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APPROVAL PAGE

CHARACTERIZATION OF HAND HYGIENE TECHNIQUES AMONG INTENSIVE CARE
NURSES: A DESCRIPTIVE STUDY

by

ASHLEY L. REYES

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Author's Statement Page

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ABSTRACT

CHARACTERIZATION OF HAND HYGIENE TECHNIQUES AMONG INTENSIVE CARE NURSES: A DESCRIPTIVE STUDY

By

ASHLEY LAUREN REYES

NOVEMBER 9, 2021

OBJECTIVE: Although a plethora of hand hygiene guidance and policies exist for healthcare workers, a number of barriers exist that can cause a lack of adherence. A lack of hand hygiene adherence can lead to healthcare-associated infections and altered community health. This study aimed to examine the hand hygiene techniques among intensive care nurses to gain a better understanding of current practices and needs among the population.

METHODS: Previously obtained data of 19 intensive care nurses completing simulated patient care was used. Each nurse completed care for two patients and the duration, type and number of hand hygiene instances were observed. Frequencies and means were used to compare behaviors and determine gaps in the data.

RESULTS: Of the 74 total observed hand hygiene instances, the average duration was 9.9 seconds. 66 of these instances involved using alcohol-based hand rub (88%), and 6 using soap and water (12%). Eight possible moments of hand hygiene (given interactions with two patients) should have been completed, however, most nurses completed only 4 (31.6%), and none completed the recommended 8. When using soap, the average duration of hand hygiene was 14.5 seconds (WHO recommends 40-60 seconds) and 9.29 seconds for alcohol-based hand rub (WHO recommends 20-30 seconds).

DISCUSSION: Overall, there is a large gap between recommended hand hygiene practices and those seen in this study. Research suggests that this is likely due to accessibility issues, a lack of knowledge, and demanding workload. However, there is room for further in-depth investigation of this topic to solidify true barriers to hand hygiene adherence and overall work to improve the health of healthcare workers, patients, and communities.

CHARACTERIZATION OF HAND HYGIENE TECHNIQUES AMONG CRITICAL CARE
NURSES: A DESCRIPTIVE STUDY

By

ASHLEY LAUREN REYES

BSPH, GEORGIA SOUTHERN UNIVERSITY

A Capstone Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA
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Acknowledgements

This capstone would not be possible if it were not for the support of my advisor, Lisa Casanova, Ph.D., my second committee member Laura Salazar, Ph.D., Emory Research Director Joel Mumma, Ph.D., and the love and encouragement from my family. Thank you to all who have guided and shaped me throughout graduate school and into the beginning of my career in public health.

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Chapter 1. Introduction

This chapter will cover the following topics: hand hygiene, healthcare associated infections in inpatient care, and barriers to hand hygiene adherence. This will assist in informing a broad understanding of the need for hand hygiene adherence in critical care, as well as contributing factors in the lack of adherence to hygiene guidelines set by the World Health Organization.

Hand Hygiene Overview

Hand hygiene can be defined as a way of cleaning the hands to reduce the number of microorganisms on the hands. In the 19th century, a pharmacist named Labarague provided support for a hypothesis that concluded that physicians' hands carried pathogens that could be transmitted to patients (McLaws, 2015). His work assisted in the development of the Centers for Disease Control and Prevention's 1975 handwashing guide. This guide included recommendations for using nonmedicated soap and water for less invasive and medicated soap and water for invasive medical procedures (McLaws, 2015). Since then, the development of new practices and recommendations have emerged and become frequent in medical care. In clinical care, workers are frequently exposed to a number of pathogens, which can remain on the hands for extended periods of time. Hand hygiene is a primary measure of reducing infection risk among both workers and patients. In a study from Novak et al, researchers found that despite the simplistic nature of hand hygiene, compliance among healthcare workers can be as low as 40% (Novak, et al., 2020). The two main forms of hand hygiene are using an alcohol-based hand rub (60%-90% alcohol) and washing the hands with soap and water (WHO, 2009). In most clinical

situations, alcohol-based hand rub has been implemented in addition to soap and water to improve hand hygiene frequency and compliance. This is because hand dispensers can be made more numerous and accessible than handwashing sinks, it requires less time, and it may cause less irritation and dryness compared to soap and water (WHO, 2009).

