

Article

Observational Study of Hand Hygiene Compliance at a Trauma Hospital in Iraqi Kurdistan

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Abstract: Healthcare-associated infections, commonly caused by poor hand hygiene, represent a significant source of disease and economic burden for healthcare systems, especially those in resource-limited settings. The few existing studies on hand hygiene compliance in resource-limited hospital settings suggest that compliance is insufficient. The difference in compliance rates between units in resource-limited trauma hospitals is largely unknown. We aimed to assess hand hygiene compliance rates among healthcare workers at a trauma hospital in Iraqi Kurdistan and compare the levels of compliance between the emergency room (ER), the intensive care unit (ICU), and the acute care ward (ACW). We carried out overt observations in 2018 using the validated World Health Organization ‘five moments for hand hygiene’ observational tool. We observed a total of 622 hand hygiene opportunities performed by 149 healthcare workers. Hand hygiene compliance was defined as handwashing with soap and water or the use of alcohol-based hand rub, in accordance with the ‘five moments for hand hygiene’ concept. Overall, the hand hygiene compliance rate was found to be 6.8% (95% confidence interval 5.0–9.1). Compliance was significantly lower in the ER (1.0%), compared with the ICU (8.1%) ($p = 0.0012$), and the ACW (11.1%) ($p < 0.0001$). In all three units, the availability of alcohol-based hand rub and handwashing sinks was insufficient in relation to the number of patient beds. We conclude that the overall level of hand hygiene compliance was low, with the lowest level of compliance in the ER. Our findings call for improved resource allocation and strengthened hand hygiene routines. These relatively simple measures could potentially lower the incidence of healthcare-associated infections and improve the mortality and morbidity of patients in already overburdened healthcare systems.

Keywords: hand hygiene compliance; healthcare-associated infection; trauma care



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1. Introduction

Healthcare-associated infections (HAIs) are spread by the transmission of microorganisms from a patient or a patient’s surroundings to another patient, usually via equipment or via the hands of healthcare workers (HCWs) [1]. HAIs are associated with significant mortality and morbidity, and place an economic burden on healthcare systems [2]. In European high-income countries, more than 4 million patients are affected by HAIs annually, with urinary tract infections being the most frequent type of HAI, followed by lower respiratory tract infections, surgical site infections, and bloodstream infections [3,4].

HAIs are of greatest prevalence in low- and middle-income countries, in part due to the limited resources available at public hospitals, including those for hand hygiene, with surgical site infections being the most frequent type of HAIs [5,6]. Cesarean sections are among the most common operative procedures in low- and middle-income countries and are associated with maternal and neonatal mortality caused by HAIs [7]. A high prevalence

of antimicrobial resistance adds to the severity of HAIs in resource-limited hospitals [8,9]. In addition to HAIs caused by microorganisms, viral HAIs remain a challenge to healthcare systems worldwide [10,11]. This significant burden has been exemplified by the ongoing COVID-19 pandemic [12].

Proper hand hygiene among HCWs is recognized by the World Health Organization (WHO) as the single most effective strategy for preventing HAIs [13,14]. The WHO's concept of 'five moments for hand hygiene' takes an evidence-based approach and defines five key moments at which HCWs should perform hand hygiene routines during clinical care [14,15]. Low hand hygiene compliance (HHC) has been proven to cause higher rates of HAIs [1,2,16]. Hand wash with soap and water and alcohol-based hand rub (ABHR) have proven to be effective against HAIs caused by microorganisms and viruses [17].

