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Assessment of Infection Prevention and Control (IPC) in Healthcare Facilities in Complex Humanitarian Emergencies - Cox's Bazar Rohingya Refugee Camps - 2020

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Abstract

Infection prevention and control (IPC) is crucial for the prevention of healthcare-associated infections (HAIs) in healthcare facilities (HFs). The World Health Organization (WHO) published eight core components (CCs) of IPC to guide IPC program implementation in HFs. WHO also developed the IPC Assessment Framework (IPCAF) tool to assess the level of IPC program implementation and identify areas for improvement in HFs. We conducted a cross-sectional study in Nov 2024 using the IPCAF tool by extracting data from February 2020 IPCAF reports from 45 HFs in Rohingya refugee camps. Conducted descriptive analysis using SPSS 29 for each IPC CC, total IPC scores per HF and level of IPC promotion and practices obtained. 46.7% of HFs scored as inadequate, 37.8% scored as basic, 11.1% as intermediate level and 4.4% scored as an advanced level of IPC. 71% of the HFs did not have an IPC program, 84% lacked standard precaution guidelines, 60% had not provided any IPC training and none conducted HAI surveillance. 69% of the HFs did not follow the multimodal strategy for IPC while 82% did not monitor IPC activities. 71% of HFs had appropriate staffing, workload and bed occupancy and 51.1% of HFs had functional hand hygiene stations at all points of care. There were no HFs in the Rohingya refugee camps with fully implemented IPC programs in 2020. An IPC program that aims at implementing all core components of the IPC program should be considered for HFs in Cox's Bazar refugee camps and similar settings.

Keywords: *Healthcare Facilities, Infection Prevention and Control, Rohingya Refugees, 2020 IPCAF.*

Introduction

Infection Prevention and Control (IPC) is a practical, evidence-based approach to preventing patients and health workers from being harmed by avoidable infections [1]. IPC is crucial for the prevention of healthcare-associated infections (HAIs) in healthcare facilities (HFs) and a well-implemented IPC program can reduce HAIs by at least 30% [2]. The World health Organization (WHO) developed a global strategy for infection prevention and control which highlights how important IPC implementation is globally [3]. WHO also named IPC as a core pillar in this COVID-19 fight [4, 5]. IPC is one of the contributing facets to global initiatives

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including sustainable development goals on health, antimicrobial resistance (AMR) plans, International Health Regulations, Patient and health worker (HW) safety and the WHO Framework on integrated people-centred services [6-9].

IPC is also a critical component of healthcare in settings characterized by complex humanitarian emergencies (CHEs), especially due to the difficult environment in which those HFs operate. These emergencies, often precipitated by conflict, displacement, and natural disasters, create environments where the spread of infectious diseases is amplified due to overcrowding, poor sanitation, and limited healthcare resources [10-14]. The Cox's Bazar Rohingya refugee camps have approximately 949,234 Rohingya refugees in 33 heavily congested camps making it the world's biggest refugee settlement served by 105 HFs [15, 16]. In such CHEs, the HFs receive patients with different infectious conditions and if proper IPC is not observed, could lead to a high risk of spreading infections within HFs and the refugee camps.

To support the systematic implementation of IPC, WHO published guidance on IPC programs in HFs that include eight core components (CCs) [17]. The CC includes IPC program (CC1), IPC guidelines (CC2), IPC education and training (CC3), surveillance of HAIs (CC4), multimodal strategies (CC5), Monitoring, audit and feedback (CC6), workload, staffing and bed occupancy (CC7) and built environment, materials and equipment for IPC (CC8). WHO also published the IPC Assessment Framework (IPCAF) tool to assess the performance of CCs and identify gaps for improvement [18]. The IPCAF is structured into eight sections that mirror the eight IPC CCs which are addressed by 81 indicators framed as questions with defined answers and scores totalling 800 for all CCs. Based on the overall score in all eight sections, the HF is assigned to one of the four levels of IPC promotion and practice: inadequate level (0-200), basic level (201-400), intermediate level (401-600) or advanced level (601-800).

This study which adopted the IPCAF tool assessed the level of IPC programs in HFs in Rohingya refugee camps in 2020 to inform IPC program intervention improvements in such CHEs.

Methods

Design and Study Area

This was a cross-sectional study conducted in November 2024 by reviewing secondary data from February 2020 IPCAF reports of 45 HFs in Rohingya refugee camps in Cox's Bazar Bangladesh. Approximately 949,234 Rohingya refugees live in 33 highly congested camps in Cox's Bazar [15]. Operated by 56 health sector partners, there are currently 105 HFs in the Rohingya refugee camps including health posts (HPs) which provide outpatient care, the primary healthcare centres (PHCs) that provide outpatient, inpatient care and normal delivery care and secondary healthcare facilities (SHFs) that provide outpatient, inpatient and surgical services [16]. The refugee camps' overall administration is by a dedicated government agency called the Office of the Refugee Relief and Repatriation Commissioner (RRRC).

Sample Size

All 45 HFs that participated in the February 2020 IPCAF assessment were considered in this study. These included 17 HPs, 18 PHCs, and 10 SHFs

Data Collection Tools and Data Collection

We adapted the IPCAF tool which has eight CCs including CC1, CC2, CC3, CC4, CC5, CC6, CC7 and CC8. The adapted IPCAF tool in this study supported its use in HPs which are outpatient HFs by considering full score for any question of the IPACF tool that does

not apply to the level of HP. Each CC has a set of questions with predefined answers and scores totalling 100, and the eight CCs summed to 800. An overall score out of 800 was then assigned to an HF to determine its level of IPC promotion and practices; 0–200= inadequate, 201–400= basic, 401–600= intermediate and 601–800= advanced [18]. Applying the same concept, the study also categorised levels of implementation of individual CCs in the HFs based on a score of 100; (i) 0–25=inadequate, (ii) 25.1–50=basic, 50.1–75=intermediate and 75.1–100=advanced [19].

