

## ORIGINAL ARTICLE

# Infection Control Knowledge, Attitude and Practice among Healthcare Workers in Mansoura University Hospitals, Egypt “Quality Improvement Project”

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## ABSTRACT

### Key words:

Infection Control, questionnaire, Knowledge, Practices, Nurses

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**Background:** Infection prevention and control (IPC) in healthcare settings is a critical aspect of patient and healthcare workers (HCWs) safety. Knowledge, attitude, and practice (KAP) towards IPC among HCWs play a significant role. However, the gap between knowledge and practices indicates the need for regular IPC training and audit. **Objectives:** The aim was to assess the efficiency of training sessions on IPC knowledge, attitude and practice among HCWs. **Methodology:** This was a quasi-experimental pre- and post-intervention study to assess KAP of nurses and hospital workers. Awareness sessions were implemented in 5 hospitals and 2 structured questionnaires had been administered; one before and one after sessions. Comparative analysis was done between pre- and post-intervention data. **Results:** In a project involving 134 participants, 38.80% fall within age group of 40-49 years. Two-thirds of participants had previous infection control training and 34.33% reported infection during work. Pre-campaign, 97% had knowledge that IPC standards should be implemented; post-campaign, they reached 100%. There was a statistically significant ( $p \leq 0.0018$ ) decrease in the approval of recapping needles. After sessions, 96% of participants had positive attitude that adherence to IPC standards, protects staff and patients (82% before sessions). HCWs showed statistically significant improvement after sessions towards practices of handwashing, blood spill, glove usage, disposal of sharps (0.005, 0.009, 0.003,  $\leq 0.001$ , respectively). **Conclusion:** Following interventions, the majority of hospital staff had improved KAP towards IPC. Practices of nurses, in particular, must be improved through continuous training and practice auditing.

## INTRODUCTION

Healthcare-associated infections (HAIs) claim millions of lives worldwide annually and are regarded as a serious global health concern. Adherence to infection prevention and control (IPC) measures in healthcare facilities is a critical aspect to limit the risk of HAIs. Evidence suggests that IPC knowledge, attitude, and practice (KAP) among healthcare workers (HCWs) play a significant role in maintaining standard

precautions for patient and HCWs safety <sup>1</sup>. However, there can be a gap between knowledge and practice, indicating the need for regular IPC training and practice auditing <sup>2</sup>.

Effective IPC interventions at a national level include care bundles with implementation strategies. However, the evidence for IPC programs and regulations is inconclusive due to heterogeneity in study populations, interventions, and outcomes <sup>3</sup>. Key components for effective IPC program in hospitals

include organization of infection control team at the hospital level, appropriate use of guidelines, education and training, auditing, surveillance and feedback <sup>4</sup>.

Healthcare workers' perceptions and attitude towards prevention practices can influence IPC compliance. For instance, infection prevention interventions can be perceived as burdensome, and HCWs may desire to see published data supporting these interventions. Therefore, it is crucial to provide clear, evidence-based guidelines and to involve HCWs in the development and implementation of IPC strategies <sup>5</sup>.

In the context of COVID-19, strategies such as adherence to IPC measures and periodic auditing of HCWs had also reduced infection in this group by as much as 37%. Therefore, successful IPC strategies involve a combination of education and training, implementation of evidence-based interventions, and engagement of HCWs in IPC practices. Improvement projects including; regular monitoring and feedback, as well as addressing perceived barriers to IPC compliance, are crucial for the success of these strategies. However, many facilities do not follow this in a regular manner <sup>6</sup>.

The aim of this project was to improve adherence to IPC among nurses and hospital workers at Mansoura

University Hospitals through assessing the efficiency of training sessions on IPC knowledge, attitude and practice.

## METHODOLOGY

### Study design

This infection control Quality Improvement Project (QIP) employed a quasi-experimental pilot study design with a pre- and post- intervention assessment <sup>7</sup>. It required a duration of 12 months from March 2023 to February 2024. The methodology was structured to assess the KAP of nurses and hospital workers at Mansoura University Hospitals regarding IPC measures.

