

IMPACT OF HAND HYGIENE COMPLIANCE ON THE INCIDENCE OF HOSPITAL-ACQUIRED INFECTIONS AMONG NURSING STAFF IN KARACHI

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ABSTRACT

Hospital-acquired infections (HAIs), also known as healthcare-associated infections, continue to be a major patient-safety problem for healthcare systems globally. These infections contribute to increased morbidity and mortality of patients, length of hospital stay, use of antimicrobials and overall health care costs. Hand hygiene is generally accepted as one of the most effective, simple and cost-effective measures for preventing the transmission of infectious microorganisms in the clinical setting. Although there are guidelines for infection control, healthcare workers, especially nurses, don't always follow hand hygiene protocols due to high workloads, lack of resources, lack of monitoring, and lack of safety culture in the institution. The adherence to hand hygiene and the incidence of hospital-acquired infections in inpatients were studied. Methods A quantitative descriptive correlational design was employed in the study and data were collected from 23 participants using a hand hygiene observation checklist, hospital infection records and a structured questionnaire. Reliability analysis revealed a high level of internal consistency with Cronbach's alpha .966. Descriptive statistics were employed to summarize the study variables and Pearson correlation was used to determine the relationship between hand hygiene and infection scores. The results demonstrated a strong statistically significant relationship between hand hygiene and infection scores, $r = .977$, $p < .001$. Hence, the null hypothesis was rejected and alternative hypothesis accepted. The results emphasized the necessity of improved adherence to hand hygiene by means of formal training, periodic monitoring, adequate resources, feedback mechanisms, and strict enforcement of infection-control policies. The study concluded that hand hygiene continues to be an important measure for the prevention of infections and a guarantee of patient safety in hospitals.

Keywords: Hospital-acquired infections; healthcare-associated infections; hand hygiene compliance; nurses; infection prevention; patient safety; quantitative research; Pakistan.

INTRODUCTION

Hospital acquired infections are infections that develop in a patient during a stay in a healthcare

facility that were not present or incubating at the time of admission. These infections

continue to pose a significant public health and patient safety threat because they can result in unnecessary patient harm, prolonged hospitalization, increased treatment costs, and greater risk of mortality. Healthcare associated infections are of particular concern in developing countries where infection control systems may be affected by limited resources, heavy patient load and insufficient monitoring practices. Hand hygiene is one of the most important infection prevention practices in health care settings. It limits the transmission of microorganisms between healthcare personnel, patients, equipment and hospital environment. The World Health Organization (WHO) has highlighted that hand hygiene is a simple but highly effective method of preventing healthcare-associated infections and promoting patient safety (World Health Organization (WHO, 2023). Similarly, the Centers for Disease Control and Prevention recommends hand hygiene before and after patient contact, before aseptic procedures, after exposure to body fluids, after touching patient surroundings, and after glove removal (Centers for Disease Control and Prevention (CDC, 2024). Nurses are key to infection prevention because they have frequent contact with patients when they give medications, care for wounds, perform invasive procedures, take vital signs and provide general bedside care. Thus, their hand hygiene practices play an important role in the prevention of the spread of infectious microorganisms. But compliance with the guidelines is often poor among healthcare workers. Studies have shown that workload, lack of supplies, limited training, poor supervision, skin irritation, and weak institutional support may negatively influence hand hygiene compliance (AHRQ, n.d.; Afework & Tamene, 2025). The problem is particularly critical in Pakistan where many healthcare settings continue to experience resource constraints and inconsistent infection control practices. Previous studies have reported that basic knowledge of hand hygiene among nurses and other healthcare workers is present, but actual compliance is inconsistent due to workload, lack of resources and limited monitoring (Khan et al., 2023; Akhter et al., 2024). A quasi-experimental study in Karachi revealed that the implementation of a WHO-

based multimodal hand hygiene strategy improved healthcare worker compliance from 68.0% in 2022 to 85.5% in 2024, and indicated that structured institutional interventions can improve compliance even in resource-limited settings (Asif et al., 2026). In addition, a recent study found that better compliance with hand hygiene was associated with lower infection rates. In a long-term hand hygiene intervention, hospital infection rates decreased from 2.63% to 0.90% while hand hygiene compliance increased from approximately 49% to over 86%, according to Yue and Pan (2025). The researchers concluded higher compliance can lead to lower infection rates as they found a strong negative correlation between hand hygiene compliance and hospital infection rates. Despite these findings, infections acquired in health care facilities continue to occur. This suggests the need for continued research into hand hygiene compliance and infection outcomes. The present study was conducted to find out whether there was any significant association between hand hygiene compliance and incidence of hospital-acquired infections in hospitalized patients. The study is important because it provides quantitative evidence to support better infection-control policies, better nursing practice, and better patient-safety outcomes.

