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Is hand hygiene before putting on nonsterile gloves in the intensive care unit a waste of health care worker time?—A randomized controlled trial

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Abstract

Background—Hand hygiene (HH) is recognized as a basic effective measure in prevention of nosocomial infections. However, the importance of HH before donning nonsterile gloves is unknown, and few published studies address this issue. Despite the lack of evidence, the World Health Organization and other leading bodies recommend this practice. The aim of this study was to assess the utility of HH before donning nonsterile gloves prior to patient contact.

Methods—A prospective, randomized, controlled trial of health care workers entering Contact Isolation rooms in intensive care units was performed. Baseline finger and palm prints were made from dominant hands onto agar plates. Health care workers were then randomized to directly don nonsterile gloves or perform HH and then don nonsterile gloves. Postgloving finger and palm prints were then made from the gloved hands. Plates were incubated and colony-forming units (CFU) of bacteria were counted.

Results—Total bacterial colony counts of gloved hands did not differ between the 2 groups (6.9 vs 8.1 CFU, respectively, $P = .52$). *Staphylococcus aureus* was identified from gloves (once in “hand hygiene prior to gloving” group, twice in “direct gloving” group). All other organisms were expected commensal flora.

Conclusion—HH before donning nonsterile gloves does not decrease already low bacterial counts on gloves. The utility of HH before donning nonsterile gloves may be unnecessary.

Keywords

Infection control; Handwashing; Health care-associated infection; Nosocomial infection; Alcohol hand rub

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Conflicts of interest: None to report.

Hand hygiene is an essential measure in the prevention of health care-associated infections.¹ Recommended and validated opportunities for hand hygiene include prior to patient contact when gloves are not required, before performing a clean or aseptic procedure, and after touching the patient or their surroundings.² The need for hand hygiene after removal of nonsterile gloves should also be emphasized because hands can be contaminated with pathogenic organisms during glove removal.³ However, the importance of hand hygiene before donning nonsterile gloves is unknown, and few published studies address this issue. Despite the lack of evidence, the World Health Organization, in the World Health Organization Glove Use Information Leaflet, recommends that health care workers perform hand hygiene before nonsterile gloving.⁴ It is also a part of the How-to Guide: Improving Hand Hygiene. A Guide for Improving Practices among Health Care Workers, prepared on collaboration with the Center for Disease Control, Association for Professionals in Infection Control and the Society of Healthcare Epidemiology of America, where it is recommended that it be incorporated into assessment of hand hygiene compliance observations.⁵ In the clinical setting, most infection prevention groups routinely recommend this practice. However, the additional benefit of hand hygiene before gloving is uncertain. Needless recommendation of hand hygiene before donning non-sterile gloves could be a waste of valuable health care worker time, which might be spent more productively on other quality control interventions or patient care. We conducted a prospective, randomized, controlled trial of health care workers entering Contact Isolation rooms in intensive care units (ICU) to determine the utility of hand hygiene prior to donning of nonsterile gloves. To our knowledge, this is the first randomized controlled trial to examine this issue.

Methods

Study design

This study was conducted in 7 adult ICUs at the University of Maryland Medical Center; a medical, surgical, cardiothoracic, and cardiac ICU, and 3 trauma ICUs at R. Adams Cowley Shock Trauma Center. These ICUs provide care for critically ill patients with various medical and surgical illnesses. Health care workers (registered nurses, physicians, technicians, and others) entering Contact Isolation rooms in designated ICUs were randomized to either perform hand hygiene and then don nonsterile gloves (“hand hygiene prior to gloving” group) or directly glove without performing hand hygiene (“direct gloving” group). Health care workers were excluded from participation if they were seen to perform hand hygiene just prior to randomization or had previously participated in the study. In both groups, hands were cultured at baseline by imprinting 4 fingertips, thumb, and palm of the dominant hand for 5 seconds onto a 150-mm Trypticase soy agar plate (Teknova, Hollister, CA) as has been done previously in similar studies.^{6,7} This was done to ensure similar bacterial hand contamination at baseline. Participants in the “hand hygiene prior to gloving” group were instructed by the researcher to perform hand hygiene using a commercially purchased hand sanitizer containing 65% ethyl alcohol. After drying, they were instructed to put on a pair of nonsterile gloves. The time period from commencement of hand hygiene to donning of gloves was noted by the researcher. An imprint of the nondominant gloved hand was then taken. Participants in the “direct gloving” group were instructed to directly put on a pair of nonsterile gloves without performing hand hygiene.

The researcher timed in seconds the time taken to put on the nonsterile gloves. An imprint of the nondominant gloved hand was then taken. The protocol was approved by the Institutional Review Board of the University of Maryland.

Microbiology

After sampling, agar plates were incubated for 18 to 24 hours at 35°C. CFU were counted on all plates (baseline hands and gloves) using Count (Heathrow Scientific; Vernon Hills, IL). The maximum count was 300 CFUs; beyond this figure, it was considered that there was confluence, and a bacterial count of 350 CFUs was arbitrarily assigned to the specimen. Potential pathogenic bacteria, eg, *Staphylococcus aureus*, *Enterococcus*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*, were identified from gloves only by sub-culturing all colonies onto Trypticase soy agar with 5% sheep's blood, MacConkey, and Phenylethyl Alcohol agar (Beckton Dickinson, Sparks, MD).

Survey

Health care workers were asked a series of questions including the length of time since the start of their shift and the length of time since they had last performed hand hygiene (Table 1). They were also asked to respond to the following statement using a 5-point Likert scale: "Performing hand hygiene before donning gloves is cumbersome because placing wet hands into gloves is difficult."

