CONCISE COMMUNICATION

The Time Burden of Alcohol-Based Hand Cleanser When Using Nonsterile Gloves

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We quantified the time burden of alcohol-based handrub accompanying nonsterile-glove use among emergency physicians, through observation in controlled and clinical settings. We report gloving episodes per hour, gloving times with and without handrub, and handrub recommendations compliance. Handrub adds 46 seconds to each glove-use episode, and we provide national extrapolations.

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In the United States, there are 1.7 million healthcare-associated infections and 99,000 deaths resulting from them annually.[1] Hand hygiene (HH) is the most important intervention to prevent disease transmission.[2] HH is necessary even when gloves are used.[3]

Guidelines require hygiene with soap and water or alcohol-based handrub before and after nonsterile gloving for patient contact.[2] Compliance is poor worldwide, ranging from 27% to 83%.[4-6] The World Health Organization (WHO) recommends 20–30 seconds of rubbing until hands are dry to achieve microbial killing.[2]

The emergency department (ED) is ideal to study HH with glove use because of the frequency of nonsterile procedures, the risk of contact with fluids, and time pressures.[7] Studies found worse HH compliance with than without glove use and also found provider attitudes that glove-associated HH takes too much time.[2,4,7] Anecdotally, providers state that glove donning is difficult when hands are sticky from handrub.

We quantified the time burden of handrub-based HH with glove use among emergency physicians by (1) measuring the time added by handrub use before and after gloving in a controlled setting, (2) measuring the number of gloving events per hour among emergency medicine residents in real clinical practice, and (3) calculating the burden most US ED physicians face, by using national data to extrapolate our results.

METHODS

Controlled Setting

This was a prospective observational study of a convenience sample of ED staff members, measuring time added to nonsterile gloving by handrub. Participants blinded to the objective were asked to put on gloves as they would before placing a nasogastric tube. Subjects donned gloves once with handrub and once without handrub, serving as their own controls. We used Purell Instant Hand Sanitizer Gel (Johnson & Johnson).

Participants did not know that they were being timed. Timing for glove donning started when the participant touched the glove box and ended when the gloves were completely on. Timing for glove removal started when the participant touched one glove to the other to begin removing gloves and ended when the gloves were in the waste receptacle. Timing for pregloving HH began when the participant touched the handrub dispenser and ended when he or she touched the glove box. Timing for HH after glove removal began when the participant touched the dispenser and ended once the participant stopped rubbing the hands together. Research assistants recorded provider type, age, gender, and presence of rings, bracelets, or watch. We also calculated the proportion of hand rubbing episodes lasting 20 seconds or more.

We calculated averages and 95% confidence intervals (95% CIs) for time parameters and used paired two-tailed *t* tests to compare glove-donning, glove-removal, and handrub times for provider types. We used multivariate regression modeling to assess for confounding by provider characteristics; the dependent variable was added time for handrub use before and after gloving, and the independent variables were handrub versus gloving first, provider role, gender, age, and presence of rings, watch, or bracelets.

We performed sample size calculations based on pilot data (revealing a mean gloving time of 41 seconds with handrub and 22 seconds without, with a standard deviation of 11.3 seconds in both groups and normal distribution). To detect a difference of less than 2 seconds between times with and without handrub, we would need a sample size of 40 participants to yield a power of 80%.

Observation of Practice

Research assistants, who were medical students on observation shifts, covertly recorded the number of nonsterile gloving episodes per hour by second- and third-year emergency medicine residents during day and night shifts. They recorded whether glove use was indicated, using a checklist of clinical indications developed by the investigators and based on WHO guidelines (risk of contamination with bodily fluid; examination of a damp part of body, such as groin, anus, or axilla; or patient on posted communicable-disease precautions).[2] They recorded whether the physician missed an indicated gloving episode.

Research assistants collected data on paper sheets kept discreetly covered. Authors entered data into Microsoft Excel 2010 before importing them into JMP 9.0 (SAS Institute).

