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Infection Prevention and Control (IPC) Program Assessment in Healthcare Facilities in Cox's Bazar Rohingya Refugee Camps – 2022: Using the WHO IPCAF Tool

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Abstract

Infection prevention and control (IPC) is essential for the prevention of health care-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 developed the IPC Assessment Framework (IPCAF) tool to assess levels 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 June 2022 IPCAF reports of 45 HFs in Rohingya refugee camps. Conducted descriptive analysis using SPSS 29 for each CC, total IPC scores per HF and level of IPC promotion and practices obtained. No HFs scored as inadequate or basic, and 24% scored as intermediate level, while 76% scored as having an advanced level of IPC. 78% of the HFs had an IPC program, 100% had standard precaution guidelines, 98% had the capacity to lead IPC training; however, none conducted HAIs surveillance. 100% of the HFs followed the multimodal strategy for IPC, and 100% have a clear monitoring plan for IPC activities. 88% of HFs had appropriate staffing, workload, and 100% had 1 patient to 1 bed standard, while 91% of HFs had functional hand hygiene stations at all points of care. The HFs in the Rohingya refugee camps fully implemented IPC programs in 2022, except for one core component (surveillance of HAIs). Interventions aimed at incorporating surveillance of HAIs into IPC programs in HFs in Cox's Bazar refugee camps should be explored.

Keywords: *2022, Healthcare Facilities, Infection Prevention and Control, IPCAF, Rohingya Refugee Camps.*

Introduction

Healthcare-associated infections (HAIs) are infections that are acquired by patients while seeking care and treatment in healthcare facilities (HFs) [1]. The World Health Organisation (WHO) estimates the burden of HAIs to be 7% in high-income countries and 5.7%–19.1% in low- and middle-income countries (LMICs)[2]. Infection Prevention and Control (IPC) is a practical, evidence-based approach that prevents patients and healthcare workers (HWs) from being harmed by avoidable infections, particularly HAIs [3]. Evidence shows that a well-implemented IPC program can reduce HAIs by at least 30% [4]. IPC was also listed by WHO as one of the core pillars in the fight towards outbreak-prone diseases like COVID-19 [5, 6]. WHO

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developed a global strategy for IPC, which highlights how important IPC implementation is globally [7]. IPC is also a significant component of global public health initiatives, encompassing sustainable development goals related to health, antimicrobial resistance (AMR) strategies, International Health Regulations, and patient and HW safety [8–11].

Furthermore, in complex humanitarian emergencies (CHEs) settings, IPC is also a very important component of healthcare, especially due to the difficult environment in which those HFs operate. The CHEs, which are often precipitated by natural disasters, conflict, and displacement, create conditions such as overcrowding, poor sanitation, and limited healthcare resources, which are favourable for the spread of various infectious diseases. [12–16]. The Cox's Bazar Rohingya refugee crisis has 33 heavily congested camps housing approximately 949,234 Rohingya refugees and is considered the world's biggest refugee settlement served by 105 HFs [17, 18]. In such CHEs, the HFs receive patients with many different infectious conditions, and if proper IPC is not observed, it could lead to a higher risk of spreading infections within the HFs and the refugee camps.

WHO published guidance on IPC programs that includes eight core components (CCs) [19] To support the systematic implementation of IPC in HFs. The CCs include, 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 an IPC Assessment Framework (IPCAF) tool to support assessment of implementation of IPC programs in HFs and to identify gaps for improvement [20]. The IPCAF tool is structured into eight sections reflecting 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).

Using the WHO IPCAF tool, this study assessed the level of IPC program (all 8 IPC program CCs) implementation in HFs in Rohingya refugee camps in 2022 to identify gaps for improvement of IPC interventions in such CHEs.

