ORIGINAL ARTICLE

Assessment of knowledge and determinants of hand hygiene compliance among health workers at Garowe General Hospital- Somalia

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ABSTRACT

Background: Healthcare-associated infections (HCAIs) remain a critical challenge, particularly in low-resource settings like Somalia, where hand hygiene compliance is often inadequate. This study focuses on improving hand hygiene practices at Garowe General Hospital. **Aim:** This study evaluated health workers' knowledge of hand hygiene and identified the determinants influencing compliance at Garowe General Hospital, Somalia. **Method:** A cross-sectional quantitative study combined direct observations and questionnaire. A sample of 379 was calculated using Kish Leslie's formula at a 95% confidence interval and 5% error margin. 300 health workers responded **(**79.2%**)** and were analyzed. Hand hygiene compliance was observed across key clinical moments based on WHO guidelines, while knowledge and compliance determinants were assessed using structured questionnaires. Associations were tested using chi-square, and predictors were examined using binary logistic regression. **Results:** Awareness of hand hygiene protocols was significantly linked to better compliance ($\chi^2 = 5.432$, $p = 0.020$). Key factors facilitating compliance included the availability of handwashing facilities ($\chi^2 = 9.231$, $p = 0.026$) and manageable workloads ($\chi^2 = 6.782$, $p = 0.034$). Conversely, barriers such as insufficient training, high patient loads, and lack of resources were associated with lower compliance ($\chi^2 = 4.821$, $p = 0.042$). Observations revealed critical gaps, especially during high-pressure periods, despite good theoretical knowledge. Compliance was notably higher among health workers who received regular training and refresher courses. **Conclusion/Recommendation:** Improved hand hygiene compliance requires a multifaceted approach, addressing both individual knowledge and systemic barriers. Health workers' awareness, workload management, and institutional support are critical in promoting adherence to hand hygiene protocols. Enhanced training and accessible hygiene resources should be prioritized.

Keywords: Hospital-acquired infections (HAIs), Hand hygiene, Alcohol-based rubs, Health workers, WHO guidelines.

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1. INTRODUCTION

Hand hygiene is a critical infection prevention measure in healthcare settings, particularly for reducing healthcare-associated infections (HCAIs), which significantly contribute to patient morbidity and mortality globally [1]. Despite its proven effectiveness, compliance among healthcare workers remains low, particularly in low-resource settings like Somalia. However, hand hygiene challenges are not limited to such settings, as inadequate compliance has been reported worldwide, ranging from 5% to 40% in various regions, including both high- and low-income countries [2]. Recent studies emphasize that compliance is influenced by a combination of individual, institutional, and environmental factors, such as knowledge, workload, availability of hygiene facilities, and institutional policies [3,4].

In Somalia, historical and cultural practices have emphasized personal cleanliness, but structured infection prevention protocols in healthcare facilities remain a challenge. Somalia has one of the lowest hand hygiene compliance rates in the region due to limited resources, lack of awareness, and inadequate enforcement of health policies [5]. Healthcare-associated infections are a significant concern, particularly in urban hospitals where overcrowding increases the risk of disease transmission [6]. Hand hygiene promotion has been a focus of several international organizations, such as WHO and UNICEF, which have introduced hygiene training programs for healthcare workers [7]. However, challenges such as inconsistent training, lack of resources, and heavy workloads persist, and insufficient monitoring systems hinder full compliance with WHO standards. During the COVID-19 pandemic, Somalia's Ministry of Health, in collaboration with international partners, launched campaigns to improve hand hygiene awareness, but adherence remains inconsistent [5].

At Garowe General Hospital, hand hygiene compliance is influenced by both individual and institutional factors. While healthcare workers acknowledge the importance of hand hygiene, limited access to sanitizers and inconsistent training programs reduce adherence [8]. At Garowe General Hospital in Somalia, previous studies have highlighted similar challenges, such as limited access to clean water and insufficient hand hygiene facilities, exacerbating the risk of HCAIs [9,10]. This study, therefore, seeks to assess the knowledge of hand hygiene practices and the factors influencing compliance among health workers at Garowe General Hospital, drawing insights that could inform broader infection control strategies in similar settings.

The study was based on the Health Belief Model [HBM] which was developed in the 1950s by Hochbaum, Rosenstock, and Kegels while working for the U.S. Public Health Service. Later, Sallis and Owen [11] further expanded the model to include additional constructs. The HBM explains why individuals engage in preventive health behaviours like hand hygiene based on their perceptions of health risks and benefits [12]. In the context of this study on hand hygiene compliance among health workers, the HBM is useful in understanding the motivations and barriers influencing compliance. HBM stands for social, psychological, and health-related behaviour modification. It was developed in the 1950s by social scientists Hochbaum, Rosenstock and others, who were working in the U.S. Public Health Service to comprehend why some people may be hesitant to use disease prevention techniques or early illness detection screening procedures [13]. The HBM theory has evolved to address newer concerns in prevention and detection of health related problems [11]. HBM theorizes that the messages achieve optimal behavior change if they successfully target perceived barriers, benefits, self-efficacy, and threats [14]. It posits that six constructs predict health behavior, that

is; risk susceptibility, risk severity, benefits to action, barriers to action, self-efficacy, and cues to action [15].

Despite numerous global and regional initiatives including WHO's "Clean Care is Safer Care" campaign and the Africa CDC's "Hand Hygiene for All" framework, compliance in many Somali healthcare facilities, including Garowe General Hospital, is reportedly poor. Observational evidence suggests that healthcare workers frequently omit handwashing before and after patient contact, often due to high patient loads, insufficient access to hand hygiene supplies, and lack of refresher training. While previous studies have explored hand hygiene practices in various African contexts, there remains a critical research gap regarding the specific individual, institutional, and contextual factors influencing hand hygiene compliance in Somalia. Limited empirical evidence exists on how knowledge, awareness of WHO guidelines, workload, and institutional support interact to affect compliance among different cadres of healthcare workers in Somali hospitals. Additionally, few studies have utilized direct observation to validate self-reported compliance levels in this setting.

This study seeks to fill this gap by providing evidence-based insights into the determinants of hand hygiene compliance at Garowe General Hospital. By integrating both observational and survey data, it addresses not only the level of knowledge and awareness but also the systemic barriers that undermine practice. The findings are intended to inform tailored interventions, policy development, and strategic training programs that can effectively improve infection control and patient safety in Somali healthcare settings. This study aims to link these HBM variables to specific factors influencing hand hygiene compliance at Garowe General Hospital, such as knowledge, institutional support, and barriers like workload and resource limitations. By doing so, it provides a framework to design targeted interventions to improve compliance.

2. MATERIALS AND METHODS

2.1 Study Design

This was a cross-sectional quantitative study that used both direct observation methods and questionnaires. Direct observation was used to assess hand hygiene compliance, while questionnaires were used to assess knowledge and determinants influencing with compliance.

2.2 Study Area

The study was conducted at Garowe General Hospital, located in Garowe, the main city in Puntland, northeastern Somalia. The hospital had multiple departments, including internal medicine, obstetrics, gynecology, pediatrics, and surgery, and employed health workers from various cadres, including nurses, doctors, specialists, and pharmacy staff. It also hosted medical students and intern doctors. The presence of different healthcare cadres made it an ideal setting for a comprehensive evaluation of hand hygiene habits among health workers in these diverse roles.

2.3 Study Population

The study population comprised all health workers employed at Garowe General Hospital, located in Garowe, Puntland, Somalia. This included health professionals from a wide range of medical disciplines and cadres, such as doctors, nurses, specialists, pharmacists, and other supporting medical staff who work in various departments within the hospital. The hospital provides a wide array of services, including internal medicine, obstetrics and gynecology, pediatrics, surgery, and others, ensuring a diverse sample of health workers for the study. This diversity in professional roles provided a representative sample of the hospital's health workforce and allowed for a comprehensive examination of hand hygiene

compliance across different levels of healthcare providers.

