



KNOWLEDGE, ATTITUDE, AND PRACTICE TOWARD STANDARD INFECTION CONTROL PRECAUTIONS AMONG UNDERGRADUATE MEDICAL STUDENTS.

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Abstract

Background: Standard infection control precautions are essential in preventing healthcare-associated infections and ensuring patient and healthcare worker safety. Medical students, as future healthcare providers, play a critical role in adherence to these practices. However, gaps in knowledge, attitude, and practice (KAP) may compromise infection control measures. Evaluating these domains helps identify deficiencies and guide targeted educational interventions to improve compliance and reduce the risk of infection transmission in clinical settings. **Aims:** To assess the knowledge, attitude, and practice toward standard infection control precautions among undergraduate medical students and to determine the association between these domains and selected variables.

Materials and Methods: This cross-sectional study was conducted over a period of 1 month among 300 undergraduate medical students in a tertiary care teaching hospital. Students from different academic years were included, and data were collected using a structured, pre-validated questionnaire administered through Google Forms. Knowledge and practice responses were scored as correct or incorrect, while attitude was assessed using a Likert scale. Based on predefined cut-offs, participants were categorized into adequate or inadequate knowledge and practice, and positive or negative attitude. Data were analyzed and associations were tested using chi-square test with $p < 0.05$ considered statistically significant. **Results:** Out of 300 students, 168 (56.0%) had adequate knowledge, while 132 (44.0%) were inadequate. Awareness of hand hygiene (246; 82.0%) and PPE use (228; 76.0%) was high, but knowledge of biomedical waste disposal and needle-stick protocols was lower (174; 58.0%). A positive attitude was observed in 228 (76.0%) students, with 252 (84.0%) recognizing its importance and 264 (88.0%) willing to follow guidelines. Adequate practice was seen in 186 (62.0%), with good hand hygiene (210; 70.0%) and PPE use (198; 66.0%), but poorer waste disposal practices (162; 54.0%). Knowledge was significantly associated with training, year of study, and attitude ($p < 0.05$). **Conclusion:** The study revealed moderate levels of knowledge and practice with a generally positive attitude toward standard infection control precautions among undergraduate medical students. Despite good awareness of basic principles, gaps persist in specific areas such as waste disposal and needle-stick injury management.

Keywords: Attitude, Infection control, Knowledge, Medical students, Practice, Standard precautions.



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INTRODUCTION

Healthcare-associated infections (HAIs) remain a major challenge in modern medicine, contributing significantly to increased morbidity, mortality, and healthcare costs worldwide.¹ Standard infection control precautions, which include hand hygiene, use of personal protective equipment (PPE), safe injection practices, and proper biomedical waste disposal, are fundamental measures designed to prevent transmission of infectious agents in healthcare settings. These precautions are universally applicable to all patients regardless of their diagnosis and are considered the cornerstone of infection prevention strategies.^{2,3}

Medical students, as future healthcare professionals, are introduced to clinical environments early in their training and are frequently exposed to situations requiring adherence to infection control practices.⁴ Their level of knowledge, attitude, and practice (KAP) regarding standard precautions plays a critical role in determining their compliance and effectiveness in preventing infections.⁵ Inadequate knowledge or poor adherence can increase the risk of cross-infection, endangering both patients and healthcare workers. Therefore, it is essential to ensure that medical students are adequately trained and consistently follow recommended infection control protocols.⁶

Knowledge forms the foundation for appropriate practice, but it alone may not guarantee compliance. Attitude, which reflects an individual's beliefs and perceptions toward infection control, significantly influences behavior.⁷ A positive attitude towards infection prevention measures is often associated with better compliance, whereas a lack of perceived importance may lead to negligence. Practice, on the other hand, represents the actual implementation of these measures in clinical settings. Discrepancies between knowledge and practice have been widely reported, highlighting the need for continuous monitoring and reinforcement.⁸

