Antiseptic Technology: Access, Affordability, and Acceptance

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Factors other than antimicrobial activity of soaps and antiseptic agents used for hand hygiene by health personnel play a role in compliance with recommendations. Hand hygiene products differ considerably in acceptance by hospital personnel. If switching from a nonmedicated soap to an antiseptic agent or increased use of an existing antiseptic agent for hand hygiene prevented a few more infections per year, additional expenditures for antiseptic agents would be offset by cost savings.

Although the antimicrobial activity of preparations used by health-care workers for hand hygiene (soap and water or waterless antiseptic agents) is an important aspect of such preparations (1,2), other factors that influence the frequency of use of hand hygiene products by personnel are important.

Access

The accessibility of sinks or other facilities may be an important factor, since nurses and other health-care personnel are expected to wash their hands frequently. Nurses wash their hands an average of 13 to 30 times each day, with as many as 44 times reported (Table 1) (3–5). In an observational study in an intensive care unit (ICU), nurses needed an average of 62 seconds to walk to a sink, wash and dry their hands, and return to the patient's bed (6). If nurses wash their hands for 10 seconds and 12 nurses work in an ICU, handwashing would require 16 hours of nursing time per shift (assuming 100% compliance with recommended handwashing practices). If nurses obtain an alcohol hand disinfectant from a bedside dispenser and 15 seconds is required for drying, 100% compliance would require 4 hours of nursing time per shift. Making a rapidly effective waterless antiseptic agent accessible at each patient's bedside should make it easier for nurses with heavy workloads to comply with recommended hand hygiene practices.

Few investigators have studied the relationship between access to sinks and handwashing frequency among health-care workers. Preston and colleagues (7) recorded personnel compliance with recommended handwashing in an open ICU with six beds and two sinks. After the ICU was converted into an isolation unit with 16 beds and 15 sinks (a sink for nearly every bed), the crude rate of compliance improved from 16% to 30%.

In an observational study in two ICUs, frequency of handwashing by health-care workers after contact with patients or their environment was recorded (8). In the medical ICU, where the sink:bed ratio was 1:1, personnel complied with recommended handwashing measures 76% of the time. In the surgical ICU, where the sink:bed ratio was 1:4, compliance decreased to 51%, indicating that improved access to handwashing facilities increases handwashing compliance. However, differences in handwashing compliance on medical and surgical services may be related to factors such as the number of opportunities for handwashing and attitudes of personnel toward hand hygiene (9).

In a study of the impact of sink location on incidence of nosocomial infections (10), patients whose beds were located next to a sink had a 26% reduction in risk for infection compared with those whose beds were located farther away from a sink. In addition to placing sinks near patient beds whenever possible, hospitals should ensure that medical equipment adjacent to the patients' beds (e.g., ventilators or intravenous pumps) does not obstruct access to sinks. Physical barriers that restrict access to sinks may discourage personnel from washing their hands.

Automated handwashing machines have been tested, usually for improving the quality or the frequency of handwashing (11,12). Health-care personnel used these automated sinks infrequently, and they do not appear to be a useful solution to improving hand hygiene.

Other investigators observed health-care worker compliance with recommended hand hygiene practices in a medical ICU unit during three periods (13). During the baseline period, hands were washed with soap and water. Then, an alcohol-based hand disinfectant was made available, with one alcohol dispenser for each bed. In the third period, additional dispensers were added so that there was one alcohol dispenser for every four beds. In the surgical ICU, where the sink:bed ratio was 1:1, personnel complied with recommended handwashing measures 76% of the time. In the medical ICU, where the sink:bed ratio was 1:4, compliance decreased to 51%, indicating that improved access to handwashing facilities increases handwashing compliance. However, differences in handwashing compliance on medical and surgical services may be related to factors such as the number of opportunities for handwashing and attitudes of personnel toward hand hygiene (9).