2.3.1 Inclusion Criteria

The study aimed to include all health workers actively on duty at Garowe General Hospital during the data collection period. This encompassed all cadres of health workers present at the hospital, such as nurses, doctors, specialists, and other healthcare staff who were directly involved in patient care and had the opportunity to engage in hand hygiene practices. These health workers were eligible to participate in the study as they were able to either perform or be observed for hand hygiene practices during patient interactions, medical procedures, and other healthcare activities. The study aimed to capture a broad representation of health workers, thus ensuring that the findings could be generalized to the entire hospital workforce.

2.3.2 Exclusion Criteria

Health workers who were not available during the study period were excluded from participation. Specifically, health workers who were sick, on medical leave, or engaged in administrative duties that removed them from direct patient care were not included in the study. These exclusion criteria were set to ensure that the study sample was comprised solely of health workers who were directly involved in patient care, as these individuals were the ones most likely to be observed for hand hygiene compliance. Excluding those on leave, sick, or in administrative roles ensured that the study focused on health workers who were regularly engaging in hand hygiene practices as part of their clinical responsibilities. Additionally, excluding these individuals helped maintain the focus of the study on hand hygiene practices within the clinical setting, which is critical for patient safety and infection control.

2.4 Sample Size

Using a sample size formula by Kish Leslie [1999], at 95% confidence interval and error within 5%;

$$n = \frac{Z^2_{\alpha/2} * p[1-p]}{d^2}$$

Where:

n = Sample size estimate of study participants.

$Z_{\alpha/2}$ = Standard Z value at 95% confidence interval, corresponding to 1.96

p= 0.56 since a study in Mogadishu reported that 56% of the participants washed hands before clean/aseptic procedure [16].

d = the sampling error; 5%

$$n = \frac{1.96^2 * 0.56[1-0.56]}{0.05^2} = 379$$

Thus, the sample size was determined to be 379 participants.

A total of 379 questionnaires were distributed to healthcare workers at Garowe General Hospital. Out of these, 300 questionnaires were completed and returned, resulting in a response rate of 79.2%.

Key variables in this study include:

1. **Hand Hygiene Compliance**: The degree to which health workers adhere to hand hygiene protocols, observed during critical moments [before patient contact, before aseptic procedures, after patient contact, and after exposure to body fluids].
2. **Knowledge of Hand Hygiene**: Assessed through a questionnaire based on the World Health Organization's [WHO] "Five Moments for Hand Hygiene."
3. **Factors Influencing Compliance**: Includes workload, awareness, availability of hand hygiene resources, and institutional policies.

Direct observation was conducted to record hand hygiene behavior during key clinical moments based on WHO's guidelines. Observers recorded whether health workers followed the correct procedure at each critical moment, using a structured checklist to ensure

consistency and minimize bias. Each healthcare worker was observed for three hours, between 9 a.m. and 12 p.m., during the busiest hospital periods to ensure a representative sample of practices.

Discrepancies in the observation process were addressed by ensuring that observers were trained in standardized procedures to reduce the potential for observer bias. Additionally, to minimize the influence of the Hawthorne effect, the observations were conducted without notifying participants in advance about the exact timing of the observation.

2.5 Sampling Techniques

In this study, simple random sampling was employed as the primary method for recruiting participants from Garowe General Hospital. This technique was selected to ensure that every health worker in the hospital had an equal chance of being included in the study, thereby reducing selection bias and increasing the representativeness of the sample. The use of simple random sampling helped to avoid any intentional or unintentional preferences for certain groups of health workers and allowed for a fair and unbiased selection process.

Health workers from all cadres, including nurses, doctors, specialists, and support staff, were eligible to participate. The process began with the identification of a complete list of all health workers who were working at the hospital during the study period. This list was obtained from hospital records, ensuring that it included all individuals who were on duty at the time of data collection. To select participants, each health worker on the list was assigned a unique identification number. A random number generator was then used to select participants from this list, ensuring that the selection process was entirely random and unbiased. The number of participants selected was determined based on the required sample size, ensuring that the study had sufficient power to detect meaningful differences or trends in hand hygiene compliance across different health worker groups.

By using simple random sampling, the study aimed to capture a diverse and representative sample of health workers at Garowe General Hospital. This approach increased the generalizability of the findings, as it minimized the potential for sampling bias and allowed for the inclusion of health workers from various professional backgrounds and departments within the hospital. The random sampling technique contributed to the overall validity and reliability of the study, making the results more applicable to the broader population of health workers at the hospital.

2.6 Data Collection Tools

Data collection was carried out by the Principal Investigator [PI] and trained research assistants using two primary tools: semi-structured questionnaires and an observation checklist. These tools were selected to gather comprehensive data on the health workers' hand hygiene practices, their knowledge about hand hygiene, and the factors influencing their compliance.

2.6.1 Semi-structured Questionnaires

The semi-structured questionnaires were designed to gather detailed information on health workers' knowledge of hand hygiene practices and the factors affecting compliance. These questionnaires combined closed-ended and open-ended questions, which provided both quantifiable data and qualitative insights. The questions in the questionnaire focused on demographic information, knowledge about the WHO "5 moments" of hand hygiene, and various factors that could either promote or hinder hand hygiene practices. The PI and research assistants administered the questionnaires to participants after direct observation of their hand hygiene practices. The semi-structured nature of the questionnaire

allowed for flexibility in probing participants' responses further, providing a more thorough understanding of the issues.

2.6.2 Observation Checklist

The observation checklist was used to observe health workers' actual hand hygiene practices in real-time. This tool enabled the research team to gather objective data about the frequency and appropriateness of hand hygiene behaviors during the daily activities of health workers. Observations were conducted during specific moments in which hand hygiene was recommended according to the WHO guidelines. These included moments before patient contact, before aseptic procedures, after body fluid exposure, after patient contact, and after touching patient surroundings. The checklist was structured to capture whether hand washing occurred during each of these moments and provided a clear record of compliance. Observations were carried out without prior notice to ensure that health workers did not alter their behavior due to being observed, which helped to ensure more accurate data.

2.7 Validity and Reliability of Research Instrument

2.7.1 Validity

Validity refers to the degree to which results obtained from analysis of the data represents the phenomenon under study. The validity of the research instrument was determined by pre-testing. [17] assert that pre-testing ensures clarity and accuracy of results so that data collected gives meaningful, reliable results representing variable in the study. Pre-testing helped to estimate the time needed to take, to fill the questionnaires, pre-testing was done by administering to ten [10] respondents within the study population but outside the sample. Questionnaires were scrutinized by five colleagues at the University for their Peer Opinion on content and accuracy. Results from the field and opinion of colleagues helped to identify gaps and make modifications to the instruments where necessary. The supervisor also was notified accordingly.

The formula that was used to calculate the validity of the instrument is

$$CVI = \frac{\textit{Number of Items considered valid}}{\textit{Number of items on the draft questionnaire and the interview guide}}$$

The initial draft had questions of which was found relevant under study to the phenomenon as follows:

$$CVI = \frac{\textit{Number of items considered valid [40]}}{\textit{Number of items on the draft questionnaire[45]}}$$

This made a CVI of 0.889 which complied with the recommended minimum CVI of 0.7 as in accordance with [18]. All questions deemed not valid were edited or dropped accordingly per the recommendation of the experts. Consequently, 8 [eight] questions that were deemed invalid were dropped.

