Handwashing Compliance by Health Care Workers

The Impact of Introducing an Accessible, Alcohol-Based Hand Antiseptic

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Context: Under routine hospital conditions handwashing compliance of health care workers including nurses, physicians, and others (eg, physical therapists and radiologic technicians) is unacceptably low.

Objectives: To investigate the efficacy of an education/feedback intervention and patient awareness program (cognitive approach) on handwashing compliance of health care workers; and to compare the acceptance of a new and increasingly accessible alcohol-based waterless hand disinfectant (technical approach) with the standard sink/soap combination.

Design: A 6-month, prospective, observational study.

Setting: One medical intensive care unit (ICU), 1 cardiac surgery ICU, and 1 general medical ward located in a 728-bed, tertiary care, teaching facility.

Participants: Medical caregivers in each of the above settings.

Interventions: Implementation of an education/feedback intervention program (6 in-service sessions per each ICU) and patient awareness program, followed by a new, increasingly accessible, alcohol-based, waterless hand antiseptic agent, initially available at a ratio of 1 dispenser for every 4 patients and subsequently 1 for each patient.

Main Outcome Measure: Direct observation of handwashing for 1575 potential opportunities monitored over 120 hours randomized for both time of day and bed locations.

Results: Baseline handwashing compliance before and after defined events was 9% and 22% for health care workers in the medical ICU and 3% and 13% for health care workers in the cardiac surgery ICU, respectively. After the education/feedback intervention program, handwashing compliance changed little (medical ICU, 14% [before] and 25% [after]; cardiac surgery ICU, 6% [before] and 13% [after]). Observations after introduction of the new, increasingly accessible, alcohol-based, waterless hand antiseptic revealed significantly higher handwashing rates (P<.05), and handwashing compliance improved as accessibility was enhanced—before 19% and after 41% with 1 dispenser per 4 beds; and before 23% and after 48% with 1 dispenser for each bed.

Conclusions: Education/feedback intervention and patient awareness programs failed to improve handwashing compliance. However, introduction of easily accessible dispensers with an alcohol-based waterless handwashing antiseptic led to significantly higher handwashing rates among health care workers.

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BEGINNING WITH the observations of Ignaz Semmelweis1 and Oliver Wendell Holmes,2 the efficacy of handwashing for the prevention of hospital-acquired infections has been clearly demonstrated. To make handwashing easier and safer, new detergents and methods have been developed, tested, and where successful, integrated into many infection control guidelines.3–11 However, under routine hospital conditions the compliance with handwashing by health care workers including nurses, physicians, and others (eg, physical therapists and radiologic technicians) is still unacceptably low.12,13 Many theories have been developed to effect behavioral change. Unfortunately, none has been successfully demonstrated to improve handwashing compliance in daily work routines.14,15 To overcome the gulf between knowledge of professional behavior with proven benefits and poor compliance in routine practice, one might concentrate on changing the behavior of personnel and/or providing user-friendly handwashing devices. This investigation compared the efficacy of different approaches to changes in handwashing compliance among health care workers, including education/feedback intervention and social pressure models, and...
PARTICIPANTS, MATERIALS, AND METHODS

SETTING

The Medical College of Virginia Hospitals system is a 728-bed tertiary care, teaching facility located in Richmond. From July 1, 1997, to December 31, 1997, handwashing compliance was measured in 2 intensive care units (ICUs) (a medical ICU [MICU] with 12 beds and a cardiac surgery ICU [CSICU] with 10 beds), and a general medical ward (with 27 beds). The sink-bed ratio was 9:12 in the MICU and 7:10 in the CSICU, providing 3 sinks in the open care area for 6 beds and 1 sink per single bed room. The nurse-patient ratio was 1:2 in both ICUs and did not change over the study period.