Still, often the importance of hand hygiene is insufficiently recognized by HCWs, and poor levels of compliance with the WHO recommendations on hand hygiene have been repeatedly documented in resource-limited hospitals [5,18,19]. Moreover, the implementation of hand hygiene strategies remains a challenge due to a limited access to soap and ABHR, as well as the limited provision of handwashing sinks, and hand hygiene guidelines [20,21]. The WHO recommends a hospital sink-to-bed ratio of at least 1:10 and an ABHR-to-bed ratio of 1:1 [22]. However, resource-limited hospitals often do not adhere to these recommendations [22]. Differences in HHC rates between the units in resource-limited trauma hospitals are largely unknown and there is a paucity of information on the availability of hand hygiene resources at such hospital units [5,6,16]. Improved knowledge of HHC and the hand hygiene resources that are available is necessary to identify hospital units where there is an increased risk of the patients developing HAIs. Therefore, we aimed to assess and compare the levels of HHC in the emergency room (ER), the intensive care unit (ICU), and the acute care ward (ACW) of a resource-limited trauma hospital. In addition, we aimed to measure the ABHR-to-bed and sink-to-bed ratios in the same units.

2. Results

2.1. Infrastructure

Six handwashing sinks were available for the 56 patient beds (10.7%; thus, a sink-to-bed ratio of 1:9). Soap was provided at four of the six sinks (66.7%). There was ABHR at two of the 56 patient beds (3.6%; thus, an ABHR-to-bed ratio of 1:28) (Appendix A Table A1).

2.2. Observations

We performed six observation sessions with a mean observation time of 224 min (range: 147–283 min); there were a total of 22.4 observation hours. Some 622 hand hygiene opportunities performed by 149 HCWs were observed. Among the 149 HCWs, 63 (42.3%) were medical doctors, 69 (46.3%) were nurses, 16 (10.7%) were nursing students, and one (0.7%) was a medical student (Table 1). Since only one medical student was observed, this person was merged into the doctors' group for the purpose of the analyses.

Table 1. Observed healthcare workers at the West Emergency Hospital.

Profession	Number (%)
Medical doctors	63 (42.3%)
Medical students	1 (0.7%)
Nurses	69 (46.3%)
Nursing students	16 (10.7%)
Total	149 (100%)

2.3. Compliance of Units and Healthcare Workers

The overall observed HHC rate was 6.8% (95% confidence interval 5.0–9.1). The HHC rate was significantly lower at the ER (1.0%), when compared with the ICU (8.1%) ($p = 0.0012$), and the ACW (11.1%) ($p < 0.0001$). No significant difference was observed

between the ICU and the ACW. The HHC rate was significantly higher among the nursing students (19.4%) than it was for the nurses (5.7%) ($p = 0.0003$), or the doctors (4.3%) ($p < 0.0001$). No significant difference was observed between the nurses and the doctors (Table 2).

Table 2. Hand hygiene compliance of observed healthcare workers at the West Emergency Hospital.

Characteristic	Hand Hygiene Opportunities, n	Hand Hygiene Actions, n	Compliance, % (95% CI)
<i>Unit</i>			
Emergency room	205	2	1.0 (0.7–3.9)
Intensive care unit	209	17	8.1 (5.0–13.0)
Acute care ward	208	23	11.1 (7.3–16.3)
<i>Professional category</i>			
Doctors & medical student	235	10	4.3 (2.2–7.9)
Nurses	315	18	5.7 (3.5–9.0)
Nursing students	72	14	19.4 (11.4–30.8)
<i>Indication</i>			
Before patient contact	148	1	0.7 (0.4–4.3)
Before aseptic task	29	1	3.4 (1.8–19.6)
After body fluid exposure risk	56	5	8.9 (3.3–20.4)
After patient contact	165	12	7.3 (4.0–12.6)
After contact with patient surroundings	224	23	10.3 (6.8–15.2)
Overall	622	42	6.8 (5.0–9.1)

CI, confidence interval.

2.4. Compliance with the Five Action Indications

Table 2 demonstrates how HHC varied according to the ‘five moments for hand hygiene’ tool. Levels of compliance were observed to be the lowest before patient contact. HHC was significantly higher after body fluid exposure ($p = 0.0080$), after touching a patient ($p = 0.0084$), and after contact with patient surroundings ($p = 0.0005$). The HCWs’ level of HHC before patient contact was not significantly different from their levels of HHC before an aseptic procedure.