Despite the inclusion of infection control principles in the medical curriculum, studies have shown that gaps still exist in various domains, particularly in areas such as biomedical waste management, needle-stick injury prevention, and consistent use of PPE.⁹ Factors such as lack of training, inadequate supervision, and limited clinical exposure may contribute to these deficiencies. Furthermore, the transition from theoretical knowledge to practical application is often suboptimal, emphasizing the importance of structured training programs and hands-on learning experiences.^{10,11}

Assessing the KAP of medical students provides valuable insights into their preparedness to adhere to infection control practices. It also helps identify specific areas of weakness that can be targeted through educational interventions. Regular evaluation and reinforcement of these practices are essential to ensure that students develop safe and responsible clinical behaviors early in their careers. Such measures not only protect the students themselves but also contribute to overall patient safety and quality of healthcare delivery.

This study is novel in simultaneously evaluating knowledge, attitude, and practice of standard infection control precautions among undergraduate medical students in a tertiary care setting. The rationale lies in the need for early identification of deficiencies and implementation of targeted training strategies to enhance compliance, thereby reducing the risk of healthcare-associated infections and improving patient safety outcomes.

AIMS AND OBJECTIVES

- To assess the knowledge, attitude, and practice toward standard infection control precautions among undergraduate medical students
- To determine the association between these domains and selected variables.

MATERIALS AND METHODS

This cross-sectional study was conducted in January 2026 in the Department of Microbiology at Sree Mookambika Institute of Medical Sciences among undergraduate medical students. After obtaining approval from the Institutional Ethics Committee, permission was secured from the academic authorities to approach students during scheduled sessions. The purpose of the study was explained in detail, and written informed consent was obtained from all participants prior to enrollment.

Inclusion criteria comprised all undergraduate medical students present during the study period who consented to participate. Exclusion criteria included students who were absent at the time of data collection, those who declined to participate, and incomplete or improperly filled questionnaires.

A structured, pre-validated questionnaire was used as the study tool and administered using Google Forms for efficient data collection. The questionnaire was initially developed based on standard infection control guidelines and previously published KAP studies, and was subjected to content validation by experts in microbiology and clinical departments. A pilot study was conducted on a small group of students to assess clarity, feasibility, and reliability, following which necessary modifications were made. The final questionnaire consisted of three sections assessing knowledge, attitude, and practice related to standard infection control precautions, including hand hygiene, use of personal protective equipment, safe injection practices, and biomedical waste management.

Each correct response in the knowledge and practice sections was awarded one mark, while incorrect or unanswered responses received zero. Attitude responses were assessed using a three-point Likert scale and scored accordingly. Based on predefined cut-off values, participants were categorized into adequate or inadequate knowledge and practice, and positive or negative attitude. Data were coded and entered into a spreadsheet, and statistical analysis was performed using appropriate software. Descriptive statistics were used to summarize the data, and inferential analysis using the chi-square test was applied to assess associations between variables, with a p-value of less than 0.05 considered statistically significant.

RESULTS

Responses to the structured questionnaire assessing knowledge, attitude, and practice toward standard infection control precautions were analyzed. Knowledge was highest for infection transmission (84.0%) and hand hygiene (82.0%), while gaps were noted in waste disposal (58.0%) and needle-stick injury protocols (56.0%). (Table 1)

Table 1: Knowledge-Based Questionnaire Responses

Q. No	Question	Yes (Correct) n (%)	No n (%)
1	Do you know the importance of hand hygiene?	246 (82.0%)	54 (18.0%)
2	Are you aware of WHO hand hygiene steps?	228 (76.0%)	72 (24.0%)
3	Do you know indications for hand washing?	234 (78.0%)	66 (22.0%)
4	Are you aware of PPE components?	228 (76.0%)	72 (24.0%)
5	Do you know proper biomedical waste disposal?	174 (58.0%)	126 (42.0%)
6	Are you aware of needle-stick injury protocol?	168 (56.0%)	132 (44.0%)
7	Do you know color coding of waste bins?	186 (62.0%)	114 (38.0%)
8	Are you aware of infection transmission routes?	252 (84.0%)	48 (16.0%)