### Study settings and schedule

This project was implemented in 5 hospitals with assignment of contact nurse in each hospital. The 1st cycle was held in the Mansoura University Emergency Hospital and Main Mansoura University Hospital (ENT, Neurology, Dermatology, Tropical, Chest 13 and 14 internal medicine Departments). The 2nd cycle included Mansoura University Pediatric Hospital, Specialized Medical Hospital and Ophthalmology center as illustrated in table 1.

**Table 1: Project schedule divided into 1<sup>st</sup> and 2<sup>nd</sup> cycles.**

Activity	Mar/ Apr 2023	May/ Jun 2023	Jul/ Aug 2023	Sep/ Oct 2023	Nov/ Dec 2023	Jan/ Feb 2024
Draft proposal						
Project plan and documents						
Ethics approval						
Data collection		1 <sup>st</sup> Cycle			2 <sup>nd</sup> Cycle	
Awareness sessions		1 <sup>st</sup> Cycle			2 <sup>nd</sup> Cycle	
Data analysis						
Write report						
Present findings/ Report submission						

### Inclusion and exclusion criteria.

The project had focused on nurses and hospital workers with varying years of experience in the healthcare field and were directly involved in patients' care to ensure relevance to IPC practices. Participants who were not directly involved in patients' care were excluded from our study.

### Intervention implementation (Awareness sessions)

Structured and targeted awareness sessions were designed and implemented to educate participants about IPC. The intervention included the dissemination of updated guidelines, best practices and evidence-based strategies for infection prevention. Furthermore, monitoring of resources availability and utilization to address challenges and recommendations. The sessions were interactive, engaging participants in discussions and practical demonstrations <sup>8</sup>.

### Questionnaire design (Pre- and post- intervention assessment).

To collect the required information, a structured questionnaire translated in Arabic had been administered to the target audience. Every question had been formulated to be answered by "Yes/ No" answer. Participants completed the questionnaire twice; once before the awareness sessions (pre-intervention) and again after the sessions (post-intervention) <sup>9-10</sup>.

The questionnaire included three sections; 1<sup>st</sup> section about participants' demographics (age, gender, work experience, exposure to infections, previous infection control training), 2<sup>nd</sup> section about assessment of KAP towards IPC (8 items for knowledge, 4 items for attitude and 9 items for practice) and 3<sup>rd</sup> section about their feedback (**Appendix**) <sup>7</sup>. The structured questionnaire was adapted from the IPC guidelines provided by

reputable health organizations as World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) <sup>11-12</sup>.

Knowledge of HCWs was evaluated based on understanding of infection and infection control principals. Professional attitude in different scenarios was analyzed through situation based questions. Safe practice was evaluated by determining the habits of handwashing, wearing personal protective equipment (PPE), dealing with blood spills, using sharps and disposing medical and non-medical wastes <sup>13</sup>.

#### **Pre-intervention Assessment**

A baseline assessment of KAP of the target audience was conducted by the administration of a pre-intervention questionnaire <sup>8</sup>.

#### **Post-Intervention Assessment**

A post-intervention questionnaire was administered to evaluate the changes in participants' KAP levels following the awareness sessions. The KAP was assessed 4 weeks after the intervention sessions to assess the change in practice <sup>8</sup>.

#### **Data Collection and analysis**

Trained data collectors, included members of the project team, were responsible for administering the questionnaires and collecting data. The collected data were analyzed using appropriate statistical methods to quantify the changes observed in KAP levels. Comparative analysis between pre- and post-intervention results was provided <sup>1</sup>.

#### **Feedback and continuous improvement**

Feedback was collected from participants to understand the weak points in the IPC system and to assess the perceived value and effectiveness of the intervention. This feedback was used to provide proper recommendations to the IPC units to make any necessary adjustments for continuous improvement <sup>8</sup>.