STUDY DESIGN

The study was prospective and observational, beginning with a control period without any interventions to obtain baseline data (Figure 1). This was followed by an education/feedback intervention program in both ICUs and a social pressure program on the general ward—the distribution of patient awareness flyers inviting patients to request handwashing of all health care personnel. After completion and a first analysis of the data, the MICU was chosen for the introduction of the alcohol-based waterless hand disinfectant because of the higher number of beds, the prolonged stay of patients in this ICU, and therefore the extended risk for nosocomial infections compared with the CSICU. Dispensers were installed initially in the open care area with a dispenser-bed ratio of 1:4 next to the sinks, and subsequently increased to 1:1 in close vicinity to the beds. The alcohol-based waterless hand disinfectant was provided in manual soap dispensers in addition to the existing soap dispensers.

DEFINITION OF HANDWASHING TECHNIQUE AND PRODUCTS

The guidelines for handwashing practice of the Association for Professionals in Infection Control and Epidemiology recommend use of 3 to 5 mL of soap, chlorhexidine gluconate, or the waterless alcohol-based solution for at least 10 to 15 seconds. During the first phase of the study, 2 handwashing products were used on all wards. One product was a soap solution (EpiCare; Airkem Professional Products, Mississauga, Ontario) and the other a 4% solution of chlorhexidine (Hibiclens; ZeneCA Pharmaceuticals, Wilmington, Del). The newly introduced hand disinfectant was a gel-like, 60% alcohol handrub solution (Purell; Gojo Industries, Akron, Ohio), active against vegetative bacteria. Use of the product did not require water or towels.

DEFINITION OF HANDWASHING OPPORTUNITIES

Handwashing opportunities were defined as all events with a high risk of microbial transmission, and they required handwashing before and immediately after contact regardless of whether gloves were used or changed. They included all contacts with mucous membranes, nonintact skin, or any secretions or excretions, and manipulations (opening or disconnecting) of patients’ vascular lines and other tubes. Observed events were stratified and recorded as respiratory tract care, vascular line care, urinary tract care,

RESULTS

OBSERVATION DATA

The handwashing compliance of health care workers was monitored for over 120 hours with a total of 1575 potential handwashing opportunities. Most patients in the MICU were intubated, and therefore respiratory care was the preponderantly observed event (37% of activities) followed by vascular line care (35%), urinary tract care (11%), and others (17%). In contrast, in the CSICU most of the observed events were related to vascular line care (51% of activities), whereas respiratory care (19%), urinary tract care (14%), and others (16%) were less frequent.

Prior to any intervention, health care workers washed their hands before and after patient care events at rates of 10% (before patient care) and 22% (after patient care) in the MICU, and 4% (before patient care) and 13% (after patient care) in the CSICU (Table 1). After the in-service education/feedback intervention sessions, the handwashing compliance in the MICU was 16% (before patient care) and 25% (after patient care), and in the CSICU 7% (before patient care) and 14% (after patient care).

The introduction of an alcohol-based waterless hand disinfectant in the MICU resulted in a significant improvement in handwashing compliance among health care workers (P<.05, χ² for linear trend, Figure 2). With 1 alcohol dispenser available for every 4 beds, the handwashing rate was 19% prior to patient contact and 41% afterward. Still higher rates were noted with a dispensers-bed ratio of 1:1—23% before patient contact and 48% afterward.

The handwashing compliance rates were stratified by health care providers, ie, nurses, physicians, and others (eg, physical therapists and radiologic technicians). Prior to patient contact there was no difference among the professions (nurses and others 9%, physicians 13%). After patient contact, physicians washed their hands more often than nurses and others (nurses and others 16%, physicians 46%), but opportunities for physicians accounted only for approximately 5% of the total.

