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ORIGINAL ARTICLE

Infection prevention and control practices among healthcare workers at basic health units in Khyber Pakhtunkhwa using the WHO infection prevention and control assessment framework (WHO-IPCAF)

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ABSTRACT

Background: BHUs are pivotal healthcare centers in rural areas, but their Infection Prevention and Control (IPC) practices have remained largely unexplored. Our study assessed IPC compliance in a cohort of HCWs working in BHUs of Peshawar.

Methods: A cross-sectional study was carried out from June '23 to January '24 among 15 BHUs in Peshawar, using a simple random technique. One hundred five HCWs were surveyed using a WHO-IPCAF assessment tool with domains of hand hygiene practices, personal protective equipment usage, aseptic practices, and medical waste management. Infection control compliance was measured using a three-point Likert scale and classified into high (2.5-3) or poor (<2) with moderate in between. SPSS analysis software, version 23, was used to both descriptively and inferentially analyze the results with chi-square tests.

Results: Aseptic procedures and waste management had good levels of compliance with high scores of 2.78-3.00, with very good performance in using sterile needles at 99% and discarding sharps at 100%. Hand washing was a poor practice with a very low percentage of 14.3% washing hands before patient interaction with a score of 1.71. Use of PPE had a moderate level with a score of 1.87-2.73, with a lower level of mask usage at 23.8%. There were strong correlations with increased levels of compliance with IPC training with a significance level of $p=0.004$, whereas gender, age, education, and experience had zero correlations with significance level $p > 0.05$.

Conclusion: Although BHUs in Peshawar have strengths in aseptic procedures and waste management, observed deficiencies in hand hygiene practices and personal protective equipment usage emphasize the necessity for focused efforts in these areas. Integrated interventions such as enhanced training in infection control practices and availability of resources can improve patient safety and lowers the hospital-acquired infections.

Keywords: Aseptic Techniques, Hand Hygiene, Healthcare Workers, Infection Control, Medical Waste Disposal, Personal Protective Equipment

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Introduction

Infection prevention and control is central to healthcare safety, with a key focus on the reduction of HAIs and protection of both patients and HCWs against infectious diseases (1). HAIs continue to be a significant challenge in LMICs because of the lack of resources, a high volume of patients, & inadequate training, which greatly heightens the chances of infection, leading to higher morbidity, mortality, and healthcare costs incurred (2,3). BHUs are principal primary care facilities that provide healthcare services at the rural and underserved levels; despite their importance in infection control, little has been documented about the current state of facilities and practices for effective IPC in BHUs of Pakistan (4).

Infection prevention and control practices include medical waste management, aseptic techniques, hand hygiene, and the use of PPE, and are required for effective healthcare delivery (5). The use of PPE helps prevent the spread of respiratory and contagious infections, especially post-COVID-19. Its practice, however is hindered by both shortages and discomfort (1). Hand hygiene is a cornerstone practice that can significantly reduce healthcare-associated infections if implemented consistently. However, compliance remains poor in low and middle-income countries (6). Aseptic technique and proper waste disposal are necessary to reduce risks through the maintenance of sterile procedures and safe biohazard management, respectively (5, 7). Hygienic practices compliance is yet to be certain. Recent evidence in Pakistan shows significant gender ($P < 0.01$) and geographical ($P = 0.009$) differences in hygiene compliance, with females displaying better compliance with guidelines compared to males (8). This indeed points to the lapses that still characterize infection prevention practices in the country. Insufficient staffing, erratic supply chains, and a lack of infection prevention and control training make it difficult for BHUs in Pakistan to maintain active infection control (9). The local evidence shows specific deficiencies in erratic application of PPE practices & low compliance with hand hygiene, which are linked to systemic factors such as high workloads and low supervisions (6,7). Despite the fact that standardized protocols improve medical waste management, primary care providers do not apply standardized protocols consistently. Thus, an infection prevention and control approach seem necessary at the level of the health system of Pakistan to bring down communicable and nosocomial infections.

Our study aimed to assess the IPC practices among HCWs in BHU, Peshawar, Khyber Pakhtunkhwa, Pakistan using the WHO-IPCAF framework. It gives specific attention to the evaluation of compliance related to hand hygiene, PPE use, aseptic technique, and medical waste disposal.

Methods

A descriptive cross-sectional design was adopted to evaluate IPC practices among healthcare workers at 16 Basic Health Units in Peshawar, Khyber Pakhtunkhwa, Pakistan, using the WHO Infection Prevention and Control Assessment Framework. Data was collected between June to August'23 and the data analysis & write up commenced from September to January'24.