2.5. Glove Usage

Glove usage was significantly higher in the ICU than in the ER ($p < 0.0001$), or the ACW ($p < 0.0001$). No significant difference in glove usage was observed between the ER and the ACW (Table 3).

Table 3. Glove usage of observed healthcare workers at the West Emergency Hospital.

Characteristic	Hand Hygiene Opportunities, n	Glove Usage, n (%)
<i>Unit</i>		
Emergency room	205	59 (28.8)
Intensive care unit	209	154 (73.7)
Acute care ward	208	49 (23.6)
Overall	622	262 (42.1)
<i>Indication</i>		
Before patient contact	148	79 (53.4)
Before aseptic task	29	14 (48.3)
After body fluid exposure risk	56	20 (35.7)
After patient contact	165	64 (38.8)
After contact with patient surroundings	224	85 (37.9)

3. Discussion

We found that, overall, there was an insufficient level of compliance with the WHO's recommendations on hand hygiene, with significantly lower compliance in the ER than the ICU and the ACW. While the minimum sink-to-bed ratio was met, one third of the handwashing sinks were missing soap, and the access to ABHR was far from adequate. In the ER, ABHR was unavailable and, consequently, was not used at any point during the period of our observations. Additionally, we found that gloves were used in all three units, among which the ICU had the highest glove usage.

Previous studies have delivered similar findings on insufficient HHC and scarce availability of hand hygiene resources in resource-limited hospital settings, though previous findings have not been profoundly beneath the recommendations [19,20,23,24]. Studies from several Asian countries, including some set in resource-limited hospitals, have demonstrated HHC levels ranging from 18–46% [21,25]. Studies conducted in India and China have suggested that, in these countries at least, HHC is lower in public hospitals compared to private hospitals [19,26]. In one study, conducted in the ICU of a public hospital in Turkey, overall HHC was found to be 13% [23]. Differences in HHC rates between the units in resource-limited trauma hospitals are largely unknown.

In the ER and the ICU in this study, all patients were situated in one room with little space between the patients' beds. In the ACW, on the other hand, a maximum of two patients were kept in each room. The less crowded environment in the ACW led to the observer being more noticeable in the ACW than in the ER and the ICU. Furthermore, patient contact and routine procedures in the ACW were less frequent and more planned, as opposed to in the ER and the ICU. That difference in frequency and planning might have affected our results, given that a high workload, which tends to be more common in the ERs and ICUs of resource-limited hospitals, is associated with insufficient HHC; on the other hand, action planning has been reported to improve the hand hygiene behavior of HCWs [19,27,28]. One study, from an Indian hospital, demonstrated that hand hygiene is missed three times more often during resuscitation procedures, compared with other hand hygiene opportunities [29]. As resuscitation procedures occur more frequently in the ER and the ICU than during planned contact on the ward, hand hygiene may accordingly be missed more often in the ER.

The absence of ABHR in the ER in our study likely contributed to the significantly lower HHC that was observed in this unit. It has previously been suggested that an increase in the number of handwashing sinks, as a sole measure, does not increase HHC [30]. Considering that the use of ABHR takes less time than handwashing, increased availability of ABHR has been proven to be more effective in improving HHC in hospitals than adding extra sinks [29,31]. In addition, ABHR has been proven to more greatly reduce bacterial contamination compared to handwashing [32]. Interestingly, we found that visitors to the ICU were required to wear gloves before they could have any patient contact, while in the ER and the ACW there was no such requirement. The requirement to wear gloves is likely reflected in our results, demonstrating a higher glove usage in the ICU compared with the ER and the ACW. This practice in the ICU might have been a counterproductive measure, given that glove usage tends to decrease the HHC [23,33]. While ABHR is known to reduce bacterial and viral contamination, studies have suggested that single use of ABHR might be less effective against certain respiratory viruses compared with hand washing with soap and water, with the conclusion that ABHR should be combined with additional hygienic measures to reduce the rates of viral respiratory HAIs [34,35].

