Hand hygiene compliance in the intensive care unit of the Onderstepoort Veterinary Academic Hospital.

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Abstract

Hand hygiene compliance remains the cornerstone of infection prevention and control (IPC) in healthcare facilities. However, there is a paucity of information on the level of IPC in veterinary health care facilities in South Africa. Therefore, this study evaluated hand hygiene compliance of healthcare workers and visitors in the intensive care unit (ICU) at the Onderstepoort Veterinary Academic Hospital (OVAH). Method: A cross-sectional study was conducted among healthcare workers (HCWs) and visitors in the ICU using the infection control assessment tool (ICAT) as stipulated by the South African National Department of Health. Direct observations using the “five hand hygiene moments” criteria as set out by the World Health Organisation were also recorded. The level of compliance and a 95% confidence interval were calculated for all variables. Results: Individual bottles of alcohol-based hand-rub solution and hand-wash basins with running water, soap dispensers, and paper towels were easily accessible and available at all times in the ICU. In total, 296 observations consisting of 734 hand hygiene opportunities were recorded. Hand hygiene compliance was also evaluated during invasive (51.4%) and non-invasive (48.6%) procedures. The overall hand hygiene compliance was 24.3% (178/734). In between patients, most HCWs did not sanitize stethoscopes, leashes, and cellular phones used. Additionally, the majority of HCWs wore jewellery below the elbows. The most common method of hand hygiene was hand-rub (58.4%), followed by hand-wash (41.6%). Nurses had a higher (44%) level of compliance compared to students (22%) and clinicians (15%). Compliance was also higher after body fluid exposure (42%) compared to after patient contact (32%), before patient contact (19%), after contact with patient surroundings (16%), and before an aseptic procedure (15%). Conclusion: Hand hygiene compliance in this study was low, raising concerns of potential transmission of hospital-acquired infections and zoonoses in the ICU. Therefore, it is essential that educational
programs be developed to address the low level of hand hygiene in this study.

Background

Transmission of most hospital-acquired infections (HAIs) occurs via contaminated hands of healthcare workers [1–3]. Their hands may become contaminated during routine procedures such as lifting of patients, taking of temperatures, as well as by touching contaminated surfaces and formites including stethoscopes [4]. Hand hygiene therefore remains the most effective means to prevent and control infection in healthcare facilities [1, 2, 5–7].

Adequate hand-washing and proper hand disinfection have been shown to reduce the risk of transmission of HAIs, zoonotic diseases, and antimicrobial-resistant pathogens [2, 5, 8–13]. Notwithstanding the advantages of hand hygiene, the overall level of compliance in healthcare units remains low [14]. This has been attributed to factors such as a high workload, lack of resources, forgetfulness, lack of knowledge and training in hand hygiene practices, and avoidance due to underlying clinical conditions of HCWs including skin irritation [8, 9, 12, 15].

Direct observation is the preferred method of evaluating hand hygiene compliance in healthcare facilities [3, 14, 16] and this is done based on the “hand hygiene five moments” as defined by the World Health Organization (WHO) [3]. This method has been applied in some form in both veterinary [15, 17–20] and human healthcare facilities [5, 21]. In South Africa, studies on hand hygiene compliance have been done in human healthcare facilities [13, 22]. There are however no published studies on the level of hand hygiene compliance in veterinary health facilities in South Africa. This study aims to evaluate the level of hand hygiene compliance among healthcare workers in the intensive care unit (ICU) at the Onderstepoort Veterinary Academic Hospital (OVAH). The authors hypothesized that the level of hand hygiene compliance among healthcare workers in the
intensive care unit at the OVAH was low, similar to that reported in other studies [14, 15].

Methods

Study design

A cross-sectional study on hand hygiene compliance was conducted among healthcare workers (HCWs) and visitors at the OVAH between January and March of 2019. The HCWs evaluated were clinicians, veterinary nurses, and students (veterinary and nursing). The OVAH is located north of Pretoria in the City of Tshwane Municipality; it is part of the only veterinary faculty in South Africa, which is part of the University of Pretoria. This study was performed within the Companion Animal Clinical Studies (CACS) Department, which forms one of the five departments within the Faculty. This department is further divided into small animal surgery, small animal medicine, and outpatients. All patients from these sections that require critical care are referred to the same intensive care unit (ICU), excluding those with contagious infectious diseases like canine parvovirus, which are admitted to a separated isolation ward. There are three duty shifts in the ICU: morning (08h00 to 12h00), afternoon (12h00 to 20h00) and night shifts (20h00 to 08h00).