The Centers for Disease Control and Prevention (CDC) recommend that healthcare personnel utilize hand hygiene methods before a number of clinical scenarios, including the following: prior to touching a patient, prior to performing an aseptic task (such as catheter placement or wound care), prior to moving from working on a soiled section of the body to another clean section on a patient, after touching a patient or patient surroundings, after contact with bodily fluids, blood, or contaminated surfaces, and after removing gloves (CDC, 2021). The World Health Organization refers to these as the “Five Moments” for hand hygiene. Additional research has documented that the two moments most likely to be neglected are before patient contact and before clean/aseptic procedures (Allegranzi, 2010). It is the responsibility of the healthcare facility to ensure that healthcare personnel are performing hand hygiene measure in accordance with CDC guidelines, as well as providing adequate supplies necessary for adherence to guidelines. Literature reveals that hand hygiene compliance in the United States is significantly lower than international targets (Lambe et. al, 2019). Many healthcare facilities now use compliance monitoring systems to ensure that individuals are held accountable for hand hygiene use.

The World Health Organization (WHO) recommends using alcohol-based hand rub for at least 20-30 seconds, and soap and water for 40-60 seconds (WHO, 2009). All areas of the hands should be cleaned, including palms, fingers, wrists, and fingernails. In addition, the WHO cautions against the wear of artificial fingernails when in direct contact with patients, as well as

straying away from using an alcohol-based hand rub immediately prior or after washing hands with soap and water (WHO, 2009). Hands should also be completely dried prior to wearing gloves, and a protective hand cream or lotion should be used daily. Similar to the CDC's recommendations for when to complete hand hygiene, the WHO has 5 defined moments for hand hygiene when interacting with one patient. They are as follows: prior to touching a patient, before clean/aseptic procedure, after touching a patient, after body fluid exposure risk, and after touching patient surroundings (WHO, 2009). The use of gloves should not replace hand hygiene, and washing must be performed regardless of the need for gloves. Hygiene should not be performed over gloves, and each pair should be discarded after each task (WHO, 2009).

Healthcare-Associated Infections

Healthcare-associated infections (HAIs) also known as nosocomial infections can be defined as infections acquired when receiving treatment for medical conditions. Many HAIs are preventable, and hygienic practices such as handwashing can be used to decrease risk (WHO, 2009). Studies show that healthcare providers clean their hands less than half of the recommended number of times, contributing to the number of HAIs in clinical settings (CDC, 2021). Studies have shown that healthcare workers' hands are the most common mode of transmission of nosocomial pathogens between patients (Allegranzi, 2010). In hospitals, 1 in 31 patients are affected by HAIs (CDC, 2021). These infections can occur in a variety of settings, including hospitals, surgery centers, outpatient care facilities, and more. Frequently diagnosed HAIs include catheter-associated urinary tract infections (CAUTI), bloodstream and surgical site infections, pneumonia, and *Clostridium difficile*, or c.diff (Healthy People, 2020).

Healthcare-associated infections may be preventable with a range of different precautions and can be reduced by almost 70% if adequate practices are used (Healthy People, 2020).

Healthy People 2020 reports that these practices can also contribute to financial gain by saving \$25 to \$31.5 billion dollars in medical costs (Stone, 2009). Approximately 2 million patients in the United States suffer from HAIs each year, and 90,000 cases become fatal (CDC, 2021). These infections can also result in an additional 6.5 days spent in the hospital, as well as increased likelihood of readmission to the intensive care unit (Patient Care Link, 2020).

HAIs can occur in not only open wounds, but also in intact patient skin. Individuals with preexisting conditions such as diabetes, renal failure, and dermatitis are at an increased risk of developing complications from HAIs (Healthy People, 2020). It is believed that many HAIs occur due to poor hand hygiene and lack of precautions. In one study, researchers had nurses touch an area of a patient heavily colonized with gram negative bacilli. Nurses then completed hand washing and touched a urinary catheter. Researchers examined the surfaces of the catheter and found that enough bacteria had been transferred to cause infection (WHO, 2009). Around 32% of all HAIs are urinary tract infections, thus proving the need for hand hygiene adherence (Patient Care Link, 2020). Additionally in a study from the American Association of Critical-Care nurses, researchers found that the use of new hand hygiene protocol led to a reduction in hospital-associated infections and an improvement of nurse hand hygiene compliance (Fox et. al, 2015).