The IPCAF tool was entered into Kobo collect and 6 trained health professionals extracted data.

Data Management and Analysis

Data was downloaded, cleaned in Excel® and analysed in SPSS version 29. IPCAF scores were summarized using mean, median, mode for each CC and overall score to obtain the level of IPC promotion and practices for each HF.

Results

Overall Level of IPC Promotion and Practice

The majority (46.7%) of the HFs had inadequate IPC with scores between 0 and 200 out of 800, 37.8% of the HFs had basic IPC level with scores between 201 and 400 out of 800, 11.1% of the HFs had intermediate level having scored between 401 and 600 out of 800 while only 4.4% of the HFs had advanced IPC level having scored between 601-800 out of 800 as reflected in table 1.

Table 1. Overall Level of IPC Promotion and Practice

Overall IPC program score range	Assigned IPC level	Frequency (N=45)	Percentage
0-200	Inadequate	21	46.7
201-400	Basic	17	37.8
401-600	Intermediate	5	11.1
601-800	Advanced	2	4.4

Performance for all IPC CCs

We found that six CCs (CC1, CC2, CC3, CC4, CC5, CC6) scored below 40% and only two components (CC7 and CC8) scored over 70%. CC1 had 50% of the HFs scoring ≤ 5%, while 25% of the HFs had scored between 52.5% and 90%. Considering CC2, 50% of the HFs scored ≤ 37.5% while 25% of the HFs scored between 72.5% and 100%. In CC3, 50% of the HFs scored ≤ 20% while 25% of the HFs scored between 50% and 100%. No CC4 was reported in the HFs. Approximately 75% of the HFs scored ≤ 45% in CC5 while for CC6, 50% of the HFs scored 0%. In CC7, 75% of the HFs scored ≥ 60% while for CC8, 75% of the HFs scored ≥ 65%. Figure 1 summarizes the performance scores of the HFs in all the IPC CCs.

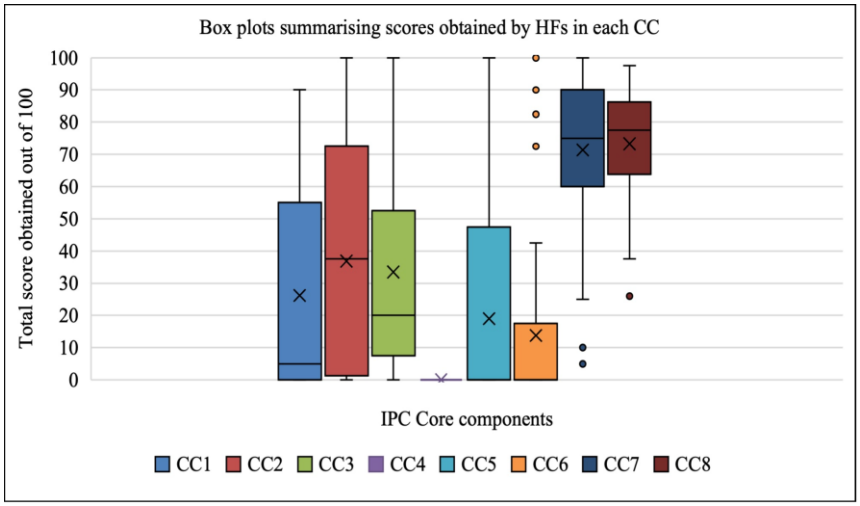

Figure 1. Summary of Performance Per IPC CC

Performance by IPC CC

Detailed scores on all indicators assessed in each of the 8 IPC CCs can be found in tables 1-9 of the supplementary materials of this paper.

CC1: About 57% of HFs scored as inadequate, 15.8% were basic, 17.8% were intermediate and 8.9% had an advanced implementation of CC1. The mean score was 26.2%, the best score was 90% while the lowest score as well as the modal score was 0%. Notably, 71.1% of the HFs did not have an IPC program of any sort, 24.4% had an IPC program but not with clearly defined objectives and only 4.4% had an IPC program with well-defined objectives and a clear annual work plan. Additionally, 53.3% of the HFs did not have anyone in charge of IPC and 66.7% of the HFs did not have a dedicated budget for IPC.

CC2: About 46.7% of the HFs scored as inadequate, 15.6% were basic, 17.8% were intermediate and only 20% scored as advanced in the implementation of CC2. The mean score for CC2 was 36.8/100, the highest score was 100%, the lowest score was % and the modal score was 7.5%. Notably, 75.6% of HFs could not develop or adapt guidelines. 84% of HFs lacked standard precautions guidelines, 93.3% lacked handwashing guidelines, 77% lacked transmission-based precautions guidelines and 89% lacked disinfection and sterilization guidelines.

CC3: More than half (55.6%) of the HFs scored as inadequate, 20% scored as basic, 8.9% were intermediate while only 15.6% scored advanced implementation of CC3. The mean score for CC3 was 33.4%, the lowest score was 0%, the highest score was 100% and the modal score was 0%. 78% of the HFs had no expertise to lead IPC training while 60% had never received any form of IPC training. Over 91% of HFs did not provide any form of IPC education to patients and 57.8% had not trained cleaners at all.

