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Hand Hygiene Compliance in the Setting of Trauma Resuscitation

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Abstract

Background—Healthcare-associated infections are a significant health burden, and hand hygiene (HH) is an essential prevention strategy. World Health Organization (WHO) 2009 guidelines recommend washing hands during five moments of patient care; 1) before touching a patient; 2) before a clean procedure; 3) after body fluid exposure; and 4) after touching a patient or 5) patient surroundings. HH opportunities at these 5 moments are frequent and compliance is low (22-60%). Infection risk is particularly high in trauma patients, and HH compliance during active trauma resuscitation has yet to be evaluated.

Study Design—Using video surveillance, all healthcare worker (HCW)-patient interactions for 30 patients were retrospectively reviewed for HH compliance according to WHO guidelines and glove use during initial resuscitation at a level-1 trauma center.

Results—342 HCW-patient interactions and 1034 HH opportunities were observed. HH compliance with the WHO moments was 7% (71/1034) overall; 3% (10/375) before patient contact, 0% (0/178) before a clean procedure, 11% (2/19) after body fluid contact, 15% (57/376) after patient contact and 2% (2/86) after contact with the environment. Glove use was more common, particularly before (69%) and after (47%) patient contact and after body fluid contact

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(58%). No HH was observed before clean procedures, but HCW donned new gloves 75% of the time before bedside procedures. If donning/removing gloves was included with HH as compliant, compliance was 57% overall.

Conclusion—HH opportunities are frequent and compliance with WHO HH guidelines may be infeasible, requiring significant amounts of time that may be better spent with the patient during the golden hour of trauma resuscitation. In an era where more scrutiny is being applied to patient safety, particularly the prevention of inpatient infections, more research is needed to identify alternative strategies (e.g. glove use, prioritizing moments) that may more effectively promote compliance in this setting.

Keywords

Hand Hygiene; Compliance; Trauma; Resuscitation

Introduction

Healthcare-associated infections are globally recognized as a significant health burden, safety issue and financial strain.[1-5] The reported incidence ranges from approximately 4.5% in developed countries to 15.5% in resource-limited settings. The resulting financial burden of these infections is high.[1,3,6] The Centers for Disease Control and Prevention estimates the overall direct medical costs range from $28.4 to $45 billion annually.[6] Risk of infection is particularly high in trauma patients and is associated high morbidity, mortality and cost.[7-10]

Hand hygiene (HH) is an essential infection prevention strategy. World Health Organization (WHO) 2009 guidelines recommend using alcohol-based hand rub or washing hands with soap and water during five moments of HH to minimize risk of health care-associated infections: 1) before touching a patient; 2) before a clean/aseptic procedure; 3) after body fluid exposure risk; and 4) after touching a patient or 5) patient surroundings.[11] Previous studies evaluating compliance with WHO guidelines have shown that HH opportunities are frequent, sometimes over 44 HH opportunities per patient per hour, and are associated with low compliance (22 to 60%) suggesting that strict adherence to the guidelines may not be feasible.[12-23] In time sensitive conditions, like emergent care, time is of the essence. It is unclear if the time used for HH would be better spent in direct patient care which could be live saving and whether HH in these particular settings actually improves outcomes.

There have been no published studies to our knowledge that have examined HH compliance with WHO guidelines specifically in trauma patients or in the setting of active resuscitation where opportunities for HH are great and multiple barriers to compliance may exist.[1,24] The University of Maryland's R. Adams Cowley Shock Trauma Center offers a unique opportunity to study HH compliance in this context where existing video surveillance infrastructure allows for unbiased viewing of healthcare worker (HCW) behavior. We aimed to quantify opportunities for HH according to WHO guidelines and to measure HH compliance and glove use during active resuscitation of trauma patients in the center's Trauma Resuscitation Unit (TRU).

