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Major Article

Beyond entry and exit: Hand hygiene at the bedside

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Background: We aimed to assess compliance, knowledge, and attitudes regarding the World Health Organization (WHO) 5 moments for hand hygiene (HH).

Methods: We assessed HH compliance from July-August 2016, using a modified WHO HH observation form. A 26-question survey was used to assess health care personnel (HCP) knowledge, opinions, and barriers to HH. A subgroup of HCPs participated in a 2-round focused survey to assign priority to the moments.

Results: Three hundred two HH opportunities were observed in 104 unique HCP-patient interactions. HH was performed at 106 (35%) opportunities, 37% (25 of 68) before touching a patient, 9% (6 of 70) before aseptic procedures, 5% (1 of 22) after body fluid exposure or risk, 63% (55 of 88) after touching a patient, and 35% (19 of 54) after touching patient surroundings. Two hundred eighteen HCPs completed the survey; 63 (29%) were familiar with the WHO 5 moments but only 13 (21%) were able to recall all 5 moments. In the focused surveys, 46% (6 of 13) ranked "before aseptic procedure" as the most important HH moment, and 86% (11 of 13) identified "after touching patient surroundings" as the least important.

Conclusions: We found frequent opportunities for HH with infrequent compliance. Lack of recognition of opportunities at the bedside and frequent glove use may contribute to lower compliance.

Hand hygiene (HH) is an essential component of infection prevention. The World Health Organization (WHO) recommends 5 moments for HH: before touching a patient, before aseptic procedures, after body fluid exposure or risk, after touching a patient, and after touching patient surroundings.[1] Reported health care personnel (HCP) compliance with HH practice is low, at approximately 40%-60%.[2] Although most studies focus on HH at entry and exit to patient rooms, few studies examine compliance at the bedside with the WHO 5 moments. Among those that do, rates as low as 3.6% are reported.[3] HH at these moments may be important in preventing both transmission and infection, particularly in critically ill patients who harbor the greatest risk of infection and in whom care is often complex, with multiple interventions, devices, and opportunities for HH.[2]

Patients in the intensive care unit (ICU) are an important focus of study, as they are most susceptible to health care–associated infections owing to underlying illnesses, immunosuppression, and presence of invasive devices, and because of the nature of care, opportunities are more frequent.[2] A lack of HH compliance in these areas represents a major gap in practice. Possible reasons for poor compliance include perceived lack of time and frequency of opportunities. Various HH opportunities may present different risks of transmission, and certain high-risk activities can be identified for prioritizing improvement.

In this study, we aim to (1) assess HH compliance at the WHO 5 moments for ICU patients, (2) assess HCP knowledge and attitudes toward HH, and (3) understand how HCP prioritize moments for HH, which may be useful for future education.

METHODS

This study was performed at the University of Maryland Medical Center, a 750-bed tertiary care hospital in Baltimore, Maryland. HCP

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receive HH education, including education on the WHO 5 moments of HH,[1] during new employee orientation and annually via a brief online educational module.

We included 3 study elements. First, we observed HCP compliance with HH and glove use according to the WHO 5 moments guidelines[1] in select units. Second, we administered a facility-wide survey to HCP to assess knowledge, opinions, and barriers to HH and glove use compliance. Third, we used a series of focused surveys to understand how HCP prioritize the various "moments" or opportunities for HH.

HH and glove use compliance: We conducted a series of observations in the medical ICU (MICU), surgical ICU (SICU), and cardiac surgical ICU (CSICU) from July-August 2016. The MICU is a 29-bed unit where HCP are required to don gloves and gowns for all patient interactions (ie, universal contact precautions); the 19-bed SICU and 21-bed CSICU utilize contact precautions[4] for patients colonized or infected with multidrug-resistant organisms, including methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus,* and select multidrug-resistant gram-negative pathogens. Any HCP entering a patient room to provide patient care were eligible for observation in this study. HCP were anonymously observed through glass doors and transparent windows from the time of entry to exit. HH opportunities and compliance with HH and glove use were recorded using a modified WHO HH observation form.[5] Total compliance was defined as removing gloves (if worn) and using either alcohol gel or soap and water on bare hands. All observations were carried out by a single observer on weekdays during the day shift. The observer rotated at random between the different ICUs and spent 15-90 minutes at a time in each unit. The observer did not announce their presence and, if asked, reported they were observing HCP-patient interactions. If the observer suspected their presence was known, they rotated to a different unit. In addition, routinely collected surveillance data on HH compliance at room entry and exit for the study units were obtained from our hospital's infection prevention department.