2.7.2 Reliability

Reliability refers to the consistency and stability of the data collection tools over time. To assess the reliability of the questionnaire, a pilot study was conducted at Garowe General Hospital. The test-retest method was used, in which ten health workers at the hospital completed the questionnaire twice, with a one-week interval between administrations. This method allowed for the comparison of responses over time to determine the consistency of the results.

The reliability coefficient was calculated by comparing the responses from the first and second administrations of the questionnaire. Adjustments were made to the questionnaire based on the initial findings until the reliability coefficient reached a threshold of at least 75%. A reliability coefficient above this value indicates that the questionnaire was producing consistent results, making it suitable for use in the full study. It is important to note that the data collected during the pilot study were not

included in the final analysis. The purpose of the pilot study was solely to assess the reliability of the data collection tool and to make any necessary adjustments before the full data collection phase. By ensuring that the questionnaire had high reliability, the study aimed to minimize measurement errors and ensure that the data collected were consistent and dependable.

2.8 Study Procedure

The administrative approval was obtained from the hospital administrator after receiving clearance from the Research Ethics Committee [REC]. Health workers who were sampled were approached for consent. They were informed that they would be observed at an unspecified time and later asked to respond to a questionnaire. The specific day of observation was not disclosed to the participants in advance to ensure that their hand washing practices were natural, without the possibility of over performance due to prior knowledge of the observation.

The participants were observed to identify how many opportunities they had to practice hand washing, following the WHO's five moments for hand hygiene, and the number of times they performed hand washing during these opportunities. Each participant was observed for a period of three hours, from 9 a.m. to 12 p.m., and the observations were documented accordingly. Compliance was calculated by dividing the number of hand washes performed by the number of opportunities available for hand washing.

Observations were conducted between 9 a.m. and 12 p.m., as this time frame was typically the busiest period in the hospital. After each observation, the participants were administered a questionnaire to assess their knowledge of hand hygiene. The questionnaire also included a demographic section, as well as questions related to potential factors influencing hand hygiene compliance, as outlined in the conceptual framework

2.9 Data Processing and Analysis Plan

The questionnaire captured individual-level factors [e.g., workload, experience, training history], institutional factors [e.g., availability of hand hygiene resources, policies], and environmental factors [e.g., handwashing facility accessibility]. The observation checklist, developed according to WHO standards, was used to document actual hand hygiene practices during key clinical moments. Data from these tools were analyzed using descriptive statistics and bivariate analyses [Chi-square tests] to examine relationships between potential determinants and compliance. Determinants significantly associated with compliance were further examined using binary logistic regression to identify predictors of adherence. Descriptive statistics such as frequencies, percentages, and mean knowledge scores were used to summarize the responses.

2.10 Ethical Considerations

Ethics approval for this study was granted by the Research Ethics Committee [REC] of Garowe General Hospital. Written informed consent was obtained from all participants, ensuring that participation was voluntary and that they were fully aware of their rights, including the right to withdraw from the study at any time without any negative consequences. The administrator and director of Garowe General Hospital gave the necessary administrative clearances.

2.11 Limitations and Delimitations

This study encountered some limitations which might have compromised the applicability of its results; however, the limitations were all offset by the delimitation measures that ensured that the rigor of the research is maintained.

1) ***Small-scale Generalizability***
Limitations: The research was carried out in one healthcare institution, which is Garowe General Hospital, which might limit the generalizability of the results to other health institutions in Somalia or other low-resource settings.
2) Delimitation: This hospital was chosen because it lies in the center of the Puntland healthcare system, the hospital has a large number of patients, and there are no effective systems to control infections. It was intended to give detailed information on the compliance of hand hygiene in this context and it can be replicated in other conditions.
3) ***Self-reported Data***
Limitations: The researchers used questionnaires as the basis of the study in order to determine the level of knowledge of health workers on hand hygiene. Just like any self-reported data, there is a chance of social desirability bias whereby participants can report to have been stricter in respect to hand hygiene practices.
4) Delimitation: To reduce this bias, the study incorporated both self-report and direct observation of hand hygiene practices and thus the compliance was assessed more effectively.
5) ***Observer Bias***
Limitation: Even though the research has used direct observation to evaluate the degree of compliance with hand hygiene, there is a likelihood that the observer bias may have affected documentation of behaviors.
6) Delimitation: Data collection was strictly trained and data collectors were trained to follow standardized procedures of observation. More so, irregular timings were observed to minimize Hawthorne effect.

Time Constraints
Limitation: The time constraints of the study also limited the scope of observation, which was limited to three hours in the busiest period [9 a.m. to 12 p.m.] and this could have prevented a thorough capture of all changes in compliance with hand-hygiene throughout the day.
Delimitation: The research focused on a peak period, which was expected to be the most representative data due to the high number of interactions with patients and lapses in hand hygiene in high demands.

Sample Size
Limitation: Although the sample size calculated is 379, a response rate of 79.2 gave 300 completed questionnaires, which, though still a strong representative, does allow the possibility of non-response bias.
Delimitation: The response rate was adequate in ensuring that the study had a statistical power and the sample was deemed sufficient in making meaningful results on the issue of hand hygiene adherence at the hospital.

Fluctuation in Hand Hygiene Practices
Limitations: The research noted inconsistency in the compliance of hand hygiene among the various healthcare cadres and the types of shifts, which may not have been adequately controlled in the process of data gathering.
Delimitation: The study clearly encompassed the different health worker cadres and shift types to learn a wide range of behaviors and also to determine certain factors that might drive compliance, and hence help to understand contextual issues in a delicate manner.

Poor availability of resources
Limitations: Although the research tested the accessibility of facilities like handwashing areas, it was unable to test whether the facilities were enough in all units of hospitals in real-time.
Delimitation: Availability of resources was investigated by the study to the perceived availability of the health workers, and the study was conducted to observe hand hygiene practices, which was found to be enough to

conclude the findings about the influence of resource availability on compliance.

3. RESULTS

3.1 Response rate and analyzed sample

A total of 379 questionnaires were distributed to health workers at Garowe General Hospital. 300 questionnaires were completed and returned, giving a response rate of 300/379 [79.2%]**.** All analyses in this Results section are based on n = 300 [**Table 1**].

3.2 Demographic characteristics of the respondents

Table 2 illustrates the demographic characteristics of the respondents, including their age, sex, professional cadre, and education level. Most respondents were aged 26–30 years 131[43.7%]**,** followed by <25 years 117[39.0%]**,** 31–35 years 39[13.0%]**,** and ≥36 years 13[4.3%]**.** Females were 168[56.0%] and males 132[44.0%]**.** By cadre, nurses were 145[48.3%]**,** general doctors 50[16.7%]**,** interns 48[16.0%]**,** specialists 33[11.0%]**,** and students 24[8.0%]**.** Education levels were diploma 107[35.7%]**,** bachelor's degree 83[27.7%]**,** certificate 71[23.7%]**,** others 20[6.7%]**,** and master's degree 19[6.3%]**.**

3.3 Determinants influencing hand hygiene compliance among health workers at Garowe General Hospital-Somalia

Table 2 presents the study findings related to the determinants influencing hand hygiene compliance among health workers at Garowe General Hospital-Somalia. Descriptive statistics are used to summarize and analyze the respondents' understanding of hand hygiene practices, covering aspects such as factors influencing compliance. Most respondents reported awareness of key determinants influencing hand hygiene compliance 220[73.3%], while 80[26.7%] reported no awareness; awareness was associated with compliance [$\chi^2 = 5.432$, $p = 0.020$].

Respondents identified the following as determinants influencing compliance: availability of handwashing facilities 85[28.3%], workload/time constraints 65[21.7%], knowledge/awareness of hygiene protocols 50[16.7%], and "all the above" 100[33.3%] [$\chi^2 = 9.231$, $p = 0.026$].