Barriers to Adherence

Although previous programs have been used as an effort to improve hand hygiene compliance, many have been unsuccessful. The main issues with adhering to hand hygiene protocol include knowledge, skin integrity and accessibility. A study from 2000 shows that repeated skin exposure to water and cleansers can negatively impact the stratum corneum layer of the skin (Visscher, 2000). Dermatitis is another condition that occurs frequently in those

providing direct patient care. Regardless of season, this study showed that increased frequency of hand hygiene practices can lead to chronic, unresolved skin irritation. The nurse's hands were also studied, and those with more damaged skin had higher colonization levels of *Staphylococcus aureus*, gram-negative bacteria, enterococci, and *Candida* (Visscher, 2000). Instituting further policy for providing healthcare workers with lotions or creams would assist in decreasing this issue.

Perhaps one of the main issues with hand hygiene compliance is accessibility. Having sanitizing and handwashing stations nearby would assist in increasing use. In addition, hospitals frequently become short staffed during seasons of elevated illness, thus leading to nurses having increased patient assignments. When nurses are assigned to more patients, less time can be spent focusing on infection prevention. Short staffing, along with decreased accessibility to hygiene products ultimately can set nursing staff up for failure.

In addition, research has shown that healthcare staff often do not have an extensive understanding of the proper way to complete hand hygiene. It can be hoped that the guidelines from both the CDC and the WHO will be used as a starting point for increasing knowledge in clinical care. Fortunately, knowledge is less of an issue in high-resource countries such as the United States. The regulation of hygienic protocol in the United States has proven that education is vital in increasing hand hygiene compliance (compared to low-resource countries).

Patient needs can also be a barrier to hand hygiene. In intensive care, patients are often critical in nature, and any slight change can lead to a rapid decline. In these situations, the patients' health and wellbeing is considered more vital than hand hygiene. Unfortunately, this lack of hand hygiene in critical circumstances can increase the risk of acquiring a nosocomial infection.

Hand hygiene compliance is a direct contributor to the increased risk of healthcare acquired infections in clinical settings. It can also lead to increased transmission rates of communicable diseases. Hospitals in the United States are required to report and demonstrate processes for both measurement and improvement of hand hygiene compliance. Facilities that do not comply will face potential financial consequences and more so for those that rely on Medicare or Medicaid reimbursements (Stone, 2009). Infection prevention assessments and workers have the ability to provide education to prevent infection transmission, but it is the responsibility of the healthcare facility and leadership staff to ensure that healthcare workers are well equipped to prevent healthcare associated infections. Ultimately, there are several barriers that if reduced could assist in both the reduction of infections and the number of deaths.

Chapter 2. Review of the Literature

Hand Hygiene

Hand hygiene in clinical care is considered to be an integral part of preventing healthcare associated infections. In a study from Haque et. al, researchers discuss updated hand hygiene protocol and its impact on healthcare. Researchers report that the most effective antimicrobial practices can be obtained with ethanol, isopropanol, and n-propanol (Haque et. al, 2018). Ethanol is considered to be the most effective, thus the reasoning for using it in clinical practice (Kampf and Kramer, 2004). Researchers further emphasize that both education and dermal tolerance are necessary for efficient hand hygiene practice.

Healthcare Associated Infections

Healthcare associated infections (HAIs) also known as nosocomial infections, are a global issue surrounding clinical care. Researchers from a study in 2018 state that the most common HAIs are lower respiratory tract infections, surgical-site infections, and primary septicemia (Haque et. al, 2018). While nosocomial pathogens can be transmitted in multiple ways, hands are the most common mode of transmission between patients (Allegranzi, 2010).

The benefits of increased hand hygiene compliance extend across several realms of both environmental and occupational health. They can be supported by numerous studies involving the efficacy of increased accessibility and knowledge. Often in clinical settings, hand hygiene knowledge and facilities are not made accessible for healthcare workers. This literature review will examine the main issues surrounding hand hygiene compliance in clinical settings and further investigate previous interventions.

Knowledge of Hand Hygiene

In lower income health facilities, it is likely that knowledge of hand hygiene practices are not emphasized. Hand hygiene is known to be the most effective measure in preventing nosocomial infections. Unfortunately, these practices are not always followed and require monitorization to increase efficacy. Novak et al. found that individuals who presumably had prior education concerning hand hygiene did not demonstrate the correct protocols in practice (Novak et. al,2020). Around one-third of study participants did not know how to properly complete hand hygiene according to WHO guidelines. Researchers attribute this issue to forgetfulness and lack of time. In addition, basic health education does not always achieve the expected level of hand hygiene compliance needed for successful clinical practice. Recommendations in this study include repeated education for proper hand hygiene, and

increased accessibility of handwashing facilities such as sinks, water, soap, paper towels, and alcohol-based hand rub (Novak et. al, 2020).