CC4: There was no CC4 as a well-defined component of any HF IPC program in the HFs in the HFs in the Rohingya refugee camp. There was no HAI surveillance targeted at conditions like Surgical site infections, device-associated infections, or clinically defined infections in the absence of laboratory and microbiological testing. No surveillance targeted colonization or infections caused by multidrug-resistant pathogens or infections in vulnerable populations, and infections that may affect health care workers in clinical, laboratory, or other settings.

CC5: About 68.9% of the HFs scored as inadequate, 8.9% scored basic, 15.6% had intermediate and 6.7% scored as advanced for CC5. The mean score CC5 was 19%, the lowest which was also the modal score was

0% while the highest score was 100%. Approximately 69% of the HFs did not implement their IPC activities with a multimodal approach. Also, 68.9% implemented neither system change nor education and training, 82.2% did not include monitoring, 77.8% had no communication and reminders and 95.6% had no safety climate and culture change.

CC6: The majority **(**82.2%) of the HFs scored inadequately, 6.7% scored basic, 2.2% were intermediate and 8.9% scored advanced implementation of CC6. The mean score was 13.8%, the lowest as well as modal score was 0% and the highest score was 100%. About 80% of the HFs did not have anyone trained in monitoring of IPC and 88.9% had no monitoring plan. The most and least monitored indicators were environmental cleaning wound dressing and catheter insertion and care by 17.3% and 4.4% of HFs respectively.

CC7: 8.9% of the HFs scored as inadequate, 11.1% scored basic, 31.1% were intermediate while 48.9% achieved an advanced level of implementation of CC7. The mean score was 71.3%, the lowest and highest scores obtained were 5% and 100% respectively while the modal scores were 80%, 90% and 100%. 71.1% of HFs had appropriate staffing levels, 84.4% kept bed occupancy at one patient to one bed in all units and 53.3% maintained > 1 meter between patient beds.

CC8: No HFs scored as inadequate for CC8, 11.1% scored basic, 35.6% achieved intermediate and 53.3% achieved an advanced level of implementation of CC8. The mean score was 73.3%, the lowest and the highest scores were 26% and 95% respectively while the modal score was 73.5%. Most (84.4%) HFs had water for all uses, 82.2% had drinking water at all times and 51.1% had functional hand hygiene stations at all points of care. Also, 64.4% had sufficient and functioning toilets, 77.8% had sufficient power supply at all times while 75.6% had no records of cleaning. Additionally, 75.6% had sufficient quantities of personal protective equipment (PPE), 64.4% had waste segregation bins, and 64.4% had sterile and disinfected equipment ready for use.

Discussion

Generally, our finding in the 2020 IPCAF in HFs in the Rohingya camps revealed that the majority of the HFs were classified as meeting inadequate and basic levels of IPC which according to the WHO IPCAF [20], indicates that IPC program implementation in Rohingya camps was deficient or not sufficiently implemented. These findings are in agreement with other IPCAF studies in conflict settings [21] and low- and middle-income countries (LMICs) [22-25]. We discuss each CC of the IPC program below.

CC1: The majority of the HFs did not have functional IPC programs with 57% classified under the inadequate level for CC1 which relates to findings from Syria [21]. Few HFs with IPC programs had no objectives, a budget or staff dedicated to running IPC similar to other IPCAF findings in Asia, and Africa [21, 23, 25-27] These gaps in the CC1 could be largely explained by limited knowledge of the need for IPC program by HFs management and leadership hence the lack of objectives, work plans, staff, prioritization and budgeting for IPC. IPC programs at the national and facility levels should be established because IPC in HFs is part of the global reference list of the 100 core health indicators [28]. Additionally, the Global IPC Strategy passed by the WHA in 2023 emphasizes IPC implementation in HFs and this study provides further impetus for the improvement of IPC in HFs in CHE.

CC2: Our study found that many HFs did not have any IPC guidelines. A lack of IPC guidelines could lead to suboptimal IPC practices because the HWs have no common guide to consistently follow for different procedures hence increasing the risk of infection spread. The government of

Bangladesh published a hospital IPC manual in 2018 [29] which has all IPC guidelines including hand hygiene, use of PPE, and standard and transmission-based precautions among others. HFs in Rohingya refugee camps did not have a copy of the manual which if they had would have led to improved scores in CC2. Guidelines at the HF level can be attributed to policy implementation gaps which can be addressed through proper planning for IPC programming at national, district and HF levels to ensure that such essential documents are disseminated to the point of use.

CC3: Many HFs in Rohingya camps had not provided any form of IPC training to the HWs. Cleaners for example may handle infectious wastes, linen, contaminated equipment and surfaces yet have no training. It has been demonstrated that IPC training of cleaning staff can improve and sustain proper environmental cleaning and disinfection of HFs which is crucial for IPC [30]. Evidence shows that HFs with more trained IPC professionals performed better in hand hygiene compliance and central venous catheter-related bloodstream infection prevention practices compared to HFs with fewer trained IPC professionals [31, 32]. The lack of training of different cadres of HWs in the HFs could be largely due to a lack of trained HWs on IPC and IPC focal persons who could routinely train others. There is therefore need to train HWs in IPC in the Rohingya camps HFs, a need that was also recommended by a 2018 Water Sanitation and Hygiene Facility Improvement Tool (WASHFIT) assessment in Rohingya refugee camps [33].