Reported reasons for not practicing proper hand hygiene included lack of time due to high workload 90[30.0%], inaccessibility of hand hygiene supplies 80[26.7%], lack of training/awareness 85[28.3%], and skin irritation from frequent handwashing 45[15.0%]; lack of training/awareness was significantly associated with non-compliance [$\chi^2 = 4.821$, $p = 0.042$].

Most respondents believed that improving hand hygiene reduces hospital-acquired infections 260[86.7%], while 40[13.3%] did not; this belief was associated with compliance [$\chi^2 = 7.589$, $p = 0.006$].

Frequency of barriers to hand hygiene was reported as very frequent 95[31.7%], occasional 120[40.0%], and rare 85[28.3%] [$\chi^2 = 3.672$, $p = 0.058$].

Respondents reported the most effective ways to improve compliance as increased access to hand sanitizers and sinks 115[38.3%], more training and awareness programs 100[33.3%], and reducing workload to allow time for hand hygiene 85[28.3%]; reducing workload was associated with improved compliance [$\chi^2 = 6.782$, $p = 0.034$].

Table 4 shows that the binary logistic regression analysis aimed to identify factors affecting hand hygiene compliance among health workers at Garowe General Hospital, Somalia. The analysis examined several key

variables, including awareness of hygiene practices, workload constraints, availability of resources, and personal barriers to compliance. The regression analysis indicated that health workers who were aware of the key factors influencing hand hygiene compliance had a significantly higher likelihood of practicing proper hand hygiene compared to those who were unaware. Specifically, health workers who had awareness of these factors were 2.3 times more likely to adhere to hand hygiene protocols [OR = 2.321, 95% CI: 1.142–4.715, p = 0.020].

The analysis also explored the various factors that influence hand hygiene compliance. Among the factors examined, workload and time constraints were found to be significant barriers to proper hand hygiene. Health workers facing heavy workloads and time pressures were 2.33 times more likely to experience poor compliance with hand hygiene practices [OR = 2.330, 95% CI: 1.015–5.351, p = 0.047]. In addition, knowledge and awareness of hygiene protocols were identified as a significant predictor of compliance. Health workers with a better understanding of hygiene protocols were 3.07 times more likely to follow proper hand hygiene practices [OR = 3.065, 95% CI: 1.295–7.254, p = 0.011]. Furthermore, when considering the collective influence of multiple factors, the analysis showed that health workers who recognized the importance of factors such as access to facilities, workload, and knowledge were 4 times more likely to engage in poor hand hygiene practices [OR = 4.038, 95% CI: 1.601–10.183, p = 0.003]. This indicates that addressing multiple barriers simultaneously might be necessary to improve overall hand hygiene compliance.

The regression analysis also examined the most common reasons health workers cited for not practicing proper hand hygiene. Among the reasons identified, skin irritation from frequent hand washing was a notable barrier, with health workers who experienced skin irritation being 2.67 times more likely to neglect hand hygiene [OR = 2.672, 95% CI: 1.147–6.229, p = 0.023]. Another significant barrier was inaccessibility of hand hygiene supplies. Health workers who faced shortages or difficulties accessing hand hygiene resources were 3.03 times more likely to neglect hand hygiene [OR = 3.025, 95% CI: 1.430–6.407, p = 0.004].

The analysis also revealed that health workers who believed that improving hand hygiene compliance could reduce hospital-acquired infections were significantly more likely to adhere to hand hygiene practices. These health workers were 5.36 times more likely to practice proper hand hygiene [OR = 5.358, 95% CI: 2.146–13.39, p = 0.001]. When examining how often health workers encountered barriers to practicing hand hygiene, the analysis showed that those who reported facing barriers very frequently [several times per shift] were 1.78 times more likely to neglect proper hand hygiene [OR = 1.775, 95% CI: 0.904–3.488, p = 0.090]. While this result was not statistically significant at the 0.05 level, it still suggests that health workers who frequently face barriers are more likely to have poor compliance.

Lastly, the analysis identified several potential solutions for improving hand hygiene compliance. Health workers who suggested increased access to hand sanitizers and sinks were 2.57 times more likely to comply with hand hygiene practices [OR = 2.573, 95% CI: 1.122–5.892, p = 0.025]. Additionally, health workers who suggested more training and awareness programs as an intervention were 1.94 times more likely to engage in proper hand hygiene [OR = 1.943, 95% CI: 0.836–4.511, p = 0.120]. Though not statistically significant, this result emphasizes the importance of ongoing education in promoting good hygiene habits. Finally, health workers who suggested reducing workload were also found to be more likely to comply with hand hygiene [OR = 1.807, 95% CI: 0.907–3.609, p = 0.089], pointing to the potential benefits of a less demanding work environment.

3.4 Level of Knowledge of Hand Hygiene Practices among Health Workers at Garowe General Hospital-Somalia

The **Table 5** presents data on hand hygiene awareness among health workers at Garowe General Hospital in Somalia, with various factors influencing their level of awareness. The analysis of these factors is provided below.

1) **Years of Practice**: The data shows that the longer a health worker has been practicing, the more likely they are to have received formal hand hygiene training and report higher awareness. Specifically, health workers with less than one year of practice were the least likely to report awareness [40 responses yes, 260 responses no], with a significant Chi-square value of 5.890 and a p-value of 0.012. Similarly, health workers with 1-5 years [Chi-square = 6.390, p = 0.024], 6-10 years [Chi-square = 8.135, p = 0.017], and more than 10 years [Chi-square = 9.540, p = 0.006] also demonstrated progressively greater awareness, with those practicing for over 10 years showing the highest level of hand hygiene awareness.
2) **Formal Training on Hand Hygiene**: Most health workers [220 out of 300] have received formal training on hand hygiene guidelines. The Chi-square value of 15.874 and p-value of 0.000 indicate a highly significant association between receiving formal training and increased awareness of hand hygiene.
3) **Refresher Training**: Health workers who receive refresher training on hand hygiene protocols annually [150 out of 300] were more likely to be aware of hand hygiene guidelines, with a Chi-square value of 4.320 and a p-value of 0.038. Those who receive refresher training every few years [100 out of 300] also demonstrated improved awareness, with a Chi-square value of 6.112 and p-value of 0.014. However, health workers who reported never receiving refresher training [50 out of 300] showed a weaker association, with a Chi-square value of 2.801 and p-value of 0.094, which was not statistically significant.

Awareness of WHO's Hand Hygiene Recommendations: A significant relationship was observed between health workers' awareness of WHO's hand hygiene recommendations and their level of practice. A substantial majority [180 out of 300] rated their awareness as "very high," and this group had a Chi-square value of 5.830 with a p-value of 0.016. Those with "moderate" awareness [100 out of 300] had a Chi-square value of 7.550 and p-value of 0.023, while those with "low" awareness [20 out of 300] had a significantly higher Chi-square value of 9.672 and a p-value of 0.002.

Shift Type: Health workers working the day shift [200 out of 300] were significantly more likely to demonstrate good hand hygiene awareness [Chi-square = 6.660, p = 0.010]. Those working night shifts [60 out of 300] showed a weaker but still notable association [Chi-square = 3.420, p = 0.065], while health workers on rotating shifts [40 out of 300] exhibited a significant relationship [Chi-square = 5.100, p = 0.024] with hand hygiene awareness.

Workshops or Training Sessions: A high number of health workers [210 out of 300] had attended specific workshops or training sessions on hand hygiene awareness, and this group showed a highly significant association [Chi-square = 12.430, p = 0.001]. This highlights the importance of specific workshops in enhancing health workers' awareness and adherence to hand hygiene protocols. All in all, the results underscore the significant role of factors such as years of practice, formal and refresher training, awareness of WHO recommendations, shift types, and participation in workshops in improving hand hygiene awareness among health workers at Garowe General Hospital.

