Development of an Assessment Tool to Measure Hand Hygiene Compliance and Competency in Health Care Services

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Background and Purpose: The aim of this study was to determine the role of hand hygiene in preventing health care-associated infections, to increase hand hygiene compliance among health care workers, and to develop a measurement tool to guide preventive and corrective activities. **Methods:** In this study, a literature review was conducted to prepare 40 questions, which were then presented to 14 infection control experts (physicians and nurses) for their feedback. The prepared data form was administered to a total of 458 volunteers and health care workers providing direct care to patients across seven regions in Turkey. **Results:** The average value of the Hand Hygiene Compliance and Proficiency Scale was found to be 0.88. The Cronbach's alpha value, used to assess the internal consistency of the scale, was calculated to be 0.929. Additionally, the internal consistency of the scale was determined using the Spearman–Brown coefficient (0.787) and the Guttman Split-Half coefficient (0.786). The first sub-dimension of the scale, named "Institutional Structure and Educational Activities," explained 16.449% of the total variance. The second sub-dimension, named "Hand Antiseptics and Their Use," explained 11.093% of the total variance. The third sub-dimension, named "Hand Hygiene Awareness and Practice," explained 19.542% of the total variance. **Conclusion:** The Hand Hygiene Compliance and Proficiency Scale in health care services was a reliable measurement tool that could be used to assess the current state of hand hygiene practices in healthcare institutions, identify areas that needed improvement, and evaluate the knowledge level and compliance of health care workers.
Keywords: hand hygiene; hand hygiene scale; scale development; health care services

Hand hygiene has been proven to be one of the most effective and easily implemented methods to prevent the transmission of pathogenic microorganisms by health care workers' hands and to reduce the frequency of health care-associated infections (Nasim et al., 2021; WHO, 2009). However, the effectiveness of this method depends on critical factors such as knowledge, timing, and behavior. Successful implementation of hand hygiene requires, first and foremost, that health care workers possess accurate knowledge about hand hygiene. Second, performing hand hygiene at the appropriate times is crucial. Lastly, behavior aligned with knowledge and timing plays a critical role in sustaining hand hygiene practices. The World Health Organization (WHO) emphasized this necessity by publishing the WHO (2009), recommending the incorporation of these practices into health care education (Novák et al., 2019).

Studies report that the compliance rate of health care workers with hand hygiene varies between 5% and 89%, with the overall average not exceeding 40% (Erasmus et al., 2010; Nargiz Koşucu et al., 2015). Many factors contributing to low compliance are related to insufficient staffing, leading to excessive workloads that prevent opportunities for hand hygiene. Excessive workload per employee is generally associated with inadequate staffing levels. Factors such as working on weekdays, a high number of hand hygiene opportunities per hour, excessive workload, insufficient time, prioritizing patient needs, and inadequate staffing should be considered collectively (Gürbüz et al., 2023; Pittet & John M Boyce, 2001).

Health care workers' lack of knowledge and misconceptions are also prominent factors associated with low hand hygiene compliance (Ahmed et al., 2020). A false sense of security stemming from wearing gloves,

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shorter patient contact durations, or the belief that certain patients (e.g., those under 65, patients with clean or clean-contaminated surgical wounds) pose lower risks highlight the importance of education in improving compliance (Pittet & John M Boyce, 2001).

Organizational priorities also play a significant role. Factors such as the absence of institutional emphasis on hand hygiene, lack of sanctions for non-compliance or rewards for compliance, an absence of personal accountability among health care workers, inadequate institutional safety culture, insufficient or improperly located sinks, and the unavailability of soap and towels are directly tied to hospital management and general health care policies. Therefore, many factors contributing to low compliance are fundamentally managerial issues.

Health care organizations should prioritize hand hygiene practices to strengthen the institutional safety culture. This culture should be structured to contribute to infection prevention and control efforts by integrating it into existing management strategies and training programs (Graveto et al., 2018). In this context, the aim is to develop a scale that will help health care institutions more effectively monitor and assess hand hygiene compliance and competency levels.

