

Hand hygiene in the intensive care unit: prospective observations of clinical practice

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KEY WORDS

critical care, hand hygiene, hand washing

ABSTRACT

INTRODUCTION Adherence to hand hygiene recommendations in the intensive care unit (ICU) is variable and moderate, at best.

OBJECTIVES To measure adherence to hand hygiene recommendations among ICU clinicians in a prospective observational study in 6 multidisciplinary ICUs among 4 hospitals.

PATIENTS AND METHODS We observed 115 clinicians (64 nurses, 21 respiratory therapists, 18 residents and 12 physicians) during 1 patient encounter, each. Clinicians were unaware that they were under observation. We documented use of gloves, soap, and alcohol solution before and after patient encounters for purposes of physical examination or patient care.

RESULTS The rate of adherence to current recommendations was 20% (95% CI 13.7–28.2). All 23 clinicians adhering to recommendations used gloves followed by washing with soap or alcohol solution. 57.4% (95% CI 48.3–66.0) of clinicians used some form of hand hygiene without fully adhering to recommendations, whereas 42.6% did not appear to attend to hand hygiene at all during observation. By univariate analysis, with nurses as the reference group, we found trends suggesting lowest adherence rates among residents (odds ratio [OR] 0.32, 95% CI 0.11–0.96) and intensivists (OR 0.46, 95% CI, 0.13–1.60), and highest adherence among respiratory therapists (OR 2.05, 95% CI 0.67–6.30). We also observed a center effect ($p = 0.04$). However, multivariate analysis showed no relationship of hand hygiene to clinician group ($p = 0.06$) nor ICU ($p = 0.05$).

CONCLUSIONS Multidisciplinary, multimethod approaches to improving hand hygiene are likely necessary to improve the modest adherence to hand hygiene that we observed.

INTRODUCTION Hand hygiene is considered to be the cornerstone of infection control.¹ Semmelweis first demonstrated the importance of hand hygiene over 150 years ago when he systematically observed that hand washing reduced the rate of puerperal streptococcal infection from 12.3% to 1.3% among a cohort of postpartum women.² Since then, innumerable microbiologic and epidemiologic clinical studies have corroborated the importance of hand hygiene in medical care. This evidence has been synthesized in a systematic review.³ Authors of this review concluded that hand washing is an important infection control strategy in acute care settings, notwithstanding the important challenges to quantifying

perceived effects on nosocomial infection rates. Although observational studies show an association between hand hygiene and both nosocomial infection rates and emergence of antimicrobial-resistant bacteria, there are no randomized trials addressing this question.⁴

Hand hygiene is particularly important in the management of critically ill patients within an intensive care unit (ICU). The provision of intensive care includes relatively frequent and close interaction between patients and health-care workers. Meanwhile, colonization of the ICU staff is common, transmission of microorganisms via the hands of health-care workers is universal, and the prevalence of multiresistant organisms

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TABLE 1 Observed rates of hand hygiene among 115 intensive care unit clinicians

Hand hygiene behavior	Proportion (95% CI)
Glove use, followed by hand washing "Adherence to recommendations"	20 (13.7–28.2)
Glove use, alone	8.7 (4.8–15.3)
Hand washing with soap, alone	
Before encounter, only	0
After encounter, only	40.9 (32.3–50.0)
Before and after encounter	1.7 (0.5–6.1)
Hand washing with alcohol solution, alone	
Before encounter, only	0
After encounter, only	5.2 (2.4–10.9)
Before and after encounter	0.9 (0.2–4.8)
Hand washing with sink or solution, both before and after encounter	2.6 (0.9–7.4)
Any form of hand hygiene, before or after encounter	57.4 (48.3–66.0)

in the ICU is high.⁵⁻⁷ Critically ill patients are particularly vulnerable to nosocomial infection as a result of their immune-compromised state and multiple invasive catheters.

Hand hygiene guidelines endorsed by the Society for Healthcare Epidemiology of America, the Association for Professionals in Infection Control, and the Infectious Diseases Society of America¹, recommend that clinicians wash hands with soap and water, or disinfectant, for at least 15 seconds before and after patient contact and after any contact with a source of microorganisms; or, alternatively, that clinicians wear gloves on these occasions and wash hands after removing their gloves.

Current reports suggest that adherence to hand hygiene recommendations in numerous ICUs has been highly variable and generally poor.⁸⁻¹¹ A number of investigators have studied barriers to hand hygiene among health care providers, particularly in the ICU. In an institution-wide study, Pittet et al. showed that the ICU setting was an independent predictor of poor hand hygiene practice.¹⁰ Clinicians reporting on important barriers to their own use of proper hand hygiene included hand irritation and dryness, inconvenience, and limited awareness of, or limited agreement with, published recommendations.¹²⁻¹⁴ Meanwhile, infection control experts have identified hand hygiene as of paramount importance in the ICU, and have called for behavioral change to improve this practice.

