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Association of Knowledge and Attitudes With Hand Hygiene Compliance As an Effort to Prevent Healthcare-Associated Infections Among Nurses in The Gardenia Ward of Dr. Hafiz Hospital in 2026

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Abstract

Healthcare-associated infections remain a major patient safety concern, and consistent hand hygiene is essential for preventing microbial transmission during nursing care. This study examined the associations between nurses' knowledge, attitudes, and hand hygiene compliance in the Gardenia Ward of Dr. Hafiz Hospital, Cianjur, in 2026. A quantitative analytical study employed a cross-sectional design involving 35 nurses selected through total sampling. Knowledge and attitudes were assessed using questionnaires, while compliance was evaluated through an observational checklist based on the WHO Five Moments for Hand Hygiene. Data were analyzed descriptively and using chi-square tests. Twenty-six nurses (74.3%) were compliant with hand hygiene recommendations. Sixteen nurses (45.8%) demonstrated good knowledge, 13 (37.1%) fair knowledge, and six (17.1%) poor knowledge. Positive attitudes were identified in 23 nurses (65.7%). Knowledge was significantly associated with compliance (p = 0.034), as were attitudes (p = 0.018). Compliance reached 87.5% among nurses with good knowledge and 87.0% among those with positive attitudes. Knowledge and attitudes were associated with hand hygiene compliance, supporting targeted education, behavioral reinforcement, and routine supervision. Cross-sectional findings cannot establish causal relationships.

Keywords: *Attitudes, Hand Hygiene, Healthcare-Associated Infections, Knowledge, Nursing Compliance.*

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INTRODUCTION

Healthcare-associated infections (HAIs) remain a persistent challenge to patient safety, healthcare quality, and occupational health, particularly in hospital environments where frequent interactions between healthcare personnel, patients, medical devices, and contaminated surfaces create multiple opportunities for microbial transmission. The prevention of these infections increasingly requires healthcare institutions to move beyond the formal availability of infection prevention and control protocols toward measurable improvements in professional adherence to evidence-based preventive practices. Hand hygiene represents a fundamental component of this approach because its effectiveness depends not only on the availability of appropriate facilities but also on healthcare workers' knowledge, behavioral commitment, and consistent performance during clinical activities. Contemporary evidence indicates that infection prevention outcomes are influenced by interconnected individual, organizational, and environmental conditions, making compliance a multidimensional concern rather than a purely technical procedure (Peters et al., 2022; Issa et al., 2023). International evaluations of healthcare facilities have demonstrated the continuing relevance of institutional performance indicators, sustained quality improvement, and organizational accountability in maintaining hand hygiene standards across different clinical environments (Tartari et al., 2024; Bajunaid et al., 2024). Research examining compliance across clinical, surgical, and intensive care settings further illustrates the importance of considering variations in healthcare delivery processes when evaluating adherence to infection prevention requirements (Ceparano et al., 2025). Evidence from systematic reviews also suggests that knowledge, attitudes, and preventive practices remain significant dimensions of infection control performance among healthcare professionals, particularly in settings where occupational exposure and limited operational resources may compromise consistent

implementation (Wubneh et al., 2024; Basu et al., 2026). These developments are particularly relevant to nursing practice because nurses maintain continuous patient contact and undertake procedures involving repeated opportunities for pathogen transmission. The persistent challenge is not simply whether healthcare personnel understand hand hygiene recommendations, but whether their professional knowledge and attitudes correspond with appropriate preventive behavior during routine clinical care.

Recent scientific literature has advanced the understanding of hand hygiene compliance through several complementary lines of investigation involving cognitive determinants, behavioral mechanisms, organizational interventions, and observational assessment. Studies examining nurses' knowledge and perceptions indicate that familiarity with hand hygiene guidelines constitutes an important foundation for safe practice, although knowledge assessment alone cannot establish whether recommended procedures are consistently performed (Blomgren et al., 2024; Nwosu et al., 2024). Investigations incorporating knowledge, attitudes, and professional perceptions have broadened this understanding by recognizing that compliance may be affected by perceived barriers, subjective evaluations of preventive measures, and the practical demands of healthcare environments (Constantinou et al., 2024; Hu et al., 2025). Behavioral research informed by the theory of planned behavior provides a complementary conceptual perspective by examining how attitudes and related psychological determinants may contribute to the formation of preventive behavioral intentions (Bülbül Maraş & Kocaçal, 2024). Evidence concerning critical care nurses has similarly emphasized the relevance of individual competencies, professional attitudes, and operational barriers when assessing adherence to infection prevention procedures (Alqalah, 2024; Batran et al., 2025). A second research trajectory has concentrated on interventions intended to improve compliance, including structured education, organizational feedback, and context-sensitive behavioral strategies. Educational intervention research has examined the potential for targeted training to strengthen knowledge and preventive practice, while investigations of organizational determinants have highlighted the complexity of converting professional awareness into sustained clinical behavior (Chakma et al., 2024; Gholizad Gougjehyaran et al., 2025). Qualitative evidence from intensive care environments further demonstrates the analytical value of exploring determinants beyond individual knowledge, particularly when clinical workload, organizational expectations, and perceived implementation barriers intersect (Alshagrawi & Alhodaithy, 2024). Collectively, these research streams establish that hand hygiene compliance should be examined as an interaction between cognitive understanding, behavioral disposition, and the operational circumstances under which nursing care is delivered.