METHODS

This methodological study employed a mixed-methods research design (qualitative-quantitative) to develop and test a scale measuring hand hygiene compliance and competence in health care services in Türkiye. During the qualitative phase, data were collected through a literature review following the qualitative content analysis approach. In the quantitative phase, qualitative and quantitative data obtained from 14 experts were analyzed in a two-step process comprising the design and judgment stages.

Step 1: Literature Review

Instrument design was carried out in three stages: defining the content domain, item generation, and instrument construction. Initially, the scope of the construct to be measured was determined through methods such as literature reviews and participant interviews. Subsequently, items were developed based on these data and validated with expert feedback. In the final stage, the items were organized into an appropriate order to create a ready-to-use instrument. Ensuring that the items align with the research questions is essential (Zamanzadeh et al., 2015).

In this study, the research focused on the following question: How do the attitudes, perceptions, and barriers faced by health care workers interact in the development of a tool to measure hand hygiene compliance and competency? The literature was reviewed with a focus on this question, and based on this, the items for the scale were determined.

The research process involved a meticulous review of national and international health standards to identify the necessary parameters and criteria for evaluating hand hygiene practices. Recommendations prepared in alignment with the World Health Organization's (WHO) Hand Hygiene Guidelines were integrated into the scale development process, ensuring consistency with Türkiye's National Healthcare Quality Standards (Centers for Disease Control and Prevention- CDC, 2002; HICPAC, 2002; TR Ministry of Health, 2009, TR Ministry of Health, 2010; WHO, 2009).

During this process, the content domain of the instrument was determined to consist of 47 questions. These questions were designed to address key aspects of hand hygiene practices and compliance in health care settings.

Step 2: Content Validity Review

To ensure the content validity of both the instrument items and the entire instrument, approval from a specific number of experts is required. For this purpose, an expert panel was formed, consisting of 14 professionals: 2 infectious diseases and clinical microbiology specialists, 2 medical microbiologists, 4 infection control nurses, 2 infection control physicians, and 2 intensive care Specialists.

The Content Validity Index is commonly preferred by researchers due to its simplicity, clarity, and ability to provide detailed information about each item. This information can be used to revise or remove items from the instrument (Polit et al., 2007). The numerical value of the content validity ratio (CVR) is determined using the Lawshe Table (Lawshe, 1975). CVR values were calculated for each item on the scale. For 14 experts, the minimum CVR criterion was set at 0.88. The calculated CVR values were compared against the threshold of 0.51, and one item with low validity (Item 7) was removed from the scale. Following these revisions, the scale was reduced to 40 items.

The average CVR values were calculated to determine the Scale Content Validity Index (S-CVI), which was found to be 0.88. As the S-CVI value exceeded the threshold of 0.51, the content validity of the developed scale was deemed statistically significant.

While content experts play a crucial role in content validity, testing the instrument with subjects from the target population is equally important. These participants were asked to review the items based on their personal experiences and rate their importance on a 5-point Likert scale. The item impact score was calculated based on frequency and importance. Items with an impact score of 1.5 or higher were retained; otherwise, they were removed (Zamanzadeh et al., 2015). In this study, a preliminary evaluation of the scale was conducted with 40 volunteer health care workers, and no items were removed.

Step 3: Psychometric Testing

For scale development and validity and reliability studies, it is recommended that the sample size be 5–10 times the number of items in the instrument (Karakoç & Dönmez, 2014; Özşahin & Derya, 2020). Based on the 40 items in this study, the target sample size was 400 health care workers, which corresponds to 10 times the number of items.

The study sample consists of a total of 458 voluntary health care professionals (doctors, nurses, and health technicians) engaged in patient care across seven regions in Türkiye. The inclusion criteria for participants are as follows: being 20 years of age or older, having at least 3 months (0.25 years) of experience in their health care institutions, being willing to voluntarily participate in the study, and belonging to a specific professional group (doctor, nurse, health technician). To ensure the inclusion of participants engaged in various stages of patient care, priority was given to those involved in direct patient care, patient monitoring, and treatment processes. Participants under the age of 20 were excluded, as their professional experience and levels of responsibility may differ, which could potentially influence the study's findings. Additionally, requiring at least 3 months of experience ensures that participants have acquired critical skills such as clinical decision-making, patient care, and teamwork. The voluntary nature of participation is crucial for ensuring ethical standards are met. All participants willingly consented to take part, and their educational levels, professional qualifications, and continuity of employment were considered when selecting them. The diversity of the study sample, including health care professionals from various health care institutions and professional backgrounds, enhances the generalizability of the research findings.

