LIBYAN JOURNAL OF MEDICAL SCIENCES AND TECHNOLOGIES (LJMST)
Volume 1, Issue 1 | May 2026 | www.ijamred.com
Peer-Reviewed Open Access Journal
DOI: https://doi.org/10.77777/ljmst.v1i1.001

Knowledge, Attitude, and Practice of Infection Control Management and Prevention Among Medical Staff in Tobruk

A Quasi-Experimental Study

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Abstract

Background: Healthcare-associated infections (HAIs) remain a critical challenge in healthcare systems worldwide, particularly in low- and middle-income countries such as Libya, where infection prevention and control (IPC) infrastructure is limited. Enhancing healthcare workers' (HCWs') knowledge, attitudes, and practices (KAP) regarding IPC is essential for reducing HAI burden.

Objectives: This study aimed to assess the impact of a structured educational workshop on improving the KAP of HCWs toward IPC in Tobruk city, Libya, and to identify demographic and professional factors associated with KAP levels.

Methods: A quasi-experimental pre-post intervention design was conducted across three governmental health facilities in Tobruk from February to May 2025. A validated questionnaire was administered before and after the workshop. Data were analyzed using the Wilcoxon Signed-Rank Test and multinomial logistic regression in RStudio.

Results: A total of 54 HCWs participated. Statistically significant improvements were observed across all three domains: knowledge ($p < 0.001$), attitudes ($p = 0.014$), and practices ($p = 0.011$). The proportion of participants with "good knowledge" increased from 83.3% to 92.6%. Physician specialization was significantly associated with knowledge level (OR = 0.02; 95% CI: 0.00–0.43; $p = 0.026$).

Conclusions: Targeted educational interventions are effective in improving KAP among HCWs, even when baseline knowledge is relatively high. A notable knowledge-practice gap was identified, underscoring the need for structured, simulation-based training and systematic auditing.

Keywords: *Infection prevention and control; Healthcare-associated infections; Knowledge attitude and practice; Healthcare workers; Libya; Educational intervention*

1. Introduction

Healthcare-associated infections (HAIs) represent a persistent global challenge with significant implications for patient safety, healthcare costs, and public health. These infections compromise the quality of care, increase morbidity and mortality rates, and impose a considerable burden on healthcare systems.

Nosocomial infections—a term used interchangeably with HAIs—are those acquired during the course of inpatient medical care and are not present or incubating at the time of admission. It is anticipated that all healthcare providers (HCPs) adhere rigorously to established standards of

practice. These standards, encompassing knowledge, attitude, and practice (KAP), must be integrated into the institutional fabric of all health facilities to ensure client safety and protection.

In 2016, the World Health Organization (WHO) issued guidelines delineating eight core components for the effective implementation of infection prevention and control (IPC) programs at both national and facility levels. These components emphasize evidence-based interventions, including care bundles and comprehensive implementation strategies.

The burden of HAIs is disproportionately higher in low- and middle-income countries, including Libya, owing to limited resources and suboptimal IPC infrastructure. In Libya, data indicate suboptimal adherence to key IPC practices. A study conducted at Benghazi Medical Centre found that only 51.3% of HCWs had received formal training in hand hygiene, while a study in Tripoli revealed that only 40% of HCWs met WHO-recommended handwashing standards.

Successful IPC strategies depend not only on education and training but also on the engagement and attitudes of HCWs toward prevention practices. The primary aim of this study was to assess the impact of an interactive infection control workshop on improving the KAP of HCWs in Tobruk city.

2. Methodology

2.1 Study Design

This study adopted a quasi-experimental pre-post intervention design to assess the knowledge, attitudes, and practices related to IPC among healthcare workers in governmental hospitals in Tobruk city. This design enables comparison of data collected before and after an intervention without requiring a control group, making it particularly suitable for training evaluations in resource-limited environments.

2.2 Study Settings and Schedule

The study was implemented across three governmental health facilities in Tobruk city: Tobruk Medical Centre, Bab Derna Centre, and the Blood Bank Centre. The full study period extended from February 10 to May 17, 2025.

2.3 Inclusion and Exclusion Criteria

Participants included nurses and physicians working in clinical departments with direct patient care responsibilities, across varying levels of professional experience. Administrative staff, support personnel, and individuals not directly engaged in patient care were excluded from the study.

2.4 Intervention Implementation

Structured and targeted awareness sessions were designed and delivered to educate participants on IPC principles. The intervention encompassed the dissemination of basic infection control principles, standard precautions, and evidence-based practices for preventing HAIs. Training was conducted in an interactive format, encouraging discussion and participation in practical demonstrations.