CC4: Surveillance of HAIs helps to monitor the implementation of IPC in the HFs and therefore reduce the rate of HAIs [34]. The absence of HAI surveillance is not unique to HFs in Rohingya camps as a gap analysis on IPC in low- and middle-income countries (LMICs) had similar findings across different regions globally [35]. The absence of HAI surveillance in this refugee setting could be attributed to limited knowledge and skills, human resources, laboratory support and technologies as has been observed in other LMICs [36, 37]. Investment in a comprehensive IPC program and the support noted would be necessary to implement HAI surveillance in refugee camp settings.

CC5: Many HFs in the Rohingya camps did not implement a multimodal approach to their IPC interventions which is a threat to the sustainability of their interventions. WHO encourages that IPC interventions always target; systems change, education and training, monitoring and feedback, communications and reminders and safety climate and culture change [38]. IPC interventions like; hand hygiene programs, environmental cleaning, education and training, that have utilized a multimodal strategy have seen sustained improvements in IPC practices [30-40]. The limited implementation of the multimodal strategy in HFs in the Rohingya refugee camps could be due to a lack of trained IPC professionals, IPC committees and focal persons who are central to the implementation of the multimodal strategy in IPC.

CC6: The limited monitoring of IPC practices in the Rohingya camps could have been due to limited knowledge, human resources, skills and tools for monitoring IPC. These can be addressed by training HWs and providing tools to monitor IPC in HFs. Monitoring of IPC practices like hand hygiene in hospitals has been reported to improve with increased monitoring and immediate feedback [41-43]. Several monitoring tools for IPC including hand hygiene self-assessment framework [44] and other tools should be made accessible to HWs and training conducted on the use of these tools.

CC7: Although CC7 was one of the better-scored CCs in the HFs in Rohingya camps, some HFs had challenges with poor bed spacing and high workload, as seen in other conflict settings in Africa and Asia [45] and

other countries [46, 27, 23]. At least 1 meter between beds is required to reduce the spread of infections and offer sufficient space for the management of patients by HWs [47]. High patient-to-HW ratios should be addressed because overworked HW leads to compromises in IPC practices and increases the risk of infections [48]. Therefore, HF managers should strive to maintain the patient-to-HW ratios recommended by national or global guidelines [49, 50].

CC8: The majority of the HFs in the Rohingya camps scored well in CC8 findings consistent with other IPCAF studies within South East Asia that found relatively good performance in CC8 [46, 26]. Evidence from a qualitative study in 12 conflict-affected countries in Asia and Africa reported challenges in many aspects of CC8 including lack of clean water, limited sources of energy, poor waste management and limited PPE availability [45]. Compared to this evidence we come to a surmise that, HFs in Rohingya camps had better CC8 compared to other conflict settings in Africa and Asia since several aspects of CC8 were available including clean water, PPE, hand hygiene stations, cleaning materials, waste management and sufficient energy.

Limitations of the Study

The use of secondary data for this study limited our ability to observe actual IPC practices of HW as would have been the case with primary data collection. However, the reported practices in IPCAF can be a proxy to the actual practices and can inform interventions for IPC improvement.

Conclusions

The IPC program CCs in Rohingya camps in 2020 were largely lacking without well-structured IPC programs, clear objectives and activities. HFs did not have trained IPC HWs, largely lacked basic IPC guidelines, IPC training and education and did not conduct any surveillance of HAIs. Multimodal strategies for the implementation of IPC were inadequate while audit, monitoring, and feedback of IPC practices were lacking in almost all the HFs. Workload, staffing and bed occupancy, and environment, materials and equipment for IPC were generally well implemented in many HFs in the Rohingya refugee camp. A holistic IPC program should be introduced, implemented and sustained in the Rohingya refugee camps of Cox's Bazar.

Supplementary Material

Tables 1-9 provided details on the scores obtained by the HFs in all indicators studied under each IPC program CC.

Table 1. IPC Program (CC1): HF Scores Per Indicator (N=45)

Indicator	Category	Score	n	%
The health facility (HF) has an IPC program	No	0	32	71.1
	Yes, without clearly defined objectives	5	11	24.4
	Yes, with clearly defined objectives and an annual activity plan	10	2	4.4
The IPC program is supported by an IPC team comprising of IPC professionals	No	0	24	53.3
	Not a team, only an IPC focal person	5	14	31.1
	Yes	10	7	15.6
The IPC team has at least one full-time IPC professional or equivalent	No IPC professional is available	0	26	57.8
	No, only a part-time IPC	2.5	15	33.3

	professional			
	Yes, one per > 250 beds	5	4	8.9
	Yes, one per ≤ 250 beds	10	0	0.0
The IPC team or focal person has dedicated time for IPC activities	No	0	30	66.7
	Yes	10	15	33.3
The IPC team include both doctors and nurses	No	0	35	77.8
	Yes	10	10	22.2
The HF has an IPC committee actively supporting the IPC team	No	0	36	80.0
	Yes	10	9	20.0
The following professional groups represented/included in the IPC committee.				
Senior facility leadership (eg, administrative director, CEO, medical director)	No	0	35	77.8
	Yes	5	10	22.2
Senior clinical staff (for example, physician, nurse)	No	0	35	77.8
	Yes	2.5	10	22.2
HF management	No	0	34	75.6
	Yes	2.5	11	24.4
The HF has clearly defined IPC objectives (that is, specific to critical areas	No	0	37	82.2
	Yes, IPC objectives only	2.5	5	11.1
	Yes, IPC objectives and measurable outcome indicators	5	3	6.7
	Yes, IPC objectives, measurable outcome indicators and set future targets	10	0	0.0
The senior facility leadership show commitment & support for the IPC program through				
Allocated budget specifically for the IPC program	No	0	30	66.7
	Yes	5	15	33.3
By demonstrable support for IPC objectives and indicators within the HF	No	0	30	66.7
	Yes	5	15	33.3
The HF has microbiological laboratory support for routine day-to-day use	No	0	45	100.0
	Yes, but not delivering results reliably	5	0	0.0
	Yes, and delivering results reliably	10	0	0.0