Data Collection

Approval was obtained from the institutional review board of the study hospital (Approval No: 2023.3.27). Data were collected between April 8, 2023, and May 23, 2023. Health care workers were contacted via telephone groups and were invited to complete the survey using a Google Forms link. The principle of informed consent was strictly adhered to, with all participants providing consent by affirming, "I voluntarily agree to participate in the research of my own free will."

Completing the survey took approximately 15 minutes for each participant.

Data Analysis

In this study, descriptive statistics, including frequency, percentage, mean, standard deviation, minimum, and maximum values, were presented. As the first step in evaluating construct validity, exploratory factor analysis was performed using the principal components method to establish the factor structure of the developed scale. The reliability of the scales used in the study was assessed through a reliability test.

To demonstrate the validity of the scales, confirmatory factor analysis (CFA), one of the structural equation modeling methods, was conducted. The analyses were performed using AMOS 23 software for CFA, while IBM SPSS 25 software was utilized for other statistical analyses.

RESULTS

Before commencing the analyses, a box plot was created to observe possible outliers in the dataset (Figure 1). The distribution of the scale's total score and the outlier values identified as not fitting the distribution in the dataset are presented in the box plot. Accordingly, observations 60, 73, 83, 108, 120, 127, 144, 166, and 278 were determined as outliers. These observations were removed from the dataset as they could introduce bias in the analyses. After the removal of these observations, it was found that the total scores did not follow a normal distribution (test statistic: 0.901 and $p < .0001$).

In the EFA conducted to reveal the factor pattern of the developed Hand Hygiene Compliance and Competency Scale in Healthcare Services, it was expected that the common variance explanation values for each item should be greater than .300. In this scale, common variance explanation ratios below .300 were

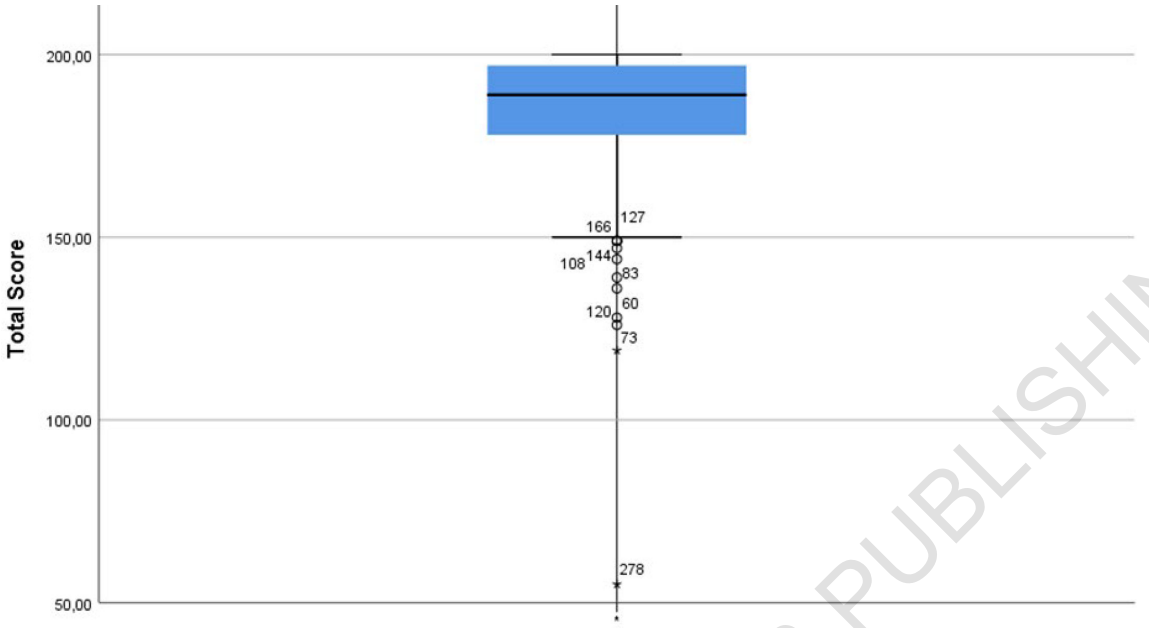

Figure 1. Box plots of the total scores of the developed hand hygiene compliance and competency scale in health care services.