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The study took place in an adult-only tertiary care academic ED with an annual census of 60,000 and a 26% admission rate, and it was reviewed and approved by the hospital's institutional review board with a waiver of informed consent. We calculated the frequency of gloving episodes per hour, the number of patients seen per hour, and the number of patient interactions per hour (defined as entering patients' rooms or hall spaces).

Extrapolation to National Data

Nationally, the fifth percentile for patients per hour is 1.25, and the 95th percentile is 3.5. Our subjects saw 1.2 patients per hour. This reflects the fact that our subjects were trainees, who see fewer patients than fully trained physicians in the community. A correction factor of 1.25/1.2 gives the time spent per shift on handrub and glove-associated HH for the fifth percentile, and a correction factor of 3.5/1.2 gives the corresponding figure for the 95th percentile.

RESULTS

In the controlled-setting part of the study, subjects were 2 attending physicians, 11 residents, 4 physician assistants, 20 nurses, and 3 medical students. Total time for gloving and removal with handrub was 44 seconds (95% CI, 39–49 seconds; Table 1). HH before gloving took 17 seconds (95% CI, 13–22 seconds). This added time was divided into 11 seconds for HH (95% CI, 9–13 seconds) plus 6 additional seconds donning gloves after HH (95% CI, 3–10 seconds). HH after glove removal took 6 seconds (95% CI, 4–9 seconds). Total time for HH with nonsterile gloves was 24 seconds per episode, not including time for gloving. If providers waited 20 seconds for the handrub to dry before and after glove use, as suggested by the WHO, the added burden of handrub before and after gloves would be 46 seconds per gloving episode (Table 1). Of the covariates tested, only age was associated with added time for handrub use. Each additional year of age added 1.2 seconds to handrub use time ($P = .03$).

In the clinical part of the study, subjects were 11 residents observed for 42 hours. Residents donned gloves a mean of 0.8 times per hour (95% CI, 0.5–1.1). Of the observed gloving episodes, 77% were clinically indicated, according to the investigators' checklist (95% CI, 63%–91%). Residents saw 1.2 new patients per hour (95% CI, 1.0–1.5) and entered a patient's room or hall space 3.7 times per hour (95% CI, 3.2–4.2). There was 1 failure to use gloves when indicated. Compliance with the requirement for HH before glove donning was 44% (95% CI, 27%–61%). Hands were rubbed for 20 seconds or more in only 3% of episodes (95% CI, 0%–9%). No instances of soap-and-water HH were observed.

If allowing 20 seconds for handrub drying before and after gloving, a typical emergency physician in the fifth percentile for patient volume would spend 39 seconds per hour on handrub use before and after gloving, assuming our observed gloving rate of 0.7 times per patient. A physician in the 95th percentile for patient volume would spend 108 seconds per hour. In comparison, gloving alone occupies 17 and 58 seconds per hour for physicians in the fifth and 95th percentiles of patient volume, respectively.

DISCUSSION

When handrub is allowed to dry completely for at least 20 seconds, as suggested by WHO guidelines, HH associated with nonsterile glove use occupies 46 seconds per gloving episode. Participants adhered to the WHO guideline of 20 seconds of hand rubbing only 3% of the time, consistent with prior observations.[5]

The extra time our subjects spent donning gloves with sticky hands was only 6 seconds. In comparison, emergency

TABLE 1. Average Time for Alcohol-Based Handrub Use, Glove Donning, and Glove Removal by Provider Type