Methods

Design and study Area

This was a cross-sectional study conducted in November 2024 by reviewing secondary data from June 2022 IPCAF reports of 45 HFs in Rohingya refugee camps to the health sector in Cox's Bazar, Bangladesh. Approximately 949,234 Rohingya refugees live in 33 highly congested camps in Cox's Bazar. [17]. 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 deliveries care and secondary healthcare facilities (SHFs) that provide outpatient, inpatient and surgical services. [18]. The overall administration of the refugee camps 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 June 2022 IPCAF assessment conducted by the Cox's Bazar health sector in Rohingya refugee camps were considered for this study. These included 17 HPs, 18 PHCs, and 10 SHFs.

Data Collection Tools and Data Collection

We adapted the WHO IPCAF tool for use in the outpatient HFs like HPs, and we considered a full score for any question of the IPACF tool that does not apply to the level of HP, as recommended in the IPCAF tool. Each CC has a set of questions with predefined answers and scores adding up to 100; the eight CCs sum up to 800. Then assigned an overall score out of 800 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 [20]. Applying the same concept, the study also categorised levels of implementation of the individual IPC program CCs in the HFs based on total CC score out of 100; (i) 0–25=inadequate, (ii) 25.1–50=basic, 50.1–75=intermediate, and 75.1–100=advanced [21]. 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, range, median, and 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 (76%) of the HFs had advanced IPC promotion and practices with scores between 601 and 800 out of 800, while 24% of the HFs had intermediate IPC promotion and practices with scores between 401 and 600 out of 800. No HFs were found with an inadequate or basic level of IPC promotion and practices as reflected in Table 1.

Table 1. Overall Level of IPC Promotion and Practice in HFs

Overall IPC program score range	Assigned IPC level	Frequency (N=45)	Percentage
0-200	Inadequate	0	0
201-400	Basic	0	0
401-600	Intermediate	11	24%
601-800	Advanced	34	76%

Performance for all IPC Program CCs

All CCs scored at least 30% except CC4, which scored 0%. CC1 had 75% of the HFs scoring between 81% and 90%, while 25% of the HFs scored between 72.5% and 81%. CC2 had 75% of the HFs scoring ≥ 81%, while 25% of the HFs scored between 65% and 81%. CC3 had 75% of the HFs scoring between 77.5% and 100%, while 25% of the HFs scored between 45 and 77.5%. All HFs scored 0% for CC4. CC5 had 75% of the HF scoring between 82.5% and 100 %, while 25% scored between 60% and 82.5%. Considering CC6, 50% of the HFs scored between 90% and 100%. CC7 had 75% of the HFs scoring 85% and 100%, while for CC8, almost all HFs scored 100/% %. Figure 1 summarizes the performance scores of the HFs in all the IPC program CCs.