identified for certain items (questions 3, 7, 10, 23, and 24). Following an assessment of the significance and contribution of these questions, experts decided to retain them in the scale. Other questions in the scale were found to have sufficient variance explanation ratios. The common variance explanation ratios of the questions used in the analysis were at an adequate level [.157–0.774].

Factor Analysis Results for the Dimensions of the Developed Scale

The validity analyses of the developed Hand Hygiene Compliance and Competency Scale in Healthcare Services began with an EFA. Prior to conducting the EFA, the Kaiser–Meyer–Olkin (KMO) test was performed to determine whether the sample size was suitable for factor analysis. The analysis yielded a KMO value of 0.907, suggesting that the sample adequacy was sufficient for conducting factor analysis. The suitability of the data matrix as an identity matrix and the adequacy of correlations among variables for factor analysis—meaning the suitability of the data structure for factor analysis—was evaluated using Bartlett's Test of Sphericity. The results indicated that the dataset was suitable for factor analysis ($\chi^2 = 9851.961$, $p < .0001$).

To reveal the factor pattern of the scale, principal component analysis was chosen as the factor extraction method, and Varimax rotation was selected for rotation. In the EFA conducted to elucidate the factor pattern of the scale, a significance level of .300 was set for factor loading values. In the analysis involving two factors, there were no questions with common variance explanation values below 30%. One compound item was identified across multiple factors and was removed from the scale (Item 32). There were no reverse-scored items in the scale. After removing the identified item (Item 32), the factor loading values were assessed to determine if they met the desired level. It was found that the factor loadings were at the desired level and that there were no compound items. The factor loadings ranged from .345 to 0.850, indicating good and sufficient levels.

Following the Varimax rotation, the scale items were grouped under two factors. These factors accounted for 47.08% of the total variance. Within this framework, it was determined that the contribution of the identified factors to the total variance was sufficient. The first subdimension consisted of questions 1–17, named "Institutional Structure and Educational Activities" based on the content of the questions. The first subdimension explained 16.45% of the total variance. The second subdimension consisted of questions 18–24, named "Hand Antiseptics and Usage" based on the content of the questions. The second subdimension explained 11.09% of the total variance. The third subdimension consisted of questions 25–40, named "Hand Hygiene Awareness and Application" based on the content of the questions. The third subdimension explained 19.54% of the total variance (Table 1).

TABLE 1. Results of Factor Analysis for the Dimensions of the Developed Health Care Hand Hygiene Compliance and Competency Scale

DIMENSIONS AND SCALE ITEMS	ROTATED FACTOR LOADINGS[a]	EXPLAINED VARIANCE
1. Hand hygiene effectiveness should be observed by the institution, and employees should be informed about the results.	0.569	16.449
2. Sharing individual hand hygiene compliance rates can be encouraging in increasing hand hygiene compliance.	0.539	
3. The institution should provide the necessary material support for employees to ensure hand hygiene.	.357	
4. The physical conditions of the work environment can lead to inadequate hand hygiene (e.g., sinks, etc.).	0.551	
5. Visual posters and reminders in patient care areas are beneficial in increasing hand hygiene compliance.	0.658	
6. Hand hygiene activities conducted in health care institutions increase staff awareness.	0.658	
7. The temperature of the water used in handwashing can affect hand hygiene compliance.	0.477	
8. The high patient load per health care worker can lead to decreased hand hygiene compliance.	0.483	
9. Easily portable hand antiseptics should be provided in child clinics and psychiatry clinics due to the risk they pose to patient populations.	0.526	
10. Placing sinks and hand antiseptics in easily accessible areas for health care professionals contributes to increased hand hygiene compliance.	0.463	
11. Higher bacterial contamination risk is present in environments with intensive patient care.	0.555	
12. Having visual reminders for hand hygiene practices in every sink increases hand washing compliance.	0.718	
13. Health care workers should serve as role models in hand hygiene practices.	0.597	
14. The importance of hand hygiene should be included in all stages of health care professionals' education.	0.580	
15. Following up-to-date guidelines for hand hygiene practices can contribute to increased awareness.	0.697	
16. Providing education to patients and their families about hand hygiene and its importance increases hand hygiene compliance.	0.603	