Olfactory and Visual Cues

Many care facilities utilize educational posters in areas where hand hygiene can be completed. These posters will include information on how to accurately clean hands for clinical purposes. In a study from the American Psychological Association, researchers investigated if priming using visual and olfactory cues influences hand hygiene compliance. This randomized controlled trial was set in a surgical intensive care unit and had health professionals and service users complete hand hygiene with either an olfactory (citrus smell) or visual cue (photo of male or female eyes). Results showed that the olfactory cue led to a significant improvement of hand hygiene compliance, and the visual cue of male eyes also led to a slight improvement (King, et al., 2016).

Accessibility to hand hygiene products

Alcohol based hand rub tends to be the primary method of hand hygiene in clinical settings (CDC, 2021). This is because it is easy to use and has the capability to rid the hands of a larger number of pathogens (compared to hand soap). While this method is preferred, alcohol-based hand rubs are not always readily available near patient rooms. A study from the American Journal of Infection Control investigated the relationship between accessibility of dispensers and hand hygiene compliance and found that the accessibility of sanitizer compared to the entrance to the patient room was statistically associated with higher compliance rates (Cure and Van Enk, 2015). Another study from Jewish General Hospital in Canada found that the distance to the sink was significantly associated with hand washing compliance. This study also found that healthcare workers who wore gloves in patient rooms were more likely to complete hand hygiene

upon exiting (Vayalumkal, et al, 2009). It seems that the lack of hand hygiene products is also the case in facilities besides acute care. A study from the Canadian Journal of Infection Control found that long term care facilities (LTAC) lack a sufficient number of alcohol-based hand rubs (Cure and Van Enk, 2015). It is likely that this contributes to the number of healthcare associated infections in LTAC facilities. An investigation in the Surgical Intensive Care Unit at Wesley Medical Center, researchers found that conspicuous display of alcohol-based hand rub resulted in a statistically significant increase in product use (Thomas et. al, 2009). Use also increased when the ratio of hand rub was increased, and dispensers were placed in the line of sight.

Chapter 3 Manuscript

3.1. Introduction

Both hand soap and alcohol-based hand rub are methods of hand hygiene used in the healthcare setting. Good hand hygiene can allow staff to provide quality care, prevent infection, and preserve the health of communities. It is estimated that approximately 61% of healthcare workers do not follow hand washing protocol, leading to excess healthcare associated infections. In developing countries, around 15.5% of patients are impacted by HAIs, which then lead to 90,000 deaths each year. HAIs can lead to increased hospital stay, disability, and increased medical costs. The improvement of hand hygiene can reduce HAIs by almost 40%, showing an increased need for hygiene development (Global Handwashing Partnership, 2017). The purpose of this study is to investigate the hand hygiene techniques among intensive care nurses participating in a study where they performed a simulated patient care task (wound care) on a mannequin. The main purpose of this study was to determine whether bacterial contamination

was transferred from the patient to other locations during and after wound care. The simulations were video recorded from several angles to observe events that might contribute to the spread of bacteria. It is important to note that all simulations occurred prior to the start of the COVID-19 pandemic.

The sample population of nurses was selected from a pool of intensive care nurses by the original research team. Nineteen nurses were identified and completed the simulation. In the simulation, each nurse completed care for two mannequin patients, one needing a dressing change for a pressure ulcer and a simple heart and lung exam for the second. For the first patient, the nurses were provided with sterile saline syringes, gauze, and tape. The simulated patient in bed (mannequin) had a soiled dressing that was placed by researchers, and the majority of nurses used the saline syringes to washout the ulcer debris. Some nurses also packed the wound with gauze and taped over the dressing. All nurses wrote the date on the dressing and removed supplies from the side table. Of the 5 moments of hand hygiene as stated by the World Health Organization, the nurses had the opportunity to complete at least 8 (five in room one, three in room two). To identify the role of hand hygiene in the healthcare setting, the nurse were provided with all hand hygiene products recommended by the WHO and were told to carry out care as they would for a typical ICU patient. Three cameras were placed throughout the room, and another secured on the nurse's head to monitor behaviors. Both quantitative and qualitative data were obtained for each nurse, and the data were then analyzed for hand hygiene behaviors. The average duration of hand hygiene was calculated using a basic mean formula. Nurses had access to hand soap, alcohol-based hand rub, and gloves. Data were only obtained concerning hand soap and alcohol-based hand rub. The purpose of this study was to analyze and code the video recording to observe hand hygiene behavior during these simulations.