Table 2. IPC Guidelines (CC2): HF Scores Per Indicator (N=45)

Indicator	**Category**	**Score**	**n**	**%**
The HF has the expertise (in IPC and/or infectious diseases) for developing or adapting guidelines	No	0	34	75.6
	Yes	7.5	11	24.4
The HF has guidelines available for:				
Standard precautions?	No	0	38	84.4
	Yes	2.5	7	15.6
Hand hygiene	No	0	42	93.3

	Yes	2.5	3	6.7
Transmission-based precautions	No	0	35	77.8
	Yes	2.5	10	22.2
Outbreak management and Preparedness	No	0	41	91.1
	Yes	2.5	4	8.9
Prevention of surgical site infection	No	0	26	57.8
	Yes	2.5	19	42.2
Prevention of vascular catheter-associated bloodstream infections	No	0	8	17.8
	Yes	2.5	37	82.2
Prevention of hospital-acquired pneumonia ([HAP]; all types of HAP including (but not exclusively) ventilator-associated pneumonia)	No	0	42	93.3
	Yes	2.5	3	6.7
Prevention of catheter-associated urinary tract infections	No	0	8	17.8
	Yes	2.5	37	82.2
Prevention of transmission of multidrug-resistant (MDR) pathogens	No	0	37	82.2
	Yes	2.5	8	17.8
Disinfection and sterilization	No	0	40	88.9
	Yes	2.5	5	11.1
Healthcare worker (HCW) protection and safety	No	0	32	71.1
	Yes	2.5	13	28.9
Injection safety	No	0	27	60.0
	Yes	2.5	18	40.0
Waste management	No	0	26	57.8
	Yes	2.5	19	42.2
Antibiotic stewardship	No	0	37	82.2
	Yes	2.5	8	17.8
The guidelines in the HF are consistent with national/international guidelines	No	0	20	44.4
	Yes	10	25	55.6
Implementation of the guidelines is adapted according to the local needs and resources while maintaining key IPC standards	No	0	25	55.6
	Yes	10	20	44.4
Frontline HCWs are involved in both planning and executing the implementation of IPC guidelines in addition to IPC personnel	No	0	39	86.7
	Yes	10	6	13.3
The relevant stakeholders are involved in the development and adaptation of the IPC guidelines in addition to IPC personnel	No	0	39	86.7
	Yes	7.5	6	13.3
The HCWs receive specific training related to new or updated IPC guidelines introduced in the HF	No	0	28	62.2
	Yes	10	17	37.8
The HF regularly monitors the implementation of at least some of the IPC guidelines	No	0	33	73.3
	Yes	10	12	26.7

Table 3. IPC Education and Training (CC5): HF Scores Per Indicator (N=45)

Indicator	Category	Score	n	%
There are personnel with IPC expertise (in IPC and/or infectious diseases) to lead IPC training	No	0	35	77.8
	Yes	10	10	22.2
There are additional non-IPC personnel with adequate skills to serve as trainers/mentors	No	0	26	57.8
	Yes	10	19	42.2
The frequency at which HCWs receive training regarding IPC in the HF	Never or rarely	0	27	60.0
	New employee orientation only for healthcare workers	5	7	15.6
	New employee orientation & regular (at least annually) IPC training for HCWs are offered but not mandatory	10	5	11.1
	New employee orientation and regular (at least annually) mandatory IPC training for all HCWs	15	6	13.3
The frequency at which cleaners and other personnel directly involved in patient care receive training regarding IPC in the HF	Never or rarely	0	26	57.8
	New employee orientation only for other personnel	5	8	17.8
	New employee orientation & regular (at least annually) training for other personnel are offered but not mandatory	10	4	8.9
	New employee orientation and regular (at least annually) mandatory IPC training for other personnel	15	7	15.6
Administrative & managerial staff receive general training regarding IPC in the HF	No	0	32	71.1
	Yes	5	13	28.9
How HCWs and other personnel are trained	No training available	0	26	57.8
	Using written information and/or oral instruction and/or e-learning only	5	6	13.3
	Includes additional	10	13	28.9

	interactive training sessions (for example, simulation and/or bedside training)			
There are periodic evaluations of the effectiveness of training programs (e.g., hand hygiene audits, and other checks on knowledge)	No	0	38	84.4
	Yes, but not regularly	5	3	6.7
	Yes, regularly (at least annually)	10	4	8.9
IPC training is integrated into the clinical practice and training of other specialities (eg, training of surgeons involves aspects of IPC)	No	0	28	62.2
	Yes, in some disciplines	5	10	22.2
	Yes, in all disciplines	10	7	15.6
There is specific IPC training for patients or family members to minimize the potential for HAIs (immunosuppressed patients, patients with invasive devices, patients with MDROs)	No	0	41	91.1
	Yes	5	4	8.9
There is ongoing development/education offered for IPC staff (attending conferences, and courses)	No	0	36	80.0
	Yes	10	9	20.0

Table 4. Surveillance of HAIs (CC4): HF Scores Per Indicator (N=45)