(*Continued*)

TABLE 1. Results of Factor Analysis for the Dimensions of the Developed Health Care Hand Hygiene Compliance and Competency Scale (*Continued*)

DIMENSIONS AND SCALE ITEMS	ROTATED FACTOR LOADINGS[a]	EXPLAINED VARIANCE
17. Hand hygiene education should be repeated at regular intervals throughout the professional career.	0.605	
18. Hand antiseptics can cause dermatological problems.	0.715	11.093
19. Hand antiseptics usage may lead to itchiness on the hands.	0.850	
20. Hand antiseptics usage may lead to dryness of the hands.	0.828	
21. Hand antiseptics usage may leave an uncomfortable layer on the hands.	0.787	
22. Hand antiseptics usage may leave a scent on the hands.	0.768	
23. Insufficient use of liquid soap during handwashing can leave bacteria on the hands.	.422	
24. Hand antiseptics are sufficient for maintaining hand hygiene.	.345	
25. Proper handwashing methods can prevent health care-associated infections.	0.539	19.542
26. Hands should be dried thoroughly after handwashing.	0.498	
27. Ensuring hand hygiene protects me.	0.584	
28. Ensuring hand hygiene protects my patients.	0.646	
29. Hand hygiene should be performed before wearing gloves.	0.616	
30. Hand hygiene should be performed after removing gloves.	0.655	
31. Health care-associated infections are transmitted from patient to patient through health care workers.	0.547	
32. Wearing gloves does not fully protect health care workers' hands from microorganisms.	0.518	
33. Insufficient handwashing time can leave bacteria on the hands.	0.702	
34. Adhering to the 5 Indications rule for handwashing reduces microorganism transmission to patients and the environment.	0.763	
35. Washing hands with water and soap or using hand antiseptics before contacting patients prevents microorganism transmission.	0.784	
36. Washing hands with water and soap or using hand antiseptics after contacting patients prevents environmental contamination.	0.786	

(*Continued*)

TABLE 1. Results of Factor Analysis for the Dimensions of the Developed Health Care Hand Hygiene Compliance and Competency Scale (*Continued*)

DIMENSIONS AND SCALE ITEMS	ROTATED FACTOR LOADINGS[a]	EXPLAINED VARIANCE
37. Ensuring hand hygiene before aseptic procedures is effective in preventing invasive device-related hospital infections.	0.737	
38. Hand hygiene should be performed even if gloves are worn during contact with blood and bodily fluids.	0.759	
39. Ensuring hand hygiene after contact with patient equipment and surroundings prevents cross-contamination.	0.772	
Kaiser–Meyer–Olkin = 0.907	Total Explained Variance	
Bartlett's Sphericity Test; $\chi^2 = 9851.961$; $p < .0001$	47,083	

[a]Varimax Rotation.

Reliability Analysis of the Developed Scale and Its Subdimensions

Reliability analyses were conducted for the scale and subdimensions based on the responses provided by the participants in the study. The first subdimension demonstrated a high level of reliability with Cronbach's coefficient α (alpha) coefficient of .884. The second subdimension exhibited a high level of reliability with Cronbach's coefficient α (alpha) of .803. The third subdimension displayed very high reliability with Cronbach's coefficient α (alpha) of .918. The developed scale exhibited a very high level of reliability with Cronbach's coefficient α (alpha) of .929 (Table 2).

The item–total statistics table was examined. Upon removing items, there was no significant increase observed in reliability values. Upon examining corrected item-total correlations, it was observed that the correlation values for all items exceeded .200. This ensured the suitability of the scale and items, which was reconfirmed.