A strong positive attitude was observed, particularly toward training (92.0%) and importance of infection control (84.0%). (Table 2)

Table 2: Attitude-Based Questionnaire Responses

Q. No	Question	Agree n (%)	Neutral n (%)	Disagree n (%)
1	Infection control is essential in practice	252 (84.0%)	30 (10.0%)	18 (6.0%)
2	PPE use is necessary for all patients	240 (80.0%)	36 (12.0%)	24 (8.0%)
3	Hand hygiene reduces infection	258 (86.0%)	24 (8.0%)	18 (6.0%)
4	Training should be mandatory	270 (90.0%)	20 (6.7%)	10 (3.3%)
5	Willing to attend training	276 (92.0%)	16 (5.3%)	8 (2.7%)
6	Infection control is student responsibility	246 (82.0%)	30 (10.0%)	24 (8.0%)

Practice was satisfactory for hand hygiene (70.0%) and injections (72.0%), but lower for waste disposal (54.0%) and reporting injuries (50.0%). (Table 3)

Table 3: Practice-Based Questionnaire Responses

Q. No	Question	Yes n (%)	No n (%)
1	Do you wash hands before patient contact?	210 (70.0%)	90 (30.0%)
2	Do you use PPE regularly?	198 (66.0%)	102 (34.0%)
3	Do you follow safe injection practices?	216 (72.0%)	84 (28.0%)
4	Do you dispose biomedical waste correctly?	162 (54.0%)	138 (46.0%)
5	Do you report needle-stick injuries?	150 (50.0%)	150 (50.0%)
6	Do you follow universal precautions always?	174 (58.0%)	126 (42.0%)

Knowledge and practice showed significant adequacy, while attitude was predominantly positive without statistical significance. (Table 4)

Table 4: Overall KAP Score Distribution

Parameter	Adequate n (%)	Inadequate n (%)	p-value
Knowledge	168 (56.0%)	132 (44.0%)	0.001*
Attitude	228 (76.0%)	72 (24.0%)	0.08
Practice	186 (62.0%)	114 (38.0%)	0.02*

Students with adequate knowledge demonstrated significantly better practice ($p < 0.001$). (Table 5)

Table 5: Correlation Between Knowledge and Practice

Knowledge Level	Adequate Practice n (%)	Inadequate Practice n (%)	p-value
Adequate	130 (77.4%)	38 (22.6%)	<0.001*
Inadequate	56 (42.4%)	76 (57.6%)	

Adequate knowledge was significantly associated with a positive attitude ($p = 0.002$). (Table 6)

Table 6: Correlation Between Knowledge and Attitude

Knowledge Level	Positive Attitude n (%)	Negative n (%)	p-value
Adequate	150 (89.3%)	18 (10.7%)	0.002*
Inadequate	78 (59.1%)	54 (40.9%)	

Training exposure significantly improved practice ($p < 0.001$). (Table 7)

Table 7: Correlation of Training with Practice

Training	Adequate Practice n (%)	Inadequate n (%)	p-value
Yes	120 (80.0%)	30 (20.0%)	<0.001*
No	66 (44.0%)	84 (56.0%)	

DISCUSSION

A total of 300 undergraduate medical students were included in the study to assess knowledge, attitude, and practice regarding standard infection control precautions. In the present study adequate knowledge was observed in 168 (56.0%) students, while 132 (44.0%) had inadequate knowledge. A majority were aware of infection transmission routes (252; 84.0%), importance of hand hygiene (246; 82.0%), and WHO hand hygiene steps (228; 76.0%), with satisfactory awareness of PPE use (228; 76.0%).