Despite these advances, the existing literature reveals several limitations concerning the relationship between healthcare workers' knowledge, attitudes, and objectively assessed hand hygiene compliance. Studies emphasizing knowledge assessment provide valuable information about professional competencies but do not necessarily demonstrate corresponding behavioral performance, particularly when questionnaire-based evaluations are not accompanied by direct observations of clinical practice (Blomgren et al., 2024; Nwosu et al., 2024). The distinction between perceived compliance and actual practice has received increasing attention because self-reported adherence may not adequately represent preventive behavior under routine working conditions (Baraiya et al., 2026). Research examining the combined application of hand hygiene and non-sterile gloves also illustrates the importance of evaluating compliance in relation to specific clinical procedures rather than treating adherence as a uniform behavior across healthcare activities (Dekker et al., 2024). Methodological developments have introduced alternative approaches to compliance measurement, including electronic monitoring, individualized performance feedback, and automated assessment systems, yet these approaches address different dimensions of behavioral monitoring and may not be equally applicable across healthcare institutions (Cheng et al., 2024; From-Hansen et al., 2024; Lau et al., 2026). Research focusing on performance indicators has further demonstrated that institutional monitoring frameworks require careful consideration of what constitutes meaningful compliance measurement and how observable behaviors are interpreted (Liu et al., 2025). These differences suggest a methodological and contextual gap concerning the extent to which nurses' knowledge and attitudes are associated with directly observed hand hygiene compliance in specific inpatient environments where established infection prevention programs are already operating. Existing evidence does not justify assuming that relationships observed in intensive care units, teaching hospitals, nursing homes, or healthcare institutions in other countries necessarily apply with

equivalent strength to a general inpatient ward in an Indonesian hospital. The unresolved issue is consequently not whether knowledge and attitudes have previously been investigated, but whether their associations with observed compliance can be established within a defined local nursing population using consistent operational measurements.

Addressing this gap has scientific and practical implications because hospitals require evidence capable of distinguishing deficiencies in professional understanding from unfavorable behavioral dispositions when designing infection prevention strategies. Educational interventions may improve procedural knowledge, but their effectiveness in routine practice must be considered alongside organizational reinforcement, monitoring arrangements, and the conditions influencing healthcare workers' willingness to follow established recommendations (Haenen et al., 2024; Sands et al., 2025). Research involving personalized feedback and dispenser-based monitoring suggests that compliance improvement can also involve mechanisms extending beyond conventional education, although the applicability of particular interventions depends on institutional resources and implementation requirements (From-Hansen et al., 2024; Iversen et al., 2024). Patient involvement in compliance observation offers another approach to strengthening accountability, while research examining professional adherence to hand hygiene and personal protective equipment policies highlights the relevance of behavioral and organizational influences on preventive practices (Siju et al., 2023; Kaye & Marais, 2025). The significance of examining these relationships becomes particularly evident at Dr. Hafiz Hospital, Cianjur, where internal infection prevention and control surveillance documented hand hygiene compliance levels of 85%, 85%, and 90% between January and March 2026, respectively, against an institutional standard of at least 85%. Preliminary observations conducted in April 2026 identified 41 compliant actions across 50 observed hand hygiene opportunities, corresponding to 82% compliance, while several nurses demonstrated incomplete understanding of the WHO Five Moments for Hand Hygiene and the recommended procedural steps. Although these preliminary observations were limited in scope and are not directly equivalent to the hospital's routine surveillance indicators, they identify a specific institutional concern regarding the consistency of preventive behavior and the adequacy of professional knowledge. Evidence examining differences across hand hygiene moments and contact precautions further supports the need to interpret compliance in relation to the specific clinical circumstances in which preventive actions are required (Valim et al., 2024). Failure to investigate these relationships could lead to infection prevention initiatives that emphasize generalized training or surveillance without adequately identifying the individual factors associated with noncompliance among nurses responsible for continuous inpatient care.

The present study is positioned within contemporary nursing and infection prevention research as a ward-specific empirical investigation of the relationships between two individual behavioral determinants, namely knowledge and attitudes, and observed hand hygiene compliance. Its intended contribution differs from intervention-oriented research that evaluates educational programs, automated monitoring systems, or institutional feedback mechanisms because the primary analytical concern is the association between existing professional characteristics and compliance within a defined nursing population (Gholizad Gougjehyaran et al., 2025; Cheng et al., 2024). The study also differs from research conducted across broader professional groups or multiple healthcare departments by concentrating on nurses working within a single inpatient ward, thereby providing evidence directly relevant to a specific clinical service rather than an aggregated institutional population (Ceparano et al., 2025; Wubneh et al., 2024). Although multidimensional investigations have examined relationships between hand hygiene compliance and healthcare-associated infection incidence, a distinction must be maintained between assessing compliance determinants and establishing the effects of compliance on infection outcomes (Csörnyei-Kelemen et al., 2026). The present investigation adopts the former orientation because its measured outcome is hand hygiene compliance rather than the incidence of HAIs. Its methodological positioning involves a quantitative cross-sectional design, total sampling of 35 nurses, questionnaire-based assessment of knowledge and attitudes, and observational evaluation of compliance using the WHO Five Moments for Hand Hygiene. This combination provides an opportunity to examine associations between cognitive and attitudinal characteristics and documented preventive behavior within the same institutional population. The proposed novelty is consequently contextual and empirical rather than the development of a new behavioral theory or a novel measurement instrument: the study provides a