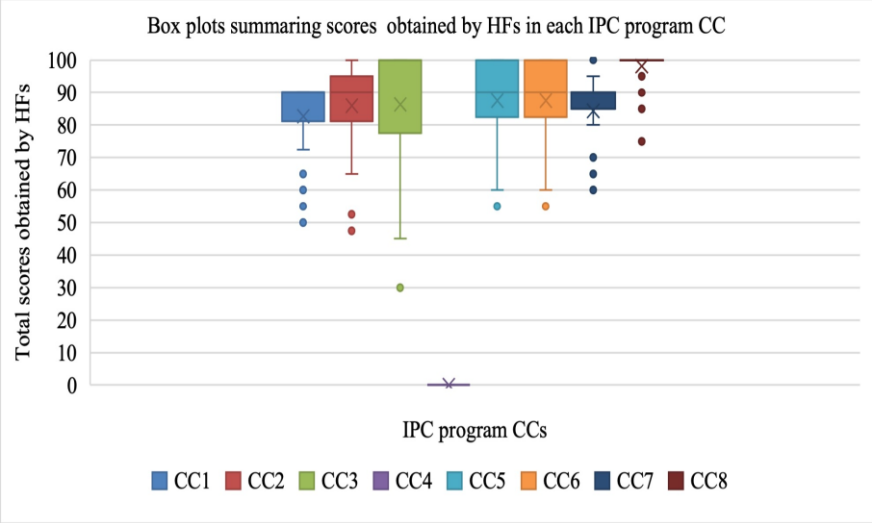

Figure 1. Summary of Performance per IPC CC

Performance by IPC CC

CC1: No HFs scored as inadequate, 6.7% scored as basic, 15.6% scored as intermediate, while 77.8% had advanced implementation of CC1. The mean score was 82.7%, the lowest and highest scores were 50% and 90%, respectively, with both the median and modal scores as 90%. Approximately 78% of the HFs had an IPC program with objectives and a work plan. All (100%) HFs had an IPC focal person, 76% of the HFs had a budget dedicated to IPC activities; however, none of the HFs had microbiology laboratory support for routine day-to-day use.

CC2: No HFs scored as inadequate, 4.4% scored as basic, 17.8% scored as intermediate, while 77.8% of the HFs scored as an advanced level of CC2 implementation. The mean score was 85.9%, the lowest and highest scores were 47.5% and 90%, respectively. 75.5% of HFs could develop or adapt guidelines, 100% of the HFs had most IPC guidelines; however, guidelines on multidrug-resistant pathogens and antimicrobial stewardship were lacking in 53% and 69% of the HFs, respectively. Most HFs (93%) had regular training of HWs on new guidelines, while 95.5% had regular monitoring of implementation of some of the IPC guidelines.

CC3: No HFs scored as inadequate, 13.3% scored as basic, 11.1% scored as intermediate, while 75.6% had an advanced level of implementation of CC3. The mean score was 86.3%, the lowest score was 30%, the highest score was 100%, while the median and modal scores were both 100%. Almost all (98%) HFs reported having expertise to lead IPC training, while all HFs assessed had received some form of IPC training. Over 78% of the HFs provided some form of IPC education to patients and caregivers.

CC4: All HFs scored as inadequate for CC4 since there was no CC4 as a well-defined component of any IPC program in the HFs in the Rohingya refugee camp. There was no HAIs 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 colonisation or infections caused by multidrug-resistant pathogens or infections in vulnerable populations, and infections that may affect HWs in the HF.

CC5: No HFs scored as inadequate or basic, only 17.8% scored as intermediate, while 82.2% scored as an advanced level of implementation of CC5. The mean score was 87.6%, and the lowest and highest scores were 55% and 100%, respectively. The multimodal strategies included system change in infrastructure and supplies in 73% of the HFs,

education and training in 77.7% of the HFs, monitoring and providing timely feedback in 84% of the HFs, initiatives to improve communication in 73% of the HFs and ownership of interventions in 77.7% of the HFs.

CC6: No HFs scored as either inadequate or basic, only 17.8% were intermediate, while 82.2% scored advanced level of CC6. The mean score was 87.6%, and the lowest and highest scores were 60% and 100%, respectively. 98% of the HFs had at least one trained person responsible for monitoring IPC, with 100% of the HFs having a clear monitoring plan. Approximately 80% of the HFs reported using the WHO hand hygiene observation tool or its equivalent for monitoring hand hygiene, while 100% monitored the consumption of hand rubs and soap for hand hygiene.

CC7: No HFs scored as either inadequate or basic level, 13.3% were intermediate, while 86.7% scored as advanced level of implementation of CC7. The mean score for CC7 was 84.3%, the lowest and highest scores were 60% and 100%, respectively, while the mode and median scores were both 85%. An agreed ratio of staff to patients was maintained in 88% of the HFs, while 100% of the HFs strictly maintained the standard of one patient per bed and a distance of 1m between patient beds in all wards.