Similar trends of good theoretical knowledge were reported by Gaber D et al.¹² who observed high awareness of hand hygiene (92%) and IPC guidelines (88%). However, knowledge gaps in biomedical waste disposal (174; 58.0%) and needle-stick injury protocols (168; 56.0%) in the present study are comparable to findings by Mulay MV et al.¹³ who reported deficiencies in waste management practices and infrastructure.

Attitude toward infection control precautions was predominantly positive, with 228 (76.0%) students demonstrating a favorable attitude. A large proportion acknowledged its importance in clinical practice (252; 84.0%), recognized the need for PPE (240; 80.0%), and agreed that hand hygiene reduces infection (258; 86.0%). Notably, 276 (92.0%) students expressed willingness for training, and 270 (90.0%) supported mandatory training.

These findings were consistent with Abalkhail A et al.¹⁴ who reported good attitude levels (61.5%) and identified training as a key predictor of positive attitude. Similarly, Ponnampalavanar S et al.¹⁵ demonstrated a strong association between higher knowledge and improved attitude, reinforcing the interrelationship between these domains.

Despite adequate knowledge and positive attitude, practice levels were suboptimal, with only 186 (62.0%) students demonstrating adequate adherence. Regular hand hygiene was practiced by 210 (70.0%), and 198 (66.0%) consistently used PPE, while safe injection practices were followed by 216 (72.0%). However, proper biomedical waste disposal was observed in only 162 (54.0%) students, and needle-stick injury reporting was noted in 150 (50.0%).

Wani AA et al.¹⁶ in their study reported high awareness (93%) but poor adherence to practices such as hand hygiene (56%) and PPE use (17%), highlighting the persistent gap between knowledge and practice. Similarly, Akinwaare MO et al.¹⁷ observed that although knowledge was high (91.6%), compliance remained low due to barriers such as lack of resources and time constraints.

The present study also demonstrated a significant association between knowledge and practice, with 130 (77.4%) students with adequate knowledge showing good practices compared to 56 (42.4%) among those with inadequate knowledge ($p < 0.001$). A positive attitude was more common among those with adequate knowledge (150; 89.3%) than those with inadequate knowledge (78; 59.1%) ($p = 0.002$).

This was comparable to Bhugun-Aumeerbocus BN et al.¹⁸ who reported a strong association between positive attitude and better practice ($p = 0.001$). Furthermore, training exposure significantly influenced practice in the present study, with 120 (80.0%) trained students demonstrating adequate practice compared to 66 (44.0%) untrained students ($p < 0.001$), which was supported by Abalkhail A et al.¹⁴ and Jeyasheelan VP et al.¹⁹ who identified training and institutional support as key determinants of improved infection control behavior.

The persistence of gaps in practical implementation despite adequate knowledge and attitude underscores the importance of addressing systemic barriers, as also emphasized by Mulay MV et al.¹³ and Akinwaare MO et al.¹⁷ Additionally, variability in adherence observed in this study was comparable to Seetan K et al.²⁰ who reported differences in knowledge and attitude among medical students across institutions. Similarly, Ali A et al.²¹ highlighted variability in hand hygiene practices among healthcare workers despite good knowledge, emphasizing the need for targeted interventions.

In concordance with existing literature, the findings highlight a consistent gap between knowledge and practice. Strengthening structured training programs, ensuring availability of resources, and reinforcing infection control practices through continuous monitoring and education are essential to improve compliance and reduce the risk of healthcare-associated infections.

CONCLUSION

Undergraduate medical students demonstrate moderate knowledge and a generally positive attitude toward standard infection control precautions; however, practical adherence remains suboptimal in key areas such as biomedical waste disposal and needle-stick injury reporting. Significant associations between knowledge, attitude, and practice, as well as the positive impact of training, highlight the need for structured and continuous educational interventions. Early integration of infection control training, regular reinforcement, and hands-on clinical exposure are essential to bridge the gap between knowledge and practice and to ensure effective implementation of infection prevention measures in clinical settings.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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