Data collection

Facility check

The facility was audited using a facility checklist outlined in the infection control assessment tool (ICAT) [23]. The questions in the checklist covered the number of cots and cages, number of animals admitted, presence, number, and distribution of hand hygiene facilities such as hand washing basin, alcohol-based hand rub, and the type of soap available for use, if any.

Observation checklist

Health care workers were observed by the researcher during their routine patient care in the morning, afternoon, and night shifts. The day of data collection was randomised and
the HCWs were not made aware of the scheduled date for observation. The duration of observation was at least two hours per shift. Direct observation of hand hygiene was conducted using ICAT recommended by WHO [3, 23, 24].

The five moments of hand hygiene within the patient zone were evaluated, namely: (1) before patient contact, (2) before an aseptic procedure, (3) after contact with body fluids, (4) after patient contact, and (5) after contact with patient surroundings [3]. The information was recorded manually on paper and entered into Epi Info™ software [25] at the end of each observation sessions.

The ICAT was pre-tested in the ICU before the commencement of the project and modifications were made to improve the quality and relevance of the questions to the veterinary ICU setting. In addition, the observer was trained on how to conduct observations.

Data management and data analysis

The dataset was assessed for missing data such as incomplete entry of observed moments and inconsistencies such as improbable values, none being identified. For each opportunity, the outcome was coded as a binary, 1-complied or 0-not. The hand hygiene compliance as a proportion was calculated by dividing the number of hand hygiene actions by the total number of opportunities [3]. In addition, 95% confidence intervals were calculated for all variables in the dataset.

Ethics approval

The study was approved by the Research Ethics Committee of the University of Pretoria (Project number: REC034-18). Permission was also secured from the Director of the hospital and the Head of the Department of CACS.

Results

Facility audit
The intensive care unit has 21 fixed cages positioned two storeys against the wall and three freestanding cots on wheels. When the need arises, more portable cages are added. On average, there were six HCWs per shift. During the study, an average of 11 dogs per day were housed in ICU with two being in critical condition. In addition, on average, two cats per day were housed in ICU.

Individual bottles of alcohol-based hand-rub solutions with 0.5% chlorhexidine gluconate and 70% alcohol were distributed throughout the ICU allowing easy access by HCWs. Some were mounted on the outside of cages and cots; one for every three cages and one for each cot and others were on the benches and medicine tables in the ICU.

Three hand-wash basins each equipped with running water, antiseptic soap dispensers, and one paper towel were placed near all the three doors in the ICU (two entrances and one to the duty room).

Information on infection prevention and control, including the wearing of protective clothing, was displayed on each cage depending on the condition or clinical diagnosis of the patient. In addition, English posters in picture and text showing the five moments of hand hygiene were displayed above each hand-washing basin. However, there was no formal training program on hand hygiene within the ICU.

Morning and night shifts are regarded as busy compared to the afternoon shift. During all the shifts, there was at least one ICU sister on duty. The morning shift was manned by student nurses, while the afternoon and evening shifts were manned by student veterinarians. During the afternoon shift, veterinary students and veterinary clinicians visited the ICU to attend to their cases.

**General observation**

Healthcare workers were responsible for taking patients for walks outside the building to allow them to urinate and defecate. During this process, no hand hygiene was applied
before using a leash or touching a patient. Similarly, no hand hygiene was practiced before or after contact with the patient, especially at times when patients needed/vocalised for attention. No hand hygiene was performed by the majority of students before or after patient contact or with environmental fomites, including stethoscopes, telephone, cellphones, thermometers, medicine cabinet, drugs and intravenous infusion pumps. The majority of veterinary students were not ‘bare below the elbow’ as they were wearing wristwatches and rings. However, most HWCs, seemed to adhere to the hand hygiene instructions given on infection prevention and control when dealing with infectious disease cases such as hemorrhagic gastroenteritis, urinary tract infections, and multidrug resistant Pseudomonas aeruginosa. Most HCWs did not perform any hand hygiene before putting on or after removing gloves.

**Hand hygiene compliance**

There were 296 total observations made in the ICU. A total of 734 hand hygiene opportunities were recorded during the study. A hand hygiene opportunity existed whenever one of the moments for hand hygiene was present and a hand hygiene action was expected. Therefore, there was an opportunity for the observer to assess compliance.