CC8: No HFs scored as either inadequate or basic, only 2.2% scored as intermediate, while 97.8% scored as an advanced level of CC8. The mean score was 98.1%, and the lowest and highest scores were 75% and 100%, respectively. 97.7% of HFs had reliable drinking water, and 91% had functional hand-washing stations at all points of patient care. Also, 100% had waste segregation bins, 96% had records of cleaning, and 100% had sufficient and functioning toilets. Additionally, 95.6% of the HFs had sufficient quantities of personal protective equipment (PPE), 95.6% had sterile equipment ready for use, and 95.6% had a sufficient power supply at all times.

Discussion

Generally, our findings showed that seven IPC program CC were largely well implemented, but surveillance of HAI was non-existent. The majority (76%) of the HFs were classified as meeting advanced levels, while a few (24%) HFs were classified as meeting intermediate levels of IPC a performance as classified in the WHO IPCAF tool [22]. The findings mirror other IPCAF results from high-income and Upper-middle-income countries. [23–27].

CC1: This study found that 78% of the HFs had IPC programs with clearly defined objectives, activities, workplans and dedicated budgets, and 100% had IPC focal persons and committees, which was in agreement with a 2021 IPCAF study in China [26]. The HFs, however, lacked microbiology laboratory support, which challenges efforts on surveillance of HAIs. The lack of a microbiology laboratory in the Rohingya refugee camps could be explained by the difficulties in CHEs, which include complexities in setting up and operating, limited equipment and supplies, and inadequate skilled human resources.

CC2: This study found that by 2022, the majority of the HFs had different IPC guidelines and a median score of 90% in CC2. The study reveals that IPC guidelines in the HFs in Rohingya refugee camps are well established. This finding is close to a nationwide German hospitals IPCAF survey, which found a CC2 median score of 100% [23]. All HFs also had the government of Bangladesh hospital IPC manual of 2018, which is used by all HFs in Bangladesh. [28]. The presence of guidelines in Rohingya camps is a great strength because these guide consistent and uniform implementation of IPC activities in HFs.

CC3: 77.8% of the HFs provided IPC training to patients and family members, a finding slightly higher than that of an IPCAF study in China, where 73.4% of the HFs trained patients and family members [26]. Almost all HFs had the expertise to perform IPC training on site, similar to an Austrian IPCAF study of 2018 [25]. This performance in CC3 could be attributed to the presence of trained IPC focal persons who support continuous IPC training and education. HFs with more IPC-trained HWs performed better in hand hygiene and Central Venous Catheter-Related Bloodstream infection prevention practices compared to HFs with fewer IPC HWs [29, 30].

CC4: Absence of HAIs surveillance in the HFs in the Rohingya camps could have been largely due to limited capacity in terms of training on HAIs surveillance and microbiology laboratory. This finding is in agreement with a study in conflict-affected areas of Syria that found almost no HF with HAIs surveillance. [31]. Absence of HAI surveillance in HFs is not unique to conflict-affected areas or CHEs like Rohingya refugee camps, but is also found in other studies in contexts outside CHEs, especially in LMICs [32–36]. A comprehensive program to support surveillance of HAIs in the HFs in the Rohingya refugee camps is crucial.

CC5: All HFs in Rohingya refugee camps practised a multimodal approach in the implementation of IPC, and with a median of 90%, the study shows that the HFs in the Rohingya camps widely implemented the multimodal strategies of IPC. WHO encourages that all IPC interventions should always target systems change, education and training, monitoring and feedback, communications and reminders and safety climate and culture change [37]. If an intervention takes into consideration all these facets, it will be more reliable and sustainable.

CC6: All HFs had monitoring plans and tools, with 98% having IPC focal persons trained in monitoring of IPC activities, a finding in agreement with the IPCAF studies in China and Turkey [26, 27]. Compared to the IPCAF study in conflict settings conducted in Syria, where the median score for CC6 was only 15% [31] the median in this study (85%) is more than 5-fold higher. Monitoring of IPC practices like hand hygiene in hospitals has been reported to improve with increased monitoring and immediate feedback. [38–40] Which intern reduces the spread of HAIs in the HF?