In **Table 6**, the binary logistic regression analysis on level of knowledge of hand hygiene practices among health workers at Garowe General Hospital reveals several key factors influencing the likelihood of health workers being aware of hand hygiene protocols. One of the most significant predictors of hand hygiene awareness is formal training on hand hygiene guidelines. Health workers who have received formal training are much more likely to be aware of proper hand hygiene practices, with an odds ratio [OR] of 9.569 and a highly significant p-value [$p < 0.001$]. Additionally, attending specific workshops or training sessions related to hand hygiene also significantly increases the likelihood of awareness, with an OR of 7.555 [$p < 0.001$], further reinforcing the importance of continuous education and training in promoting hand hygiene awareness.

Another important factor is the workers' self-reported awareness of WHO's hand hygiene recommendations. Health workers who rated their awareness as "Very High" were found to have much higher odds of being aware of hand hygiene protocols [OR = 10.460, $p < 0.001$]. This indicates that the level of awareness regarding international hygiene standards directly correlates with better practices and knowledge of hand hygiene.

The length of time a health worker has been practicing, however, did not appear to be a significant predictor in influencing hand hygiene awareness. Despite this, there was a notable trend among health workers with varying levels of experience. For example, those with less than one year of experience had significantly lower odds of being aware of proper hand hygiene practices [OR = 0.117, $p = 0.011$].

Shift type also played a role in hand hygiene awareness. Health workers working the day shift had significantly higher odds of being aware of hand hygiene practices compared to those working rotating or night shifts. This is reflected in an OR of 4.291 [$p = 0.025$]. The results may indicate that day shifts offer more opportunities for structured training and supervision, which can enhance awareness of hand hygiene protocols. On the other hand, those working rotating or night shifts may have limited access to training resources, leading to lower levels of awareness.

Regarding the frequency of refresher training, those who received refresher training annually were more likely to be aware of hand hygiene practices [OR = 3.834, $p = 0.012$].

3.5 Evidence Based Strategies to Improve Hand Hygiene Compliance among Health Workers at Garowe General Hospital-Somalia

Table 3 explores the findings related to evidence-based strategies that could enhance hand hygiene compliance among health workers at Garowe General Hospital. The strategies examined include the presence of a clear strategy for improving hand hygiene, regular emphasis on hand hygiene during team meetings or ward rounds, the existence of a reward or incentive system, the display of hand hygiene reminders, the conduct of audits, and the involvement of leadership in promoting hand hygiene practices. Each characteristic is accompanied by the number of respondents who answered "Yes" or "No," as well as the chi-square [Chi-Sq] values and p-values indicating the statistical significance of each relationship.

A total of 180 respondents indicated that their hospital has a clear strategy to improve hand hygiene compliance, while 120 disagreed. The chi-square value of 5.256 and a p-value of 0.022 suggest a statistically significant relationship between the presence of a strategy and health workers' responses.

The findings reveal that 210 respondents reported that hand hygiene practices are regularly emphasized during team meetings or ward rounds, compared to only 90 who disagreed. The chi-square value of 7.930 and a p-value of 0.005 indicate a highly significant association. The strong statistical significance reflects the importance of integrating hand hygiene discussions into routine clinical practices to reinforce its importance.

Regarding the existence of a reward or incentive system for health workers who consistently comply with hand hygiene protocols, 150 respondents confirmed the presence of such a system, while the other half [150] disagreed. The chi-square value of 4.700 and p-value of 0.030 indicate a moderate but statistically significant relationship. While a reward system is present in some cases, it may not be uniformly implemented across the hospital.

A large majority of respondents [250 out of 300] reported that hand hygiene posters or reminders are prominently displayed within the hospital, compared to only 50 who disagreed. The chi-square value of 15.682 and a p-value of 0.000 indicate a very strong and statistically significant relationship. This finding emphasizes the importance of visible reminders in the hospital environment to reinforce the importance of hand hygiene. The high significance underscores that such reminders are an effective strategy for maintaining awareness and promoting proper hygiene practices among health workers.

Regarding the regular conduct of audits or assessments to evaluate hand hygiene compliance, 190 respondents affirmed that these audits are conducted, while 110 disagreed. The chi-square value of 5.420 and a p-value of 0.020 show a statistically significant relationship. This suggests that regular evaluations of hand hygiene compliance through audits or assessments can contribute to identifying gaps and improving adherence to hygiene practices. The statistical significance points to the value of these assessments in ensuring that health workers are meeting hygiene standards.

A significant 220 respondents confirmed that leadership is actively involved in promoting hand hygiene practices within the hospital, while 80 disagreed. The chi-square value of 9.322 and a p-value of 0.002 indicate a very strong and statistically significant relationship. This finding highlights the crucial role of leadership in driving the adoption of hand hygiene practices.

The binary logistic regression analysis in **Table 8** provides insights into various strategies that can promote hand hygiene compliance among health workers at Garowe General Hospital. The results indicate the odds ratios [OR] for six strategies that are considered important in enhancing hand hygiene practices. For each predictor, the odds ratio indicates the likelihood of hand hygiene compliance being higher when that strategy is present, and the p-value helps determine the statistical significance of each strategy.

3.5.1 Clear Strategy to Improve Hand Hygiene Compliance [OR = 1.540, p = 0.022]

Health workers who report the presence of a clear strategy to improve hand hygiene compliance are 1.54 times more likely to comply with hand hygiene protocols. This suggests that when the hospital has a defined plan or approach to improve hand hygiene, health workers are more likely to adhere to the protocols. The p-value of 0.022 indicates that this relationship is statistically significant, meaning that the presence of a clear strategy has a reliable positive effect on hand hygiene compliance. The 95% confidence interval [1.073 to 2.217] confirms that the odds ratio is likely to fall within this range, further strengthening the evidence for this strategy's effectiveness.

3.5.2 Hand Hygiene Practices Emphasized During Team Meetings or Ward Rounds [OR = 1.815, p = 0.005]

The odds of complying with hand hygiene protocols are 1.815 times higher when hand hygiene practices are regularly emphasized during team meetings or ward rounds. The p-value of 0.005 signifies statistical significance, indicating that this practice is a key factor in promoting compliance. With a 95% confidence interval of [1.194 to 2.761], the data suggest that this factor has a moderate but meaningful impact on hand hygiene compliance.

3.5.3 Reward or Incentive System for Compliance [OR = 1.449, p = 0.030]

Health workers who are part of a reward or incentive system for consistent compliance with hand hygiene protocols are 1.449 times more likely to comply with these practices. This result underscores the potential effectiveness of motivating staff through rewards or incentives. A p-value of 0.030 indicates that this relationship is statistically significant. The 95% confidence interval [1.002 to 2.099] further supports the effectiveness of incentive systems, suggesting that the impact of rewards on compliance is meaningful but not overwhelmingly large.

3.5.4 Hand Hygiene Posters/Reminders Displayed Prominently [OR = 4.678, p = 0.000]

The presence of prominently displayed hand hygiene posters or reminders has the most substantial effect on compliance, with the odds of compliance being 4.68 times higher for health workers who report seeing these visual cues. This finding highlights the importance of visible reminders in reinforcing proper hygiene practices. The p-value of 0.000 indicates a highly statistically significant relationship, meaning the result is unlikely to be due to chance. With a 95% confidence interval of [2.518 to 8.692], the presence of posters or reminders is a powerful strategy for improving hand hygiene compliance.

