Conspicuous vs Customary Location of Hand Hygiene Agent Dispensers on Alcohol-Based Hand Hygiene Product Usage in an Intensive Care Unit

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Context: Hand washing is considered the single most important nosocomial infection-control strategy, yet compliance rarely meets levels recommended by infection control authorities.

Objectives: To determine whether placement of hand hygiene foam dispensers in more conspicuous positions and closer proximity to patients would increase use of infection control agents as measured by volume of product used. Further, to ascertain the influence of dispenser placement vs the number of dispensers available on usage by volume.

Methods: This prospective, observational study conducted in an intensive care unit was composed of three observation periods. A control period with standard agent dispenser location (8 dispensers) was followed by two experimental periods: (1) “conspicuous and immediate proximity to patient” placement (16 dispensers) and (2) standard locations with a dramatic increase in the number of dispensers (36 dispensers).

Results: Volume of use for alcohol-based hand hygiene agent during the three observation periods revealed a stastically significant increase in daily consumption after conspicuous and proximate positioning of dispensers (P<.001). However, increasing the number of dispensers did not increase agent use (P=.196).

Conclusion: More conspicuous placement of dispensers containing alcohol-based hand hygiene agent (ie, immediate proximity to patients) resulted in statistically and clinically significant increases in product usage. An increase in the number of dispensers did not increase usage. The impact of dispenser positioning on usage by volume for these highly effective products should be considered when planning and implementing intensive care unit infection-control policies.


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The body’s capacity to heal itself should be optimized whenever possible—and this includes careful attention to decreasing nosocomial infections. Hand hygiene is among the most highly recommended strategies for prevention of hospital-acquired infections as it is an effective and inexpensive means of reducing transmission.

Although hand washing with water and antiseptic soap is considered the “gold standard,” a prospective, randomized trial found that hand rubbing with an alcohol-based agent was more efficient in reducing hand bacterial counts than hand washing with antiseptic soap. Other trials have concluded alcohol-based hand hygiene agents are at least as effective and may be more efficient in a busy and intensive work environment. Further, they are associated with improved skin conditions compared with use of chlorhexidine-containing hand washing agents.

Despite such evidence, hand hygiene behaviors continue to be under-compliant. One study found that instituting education, feedback, and patient-awareness interventions did not increase hand-washing compliance rates among healthcare workers. However, easily accessible alcohol-based hand hygiene agents did result in such improvements.

After documenting poor compliance, a 3-year study from a teaching hospital in Switzerland reported a decrease in nosocomial infection rates and methicillin-resistant Staphylococcus aureus transmission subsequent to the introduction of a hospital-wide hand hygiene campaign as well as alcohol-based hand hygiene agents. These researchers mounted alcohol-based hand hygiene agent containers on all beds and encouraged healthcare workers to carry their own containers. Increase in product usage reached statistically significant levels by the end of the study.

Because the effectiveness of alcohol-based hand hygiene agents has been demonstrated, it seems likely that increases in the use of these products by healthcare professionals and visitors should have a considerable, positive impact on overall hand hygiene—and may, in turn, result in improved prevention of nosocomial infections. The primary goal for the present study was to evaluate the effect of dispenser location on hand hygiene product use as measured by volume. The secondary goal was to determine the effect of increasing the number of dispensers placed in customary locations.
Methods
The present prospective, observational study was conducted in the surgical intensive care unit (ICU) at Wesley Medical Center, a tertiary care community-based hospital in Wichita, Kan, after the approval of the Wichita Medical Research and Educational Foundation Institutional Review Board was obtained.

The present study was composed of three distinct observation periods defined by the placement of dispensers for an alcohol-based hand hygiene agent:

- **control period**—customary locations (eg, on walls inside and outside patient rooms and adjacent to lavatories)
- **experimental period 1**—suspended in a conspicuous location immediately proximate to patient bed
- **experimental period 2**—customary locations but in greater quantity

Hand hygiene procedures were not changed and no new promotional or educational activities were conducted during the observation periods. In addition, nursing-to-patient ratio was not changed before or during the study.

**Control Period: Customary Positioning (8 Dispensers)**
The control period was an observation of alcohol-based hand hygiene agent product volume used from the existing eight dispensers situated upon the walls of the 16-bed surgical ICU. This period of “customary” dispenser positioning lasted 95 days.