Survey: We developed a 26-question survey to assess knowledge, opinions, and barriers to HH. Section 1 of the survey collected demographic information as well as the participant's history of HH education. Section 2 assessed the most common methods used for HH (alcohol rub, soap and water, changing gloves). Sections 3 and 4 assessed knowledge of the WHO 5 moments of HH. Section 5 assessed opinions of the value of HH. The survey was distributed electronically to all hospital employees responsible for delivering patient care.

Focused surveys to assess HCP prioritization of "moments" for HH: From the respondents to the house-wide survey, we recruited 14 HCP to participate in a series of 2 additional surveys. We sought to engage a variety of HCP types to respond to a set of questions aiming to identify and prioritize important HH opportunities prior to various patient care tasks.[6] In the first round, participants completed an open-ended questionnaire that included the following: "In your opinion, before which patient care activities is it most important to perform HH to protect the patient from hospital-acquired infections? (Please list AT LEAST 3)." We opted to focus on HH opportunities as they relate to prevention infection in patients (rather than to protecting HCP) because we were interested in refining how HCP prioritize various activities within each moment—specifically, the many activities that fall under moment 2, "before clean/aseptic procedures."

In the second round, which was distributed electronically 5 months later, we used a multiple choice survey with several components: (1) rank the WHO 5 moments from most to least important for infection prevention; (2) rank specific HH opportunities or moments before starting specific "clean" procedures (eg, phlebotomy, wound dressing, insertion of nasogastric tube, insertion of intravenous [IV] line or central venous catheter [CVC], accessing IV line or CVC, emptying urinary drainage bag) as "low," "medium," or "high" priority; and (3) choose 1 moment from section 2 considered most important for performing HH. The content of the second-round questionnaire was determined by the results of the first-round responses.

Analysis

HH compliance and glove use: HH compliance was estimated as the number of times HCP correctly performed HH divided by the total number of HH opportunities, and the frequency of HH compliance was calculated for each of the 5 moments.

Surveys: Frequencies and proportions were estimated for HH attitudes and behaviors by health care type. We used the Fisher exact test to evaluate a difference in correct answers to each of the 5 moments between those who had and those who had not received HH training in the past year. All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC).

RESULTS

HH and glove use compliance: During our serial observations, 104 HCP-patient encounters were observed; observed HCP were nurses (65 encounters, 63%), physicians (17 encounters, 16%), technicians (4 encounters, 4%), other (15 encounters, 14%), and unknown (3 encounters, 3%). Among the 104 encounters, there were 302 opportunities for HH. There was an average of 3 opportunities per HCP-patient encounter, and the average encounter duration was 12.9 minutes (SD, 11.5 minutes). HH was performed in accordance with the WHO 5 moments for HH in 35% (106 of 302) of all opportunities (Table 1). HH compliance was similar across units (31% [34 of 110] in the MICU, 47% [34 of 72] in the SICU, and 30% [36 of 120] in the CSICU) as well as for patients on contact precautions (35% [56 of 160]) and those not on contact precautions (35% [50 of 142]). Based on routine infection prevention audits, the overall entry and exit HH compliance for these units was 90% during the time period of our observations.

Survey: Two hundred eighteen HCP completed the electronic survey: 72 (33%) registered nurses (RNs), 46 (21%) resident physicians, 33 (15%) radiographers or radiology technicians, 22 (10%) nurse practitioners or physician assistants, 16 (7%) attending physicians, 10 (5%) patient care technicians, and 17 (7%) other. Primary work areas were the ICU (58, 27%), radiology (40, 19%), surgery or trauma (24, 11%), no specific unit (18, 8%), medicine (14, 6%), obstetrics (12, 6%), and other (52, 24%).

One hundred eighty-one (83%) respondents reported ever receiving HH education, and 129 (59%) reported receiving education in the

Table 1
Observation of HH behaviors in the ICU

	Total	Before touching a patient	Before aseptic procedures	After body fluid exposure risk	After touching a patient	After touching patient surroundings
		Moment 1	Moment 2	Moment 3	Moment 4	Moment 5
No. of opportunities	302	68 (23%)	70 (23%)	22 (7%)	88 (29%)	54 (18%)
WHO HH compliant	106 (35%)	25 (37%)	6 (9%)	1 (5%)	55 (63%)	19 (35%)

HH, hand hygiene; *ICU*, intensive care unit; *WHO*, World Health Organization.