We conducted a census and 32 BHUs in district Peshawar was located. Out of those 16 functional units were selected through simple random sampling using the lottery method. Four BHUs were selected from each

administrative town. Non-functional or temporarily closed BHUs were excluded from the sample. 15 BHUs were functional & open. Bazaid Khel, Chaghar Mitti, Charpareeza, Darmangi, Faqeer Kalay, Gulabad, Gulshan Rehman Colony, Hazar Khawani, Mathra, Mashu Khel, Nasirbagh, Palosi, Pishtakhara, Regi Model Town, and Sheikh Muhammadi were among the 15 BHUs that were included. These BHUs were selected to represent KPK's rural and semi urban primary healthcare settings. A census of the registered HCWs at BHUs was conducted. It included on duty medical officers, paramedics, LHVs, vaccinators, technicians, and midwives. A total of 105 HCWs were evaluated & those who were not on duty were recorded as non-respondents and excluded.

Data was collected utilizing a structured WHO-IPCAF questionnaire. It was further customized by research experts to achieve specific research objectives. The questionnaire comprised two sections. First part was on demographic data to collect information on gender, age, educational level & years of experience. Second part comprised of IPC training attendance, practices and compliance, which included 30 items based on WHO-IPCAF Core Components across four domains. Hand hygiene (12 items), personal protective equipment uses (5 items), aseptic technique (9 items), medical waste disposal (3 items) was among the domains. A three-point Likert scale was used to score the practice items: "always" (3), "sometimes" (2), and "never" (1). The cutoff for adequacy was 2 (calculated as [1 + 2 + 3]/3 = 2], relative sufficiency [RS] = 66.67%). Practice levels were divided into three categories. Low, moderate and high compliance was calculated as (<2), (2–2.49) & (2.5–3) respectively.

Ethical approval was obtained from the IREB of Alliance Health care with reference number IRB&EC/2023-SM/015 on 8th May'23. Trained researchers collected data during official operating hours to minimize disruption. Verbal consent was obtained from the participants,and a self-administered questionnaire was filled out by each (20–30 minutes). Inconspicuous observations of IPC practices were conducted with administrative approval. Participant data were kept anonymous to protect confidentiality.

Data were analyzed using SPSS version 23. Descriptive statistics, i.e., frequencies, percentages, and mean scores were calculated forsocio-demographic profiles, IPC compliance, and Core Component assessments. Inferential statistics and chi-square test was employed to assess associations between demographic factors such as gender, age, level of education, training, and experience. The significance was set at $p < 0.05$. The methodology is summarized in Figure 1.

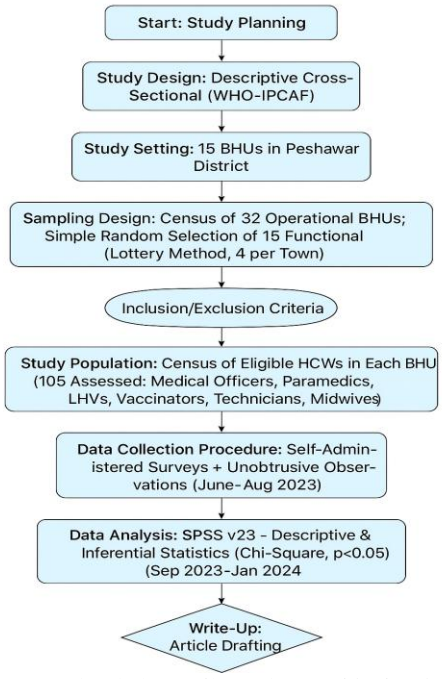

Figure 1. Methodology flowchart of infection prevention and control practices among healthcare workers in BHUs of Peshawar, Khyber Pakhtunkhwa.

Results

The study included 105 healthcare workers from 15 BHUs in Peshawar, predominantly male (68.6%), aged 30–39 years (35.2%). Most participants (71.4%) had Master's/Specialitylevel education, and almost half of them (52.4%) reported 1–5 years of professional experience. Although only 23.8% had received formal IPC training, this highlights a critical gap in capacity building as shown in Table 1.