Research Objectives

- To evaluate the relationship between hand hygiene compliance and HAIs
- To provide recommendations to improve infection control practices

Hypothesis:

H0: There is no statistically significant relationship between hand hygiene compliance rates among healthcare workers and healthcare-associated infection rates among hospitalized patients.

H1: There is a statistically significant relationship between hand hygiene compliance rates among healthcare workers and healthcare-associated infection rates among hospitalized patients

Problem Statement

Hospital-acquired infections are a major problem in health care, adding to morbidity,

mortality, length of hospital stay, and health care costs. Hand hygiene is one of the most effective strategies for infection prevention; however, compliance rates among healthcare professionals are variable. This is especially true for nurses who have regular direct contact with patients and who are directly involved in clinical procedures.

In many health care settings, hand hygiene compliance is hampered by heavy workload, lack of training, inadequate availability of hand hygiene supplies, poor supervision and weak institutional monitoring systems. In many hospitals in Pakistan, infection-control practices are still evolving. Poor compliance with hand hygiene may be contributing to the persistence of hospital-acquired infections. Studies have shown that healthcare workers may be aware of the significance of hand hygiene, but the practical implementation of the recommended guidelines is inconsistent (Khan et al., 2023; Akhter et al., 2024).

Thus, the present study aimed to examine the association between the hand hygiene compliance rates of healthcare workers and the healthcare-associated infection rates of hospitalized patients. The findings may assist healthcare administrators, nursing leaders and infection-control committees in developing stronger evidence-based strategies to enhance compliance, minimize infection transmission and foster patient safety.

Literature Review

There is strong global evidence that good hand hygiene can significantly reduce hospital acquired infections. Hand hygiene prevents the transmission of microorganisms from the hands of the healthcare worker to the patient, medical devices and the healthcare environment. The World Health Organization (WHO) has identified hand hygiene as a key component of infection prevention and control and has stressed the importance of sustained compliance in healthcare settings (WHO, 2023). Compliance is still low or inconsistent in many healthcare institutions, despite the importance of compliance. Adherence of health workers to hand hygiene practices is a continuing challenge worldwide (Allegranzi and Pittet 2022). Barriers include lack of time, high workload, poor access to supplies, skin

irritation, forgetfulness, limited training and poor organisational support. These barriers highlight the individual behavior and institutional responsibility for hand hygiene. Similar concerns have been reported in recent studies in Pakistan. Implementation of WHO multimodal strategies increased hand hygiene compliance from 68.0% to 85.5% in a longitudinal study in Karachi (Asif et al., 2026). The finding implies that structured interventions like education, monitoring, reminders, feedback, and institutional support can significantly improve hand hygiene compliance. In the same vein, a cross-sectional study conducted in Lahore showed that nurses had moderate knowledge and poor compliance owing to workload and lack of resources (Akhter et al., 2024). Similar results were observed in Multan where low to moderate compliance with hand hygiene protocols was reported and a need for continuous training and monitoring was highlighted (Khan et al., 2023).

Moreover, recent studies have examined the relationship between hand hygiene compliance and infection outcomes. Yue and Pan (2025) found that higher hand hygiene compliance was associated with lower hospital infection rates. In their study, when compliance rose from about 49% to over 86%, hospital infection rates dropped from 2.63% to 0.90%. These results support the hypothesis that hand hygiene compliance is a key measurable parameter for infection prevention performance. Technology-based monitoring systems have been developed to improve measurement of hand hygiene. The traditional method of direct observation is subject to the Hawthorne effect, whereby the healthcare workers may alter their behavior if they know they are being observed (Lin et al., 2026). Electronic and AI-based monitoring systems may provide more objective and continuous compliance data. However, technology alone may not be enough without education, leadership support, workflow integration and feedback systems (Srigley et al., 2025; Lin et al., 2026). Quality of hand hygiene performance is also important. Compliance measures whether hand hygiene was performed; quality measures whether it was performed correctly. Ferreira et al. (2025) emphasized that proper hand hygiene needs the correct