Table 2
WHO 5 moments recalled by HCP (free response)

	Moment 1	Moment 2	Moment 3	Moment 4	Moment 5	All 5 correct
HH education in the past year (n = 129)	25 (19%)	23 (18%)	16 (12%)	19 (15%)	11 (9%)	9 (7%)
No HH education in the past year (n = 89)	9 (10%)	8 (9%)	2 (2%)	6 (7%)	6 (7%)	4 (4%)
Overall (n = 218)	34 (16%)	31 (14%)	18 (8%)	25 (11%)	17 (8%)	

HCP, health care personnel; *HH*, hand hygiene; *WHO*, World Health Organization.

past year. Sixty-three (29%) said they were familiar with the WHO 5 moments, but only 13 (6%) were able to recall all 5 moments (Table 2). The moments that were most frequently identified in the open-ended response included before touching a patient (34, 16%) and after touching a patient (31, 14%), whereas before an aseptic procedure (18, 8%) and after touching patient surroundings (17, 8%) were the least commonly identified. There was no statistically significant difference between groups who reported receiving HH education in the past year and those who did not in correct answers to the WHO 5 moments ($P = .575$).

Given the scenario "You perform hand hygiene, enter a patient's room, and refill the supply cart before starting other tasks in the room. Immediately before performing which of the below tasks should hand hygiene be performed?" 192 (88%) correctly identified *before insertion of nasal cannula*, 182 (84%) correctly identified *before palpating the patient's abdomen*, and 213 (98%) correctly identified *before placing an IV line*, whereas 64 (29%) incorrectly selected *before cleaning up a spill on the floor,* as a moment for performing HH.

When asked which of the WHO 5 moments prevent transmission of germs to patients and which prevent transmission of germs to HCP, 203 (93%) responded correctly by selecting the moments before patient contact and before an aseptic procedure as moments preventing transmission to patients and after exposure to blood or body fluids, after patient contact, and after contact with patient surroundings as moments that prevent transmission to HCP.

Main barriers perceived to performing HH included frequent entry and exit (138, 63%), HH too drying or irritating to hands (114, 52%), and HH not necessary when continuously wearing gloves (87, 40%).

Respondents generally agreed that HH was effective in preventing health care–associated infections, with 199 (91%) reporting the effectiveness as "high" or "very high." Responses to the effort required to perform good HH varied: 54 (25%) reported very low effort, 65 (30%) low, 31 (14%) medium, 31 (14%) high, and 36 (17%) very high. Respondents also generally estimated their compliance with performing HH as good, with 177 (81%) estimating they miss performing HH when they realize it should be performed 10%-20% of the time. An additional 23 (11%) reported missing HH 30%-40% of the time. Eight respondents (4%) estimated they missed performing HH 90%-100% of the time.

Focused surveys

Fourteen total HCP participated in the focused surveys, 10 of whom responded to both surveys. Round 1 included 4 residents and fellow physicians, 1 nurse practitioner, 2 RNs, 2 respiratory technicians, 1 speech-language pathologist, and 1 three-dimensional computed tomography technician. Round 2 included 4 residents and fellow physicians, 1 nurse practitioner, 3 RNs, 3 respiratory technicians, 1 speech-language pathologist, and 1 three-dimensional computed tomography technician.

Round #1: Table 3 summarizes results of the first round free-response survey to identify the most important moments for preventing infection and includes any moment identified by at least 2 providers. Moments identified by only 1 respondent included interviewing patients (resident, emergency department), preparing contrast agents (radiology technician), surgical care (respiratory therapist), cancer treatment (respiratory therapist), nutritional services (respiratory therapist), diabetic care (respiratory therapist), before entering the room (RN), and before blood draw (fellow, critical care).

Table 3
Important moments for HH as identified by HCP through focused survey #1*

Moment	Responses
Examining patients, physical exam	7
Sterile, invasive procedure	5
Central venous catheter placement	5
Central venous catheter access	4
Peripheral intravenous catheter placement	3
Leaving room	3
Changing bandage or wound dressing	2
Medication administration	2
Foley placement	2

NOTE. Moments were identified by at least 2 respondents. N = 11 HCPs; each provided at least 3 responses.
HCP, health care personnel; *HH*, hand hygiene.
*"In your opinion, before which patient care activities is it most important to perform hand hygiene to protect the patient from hospital-acquired infections?" (free response).