#### **Ethical approval.**

Study design was accepted by the Institutional review board (IRB), Mansoura Faculty of Medicine (Code R.24.03.2527). A written consent was obtained from participants. Confidentiality were respected in all levels of the study. Approval of the managers of the hospitals in which the study was conducted. Participants were assured that responses would remain anonymous and could withdraw from the study at any time. The study was done in accordance with Helsinki Standards for Medical Research.

#### **Statistical analysis.**

The collected data were coded, processed and analyzed using SPSS program (Version 26). Qualitative data were shown as number and percent. The appropriate statistical tests were used when needed. P values less than 0.05 (5%) was considered to be statistically significant.

## **RESULTS**

### **General traits of participants**

A total of 134 questionnaires were collected from nurses and hospital staff. Demographic data revealed that the majority fall within the age groups of 40-49 (38.80%) and 30-39 (28.35%). Gender distribution showed that 68.66% were females, and 31.34% were males. Half of the participants had at least 7 years of experience in medical field. Regarding infection history, 34.33% reported infections during their work. Two third of participants had received previous infection control training (table 2).

**Table 2: Personal and demographic data of participants**

<b>Participants (No= 134)</b>	<b>No (%) of Total</b>
<b>Age group (years)</b>	
<20	10 (7.46%)
20-29	17 (12.68%)
30-39	38 (28.35%)
40-49	52 (38.80%)
>=50	17 (12.68%)
<b>Gender</b>	
Male	42 (31.34%)
Female	92 (68.66%)
<b>Years of Experience</b>	
Less than 7 years	67 (50%)
Equal or more than 7 years	67 (50%)
<b>History of acquiring infections during work</b>	
Yes	46 (34.33%)
No	88 (65.67%)
<b>History of previous infection control training</b>	
Yes	89 (66.42%)
No	45 (33.58%)

### **Knowledge assessment towards IPC.**

Regarding knowledge among participants, initially 97.76% agreed that IPC standards should be implemented in the hospital and it reached post-intervention to 100%. After sessions, percentages of nurses that showed average knowledge towards handwashing, PPE usage and waste disposal were increased but statistically insignificant except for moments of hand hygiene and mask use with respiratory infection ( $p= 0.023$  and  $p=0.013$ , respectively). Moreover, there was a statistically significant ( $p \leq 0.0018$ ) decrease in the approval of recapping needles before disposal as shown in table 3.