CC7: 100% of the HFs in the Rohingya refugee camps maintained a 1 metre spacing between patient beds, which was much higher than the rest of Bangladesh, which had only 27.3% [32] And higher than other places, countries where bed 1 metre bed spacing ranged from 42.8% to 59% [35, 41, 26]. Ample patient bed spacing not only helps reduce the spread of HAIs, but also offers sufficient space for ease cleaning and better ergonomics for HWs [42, 43]. Heavy workload for HWs leads to compromise in IPC standard precautions; thus, the need to maintain patient ratios recommended by national or global guidelines to reduce the chances of HAIs [44, 45].

CC8: The WHO recommends that patient care activities be conducted in a clean and hygienic environment to prevent and reduce the spread of HAIs [19, 46]. Almost all HFs (97.8%) in the Rohingya camps had an advanced level of CC8, which reveals that most aspects of the CC8 are well implemented. Almost all HFs (97.8%) had water services available at all times and of sufficient quantity for all uses, a finding close to 95.6% in the Turkish IPCAF tool study. [27] However, much higher than 63.6% in other HFs in the rest of Bangladesh [32]. Although the availability of PPE, record of cleaning and hand hygiene were found to be high, appropriate use of PPE, accuracy of cleaning records and hand hygiene practices should be further studied.

Limitations of the study

The use of secondary data for this study limited our ability to observe actual IPC practices of HWs as would have been the case with primary data collection. However, the reported practices in the IPCAF tool can be a proxy for the actual practices and can inform interventions for IPC improvement. Future studies could explore direct observation of IPC practices in the HFs in the Rohingya camps to ascertain actual practice.

Conclusions

The IPC program CCs were largely well implemented in Rohingya refugee camps in 2022 with well-structured IPC programs, clear objectives and activities. HFs had trained IPC HWs, basic IPC guidelines, conducted IPC training and education and used multimodal strategies for implementation of IPC. Additionally, audit, monitoring, and feedback of IPC practices were well implemented 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. However, the HFs lacked surveillance of HAIs as a defined component of their IPC programs. We recommend the introduction of HAI surveillance as a clearly defined and implemented component of the IPC programs in HFs in the Rohingya refugee camps of Cox's Bazar.

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 in Cox's Bazar. No. 51.04.2200.009.16.34(04).23-4282 dated 04 Nov 2022. No identifying information of 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 on 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 conceptualisation, tools adaptation, data collection, analysis and manuscript writing. SSK, ESE, KVH, POA and MSM contributed to data collection, analysis and write-up of the manuscript. ATNRHB and MMR contributed to the writing of the manuscript. All authors read and approved the final manuscript.

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References

[1]. Storr, J., Twyman, A., Zingg, W., Damani, N., Kilpatrick, C., Reilly, J., et al., 2017, Core components for effective infection prevention and control programmes: New WHO evidence-based recommendations. *Antimicrobial Resistance and Infection Control*, *6*(1). https://doi.org/10.1186/s13756-016-0149-9

[2]. Tomczyk, S., Storr, J., Kilpatrick, C., & Allegranzi, B., 2021, Infection prevention and control (IPC) implementation in low-resource settings: a qualitative analysis. *Antimicrobial Resistance and Infection Control*, *10*(1). https://doi.org/10.1186/s13756-021-00962-3

[3]. World health Organization, 2024, August 3, *Infection Prevention and Control*. Infection Prevention and Control Overview. https://www.who.int/health-topics/infection-prevention-and-control#tab=tab_1

[4]. World Health Organisation. (n.d.). 2020, *Infection prevention and control*. Who.Int. Retrieved March 15, 2020, from https://www.who.int/infection-prevention/en/

[5]. World Health Organization, 2020, Operational planning guidance to support country preparedness and response. COVID-19 strategic preparedness and response. *22 May 2020. COVID-19: Critical preparedness, readiness and response*.