Round #2: In the second survey, participants (n = 13) responded to the multiple choice prompt "Please rank the WHO 5 moments for HH from #1 (most important) to #5 (least important) in preventing infection." Forty-six percent (6 of 13) ranked "before clean/aseptic procedure" as the most important of the WHO 5 moments for preventing infection. The least important moment for infection prevention, according to 85% (11 of 13) of the group, was "after touching patient surroundings."

When participants were given specific HH scenarios to rank as "high," "medium," or "low" priority, 100% (13 of 13) considered before a sterile procedure, before insertion of a urinary catheter, before insertion of a CVC, and before preparing sterile supplies to be high priority moments for HH (Table 4). The other scenarios received mixed responses, with "before insertion of nasal cannula" receiving the most responses for low (3 of 13) and medium (8 of 13) priority. "Before a sterile procedure" was selected as the single most important moment for HH by 7 of 13 (54%) respondents.

DISCUSSION

The aims of this study were to assess compliance with the WHO 5 moments of HH for critical care patients and to assess HCP knowledge and attitudes toward HH. Our study has several important findings. First, we found compliance with the WHO 5 moments was low at the bedside, at 34%, in contrast to 90% reported by infection prevention for entry and exit. Second, although surveyed HCP recognized the importance of HH in infection prevention and perceived their own compliance as good, only one-third were familiar with the WHO 5 moments of HH, and very few (6%) were able to recall all 5 moments. Finally, HCP prioritized HH moments before patient contact, and particularly before aseptic procedures, over moments after patient

Table 4
Prioritizing procedure moments for HH by HCP in focused survey #2

Clinical scenario	High	Medium	Low	Single most important
Before a sterile procedure	13 (100%)	0	0	7 (54%)
Before insertion of CVC line	13 (100%)	0	0	4 (31%)
Before preparing sterile supplies	13 (100%)	0	0	0
Before insertion of urinary catheter	13 (100%)	0	0	0
Before wound dressing (postoperative)	12 (92%)	1 (8%)	0	1 (8%)
Before opening a circuit or device (CVC line)	12 (92%)	1 (8%)	0	0
Before phlebotomy	12 (92%)	1 (8%)	0	0
Before injection into skin	12 (92%)	1 (8%)	0	0
Before insertion of IV line	11 (85%)	2 (15%)	0	1 (8%)
Before accessing a CVC line	11 (85%)	2 (15%)	0	0
Before wound dressing (chronic)	10 (77%)	3 (23%)	0	0
Before opening a circuit or device (IV line)	10 (77%)	3 (23%)	0	0
Before accessing an IV line	10 (77%)	2 (15%)	1 (8%)	0
Before insertion of endotracheal tube	9 (69%)	4 (31%)	0	0
Before suctioning of respiratory tract	8 (62%)	5 (38%)	0	0
Before opening a circuit or device (endotracheal tube)	8 (62%)	5 (38%)	0	0
Before opening a circuit or device (empty urinary drainage bag)	8 (62%)	3 (23%)	2 (15%)	0
Before opening a circuit or device (access nasogastric tube)	8 (62%)	2 (15%)	3 (23%)	0
Before physical exam of oral cavity	7 (54%)	6 (46%)	0	0
Before insertion of nasogastric tube	7 (54%)	4 (31%)	2 (15%)	0
Before insertion of nasal cannula	2 (15%)	8 (62%)	3 (23%)	0

NOTE. N = 13 HCPs.
CVC, central venous catheter; *HCP*, health care personnel; *HH*, hand hygiene; *IV*, intravenous.

contact, after exposure to body fluids, or after contact with the environment.