3.2 Methodology

For the data collection, 19 videos (one per participant) were watched and coded based on the number and duration of hand hygiene instances observed. The duration of each instance was recorded based on when the nurse's hands initially came together, and when they separated. The type of hygiene (0=hand soap, 1=alcohol-based hand rub) was also recorded. After the main data collection, the total number of instances and each type of moment were obtained for each nurse. Data for each nurse were placed into SAS and "PROC FREQ" was used and a fit plot was created for the selected variables. Box and whisker plot were created to display the range of duration of each instance, and bar charts were used to display the observed rates of each moment. Approval from the Emory University Institutional Review Board was obtained prior to study start.

The sample population of nurses was selected from a pool of ICU nurses by the original research team. Nineteen nurses were identified and completed the simulation. To identify the role of hand hygiene in the healthcare setting, the nurses were provided with all hygiene products recommended by the WHO and were told to carry out care how they would for a typical ICU patient. Three cameras were placed throughout the room, and another secured on the nurse's head to monitor behaviors. Both quantitative and qualitative data were obtained for each nurse, and the data were then analyzed for hand hygiene behaviors. The average duration of hand hygiene was calculated using a basic mean formula. Nurses had access to hand soap, alcohol-based hand rub, and gloves. Data were only obtained concerning hand soap and alcohol-based hand rub.

3.2 Results

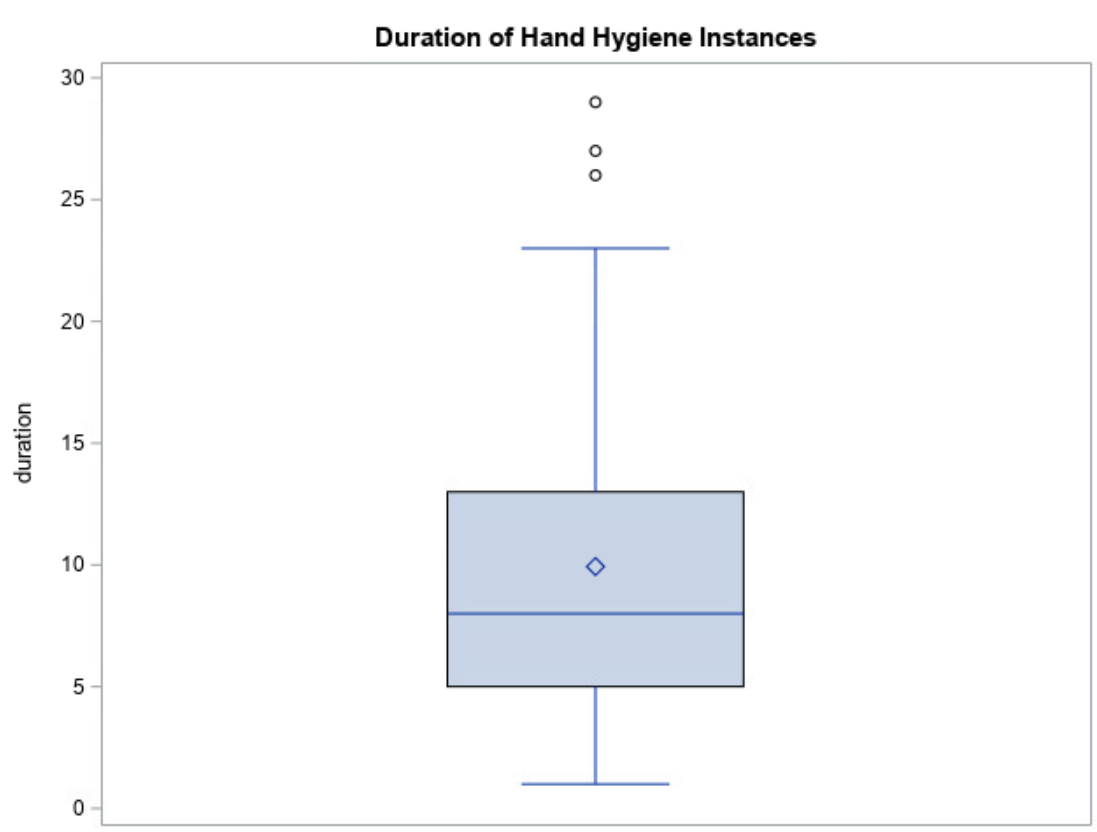
Of the 19 ICU nurses enrolled in the study, 3 were men and 16 were women. These were the only available demographic data for the sample. Data findings showed that the average number of hand hygiene instances for all nurses was 3.9, with 4 and 3 observed instances (31.6% and 21.1%, respectively, table 3.1) being the highest frequencies.