Methods

Study Design

We conducted a retrospective review of HH compliance among trauma patients during their initial resuscitation event using a video surveillance system to eliminate potential Hawthorne effect. With Hawthorne effect, the knowledge that the HCW is being observed for compliance can influence the HCW actions and improve HH compliance.[25] The study was conducted at the R. Adams Cowley Shock Trauma Center's Trauma Resuscitation Unit (TRU) over a one-month period from August 25, 2015 to September 24, 2015. This study was reviewed and approved by the University of Maryland Institutional Review Board.

Study Setting

The R. Adams Cowley Shock Trauma Center is a 110-bed freestanding trauma hospital with capabilities exceeding a Level-1 trauma center designation. It serves as the primary adult trauma referral center for the entire State of Maryland. The center serves more than 8,000 critically ill and severely injured patients annually; 18% arrive via air transport. A majority (37%) of injuries seen are a result of motor vehicle collisions; 32% from falls, 18% from violence and 13% are other injury types.[26]

The TRU is the resuscitation and admitting area for all trauma patients brought to the center. It has 12 trauma bays capable of accommodating 26 patients positioned in a semi-circular manner around a central provider work area. Each bay is equipped with two HH stations that have alcohol gel and gloves. Additional HH stations, which include a sink with soap and alcohol gel, are located in the general TRU work area. However, these additional HH stations are not monitored by the surveillance videos. HCWs receive training in HH during hospital orientation and annual competencies for the medical center that covers each of the WHO HH moments in a brief online educational module followed by a required test. The training does not specify all clean procedure indications so HCW may be unaware of certain specific HH indications (e.g. inserting or accessing a nasogastric tube). The unit uses an anonymous embedded observer to audit HH compliance on bay entry/exit, and the unit is provided with monthly reports of compliance. The TRU is known for having high HH compliance as reported by the hospital with rates on entry/exit reported at 80% during the study period.

Surveillance cameras are located in each TRU bay and provide three views of the bay: one bird's eye view of the entire bay and two close-up views from different angles. Surveillance cameras have been in place for the past twenty years years, further limiting the potential Hawthorne effect. The camera system was primarily designed for training, quality and research purposes. While HCWs may be aware of the cameras they were unaware that they were being monitored with respect to HH compliance.

Study Participants

Thirty patients were selected for review; similar numbers of critical and non-critical patients and various presentation times during weekdays, weekends and day and night shifts were included. For the purposes of this study, critical condition patients were defined as those

needing cardiopulmonary resuscitation, emergent intubation or an emergent surgical procedure such as central or arterial line, chest tube, resuscitative-endovascular balloon occlusion of the aorta or clamshell thoracotomy.

Data Collection

A general surgery resident with experience running traumas in the TRU reviewed all HCW-patient interactions during the initial assessment and resuscitation period for each patient for HH compliance. A HCW-patient interaction was defined as the period of time from when a HCW entered the patient bay (surrounded by curtain) to final exit from the patient bay during initial resuscitation of the trauma patient. The resident reviewing the videos was trained in WHO 5 moments data extraction and a modified WHO data collection form was used (Appendix 1).[27] Each HH moment as defined by the WHO guidelines was documented including the reason for HH, the indication if the moment was before a clean procedure, and the type of HH (e.g. alcohol versus soap and water) performed, if any, by the HCW. Glove use was also recorded, specifically whether HCWs donned new gloves during opportunities for HH. Trauma bay, day of the week, shift (day versus night), HCW type, and time of initial room entry and exit were recorded. Additional data were collected based on potential to influence HH compliance such as whether the patient appeared awake and appropriately interactive, whether the patient was in critical condition and whether family was in the patient bay.

All digital cameras are networked via hospital video intranet and all video data were recorded in a digital video recoder at a rate of 30 frames per second. The resuscitation was reviewed as many times as needed to get clarity on the HH indications and compliance for each HCW-patient interaction. Videos could be rewound, timing slowed and areas of the scene could be magnified for review if the HH method was unclear initially. Video review is a robust data collection method for quality improvement for emergency tasks. It has been used extensively in the trauma resuscitation setting to evaluate adherence to universal barrier precautions.[28-31] It allows for identification of performance details not found in other quality improvement approaches while at the same time reducing personnel requirements for capture and simplifying data collection.