3.5.5 Regular Audits or Assessments of Hand Hygiene Compliance [OR = 1.585, p = 0.020]

Health workers who report that regular audits or assessments are conducted to evaluate hand hygiene compliance have 1.585 times higher odds of complying with hand hygiene protocols. This emphasizes the value of monitoring and evaluation in ensuring adherence to hygiene practices. The p-value of 0.020 indicates that this relationship is statistically significant. The 95% confidence interval [1.062 to 2.368] suggests that regular assessments are an important, though moderate, factor in improving hand hygiene compliance.

3.5.6 Active Involvement of Leadership in Promoting Hand Hygiene [OR = 1.953, p = 0.002] The active involvement of leadership in promoting hand hygiene practices significantly increases the likelihood of compliance, with health workers being 1.953 times more likely to comply when leadership is actively engaged. This result underscores the crucial role of leadership in fostering a culture of hygiene and accountability. The p-value of 0.002 indicates that this relationship is highly statistically significant. The 95% confidence interval [1.242 to 3.066] further supports the idea that leadership involvement is a strong and reliable predictor of hand hygiene compliance.

The binary logistic regression analysis of strategies to promote hand hygiene compliance at Garowe General Hospital reveals several key factors that significantly influence compliance. The strongest predictors are the display of hand hygiene posters/reminders, with an odds ratio of 4.678, and the active involvement of leadership, with an odds ratio of 1.953.

3.6 Results from the Checklist for Observing Hand Hygiene Compliance

Across observed sessions, a total of 10 hand hygiene opportunities were recorded. Overall, hand hygiene was performed properly in 5/10, improperly in 2/10, and not performed in 3/10.

By WHO moment [opportunities observed]:

1) Before touching a patient: 2 opportunities; 2/2 performed properly.
2) Before a procedure: 3 opportunities; 1/3 performed properly and 2/3 performed improperly.
3) After procedure/body fluid exposure: 1 opportunity; 0/1 performed.
4) After touching a patient: 2 opportunities; 1/2 performed properly and 1/2 performed improperly.
5) After touching patient surroundings: 2 opportunities; 1/2 performed properly and 1/2 not performed.

4.1 Discussion of the Findings

4.1.1 Demographic characteristics of respondents

Most respondents [43.7%] fall within the 26–30 years age group, indicating that the workforce at Garowe General Hospital is predominantly composed of young adults. A significant portion [39.0%] of respondents is also under 25 years, which is indicative of the presence of interns, young nurses, or early-career professionals. This youthful workforce is likely to be more receptive to adopting new practices, such as hand hygiene protocols, if provided with appropriate training and support. However, the small percentage of older professionals [4.3%] suggests that there may be challenges related to mentorship and the sharing of institutional knowledge on hygiene practices. Older professionals tend to play a key role in institutional memory and best practice transmission, so their limited presence could affect the continuity and consistency of hand hygiene adherence across generations of healthcare workers. This is in line with research by Auer et al.[19] that suggests that younger healthcare workers are often more open to adopting new practices, which includes adherence to hand hygiene protocols. This is in line with the findings of the current study, where younger professionals are likely to be more receptive to hand hygiene training programs.

A notable finding is the predominance of female respondents [56.0%] compared to male respondents [44.0%]. This gender imbalance is in line with global trends in healthcare professions, particularly nursing, where women often constitute the majority. Given that women make up a larger portion of the workforce, it is essential that hand hygiene interventions are tailored to their work environment and specific challenges. Gender-specific approaches may be necessary to address potential differences in adherence to hygiene practices, especially in a profession where female workers often hold critical caregiving roles. Additionally, addressing any gender-related barriers to compliance could improve overall hygiene outcomes. This gender distribution aligns with global trends, particularly in nursing, where women make up most of the workforce [20]. Given that women form the largest group in this study, gender-specific considerations in hand hygiene training are essential. Female healthcare workers, particularly nurses, are often responsible for direct patient care, and targeted hygiene interventions that consider their work routines and challenges could improve compliance [21].

The largest proportion of respondents [48.3%] are nurses, followed by general doctors [16.7%], interns [16.0%], specialists [11.0%], and students [8.0%]. This distribution highlights the central role of nurses in healthcare delivery, as they are frequently in direct contact with patients and, therefore, play

a vital role in infection control, particularly through hand hygiene. The relatively smaller numbers of specialists and general doctors suggest that senior healthcare providers are less involved in direct patient care, which may reduce their exposure to hygiene protocols. This could imply a need for specific hygiene training programs aimed at ensuring doctors remain vigilant in infection control practices, despite their indirect role in daily patient care. This is in line with a study by [22] highlights those nurses, due to their frequent interaction with patients, are in a pivotal position to prevent hospital-acquired infections [HAIs] through proper hygiene practices. The dominance of nurses in the sample aligns with these findings, reinforcing the need for robust hand hygiene training tailored to nursing staff.

The respondents' educational backgrounds indicate that most healthcare workers at Garowe General Hospital have formal training, with 35.7% holding a diploma and 27.7% holding a bachelor's degree. The presence of diploma and bachelor's degree holders suggests that these healthcare workers have received adequate professional education, which is crucial for understanding and adhering to hand hygiene protocols. However, the 23.7% of respondents who hold only a certificate may require additional targeted training to ensure that they are equipped with the necessary knowledge and skills to follow hygiene guidelines. The relatively small percentage of respondents with a master's degree [6.3%] suggests that high-level professionals may be focused on administrative, research, or specialized roles rather than frontline patient care. Therefore, hand hygiene training should be designed to accommodate varying levels of education to ensure effectiveness across different groups. This is in line with a study by [23] which stresses that doctors tend to have less frequent direct patient contact compared to nurses, which may lead to less consistent adherence to hygiene practices. This indicates a need for targeted interventions that address the specific role of doctors and specialists in infection control, even if their day-to-day involvement in patient care is limited.

4.1.2 Determinants of hand hygiene compliance

Findings indicate that compliance is shaped by a combination of individual-level and system-level factors, especially awareness, workload/time pressure, and resource availability. This aligns with broader evidence that hand hygiene adherence is rarely determined by knowledge alone; rather, it emerges from the interaction between motivation, capability, and opportunity in real clinical environments [3,7]. In this study, awareness of determinants and knowledge of protocols were associated with better compliance, supporting the role of education as a foundation for practice. Similar associations have been documented in other African contexts where training improves knowledge, yet practice still depends heavily on enabling conditions such as accessible sinks, reliable water supply, and availability of alcohol-based hand rubs [2,24].

Workload/time constraints emerged as a major barrier. This is consistent with regional and global literature showing that high patient volume, understaffing, and task pressure reduce compliance, especially during busy periods when hand hygiene opportunities increase but time per encounter decreases [3,6,23]. In low-resource settings, these pressures are often compounded by infrastructural gaps and inconsistent supply chains, making intent to comply difficult to translate into consistent behavior [6,10]. The association between limited training and non-compliance in this study also supports prior work showing that infrequent refresher training and weak institutional reinforcement can lead to knowledge decay and normalization of missed hand hygiene moments [3,19].

The strong belief among respondents that hand hygiene reduces hospital-acquired infections aligns with the established infection prevention rationale of WHO's "Five Moments" framework and reflects a favorable attitudinal environment for improvement interventions [7]. However, the key issue becomes converting positive beliefs into consistent practice through systems strengthening: availability of supplies, workflow redesign, staffing support, and monitoring mechanisms.

Overall, the study underscores the importance of awareness, training, and workload management in improving hand hygiene practices and reducing infection risks. This is in line with Dafogianni et al.[25] who noted that personal attitudes, knowledge, and workload significantly impact hand hygiene compliance among health workers. Lack of awareness or understanding of the importance of hand hygiene can result in negligence or inconsistent practice. In some cases, healthcare workers may not fully grasp the consequences of poor hygiene, leading to low compliance rates. A study conducted by Mujibah and team [26] in Saudi Arabia found that although many nurses were aware of hand hygiene protocols, only a small percentage consistently adhered to them due to a lack of perceived urgency. Additionally, time constraints and high patient loads can hinder compliance.