technique, sufficient time, sufficient product volume, and complete coverage of the hand surfaces. Thus, healthcare workers may be regarded as compliant with hand hygiene even when performed improperly or inadequately. This distinction is important in studying the relationship between hand hygiene and HAIs. In all, the literature endorses the importance of hand hygiene as a major infection prevention strategy. However, implementation has remained a challenge especially in resource-constrained healthcare settings. The present study contributes to the literature by studying the statistical relationship between hand hygiene compliance and hospital-acquired infection scores for healthcare workers and hospitalized patients.

Theoretical Framework

The Health Belief Model was the basis of this study, which explains health behaviors based on the beliefs and perceptions of individuals. The Health Belief Model posits that people are more likely to engage in preventive health behaviors if they believe a health problem is serious, they or others are at risk, the preventive behavior is

beneficial, and barriers to performing the behavior can be overcome. Nurses who perceived hospital-acquired infections as serious and who believed that patients were vulnerable to infection were more likely to comply with hand hygiene practices in this study. Perceived benefits included the belief that hand hygiene prevents transmission of infection and protects patients and health care workers. Workload, lack of supplies, limited time, skin irritation, and inadequate institutional support were perceived as barriers. Reminders, posters, training, supervision and feedback were cues to action. Nurses' self-efficacy was defined as confidence in the correct and consistent performance of hand hygiene. The Health Belief Model was appropriate for this study because compliance with hand hygiene is influenced by knowledge, attitudes, perceived susceptibility, perceived benefits, perceived barriers, and institutional cues. This model helped explain why nurses do or do not practice hand hygiene as recommended in the clinical setting.

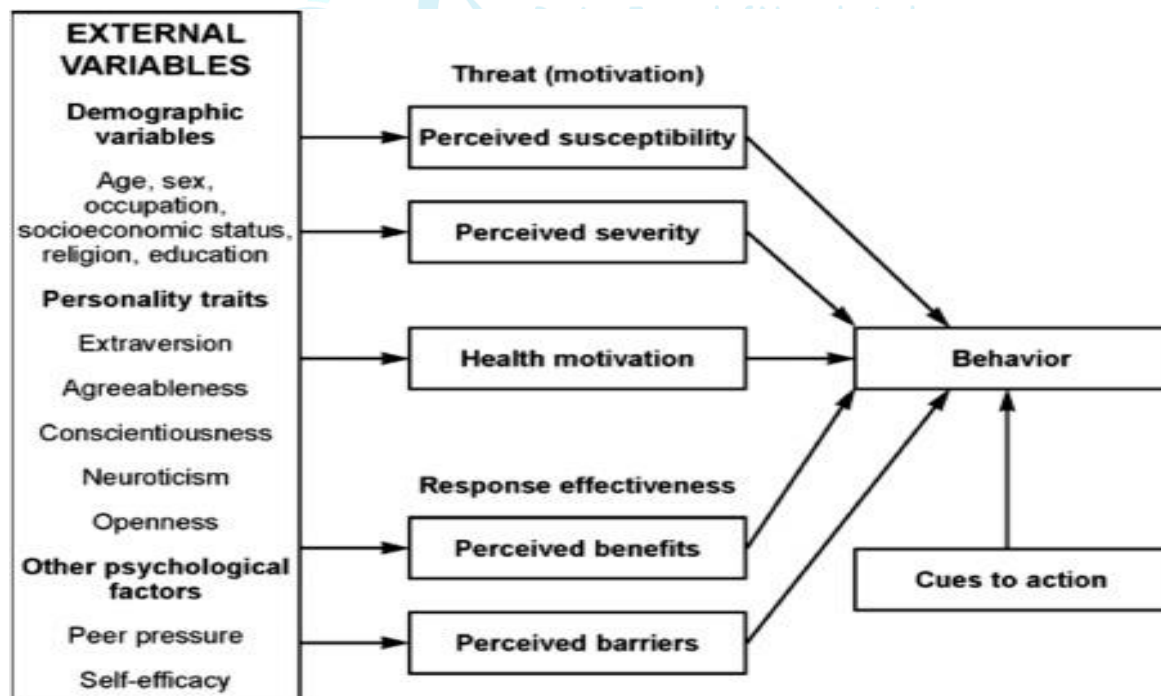


Fig 1: Health Belief Model

Research Methodology

Research Design:

A quantitative research approach was used to measure hand hygiene compliance and the relationship to hospital acquired infections. This approach was appropriate since the study variables were quantitatively measured and analyzed statistically. Hand hygiene compliance was assessed by observation checklist and structured questionnaire and infection related data were extracted from hospital infection records. The quantitative methodology allowed the researcher to establish if a statistically significant association existed between hand hygiene and infection scores. The study employed a descriptive correlational design and a randomized sampling. This design was appropriate because the study's purpose was to explore the association between hand hygiene compliance and hospital-acquired infections without manipulating the variables. The study described the participants and examined the relationship between the independent variable, compliance with hand hygiene, and the dependent variable, incidence of infection. The correlational design was appropriate because the study was to determine whether a relationship existed rather than to demonstrate direct causation.

Sampling Technique:

Nurses were randomly sampled from different hospital wards using a probability technique. This method also ensured that every eligible nurse had an equal opportunity of being selected and helped in reducing selection bias. Participants were recruited from clinical areas where nurses had direct patient contact and frequent opportunities for hand hygiene. The study only included nurses involved in direct patient care. Nurses not involved in direct clinical care or who refused to participate were not included. A total of 23 participants were enrolled in the study.

Research Instrument

Data was collected through an online platform developed by Google forms using a structured questionnaire. A Google Form was created according to the objectives of the study, and it was sent electronically to the selected participants. It was split into three main

sections.

The first section collected demographic information from the participants including age, gender, qualification, working area or ward and clinical experience. This section presented the characteristics of the study participants. The second part evaluated the level of hand hygiene compliance among healthcare workers. It included questions about hand hygiene before and after contact with patients, before aseptic procedures, after contact with body fluids, after contact with patient surroundings and after glove removal. Items were designed based on principles of hand hygiene consistent with recommendations for infection prevention in healthcare settings. The third section assessed factors associated with hospital acquired infection as well as knowledge and attitude of participants toward infection prevention. This section contained questions regarding knowledge of hospital-acquired infections, perceived association between hand hygiene and infection prevention, availability of hand hygiene resources, and barriers regarding workload and institutional infection-control practices. The questionnaire was a close-ended one so as to allow for easier quantitative analysis of responses. Participants filled the form online and the answers of the participants were automatically recorded in Google Forms. The data collected were then exported for statistical analysis. Cronbach's alpha was used to determine the reliability of the instrument, and it demonstrated excellent internal consistency with a value of .966.

Ethical Considerations

Prior to data collection, ethical approval was obtained from the relevant institutional authority. Participants were informed about the purpose of the study, the procedure, voluntary nature of the participation and the right to withdraw at any time, and informed consent was obtained. Confidentiality and anonymity were guaranteed throughout the study. No names or other personal identifiers of participants were used in the analysis or reporting of the results. Records of hospital infections were only used for research purposes and were handled according to institutional privacy requirements. The study did not

interfere with patient care or with routine nursing duties.

Data Analysis

The data were analyzed with IBM SPSS . Descriptive statistics (frequency, percentage, mean and standard deviation) were used to summarize demographic and study variables. Inferential statistics were used to analyze hand hygiene and infection score association. Pearson correlation analysis was used to assess

the strength and direction of the relationship between the two variables. P-value of less than 0.05 was considered statistically significant. First of all Cronbach alpha was run to test the internal consistency of the items.

Table 1: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.966	.988	

Reliability analysis revealed excellent internal consistency with a Cronbach's alpha value of .966. This showed that the study instrument was highly reliable in measuring the selected

variables. The Cronbach's alpha for the standardized items was .988, which further confirms the reliability of the instrument.