Data Analysis

Data was entered into a Microsoft Access database and results were analyzed using Stata 11. Categorical variables were compared with chi-squared tests. A p-value <0.05 was considered significant.

Results

From the 30 patient surveillance videos reviewed, 342 HCW-patient interactions and 1034 HH opportunities based on the WHO recommendations were observed. Of our 30 patients, 47% (14/30) were considered to be in critical condition on presentation, none were awake and appropriately interactive during the resuscitation period. Four patients were observed on each day of the week, except six patients were observed on a Friday. Just over half (57%,

n=17) of our patients presented during the night shift from 19:00 to 7:00. No patients had family in the room with them during the observation time period.

We observed an average of 11.4 (range 7-19) HCW-patient interactions per patient with an average 3 (range 1-12) HH opportunities per interaction, which was similar regardless of whether a patient presented during the day or night shift. Multiple HCWs were present in the bay during all HCW-patient interactions. The average duration of each HCW-patient interaction was 25 minutes, and each patient had an average of 34 HH opportunities observed during resuscitation.

Of the 1034 HH opportunities, 36% (n=375) occurred before patient contact, 17% (n=178) before a clean procedure, 2% (n=19) after contact with body fluids, 36% (n=376) after patient contact and 8% (n=86) after contact with patient surroundings (Table 1). Using the WHO standard of compliance, requiring hand washing with soap and water or alcohol gel, HCW were only compliant during 7% (n=71) of HH moments. Compliance with each of the aforementioned WHO HH moments was 3% (10/375), 0% (0/178), 11% (2/19), 15% (57/376) and 2% (2/86) respectively. HCWs donned and removed gloves without performing HH in 51% of WHO HH opportunities. HCW donned new gloves 69% of the time before patient contact and removed their gloves 47% of the time after patient contact and 58% of the time after contact with body fluids without any additional HH performed.

One hundred and seventy eight clean procedures were observed (17% of all opportunities). The most common clean procedure indications were prior to device insertion (42%, n=76, including IV catheters and central lines, endotracheal tubes, nasal cannulas, nasogastric tubes and foley catheters), prior to opening a circuit or device (32%, n=52, including the IV circuit and endotracheal circuit), and prior to emergent bedside surgical procedures (11%, n=20). No HH was observed before clean procedures, but HCW donned new gloves 75% of the time before emergent bedside surgical procedures (Table 2).

There was no significant difference in HH compliance between critical and noncritical patients or during the day vs. night shift ($p>0.05$). Technicians (17%, n=5/29 moments) and students (13%, n=5/39 moments) had slightly higher HH compliance compared to other HCW types, but still had considerably poor compliance. Compliance was similar between different HCW types when glove donning or removal was included as a compliant HH method (RN 51%, MD 63%, tech 62%, RT 60%, student 59%).

Discussion

To our knowledge, we are the first to report HCW behavior with regard to HH and glove use in the setting of trauma resuscitation. We found that HH opportunities were frequent and that overall HH compliance according to the WHO 5 moments was low at only 7%. The HH moment with the best compliance, after contact with the patient, only had 15% compliance. Although our compliance is lower than other reported studies, our results may present a more accurate picture since HCWs were unaware that HH compliance was being assessed as a result of the video surveillance methodology. Furthermore, these findings highlight

possible infeasibility of full compliance with HH according to the WHO 5 moments in this setting where unique barriers to compliance exist.