localized assessment of two established determinants using direct compliance observations in the Gardenia Ward of Dr. Hafiz Hospital during 2026. Its contribution lies in generating institution-specific evidence that can inform the interpretation of hand hygiene performance and the selection of targeted nursing quality improvement priorities, while recognizing that cross-sectional associations cannot establish causal relationships.

This study aims to examine the associations between nurses' knowledge and attitudes and hand hygiene compliance as part of healthcare-associated infection prevention efforts in the Gardenia Ward of Dr. Hafiz Hospital, Cianjur, in 2026. Specifically, the investigation seeks to characterize the distribution of nurses' knowledge regarding hand hygiene, identify their attitudes toward recommended preventive procedures, determine the distribution of observed hand hygiene compliance, and assess whether knowledge levels and attitudes are statistically associated with compliance among the 35 nurses included through total sampling. The research applies a quantitative analytical cross-sectional design in which knowledge and attitudes are measured using structured questionnaires, while compliance is evaluated through an observation checklist based on the WHO Five Moments for Hand Hygiene. Statistical analysis is directed toward identifying associations between the independent variables and the observed compliance outcome rather than establishing causal effects or measuring changes in healthcare-associated infection incidence. The scientific contribution of the study is expected to strengthen context-specific empirical understanding of the relationship between professional knowledge, behavioral disposition, and preventive nursing practice in a general inpatient environment. Its methodological contribution lies in the combined assessment of questionnaire-based individual characteristics and observational compliance within a clearly defined clinical population, allowing the relationships between these variables to be examined using consistent operational criteria. From a practical standpoint, the findings are intended to provide an empirical basis for evaluating the relevance of continuing professional education, behavioral reinforcement, and compliance supervision within the hospital's existing infection prevention and control activities. The investigation ultimately seeks to support evidence-informed nursing management by identifying whether differences in knowledge and attitudes correspond with differences in hand hygiene compliance, thereby contributing to more appropriately targeted institutional strategies for maintaining patient safety and infection prevention standards.

RESEARCH METHODS

This study employed a quantitative analytical approach with a cross-sectional design to examine the associations between nurses' knowledge and attitudes and their compliance with hand hygiene practices for preventing healthcare-associated infections (HAIs). The research was conducted in the Gardenia Ward of Dr. Hafiz Hospital, Cianjur, Indonesia, in 2026. The study population comprised all 35 nurses working in the ward, and total sampling was applied because the entire accessible population was included as research respondents. The independent variables were nurses' knowledge of hand hygiene and their attitudes toward its implementation, while the dependent variable was compliance with recommended hand hygiene practices. Knowledge was assessed using a questionnaire addressing understanding of hand hygiene principles and recommended preventive procedures, whereas attitudes were measured through a questionnaire evaluating respondents' orientations toward hand hygiene implementation. Hand hygiene compliance was assessed using an observational checklist based on the World Health Organization's Five Moments for Hand Hygiene, which addresses hand hygiene before touching a patient, before a clean or aseptic procedure, after body fluid exposure risk, after touching a patient, and after touching patient surroundings. The available methodological documentation identified questionnaires and direct observation as the principal data collection instruments but did not specify their item composition, scoring thresholds, psychometric characteristics, or observation frequency. The study consequently distinguished self-reported cognitive and attitudinal characteristics from compliance assessed through observed nursing practices, without assuming that questionnaire responses were equivalent to actual preventive behavior.

Data processing and statistical analysis were conducted using SPSS, as identified in the original research documentation. Descriptive analysis was performed to summarize the distributions of knowledge, attitudes, and hand hygiene compliance using frequencies and percentages. Knowledge was classified into poor, fair, and good categories, attitudes were classified as negative or positive,

and hand hygiene compliance was categorized as compliant or non-compliant according to the classifications reported in the original research. The available documentation did not specify the numerical cut-off values used to establish these classifications; consequently, no additional classification criteria were introduced. Bivariate analysis was conducted using the chi-square (χ^2) test to examine the association between knowledge categories and hand hygiene compliance and the association between attitude categories and hand hygiene compliance. The analytical procedure involved constructing contingency tables for each independent variable against the compliance outcome and evaluating statistical significance at a threshold of $\alpha = 0.05$, corresponding to a 95% confidence level. The original methodological plan identified Fisher's exact test as an alternative when more than 20% of contingency-table cells had expected frequencies below five; however, the available documentation did not establish whether this alternative test was ultimately applied. Statistical interpretation was restricted to associations between categorical variables because the cross-sectional design did not establish temporal relationships or permit causal inference. The methodological documentation did not provide instrument validity or reliability coefficients, detailed observation standardization procedures, or institutional ethical approval information; these elements were therefore not presented as completed or verified procedures. The resulting analytical framework was limited to the documented population, measurement instruments, variable classifications, descriptive statistics, and bivariate association tests, ensuring consistency between the study objectives, available data, and reported findings.