The findings of this study should be considered in the context of a number of limitations. First, observations were carried out during a limited time period, which might have resulted in a false low level of HHC observed [36]. To increase the statistical power, we observed over 200 hand hygiene opportunities per unit, in accordance with recommendations of the WHO [15]. Second, the study was performed at a single hospital, which affects the generalizability of our findings. Third, all observations were conducted by one researcher with consistency in mind, though this may have introduced researcher bias. To

reduce this risk, we conducted a pilot study in the same hospital in which the observer was supervised by experienced researchers. Fourth, the observations in the ACW may have been more greatly subject to the Hawthorne effect than those in the ER and the ICU due to the observer being more noticeable in the less crowded and less busy work environment. The Hawthorne effect can be described as a type of reaction where individuals alter their behavior in response to their awareness of being observed. This effect may introduce observation bias as it may increase HCWs' frequency of hand hygiene actions during the period in which they are under overt observations [37].

Keeping these limitations in mind, we have demonstrated the utility of the WHO's concept of 'five moments for hand hygiene' for assessing and comparing the levels of HHC at different units of a resource-limited trauma hospital. Our results indicate that the availability and accessibility of ABHR must be ensured for hand hygiene routines in this setting to be strengthened. Furthermore, attention should be paid to hand hygiene awareness and education among HCWs [38]. We recommend that these interventions are based on established documents, such as the WHO's 'Multimodal Strategy for Hand Hygiene Improvement', which specifies different types of interventions at local and national levels [22]. Key interventions for raising the level of HHC in resource-limited hospital settings include education, training, evaluation, and feedback [20,21]. Hopefully, the results of our study will be prove to be valuable for the development and customization of future research on interventions that are aimed at improving HHC in settings of resource-limited trauma care.

4. Materials and Methods

4.1. Study Setting

Iraq is a southwest Asian, upper-middle-income country [39]. Over the last three decades, continuous armed conflicts have disrupted the Iraqi healthcare system and impoverished the public hospitals [40]. During times of armed conflict, the healthcare services of the affected areas are overburdened and, thus, can be considered to be resource-limited. We conducted our study at the West Erbil Emergency Hospital in Erbil, within the Kurdistan region of Iraq. This is a public emergency hospital that provides acute trauma care and surgery for the general civilian population. To our knowledge, no national or regional policy exists for the surveillance of hospitals' hand hygiene in Iraq.

4.2. Study Design and Participants

This is an observational study, in which we observed nurses, student nurses, doctors, and medical students. The study was based on the WHO's concept of 'five moments for hand hygiene', which defines when and how HCWs should perform hand hygiene routine during the course of clinical care [5]. We did not offer the HCWs any training in the WHO's concept prior to our observations.

4.3. Data Collection

We collected and recorded the data using a validated WHO hand hygiene observation tool [41]. All observations were carried out by one observer (I.M.). The first author performed a pilot test, followed by methodological discussions within the research group. The pilot test is not included in the results. Subsequently, the first author collected the data for the study over four days in July 2018. The observations were overt and the HCWs were informed about the study by the observer beforehand. When approached with questions by the hospital's staff, the observer disclosed information about the study without revealing any results.

The observer was present in one unit at a time and moved between the rooms in each unit. In all three units, the observer was positioned discretely so as not to disturb the staff's workflow. Observations were conducted based upon five hand hygiene action indications: before patient contact, before aseptic task, after body fluid exposure risk, after patient contact, and after contact with patient surroundings. Each patient was considered a unique

observation field, meaning that when an HCW moved from one patient to another, a new observation field was created and the number of observed hand hygiene opportunities was increased by one. Similarly, if the HCW returned to a patient after terminating the previous contact, a new observation field was created and the number of observed hand hygiene opportunities was again increased by one. The observations were recorded per opportunity, meaning that one observation was considered one of the five moments in which hand hygiene action was indicated. A compliant action was defined as the presence of hand hygiene action while a non-compliant action was defined as the absence of hand hygiene action. A maximum of three HCWs were observed simultaneously and each observation lasted for a maximum of 30 min. The selection of the observed HCWs was based on their patient contact debut within the observer's field of view, i.e., the first HCWs who were seen initiating patient contact were first selected. The observer completed a minimum of 200 observations in each unit, after which the observer moved to the next unit.