Table 3.1. Frequency of number of instances observed for each nurse

Number of instances (n=74)	Observed frequency	Total percent
1	2	10.53
2	1	5.26
3	4	21.05
4	6	31.58
5	3	15.79
6	2	10.53
7	1	5.26

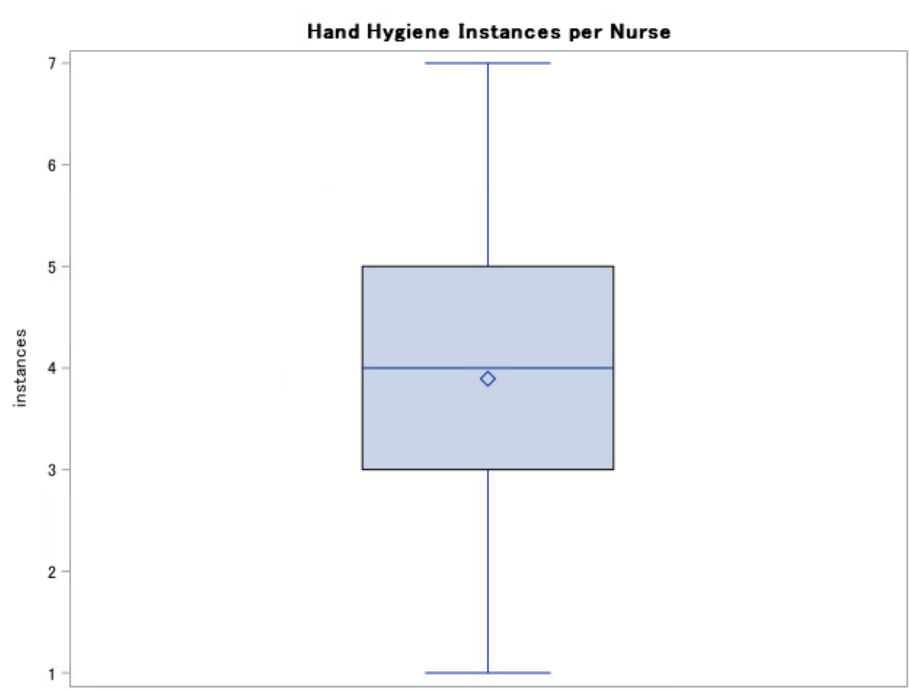
Additionally, for all instances (both soap and alcohol-based hand rub), nurses engaged in hand hygiene for an average of 9.9 seconds and with a range of 1 to 29 seconds (figure 3.1).

Figure 3.1. Duration of hand hygiene instances



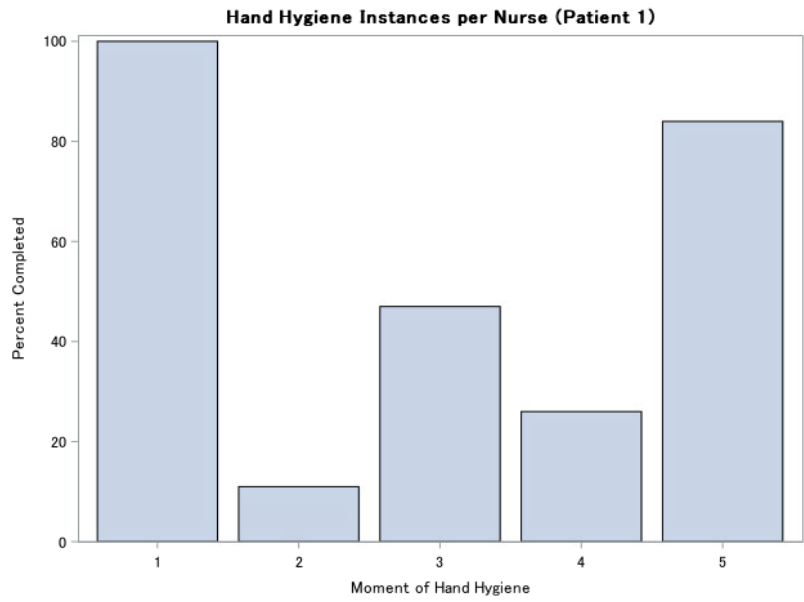
While nurses had the option of both soap and hand-rub, of the 74 instances for all 19 nurses, 66 occurrences involved alcohol-based hand rub (88%) and 9 involved soap and water (12%). Fit plots can be used to determine trends in the data with confidence limits (95%). Figure 3.2 shows the mean number of hand hygiene instances observed for each nurse (3.89) outliers, and the range of data (1-7).