Table 1. Socio-demographic data of Healthcare Workers based in various basic health units across KPK (N = 105)

Demographic Data	F	%
Gender		
Male	72	68.6
Female	33	31.4
Total	105	100
Age (years)		
20–29	28	26.7
30–39	37	35.2
40–49	25	23.8
≥50	15	14.3
Total	105	100
Level of Education		
Bachelor's/Diploma	30	28.6
Masters/Specialty	75	71.4
Total	105	100
Years of Experience		
1–5	55	52.4
6–10	22	21.0
11–15	20	19.0
≥16	8	7.6
Total	105	100
Training Related to IPC		
Yes	25	23.8
No	80	76.2
Total	105	100

The compliance showed greater variation in infection prevention and control practices across various Basic Health Units. Aseptic technique and waste disposal showed high compliance consistently, with the majority of BHUs scoring between 2.5 and 3.0. On the contrary, hand hygiene showed weak compliance, with several unitsdepicting poor compliance category (<2.0). PPE use was moderate (2.0–2.49), with only fewcentres achieving optimal scores, as shown in Figure 2.

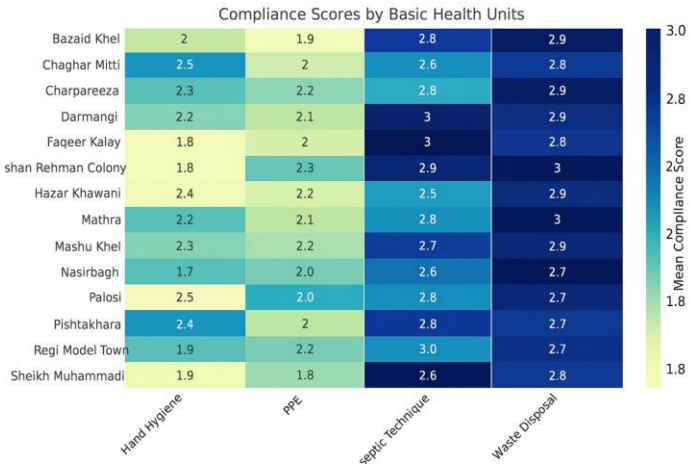

Figure 2. Variation in compliance levels of hand hygiene, PPE use, aseptic technique, and waste disposal among BHUs in Peshawar

Hand hygiene practices were moderate overall, with 88.6% keeping nails unpainted and 72.4% rinsing with sufficient water, but only 14.3% washed hands before patient contact and 26.7% followed all WHO protocols. PPE use was mixed, 76.2% always wore protective vests and 57.1% used gloves before procedures, but only 23.8% wore masks consistently (M.S. = 1.87, low). Aseptic techniques depicted high compliance for sterile needle use (99.0%) and sharps disposal (87.6%), but hand hygienepractice before and after injections remained low (38.1% and 42.9%, respectively). Waste disposal showed the highest compliance, with 100% sharps disposal and 90% correct disposal of general medical waste (M.S. up to 3.00).

Table 2. Observation Checklist for Healthcare Workers' Practices During Infection Control Measures (N = 105)

