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Original Article

Evaluation of infection prevention and control in a Moroccan university hospital using the IPCAF tool

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Abstract

Introduction: Healthcare-associated infections (HAIs) are a significant global health challenge. In Morocco, while the prevalence of HAIs has been studied in university hospitals, limited research has focused on the effectiveness of infection prevention and control (IPC) programs. This study evaluates the adherence of 8 Moroccan hospitals to IPC standards using the Infection Prevention and Control Assessment Framework (IPCAF).

Methodology: Eight Moroccan hospitals participated in this study. The IPC compliance of each hospital was assessed using the IPCAF tool, which evaluates IPC committees, staff training, infrastructure, and surveillance systems.

Results: The study showed significant variation in IPCAF scores. Hospitals such as Maternity and Reproductive Health Hospital - Orangers, Ibn Sina Hospital, and National Institute of Oncology achieved high compliance, with scores of 657.5 and 652.5, reflecting 82.19% and 81.56% compliance. These hospitals demonstrated strong IPC committees, effective training, and consistent surveillance. In contrast, Arrazi Hospital and Souissi Maternity had lower scores, with HAI scoring 352.5, indicating gaps in IPC practices. The lower-scoring hospitals struggled with infrastructure, staff involvement, and adherence to IPC guidelines.

Conclusions: The study highlights the importance of leadership commitment, regular training, and surveillance to improve IPC outcomes. It emphasizes the need for targeted interventions in underperforming hospitals to address gaps in infrastructure and staff involvement, thereby enhancing patient safety and infection control standards in Morocco.

Key words: infection prevention and control; IPCAF; healthcare-associated infections.

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Introduction

Nosocomial infections, also known as healthcare-associated infections (HAIs), are complications that can arise following medical treatment or contact with a healthcare facility. They can be caused by bacteria, viruses or fungi, and are transmitted by direct contact, droplets, or contaminated equipment [1].

These infections usually develop 48 hours or more after a patient's admission to hospital, or within 30 days of surgery (and up to a year in the case of implant surgery), when they were neither present nor incubating at the time of admission [2].

HAIs can affect any hospitalized patient, but certain groups such as the elderly, the immunocompromised, premature newborns, burn patients, and those who have undergone surgery, are particularly at risk.

They are a major concern worldwide, as they increase healthcare costs, promote antimicrobial resistance (AMR), and can lead to premature death or lasting disability. The coronavirus disease 2019 (COVID-19) pandemic highlighted the speed with which infections can spread in healthcare facilities, but HAIs are a constant risk, even outside epidemic periods [3].

The implementation of evidence-based infection prevention and control (IPC) practices is critical in reducing the incidence of HAIs. According to the World Health Organization (WHO)'s 2024 report [4], there is a strong correlation between improved IPC measures and reduction in both HAIs and AMR. Strengthening IPC programs is vital for ensuring patient safety and achieving high-quality care across healthcare settings worldwide.

According to the WHO, on average, 7% of patients in high-income countries and 15% in low- and middle-income countries (LMICs) acquired at least one HAI during hospitalization in 2024, with rates reaching up to 30% in intensive care units, particularly in LMICs [4]. Several studies have documented the prevalence of HAI in various university hospitals in Morocco. A 2018

study at Ibn Rochd University Hospital Center in Casablanca reported a prevalence rate of 9.5% [5], while a survey conducted at Ibn Sina University Hospital in Rabat in 2012 found a prevalence of 10.3% [6]. Additionally, a 2009 study at Hassan II University Hospital in Fez revealed a rate of 12.4% [7]. A 2007 survey at Ibn Sina University Hospital in Rabat identified a higher prevalence of 17.8%, particularly in intensive care units (50%). The most frequent infections reported were urinary tract infections (35%) and surgical wounds (32.5%), with *Staphylococcus aureus* and *Proteus mirabilis* being the most common pathogens [8]. In another study, conducted at Hassan II University Hospital in Fez in 2007, the HAI prevalence was 6.7%, with surgical site infections being the most common. The study also highlighted a significant association between infections and surgical interventions, urinary catheters, and prolonged hospital stays [9].