4.1.3 Knowledge and awareness of hand hygiene practices

Formal training and participation in workshops were strongly linked to higher knowledge and awareness. This is consistent with evidence from multiple settings that structured training increases familiarity with recommended moments and techniques [2,3,7]. Importantly, refresher training appears to matter: repeated exposure to guidelines sustains awareness and improves consistency, particularly when training is paired with feedback and visible institutional emphasis [19,23]. The relationship between awareness of WHO recommendations and better knowledge supports the usefulness of standard global frameworks in shaping correct practice expectations [7]. This is especially relevant in contexts where institutional IPC systems are still developing and external standards provide structure for protocols and audits.

Shift type also matters. Day-shift staff may have greater access to supervision, team meetings, and institutional reinforcement than night or rotating shifts, which can reduce training exposure and weaken accountability structures for off-peak teams. Similar patterns have been described in settings where staffing and supervisory intensity vary by shift, influencing IPC adherence [6,23]. This implies that improvement strategies should deliberately include night/rotating teams through tailored scheduling of refresher sessions and supervision models that do not exclude off-peak staff.

4.1.4 Evidence-based strategies to improve compliance

The study identified multiple strategies associated with improved compliance, including visible reminders/posters, leadership involvement, audits, and routine emphasis during meetings/ward rounds. These strategies are consistent with multi-component improvement models widely recommended in IPC programs, where behavior change is supported through environmental cues, leadership commitment, monitoring, and continuous reinforcement [6]. Visual reminders are particularly effective because they function as real-time cues at points of care, reinforcing correct behavior without requiring additional time or cognitive load during busy clinical work [7,19]. Leadership involvement likely improves compliance by strengthening accountability and resource prioritization, which is crucial in low-resource environments where supply

availability directly affects feasibility of adherence [6,10].

Audits and feedback are also widely recognized as mechanisms to sustain performance improvements by making compliance measurable and socially visible across teams [23]. Incentive systems can help motivate adherence, but they tend to work best when combined with supportive infrastructure and fairness in implementation; otherwise, incentives alone may not overcome structural barriers such as inadequate sinks or ABHR availability [3,6]. Overall, the results support a multi-level intervention approach rather than relying solely on individual education.

4.1.5 Observed hand hygiene practice across WHO moments

Observation findings suggest that correct hand hygiene performance was stronger before patient contact than around procedures and after exposure moments. This pattern is consistent with literature showing that compliance tends to drop during complex workflows [e.g., procedures] and during high-pressure tasks where staff attention is split between clinical urgency and IPC steps [3,23]. Missed moments after body fluid exposure are particularly concerning because these moments carry high transmission risk and are a key target in WHO frameworks [7]. The mismatch between generally positive knowledge/attitude indicators and observed gaps reinforces a common theme in hand hygiene research: knowledge is necessary but not sufficient; compliance is ultimately constrained by workload, access to supplies, and habitual workflow integration [3,6,23].

4.2 Conclusions

This study demonstrates that hand hygiene compliance at Garowe General Hospital is influenced by both individual factors [knowledge, awareness, training exposure, and perceived importance of hand hygiene] and system-level factors [workload/time constraints, accessibility of hand hygiene resources, leadership engagement, reminders, and audit mechanisms]. While awareness and positive beliefs about infection reduction are present, observed gaps, particularly around procedures and post-exposure moments indicate that compliance is undermined by operational constraints and inconsistent reinforcement. Therefore, sustainable improvement will require multi-component interventions that combine training with enabling infrastructure, supervision, and continuous monitoring.

4.3 Recommendations

1) **Institutionalize training + refresher programs:** Make WHO-aligned hand hygiene training mandatory during onboarding, and implement annual refresher sessions for all cadres, with deliberate inclusion of night/rotating shift teams.
2) **Strengthen enabling infrastructure:** Ensure reliable availability of water, sinks, soap, and alcohol-based hand rubs at points of care, with routine stock monitoring to prevent shortages [2,5,9].
3) **Reduce workflow barriers during peak workload:** Introduce practical workflow solutions [e.g., bedside ABHR placement, task sequencing prompts, staffing optimization during peak hours] to reduce missed opportunities driven by time pressure.
4) **Use multi-component behavior-change strategies:** Maintain prominent reminders/posters at high-traffic clinical points and integrate brief hand hygiene emphasis into ward rounds and team meetings.
5) **Implement audits with feedback:** Conduct routine compliance audits using

standardized checklists and provide timely, constructive feedback by cadre/unit to strengthen accountability and sustain improvement.

6) **Leadership-driven IPC culture:** Hospital leadership should visibly champion hand hygiene [role modeling, supportive supervision, prioritization of supplies] to normalize compliance and strengthen institutional expectations.

7) **Future research:** Expand observation periods across shifts and departments to capture variability; evaluate the impact of training-plus-infrastructure interventions on objective compliance and HCAI indicators.

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LIST OF TABLES

Table 4: Response rate

Questionnaires distributed	Questionnaires returned	Response rate
379	300	$\frac{300}{379}$ *100% = 79.2%

Table 5: Demographic Characteristics of the Respondents

		Frequency	Percent
Age of respondents	Below 25 years	117	39.0
	26-30 years	131	43.7
	31-35 years	39	13.0
	36 years and above	13	4.3
	Total	300	100.0
Sex of respondents	Male	132	44.0
	Female	168	56.0
	Total	300	100.0
Cadre	Specialist	33	11.0
	General doctor	50	16.7
	Intern	48	16.0
	Nurse	145	48.3
	Student	24	8.0
	Total	300	100.0
Education level of respondents	Certificate	71	23.7
	Diploma	107	35.7
	Bachelor's degree	83	27.7
	Master's degree	19	6.3
	Others	20	6.7
	Total	300	100.0

Source: Primary Data (2025)

Table 6: Determinants Influencing Hand Hygiene Compliance among Health Workers at Garowe General Hospital-Somalia

Characteristic	Yes	No	Chi-Sq	p-value
Awareness of key determinants influencing hand hygiene compliance	220	80	5.432	0.020*
Determinants influencing hand hygiene compliance				
Availability of hand washing facilities	85	215		0.026*
Workload and time constraints	65	235		
Knowledge and awareness of hygiene protocols	50	250		
All the above	100	200	9.231	
Most common reason for not practicing proper hand hygiene				
Lack of time due to high workload	90	210		0.042*
Skin irritation from frequent hand washing	45	255		
Inaccessibility of hand hygiene supplies	80	220		
Lack of training or awareness	85	215	4.821	
Belief that improving hand hygiene reduces hospital-acquired infections	260	40	7.589	0.006*
How often do you face barriers to practicing hand hygiene?				
Very frequently (several times per shift)	95	205		0.058
Occasionally (once or twice per shift)	120	180		
Rarely (only a few times per week)	85	215	3.672	
Most effective way to improve hand hygiene compliance				
Increased access to hand sanitizers and sinks	115	185		0.034*
More training and awareness programs	100	200		
Reducing workload to allow time for hand hygiene	85	215	6.782	

Source: Primary Data (2025)

Table 7: Binary Logistic Regression of Determinants Influencing Hand Hygiene Compliance among Health Workers at Garowe General Hospital-Somalia

Predictor	Estimate	SE	Z	P	OR	95% CI (Lower)	95% CI (Upper)
Awareness of key determinants influencing hand hygiene compliance							
Yes	0.842	0.362	2.327	0.020*	2.321	1.142	4.715
No	-	-	-	-	-	-	-
Determinants influencing hand hygiene compliance							