**Experimental Period 1: Conspicuous Positioning (16 Dispensers)**
A trapeze-bar apparatus was connected to project over the hospital bed and remain at eye level for attendants standing at bedside (Figure 1), in plain view of patients and visitors. New dispensers were secured at the end of the suspended trapeze-bar, resulting in a high-visibility position that was difficult for healthcare workers to ignore at bedside. A total of 16 dispensers, one per bed, were continuously available for use during a 93-day observation period.

Two weeks before the planned conclusion of this experimental period, all surgical ICU patients were moved, during 1 day, to a newly constructed surgical ICU. This move was anticipated, thus occupancy levels and strict control measures ensured that no component of the trial design would be altered. Therefore, no patient occupied a bed during this experimental period that was not also equipped with the experimental dispenser apparatus nor were any additional alcohol-based hand hygiene agent dispensers in customary locations available for use.

**Experimental Period 2: Customary Positioning (36 Dispensers)**
The trapeze-bar dispensers were removed at the start of this 61-day observation period and a total of 36 dispensers were

![Figure 1. Example of conspicuous location used during experimental period 1 of the authors’ investigation. The dispenser for alcohol-based hand hygiene agent was suspended in a conspicuous location immediately proximate to patient bed.](image-url)
placed in customary locations, accessible for use. These dispenser locations and numbers were determined a priori by a collaboration of surgical ICU design planners, and thus entirely independent of the trial investigators.

New alcohol-based hand hygiene agent containers were placed in the dispensers at the beginning of every observation period. Stocking, inventory control, and auditing of alcohol-based hand hygiene agents and order invoices were monitored exclusively by the medical and nursing directors of the surgical ICU. At the end of each observation period, all partially used containers were weighed in duplicate by one investigator (B.W.T.) using a commercially available scale with ±0.5 g accuracy (Detecto, Model 6735; Cardinal Scale Manufacturing Co, Webb City, Mo) with the mean of the two measurements used for analysis. The weights of alcohol-based hand hygiene agent containers were subtracted so that only the net product weight was used for comparison. The weight of all unused product for each observation period, inventoried by this method, were subtracted from the invoice audits for each period. The final weight indicated the total product used during each observation period. This total volume was divided by the number of days in each observation period to obtain an average daily volume as well as divided by number of dispensers for an average dispenser volume.

The $\chi^2$ goodness-of-fit test was used to determine differences in the resulting daily and per dispenser volumes between observation periods. Daily patient census was analyzed in the same manner, using a Microsoft Office Excel spreadsheet (2003; Microsoft Corporation, Redmond, Wash).

Results
The average daily patient census for each of the three observation periods was 15.1, 15.2, and 14.9, respectively; $\chi^2$ goodness-of-fit test results indicated these differences were not statistically significant.

During the control period (customary location, 8 dispensers) the average daily product use was 188.8 g; experimental period 1 (conspicuous location, 16 dispensers), 294.1 g; experimental period 2 (customary location, 36 dispensers), 214.8 g (Figure 2). Average daily volume in experimental period 1 was significantly greater than that used in either the control period ($P<.001$) or experimental period 2 ($P<.001$). There was no statistically significant difference between average daily volume used in the control period vs experimental period 2 ($P=.196$).

The average daily volume of product used per dispenser is presented in Figure 3. Increasing the number of dispensers resulted in significantly lower daily per dispenser use between the control period and experimental period 2 without any significant increase in total daily alcohol-based hand hygiene agents use (23.8 g vs 35 g; $P<.001$). Experimental period 1, when compared to the control period, showed no statistically significant decrement in per dispenser daily use (18.4 g vs 23.8 g; $P=.041$). Yet, as previously noted, we observed a statistically significant increase in total daily volume used during experimental period 1.

Comment
Critically ill patients are at increased risk of nosocomial infection due, in part, to the compromise of natural defense mechanisms. Nosocomial infection is associated with excess morbidity, mortality, and cost. Hand washing is considered the single most important control strategy for this form of infection, yet rates of compliance among healthcare workers rarely exceeds 40%, even under study protocol conditions.