Table 2: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
age	23	2	4	2.52	.730	1.068	.481	-.168	.935
qualification	23	1	3	1.65	.832	.766	.481	-1.094	.935
Handhygiene	23	3.00	6.00	3.5217	.89796	1.992	.481	3.606	.935
infection	23	2.00	4.00	2.4348	.66237	1.288	.481	.625	.935
Valid N (listwise)	23								

Descriptive statistics indicated that data were collected from 23 participants. The mean age score was 2.52 (SD=.730), the mean qualification score was 1.65 (SD=.832). Average score for hand hygiene was 3.5217 with a standard deviation of .89796 indicating variation in responses of the participants related to hand hygiene. The mean infection

score was 2.4348 with a standard deviation of .66237. The values of skewness and kurtosis indicated that some of the variables were not perfectly normally distributed. Pearson correlation was used to measure the relationship between the study variables.

Table 3: Correlations

		Handhygiene	infection
Handhygiene	Pearson Correlation	1	.977
	Sig. (2-tailed)		.000
	N	23	23
infection	Pearson Correlation	.977	1

	Sig. (2-tailed)	.000	
	N	23	23

Pearson correlation analysis indicated a strong and significant correlation between hand hygiene and infection scores ($r = .977$, $p < .001$). The relation was statistically significant because p-value was < 0.05 . Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted. This finding indicates that in the study sample, hand hygiene and infection scores were highly correlated.

The interpretation of the relationship direction should be based on the scoring pattern of the hand hygiene variable. If poor hand hygiene practice or non-compliance was associated with higher hand hygiene scores then the positive correlation would suggest poor hand hygiene was associated with higher infection scores. This interpretation is consistent with previous literature that shows that poor hand hygiene increases the risk of hospital-acquired infections (WHO, 2023; Yue & Pan, 2025). However, if the higher scores represented better hand hygiene compliance, then the positive correlation would need to be carefully reviewed in the coding and scoring system before final interpretation.

Results

The study results indicated that the research instrument was highly reliable as evidenced by the Cronbach's alpha value of .966. This indicated good internal consistency of the study items. Descriptive statistics revealed that the study comprised 23 participants. The mean hand hygiene score was 3.5217 and the mean infection score was 2.4348. These results showed measurable variation in participants' hand hygiene and infection-related responses. There was a strong and statistically significant relation between hand hygiene and infection scores according to Pearson correlation analysis, $r = .977$, $p < .001$. This finding suggested a strong link between hand hygiene and infection. The correlation is significant at the 0.01 level, so we reject the null hypothesis and accept the alternative hypothesis. In conclusion, the study showed a statistically significant correlation between the rates of hand hygiene compliance among healthcare workers and the rates of healthcare-associated

infections in hospitalized patients. The study confirmed the importance of hand hygiene in preventing infection. Poor performance or low compliance with hand hygiene may increase the risk for transmission of infection. Thus, it is important to enhance hand hygiene practices in nurses to reduce hospital-acquired infections and improve patient safety outcomes.

Discussion

The present study results showed a strong statistically significant relationship between hand hygiene and hospital-acquired infection scores, $r = .977$, $p < .001$. The finding showed that hand hygiene practices were significantly associated with infection outcomes among the study participants. Thus the null hypothesis was rejected and the alternative hypothesis accepted. This result is in line with previous studies showing that hand hygiene is a major infection prevention measure and poor compliance may increase the risk of healthcare-associated infections. The results of this study support the World Health Organization's stance that many healthcare associated infections can be prevented by correct hand hygiene practices. According to the World Health Organization (WHO, 2023), hand hygiene is essential to the provision of safe health care and remains one of the most important strategies for improving quality of care and patient safety. The Centers for Disease Control and Prevention (CDC) also reports that adequate hand hygiene reduces the transmission of dangerous microorganisms to patients, including organisms resistant to antibiotics (Centers for Disease Control and Prevention (CDC, 2024). Therefore, the strong association found in the present study is in line with the established infection-prevention guidelines from major international health organizations.