[6]. World Health Organization., 2021, Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed. *interim guidance. 12 July 2021*.

[7]. World Health organization, 2023, Global strategy on infection prevention and control.

[8]. United Nations, 2015, Transforming our world: the 2030 agenda for sustainable development. https://sdgs.un.org/2030agenda

[9]. World health Organization, 2015, Global Action Plan on Antimicrobial Resistance 2015.

[10]. World Health Organization, 2005, *International Health Regulations (2005) - Third Edition*. (World Health Organization, Ed.; Third, Vol. 3). World Health organization. https://iris.who.int/bitstream/handle/10665/246107/9789241580496-eng.pdf

[11]. World Health Organization, 2016, Health care without avoidable infections: the critical role of infection prevention and control. *World Health Organization*.

[12]. Shackelford, B. B., Cronk, R., Behnke, N., Cooper, B., Tu, R., D'Souza, M., Bartram, J., Schweitzer, R., & Jaff, D., 2020, Environmental health in forced displacement: A systematic scoping review of the emergency phase. *Science of the Total Environment*, *714*. https://doi.org/10.1016/j.scitotenv.2020.136553

[13]. Breiman, R. F., Shultz, A., Omollo, J. O., Burke, H., Qassim, M., Ochieng, J. B., Weinberg, M., & Feikin, D. R., 2009, Cholera outbreak in kenyan refugee camp: Risk factors for illness and importance of sanitation. *American Journal of Tropical Medicine and Hygiene*, *80*(4). https://doi.org/10.4269/ajtmh.2009.80.640

[14]. Connolly, M. A., Gayer, M., Ryan, M. J., Salama, P., Spiegel, P., & Heymann, D. L., 2004, Communicable diseases in complex emergencies: Impact and challenges. In *Lancet*, 364(9449). https://doi.org/10.1016/S0140-6736(04)17481-3

[15]. Behnke, N. L., Cronk, R., Shackelford, B. B., Cooper, B., Tu, R., Heller, L., & Bartram, J., 2020, Environmental health conditions in protracted displacement: A systematic scoping review. *Science of the Total Environment*, *726*. https://doi.org/10.1016/j.scitotenv.2020.138234

[16]. Cooper, B., Behnke, N. L., Cronk, R., Anthonj, C., Shackelford, B. B., Tu, R., & Bartram, J., 2021, Environmental health conditions in the transitional stage of forcible displacement: A systematic scoping review. In *Science of the Total Environment* (Vol. 762). https://doi.org/10.1016/j.scitotenv.2020.143136

[17]. UNHCR, & Government of Bangladesh., 2024, *Joint Government of Bangladesh - UNHCR Population Factsheet - 30 June 2024*. https://data.unhcr.org/en/country/bgd

[18]. Cox's Bazar Health Sector., 2024, *Cox's Bazar Health Sector bulletin - May 2024*. https://rohingyaresponse.org/wp-content/uploads/2024/06/CXB-Health-Sector-Bulletin-May-2024.pdf

[19]. World Health Organization, 2016, Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. In *World Health Organization*.

[20]. World Health Organization, 2018, Infection prevention and control assessment framework at the facility level. *World Health Organization*.

[21]. Kamara, R. Z., Kamara, I. F., Moses, F., Kanu, J. S., Kallon, C., Kabba, M., et al., 2023, Improvement in Infection Prevention and Control

Compliance at the Three Tertiary Hospitals of Sierra Leone following an Operational Research Study. *Tropical Medicine and Infectious Disease*, *8*(7). https://doi.org/10.3390/tropicalmed8070378

[22]. World Health Organization., 2018, Infection prevention and control assessment framework at the facility level. *World Health Organization*.