In the context of a quality improvement research initiative, we sought to measure adherence to hand hygiene guidelines among ICU clinicians in Hamilton, Ontario, Canada.

PATIENTS AND METHODS We conducted a prospective, anonymous observational study of hand hygiene practices (including hand washing and glove use) among clinicians within 6 multidisciplinary ICUs at 4 hospitals in Hamilton, Ontario. To avoid the possibility that knowledge of being

observed would change hand washing behavior, the ICU team was blinded to the study objective and study period. Prior to the study, hospital infection control nurses notified ICU clinicians that an anonymous observer might monitor their hand washing practices over the coming months. This study was approved by the Research Ethics Board of Hamilton Health Sciences which waived the need for informed consent given the objectives and design.

The study data form, stored on a handheld computing device, allowed for 1 of 2 anonymous observers (a critical care fellow and an ICU consultant) to record data related to hand hygiene opportunities observed during ICU rounds or during clinical care. We defined a hand hygiene opportunity as any direct patient contact associated with a risk of infection transmission. These included contact for the purpose of physical examination or patient care (including patient repositioning, peripheral intravenous line insertion, nasogastric tube insertion, suctioning, manual ventilation, ventilator circuit changes, urinary catheter care, or linen changes). We did not include invasive procedures such as endotracheal intubation, central venous catheter or chest tube insertions. Observers recorded clinician name and designation (registered nurse, registered respiratory therapist, resident, intensive care physician); type of patient encounter (physical examination, patient care); the use of gloves, antiseptic solution (before and after patient contact), or soap (before and after patient contact); and whether hand hygiene preceded or followed the patient encounter. We did not measure the duration of hand washing.

Before commencing the study, the 2 observers tested and refined the data collection and recording procedures. An inter-observer reliability study was also undertaken to record concordance on 5 aspects (clinician type, patient encounter type, gloving, use of soap, and use of solution) of 23 hand hygiene opportunities. Then, we observed hand hygiene practices for a 5 month

TABLE 2 Variation in hand hygiene practice among intensive care unit clinicians

Clinician groups (N)	Proportion using any form of hand hygiene (95% CI)
Registered nurses (64)	60.9 (48.7–71.9)
Respiratory therapists (21)	76.2 (54.9–89.4)
Residents (18)	33.3 (16.3–56.3)
Intensivists (12)	41.7 (19.3–68.0)

TABLE 3 Variation in hand hygiene practice in intensive care units among 4 hospitals

Participating hospitals	Number of clinicians	Proportion using hand hygiene (95% CI)
Center 1	41	39.0 (25.7–54.3)
Center 2	30	66.7 (48.8–80.8)
Center 3	27	66.7 (47.8–81.4)
Center 4	17	70.6 (46.9–86.7)

period primarily during ICU rounds. Each clinician was observed during a single patient encounter, only, and clinicians were unaware that they were under observation at the time.

In quantifying our findings, our primary goal was to measure the proportion of opportunities in which clinicians' hand hygiene practice was consistent with guidelines published by the Healthcare Infection Control Practices Advisory Committee.¹ According to these guidelines, clinicians should wash their hands with soap and water, or disinfectant, for at least 15 seconds before and after patient contact, after any contact with a source of microorganisms, and after removing gloves.

Statistical analysis In determining the necessary sample size, we assumed an adherence rate of 50%. To achieve a 95% CI of $\pm 10\%$ around this estimate would require a sample of 96 observations.

We used unweighted κ with a 95% CI to calculate the inter-observer reliability of observations made during the pilot phase.

The prevalence of various types of hand hygiene is expressed as percentages of behaviors observed among health care workers. We used logistic regression analyses to determine differences in hand hygiene (the dependent variable) among clinician groups and among the 4 centers (2 independent variables). Results are expressed using odds ratios (OR) and 95% CI.

RESULTS In the pilot study, inter-observer reliability for all data items was very good, with an average κ of 0.93 (range 0.74–1.0).

We observed 115 clinicians, including 64 nurses, 21 respiratory therapists, 18 residents and 12 intensivists (TABLE 1).

23 (20%) of observations were consistent with published guidelines (95% CI 13.7–28.2). On each of these occasions, clinicians wore gloves and washed with soap or alcohol after removing gloves; 3 individuals also washed before gloving.

In total, 57.4% (95% CI 48.3–66.0) of clinicians used some form of hand hygiene in the setting of the patient encounters we observed (TABLE 1). In addition to the 20% who followed recommendations, 8.7% used gloves alone and 28.7% used either soap or alcohol solution only after the patient encounter.