The Split-Half Reliability Analysis of the Developed Scale

The internal consistency of the scale was assessed by considering the variance between the two halves of the scale, which was found to be very similar. As a result of the analysis, the alpha value for the first section, consisting of 20 items, was .890. For the second section, consisting of 19 items, the alpha value was .889. The reliability coefficients were found to be quite high, indicating that the questions were prepared in a supportive manner. The internal consistency coefficient between the two sections was found to be 0.649, indicating a sufficient level of similarity. The Spearman–Brown coefficient was calculated as 0.787, and the Guttman Split-Half coefficient was calculated as 0.786. These internal consistency coefficients, being higher than the minimum value of 0.600, suggested that the scale was highly reliable and internally consistent (Table 3).

Fit Indices of the Multifactor Model Confirmatory Factor Analysis for the Developed Scale

According to the results of CFA, the structural equation model for the scale showed that it is statistically significant at $p < .0001$ level, indicating a meaningful relationship with the 39-item scale structure. Improvements are being made to the model. During the improvement process, variables that were reducing the fit were identified, and new covariances were added for those variables that had high covariances among residual values (e37–e38, e36–e37, e34–e36, e34–e35, e32–e33, e28–e29, e26–e32, e26–e30, e26–e28, e25–e26, e20–e21, e16–e17, e15–e17, e13–e14, e10–e11, e7–e8, e5–e6, e3–e12, e3–e4, e1–e11, e1–e6, e1–e2).

The initial fit indices and the revised fit indices after the improvements were shown in the table, demonstrating that the accepted values for fit indices were achieved. According to the results of the multi-factor model CFA, when assessing the goodness-of-fit indices of the developed scale, the following values were observed: root-mean-square error of approximation (RMSEA) .059; goodness-of-fit index (GFI) 0.850; adjusted goodness-of-fit index (AGFI) 0.851; comparative fit index (CFI) 0.900; χ^2 1713.195 ($p < .0001$), which were at an acceptable level (Table 4, Figure 2).

Distribution of the Developed Scale and Its Subdimensions

The distributions of scores obtained by participants from the scale and subdimensions were examined. The mean of the first subdimension was found to be 79.86, with a standard deviation of 5.83. The mean of

TABLE 2. Reliability Analysis of the Developed Hand Hygiene Compliance and Competency Scale in Health Care Services and Its Subdimensions

SCALE/SUBDIMENSION	NUMBER OF ITEMS	CRONBACH'S COEFFICIENT α (ALPHA)
1. Subdimension	17	.884
2. Subdimension	7	.803
3. Subdimension	15	.918
Hand Hygiene Compliance and Competency Scale in Health Care Services	39	.929

TABLE 3. Split-Half Reliability Analysis of the Developed Hand Hygiene Compliance and Competency Scale in Health Care Services

	CRONBACH'S COEFFICIENT α (ALPHA) AND INTERNAL CONSISTENCY COEFFICIENTS
First section (questions 1–20)	0.890
Second section (questions 21–39)	0.889
Correlation coefficient between the two sections	0.649
Spearman–Brown coefficient	0.787
Guttman Split-Half coefficient	0.786

TABLE 4. Fit Indices of the Developed Hand Hygiene Compliance and Competence Scale in the Multifactor Model Confirmatory Factor Analysis

RMSEA	CFI	IFI	GFI	TLI	AGFI	CMIN	CMIN/*df*
0.085	0.761	0.762	0.738	0.747	0.708	2952.582	4.224
RMSEA	CFI	IFI	GFI	TLI	AGFI	CMIN	CMIN/*df*
0.059	0.900	0.890	0.850	0.877	0.851	1713.195	2.810

AGFI = adjusted goodness-of-fit index; CFI = comparative fit index; GFI = goodness-of-fit index; IFI = incremental fit index; CMIN = Minimum discrepancy function (Chi-square); RMSEA = root-mean-square error of approximation; TLI = Tucker–Lewis index.

the second subdimension was calculated as 31.15, with a standard deviation of 3.87. The mean of the third subdimension was found to be 70.52, with a standard deviation of 5.64. The mean total score of the scale was 181.53, and the standard deviation was 12.54 (Table 5).