First: The Practice of Hand Hygiene						
No.	**Items**	**Always (F, %)**	**Sometimes (F, %)**	**Never (F, %)**	**M.S**	**Eval**
1.1	Manicured& nails not painted	93 (88.6)	7 (6.7)	5 (4.7)	2.84	H
1.2	Routine handwashing before patient contact	15 (14.3)	45 (42.9)	45 (42.9)	1.71	L
1.3	Routine handwashing after patient contact	36 (34.3)	52 (49.5)	17 (16.2)	2.18	M
1.4	Hands free of ornaments/accessories	31 (29.5)	59 (56.2)	15 (14.3)	2.15	M
1.5	Sleeves above the elbow	40 (38.1)	32 (30.5)	33 (31.4)	2.07	M
1.6	Use of liquid soap	34 (32.4)	60 (57.1)	11 (10.5)	2.22	M
1.7	Proper handwashing steps	28 (26.7)	30 (28.6)	47 (44.7)	1.82	L
1.8	Rinse hands with sufficient running water	76 (72.4)	19 (18.1)	10 (9.5)	2.63	H
1.9	Dry hands with a towel/tissue/air dryer	58 (55.2)	30 (28.6)	17 (16.2)	2.39	M
1.10	Avoid recontamination at the tap	49 (46.7)	32 (30.5)	24 (22.8)	2.24	M
1.11	Wash hands ≥40–60 seconds	42 (40.0)	45 (42.9)	18 (17.1)	2.23	M
1.12	Use alcohol rub properly	48 (45.7)	41 (39.0)	16 (15.2)	2.30	M
Second: The Practice of PPE (Vest, Gloves, Face Masks)						
No.	**Items**	**Always (F, %)**	**Sometimes (F, %)**	**Never (F, %)**	**M.S**	**Eval**
2.1	Wear a vest inside the health centre	80 (76.2)	22 (21.0)	3 (2.8)	2.73	H
2.2	Wear gloves before intervention	60 (57.1)	34 (32.4)	11 (10.5)	2.47	M
2.3	Use gloves for high-risk procedures	55 (52.4)	40 (38.1)	10 (9.5)	2.43	M
2.4	Use thick gloves for waste handling	48 (45.7)	38 (36.2)	19 (18.1)	2.28	M
2.5	Wear a mask to cover the mouth and nose	25 (23.8)	42 (40.0)	38 (36.2)	1.87	L
Third: The Practice of Aseptic Technique						
No.	**Items**	**Always (F, %)**	**Sometimes (F, %)**	**Never (F, %)**	**M.S**	**Eval**
3.1	Provider prepares sterile tools	70 (66.7)	33 (31.4)	2 (1.9)	2.65	H
3.2	Hand hygiene before injection	40 (38.1)	45 (42.9)	20 (19.0)	2.19	M
3.3	Use a sterile syringe and needle	104 (99.0)	1 (1.0)	0 (0.0)	3.00	H
3.4	Use sterile cotton/gauze for the ampoule	45 (42.9)	30 (28.6)	30 (28.6)	2.14	M
3.5	Use clean gloves for IV injection	47 (44.8)	30 (28.6)	28 (26.7)	2.18	M
3.6	Use the correct injection technique	70 (66.7)	34 (32.4)	1 (1.0)	2.66	H
3.7	Dispose of sharps in resistant containers	92 (87.6)	13 (12.4)	0 (0.0)	2.88	H
3.8	Dispose syringe & needle together	90 (85.7)	15 (14.3)	0 (0.0)	2.86	H
3.9	Hand hygiene after injection	45 (42.9)	42 (40.0)	18 (17.1)	2.26	M
Fourth: The Practice of Medical Waste Disposal						
No.	**Items**	**Always (F, %)**	**Sometimes (F, %)**	**Never (F, %)**	**M.S**	**Eval**
4.1	Dispose of waste in allocated containers	95 (90.5)	8 (7.6)	2 (1.9)	2.89	H
4.2	Dispose of sharps in resistant containers	105 (100)	0 (0.0)	0 (0.0)	3.00	H
4.3	Dispose of swabs/contaminated material properly	85 (81.0)	17 (16.2)	3 (2.8)	2.78	H

Abbreviations M.S = Mean Score; Eval = Evaluation; H = High compliance; M = Moderate compliance; L = Low compliance.

The analysis of practice among healthcare workers indicated different levels of conformity in relation to domains of infection control. Hygiene practices were moderately performed (M.S = 2.15–2.39) concerning hand washing before patient interaction (14.3% always, M.S = 1.71) and following hand washing procedures (26.7% always, M.S = 1.82). Gloves and personal protective vest were used with high conformity levels at 76.2% & 57.1%, respectively. Hand washing with sufficient flowing water had a higher level of conformity with 72.4%, while maintaining an unpainted nail had a higher level of conformity at 88.6%. Whereas mask compliance was recorded low (23.8% always, M.S = 1.87). Aseptic techniques showed high adherence to critical practices including sterile needle use (99.0%) and sharps disposal (87.6%). Waste management practices showed greater compliance with 100% reporting proper sharps disposal and 90% disposing of general waste in designated containers (M.S = 2.78–3.00) as shown in Table 2.

Chi-square analysis showed statistically insignificant association between IPC practices and gender, age, education, or years of professional experience ($p > 0.05$). IPC training and practices ($X^2 = 11.27$, df = 2, $p = 0.004$) were highly significant. It indicates that HCWs who had received formal training were more likely to demonstrate higher compliance compared to those without training, as shown in Table 3.

Table 3. Association of Demographic Variables with Healthcare workers Infection Control Practices (n = 105)

Variable	Category	Low (Poor)	Moderate	High	Total	χ^2 (d.f., p)
Gender	Male (n=72)	16	34	22	72	**1.82**
	Female (n=33)	8	15	10	33	**(2, p>0.05, NS)**
Age (years)	20–29 (n=28)	7	14	7	28	
	30–39 (n=37)	8	18	11	37	**5.64**
	40–49 (n=25)	5	12	8	25	**(6, p>0.05, NS)**
	≥50 (n=15)	4	5	6	15	
Level of Education	Secondary Nursing (n=30)	9	13	8	30	**3.72**
	Diploma/Institute (n=75)	15	36	24	75	**(2, p>0.05, NS)**
Years of Experience	1–5 yrs (n=55)	12	26	17	55	
	6–10 yrs (n=22)	5	10	7	22	**6.48**
	11–15 yrs (n=20)	4	9	7	20	**(6, p>0.05, NS)**
	≥16 yrs (n=8)	3	4	1	8	
Training Related Course	Yes (n=25)	3	10	12	25	**9.84**
	No (n=80)	21	39	20	80	**(2, p<0.01, HS)**