The video-surveillance methodology used in this study was a significant strength, which likely resulted in a more truthful and accurate assessment of HCW behavior and compliance with HH and glove use.[28-31] By using video, in which we were able to rewind and re-review, we were able to get the full assessment of all HCW-patient interactions including indications for HH, something that would not be possible with direct observations. We were also able to mitigate the Hawthorne effect since HCWs were unaware they were being monitored. In comparison, much of the current literature has relied upon direct observation to study HH compliance.[14,17-22,32-33] Srigley et al. demonstrated that the Hawthorne effect can significantly improve HH compliance when HCWs are under direct observation; therefore, true compliance is likely lower than what has previously been reported. In addition, none of these studies have examined compliance with the WHO ‘My 5 Moments’ during initial trauma evaluation and resuscitation when barriers to compliance are likely greatest.

Our HH compliance rate is also significantly lower than that documented by the TRU's embedded hand hygiene observer. These results are likely incongruent for multiple reasons. First, the embedded observer is a single anonymous observer who works in the TRU. Given the set up of patient care in this unit, this observer is most likely monitoring HH during non-critical times in patient care when compliance is likely better than during the acute and often critical initial evaluation and resuscitation period when this observer is likely busy with other tasks. In addition, the presence of many HCWs in the trauma bay translates into multiple HH opportunities per HCW during the short resuscitation time period. Using the video-review technology, we had to re-wind and re-play each patient video several times, often magnifying different areas of the video, to fully evaluate each HH moment. It is likely that many HH moments are neither witnessed nor documented by the observer. Finally, although the embedded observer is anonymous, potential exists for that individual to be recognized by HCWs over time leading to improved compliance through the Hawthorne effect.

Identification of reasons for poor compliance was outside the scope of this study, and few studies exist regarding HH compliance in this setting. However, it is our belief that many HCWs may not be fully aware of each of the WHO 5 moments, which may be a factor in this setting. Working in a critical care setting and increased density of HH opportunities (both of which apply to our study population) have previously been associated with non-compliance. Additional barriers to compliance identified in routine and emergency care settings include insufficient time, understaffing, glove use and patient crowding, which again may have influenced our results.17,18,32,33 Finally, additional barriers are likely in the setting of trauma resuscitation and may include HCW crowding in the trauma bay making access to HH stations difficult, frequent HCW interruptions, an open trauma bay model blurring the boundary between the patient bedside the rest of the TRU, absence of a HH champion or senior role model for the unit, lack of feedback on HH compliance during the resuscitation period, and a general acceptance that infection is often unavoidable in the setting of injury and a non-sterile environment.

Glove use is frequent, and often worn without specific indication, in the critical care setting.[33] In our study, we found that HCWs frequently donned and removed gloves at WHO HH opportunities, suggesting that HCWs may be substituting glove use for HH. In fact, if we broadened our definitions of compliance to include compliance with either HH or glove use, we find a greater than eight-fold increase (57% compliance compared to only 7% with HH) with the same moments having the best compliance (Table 1).

HCWs were more likely to perform HH before patient contact, after contact with body fluids and after patient contact. At first, it may seem surprising that HH was lowest during moments before clean procedures. However, on closer examination, HCW use of gloves for HH is highest in the category of clean procedures that are done under sterile conditions when non-emergent. Several of the WHO-defined clean procedures like placement of a nasal cannula or nasogastric tube are likely not intuitively perceived as clean procedures by HCWs. The WHO treats all HH moments equally, but HCWs may prioritize HH for different moments differently. This is consistent with studies that have found that HCWs perform HH most often when they perceive it will protect themselves or their patients.[15, 33-36] More research is needed to understand if certain moments are more important to HCWs than others and whether certain moments may pose a greater risk for transmission.