[23]. Aghdassi, S. J. S., Hansen, S., Bischoff, P., Behnke, M., & Gastmeier, P., 2019, A national survey on the implementation of key infection prevention and control structures in German hospitals: Results from 736 hospitals conducting the WHO Infection Prevention and Control Assessment Framework (IPCAF). *Antimicrobial Resistance and Infection Control*, *8*(1). https://doi.org/10.1186/s13756-019-0532-4

[24]. Nomoto, H., Saito, H., Ishikane, M., Gu, Y., Ohmagari, N., Pittet, D., Kunishima, H., Allegranzi, B., & Yoshida, M., 2022, First nationwide survey of infection prevention and control among healthcare facilities in Japan: impact of the national regulatory system. *Antimicrobial Resistance and Infection Control*, *11*(1). https://doi.org/10.1186/s13756-022-01175-y

[25]. Aghdassi, S. J. S., Aghdassi, S. J. S., Grisold, A., Grisold, A., Wechsler-Fördös, A., Hansen, S., Hansen, S., Bischoff, P., Bischoff, P., Behnke, M., Behnke, M., Gastmeier, P., & Gastmeier, P., 2020, Evaluating infection prevention and control programs in Austrian acute care hospitals using the WHO Infection Prevention and Control Assessment Framework. *Antimicrobial Resistance and Infection Control*, *9*(1). https://doi.org/10.1186/s13756-020-00761-2

[26]. Ni, K., Jin, D., Wu, Z., Sun, L., & Lu, Q., 2022, The status of infection prevention and control structures in Eastern China based on the IPCAF tool of the World Health Organization. *Antimicrobial Resistance and Infection Control*, *11*(1). https://doi.org/10.1186/s13756-022-01087-x

[27]. Azak, E., Sertcelik, A., Ersoz, G., Celebi, G., Eser, F., Batirel, A., Cag, Y., et al., 2023, Evaluation of the implementation of WHO infection prevention and control core components in Turkish health care facilities: results from a WHO infection prevention and control assessment framework (IPCAF)—based survey. *Antimicrobial Resistance and Infection Control*, *12*(1). https://doi.org/10.1186/s13756-023-01208-0

[28]. Government of Bangladesh., 2018, Hospital Infection Prevention and Control manual.

[29]. Allegranzi, B., Conway, L., Larson, E., & Pittet, D., 2014, Status of the implementation of the World Health Organization multimodal hand hygiene strategy in United States of America health care facilities. *American Journal of Infection Control*. https://doi.org/10.1016/j.ajic.2013.11.015

[30]. Krein, S. L., Hofer, T. P., Kowalski, C. P., Olmsted, R. N., Kauffman, C. A., Forman, J. H., Banaszak-Holl, J., & Saint, S., 2007, Use of central venous catheter-related bloodstream infection prevention practices by US hospitals. *Mayo Clinic Proceedings*, *82*(6), 672–678.

[31]. Ahmado, M. A., Alghajar, M., Meagher, K., Patel, P., & Ekzayez, A., 2024, Infection Prevention and Control (IPC) in conflict-affected areas in Northeast Syria: A cross-sectional study. *IJID Regions*, 100412. https://doi.org/10.1016/J.IJREGI.2024.100412

[32]. Harun, M. G. D., Anwar, M. M. U., Sumon, S. A., Hassan, M. Z., Haque, T., Mah-E-Muneer, S., Rahman, A., Abdullah, S. A. H. M., Islam, M. S., Styczynski, A. R., & Kaydos-Daniels, S. C., 2022, Infection prevention and control in tertiary care hospitals of Bangladesh: results from WHO infection prevention and control assessment framework (IPCAF). *Antimicrobial Resistance and Infection Control*, *11*(1). https://doi.org/10.1186/s13756-022-01161-4

[33]. Rabbani, F., Lalji, S., Abbas, F., Jafri, S. M. W., Razzak, J., Nabi, N., Jahan, F., Ajmal, A., Petzold, M., Brommels, M., & Tomson, G., 2011, Understanding the context of balanced scorecard implementation: a hospital-based case study in Pakistan. *Implementation Science*, *6*(1), 31. https://doi.org/10.1186/1748-5908-6-31