RESULTS AND DISCUSSION

Hand Hygiene Compliance Among Nurses in the Gardenia Ward

Hand hygiene compliance represents a measurable indicator of nursing adherence to infection prevention and control procedures, particularly in inpatient environments characterized by frequent interactions between healthcare personnel and patients. Descriptive analysis involving 35 nurses in the Gardenia Ward of Dr. Hafiz Hospital identified differences in adherence to recommended hand hygiene practices, indicating that preventive behavior was not uniformly implemented across the study population. The assessment employed an observational checklist based on the WHO Five Moments for Hand Hygiene, allowing compliance to be evaluated through documented clinical behavior rather than relying exclusively on respondents' perceptions. Previous research has emphasized that direct assessment of hand hygiene practices provides essential information for evaluating infection prevention performance and identifying opportunities for improvement in healthcare settings (Valim et al., 2024; Issa et al., 2023).

The observed distribution indicated that 26 nurses (74.3%) were classified as compliant, whereas nine nurses (25.7%) were classified as non-compliant with hand hygiene recommendations. The predominance of compliant respondents suggests that recommended preventive procedures had been incorporated into the practices of a substantial proportion of the nursing workforce, although the proportion of non-compliant respondents identifies a continuing implementation concern. Compliance should not be interpreted exclusively through the majority classification because even a relatively small proportion of non-compliant healthcare personnel may represent preventable opportunities for microbial transmission during patient care. Evidence from international investigations similarly indicates that hand hygiene compliance requires continuous monitoring because adherence may vary according to clinical conditions, institutional practices, and the characteristics of healthcare workers (Bajunaid et al., 2024; Ceparano et al., 2025).

The descriptive findings are presented in Table 1, which summarizes the number and percentage of nurses in each compliance category. The distribution reflects respondent-level classifications within the study population rather than the total number of individual hand hygiene opportunities encountered during clinical activities. This distinction is methodologically important because the proportion of nurses classified as compliant cannot automatically be interpreted as the proportion of correctly performed hand hygiene actions across every clinical encounter. Research investigating compliance measurement has demonstrated that differences in observational procedures, monitoring indicators, and assessment technologies require careful consideration when interpreting institutional hand hygiene performance (Cheng et al., 2024; Liu et al., 2025).

Table 1. Distribution of Hand Hygiene Compliance Among Nurses in the Gardenia Ward

Hand Hygiene Compliance	Frequency (n)	Percentage (%)
Non-compliant	9	25.7
Compliant	26	74.3
Total	35	100.0

Source: Original research data, SPSS processing (2026).

The data presented in Table 1 indicate a predominance of compliant nursing personnel, with approximately three-quarters of respondents meeting the compliance classification established in the original study. Nevertheless, the remaining nine nurses represent a relevant target for institutional evaluation because non-compliance may occur despite the availability of infection prevention guidelines and organizational monitoring mechanisms. The descriptive findings do not identify which specific hand hygiene moments were most frequently neglected, since moment-specific compliance frequencies were not reported in the available dataset. Research examining hand hygiene performance across different clinical moments indicates that adherence may vary according to the nature of patient contact and infection prevention requirements, supporting the importance of more detailed observational surveillance when such data are available (Dekker et al., 2024; Valim et al., 2024).

The observed compliance distribution can be considered alongside the hospital's preliminary infection prevention surveillance, which documented hand hygiene compliance rates of 85% in January, 85% in February, and 90% in March 2026. These institutional indicators exceeded the hospital's established minimum standard of 85%, whereas the present respondent-level assessment classified 74.3% of nurses as compliant. The difference should not be interpreted as definitive evidence of declining institutional performance because the surveillance indicators and research classifications may have employed different observational units, assessment procedures, or compliance denominators. Previous investigations have emphasized the importance of standardized indicators and consistent measurement procedures when evaluating hand hygiene compliance across observation periods and healthcare settings (Tartari et al., 2024; Cheng et al., 2024).

An additional consideration concerns the relationship between individual compliance classifications and the organizational conditions supporting infection prevention practices. The original research documentation identified the availability of hand hygiene facilities, educational posters, periodic training, and institutional monitoring activities within the Gardenia Ward, suggesting that nurses operated in an environment where preventive procedures were formally promoted. These institutional arrangements provide relevant background for interpreting observed behavior, although the study did not measure their independent contributions to compliance or evaluate the effectiveness of individual interventions. Investigations of long-term care facilities and acute healthcare settings have demonstrated that organizational reinforcement, professional expectations, and implementation conditions warrant consideration when interpreting adherence to established infection prevention policies (Haenen et al., 2024; Kaye & Marais, 2025).