Indicator	**category**	**Score**	***n***	**%**
Organisation of Surveillance				
Surveillance is a defined component of the HF IPC program	No	0	45	100
	Yes	5	0	0
HF has personnel responsible for surveillance activities	No	0	45	100
	Yes	5	0	0
Professionals responsible for surveillance activities have been trained in basic epidemiology, surveillance and IPC (that is, the capacity to oversee surveillance methods, data management and interpretation)	No	0	45	100
	Yes	5	0	0
HF has informatics/IT support to conduct your surveillance (for example, equipment, mobile technologies, electronic health records)	No	0	45	100
	Yes	5	0	0
Priorities for surveillance - defined according to the scope of care				
HF conducts a prioritization exercise to determine the HAIs to be targeted for surveillance according to the local context (that is, identifying infections that are major causes of morbidity and mortality in the facility)	No	0	45	100
	Yes	5	0	0
The HF conducts surveillance for:				
Surgical site infections	No	0	45	100
	Yes	2.5	0	0
Device-associated infections (for example,	No	0	45	100

catheter-associated urinary tract infections, central line-associated bloodstream infections, peripheral-line-associated bloodstream infections, ventilator-associated pneumonia)	Yes	2.5	0	0
Clinically defined infections (e.g, definitions based only on clinical signs or symptoms in the absence of microbiological testing)	No	0	45	100
	Yes	2.5	0	0
Colonization or infections caused by multidrug-resistant pathogens according to your local epidemiological situation.	No	0	45	100
	Yes	2.5	0	0
Local priority epidemic-prone infections (e.g, norovirus, influenza, tuberculosis [TB], severe acute respiratory syndrome [SARS], Ebola, Lassa fever)	No	0	45	100
	Yes	2.5	0	0
Infections in vulnerable populations (e.g, neonates, intensive care unit, immunocompromised, burn patients)	No	0	45	100
	Yes	2.5	0	0
Infections that may affect healthcare workers in clinical, laboratory, or other settings (for example, hepatitis B or C, human immunodeficiency virus [HIV], influenza)	No	0	45	100
	Yes	2.5	0	0
Do you regularly evaluate if your surveillance is in line with the current needs and priorities of your facility?	No	0	45	100
	Yes	5		
HF uses reliable surveillance case definitions (defined numerator and denominator according to international definitions [e.g. CDC NHSN/ECDC] or if adapted, through an evidence-based adaptation process and expert consultation	No	0	45	100
	Yes	5	0	0
HF has standardized data collection methods (for example, active prospective surveillance) according to international surveillance protocols (for example, CDC NHSN/ECDC) or if adapted, through an evidence-based adaptation process and expert consultation.	No	0	45	100
	Yes	5	0	0
HF has processes in place to regularly review data quality (for example, assessment of case report forms, review of microbiology results, denominator determination, etc.)	No	0	45	100
	Yes	5	0	0
HF has adequate microbiology and laboratory capacity to support surveillance.	No	0	45	100
	Yes, can differentiate gram-positive/negative strains but cannot identify the pathogen	2.5	0	0
	Yes, can reliably identify	5	0	0

	pathogens (for example, isolate identification) promptly			
	Yes, can reliably identify pathogens and antimicrobial drug resistance patterns (that is, susceptibilities) promptly	10	0	0
Information analysis and dissemination/data use, linkage, and governance				
HF used surveillance data to make tailored unit/facility-based plans for the improvement of IPC practices.	No	0	45	100
	Yes	5		
HF analyzes antimicrobial drug resistance regularly (for example, quarterly/half-yearly/annually)	No	0	45	100
	Yes	5	0	0
Regularly (for example, quarterly/half yearly/annually) feedback up-to-date surveillance information to:				
Frontline healthcare workers (doctors/nurses	No	0	45	100
	Yes	2.5	0	0
Clinical leaders/heads of department	No	0	45	100
	Yes	2.5	0	0
IPC committee	No	0	45	100
	Yes	2.5	0	0
Non-clinical management/administration (chief executive officer/chief financial officer)?	No	0	45	100
	Yes	2.5	0	0
How feedback on up-to-date surveillance information is done (at least annually)	No feedback	0	45	100
	By written/oral information only	2.5	0	0
	By presentation and interactive problem-orientated solution-finding	7.5	0	0

Table 5. Multimodal Strategies for Implementing IPC Interventions (CC5): HF Scores Per Indicator (N=45)

Indicator	**Category**	**Score**	**n**	**%**
The HF uses multimodal strategies to implement IPC interventions	No	0	31	68.9
	Yes	15	14	31.1
The multimodal strategies used by the HF include any or all of the following elements: one answer per element.	**System change**			
	Element not included in multimodal strategies	0	31	68.9
	Interventions to ensure the necessary infrastructure and continuous availability of supplies are in place	5	12	26.7
	Interventions to ensure the necessary infrastructure and continuous availability	10	2	4.4

