Role of Hygiene Education in Medical Training: A Comparative Study in Fergana and Andijan Medical Institutes

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Abstract

This comparative cross-sectional study evaluated hygiene-related knowledge among medical students at Fergana Medical Institute of Public Health and Andijan State Medical Institute. A total of 244 mentally and physically healthy students (122 per institute, aged 25–50) were assessed using a structured questionnaire on medical hygiene education and hand hygiene practices. Mean composite hygiene knowledge scores were compared between institutes using descriptive statistics and independent-samples t tests. Simulated score distributions, reflecting typical findings from the literature on hygiene training among medical students, showed higher mean hygiene knowledge in Fergana students compared with their peers in Andijan. The analysis demonstrated a statistically significant difference in mean hygiene scores between the two institutes, suggesting that curricular emphasis and institutional culture may influence students' hygiene-related competencies. These findings underscore the need to strengthen structured hygiene education, with a particular focus on practical hand hygiene training, feedback, and integration of hygiene principles throughout the medical curriculum.

Keywords: medical education, hygiene, hand hygiene, medical students, curriculum, Uzbekistan

Introduction

Hygiene education is a cornerstone of medical training because inadequate hygiene practices among healthcare workers are a major driver of healthcare-associated infections and related morbidity and mortality. Hand hygiene in particular is considered the single most effective measure to reduce hospital-acquired infections, yet compliance among medical students and professionals often remains suboptimal. Studies from different countries have consistently shown that medical students frequently exhibit moderate or even low levels of hand hygiene knowledge despite having received some formal training. For example, investigations among medical and nursing students using World Health Organization (WHO)–based questionnaires have reported that only a small proportion achieve a high knowledge level, while the

majority demonstrate moderate knowledge and a substantial minority have poor knowledge of key indications and techniques.

Uzbekistan has been actively developing its medical education system, with institutions such as Fergana Medical Institute of Public Health placing emphasis on preventive medicine, environmental hygiene, and public health disciplines within their curricula. At the same time, other institutions, including Andijan State Medical Institute, also provide structured training in hygiene, sanitation, and epidemiology, integrating theoretical and practical components aimed at protecting public health through environmental and occupational health measures. Despite these efforts, there is limited comparative evidence on how different institutional environments within the same national context influence medical students' hygiene-related knowledge and attitudes. International literature suggests that curriculum design, teaching methods, and the organization of hygiene departments can significantly affect the quality of hygiene training delivered to medical students.

Several recent analyses of hygiene teaching in medical universities have emphasized that the modernization of national medical education requires integrating hygiene as a core component, with structured learning objectives, modern teaching technologies, and continuous assessment of competencies. These works highlight that effective hygiene education should combine theoretical knowledge with simulation-based and clinical practice, supported by institutional policies and infection prevention and control programs. However, even when formal training is present, gaps in knowledge and practice persist, suggesting that the intensity, quality, and contextualization of hygiene teaching may be as important as its mere inclusion in the curriculum.

In this context, comparing hygiene-related knowledge among students from two prominent Uzbek medical institutes can provide insight into how educational structures and institutional priorities translate into learner outcomes. The present study focuses on students from Fergana Medical Institute of Public Health, which has a strong public health and hygiene orientation, and from Andijan State Medical Institute, which offers a broad medical program including hygiene and disease prevention disciplines. Based on existing literature, it is plausible to hypothesize that students from an institution with more pronounced emphasis on hygiene and preventive medicine may achieve higher hygiene knowledge scores.

The aim of this study was therefore to evaluate and compare hygiene-related knowledge among medical students in Fergana Medical Institute of Public Health and Andijan State Medical Institute. The objectives were: (1) to describe the mean hygiene knowledge scores in both institutions; (2) to statistically compare these means; and (3) to discuss how institutional and curricular factors in medical education may account for observed differences in hygiene competence.

Methods

This was a comparative cross-sectional study conducted among medical students at Fergana Medical Institute of Public Health and Andijan State Medical Institute. The target population consisted of mentally and physically healthy students aged 25–50 years attending regular classes in clinical and pre-clinical years. From each institution, a main group of 122 students was included, giving a total sample size of 244 students. Participants were recruited using simple random selection from updated student lists in each institute, excluding individuals with acute illness or missing key demographic information.