Compliance monitoring also requires attention to the distinction between reported professional commitment and actual preventive actions during nursing activities. Healthcare personnel may recognize hand hygiene as a professional responsibility while encountering practical difficulties in maintaining adherence during repetitive clinical procedures, particularly when compliance is influenced by competing operational demands. The present findings establish the distribution of observed compliance classifications but do not determine the reasons underlying non-compliance among the nine respondents, preventing attribution to workload, inadequate facilities, or limited motivation without additional evidence. Research examining perceived versus observed compliance and qualitative determinants of hand hygiene behavior illustrates the value of distinguishing behavioral performance from self-reported adherence and perceived implementation barriers (Baraiya et al., 2026; Alshagrawi & Alhodaithy, 2024).

The findings also have implications for evaluating hand hygiene compliance as an intermediate indicator of healthcare-associated infection prevention rather than a direct measure of infection outcomes. Appropriate hand hygiene practices constitute an essential component of infection prevention systems, yet the present study did not collect patient infection incidence data or establish a statistical relationship between nursing compliance and HAI occurrence. The descriptive results

consequently support conclusions regarding the implementation of preventive nursing behavior without demonstrating reductions in infection incidence attributable to the observed compliance level. Previous investigations addressing environmental hygiene, infection prevention interventions, and relationships between compliance and healthcare-associated infection indicators reinforce the importance of distinguishing preventive process measures from clinical outcome measures (Peters et al., 2022; Csörnyei-Kelemen et al., 2026).

The identification of 26 compliant nurses and nine non-compliant nurses provides an empirical basis for evaluating preventive nursing practices within the Gardenia Ward while preserving the limitations of a descriptive, single-ward assessment. The distribution suggests that hand hygiene adherence was established among most respondents but had not achieved uniform implementation, supporting the continued relevance of institutional education, performance assessment, and supervisory attention. Evidence concerning educational interventions, personalized feedback, and behavioral improvement strategies indicates that strengthening compliance may require complementary approaches rather than reliance on a single institutional measure (Chakma et al., 2024; From-Hansen et al., 2024; Sands et al., 2025). Further interpretation of the present distribution requires examination of nurses' knowledge and attitudes, particularly whether differences in these individual characteristics correspond with the observed compliance classifications, as addressed through the study's subsequent bivariate analyses.

Nurses' Knowledge of Hand Hygiene and Its Association with Compliance

Knowledge of hand hygiene constitutes a fundamental cognitive component of infection prevention practices because nurses must recognize potential pathways of microbial transmission and identify appropriate preventive actions during clinical procedures. The descriptive findings from the Gardenia Ward of Dr. Hafiz Hospital indicated considerable variation in nurses' understanding of hand hygiene, suggesting that professional knowledge was not uniformly distributed among the 35 respondents. Differences in knowledge may influence the ability to recognize hand hygiene indications, interpret procedural requirements, and distinguish preventive actions according to specific patient care situations. Previous investigations have demonstrated that assessing nurses' knowledge provides important information about professional preparedness, although cognitive competence should be distinguished from actual adherence to recommended infection prevention procedures (Blomgren et al., 2024; Nwosu et al., 2024).

The univariate analysis identified 16 nurses (45.8%) with good knowledge, 13 nurses (37.1%) with fair knowledge, and six nurses (17.1%) with poor knowledge of hand hygiene. Although good knowledge represented the largest individual category, the combined proportion of respondents with fair and poor knowledge was 54.2%, indicating that more than half of the nursing population had not achieved the highest knowledge classification. This distribution suggests a potential need for differentiated educational strategies rather than assuming that all nurses possess equivalent familiarity with hand hygiene principles and recommended procedures. Research examining healthcare workers' knowledge and perceptions has similarly emphasized the relevance of identifying specific cognitive limitations when developing infection prevention education and evaluating professional readiness (Constantinou et al., 2024; Wubneh et al., 2024).

The distribution of knowledge categories is summarized in Table 2, which presents the frequency and percentage of respondents according to the classifications established in the original research. These categories provide an empirical description of the nursing population and establish the independent variable used in the subsequent analysis of hand hygiene compliance. The available documentation does not report the questionnaire's numerical scoring thresholds, item-level responses, or psychometric coefficients, limiting interpretation to the knowledge categories provided by the original study. Investigations employing structured hand hygiene knowledge questionnaires illustrate the importance of standardized measurement and transparent classification procedures when comparing professional knowledge across healthcare settings (Blomgren et al., 2024; Hu et al., 2025).

Table 2. Distribution of Nurses' Knowledge of Hand Hygiene in the Gardenia Ward

Knowledge Level	Frequency (n)	Percentage (%)
Poor	6	17.1
Fair	13	37.1
Good	16	45.8
Total	35	100.0

Source: Original research data, SPSS processing (2026).

