resource-intensive and less expensive than direct observation, it can be inaccurate and produce misleading results.[5,20] One potential reason for not finding a strict correlation between product volume measurement and the other methods (direct observation, electronic handwash counters) is that patients and their families inside the rooms also used the alcohol gel for hand hygiene.[14] Moreover, since the patient is taught about the importance of using alcohol gel for hand hygiene to prevent infections, but not taught about the quality of hand disinfection or the manner of using the electronic handwash device, it is possible that patients and family members, and even HCWs, pushed the dispenser multiple times in a short time-period (although the product will be dispensed on demand, only one episode of hand hygiene is recorded for every 2-s time-period). Another problem is when an incomplete push on the dispenser results in a suboptimal volume of product delivered.[6,20] An improvement would be to install electronic dispensers that deliver a fixed volume of alcohol gel.

We only monitored alcohol consumption data; we were not able to monitor chlorhexidine consumption, because this product has been used for daily bathing of our ICU and SDU patients since 2009, and is used from the same dispenser as that used for hand hygiene. However, from direct observation we know that in our ICU more than 90% of the hand hygiene product used was alcohol gel and for the SDU 87%.

We conclude that the rate of hand hygiene compliance was relatively high in the three different units in this study. Electronic counters demonstrated that alcohol gel usage was high in the hospital units that accommodate complex patients. However, we also observed that there was no correlation between the hand hygiene methods used across these three different settings. This suggests that two or more metrics should be applied to measure hand hygiene compliance in order to provide a more accurate assessment.

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