Statistical test; Chi-square test ($p < 0.05$ significant). Abbreviations; df = degrees of freedom; NS = Not significant; HS = Highly significant

Discussion

Our study gives a conclusive evaluation on the effectiveness of infection control practices among healthcare staff in basic health units in Peshawar Pakistan. It shows strengths and important deficiencies in these practices based on important dimensions such as hand washing, personal protective equipment usage, aseptic practices, and medical waste practices. The level of compliance shows variability influenced by both systematic and behavioral aspects in a manner consistent with LMIC countries. (11, 12)

The weakest area is apparently hand washing. Practices such as washing hands before a patient encounter (Mean score≈1.71)

and strictly following World Health Organization recommended guidelines (≈1.82) were found with poor implementation. Although simpler practices such as not painting hands/nails (≈2.66) & using sufficient quantities of water for rinsing hands (≈2.17) were followed better. Similar trends were found in a study where it was found that inadequately optimized standards of hand washing in Pakistani military & tertiary sectors are due to work-flow & Infrastructural barriers (13). As reported by qualitative research in hospitals in Lahore, minimal implementation in day-to-day practice during this pandemic was observed because of un availability of facilities for washing hands & excessive working pressure in hospitals because of being overwhelmed with patients during this time due to less working staff (14).

Use of PPE demonstrated a degree of compliance (average 2.17-2.73) with increased levels in gloves and protective vests, but a lower level of usage in masks (approximately 1.87). A systematic analysis of personal protective equipment usage in Pakistan indicated an inconsistent level of PPE availability and usage in non-hospital settings in Pakistan due to the culture of reuse in PPE. (15)

The above findings are in line with our analysis and were aided by intensive PPE training programs such as 'We Care' launched by WHO Pakistan, which increased levels of PPE usage among healthcare providers. (16)

On the other end, aseptic practices and managing waste were two categories with a very good level of conformity. Use of sterile needles showed nearly complete conformity at 99%, and management of sharps disposed of at 87.6%. Management of medical waste too had been performed with good caution as indicated by scores of 2.78 and 3.00. These observations tally with the research work in tertiary care institutions in South Asia, wherein conformity to protocols got better because of proper guidelines and constant observation (17, 18). Qualitative studies disclose that conformity to biomedical waste management guidelines in different institutions differs and largely because of a lack of proper training and instrumental issues (19). To maintain BHUs at a good performance level, a need arises for constant updated training and strengthening of institutions on biosafety guidelines and observation.

The gap in levels of compliance remained considerable in overt procedural aspects, relative to preventive practices. This reflected innate behavioral and systemic factors. Overall impressions suggest healthcare practitioners tend to give preference to those practices considered more important, or amenable to surveillance (20). Multi-modal programs incorporating educational, feedback, leadership, and systems-level modifications have demonstrated dramatic reductions in healthcare-associated infections, in addition to increased levels of compliance in low- and middle-income countries settings (21). Overall combinations incorporating behavioral modifications through assistance with peer monitoring, leadership, and institutional participation are thus essential in implanting preventive practices into everyday healthcare practices.

Study Limitations

Generalizability of our study may be limited to other regions since our study did not include BHUs in other regions but in one province of Khyber Pakhtunkhwa. The possibility of personal bias in this study does not appear to be completely ruled out despite our aims to be objective.

Future Recommendations

Programs for continuous training, audits, and resource allocation for hand washing and PPE usage need to be given prominence. Integration of modules of Infection Prevention and Control into continuous professional education programs, with a monitoring system in the primary healthcare setting, can help in ensuring this.

Implementing training sessions, conducting audits, and ensuring the availability of materials for both hand-hygiene and PPE practices have to become a major point of focus. Integrating modules of IP in continuous professional programs and establishing surveillance systems in the primary health care settings can aid in maintaining good practice among the healthcare staff and improve patient safety.

Conclusion

Our study draws attention to the fact that despite aseptic procedures and management of waste in BHUs of Peshawar being highly compliant, there are deficiencies in some aspects of IPC. A commitment to ensuring the availability of resources, emphasizing training, and addressing multimodal approaches in IPC practices can definitely bring a positive change in primary healthcare sites.

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Conflict of Interest

The authors declare no conflict of interest related to this study.

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All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.	