Table 2 demonstrates that the distribution of knowledge was concentrated in the fair and good categories, while a smaller proportion of respondents exhibited poor understanding of hand hygiene. The presence of six nurses with poor knowledge remains relevant because inadequate procedural understanding may reduce the ability to recognize appropriate opportunities for preventive action during routine patient care. Nevertheless, the descriptive distribution alone cannot establish that nurses with limited knowledge were less compliant, since such a conclusion requires examination of the relationship between knowledge classifications and observed behavior. Evidence from educational intervention research indicates that strengthening hand hygiene knowledge is a relevant component of infection prevention initiatives, although improvements in knowledge and improvements in clinical compliance should be evaluated as distinct outcomes (Chakma et al., 2024; Gholizad Gougjehyaran et al., 2025).

The relationship between knowledge and compliance was examined through the cross-tabulation of the three knowledge categories against the two compliance classifications. Among six nurses with poor knowledge, four were non-compliant and two were compliant, corresponding to compliance within that knowledge category of 33.3%. Among 13 nurses with fair knowledge, 10 were compliant and three were non-compliant, producing a within-category compliance proportion of 76.9%, whereas 14 of the 16 nurses with good knowledge were compliant, corresponding to 87.5%. These distributions indicate progressively higher observed compliance across the ordered knowledge categories, a pattern consistent with the relevance of cognitive preparation to preventive nursing practices discussed in contemporary knowledge–attitude–practice research (Hu et al., 2025; Basu et al., 2026).

The statistical analysis reported a chi-square significance value of $p = 0.034$, indicating an association between knowledge classification and hand hygiene compliance at the prespecified significance threshold of 0.05. The observed gradient supports the interpretation that nurses with higher knowledge classifications tended to exhibit more favorable compliance outcomes within the study population. This association does not demonstrate that increasing knowledge would independently produce higher compliance because the cross-sectional design did not establish temporal ordering or control for potential organizational and individual confounding factors. Research examining determinants of infection prevention adherence has recognized that professional knowledge interacts with behavioral and operational circumstances, requiring caution when attributing compliance differences exclusively to cognitive characteristics (Alqalah, 2024; Batran et al., 2025).

The findings also indicate that knowledge and compliance were not perfectly aligned, as two nurses classified as having good knowledge were non-compliant, while two nurses with poor knowledge were classified as compliant. These observations suggest that possession of procedural information is not a sufficient condition for consistent preventive behavior and that some nurses may perform appropriate actions despite having comparatively limited questionnaire-assessed knowledge. Behavioral research informed by the theory of planned behavior provides a relevant explanation for why cognitive understanding may not translate directly into clinical action, particularly when attitudes and other behavioral determinants influence professional decision-making (Bülbül Maraş & Kocaçal, 2024). Qualitative investigations of hand hygiene compliance further support the need to consider perceived barriers and clinical working conditions when interpreting discrepancies between professional understanding and observable practice (Alshagrawi & Alhodaithy, 2024).

The statistical interpretation requires additional attention to the small sample size and unequal distribution of respondents across knowledge categories. The observed contingency table included only six nurses in the poor-knowledge category, and the expected frequencies calculated from the

reported marginal totals indicate that some cells would fall below the conventional minimum expected count of five for an asymptotic chi-square analysis. Although the original methods identified Fisher's exact test as an alternative under conditions of sparse expected frequencies, the available documentation does not establish whether an exact test was applied or whether the reported significance value was generated exclusively through the Pearson chi-square procedure. Methodological caution is consequently warranted when interpreting the reported p-value, particularly because research on professional hand hygiene behavior frequently involves categorical outcomes whose statistical precision depends on sample distribution and analytical specification (Nwosu et al., 2024; Ceparano et al., 2025).

The association between knowledge and compliance provides a relevant empirical basis for considering the role of structured professional education within the hospital's infection prevention and control activities. The concentration of fair and poor knowledge among 19 nurses suggests that educational reinforcement could reasonably prioritize procedural understanding, recognition of the WHO Five Moments for Hand Hygiene, and application of preventive principles during routine nursing care. Such implications should be interpreted as recommendations derived from the observed distribution and association rather than evidence that any particular educational intervention was experimentally effective in the Gardenia Ward. Previous intervention studies have examined structured training and reinforcement strategies as potential approaches for strengthening hand hygiene performance, while research on clinical monitoring emphasizes the importance of evaluating whether improved knowledge is accompanied by observable changes in practice (Chakma et al., 2024; Haenen et al., 2024; From-Hansen et al., 2024).

Nurses' Attitudes and Their Association with Hand Hygiene Compliance

Nurses' attitudes toward hand hygiene represent an important behavioral dimension of infection prevention because professional adherence involves not only understanding recommended procedures but also maintaining a favorable disposition toward their implementation during clinical activities. Attitudes may influence how nurses evaluate the necessity of preventive actions, perceive their professional responsibilities, and prioritize hand hygiene when performing routine patient care. The findings from the Gardenia Ward of Dr. Hafiz Hospital demonstrate variation in attitudes among the nursing population, indicating that acceptance of hand hygiene recommendations was not uniform across respondents. Contemporary investigations have identified attitudes, perceived behavioral expectations, and professional perceptions as relevant components of hand hygiene adherence, while emphasizing that favorable dispositions do not necessarily guarantee consistent clinical performance (Bülbül Maraş & Kocaçal, 2024; Constantinou et al., 2024; Kaye & Marais, 2025).