The types of patient procedures included invasive (51.4% (152/ 296), CI: 45.7- 57.0) and non- invasive (48.7% (144/ 296), CI: 43.0- 54.3). Invasive procedures are procedures which access to the body is gained via an incision, percutaneous puncture, and needles. Additionally, intramuscular and subcutaneous injections, catheterisation, use of thermometer, and feeding tubes were also classified as invasive procedures. Non invasive were those with no break in the skin or enters internal body cavity.

Hand-rub (58.4%; CI: 51.1- 65.4) was the preferred method of hand hygiene compared to hand-wash (41.6%; CI: 34.6-48.9). Among the HCWs, 77.6% of opportunities assessed were from students, 12.3% from nurses, and 9.4% from clinicians *(Table 1).* Visitors had 0.5%
opportunities (Table 1).

The overall hand hygiene compliance in ICU was calculated to be 24.3% (Table 1). Hand hygiene compliance was higher among nurses (44.0%) compared to students (22.3%), clinicians (15.9%) and visitors (0%). The morning shift had the highest (35.3%) level of compliance compared to afternoon (13.9%) and night (23.4%) shifts. Hand hygiene compliance among HCWs was higher after body fluid exposure (41.7%) and after patient contact (32.2%). Lower hand hygiene compliance was observed before patient contact (18.8%), before an aseptic procedure (15.4%), and after contact with the patient’s surroundings (15.8%).

Table 1: Levels of hand hygiene compliance among healthcare workers and visitors in the OVAH ICU between January and March 2019.

| Variable                      | Opportunities | Hand hygiene compliance | 95% CI³ |
|-------------------------------|---------------|-------------------------|---------|
| Ward                          | 734           | 24.3 (178/734)          | 21.29- 27.48 |
| Healthcare workers            |               |                         |         |
| Clinician                     | 9.4 (69/734)  | 15.9 (11/69)            | 9.14- 26.33 |
| Nurses                        | 12.3 (91/734) | 44.0 (40/91)            | 34.21- 54.19 |
| Students                      | 77.7 (570/734)| 22.3 (127/570)          | 19.06- 25.88 |
| Visitors (Patient owners)     | 0.5 (4/734)   | 0 (0/4)                 | 0.00-48.99 |
| Time of day                   |               |                         |         |
| Morning                       | 28.2 (207/734)| 35.3 (73/207)           | 29.08- 41.99 |
| Afternoon                     | 26.4 (194/734)| 13.9 (27/194)           | 9.75- 19.49 |
| Night                         | 45.3 (333/734)| 23.4 (78/333)           | 19.19- 28.26 |
| Type of opportunity           |               |                         |         |
| Before patient contact        | 39.2 (288/734)| 18.8 (54/288)           | 14.66- 23.66 |
| After patient contact         | 36.8 (270/734)| 32.2 (87/270)           | 26.93- 38.01 |
| Before an aseptic procedure   | 3.5 (26/734)  | 15.4 (4/26)             | 6.15- 33.53 |
| After contact with the surrounding | 15.5 (114/734) | 15.8 (18/114)           | 10.23- 23.58 |
| After body fluid exposure     | 4.9 (36/734)  | 41.7 (15/36)            | 27.14- 57.80 |

³95 percent confidence interval

Nurses had the lowest compliance after body fluid exposure (14.3%) and the highest compliance was before an aseptic procedure (100%). Students had the lowest compliance before patient contact (15.6%) and the highest was before an aseptic procedure (46.2). Clinicians had the lowest compliance after contact with patients’ surrounding (0.00%) and
the highest was after patient contact (9.1%) (Table 2).