2.5 Questionnaire Design and Data Collection

A pre-designed structured questionnaire was adapted from validated literature originating from a university hospital in Qassim, Saudi Arabia, and translated from English into Arabic. The

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questionnaire underwent expert review by three specialists. Aligned with WHO and CDC guidelines, it assessed HCWs' KAP toward IPC across three domains:

- Knowledge — understanding of infection and basic IPC principles
- Attitudes — scenario-based questions exploring professional behavior in clinical contexts
- Practices — daily habits including hand hygiene, PPE use, blood spill management, sharps handling, and waste disposal

2.6 Ethical Approval

This study adhered to the ethical standards of institutional and national research committees and complied with the 1964 Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of Tobruk University.

2.7 Statistical Analysis

Data management and analysis were performed using RStudio (version 2024.12.1+563). Pre- and post-training values were compared using the Wilcoxon Signed-Rank Test. Variables with statistically significant associations were entered into a multinomial logistic regression model. Statistical significance was set at $p < 0.05$.

3. Results

3.1 Participant Characteristics

A total of 54 healthcare professionals participated. The median age was 26 years (IQR: 24–30), with females comprising 64.8% (n = 35) and males 35.2% (n = 19). The majority (83.3%, n = 45) had fewer than six years of professional experience. Physicians represented 33.3% (n = 18), followed by laboratory technicians (20.4%), nurses (14.8%), and pharmacists (5.6%). Notably, 72.2% (n = 39) had received no prior formal IPC training.

Table 1. Demographic and clinical characteristics of study participants (N = 54)

Variable	Category	n (%)
Gender	Female	35 (64.8%)
	Male	19 (35.2%)
Experience	< 6 years	45 (83.3%)
	> 6 years	9 (16.7%)
IPC Training	No	39 (72.2%)
	Yes	15 (27.8%)
Previous Work Infection	No	42 (77.8%)
	Yes	12 (22.2%)
PPE Availability	Yes	50 (92.6%)
Specialization	Doctor	18 (33.3%)
	Lab Technician	11 (20.4%)
	Nurse	8 (14.8%)

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	Pharmacist	3 (5.6%)
	Administrative	4 (7.4%)
	Other	10 (18.5%)

3.2 Pre- and Post-Intervention KAP Scores

Statistically significant improvements were observed in all three KAP domains following the educational intervention. Knowledge scores increased from median 17 (IQR: 16–18) to 19 (IQR: 17.25–19) post-intervention ($p < 0.001$). The proportion with "good knowledge" improved from 83.3% to 92.6%. Attitude scores improved ($p = 0.014$), with the "good attitude" proportion rising from 40.7% to 66.7%. Practice scores also improved significantly ($p = 0.011$).

Table 2. Comparison of pre- and post-workshop KAP scores (Wilcoxon Signed-Rank Test)

Domain	Pre-Workshop Median (IQR)	Post-Workshop Median (IQR)	p-value
Knowledge	17 (16–18)	19 (17.25–19)	< 0.001*
Attitude	53 (51–57)	57 (52–60.5)	0.014*
Practice	66.5 (56–72)	70 (63–72.75)	0.011*

** p < 0.05 — statistically significant*

3.3 Logistic Regression Analysis

Multinomial logistic regression revealed that physician specialization was the only statistically significant predictor of knowledge categorization (OR = 0.02; 95% CI: 0.00–0.43; $p = 0.026$). No significant predictors were identified for attitude or practice categorizations.

Table 3. Logistic regression for predictors of knowledge categorization

Variable	OR	95% CI	p-value
Gender: Male vs. Female	0.40	0.05–2.45	0.3
Age	0.81	0.57–1.08	0.2
Experience: > 6 years vs. ≤ 6 years	8.97	0.16–1021	0.3
IPC Training: Yes vs. No	0.30	0.02–2.74	0.3
Specialization: Doctor vs. Administrative*	0.02	0.00–0.43	0.026*
Previous Work Infection: Yes vs. No	1.87	0.17–18.4	0.6

** p < 0.05 — statistically significant*

4. Discussion

This study evaluated the effectiveness of a structured educational workshop in enhancing the KAP of healthcare workers toward infection prevention and control in Tobruk city, Libya. The findings

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demonstrated statistically significant improvements in all three domains—knowledge, attitudes, and practices—following the intervention.