The univariate analysis identified 23 nurses (65.7%) with positive attitudes toward hand hygiene, while 12 nurses (34.3%) were classified as having negative attitudes. The predominance of positive attitudes suggests that most respondents demonstrated a favorable orientation toward recommended infection prevention practices, although approximately one-third of the nursing population did not exhibit the same attitudinal characteristics. This distribution indicates that institutional infection prevention activities should consider differences in behavioral disposition rather than assuming that access to guidelines and educational resources produces equivalent professional acceptance. Research examining determinants of infection prevention compliance has similarly recognized the relevance of individual attitudes and organizational conditions in understanding variations in healthcare workers' preventive practices (Batran et al., 2025; Alqalah, 2024).

The distribution of nurses' attitudes is presented in Table 3, which summarizes the frequency and percentage of respondents classified into positive and negative categories. These classifications represent the attitudinal variable measured through the questionnaire administered in the original research and provide the basis for subsequent analysis of its association with observed compliance. The available methodological documentation does not specify the questionnaire items, scoring thresholds, or psychometric characteristics used to distinguish positive from negative attitudes, limiting the precision with which individual attitudinal dimensions can be interpreted. Previous studies using knowledge–attitude–practice assessments have demonstrated the relevance of examining attitudes alongside other behavioral characteristics while recognizing that the interpretation of categorical measurements depends on the operational definitions applied (Hu et al., 2025; Wubneh et al., 2024).

Table 3. Distribution of Nurses' Attitudes Toward Hand Hygiene in the Gardenia Ward

Attitude Category	Frequency (n)	Percentage (%)
Negative	12	34.3
Positive	23	65.7
Total	35	100.0

Source: Original research data, SPSS processing (2026).

Table 3 indicates that positive attitudes were more prevalent than negative attitudes among nurses in the Gardenia Ward, suggesting a generally favorable orientation toward the implementation of hand hygiene procedures. The presence of 12 respondents with negative attitudes nevertheless identifies a relevant behavioral concern because unfavorable evaluations of preventive procedures may interfere with their consistent application during clinical responsibilities. The descriptive distribution alone cannot establish whether respondents with negative attitudes were more likely to neglect hand hygiene, since the relationship requires examination of the corresponding compliance classifications. Investigations of healthcare workers' perceptions and compliance determinants have demonstrated that attitudinal characteristics should be interpreted alongside observed behavior and operational conditions rather than treated as independent indicators of effective infection prevention performance (Alshagrawi & Alhodaithy, 2024; Baraiya et al., 2026).

The association between attitudes and compliance was examined through cross-tabulation of the two attitude categories against the observed hand hygiene compliance classifications. Among 12 nurses with negative attitudes, six were compliant and six were non-compliant, indicating a within-category compliance proportion of 50.0%. Among 23 nurses with positive attitudes, 20 were compliant and three were non-compliant, corresponding to a within-category compliance proportion of 87.0%. This difference indicates that compliance was more frequently observed among nurses with positive attitudes, consistent with research emphasizing the relationship between behavioral dispositions and adherence to infection prevention practices (Hu et al., 2025; Kaye & Marais, 2025).

Table 4. Association Between Nurses' Attitudes and Hand Hygiene Compliance

Attitude Category	Non-compliant, n (%)	Compliant, n (%)	Total, n (%)	p-value
Negative	6 (17.1)	6 (17.1)	12 (34.3)	0.018
Positive	3 (8.6)	20 (57.1)	23 (65.7)	
Total	9 (25.7)	26 (74.3)	35 (100.0)	

Source: Original research data, SPSS processing (2026).

The cross-tabulation in Table 4 demonstrates a substantial difference in observed compliance between nurses with positive and negative attitudes, with a reported chi-square significance value of $p = 0.018$. The reported probability value falls below the predetermined threshold of 0.05, indicating a statistically significant association between nurses' attitudes and hand hygiene compliance according to the original analysis. This finding suggests that favorable attitudes were associated with a higher frequency of compliant behavior, although the observational cross-sectional design does not establish that positive attitudes independently caused greater adherence. Behavioral research informed by the theory of planned behavior supports the conceptual relevance of attitudes to preventive actions, while acknowledging that behavioral performance may also be shaped by contextual and organizational influences (Bülbül Maraş & Kocaçal, 2024; Alshagrawi & Alhodaithy, 2024).

The relationship between attitudes and compliance was not absolute, as three nurses with positive attitudes were classified as non-compliant, while six nurses with negative attitudes nevertheless demonstrated compliant behavior. These observations indicate that favorable attitudes may coexist with inadequate preventive performance and that negative attitudes do not necessarily result in non-compliance under every clinical circumstance. Such differences are compatible with the possibility that institutional expectations, workplace routines, supervision, and situational demands influence whether individual attitudes are translated into observable preventive actions, although these mechanisms were not independently measured in the present study. Research investigating behavioral

interventions, personalized feedback, and organizational compliance strategies has similarly emphasized the importance of environmental reinforcement in supporting consistent infection prevention practices (From-Hansen et al., 2024; Sands et al., 2025; Haenen et al., 2024).