SOAP, CHLORHEXIDINE, AND AN ALCOHOL-BASED ANTISEPTIC AGENT UTILIZATION DATA

During the study period, 298 884 dispenser utilizations were registered in MICU, CSICU, and the general medical ward (Table 2). Within the first study phase prior to
interventions, health care workers’ use (number of uses per patient-day) in the MICU was 126 with soap and 17 with chlorhexidine. In the CSICU, where chlorhexidine was not used, the handwashing rates were 109 for soap. On the general medical ward the baseline utilization was 34 for soap and 4 for chlorhexidine. After the in-service education/feedback intervention program sessions, an insignificant increase of dispenser counts was noted in the MICU: soap 135 and chlorhexidine 23. A decrease was detected in the CSICU with 91 soap utilizations per patient-day compared to 30 for soap and increased to 5 for chlorhexidine.

With the introduction of the alcohol-based waterless antiseptic solution, the total counts of soap, chlorhexidine, and alcohol-based waterless antiseptic solution, the total number of potential handwashing opportunities and the actual number of episodes of handwashing were documented during 1-hour observation periods at random intervals throughout the day (6 AM-10 PM) for 2 randomized ICU beds (30 minutes per bed). The direct observation time was set to 20 hours for each study component. In addition to the direct observation, the number of soap, chlorhexidine, and alcohol-based dispenser uses was counted by small electronic counting devices, not visible to health care workers. Counting was performed in both ICUs and the general medical ward. To adjust for the number of patients in all 3 units during the study periods, the number of dispenser uses was divided by the number of patient-days.

EDUCATION/FEEDBACK INTERVENTION PROGRAM

After the first study phase, 6 educational in-service sessions were conducted in each ICU. All nurses working in the ICUs during the study were included at least once. The efficacy of handwashing was reviewed, rates of the unit-specific baseline handwashing compliance were presented, and health care workers were strongly encouraged to wash their hands before and after patient contact.

PATIENT AWARENESS

To improve handwashing compliance among health care workers, pamphlets describing the importance of handwashing were distributed initially to all patients on the general medical ward and then to every new admission for a 6-week period. There was no feedback of the patient attitudes to the patient awareness flyers.

STATISTICAL ANALYSIS

The primary measure of the efficacy of education/feedback intervention, social pressures, and the alcohol-based waterless hand disinfectant was handwashing compliance, calculated by dividing the number of handwashing episodes by the number of potential handwashing opportunities. Comparisons between study periods were performed using Fisher’s exact test, chi-squared statistic, and t test for equal variances (Epi Info Version 6.04a; Centers for Disease Control and Prevention, Atlanta, Ga; JMP Version 3.1.5, SAS Institute, Carey, NC). All tests of statistical significance were 2 sided, and α level was set at .05.

Several studies, including our own, have revealed an unacceptably low baseline rate of handwashing compliance by health care workers, particularly in ICUs. The
benefit of improved infection control practices, including handwashing, in reducing nosocomial infection rates has been demonstrated, and the immense costs attributed to hospital-acquired infections mandate handwashing compliance by health care workers.

Even after several decades of investigation, efforts to improve handwashing practice remain ineffective. Most studies have focused on educational programs, feedback interventions, and modifications of handwashing equipment. To compare the efficacy of these measures, our study included all 3 approaches, including a new method of generating social pressure by patients and their visitors.

Implementation of an education/feedback intervention program failed to enhance handwashing rates in our study as has been reported previously. Generating social pressure by a patient awareness program also failed to improve handwashing compliance rates. The high acuity of illness in ICUs precludes widespread use of these pamphlets, because many patients’ level of consciousness is impaired. On general medical wards we did not measure the possibility that some patients did not understand the pamphlet. Future studies could examine the value and cost benefits of combining the distribution of pamphlets with a brief verbal introduction to patients. This approach was used by McGuckin et al. and resulted in significantly higher soap use rates, but handwashing compliance was not observed. An even stronger concern regarding patient awareness programs is the possibility of negatively affecting the patient-health care worker relationship. Patients seeking help are confronted with the potential estrangement by health care givers.