Table 2: Level of hand hygiene compliance among HCWs based on the five hand hygiene moments.

| Type of HCW | BPC<sup>b</sup> | APC<sup>c</sup> | ACPS<sup>d</sup> | BAP<sup>e</sup> | ABF |
|-------------|-----------------|-----------------|-----------------|-----------------|-----|
| Nurses      | 43.6 (17/39)    | 48.6 (17/35)    | 25.00 (3/12)    | 100.0 (2/2)     | 14.3 (1/7) |
| Students    | 15.6 (35/225)   | 29.7 (63/212)   | 16.48 (15/91)   | 46.2 (13/26)    | 33.3 (1/3) |
| Doctors     | 9.1 (2/22)      | 33.3 (7/21)     | 0.00 (0/11)     | 12.5 (1/8)      | 12.5 (2/16) |

<sup>b</sup>Before patient contact; <sup>c</sup>After patient contact; <sup>d</sup>After contact with patient surrounding;

<sup>e</sup>Before an aseptic procedure; <sup>f</sup>After body fluid exposure

Discussions

The aim of this study was to evaluate the level of hand hygiene compliance among healthcare workers and visitors in the intensive care unit at the Onderstepoort Veterinary Academic Hospital.

Alcohol hand-rub was the preferred method of hand hygiene in this study. In contrast, Nakamura and colleagues [1] in a small animal private practice in the United States reported more (85%) handwashing with soap than alcohol-based hand rubs (11.6%) or chlorhexidine/betadine solution (3.8%). Alcohol-based rub is the preferred method as it is faster, more effective, and better tolerated by the skin [3]. In addition, it has a broad spectrum of action and is able to kill most microorganisms in a hospital setting [7, 26–29].

A human study by Eggimann and Pittet [30] in Switzerland, reported a decrease in the prevalence of HAIs and multidrug-resistant *Staphylococcus aureus* (MRSA) after the introduction of alcohol-based sanitizers. Notwithstanding the effectiveness of alcohol-based sanitizers, mechanical hand washing with running water and antiseptic soap should also be used in veterinary Medicine as animals are more likely to be soiled with debris.

Moreover, mechanical hand washing has been shown to be more effective against spore-forming bacteria and in the presence of organic matter [2, 26].
Most students in this study wore wristwatches and used personal cellphones during the care of patients. This is concerning as the wearing of jewellery, use of cell phones, and other personal equipment while treating a patient has been shown to increase risks of transmission of both HAIs and zoonotic infections [3, 9, 26]. Trick et al [29] showed a greater frequency of pathogens present on hands with jewellery compared to those without, regardless of the method of hand hygiene applied. Health care workers may also transport pathogens from healthcare facilities and introduce infections into their homes [9].

The majority of HCWs in this study did not perform hand hygiene before putting on or after removing gloves. The use of gloves is recommended in infection control but should not be a substitute for hand hygiene [23], which should therefore be performed prior to donning and after glove removal [9, 23, 26]. Hands could additionally be contaminated in the process of removing gloves, gloves could tear, or they may have microscopic defects resulting in contamination.

**Overall compliance**

The overall hand hygiene compliance in the OVAH ICU was similar to the 20.6% reported by Shea and Shaw [15] in a small animal veterinary hospital in the United States of America. Similarly, low (30%- 40%) hand hygiene compliance in the human ICU have been reported in the Netherlands [14]. In contrast, in a human study in the United Kingdom (UK), Randle et al [21] reported a higher (67.8%) hand hygiene compliance in the ICU. The overall low level of hand hygiene compliance in the current study could be attributed to time constraints between patients [14], a lack of perceived importance of hand hygiene [8], and low levels of hand hygiene compliance in the five moments observed in this study. The low compliance level in the current study is concerning as hand hygiene compliance has been shown to decrease cases of hospital-acquired infections and
minimise exposure to zoonotic disease [13, 15]. Therefore, it is imperative that ongoing educational programs and surveillance be implemented for sustained changes in behaviour [3, 5, 12, 15, 17] and improvement in hand hygiene compliance [1, 15, 31].

**Compliance based on the type of HCW and time of day**

We observed lower compliance among doctors when compared to nurses and students with nurses having the highest level of compliance. Similarly, Salama and colleagues [5] in a human hospital in Kuwait reported lower compliance in doctors (38.4%) compared to nurses (50.0%). Our results and results of others suggest that nurses are more adherent to and knowledgeable about hand hygiene compared to other HCWs [5, 12, 31]. Furthermore, hand hygiene compliance was higher in the morning compared with that during other shifts. This could be because nurses worked mostly in the morning shift and had higher level of compliance compared to other healthcare workers. In addition, the higher number of HCWs present in the morning shift compared to other shifts could have reduced the ratio of patient to HCW allowing more time and better implementation of hand hygiene. In view of these findings we recommend the implementation of intervention strategies including education, feedback sessions, and monitoring of non-compliant doctors and students in order to improve compliance [12].