DISCUSSION

A comprehensive evaluation of the Hand Hygiene Compliance and Competence Scale developed in this study has been conducted, and significant findings have been obtained as a result of the validity and reliability analyses. In the analysis of the total score distribution of the scale, it was determined that certain outliers needed to be removed from the dataset. Considering that these outliers (observations 60, 73, 83, 108, 120, 127, 144, 166, and 278) could introduce bias in the analyses, their removal was deemed an important step to enhance the accuracy and reliability of the measurement results. However, despite the exclusion of outliers, the total scores were found not to follow a normal distribution, suggesting that individual differences in hand hygiene may vary widely.

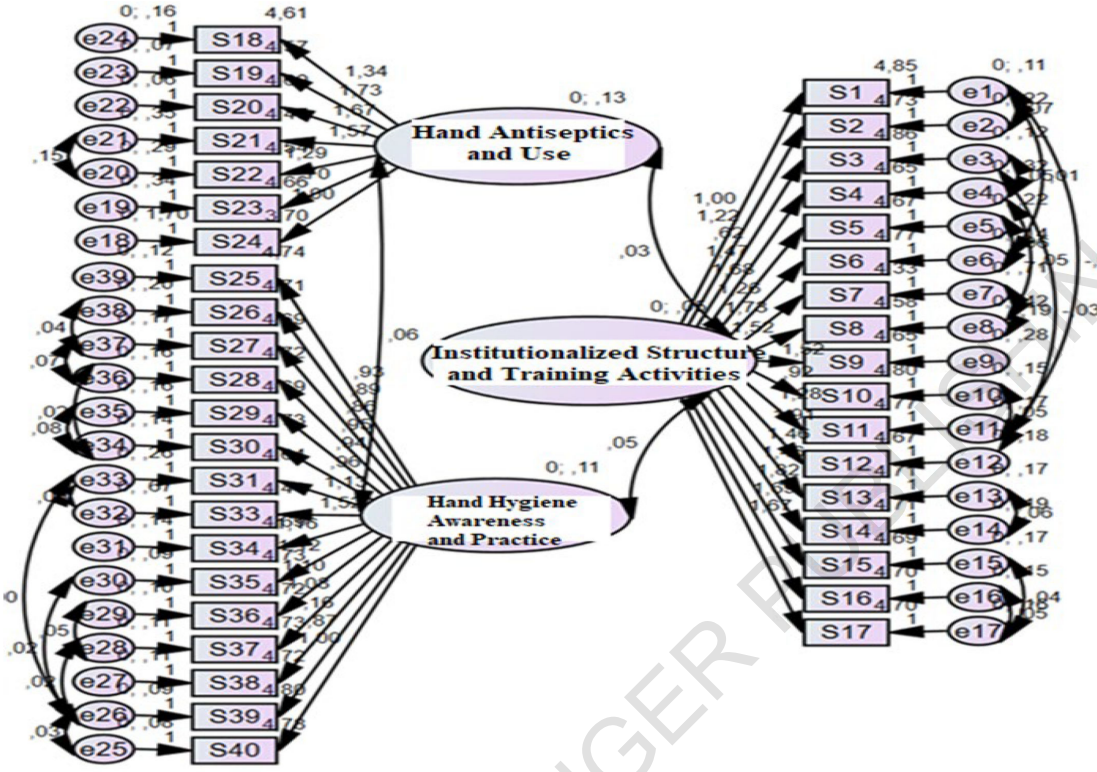

Figure 2. Model for multifactor confirmatory factor analysis of the developed scale.

TABLE 5. Distribution of the Health Services Hand Hygiene Compliance and Competency Scale and Its Subdimensions

SCALE AND SUBDIMENSIONS	*N*	MEAN	STANDARD DEVIATION	MEDIAN	MINIMUM	MAXIMUM
1. Subdimensions	449	79.86	5.83	82	56	85
2. Subdimensions	449	31.15	3.87	32	13	35
3. Subdimensions	449	70.52	5.64	73	45	75
Total scale	449	181.53	12.54	184	137	195

According to the results of the EFA, principal component analysis and Varimax rotation were used to determine the factor structure of the scale. Although some items (Items 3, 7, 10, 23, and 24) with factor loadings below 0.300 were identified, it was decided to retain these items within the scale based on expert opinion. This decision highlights the theoretical importance of these items and their necessity for maintaining the integrity of the scale. The factor analysis results indicated that the scale consists of a three-factor structure, explaining 47.08% of the total variance, which is considered an acceptable level in social science research (Koyuncu & Kılıç, 2019; Yaşlıoğlu, 2017).