Comparing hand hygiene among clinician groups, we found that 60.9% of nurses, 76% of respiratory therapists, 41.7% of intensivists, and 33.3% of residents used any form of hand hygiene (TABLE 2). The effect of clinician group on use of hand hygiene was significant in the univariate analysis ($p = 0.041$). Using nurses (the largest group) as a reference group for comparisons, only the difference in hand hygiene use between residents and nurses approached statistical significance (OR 3.12, 95% CI 1.04, 9.38).

Comparing hand hygiene among the 4 centers (TABLE 3) we found that rates of hand hygiene varied from 39.0% to 70.6%. Univariate analysis suggested a center effect ($p = 0.036$) and one center clearly fared worse than the other 3.

Multivariate analysis did not reveal either clinician group or center to be independently predictive of hand hygiene compliance in the final model (clinician group $p = 0.059$, center $p = 0.053$).

DISCUSSION This prospective multicenter ICU observational study of hand hygiene shows practices that fall short of recommendations by the Healthcare Infection Control Practices Advisory Committee.¹ Clinician behavior aligned with recommendations only 20% of the time. While the use of any hand form of hygiene related to patient encounters in the ICU was much higher, at 57.4%, even this degree of attention to hand hygiene remains suboptimal.

We also found differences among clinician groups, most notably between nurses and residents, and from center to center. It is conceivable that the poor rates of hand hygiene among intensivists and especially residents indicate poor role modeling for trainees by ICU consultants. We did not have sufficient number of observations from each center to test this hypothesis. Variable rates across centers suggest that organizational culture and lack of endorsement of infection control as an institutional priority may influence hand hygiene. Nevertheless, center and clinician type were not independent determinants of ICU hand hygiene practice in multivariate analysis.

This audit incorporated a number of methodologic strengths unique to this type of study, including a sample size calculation, formal inter-observer reliability testing of all key observations prior to commencement, and avoidance of non-independent observations by ensuring that each clinician was observed only once. We collected data on unobtrusive hand held devices used commonly on rounds, and clinician observations were anonymous to avoid the Hawthorne effect biasing our results. Our study has some notable limitations. For instance, we may

have underestimated hand washing that preceded patient encounters in the instances where clinicians had washed moments earlier at another bedside. On the other hand, we may have overestimated actual rates of hand hygiene by informing ICU staff of the upcoming audit. We do not believe that either of these phenomena occurred to an important degree. Another shortcoming is that the blinded design did not allow a more comprehensive analysis of predictors of poor hand hygiene, including demographics of the ICU team members including their years of experience and knowledge of this topic, or ICU workload on the day observation.

Our study highlights that hand hygiene is an important concern in the delivery of intensive care. A study by Bischoff et al. measured hand hygiene before and after patient contact and found that hand hygiene was 6–10% before patient contact and 13–22% after patient contact. With education and feedback, this rate improved to 23% before and 48% after patient contact.⁹ Pittet et al. found that the average level of hand washing among ICU clinicians was 48%. Consistent with our findings, compliance was higher among nurses than among physicians.¹⁰ However, they also found that female clinicians were more apt than male clinicians to attend to hand hygiene. The consistency of many of these findings with our results speaks to the pervasiveness of the problem.

A number of potential solutions to this problem exist which should address barriers to optimal hand hygiene. Several factors are likely to contribute to poor hand hygiene practices, including inadequate awareness of the issue, personal concerns such as skin irritation and dryness from frequent washing, availability of hand-washing solutions, or time constraints.¹⁵ As outlined in the infection control literature, these include education in the form of didactic lectures and interactive workshops, which have led to transient improvements in hand hygiene. Regular audit and feedback may also be useful in improving hand washing practice as shown in a time series study that introduced 3 classes by an infection control nurse (after which handwashing increased then declined) followed by feedback to staff about handwashing errors the previous day (after which handwashing increased again and was sustained).¹⁶ A complementary strategy might include the use of newsletters to inform ICU clinicians about the incidence of nosocomial infection within their institution. Quick and easy access to sinks, hand washing solutions and skin care lotion may improve hand hygiene compliance. In addition, further research is required about which is the best hand hygiene method. For example, in 3 ICUs, Girou et al.¹⁷ allocated 12 healthcare workers to handrubbing with alcohol based solution and 11 healthcare workers to handwashing with antiseptic soap before and after patient care. The median percent reduction in bacterial contamination of the palm and

fingertips of the dominant hand was significantly higher with handrubbing than handwashing (83% vs. 58%, $p = 0.01$) Additional randomized trials examining clinically important outcomes would help to inform practice.

In summary, limited attention to hand hygiene is an important concern in our ICUs. Improvement will require concerted multidisciplinary multimethod efforts using effective behavior change strategies, led by administrators, ICU leaders, and bedside clinicians, alike.

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