Figure 3.2. Hand hygiene instances per nurse



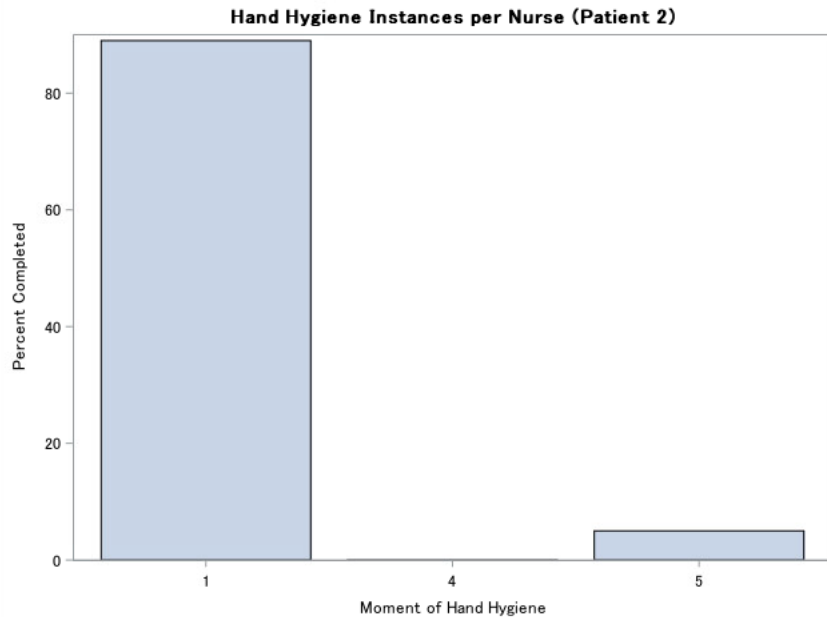
Concerning the first patient and hand hygiene compliance, the bar chart in figure 3.3 shows that 100% (N=19) of the nurses completed the first moment (before touching a patient) and 84% (N=16) completed the fifth moment (after touching patient surroundings). The lowest compliance was seen in the second moment (Before clen/aseptic procedures, 11%), followed by the fourth (after touching a patient, 26%)

Figure 3.3 Hand hygiene instances per nurse (patient 1)



Concerning the second patient and observed hand hygiene compliance, figure 3.4 displays the lowest rate in moment 4 (after touching a patient, 0%) and moment 5 (after touching patient surroundings, 5%). Data analysis also revealed 100% compliance with the first moment of hand hygiene (N=19).

Figure 3.4 Hand hygiene instances per nurse (patient 2)



3.3 Discussion

Hand hygiene instances were observed in 19 intensive care nurses under simulated conditions to assess typical behaviors of healthcare workers when performing wound care. Accessibility, knowledge, and visual/olfactory cues can alter hand hygiene adherence but were not observed in this study for the sample population. All rooms used had both soap/sinks and alcohol-based hand rub in the same areas. Our observation of common hand hygiene behaviors may identify areas for improvement.

Comparing to guidelines set by both the WHO and the CDC, it seems that only 7 instances using alcohol-based hand rub were completed in twenty seconds or more (9.5% of moments). Additionally, none of the instances using soap and water extended for at least 40-60 seconds as recommended (WHO, 2009). This study is unique in that many previous studies do not investigate the duration of hand hygiene, but rather the frequency. Basing data on the WHO's five moments of hand hygiene, one of 19 completed the potential 8 and 6 nurses only completed

4. Most hospitals have strict policies and guidelines concerning hand hygiene for healthcare workers, which leads researchers to believe that underlying issues are at play. This data also shows that nurses, doctors, and other workers might exhibit similar traits and place their patients at risk.