**Table 3: Assessment of IPC knowledge by pre- and post- intervention questionnaire**

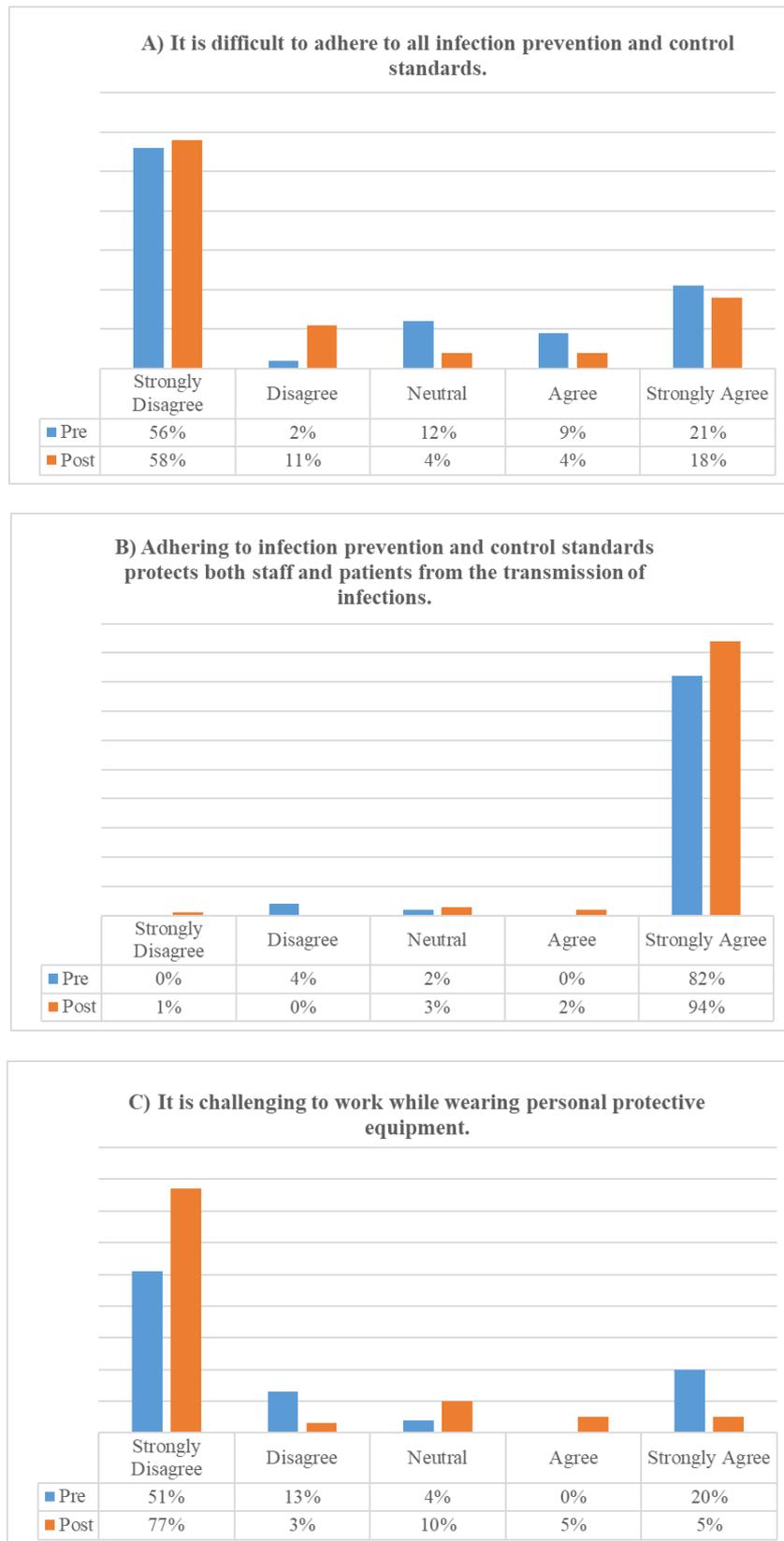
IPC knowledge Total= 134	Pre- questionnaire No (%)	Post- questionnaire No (%)	P value
<b>Infection control standard precautions should be implemented to all patients and at all times in the hospital to prevent hospital acquired infection.</b>			
Yes	131 (97.76%)	134 (100%)	0.081
No	3 (2.24%)	0 (0%)	
<b>Handwashing should be done before and after dealing with the patients and surrounding environment (<i>five moments of hand hygiene</i>).</b>			
Yes	129 (96.27%)	134 (100%)	0.023*
No	5 (3.73%)	0 (0%)	
<b>Handwashing should be done before and after tasks, whether wearing gloves or not.</b>			
Yes	131 (97.76%)	134 (100%)	0.081
No	3 (2.24%)	0 (0%)	
<b>Gloves should be worn when dealing with any tools inside the hospital.</b>			
Yes	131 (97.76%)	134 (100%)	0.081
No	3 (2.24%)	0 (0%)	
<b>Wearing masks is a mandatory when dealing with any respiratory infectious agents.</b>			
Yes	128 (95.52%)	134 (100%)	0.013*
No	6 (4.48%)	0 (0%)	
<b>Patient waste should not be disposed in red bags if it does not deal with blood or body fluids (<i>Non-medical waste</i>).</b>			
Yes	107 (79.85%)	113 (84.33%)	0.339
No	27 (20.15%)	21 (15.67%)	
<b>Separating medical and non-medical waste helps reduce the chances of infection transmission.</b>			
Yes	131 (97.76%)	131 (97.76%)	1.0
No	3 (2.24%)	3 (2.24%)	
<b>All needles and syringes should be recapped before disposal (<i>Two hand technique</i>).</b>			
Yes	121 (90.29%)	56 (41.79%)	≤0.0018*
No	13 (9.71%)	78 (58.21%)	