	of supplies are in place and addressing ergonomics and accessibility, such as the best placement of central venous catheter set and tray			
	Education and training			
	Element not included in multimodal strategies	0	31	68.9
	Written information and/or oral instruction and/or e-learning only	5	9	20.0
	Additional interactive training sessions (includes simulation and/or bedside training)	10	5	11.1
	Monitoring and feedback			
	Element not included in multimodal strategies	0	37	82.2
	Monitoring compliance with process or outcome indicators (audits of HH or catheter practices)	5	4	8.9
	Monitoring compliance & providing timely feedback on monitoring results to HCWs	10	4	8.9
	Communications and reminders			
	Element not included in multimodal strategies	0	35	77.8
	Reminders, posters, or other advocacy/awareness-raising tools to promote the intervention	5	8	17.8
	Additional methods/initiatives to improve team communication across units and disciplines	10	2	4.4
	Safety Climate and Culture change			
	Element not included in multimodal strategies	0	43	95.6
	Managers/leaders show visible support and act as champions and role models, promoting an adaptive approach and culture that supports IPC	5	0	0.0
	Additionally, teams and individuals are empowered so that they perceive ownership of the intervention	10	2	4.4
A multidisciplinary team is used to implement IPC multimodal strategies in the HF	No	0	34	75.6
	Yes	15	11	24.4
Colleagues from quality improvement and patient safety are	No	0	34	75.6
	Yes	10	11	24.4

regularly linked to develop & promote IPC multimodal strategies				
These strategies include bundles or checklists	No	0	44	97.8
	Yes	10	1	2.2

Table 6. Monitoring/Audit of IPC Practices & Feedback (CC6): HF Scores Per Indicator (N=45)

Indicator	**Category**	***Score***	***n***	***%***
HF has trained personnel responsible for monitoring/auditing IPC practices and feedback	No	0	36	80.0
	Yes	10	9	20.0
HF has a well-defined monitoring plan with clear goals, targets and activities & tools to collect data in a systematic way	No	0	40	88.9
	Yes	7.5	5	11.1
The processes and indicators the HF monitors	None	0	37	82.2
	Hand hygiene compliance (using the WHO hand hygiene observation tool or equivalent)	5	4	8.9
	Intravascular catheter insertion and/or care	5	2	4.4
	Wound dressing change	5	2	4.4
	Transmission-based precautions & isolation to prevent the spread of MDRO	5	4	8.9
	Cleaning of the ward environment	5	8	17.8
	Disinfection & sterilization of medical equipment/instruments	5	5	11.1
	Consumption/usage of alcohol-based hand rub/soap	5	5	11.1
	Consumption/usage of antimicrobial agents	5	4	8.9
	Waste management	5	6	13.3
How frequently the WHO Hand Hygiene Self-Assessment Framework Survey is undertaken	Never	0	40	88.9
	Periodically, but with no regular schedule	2.5	2	4.4
	At least annually	5	3	6.7
Feedback auditing reports (for example, feedback on hand hygiene compliance data or other processes) on the state of the IPC activities /performance given	No reporting	0	37	82.2
	Yes, within the IPC team	2.5	8	17.8
	Yes, to department leaders and managers in the areas being audited	2.5	6	13.3
	Yes, to frontline healthcare workers	2.5	7	15.6
	Yes, to the IPC committee or quality of care committees or equivalent	2.5	5	11.1
	Yes, hospital management & senior	2.5	6	13.3

	administration			
Reporting of monitoring data undertaken regularly (at least annually)	No	0	39	86.7
	Yes	10	6	13.3
Monitoring and feedback of IPC processes and indicators performed in a "blame-free" institutional culture	No	0	35	77.8
	Yes	5	10	22.2
HF assesses safety cultural factors (for example, by using other surveys such as HSOPSC, SAQ, PSCHO, and HSC22)	No	0	43	95.6
	Yes	5	2	4.4

Table 7. Workload, Staffing and Bed Occupancy (CC7): HF Scores Per Indicator (N=45)

Indicator	**Category**	***Score***	***n***	***%***
Staffing				
Appropriate staffing levels are assessed in the HF according to patient workload using national standards or a standard staffing needs assessment tool such as the WHO Workload Indicators of staffing need method	No	0	13	28.9
	Yes	5	32	71.1
There is an agreed (that is, WHO or national) ratio of HCW to patients maintained across the HF	No	0	8	17.8
	Yes, for staff in less than 50% of units	5	5	11.1
	Yes, for staff in more than 50% of units	10	8	17.8
	Yes, for all healthcare workers in the facility	15	24	53.3
A system is in place in the HF to act on the results of the staffing needs assessments when staffing levels are deemed to be too low	No	0	12	26.7
	Yes	10	33	73.3
Bed occupancy				
The design of wards in the HF is by international standards regarding bed capacity	No	0	9	20.0
	Yes, but only in certain departments	5	11	24.4
	Yes, for all departments (including emergency & paediatrics)	15	25	55.6
Bed occupancy in the HF kept to one patient per bed	No	0	4	8.9
	Yes, but only in certain departments	5	3	6.7
	Yes, for all units (including emergency & paediatrics)	15	38	84.4
Patients in HF are placed in beds standing in the corridor outside of the room (including beds in the emergency department)	Yes, more frequently than twice a week	0	1	2.2
	Yes, less frequently than twice a week	5	4	8.9
	No	15	40	88.9

Adequate spacing of > 1 meter between patient beds ensured in the HF	No	0	12	26.7
	Yes, but only in certain departments	5	9	20
	Yes, for all departments (including the emergency department and paediatrics)	15	24	53.3
A system is in place in the HF to assess and respond when adequate bed capacity is exceeded	No	0	6	13.3
	Yes, this is the responsibility of the head of the department	5	7	15.6
	Yes, this is the responsibility of the hospital administration/ management	10	32	71.1

Table 8. Built Environment, Materials & Equipment for IPC (CC8): HF Scores Per Indicator (N=45)