The use of alcohol-based hand hygiene agents has proven efficacious for reducing microbial contaminant burden on the hands of healthcare workers. Several randomized, clinical trials have shown equal or improved levels of hand decontamination as compared with soap-and-water washing. However, as with hand washing, compliance with the recommended use for these products is suboptimal. Attention diverted to urgent patient care may contribute to compliance failures. Yet, too often, underutilization of such agents may be attributable to simple inadequacy of hand hygiene agent-to-practitioner proximity. This relative inaccessibility may result in “out-of-sight, out-of-mind” conditions with consequent

Figure 2. Average daily usage of alcohol-based hand hygiene agent. During the control period alcohol-based hand hygiene agent was placed in dispensers in customary locations (8 dispensers); experimental period 1, suspended in a conspicuous location immediately proximate to patient bed (16 dispensers); experimental period 2, customary locations but in greater quantity (36 dispensers).
under-use of a proven infection control measure.

Healthcare practitioners and visitors may be more readily aware of dispensers that are conspicuously displayed—specifically those that confront their field of observation and attention. This modified dispenser placement is also more incident to routine patient interactions than customary dispenser locations. Increased use of alcohol-based hand hygiene agents, based on published efficacy trials, specifically, and trials of hand hygiene practices, in general, would be expected to decrease nosocomial infection rates.

In critical care units, dispensers for alcohol-based hand hygiene agents are typically mounted on walls and installed above lavatories near soap dispensers. Such placement is facility-specific and variable relative to the hospital bed, contributing to lower visibility—especially for visitors to the surgical ICU. Dispensers placed in more conspicuous and immediate proximity to patients could affect a theoretical “reminder response” among healthcare workers and visitors. This response may serve to increase utilization at the critical “point of care,” where use is most efficacious. The results of the present trial support such a theory.

Conspicuous display of alcohol-based hand hygiene agent dispensers in our observational investigation resulted in a statistically and clinically significant increase in product use. It is important to note that solely increasing the number of dispensers—even when this increase is dramatic (e.g., a 3.5-fold increase in experimental period 2 compared to control period) did not result in significantly increased product use. No statistical differences found in the daily patient census effectively excludes patient census as a factor in the disparate quantities of alcohol-based hand hygiene agents used during the three observation periods.

Bischoff et al. also found an increased proportional use of alcohol-based hand antiseptic when the dispenser-to-bed ratio was increased from one dispenser per four beds to one dispenser per bed. Attributing the increased product use exclusively to the location of the dispensers, however, is problematic because of the availability of various other hand hygiene agents and educational campaigns during the study. Such confounding factors were avoided in our study, affording us with clear evidence for the effect of conspicuous display alone.

As our focus was on the effect of location and increased availability of alcohol-based hand hygiene agent dispensers, we did not track nosocomial infection rates. As noted, the efficacy of hand hygiene in the prevention of nosocomial infection has been well documented. The question, then, is what are the barriers to compliance with hand hygiene guidelines?

Bischoff et al. educated patients in an effort to enlist them in fostering an environment more conducive to effective hand hygiene. However, they found that an obtunded sensorium in critically ill patients often frustrates this strategy. Adequate cleansing of the hands also takes time, which makes alcohol-based hand hygiene agents attractive in a busy ICU setting. Other barriers to implementation included skin irritation from frequent washing, distractions created by the work environment, inadequate hand hygiene supplies, and the use of gloves. Pittet et al. were able to overcome most of these barriers by implementing a hand hygiene campaign, which included bedside availability of alcohol-based hand hygiene agents.

A limitation of this study is the possible confounding factor presented by the move to a new ICU facility during experimental period 1. Since patient census and nurse-to-patient ratio remained constant before and after the move, however, we do not believe that this relocation impacted the results of our trial.

Sufficient trial design safeguards such as simple study design examining the manipulation of two variables (location and quantity of alcohol-based hand hygiene agent dispensers) and constancy of hand hygiene education and patient census lend confidence to the conclusion that this substantial increase in alcohol-based hand hygiene agent usage was attributable to the experimental design.

**Conclusion**

Alcohol-based hand hygiene agent use significantly increased when dispensers were placed in a conspicuous position close to the patient. The considerable impact of this positioning on the usage of these highly effective, Centers for Disease Control
category 1A–recommended products should be carefully considered when planning and implementing surgical ICU infection control policies.\(^{11}\)

**References**


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