**Type of moment**

We observed low hand hygiene compliance after contact with the environmental formites such as medicine, drugs cabinets, drips, cages, cots, doors, telephones, bedding and leashes. In contrast, Randle Arthur, and Vaughan [21] in a human hospital in the United Kingdom reported a high (50%) compliance after contact with patient surroundings. The patient’s surroundings have been shown to harbour various microorganisms including those that cause hospital-acquired infections [9]. Anastasiades et al [32] in South Africa isolated *Staphylococcus aureus* from the computer mouse and keyboards used in the
human ICU. Similarly, and hygiene compliance in the current study was low after contact with surrounding and environmental fomites. In addition, studies have reported low hand hygiene compliance during activities that pose a low risk to HCWs when compared to patients, suggesting that HCWs perform hand hygiene for their own protection and not for that of patients’ [3, 5, 6]. This hypothesis is substantiated by the low level of compliance before an aseptic procedure (15.4%), before patient contact (18.8%) compared to high compliance after patient contact (32.2%), and after body fluid exposure (41.7%). This is most likely due to the hands of HCWs often being visibly soiled, sticky or gritty after these moments [2]. Therefore, it is recommended that hand hygiene be performed anytime when in contact with patients and patients surrounding [2, 3, 8]. Moreover, interventions must be moment specific due to the variation in compliance based on the type of moment.

Based on the five moments of hand hygiene, nurses had the lowest compliance after body fluid contact, students had the lowest compliance before contact with a patient, and doctors had the lowest compliance after contact with patient surroundings and before patient contact. Compliance during the five moments in our study was significantly different between the three groups of HCWs. These findings suggest that the type of moment, as well as the type of HCW should be considered when developing hand hygiene intervention strategies.

**Limitations**

To our knowledge, this is the first study in veterinary medicine in South Africa that used the ICAT tool to assess hand hygiene compliance. Therefore, the comparison to other studies is largely based on human studies which uses a similar system. The presence of the assessor in the ICU could have resulted in higher than normal levels of hand hygiene compliance. However, the assessor was discreet about the assessment questions and never communicated with the HCWs about the content of the assessment. The HCWs
assessed in this study were not inclusive of other ICU workers such as kennel cleaners and cleaning staff members which are also capable of transmitting HAI pathogens. Nonetheless, the results in this study provide a useful indication of hand hygiene compliance level in the ICU at OVAH.

Conclusions

The low level of hand hygiene compliance in this study is concerning because of the possible risk of transmission of hospital-acquired infections and zoonotic diseases via the hands of healthcare workers. This is likely to result in increased incidence and transmission of antimicrobial resistant pathogens within the intensive care unit, posing risks of infection especially to immunosuppressed patients.

Hand hygiene compliance was lower among doctors, during the night shift, before patient contact and contact with patient surroundings, and before aseptic procedures.

Interventions should therefore be considered to improve hand hygiene compliance in the hospital. These may include regular educational campaigns on the importance of adhering to hand hygiene, development and promotion of written hand hygiene protocols, and programs promoting regular hand hygiene monitoring could be developed. These interventions should be moment and HCW specific.

List Of Abbreviations

HAI: Hospital Acquired Infections, ICU: Intensive Care Unit, HCW: Healthcare workers, OVAH: Onderstepoort Veterinary Academic Hospital, ICAT: Infection Control Assessment Tool, CACS: Companion Animal Clinical Studies

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the University of Pretoria
(Project number: REC034-18). Permission was also secured from the Director of the OVAH and the Head of the Department of Companion Animal Clinical Studies.

**Consent for publication**

Not applicable

**Availability of data and materials**

All the data that support the findings of this study is described in the manuscript. Raw can also be made available following submission of necessary document in line with the regulations of the University of Pretoria.

**Competing interests**

The author declares there is no competing interest.

**Funding**

Not applicable.

**Authors' contributions**

DCS was involved in the study design. DCS performed all the statistical data analysis and interpretation as well as preparation of manuscript draft. DNQ was involved in the study design, data analysis and interpretation, and extensive editing of the manuscript. CM was involved in the study design as well as manuscript editing. CB was involved in the study design and manuscript editing.

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Supplementary Files

This is a list of supplementary files associated with the primary manuscript. Click to download.

Hand_Hygiene_Observation_Checklist.pdf
Facility_Checklist.pdf