Statistical analysis

Comparisons of continuous variables were made by *t* test and categorical variables by χ^2 test. CFU counts of gloved hands were compared using a negative binomial log linear regression model and the ungloved hands by Student *t* test.

Results

Two hundred thirty health care workers were randomized to perform hand hygiene before donning nonsterile gloves ("hand hygiene prior to gloving" group, *n* = 115) or not perform hand hygiene before donning nonsterile gloves ("direct gloving" group, *n* = 115). Baseline characteristics of the participants are reported in Table 1. There was no significant difference in the average CFU count of gloved hands in the "hand hygiene prior to gloving" compared with "direct gloving" group (6.9 vs 8.1 CFU, respectively, *P* = .52). Allowing the CFU counts in each group to follow negative binomial distributions with distinct means, we estimate the ratio of mean CFU between the 2 groups to be 0.86 (95% confidence interval: 0.53-1.37). The only pathogenic organisms identified were methicillin-resistant *Staphylococcus aureus* (1 isolate, "hand hygiene prior to gloving" group) and methicillin-susceptible *S aureus* (2 isolates, "direct gloving" group). All other organisms were expected transient flora including coagulase-negative staphylococci, micrococcus, diphtheroids, and bacillus.

The average time needed per episode for "hand hygiene prior to gloving" group was 53.3 seconds, compared with 21.8 for "direct gloving" group (*P* < .01). Sixty-eight percent (154/226) of the total health care worker group either agreed or strongly agreed with the

following statement: “Performing hand hygiene before donning gloves is cumbersome because placing wet hands into gloves is difficult.”

Discussion

Performing hand hygiene before donning nonsterile gloves, compared with directly donning gloves, did not significantly decrease the bacterial count of the gloves, making this a potentially unnecessary hand hygiene step. In addition, nearly all bacteria found on gloves, independent of whether hand hygiene was performed before donning gloves, were expected transient flora such as coagulase-negative staphylococcus.

To our knowledge, this is the first study examining this issue using alcohol-based cleaning. A previous study, Rossoff et al enrolled 42 ICU nurses and found no benefit to hand hygiene before donning of nonsterile gloves.⁸ However, this nonrandomized trial was published in 1995 prior to the emergence of many of today's multidrug-resistant nosocomial pathogens. This report was also prior to the use of alcohol hand rub, which is now considered gold standard for hand hygiene of non-visibly dirty hands. Together, these studies provide further evidence that hand hygiene prior to wearing nonsterile gloves is an unnecessary step.

A striking finding of our study is the length of time hand hygiene takes before donning of nonsterile gloves in the ICU. The group who performed hand hygiene before donning nonsterile gloves took an additional 31.5 seconds per episode compared with the group who directly put on nonsterile gloves. An ICU nurse enters a Contact Isolation room to perform patient care an average of one-and-a-half to 3 times per hour.^{9,10} This indicates approximately 19 minutes of unnecessary hand hygiene prior to gloving per 12-hour shift. This valuable time could be spent more productively in direct patient care or another quality control measure in the ICU that is proven to impact patient safety and/or quality of care. However, the ICU staff are not alone in spending time on this potentially unnecessary step: infection preventionists spend time educating, monitoring compliance, and enforcing the performance of hand hygiene prior to donning nonsterile gloves. This time and focus could be spent more productively in providing education on hand hygiene movements with proven benefit, such as after glove removal. Other significant factors that may be associated with this potentially unnecessary hand hygiene step include the cost of alcohol hand gel and drying of the health care worker's skin. It would seem that abolition of this potentially unnecessary step could potentially be acceptable to ICU staff because 68% (154/226) of subjects in this study admitted to finding it cumbersome.

This study has several limitations. First, whereas this study was conducted in several different ICU settings, it may not be applicable outside these settings. Our next step is to examine the need for hand hygiene prior to nonsterile gloves outside the ICU including in outpatient clinics and long-term care facilities. Second, for this study we chose a modified fingertip contact (impression) plate method, a technique less cumbersome and less time-consuming for the health care worker participant than more complicated sampling methods such as the glove juice method. In this real-world study, conducted in a busy ICU where every moment of health care worker time is precious, we thought that the less cumbersome imprint method was more likely to be successful. A criticism of the fingertip contact

(impression) plate method is that it does not sample the entire hand; thus, in this study we modified the technique to also include sampling of the palm of the hand.

Conclusion

Hand hygiene before nonsterile gloves in the ICU is time-consuming for health care workers and may be unnecessary. This report supports the premise that this hand hygiene step does not reduce transmission of pathogens to patients.

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Table 1
Key finding and baseline characteristics of all health care workers divided by group:
“Hand hygiene prior to gloving” and “direct gloving”

	All health care workers (N = 230)	Hand hygiene prior to gloving (n = 115)	Direct gloving (n = 115)	P value
Key finding:				
Glove contamination postgloving (CFU)	7.48	6.9	8.1	.52*
Baseline characteristics:				
Baseline hand contamination (CFU)	139.44	131	148	.6 [†]
Health care worker type, n (%)				.9
Nursing staff	127/225 (56.4)	60/111 (53)	67/114 (58.8)	
Physician	30/225 (13.3)	16/111 (14.4)	14/114 (12.3)	
Other	68/225 (30.2)	35/111 (31)	33/114 (29)	
Time since shift commencement, hours, n (%)				.4
0-5	143/226 (63.8)	69/114 (60.4)	74/112 (66.1)	
>5	83/226 (36.7)	45/114 (39.5)	38/112 (34)	

CFU, Colony-forming units.

* Negative binomial log linear regression model.

[†] Student *t* test.