4.1 Knowledge Outcomes

The proportion of participants classified under the "good knowledge" category increased from 83.3% to 92.6% ($p < 0.001$), with the complete elimination of the "poor knowledge" category. These findings are consistent with a substantial body of international literature from Egypt [10], Oman [15], Nigeria [16], Spain [17], and Yemen [18], which affirm that focused educational interventions yield measurable improvements in IPC knowledge.

A notable feature of this study is the paradox it reveals: significant knowledge improvements were achieved from an already high baseline (83.3%), despite 72.2% of participants having never received formal IPC training. This suggests that informal or implicit learning—acquired through routine practice and peer interaction—may have played a substantial role in shaping foundational understanding. The average participant age of 26 years indicates an early-career cohort whose baseline knowledge is consistent with findings from modern academic curricula emphasizing IPC.

4.2 Attitude Outcomes

Attitude scores improved significantly following the intervention ($p = 0.014$), with the proportion of participants categorized as having a "good attitude" increasing from 40.7% to 66.7%. The interactive and participatory format of the training facilitated attitudinal shifts by providing HCWs with opportunities to engage with real-world clinical scenarios, promoting intrinsic motivation for behavioral change.

4.3 Practice Outcomes and the Knowledge-Practice Gap

Practice scores showed a statistically significant improvement post-intervention ($p = 0.011$), with median scores rising from 66.5 to 70. However, despite significant gains in knowledge and attitudes, the relative magnitude of improvement in practices was comparatively modest—a phenomenon frequently referred to as the "knowledge-practice gap."

Qualitative observations during the workshop revealed critical deficiencies in fundamental IPC procedures, including improper PPE donning/doffing, incorrect sharps handling, inadequate blood spill responses, and insufficient understanding of isolation precaution types. These observations reinforce the inadequacy of relying solely on implicit learning for IPC competency development. Structured, evidence-based training is essential to consolidate informally acquired knowledge and standardize practices across healthcare teams.

4.4 Regression Analysis and Demographic Predictors

Among demographic variables assessed, physician specialization was the only statistically significant predictor of knowledge categorization (OR = 0.02; $p = 0.026$). This finding may reflect differences in question alignment with nursing-oriented IPC content or role-specific knowledge gaps among clinical staff. No significant predictors were identified for attitude or practice categorizations, likely due to the limited statistical power afforded by the sample size.

These practical gaps—closely aligned with the absence of formal IPC training among most participants—are echoed in findings from other contexts. In Pakistan, nurses were found to follow outdated protocols inherited from senior colleagues, without reference to updated national or global

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guidelines [19]. Furthermore, the average participant age of 26 years indicates an early-career cohort whose high baseline knowledge (83.3%) is consistent with findings from Saudi Arabia [14] and the United Kingdom [20], where less experienced HCWs exhibited higher knowledge levels than their senior colleagues—an observation attributed to modern academic curricula placing greater emphasis on IPC concepts.

4.5 Study Limitations

- Limited sample size (N = 54) constrained statistical power of regression models
- Self-reported data introduces potential social desirability bias
- Absence of a control group limits causal inference
- Single-city design may limit generalizability to broader Libyan contexts

5. Conclusion

This study provides compelling evidence that targeted educational interventions are essential for enhancing healthcare workers' capacity in infection prevention and control, even among cohorts with a relatively high baseline of theoretical knowledge. The educational workshop resulted in statistically significant improvements across all measured domains—knowledge, attitudes, and practices.

A central finding is the paradox of high pre-intervention knowledge (83.3%) coexisting with a profound absence of prior formal IPC training (72.2%). This phenomenon suggests that implicit learning plays a pivotal role in shaping foundational understanding of early-career health professionals. However, implicit learning alone does not guarantee procedural accuracy.

Future interventions should prioritize simulation-based, competency-assessed training to address the knowledge-practice gap. Larger, multi-center investigations with control groups are recommended to strengthen the evidence base and inform national IPC policy in Libya.

6. Recommendations

Based on the findings of this study, the following recommendations are proposed:

- Implement mandatory, structured IPC training programs for all newly hired staff, complemented by annual refresher workshops.
- Incorporate simulation-based, hands-on learning components covering PPE donning/doffing, blood spill management, and sharps disposal.
- Replicate this study on a larger scale across multiple Libyan health centers with a control group for stronger causal evidence.
- Conduct qualitative research including focus groups to investigate barriers preventing HCWs from translating knowledge into consistent clinical practice.
- Establish non-punitive, systematic auditing mechanisms combining observation-based audits with constructive feedback to cultivate a culture of continuous improvement.

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