Indicator	**Category**	***Score***	***n***	***%***
Water services are available at all times and of sufficient quantity for all uses (for example, hand washing, drinking, personal hygiene, medical activities, sterilization, decontamination, cleaning and laundry)	No, available on average < 5 days per week	0	1	2.2
	Yes, available on average ≥ 5 days per week/every day but not of sufficient	2.5	6	13.3
	Yes, every day and of sufficient quantity	7.5	38	84.4
A reliable safe drinking water station present and accessible for staff, patients and families at all times and in all locations/wards	No, not available	0	1	2.2
	Sometimes, or only in some places or not available for all users	2.5	7	15.6
	Yes, accessible at all times and for all wards/groups	7.5	37	82.2
Functioning hand hygiene stations (that is, alcohol-based hand rub solution or soap and water and clean single-use towels) available at all points of care	No, not present	0	5	11.1
	Yes, stations are present, but supplies are not reliably available	2.5	17	37.8
	Yes, with reliably available supplies	7.5	23	51.1
In the HF, there are ≥ 4 toilets or improved latrines28 available for outpatient settings or ≥ 1 per 20 users for inpatient settings	Less than the required number of toilets or latrines available and functioning	0	13	28.9
	A sufficient number are present but not all functioning	2.5	3	6.7
	A sufficient number of present and functioning	7.5	29	64.4
The HF has sufficient energy/power supply available day and night for all uses (pumping & boiling water, sterilization and decontamination, incineration or alternative treatment technologies, general lighting	No	0	1	2.2
	Yes, sometimes or only in some of the mentioned areas	2.5	9	20.0
	Yes, always and in all mentioned areas	5	35	77.8
There is functioning environmental	No	0	2	4.4

ventilation (natural or mechanical) available in-patient care areas	Yes	5	43	95.6
For floors and horizontal work surfaces, there is an accessible record of cleaning, signed by the cleaners each day	No record of floors & surfaces being cleaned	0	34	75.6
	A record exists, but is not completed and signed daily or is outdated	2.5	3	6.7
	Yes, the record is completed & signed daily	5	8	17.8
There are appropriate and well-maintained materials for cleaning (for example, detergent, mops, buckets, etc.) available	No materials available	0	1	2.2
	Yes, available but not well-maintained	2.5	5	11.1
	Yes, available and well-maintained	5	39	86.7
There are single-patient rooms or rooms for cohorting patients with similar pathogens if the number of isolation rooms is insufficient (for example, TB, measles, cholera, Ebola, SARS)	No	0	20	44.4
	No single rooms but rather rooms suitable for patient cohorts are available	2.5	14	31.1
	Yes, single rooms are available	7.5	11	24.4

Table 9. Built Environment, Materials and Equipment for IPC (CC8): HF Scores Per Indicator (N=45) - Continuation

Indicator	**Category**	**Score**	**n**	**%**
Personal Protective Equipment (PPE) is available at all times and in sufficient quantity for all uses for all healthcare workers	No	0	2	4.4
	Yes, but not continuously available in sufficient quantities	2.5	9	20.0
	Yes, continuously available in sufficient quantities	7.5	34	75.6
HF has functional waste collection containers for non-infectious (general) waste, infectious waste and, sharps waste near all waste generation points	No bins or separate sharps disposal	0	6	13.3
	Separate bins present but lids missing or more than 3/4 full; only two bins (instead of three); or bins at some but not all waste generation points	2.5	10	22.2
	Yes	5	29	64.4
HF has a functional burial pit/fenced waste dump or municipal pick-up available for disposal of non-infectious (non-hazardous/ general waste)	No pit or other disposal method used	0	7	15.6
	The pit in the facility but insufficient dimensions; overfilled or not fenced/locked; or irregular municipal waste pick up	2.5	10	22.2
	Yes	5	28	62.2
There is an incinerator/alternative treatment technology for the treatment of infectious and sharp waste	No, none present	0	6	13.3
	Present, but not functional	1	22	48.9
	Yes	5	17	37.8
There is a wastewater treatment system (for example, septic tank followed by drainage pit) present (either on or off-	No, not present	0	10	22.2
	Yes, but not functioning reliably	2.5	1	2.2
	Yes and functioning reliably	5	34	75.6

site) and functioning reliably				
HF provides a dedicated decontamination area and/or sterile supply department	No, not present	0	14	31.1
	Yes, but not functioning reliably	2.5	12	26.7
	Yes and functioning reliably	5	19	42.2
HF reliably has sterile and disinfected equipment ready for use	No, available on average < five days per week	0	2	4.4
	Yes, available on average ≥ five days per week or every day, but not of sufficient quantity	2.5	14	31.1
	Yes, available every day and of sufficient quantity	5	29	64.4
Disposable items available when necessary (for example, injection safety devices, examination gloves)	No, not available	0	3	6.7
	Yes, but only sometimes available	2.5	5	11.1
	Yes, continuously available	5	37	82.2

Declarations

Ethics Approval and Consent to Participate

No ethical clearance was needed since we used secondary data and not human subjects. However, permission to use data was obtained in writing from the office of the RRRC. No. 51.04.2200.009.16.34(04).23-4282 dated 04 Nov 2022. No identifying information about HFs was included in the report.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare no conflict of interest. The authors alone are responsible for the views expressed in this article, and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated.

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Authors' Contributions

RRA-led IPC assessment conceptualization, tools adaption, data collection, analysis and manuscript writing. SSK, ESE, KVH, NM, PD, POA and MSM contributed to data collection, analysis and write-up of the manuscript. ATNRHB, BAW, SAL, DOO, and VW contributed to the writing of the manuscript. All authors read and approved the final manuscript.

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