We know that time spent in direct patient care during the “golden hour” of trauma is crucial to improving patient outcomes. As a result, the perceived need to act quickly to save a life can be a barrier to HH, and HCW may be prioritizing time spent directly attending to the patient over hand rubbing with alcohol gel. Although strict adherence to HH almost certainly improves outcomes in standard patient care, it is less clear that is true when caring for injured patients, particularly those who are critically ill. In patients with open contaminated wounds, good HH may not be as beneficial in all moments. Evidence exists that HH before donning gloves does not significantly decrease bacterial count in the critical care setting and can take up to 46 seconds, time that could be spent in direct patient care.[22,23,37] Based on the number of opportunities observed in our study, complete HH compliance could consume an average of 138 seconds during each HCW-patient interaction, or 9% of the total time spent with the patient.

Glove use cannot replace hand hygiene. However, given the time that compliance with all of the WHO ‘My 5 Moments’ may require, guidelines promoting HH during the most essential moments and glove use for other moments may evoke greater compliance and should be a future area of investigation. In addition, the fact that HCWs donned new gloves 75% of the time before a procedure suggests that they consider these HH moments important; compliance might be further improved through further education. Identifying attitudes toward hand hygiene was beyond the scope of this study, but we hypothesize that HCWs place a lower priority on HH than other tasks during trauma resuscitations.

Despite the concern that HH may be less beneficial in some settings than others, the WHO does not discriminate between settings in its guidelines. In addition, the WHO treats all HH moments equally, but HCWs may prioritize HH for certain moments during trauma resuscitation. In our study HCW were most compliant with HH before and after patient

contact and after potential body fluid exposure. This is consistent with studies that have found that HCWs perform HH most often when they perceive it will protect themselves or their patients,[15,33-36]

More research is needed to determine if certain moments are more important to HCW than others and whether certain moments may pose a greater risk for transmission in this setting. HCW beliefs and barriers to HH in trauma care need to be better understood. Active interventions must incorporate HCW education and creative solutions to minimize barriers to HH, particularly during key moments.

This study has limitations. This study was performed at a single center and may not be generalizable to other locations. Also, surveillance videos were reviewed by a single reviewer. A second reviewer, to verify documented compliance, could improve inter-observer reliability and strengthen results. However limitations in time that surveillance videos are stored and available viewing stations made this infeasible.

Much more scrutiny is being applied to patient safety, particularly the prevention of inpatient infections. Healthcare reimbursement will increasingly be tied to these measures. Our ability to track measured outcomes, particularly to assign cause to complications is limited. Thus, we often use compliance with guidelines as a surrogate for quality. It is imperative that guidelines be well thought out, be evidence based and be accurate in the specific clinical scenarios being assessed. Our data raises concern about application of these guidelines during trauma resuscitation.

Conclusions

Despite the general consensus that HH is an important tool in infection prevention, widespread and mandatory adoption of the WHO 5 Moments has limitations including a lack of existing evidence to support the practice and the practicality (or impracticality) of its implementation, especially in emergency, critical care and surgical settings.[13-15] Clinical practice as seen in our study suggests that strict adherence to the WHO ‘My 5 Moments’ of HH may be infeasible in the setting of active resuscitation. Creating a set of guidelines that focuses on glove use for HH before and after patient care, after contact with body fluids and before certain clean procedures may be more effective in promoting HH compliance. Our study identified frequent opportunities for HH according to the WHO 5 Moments and a low compliance during active resuscitation. These results support the fact that strict adherence to these 5 moments may be infeasible in this setting. More research is needed to identify strategies to overcome unique barriers to HH in trauma and critical care and to prioritize the most essential HH moments.

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Appendix 1. Sample data collection form

Hand hygiene observation tool: **PT LINK ID:**

Instructions. *A new form should be completed for each HCW-patient interaction.* **TRU bay #:**

Day of week: Mon Tue Wed Thu Fri Sat Sun **Time of room entry:** _____

Patient awake: YES NO Unclear **HCW type:** RN MD Tech Other Unknown

Other HCW in room: YES NO **Family in room:** YES NO **Critical Condition:** YES NO

Each box below represents an opportunity for hand hygiene for a given healthcare worker and patient interactions. Healthcare workers may have multiple opportunities per patient visit to perform hand hygiene – you may need a second form to complete. For each opportunity indicate the appropriate WHO and whether or not HH was performed.