	Times by provider type, s					
Activity	Attending physician	Resident	Physician assistant	Nurse	Student	Mean (95% CI)
Gloving with handrub use						
Handrub before gloves	9	8	9	13	8	11 (9–13)
Glove donning	16	23	17	22	23	22 (18–26)
Glove removal	2	4	3	4	2	4 (4–4)
Handrub after gloves	12	7	9	8	8	8 (7–9)
Total time for handrub and gloves	40	42	38	47	41	44 (39–49)
Gloving without handrub use						
Glove donning alone	17	15	11	15	20	15 (13–18)
Glove removal alone	4	3	3	7	3	5 (3–7)
Total time for gloves alone	21	18	14	22	23	20 (16–24)
Difference in times						
Added time for handrub before gloves	8	16	14	20	11	17 (13–22)
Added time for handrub after gloves	11	8	10	5	7	6 (5–8)
Total added time for handrub with gloves	20	24	24	25	18	24 (19–29)

NOTE. Columns do not sum because of rounding. CI, confidence interval.

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physicians spend 5.3 minutes per patient on history and physical examination and 7.6 minutes per procedure.[8] At a schedule of 1,700 work hours per year, a typical emergency physician observing recommended handrub times would spend 19–54 hours per year on glove-associated handrub use. An informal calculation suggests the financial cost: at a salary of $155 per hour and with a 35% fringe rate, $4,000–$11,300 per year.[9] In comparison, each healthcare-associated infection costs more than $3,000.[10] The immediate applicability of these findings is that infection control advocates can inform providers that a real but manageable amount of time is spent on nonsterile glove-associated HH.

The principal methodological limitation of this investigation is that we did not have resources to study emergency physicians in various practice settings. We assumed that different providers—emergency physicians, residents, students, and staff—use handrub similarly. This assumption is supported by the lack of differences in time parameters in our controlled-setting analysis. However, subtle differences in handrub use, such as multitasking while applying handrub, may affect the burden of handrub use for each group. We did not assess time required for soap-and-water HH, which is imperative in the presence of visible contamination or organisms not susceptible to alcohol-based handrub.[2] In our study sample, these circumstances did not occur. We also did not investigate the time spent on HH without gloves, which may account for as much time as HH with gloves.

We conclude that alcohol-based handrub use before and after nonsterile glove use represents a real but manageable additional time commitment, requiring 39–108 seconds per hour for a typical emergency physician.

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REFERENCES

1. Klevens RM, Edwards JR, Richards CL Jr, et al. Estimating health care–associated infections and deaths in U.S. hospitals, 2002. *Public Health Rep* 2007;122(2):160–166.
2. World Health Organization. *WHO guidelines on hand hygiene in health care.* Geneva: World Health Organization, 2009.
3. Karen NH, Denise MK, David AH, Jan RK, Gabor DK. Loss of glove integrity during emergency department procedures. *Ann Emerg Med* 1998;31(1):65–72.
4. Venkatesh AK, Pallin DJ, Kayden S, Schuur JD. Predictors of hand hygiene in the emergency department. *Infect Control Hosp Epidemiol* 2011;32(11):1120–1123.
5. Hakko E, Rasa K, Karaman ID, Enunlu T, Cakmakci M. Low rate of compliance with hand hygiene before glove use. *Am J Infect Control* 2011;39(1):82–83.
6. Thompson BL, Dwyer DM, Ussery XT, Denman S, Vacek P, Schwartz B. Handwashing and glove use in a long-term-care facility. *Infect Control Hosp Epidemiol* 1997;18(2):97–103.
7. Williams CO, Campbell S, Henry K, Collier P. Variables influencing worker compliance with universal precautions in the emergency department. *Am J Infect Control* 1994;22(3):138–144.
8. Innes GD, Stenstrom R, Grafstein E, Christenson JM. Prospective time study derivation of emergency physician workload predictors. *Can J Emerg Med* 2005;7(5):299–308.
9. Daniel Stern and Associates, American College of Emergency Physicians. *2011 national emergency medicine salary survey clinical results.* http://www.danielstern.com/2011participantcopy/2011_NationalSurvey2.pdf.
10. Stone PW, Braccia D, Larson E. Systematic review of economic analyses of health care–associated infections. *Am J Infect Control* 2005;33(9):501–509.

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