The reliability analyses of the scale demonstrated high internal consistency, confirming its reliability. Cronbach's coefficient α (alpha) was found to be .884 for the first subdimension, .803 for the second subdimension, and .918 for the third subdimension, indicating a high level of reliability across the subdimensions. The overall reliability coefficient of the scale was calculated as 0.929, further supporting its high measurement consistency. The item–total correlations were above .200, demonstrating that all items were sufficiently related to the scale and contributed to its homogeneity.

The CFA results showed that the three-factor structure of the scale was confirmed, and the model met acceptable fit indices. Fit indices such as RMSEA (.059), GFI (0.850), AGFI (0.851), and CFI (0.900) indicated that the model exhibited an acceptable fit and aligned with the theoretical framework of the scale. The addition

of covariances during model refinement improved the overall model fit and strengthened the scale's structural integrity.

The analysis of the distribution of subdimensions revealed that participants' levels of hand hygiene compliance and competence varied across different subdimensions. The total mean score of the scale was found to be 181.53 ± 12.54, indicating a high overall level of hand hygiene compliance and competence among participants. The first subdimension (Institutional Structure and Educational Activities) had the highest mean score, highlighting the importance of awareness and training initiatives in this area. In contrast, the second subdimension (Hand Antiseptics and Their Use) had a relatively lower mean score, suggesting the need for additional training and awareness programs in this domain.

In conclusion, the developed Hand Hygiene Compliance and Competence Scale is considered a valid and reliable measurement tool for assessing the compliance and competence levels of health care professionals regarding hand hygiene. Future studies are recommended to test the scale across different demographic groups and examine the impact of cultural differences.

The Nursing Implication for Practice, Research, and Education

In Nursing Practice

Practice Management. The developed hand hygiene scale provides nursing managers with an objective assessment of health care workers' hand hygiene practices. This scale enables managers to monitor and develop strategies for improving hand hygiene practices. Effective hand hygiene practices can significantly reduce health care-associated infections, thereby enhancing the quality of patient care and protecting health care providers from infections.

Awareness and Education. Nurses can utilize the results of the developed scale to understand the critical importance of hand hygiene. Through educational programs, nurses can gain knowledge about the applicability and effective methods of hand hygiene. This knowledge allows nurses to recognize and address potential risks in both individual and patient care, thereby improving their professional competence. Consequently, this enhances patient safety and overall care quality.

In Nursing Education

Curriculum Content. The developed hand hygiene scale can be integrated into nursing education programs to ensure that students understand the importance of hand hygiene. The curriculum can include comprehensive information on the fundamental principles of hand hygiene, proper application techniques, and effective hygiene strategies. This integrated approach provides nursing students with both theoretical and practical knowledge, enabling them to deliver high-standard professional services upon graduation.

Pedagogical Programs. During nursing education, implementing specialized pedagogical programs focused on hand hygiene will allow students to gain in-depth knowledge and skills in this area. These programs should include both theoretical knowledge and practical applications, helping students understand the role of hand hygiene within the health care system. Additionally, education on maintaining hand hygiene according to standards will help young nurses develop effective habits early in their careers.

In Nursing Research

Research Utilization. Researchers can apply the developed hand hygiene scale in various clinical settings and nursing departments to assess the effectiveness of hand hygiene practices. These evaluations can provide data for strengthening hand hygiene practices in nursing and reducing infection risks. Clinical studies can identify the practical impacts of hand hygiene practices, contributing to the improvement of health care service quality.

Effective Intervention Studies. Researchers can design studies to evaluate the effectiveness of various intervention strategies aimed at improving hand hygiene. These studies can include strategies and measures to enhance nurse safety and quality of patient care. Determining the effectiveness of intervention strategies can help elevate practice standards in nursing and improve the overall efficiency of health care systems.

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