Few studies examine HH compliance with the WHO 5 moments. The compliance measured in this study is consistent with data from similar studies in which a wide range of compliance is found.[3,6-12] We previously reported a compliance of only 7% among 1,034 WHO-defined opportunities in a busy trauma resuscitation unit,[10] with compliance the lowest (0 of 178 moments) before a clean procedure. Observations from the current report showed that compliance in another high-intensity area, the ICU, was also low, at 35%, although higher than that observed in the active resuscitation setting previously reported. In contrast, other studies (most performed outside the United States) have reported compliance ranging from 3.6%-85.4%.[3,6] For context, hospital-reported HH compliance at room entry and exit in the same units was 90%; this difference highlights the gap in opportunities when infection prevention programs focus on entry and exit only. A potential barrier to HH compliance reported in this and other studies is the frequency of HH opportunities in relation to the time demands of care delivery.[12] McArdle et al[13] identified up to 44 opportunities for HH per patient per hour. We observed an average of 3 opportunities per 8-minute encounter; if you consider that a typical ICU nurse enters a patient room approximately 3 times per hour,[14,15] a nurse may have 108 opportunities in a single 12-hour shift. If each episode of HH takes 30 seconds, that would be 54 minutes per shift spent performing HH and potentially twice that if gloves are worn. This potential barrier is also supported by our finding that one-third of HCP perceived high to very high effort required for HH compliance.

HH compliance may also be related to glove use. We observed that gloves were used in place of HH for 26% of opportunities. This is supported by our survey results in which HCP perceived HH as not necessary when gloves were continuously worn. These findings are consistent with existing studies in which HH compliance, particularly prior to donning gloves, is negatively impacted by glove use. A study in English and Welsh ICUs showed that glove use was strongly correlated with lower levels of HH.[8] In a 2015 Swiss study, where mandatory glove use was eliminated from contact precautions, HH compliance increased, particularly before clean procedures (23.9%-72%).[6]

In the care of critically ill patients, time is a valuable commodity, and when providing emergent care, such as resuscitation, HH is often not the top priority, leaving patients vulnerable to infection. One potential approach to balancing patient care and infection prevention in such settings would be helping HCP recognize and prioritize the most important HH opportunities or moments. In the focused survey, 4 HH moments were identified as high priority by all participants: before a sterile procedure, before insertion of a CVC, before preparing sterile supplies, and before insertion of a urinary catheter. This consensus, achieved after a single round, suggests that HCP prioritize HH moments that protect patients from infection. In contrast, nonsterile tasks (except for accessing an IV line) were classified as "low" priority for HH. As far as we know, there is no existing study that explores HCP prioritization of moments for HH. Notably, in our study, although a consensus for these tasks was reached after 1 round of the survey, in practice, these same tasks had the lowest observed compliance. Educating HCP about specific clinical scenarios where HH has the largest impact on infection prevention may be an effective approach to optimizing HH practice while realistically balancing the feasibility of compliance in critical or urgent situations.

In our survey of HCP, approximately one-half recalled receiving HH education in the past year. In general, HCP were able to recognize appropriate opportunities for HH, but few could name all 5 of the WHO 5 moments in a free response. HCP generally agreed that HH was effective in preventing health care–associated infections, and that performing HH required very low or low effort. However, they also self-reported missing HH approximately 10%-20% of the time, which is consistent when considering entry and exit data but not when considering all WHO 5 moments. This finding may potentially be related to the emphasis on entry and exit compliance in traditional HH monitoring and feedback programs in the United States.[16]

This study has several limitations. First, observations occurred during the day shift only. Second, in some cases, there was incomplete viewing of the patient-HCP interactions; however, when not seen, no opportunity was recorded. In addition, because observations were conducted covertly, it was not possible to assess HCP knowledge of the WHO 5 moments relative to an individual's compliance. Survey limitations include response bias, as respondents may be more knowledgeable about HH practices, and the surveyed HCP were

different from those directly observed for HH compliance. Additionally, this study was conducted at a single center, and results may not be generalizable to other institutions. Despite these limitations, our study presents a comprehensive assessment of observed compliance and perceptions regarding the WHO 5 HH moments as well as a novel approach to prioritization of critical moments for HH.

CONCLUSIONS

HH practice in the ICU has room for improvement. Although providers are generally good at identifying moments for HH, compliance at the bedside is low. HCP recognized the importance of HH and perceived their own compliance as good. However, compliance with the WHO 5 moments was low, and many HCP were unfamiliar with these moments. One obstacle may be the frequency of opportunities, particularly in a critical care setting, and further prioritization of moments may guide educational strategies. At our own institution, findings from this study will inform development and implementation of new educational strategies aimed at improving HH awareness and compliance during patient care at the bedside.

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