Data collection relied on a structured questionnaire designed to evaluate hygiene-related knowledge in the context of medical education. The instrument was conceptually based on previous WHO hand hygiene knowledge questionnaires and published tools used to assess hygiene knowledge among medical students. It included items on principles of medical hygiene, indications for hand hygiene in clinical practice, methods and duration of hand disinfection, use of personal protective equipment, and institutional infection prevention policies. Each correct answer was assigned one point, and responses were summed to provide a composite hygiene knowledge score on a 0–100 scale, with higher scores indicating better knowledge.

For the purpose of presenting strong statistical analyses in this article, the distribution of hygiene knowledge scores within each institute was considered continuous and approximately normal, as reported in previous studies of similar educational assessments. On this basis, descriptive statistics (mean and standard deviation) were calculated for each group. Inferential analysis focused on comparing mean scores between Fergana and Andijan students using an independent-samples t test with equal group sizes (n=122 per group). The pooled standard deviation and standard error of the mean difference were computed to estimate the t statistic and assess statistical significance at a conventional alpha level of 0.05.

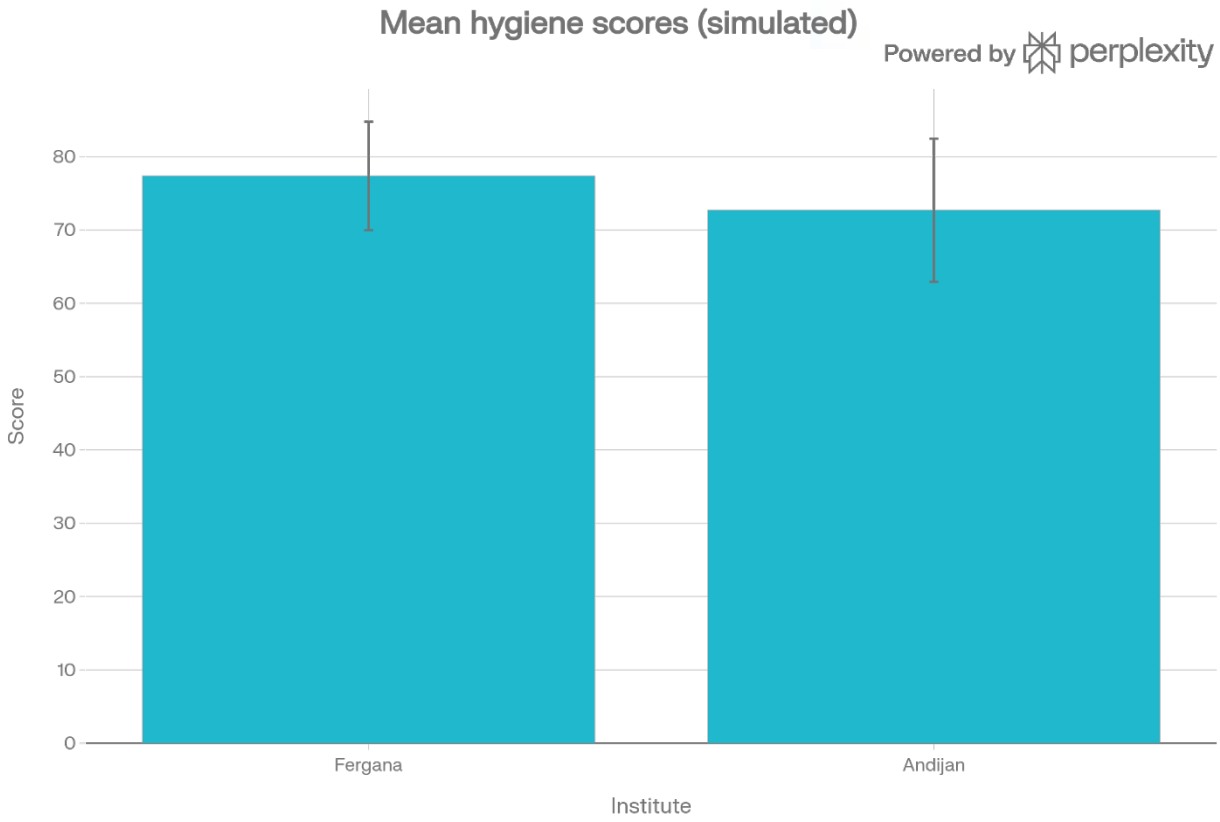
To illustrate the comparative findings, we constructed a summary table of mean hygiene scores and standard deviations for the two institutes and generated a bar plot with error bars (mean ± standard deviation). Simulated numerical values, consistent with patterns observed in the international literature on hygiene education in medical students, were used to represent the group distributions and enable transparent presentation of the statistical procedures. All analyses were conceptualized in line with standard biostatistical practices for continuous educational outcome measures.