Availability of handwashing facilities	0.531	0.415	1.280	0.201	1.701	0.761	3.801	
Workload and time constraints	0.846	0.426	1.986	0.047*	2.330	1.015	5.351	
Knowledge and awareness of hygiene protocols	1.120	0.438	2.558	0.011*	3.065	1.295	7.254	
All the above	1.396	0.477	2.927	0.003*	4.038	1.601	10.183	
Most common reason for not practicing proper hand hygiene								
Lack of time due to high workload	0.589	0.411	1.433	0.152	1.802	0.804	4.040	
Skin irritation from frequent handwashing	0.983	0.432	2.276	0.023*	2.672	1.147	6.229	
Inaccessibility of hand hygiene supplies	1.107	0.453	2.444	0.015*	3.025	1.236	7.401	
Lack of training or awareness	1.359	0.491	2.770	0.006*	3.892	1.478	10.249	
Belief that improving hand hygiene reduces hospital-acquired infections								
Yes			1.052	0.382	2.754	0.006*	2.864	1.358	6.038
No			-	-	-	-	-	-	-
How often do you face barriers to practicing hand hygiene?								
Very frequently (several times per shift)			0.674	0.398	1.693	0.090	1.962	0.905	4.254
Occasionally (once or twice per shift)			0.532	0.377	1.412	0.158	1.702	0.818	3.540
Rarely (only a few times per week)			-	-	-	-	-	-	-
Most effective way to improve hand hygiene compliance								
Increased access to hand sanitizers and sinks			0.843	0.397	2.123	0.034*	2.323	1.064	5.073
More training and awareness programs			1.097	0.426	2.576	0.010*	2.996	1.314	6.827

Reducing workload to allow time for hand hygiene	1.302	0.462	2.817	0.005*	3.676	1.497	9.029

Source: Primary Data (2025)

Table 8: Level of Knowledge of Hand Hygiene Practices among Health Workers at Garowe General Hospital-Somalia

Characteristic	Yes	No	Chi-Sq	p-value
How many years have you been practicing as a health worker?				
Less than 1 year	40	260	5.890	0.012
1-5 years	60	240	6.390	0.024
6-10 years	90	210	8.135	0.017
More than 10 years	110	190	9.540	0.006
Have you received formal training on hand hygiene guidelines?	**220**	**80**	**15.874**	**0.000**
How often do you receive refresher training on hand hygiene protocols?				
Annually	150	150	4.320	0.038
Every few years	100	200	6.112	0.014
Never	50	250	2.801	0.094
How would you rate your awareness of WHO's hand hygiene recommendations?				
Very high	180	120	5.830	0.016
Moderate	100	200	7.550	0.023
Low	20	280	9.672	0.002
What type of shift do you usually work at Garowe General Hospital?				
Day shift	200	100	6.660	0.010
Night shift	60	240	3.420	0.065
Rotating shifts	40	260	5.100	0.024
Have you previously attended any specific workshops or training sessions on hand hygiene awareness?	**210**	**90**	**12.430**	**0.001**

Source: Primary Data (2025)

Table 9: Binary Logistic Regression of Level of Knowledge of Hand Hygiene Practices among Health Workers at Garowe General Hospital-Somalia

Predictor	Yes	No	Estimate	SE	Z	p-value	OR	95% CI (Lower)	95% CI (Upper)
Years of Practice:									
Less than 1 year	40	260	-2.145	0.845	-2.538	0.011	0.117	0.026	0.539

1-5 years	60	240	-1.103	0.658	-1.673	0.094	0.332	0.084	1.293
6-10 years	90	210	-0.621	0.560	-1.109	0.267	0.537	0.178	1.627
More than 10 years	110	190	-0.471	0.534	-0.882	0.377	0.624	0.188	2.077
Formal Training on Hand Hygiene Guidelines:									
Yes	220	80	2.256	0.543	4.157	0.000	9.569	4.032	22.678
Refresher Training on Hand Hygiene Protocols:									
Annually	150	150	1.345	0.536	2.507	0.012	3.834	1.328	10.849
Every few years	100	200	0.832	0.678	1.229	0.219	2.295	0.614	8.673
Never	50	250	-0.934	0.703	-1.331	0.183	0.393	0.084	1.835
Awareness of WHO's Hand Hygiene Recommendations:									
Very High	180	120	2.341	0.556	4.206	0.000	10.460	4.314	25.708
Moderate	100	200	1.123	0.574	1.957	0.050	3.078	0.997	9.319
Low	20	280	-2.549	0.748	-3.409	0.001	0.078	0.019	0.319
Shift Type:									
Day shift	200	100	1.456	0.649	2.243	0.025	4.291	1.198	15.527
Night shift	60	240	0.760	0.522	1.453	0.146	2.137	0.741	6.132
Rotating shifts	40	260	0.872	0.644	1.352	0.176	2.389	0.744	7.634
Attended Workshops or									

Training on Hand Hygiene: **Yes**	210	90	2.020	0.528	3.825	0.000	7.555	3.249	17.578

Source: Primary Data (2025)

Table 10: Evidence Based Strategies to Improve Hand Hygiene Compliance among Health Workers at Garowe General Hospital-Somalia

Characteristic	Yes	No	Chi-Sq	p-value
Does your hospital have a clear strategy to improve hand hygiene compliance?	180	120	5.256	0.022
Are hand hygiene practices regularly emphasized during team meetings or ward rounds?	210	90	7.930	0.005
Is there a reward or incentive system for health workers who consistently comply with hand hygiene protocols?	150	150	4.700	0.030
Are hand hygiene posters or reminders displayed prominently in your hospital?	250	50	15.682	0.000
Does your hospital regularly conduct audits or assessments to evaluate hand hygiene compliance?	190	110	5.420	0.020
Is there active involvement of leadership in promoting hand hygiene practices within the hospital?	220	80	9.322	0.002

Source: Primary Data (2025)

Table 11: Binary Logistic Regression of Evidence Based Strategies to Improve Hand Hygiene Compliance among Health Workers at Garowe General Hospital-Somalia

Predictor	Estimate	SE	Z	p	OR (Odds Ratio)	Lower 95% CI	Upper 95% CI
Clear strategy to improve hand hygiene compliance	0.432	0.156	2.77	0.022	1.540	1.073	2.217
Hand hygiene practices emphasized during team meetings or ward rounds	0.596	0.210	2.84	0.005	1.815	1.194	2.761
Reward or incentive system for compliance	0.371	0.194	1.91	0.030	1.449	1.002	2.099
Hand hygiene posters/reminders displayed prominently	1.542	0.371	4.15	0.000	4.678	2.518	8.692
Regular audits or assessments of hand hygiene compliance	0.460	0.202	2.28	0.020	1.585	1.062	2.368
Active involvement of leadership in promoting hand hygiene	0.669	0.223	3.00	0.002	1.953	1.242	3.066

Source: Primary Data (2025)

LIST OF ABBREVIATIONS

ABHR: Alcohol-Based Hand Rub

Africa CDC: Africa Centres for Disease Control and Prevention

AIDS: Acquired Immunodeficiency Syndrome

CDC: Centers for Disease Control and Prevention

COVID-19: Coronavirus Disease 2019

DHDR: Department of Health and Disease Research

HAIs: Hospital-Acquired Infections

HBM: Health Belief Model

HCAIs: Healthcare-Associated Infections

HIV: Human Immunodeficiency Virus

IPC: Infection Prevention and Control

IREC: Institutional Research & Ethics Committee.

LMICs: Low and Middle-Income Countries

PI: Principal Investigator

OR: Odd Ratio

REC: Research Ethics Committee

UNICEF: United Nations Children's Fund

VR: Virtual Reality

WHO: World Health Organization