The results are also in line with the findings of Yue and Pan (2025), who demonstrated that enhanced hand hygiene compliance was associated with a decrease in healthcare-associated infections. Their long-term intervention study demonstrated that hospital infection rates declined with increasing hand

hygiene compliance, suggesting that regular monitoring, education, corrective actions, and improved access to hand hygiene supplies can help to reduce the risk of infection. The current study also found a statistically significant association between hand hygiene and infection scores, which supports the idea that hand hygiene behavior is closely related to infection-control outcomes. The findings are also consistent with the study carried out by Asif et al. (2026) in Karachi, Pakistan. They conducted a quasi-experimental study and found that a WHO-based multimodal hand hygiene strategy increased healthcare worker compliance by 17.5% over 3 years in a resource-limited healthcare setting. This is highly relevant to the current study as both studies focused on hand hygiene in the Pakistani health care setting. This alignment implies that hand hygiene compliance is not only a global patient-safety priority but also a practical and measurable infection-control concern in the Pakistani hospital setting. Well known importance of hand hygiene is not enough to ensure optimal compliance of hand hygiene among healthcare workers as evidenced in the current findings. Afework and Tamene (2025) identified barriers such as workload, limited access to supplies, lack of motivation, poor supervision, and weak institutional support that can reduce compliance among healthcare workers. These barriers may explain why hospital acquired infections still happen even with healthcare workers knowing the importance of hand hygiene. This concern is supported by the present study in which a strong association between hand hygiene and infection scores was observed indicating that hand hygiene behavior is still an important factor in infection-prevention outcomes.

The strong correlation observed in this study also reinforces the need for multimodal interventions rather than knowledge or education alone. WHO and other infection-control authorities recommend system-level strategies such as training, monitoring, feedback, reminders, leadership support and availability of hand hygiene resources (WHO, 2023). Asif et al. (2026) further demonstrated the utility of structured multimodal approaches to improve compliance in hospitals in Pakistan. The present study thus supports the argument

for hospitals to implement comprehensive programs to improve hand hygiene rather than relying on individual responsibility. The findings are also significant for nursing practice. Nurses are often involved in direct patient care, medication administration, wound care, invasive procedures and contact with the patient's environment. Due to this frequent contact, nurses' hand hygiene practices may directly influence pathogen transmission in the hospital environment. The significant relationship found in this study supports the need to make hand hygiene compliance a routine indicator of both nursing performance and patient safety. Regular training, observation, feedback and availability of alcohol based hand rubs at point of care may help improve compliance and reduce transmission of infection. However, the interpretation of the direction of the correlation is dependent on the scoring method used for the hand hygiene variable. The positive correlation found in the present study indicates that as hand hygiene scores increase, so do infection scores. If higher hand hygiene scores reflected poor hand hygiene practice or non-compliance, then the finding clearly supports previous evidence that poor hand hygiene is associated with higher risk of infection. If higher scores on hand hygiene represent better compliance, then the direction of the coding of the variable should be reviewed, as it would not match the expected relationship found in most previous studies. Therefore, a clear explanation of the scoring system must be given when presenting the final results. The results of this study are in line with previous literature and international guidelines. The study confirmed that there is a significant association between hand hygiene and hospital acquired infection. This supports the conclusion that improvement of hand-hygiene compliance could be an important factor in reducing transmission of infection, improving patient safety and strengthening infection-control practice in the hospital setting.

Conclusion

The study found that hand hygiene was significantly associated with hospital-acquired infections among patients admitted to the hospital. Reliability analysis showed that the study instrument had good internal

consistency. The correlation analysis revealed a strong statistically significant association between hand hygiene and infection scores. Therefore, the null hypothesis was rejected and the alternative hypothesis accepted. The findings added to the existing evidence that hand hygiene is a key element of infection prevention and patient safety. Nurses have considerable contact with patients and the hospital environment and therefore are important in the prevention of spread of infection. Poor or inconsistent hand hygiene practices may increase the risk of hospital-acquired infections, whereas improved compliance can contribute to safer healthcare delivery. The study stressed the need for structured training in hand hygiene, adequate supplies, continuous monitoring, feedback systems, workload management and strict enforcement of infection-control policies. Hand hygiene compliance should be a key quality indicator and patient-safety priority for hospitals

Recommendations

- Hospitals should organize regular mandatory hand hygiene training sessions for nursing staff.
- Healthcare facilities should ensure continuous availability of alcohol-based hand rubs, soap, clean water, disposable towels, and handwashing stations at all patient-care points.
- Hand hygiene supplies should be easily accessible in wards, emergency areas, intensive-care units, and procedure rooms.
- Regular monitoring of hand hygiene practices should be implemented using observation checklists.
- Hospital administration should maintain appropriate nurse-to-patient ratios to reduce workload burden.

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