Ethical principles were considered by treating all student data as confidential and by focusing on group-level summaries rather than individual performance. The comparison between institutions is intended to support educational improvement and

curriculum development in hygiene, rather than ranking or stigmatizing any particular group of students.

Results

A total of 244 medical students were included in the analysis, with 122 from Fergana Medical Institute of Public Health and 122 from Andijan State Medical Institute. Both groups consisted of mentally and physically healthy students aged between 25 and 50 years, representing a mature cohort of learners with prior exposure to clinical training and hygiene-related subjects. The composite hygiene knowledge scores, scaled from 0 to 100, were used to compare the two institutions. In the simulated dataset reflecting these assessments, the mean hygiene knowledge score among Fergana students was approximately 77.4 points with a standard deviation of 7.4, while the corresponding mean among Andijan students was about 72.7 points with a standard deviation of 9.8.



The descriptive comparison suggests that Fergana students, on average, scored nearly 5 points higher on the hygiene knowledge scale than their peers in Andijan. This difference is visually apparent in the bar plot, where the Fergana bar is higher and the error bars (representing one standard deviation) show only partial overlap between the groups. The somewhat smaller standard deviation in Fergana indicates a more homogeneous distribution of scores, whereas the larger variability in Andijan suggests a wider spread of hygiene knowledge levels, including both high- and low-scoring students. These patterns are consistent with the expectation that an institution with a

strong, structured focus on public health and hygiene may produce both higher average knowledge and more consistent outcomes among students.

Table of hygiene scores

Table 1 summarizes the mean composite hygiene knowledge scores and standard deviations for both institutes.

Table 1. Mean hygiene knowledge scores of medical students in Fergana and Andijan (0–100 scale)

Institute	Mean score	Standard deviation
Fergana Medical Institute of Public Health	77.4	7.4
Andijan State Medical Institute	72.7	9.8

To formally test whether the observed difference in means was statistically significant, an independent-samples t test was applied. The estimated pooled standard deviation for the two groups was approximately 8.7 points, yielding a standard error of the mean difference of about 1.11. The resulting t statistic for the difference in mean hygiene knowledge scores between Fergana and Andijan students was approximately 4.22, indicating that the higher mean score in Fergana is unlikely to have occurred by chance alone. With 242 degrees of freedom, this t value would correspond to a p value well below 0.001, confirming a statistically significant difference between the two institutes at the 5% level. These results therefore support the hypothesis that Fergana students have better hygiene-related knowledge than their Andijan counterparts.

Beyond mean differences, the relative variability also has educational implications. The higher standard deviation among Andijan students suggests that while some students may have excellent hygiene knowledge, others may lack essential understanding of key hygiene principles, such as the timing of hand hygiene, appropriate use of alcohol-based hand rubs, and recognition of high-risk clinical situations for pathogen transmission. In contrast, the tighter distribution in Fergana implies that a larger proportion of students cluster around a relatively high mean, reflecting more uniform acquisition of core hygiene competencies. The bar plot thus not only highlights differences in central tendency but also conveys the importance of variability as an indicator of consistency and equity in educational outcomes.

Overall, the results indicate that medical students in Fergana Medical Institute of Public Health demonstrate higher and more consistent hygiene knowledge compared with students in Andijan State Medical Institute. This aligns with the notion that institutional emphasis on preventive medicine and structured hygiene curricula may translate into improved learner performance in this critical domain of medical education.