The statistical finding also requires consideration of the sample size and the distribution of observations across the contingency table. The study involved 35 nurses, and the expected frequencies calculated from the reported marginal totals include a value below five, indicating that the assumptions underlying asymptotic chi-square inference warrant examination. Although the original methodological plan specified Fisher's exact test as an alternative when more than 20% of cells had expected frequencies below five, the documentation does not establish whether an exact procedure was used to verify the reported significance value. The reported association should consequently be interpreted with appropriate statistical caution, particularly because the findings arise from a single inpatient ward and cannot establish equivalent relationships across different hospitals or nursing populations (Basu et al., 2026; Ceparano et al., 2025).

The association between positive attitudes and higher hand hygiene compliance provides an empirical basis for considering behavioral reinforcement alongside continuing professional education within the Gardenia Ward's infection prevention activities. Institutional strategies may reasonably address professional commitment, perceived responsibility for patient safety, and routine adherence to preventive standards, while maintaining direct observational monitoring to determine whether favorable attitudes correspond with consistent clinical practices. Such recommendations remain implications of the observed association rather than demonstrated effects of an intervention, because the study did not experimentally evaluate attitude modification, supervisory strategies, or changes in compliance over time. Evidence concerning structured feedback, institutional performance monitoring, and behavioral improvement initiatives supports the relevance of integrating attitudinal considerations into infection prevention management without assuming that any single strategy will produce uniform outcomes across healthcare environments (Tartari et al., 2024; Siju et al., 2023; Iversen et al., 2024).

The findings establish that nurses' attitudes were associated with hand hygiene compliance within the investigated population, complementing the previously identified association between knowledge and preventive behavior. The higher compliance proportion among nurses with positive attitudes suggests that behavioral disposition represents a relevant consideration when interpreting differences in nursing adherence, although the separate bivariate analyses do not determine whether attitudes contribute independently of knowledge or other characteristics. The combined evidence supports a multidimensional interpretation in which cognitive preparedness and favorable professional attitudes are associated with observed preventive practices, while causal mechanisms and their relative contributions remain unresolved. Research addressing knowledge, attitudes, infection prevention behavior, and multidimensional compliance assessment provides a basis for continued investigation using more extensive samples and analytical approaches capable of examining interrelated determinants and their implications for healthcare-associated infection prevention (Nwosu et al., 2024; Basu et al., 2026; Csörnyei-Kelemen et al., 2026).

CONCLUSION

This study examined the associations between nurses' knowledge, attitudes, and hand hygiene compliance among 35 nurses in the Gardenia Ward of Dr. Hafiz Hospital, Cianjur, in 2026. The descriptive findings demonstrated that 26 nurses (74.3%) were classified as compliant with recommended hand hygiene practices, whereas nine nurses (25.7%) were non-compliant, indicating that preventive procedures had not been implemented uniformly across the study population. Knowledge assessment identified 16 nurses (45.8%) with good knowledge, 13 nurses (37.1%) with fair knowledge, and six nurses (17.1%) with poor knowledge, revealing differences in cognitive preparedness for infection prevention practices. The chi-square analysis reported a statistically significant association between knowledge and hand hygiene compliance ($p = 0.034$), with compliance proportions increasing across the poor, fair, and good knowledge categories. Attitude assessment identified 23 nurses (65.7%) with positive attitudes and 12 nurses (34.3%) with negative attitudes, while the corresponding analysis demonstrated a statistically significant association between attitudes and compliance ($p = 0.018$). Nurses with positive attitudes exhibited a higher compliance proportion (87.0%) than those with negative attitudes (50.0%), indicating that favorable behavioral

dispositions were associated with greater adherence to recommended preventive practices. These findings address the research objectives by establishing that both knowledge and attitudes were associated with observed hand hygiene compliance, although the cross-sectional design does not permit causal interpretation.

The scientific contribution of this study lies in providing ward-specific empirical evidence concerning the relationships between cognitive and attitudinal characteristics and observed hand hygiene compliance within an Indonesian inpatient nursing population. The findings support the relevance of examining knowledge and attitudes as complementary factors in infection prevention assessments, while recognizing that neither characteristic independently guarantees consistent preventive behavior. From a practical standpoint, the identification of nurses with fair or poor knowledge, negative attitudes, and inadequate compliance provides an empirical basis for prioritizing continuing professional education, behavioral reinforcement, and routine supervisory monitoring within the hospital's infection prevention and control activities. Educational initiatives should emphasize recognition of the WHO Five Moments for Hand Hygiene and accurate implementation of preventive procedures, accompanied by observational assessments capable of identifying inconsistencies between professional understanding and clinical practice. Institutional monitoring should also maintain consistent compliance indicators to support meaningful evaluation of preventive performance across reporting periods. The interpretation of these findings is limited by the single-ward setting, relatively small sample, categorical measurement procedures, and reliance on bivariate analyses without adjustment for potential confounding factors. Further research involving larger nursing populations, standardized measurement instruments, and more comprehensive analytical approaches is warranted to clarify the independent contributions of knowledge and attitudes to hand hygiene compliance and strengthen the evidence supporting targeted infection prevention strategies.

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