\*P values < 0.05 considered statistically significant.

#### Attitude assessment towards IPC

Attitude towards IPC situations was assessed among participating nurses and hospital staff and graded (strongly disagree, disagree, neutral, agree and strongly agree) as presented in figure 1 (A, B and C). After sessions, 96% of participants had positive attitude

towards the adherence to IPC standards that protects from infection transmission (versus 82% before sessions). Furthermore, 80% of participants became disagree regarding challenges to work while wearing PPE.



**Fig. 1:** Evaluation of attitude towards IPC among HCWs by pre- and post- intervention questionnaire (A, B, C).

**Practice assessment towards IPC.**

Participants reported safe practice towards various IPC measures which was increased after interventions with scores ranging from 95.52% to 99.25%, as summarized in table 4. They showed statistically

significant improvement after sessions towards practices of handwashing, blood spill disinfection, glove usage, disposal of sharps and non-medical wastes (0.005, 0.009, 0.003,  $\leq 0.001$ ,  $\leq 0.001$ , respectively).

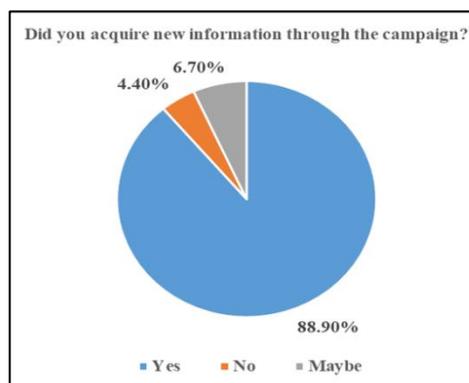
**Table 4: Assessment of practice of IPC measures among HCWs by pre- and post- intervention questionnaire.**

IPC Practices Total= 134	Pre- questionnaire No (%)	Post- questionnaire No (%)	P value
<b>Regular hand washing before and after dealing with patient</b>			
Yes	124 (92.53%)	133 (99.25%)	0.005*
No	10 (7.47%)	1 (0.75%)	
<b>Hand washing after taking off the gloves.</b>			
Yes	124 (92.53%)	131 (97.76%)	0.046*
No	10 (7.47%)	3 (2.24%)	
<b>Wearing gloves when dealing with wastes</b>			
Yes	119 (88.80%)	131 (97.76%)	0.003*
No	15 (11.20%)	3 (2.24%)	
<b>Cleaning up blood spill immediately with disinfectant</b>			
Yes	121 (90.29%)	131 (97.76%)	0.009*
No	13 (9.71%)	3 (2.24%)	
<b>Disposing gloves, cotton swaps and gauze in the red bag</b>			
Yes	128 (95.52%)	132 (98.51%)	0.151
No	6 (4.48%)	2 (1.49%)	
<b>Disposing paper and empty boxes in the black bag</b>			
Yes	82 (61.19%)	129 (96.27%)	$\leq 0.001$ *
No	52 (38.81%)	5 (3.73%)	
<b>Disposing needles and sharps in the sharp box</b>			
Yes	104 (77.61%)	128 (95.52%)	$\leq 0.001$ *
No	30 (22.39%)	6 (4.48%)	
<b>Storing of waste in the designated area within the specified time</b>			
Yes	120 (89.55%)	128 (95.52%)	0.062
No	14 (10.45%)	6 (4.48%)	

\*P values < 0.05 considered statistically significant.