The adherence to hand hygiene guidelines in the present study is not in line with recommendations by the WHO and the CDC. Typical hand hygiene behavior among the nurses was shorter and less frequent than recommended. In a study from Sickbert-Bennett et al, researchers found that a new hand hygiene program significantly increased compliance rates and decreased HAI rates (Sickbert-Bennett, 2016). Research in this area has shown that there is room for improvement for hand hygiene in healthcare workers. Comparing to the existing literature, the issues seen in this study align with many observations from previous research. Hand hygiene rates for both alcohol-based hand rub and soap and water and low in both frequency and duration. Although analyzed in this study, it seems plausible that accessibility may have been an issue. At the beginning of the study when the nurses were receiving instructions, both the researchers and nurses stood at the opening of the door directly next to the alcohol-based hand rub dispenser. Most nurses completed hand hygiene prior to entering the room, which may be because the dispenser was in their line of sight for at least 10-15 seconds. The interior of the rooms did not have alcohol-based hand rub; thus, nurses may have been less likely to complete hand hygiene after exposure to patient bodily fluids or surroundings. This lack of hand hygiene can lead to increased nosocomial infections. In a meta-analysis from the American Journal of Public Health, researchers aimed to quantify rates of respiratory and gastrointestinal illnesses in hand hygiene trials. Data found that improvements in hand hygiene compliance resulted in a significant reduction of both gastrointestinal and respiratory illnesses (Aiello, 2008). It is evident

that hand hygiene can play a significant role in the spread of both illnesses. Most nurses simply changed gloves after completing the dressing change or touching the patient and did not complete hand hygiene in between. In a study from the Journal of Infection Prevention, Pittet observes the perception of the use of gloves in third-year nursing students. Many participants reported that they had not received any specific instruction on gloves and used gloves routinely when not required or recommended (Pittet, 2017). For future research, it would be beneficial to consider the healthcare workers perception of gloves and its association with hand hygiene compliance. Perhaps the most critical opportunity for hand hygiene in the simulation was after completing wound care and before touching the patient. These moments were not frequently observed in the patient simulations. For the first patient, only 11% of nurses completed hand hygiene prior to wound care. In the second room, nurses needed to complete hand hygiene only before entering, after touching the patient and after touching patient surroundings. It should be noted that researchers instructed study participants to refrain from completing hand hygiene upon exiting the second room. All participants likely have an in-depth understanding of guidelines for hand hygiene, so it is not likely that knowledge was a barrier in this study. As previously discussed, demographics can often play a role in hand hygiene compliance and the literature in this area is often limited. One study conducted by Stevenson et al focused on implementing a hand hygiene intervention in small rural community hospitals. This cluster-randomized trial resulted in an estimated average change in complete hand hygiene compliance of 20.1%. Despite multiple geographic barriers, the hand hygiene intervention significantly improved compliance and HAI infections (Stevenson, 2014).

Several barriers were identified during the study and during analysis of the data. The duration of hand hygiene was counted based on when the nurse's hands initially came together

with the product and stopped when the hands came apart. Occasionally, the nurses held their hands together for long periods after using alcohol-based hand rub, which might have inflated duration. Some nurses also touched other items after initially rubbing their hands together and resumed rubbing after a brief moment. These time periods were accounted for and removed from each duration. Furthermore, if the camera placed on the nurse was not positioned correctly, the frame of view occasionally did not show the hands. This could have created some inaccuracies when counting the duration of each hand hygiene instance. Finally, the lack of access to further demographic information on each nurse prevented a detailed view of education and experience. It is possible that age, experience, and prior training might have played a role in hand hygiene compliance. Additionally, being observed can also alter hand hygiene behaviors, and thus should be considered in similar studies. Complete demographic data are needed to fully demonstrate the relationship between personal background and hand hygiene methods. As demonstrated in previous studies, variables such as age, education, race, and cultural background can alter adherence to hand hygiene (WHO, 2009). In proceeding with further studies on compliance, research should make it a priority to obtain detailed demographic data on participants, as well as optimizing camera placement for viewing the hands.

3.4 Limitations

Our study had several limitations. First, the primary population studied all had similar backgrounds in nursing (critical care), and all work in the Atlanta area; thus, our results may not be generalizable to other populations. Similarly, the study hospital may have different policies relating to hand hygiene compared to other health facilities across the United States. Second, the

primary focus of this study was not explicitly hand hygiene, thus the nurse behavior might differ if they had an understanding of the primary study focus. Additionally, the setup of each room may have played a role in hand hygiene habits. Because the study was not completed in an actual critical care unit, hand hygiene behaviors might have differed compared to caring for actual patients. It is possible that there are a larger number of alcohol-based hand rub dispensers and visual cues in actual intensive care units.

3.5 Conclusion

Based on the results of this analysis, there is a need to increase both the number and duration of hand hygiene instances for both alcohol-based hand rub and soap and water. This study suggests needs for future hand hygiene research addressing reasons for short duration and low number of moments where hand hygiene is happening.

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