Table 1. Frequency of handwashing per shift by health-care workers

| Author     | Average/shift | Range   |
|------------|---------------|---------|
| Ojajarvi (3)| 20–30         | 11–44   |
| Larson (4) | 16–25         | <8–25+  |
| Boyce (5)  | 13–15         | 5–27    |

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Cost

Few data are available regarding the cost of antiseptic agents used for hand hygiene. In 1999, a 450-bed community-teaching hospital spent $22,000 on 2% chlorhexidine-containing...
preparations, plain soap, and alcohol hand rinse, for a cost of 
$0.72 per patient per day (Figure 1). If hand hygiene supplies 
for clinics and non-patient care areas are included, the total 
annual budget for soaps and hand disinfectants was $30,000, 
or approximately $1 per patient per day. Because of different 
use patterns and varying product prices, annual hand 
hygiene budgets at other institutions could vary considerably.

![Image of hand hygiene products]

Figure 1. Annual expenditures for hand hygiene products used in 
patient care areas in a 450-bed community hospital, 1999.

The relative cost per liter was calculated for the products 
available through the hospital’s buying group purchase 
contract (Table 2). The 2% chlorhexidine gluconate detergent 
was 1.7 times as expensive as the nonmedicated soap, and the 
alcohol-based hand gel was twice as expensive. Expenditures 
for soap or waterless hand disinfectants may be compared 
with excess hospital costs associated with nosocomial 
infections (Table 3). The excess hospital expense associated 
with four or five nosocomial infections of average severity is 
equal to the entire annual budget for soap and alcohol 
products used for hand hygiene in inpatient care areas. A 
single severe surgical site infection, lower respiratory 
infection, or bloodstream infection may cost the hospital more 
than the entire annual budget for antiseptic agents used for 
hand hygiene. If a change from nonmedicated soap to an 
antiseptic agent or a substantial increase in the use of 
antiseptic agents resulted in preventing a few additional 
nosocomial infections per year, the additional costs associated 
with using antiseptics would be offset by cost savings.

### Acceptance

In studies of acceptance of hand hygiene products by 
health-care personnel, the adverse effects of frequent 
handwashing on the skin are considered an important issue 
by hospital personnel, one likely to affect the frequency of use 
of hand hygiene products (4,14). When hospital personnel 
rated five soap products for their tendency to cause skin 
dryness, cracking, or redness (3), the product that caused the 
greatest cracking and redness of the skin was least preferred 
by personnel. In a recent study (15), health-care workers 
subjectively evaluated four 4% chlorhexidine-containing 
products with respect to fragrance (smell), texture, lather, 
ease of rinsing, and tendency to cause itching. One of the four 
products evaluated was rated the worst in terms of smell, 
texture, and lather, but did not differ from the other preparations 
in ease of rinsing and tendency to cause itching. A subsequent 
questionnaire showed that the product with the undesirable 
smell and texture was the least popular among personnel.

Larson et al. (16) asked personnel to rate the condition of 
their skin before and after using water, bar soap, or one of 
three antiseptic preparations (antiseptics 1, 2, and 3). In self-
assessments of skin condition, washing with bar soap or 
antiseptic 3 caused the most skin problems. In objective 
assessments of skin condition based on measurements of 
transepidermal water loss, handwashing with bar soap and 
antiseptic 3 produced the most skin damage. Clearly, not all 
handwashing preparations are equally acceptable to health-
care personnel.

In the United States, health-care workers have believed 
that use of alcohol-based disinfectants causes excessive skin 
irritation and dryness. This attitude may be based on prior 
experience with products such as rubbing alcohol, which 
contains no emollients, or on outdated approaches to hand 
disinfection. Self-assessments of skin condition were recorded 
by volunteers who used an alcohol-based preparation without 
emollients and the same substance containing emollients 
(17). After 1 week of use and again after 2 weeks, the alcohol 
preparation containing emollients was thought to result in 
less damage to the skin.

In a recent prospective randomized trial (5), 29 nurses 
working on three hospital wards volunteered to participate. 
Half the nurses were randomly assigned to wash their hands 
with a nonmedicated soap (Soft N Sure, Steris, Inc., Mentor,
Conclusion

Ease of access to antiseptic agents and level of acceptance of products by personnel can influence compliance with recommended hand hygiene practices. Both these factors, as well as the costs and antimicrobial activity of preparations, should be taken into consideration in the selection of hand hygiene products for health-care workers.

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Figure 2. Electrical capacitance of dorsal hand skin surface (5).