**Feedback from participants**

The majority (119/134, 88.9%) of nurses reported new information acquired about infection prevention guidelines during the campaign. Only 11.10% reported no new IPC knowledge (figure 2).



**Fig. 2:** Feedback of participants about the new information acquired through the campaign.

## DISCUSSION

Healthcare workers' awareness and compliance with infection control principals is critical to prevent the transmission of diseases. Unfortunately, most infection control projects focus on hospital environment sanitation rather than workers' theoretical information and practical skills. The infection control audit is an organized method that facilitates benchmarking and implements corrective actions to improve standards of care<sup>14</sup>. The selection of any health facility to be audited could be influenced by some factors such as the presence of intensive care services, hospital acquired infection rates and/ or antibiotic-resistance statistics<sup>8</sup>.

In the pursuit of elevating patient safety and healthcare standards, the Community Service and Environmental Development Sector in Mansoura Faculty of Medicine, in collaboration with Infection Control Units in 5 university hospitals, had initiated this infection control improvement project. In the present study, 134 questionnaires were collected from nurses and hospital staff. Demographic data revealed that the majority fall within the age groups of 40-49 (38.80%) and 30-39 (28.35%). Gender distribution showed that 68.66% were females. Two third of participants had previous infection control training. A recent study in Yamen also involved participants with median age 33 (29-40) years, 79.0% were male and 77.0% had previous IPC training for COVID-19<sup>7</sup>. Similarly, an audit carried out by Bryce et al. involved 390 participants with 60% were submitted by nursing staff and 50% had attended IPC workshops<sup>8</sup>. Nurses play a pivotal and direct role in maintaining infection control standards. They are the most susceptible to contracting different nosocomial infections and passing them to patients<sup>15-16</sup>.

During this project, participants completed the questionnaire twice; once before awareness sessions and again after sessions. This approach allowed for a comparative analysis of the participants' KAP before and after the educational intervention, that help to detect areas that need more attention. KAP is a closely related term as knowledge gives the basics for changing practice, while attitude brings the force for this change<sup>17</sup>.

When knowledge was assessed in the current study, initially 97.76% agreed that IPC should be implemented everywhere and they reached 100% post-campaign. Statistically significant percentages supported moments of handwashing and mask usage with respiratory infection ( $p= 0.023$  and  $p=0.013$ , respectively) after sessions. There was a statistically significant ( $p \leq 0.0018$ ) decrease in the approval of recapping needles before disposal. Improvement in the knowledge level may be due to exposure of HCWs to a large amount of information about infection control during awareness sessions. In the same line with our findings, 97% of

hospital nurses were acquainted with IPC guidelines in prior study in Bangladesh<sup>18</sup>. Our result agrees with recent study in Egypt<sup>19</sup>. However, another study identified low awareness of nurses with IPC guidelines; may be due to resource constraints and heavy workload<sup>20</sup>. Recapping of needles was falsely considered as an acceptable practice due to poor knowledge. It is crucial to properly dispose discarded needles and all nurses should receive regular training to prevent needle stick injuries that could spread blood-borne HAIs<sup>21</sup>.

Attitude towards IPC standards was also assessed and graded in the current project. After sessions, 96% of participants had positive attitude that adherence to IPC standards protects from infection transmission (versus 82% before sessions). Some previous studies have the same results<sup>7,22</sup>. However, our findings are dissimilar to findings of research in India, which may be due to deficient training<sup>23</sup>. The training programs could efficiently improve the attitude among HCWs toward IPC. In turn, positive attitude is very appreciated for preventing spread of infections<sup>24</sup>.