[34]. Tartari, E., Tomczyk, S., Pires, D., Zayed, B., Coutinho Rehse, A. P., Kariyo, P., Stempliuk, V., Zingg, W., Pittet, D., & Allegranzi, B., 2021, Implementation of the infection prevention and control core components at the national level: a global situational analysis. *Journal of Hospital*

Infection, *108*. https://doi.org/10.1016/j.jhin.2020.11.025

[35]. Tomczyk, S., Twyman, A., de Kraker, M. E. A., Coutinho Rehse, A. P., Tartari, E., Toledo, J. P., Cassini, A., Pittet, D., & Allegranzi, B., 2022, The first WHO global survey on infection prevention and control in health-care facilities. *The Lancet Infectious Diseases*, *22*(6). https://doi.org/10.1016/S1473-3099(21)00809-4

[36]. Mahomed, S., Mahomed, O., Sturm, A. W., Knight, S., & Moodley, P., 2017, Challenges with surveillance of healthcare-associated infections in intensive care units in South Africa. *Critical Care Research and Practice*, https://doi.org/10.1155/2017/7296317

[37]. World Health Organization., 2016, Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. In *World Health Organization*.

[38]. Walker, J. L., Sistrunk, W. W., Higginbotham, M. A., Burks, K., Halford, L., Goddard, L., Thombs, L. A., Austin, C., & Finley, P. J., 2014, Hospital hand hygiene compliance improves with increased monitoring and immediate feedback. *American Journal of Infection Control*, *42*(10). https://doi.org/10.1016/j.ajic.2014.06.018

[39]. Meng, M., Sorber, M., Herzog, A., Igel, C., & Kugler, C., 2019, Technological innovations in infection control: A rapid review of the acceptance of behavior monitoring systems and their contribution to the improvement of hand hygiene. In *American Journal of Infection Control*, 47(4). https://doi.org/10.1016/j.ajic.2018.10.012

[40]. Northey, C., 2012, Improving Hand Hygiene Practice Through Utilization of Automated Hand Hygiene Monitoring and Feedback Technology. *American Journal of Infection Control*, *40*(5). https://doi.org/10.1016/j.ajic.2012.04.273

[41]. Oppong, T. B., Amponsem-Boateng, C., Kyere, E. K. D., Wang, Y., Gheisari, Z., Oppong, E. E., Opolot, G., Duan, G., & Yang, H., 2020, Infection prevention and control preparedness level and associated determinants in 56 acute healthcare facilities in Ghana. *Infection and Drug Resistance*, *13*. https://doi.org/10.2147/IDR.S273851

[42]. Forrest, A. W., 1935, Scarlet fever control on modern lines. *Public Health*, *49*(C). https://doi.org/10.1016/S0033-3506(35)80317-X

[43]. Oladapo, O., & Liyanage, C. L., 2010, Control of healthcare associated infections: A concerted effort. *Association of Researchers in Construction Management, ARCOM 2010 - Proceedings of the 26th Annual Conference*.

[44]. Lasater, K. B., Sloane, D. M., McHugh, M. D., Cimiotti, J. P., Riman, K. A., Martin, B., Alexander, M., & Aiken, L. H., 2021, Evaluation of hospital nurse-to-patient staffing ratios and sepsis bundles on patient outcomes. *American Journal of Infection Control*, *49*(7). https://doi.org/10.1016/j.ajic.2020.12.002

[45]. Cimiotti, J. P., Aiken, L. H., Sloane, D. M., & Wu, E. S., 2012, Nurse staffing, burnout, and health care-associated infection. *American Journal of Infection Control*, *40*(6). https://doi.org/10.1016/j.ajic.2012.02.029

[46]. World Health Organization., 2018, Improving infection prevention and control at the health facility interim practical manual supporting implementation of the WHO guidelines on core components of infection prevention and control programmes.