Moment (Check One)		Reason (Check one) See table for guide	HH Compliance	
1	Before contact w/ patient	N/A	Gloves Worn HH Performed:	Gloves NOT worn HH Performed:
2	Before clean procedure	Device insertion	NO, gloves worn continuously	NO (and no gloves)
		Prep sterile material		
		Wound dressing	NO, gloves changed or removed	NO, gloves donned
		Suctioning		
		Oral exam	YES, hand wash (gloves removed)	YES, hand wash
		Phlebotomy/Injection		
		Open circuit or device	YES, hand rub (Gloves removed)	YES, hand rub
		Bedside Surgery	Check if incomplete viewing of HH opportunity	
3	After contact w/ body fluid	N/A		
4	After contact w/ patient	N/A		
5	After patient surroundings	N/A		

Moment (Check One)		Reason (Circle One) See table for guide	HH Compliance	
1	Before contact w/ patient	N/A	Gloves Worn HH Performed:	Gloves NOT worn HH Performed:
2	Before clean procedure Exits rm wearing gloves and returns with blankets seconds later still with gloves on at 9:16, unlikely to have changed gloves and done hygiene	Device insertion	NO, gloves worn continuously	NO (and no gloves)
		Prep sterile material		
		Wound dressing	NO, gloves changed or removed	NO, gloves donned
		Suctioning		
		Oral exam	YES, hand wash (gloves removed)	YES, hand wash
		Phlebotomy/Injection		
		Open circuit or device	YES, hand rub (Gloves removed)	YES, hand rub
		Bedside Surgery	Check if incomplete viewing of HH opportunity	
3	After contact w/ body fluid	N/A		
4	After contact w/ patient	N/A		
5	After patient surroundings	N/A		

Table 1: Reasons for No. 2 Moment (Before clean procedure)		
Wound dressing Suctioning or oral exam Phlebotomy/injection Preparing sterile material	Before insertion of: nasal cannula, nasogastric tube, ETT, IV line, urinary catheter	Before opening circuit or device: IV/CVC line, ET circuit, empty urinary drainage bag, access nasogastric tube Bedside Surgery: Cricoidotomy, Chest Tube, ED thoracotomy

Time of room exit: _____

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Table 1

Hand Hygiene (HH) Moments and Compliance

	Total	Before patient contact	Before clean procedure	After body fluids contact	After patient contact	After contact with surrounding
No. of opportunities	**1034**	**375 (36%)**	**178 (17%)**	**19 (2%)**	**376 (36%)**	**86 (8%)**
WHO HH compliant *	71 (7%)	10 (3%)	0 (0%)	2 (11%)	57 (15%)	2 (2%)
Glove donning/removal	524 (51%)	260 (69%)	57 (32%)	11 (58%)	177 (47%)	19 (22%)
Compliance with HH or glove use **	595 (57%)	270 (72%)	57 (32%)	13 (68%)	234 (62%)	21 (24%)

*Compliance based on WHO guidelines, requiring hand washing with soap or alcohol gel

**Compliance if donning new gloves before a moment or removing gloves after a moment is included as compliant in addition to hand washing. Wearing gloves continuously is not included as compliant.

Table 2
Clean Procedure Hand Hygiene (HH) indications and Compliance

Clean procedure indication	Gloves Donned/Removed*	# moments
Device insertion	22/76 (29%)	76 (43%)
Prep sterile material	1/4 (25%)	4 (2%)
Wound dressing	6/16 (38%)	16 (9%)
Suctioning	0	3 (2%)
Oral exam	0	2 (1%)
Phlebotomy/injection	0	0
Open circuit/device	13/57 (23%)	57 (32%)
Bedside emergent surgical procedure	15/20 (75%)	20 (11%)
Total	57/178 (32%)	178

* No HH was observed prior to any clean procedure indication.