As regard practice of IPC measures in our study, HCWs reported statistically significant improvement after sessions towards practices of handwashing, blood spill disinfection, glove usage, disposal of sharps and non-medical wastes (0.005, 0.009, 0.003,  $\leq 0.001$ ,  $\leq 0.001$ , respectively). Likewise, studies in Egypt, Oman, Saudi Arabia match with our results<sup>19,25,26</sup>. A meta-analysis and systematic review found that effective educational program could improve the waste disposal practices of hospital workers<sup>27</sup>. The improvement in practice might be related to the knowledge gained by training.

Thus far, this project has revealed that most nurses' IPC knowledge, attitude and practice are at an average level. It should be emphasized that HCWs should be involved and the audit findings should be reviewed with staff and hospital administrations through interviews and committees. Clinical departments' involvement in the process makes it easier for recommendations to be accepted and completed on time.

### Study limitations and recommendations

Limitations of survey. First, the findings cannot be generalized across all hospitals, as it was initially conducted in five university hospitals. Further studies would be able to address this issue by enrolling a larger scale of hospitals across the country. Second, every question had been formulated to be answered by simple "Yes/ No" answer with possible over or under-reporting. Application of scaling system in future audit could overcome the possible bias<sup>10</sup>.

Recommendations of survey. The present work would be considered as a primary step of KAP evaluation, further research is highly recommended to observe actual practices of HCWs. Adequate supply of PPE, alternatives for individuals with glove allergies, different glove sizes should be provided. Lastly, it is

mandatory to enhance awareness of hospital staff on handling needle stick incidents and the importance of vaccinations.

## CONCLUSION

Following interventions, the majority of hospital staff became knowledgeable and had a positive attitude and practice towards IPC. indeed, there is still prospects for improvement. Continuous training, campaigns and auditing could enhance nurses' IPC practice.

**Authors' contributions:** All authors have contributed in the design, analysis, and interpretation of data, drafting and revising of the manuscript, and they have approved the manuscript as submitted.

**Availability of data:** All data are included in the manuscript and any other data are available upon reasonable request.

**Conflict of interest:** This study has not been published before and is not under consideration in any other reviewed media. All authors report no conflict of interest relevant to this work.

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**APPENDIX**  
***Questionnaire form***

**Date:**

**Hospital name:**

The infection control department is undergoing an improvement project in your hospital. Please take few minutes to answer this questionnaire. Responses are Confidential and anonymous and you can withdraw at any time.

**Section 1**

**Personal Information:** Participant ID (for anonymized tracking)

- Name
- Age
- Gender
- Years of work experience in the healthcare setting
- History of acquiring to infections during work
- History of previous infection control training

**Section 2**

**Knowledge Assessment:**

- Awareness of infection prevention and control standards applications
- Understanding of the necessity of handwashing before and after patient contact
- Knowledge of proper handwashing techniques
- Knowledge of glove usage and handwashing after glove removal
- Understanding of the need for wearing masks to protect against respiratory infection
- Knowledge of waste disposal protocols, including segregation and disposal of medical waste
- Knowledge of waste disposal protocols, including disposal of non-medical waste
- Knowledge of needle and syringe disposal procedures

**Attitude Assessment:**

- Agreement or disagreement with statements related to infection prevention practices.
- Attitudes toward the difficulty of adhering to infection control standards.
- Attitudes toward the importance of infection control in protecting both healthcare workers and patients.
- Attitudes toward challenges to work while wearing PPE

**Practice Assessment:**

Self-reported adherence to infection prevention practices, including:

- Hand washing before dealing with patient
- Hand washing after taking off the gloves
- Wearing gloves when dealing with wastes
- Cleaning spilled blood with water and disinfectant twice
- Disposing cotton swaps and gauze in the red bag
- Disposing gloves in the red bag
- Throwing paper and empty boxes in the black bag
- Disposing needles and sharp instruments in the sharp box
- Disposing of waste and storing it in the designated area within the specified time

**Section 3**

**Feedback:**

- New information gained about infection prevention and control during the campaign.
- Open-ended questions soliciting suggestions, difficulties faced during work, and any additional comments or concerns.