4.3.1. Emergency Room

The ER consisted of three separate rooms: two large rooms with ten patient beds each and one small consultation room with one patient bed. There was one separate entrance to each room. The observer's view of all the 21 beds was usually unobstructed, but some beds and their close surroundings were at times covered with curtains. One handwashing sink was located by the entrance in each room.

4.3.2. Intensive Care Unit

In the ICU, there were two larger adjacent rooms. One room was specifically intended for respiratory care and, at the time of the observations, patients were only being treated in the respiratory care room. There was one entrance to the respiratory care room, and there was one handwashing sink and one ABHR dispenser located by the entrance. The observer had an unobstructed view of all six beds in the room.

4.3.3. Acute Care Ward

The ACW consisted of an orthopedic trauma unit and a neurosurgery unit. The orthopedic trauma unit was comprised of two hallways of patient rooms, including one staff room in each hallway. There were two separate entrances to the orthopaedic trauma unit, one located in each hallway. The staff rooms were the first rooms to the left of each entrance. One of the staff rooms had one handwashing sink and one ABHR dispenser while the other staff room had one handwashing sink and no ABHR dispenser. The neurosurgery unit consisted of one large room with a total of seven beds. There was one entrance to the neurosurgery unit and one handwashing sink was located close to the entrance. The observer had an unobstructed view of all 29 beds.

4.4. Statistical Analysis

We calculated power based on the detection of a 15% difference between the HCWs' HHC in the ER, the ICU, and the ACW. Based on previously published literature, we expected the HHC rate to be 20% at the ACW [21,42]. On the basis of a power of 90% and a significance level of 5%, we calculated that a minimum sample size of 184 hand hygiene opportunities per unit would be required to detect a significant difference in HHC. To be able to adjust for unforeseen events, we aimed to obtain 200 observations per unit.

Data obtained from the observations were recorded on a paper observation form and then entered into an Excel[®] spreadsheet (Microsoft, Redmond, Washington, USA). Chi-square and Fisher's exact tests were used to assess statistical significance. Where statistical significance was found, a test of equal proportions was performed. Mean values and proportions with 95% confidence intervals were computed. *p*-values < 0.05 were considered to be significant. We used R version 3.5.0 software for all statistical analyses [43].

5. Conclusions

In a resource-limited trauma hospital setting, compliance with the WHO's recommendations on hand hygiene was found to be insufficient, and significantly lower in the ER when compared with the ICU and the ACW. The hand hygiene resources in all observed units were scarce and did not meet the WHO's recommendations. Given the known link between low HHC and a higher incidence of HAIs, relatively simple measures to increase HHC could potentially improve the mortality and morbidity of patients in already overburdened healthcare systems. We propose for future studies to focus on interventions to improve compliance. On a larger scale, the development and implementation of national policies and surveillance strategies to monitor and evaluate hand hygiene and other infection control measures in hospitals might reduce HAIs and its consequences.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and was approved by the Research Ethics Committee of Hawler Medical University in Erbil, Iraq (7:6 26 June 2018) before study initiation.

Informed Consent Statement: No identifying information about the HCWs was recorded; consequently, the need for individual consent to participate was formally waived by the ethics committee.

Data Availability Statement: Data will be made available on reasonable request.

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Appendix A

Table A1. Infrastructure in units of the West Erbil Emergency Hospital.

Characteristic	Beds, n	Sinks, n	ABHR, n
<i>Unit</i>			
Emergency room	21	2	0
Intensive care unit	6	1	1
Acute care ward	29	3	1

ABHR, alcohol-based hand rub.

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