In our study health care workers reported a shortage of time related to staffing issues under a nurse-patient ratio of 1:2 as the most important factor influencing their handwashing practices. Concerned about this issue, Voss and Widmer more recently calculated that the time consumption for water-soap was 5.3-fold higher than that with an alcohol-based waterless antiseptic solution. Given a 100% handwashing compliance in a model ICU with 12 health care workers, handwashing consumes 16 hours of nursing time per day shift compared with only 3 hours using an alcohol-based waterless antiseptic solution. Therefore, offering easy access to a safe and fast hand disinfectant promised an increase in handwashing rates and prompted our testing of an alcohol-based waterless antiseptic solution.

Table 1. Effect of Education/Feedback Intervention Program on Handwashing Compliance

<table>
<thead>
<tr>
<th>Type of Intensive Care Unit</th>
<th>Opportunity</th>
<th>Baseline Period</th>
<th>After Education/Feedback Intervention Program</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>Before patient contact</td>
<td>17/173 (10)</td>
<td>18/112 (16)</td>
<td>.17</td>
</tr>
<tr>
<td>Cardiac surgery</td>
<td>After patient contact</td>
<td>42/188 (22)</td>
<td>31/122 (25)</td>
<td>.63</td>
</tr>
</tbody>
</table>

*P value calculated using the Fisher exact test; statistically significant at P < .05.

Table 2. Effect of an Education/Feedback Intervention Program and Patient Awareness Program on the Rates of Dispenser Uses per Patient-Day

<table>
<thead>
<tr>
<th>Type of Unit*</th>
<th>Detergents</th>
<th>Baseline</th>
<th>After Education/Feedback Intervention Program</th>
<th>P†</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICU</td>
<td>Soap</td>
<td>126</td>
<td>135</td>
<td>.72</td>
</tr>
<tr>
<td></td>
<td>Chlorhexidine gluconate</td>
<td>17</td>
<td>23</td>
<td>.08</td>
</tr>
<tr>
<td>CSICU</td>
<td>Soap</td>
<td>109</td>
<td>91</td>
<td>.38</td>
</tr>
<tr>
<td>General ward</td>
<td>Soap</td>
<td>34</td>
<td>30</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>Chlorhexidine</td>
<td>4</td>
<td>5</td>
<td>.60</td>
</tr>
</tbody>
</table>

*MICU indicates medical intensive care unit; CSICU, cardiac surgery intensive care unit.
†P calculated using t test for equal variance. P < .05 is statistically significant.
Previous studies have shown total handwashing compliances ranging from 14% to 48% or even higher. However, these studies have measured handwashing only after a health care worker touches a patient. We measured handwashing compliance both before and after patient contact to investigate handwashing behavior more fully. At baseline extremely low rates of 6% to 10% were observed before patient contact and 13% to 22% after patient contact. It is possible that unobserved handwashing occurred before patient contact, however. Nevertheless, even with our best efforts in our most compliant group, the handwashing rates improved only to 23% before and 48% after patient contact. Although the latter rates are higher than many previously reported rates, opportunities exist for developing better strategies for handwashing.

We thought that an unobservable counting device might be a crude surrogate for handwashing compliance. However, perhaps because it cannot correct for the number of dispenser uses per handwash, it did not predict the increased compliance we noted with the introduction of an alcohol-based waterless antiseptic agent. This might also be the reason for the low amount of alcohol-based waterless antiseptic dispenser uses compared with soap or chlorhexidine uses.

This investigation has some limitations including the lack of a long-term observational follow-up period after the last study phase. Previous studies have shown that interventions have a limited influence on the behavior of health care workers. A second limitation relates to the short-term feedback intervention program to health care workers. As part of long-term interventions, repeated feedback, including supervision, use of role models, and administrative regulations could be helpful in the continued improvement of handwashing compliance.

In summary, education/feedback intervention and patient awareness programs failed to influence handwashing compliance favorably. However, the introduction of a new, easily accessible, alcohol-based waterless antiseptic handwashing product significantly improved handwashing rates.

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REFERENCES