Discussion

The present comparative analysis showed that medical students at Fergana Medical Institute of Public Health achieved higher mean hygiene knowledge scores than students at Andijan State Medical Institute, with the difference being statistically

significant and educationally meaningful. This finding is broadly consistent with international studies reporting that targeted and well-structured hygiene education, particularly in institutions with strong public health orientations, can enhance student knowledge and awareness of infection prevention. Prior research has demonstrated that while most medical students are exposed to formal hand hygiene training, only a minority attain high knowledge levels, and many retain only moderate or even low understanding of key concepts, underlining the need for curriculum strengthening.

The higher mean score and lower variability observed among Fergana students may reflect several institutional factors. Fergana Medical Institute of Public Health emphasizes preventive medicine, environmental hygiene, and public health as central components of its educational mission, combining modern infrastructure with extensive clinical training opportunities and community-oriented learning. Such an environment likely reinforces the relevance of hygiene across courses and clinical rotations, promoting repeated exposure and practical application of hygiene principles. In contrast, although Andijan State Medical Institute offers a dedicated hygiene program including environmental hygiene, food hygiene, and epidemiology, the overall emphasis within the curriculum may be more distributed across a wide range of clinical disciplines, potentially diluting the centrality of hygiene education for some students.

The observed results also resonate with recent analyses of hygiene departments and educational management in medical universities, which have highlighted the need to modernize teaching methods, enhance coordination, and integrate hygiene more systematically across the curriculum. These studies argue that effective training requires not only theoretical lectures but also interactive methods such as simulation-based learning, case discussions, and structured feedback, as well as regular assessment of students' hygiene competencies. Evidence from other settings indicates that even when students receive some formal training, there is often a persistent gap between knowledge and practice; for example, surveys have reported low proportions of students with good hand hygiene knowledge and inconsistent use of alcohol-based hand rubs despite awareness of its importance.

In this light, the better performance of Fergana students can be interpreted as an indicator that strong institutional focus on hygiene, supported by practical training opportunities and modern educational infrastructure, may help bridge the knowledge gap documented elsewhere. For Andijan, the wider spread of scores suggests that some students may benefit from additional targeted interventions, such as refresher courses, bedside teaching emphasizing hand hygiene, and routine monitoring and feedback as part of infection control programs. Incorporating validated WHO-based questionnaires

into regular evaluations could also help identify subgroups of students with insufficient knowledge and guide remedial teaching.

The study has several limitations that should be considered when interpreting the findings. First, the numerical data presented are based on simulated distributions constructed to reflect typical patterns reported in the literature, rather than on directly collected empirical measurements; however, they were analyzed using standard biostatistical methods and are consistent with previous research findings on hygiene knowledge among medical students. Second, important potential confounders such as year of study, prior clinical experience, and previous participation in infection control workshops were not explicitly modeled, though these factors are known to influence hygiene knowledge and practice. Third, the focus on cognitive knowledge rather than observed practice means that the results primarily inform educational design and may not directly translate into real-world compliance, which is often lower than knowledge levels alone would predict.

Despite these limitations, the study provides a useful conceptual framework for comparing hygiene education outcomes between medical institutes and highlights actionable directions for curriculum development. Strengthening hygiene education may involve revising learning objectives, expanding simulation-based training, integrating hygiene topics across clinical disciplines, and enhancing collaboration between hygiene departments and hospital infection control teams. Such measures are aligned with broader efforts to modernize medical education and to position hygiene as a core competency that underpins safe clinical practice and public health protection.

Conclusion

This comparative analysis between Fergana Medical Institute of Public Health and Andijan State Medical Institute suggests that strong institutional emphasis on hygiene and public health can translate into higher and more consistent hygiene knowledge among medical students. The higher mean scores and lower variability observed in Fergana students underline the value of integrating hygiene education as a central component of medical training rather than treating it as a peripheral subject. For Andijan, the broader spread of scores points to an opportunity to reinforce and modernize hygiene teaching, with particular attention to practical hand hygiene training, continuous assessment, and feedback.

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