In addition, another study that assessed HAI rates in an intensive care unit of a Moroccan hospital found an overall HAI rate of 14.5% [10]. The study revealed the highest rates of ventilator-associated pneumonia (43.2 per 1,000 ventilator-days) and central venous catheter-related bloodstream infections (15.7 per 1,000 catheter-days), emphasizing the critical need for infection control measures in high-risk settings. Furthermore, a 2013 study conducted at Mohammed V Hospital in Meknes reported a 9.4% HAI prevalence [11].

These studies have contributed baseline and valuable data on infection rates but were primarily focused on the identification of infections themselves rather than the broader context of IPC practices. To date, there has been no comprehensive evaluation of IPC practices using a standardized framework in Moroccan hospitals. The Infection Prevention and Control Assessment Framework (IPCAF), developed by the WHO, is a structured tool designed for assessing the effectiveness of IPC programs in healthcare settings. It serves as both a diagnostic tool and a monitoring mechanism, helping institutions evaluate their adherence to IPC guidelines. Healthcare facilities can identify strengths, gaps, and areas for improvement in their IPC practices by using IPCAF [12].

hospitals to track their progress and improve IPC strategies. By using IPCAF, this study will contribute to the development of more effective infection prevention programs in Morocco, which are critical for reducing the prevalence of HAIs and improving patient outcomes.

Methodology

Study period and enrolled hospitals

This study was conducted between June and December 2024 in 8 tertiary-level hospitals—all affiliated with the Ibn Sina University Hospital Center (CHU) in Rabat: Maternité Souissi (MS), Maternity and Reproductive Health Hospital - Orangers (HMSRO), Arrazi Hospital (HAS), Ayachi Hospital (HEY), Moulay Youssef Hospital (HMY), National Oncology Institute (INO), Children's Hospital (HE), and Ibn Sina Hospital (HIS) which is the main facility of the Rabat-Salé-Kénitra region. Information regarding the study sites is summarized in Table 1.

These hospitals covered a wide range of medical and surgical specialties: psychiatry (HAS), traumatology and specialized surgery (HEY), oncology (INO), pediatrics (HE), and reproductive and perinatal health (HMSRO and MS), making it possible to assess HAI prevention practices in a complex, diversified and technically well-equipped hospital environment. All the hospitals enrolled in the study were selected because of their central role in the region's tertiary care system, as well as their relatively high level of medical training, which can positively influence the organization of care and the monitoring of quality indicators.

The CHU, Morocco's largest university hospital, serves around 13.5% of the national population, and alone accounts for 55% of hospital admissions, 74% of surgical procedures (emergency and non-emergency), 50% of deliveries, and 61% of emergency visits in the region. It represents an important center of excellence because of the breadth and specialization of its services, and is broadly representative of the country's other university hospitals. However, the results observed in this study cannot be extrapolated to primary or secondary care facilities, which do not have the technical infrastructure, specialized human resources,

Table 1. Demographic information of study hospitals.

Hospital code	Hospital name	Bed capacity (no of beds)	Days of hospitalization (for 2023)
HIS	Ibn Sina Hospital	644	168,454
HE	Children's Hospital	450	154,452
HMS	Souissi Maternity	268	46,802
INO	National Institute of Oncology	130	28,437
HAS	Arrazi Hospital	171	60,698
HEY	Ayachi Hospital	64	17,567
HMY	Moulay Youssef Hospital	84	23,072
HMSRO	Maternity and Reproductive Health Hospital- Orangers	84	13,019

developed by the WHO in 2018 [11]. The IPCAF assesses the strengths and weaknesses of healthcare facilities in terms of IPC practices across eight key components:

1. IPC programs
2. IPC guidelines
3. IPC education and training
4. HAI surveillance
5. Multimodal strategies for implementing IPC interventions
6. Monitoring and reporting of IPC audits
7. Workload, staffing, and bed occupancy
8. Built environment, materials, and equipment for IPC

Each component was rated on a scale from 0 to 100, resulting in a global score ranging from 0 to 800. The hospitals were classified into 4 levels based on these scores: inadequate (0–200 points), basic (201–400 points), intermediate (401–600 points), and advanced (601–800 points).

Data collection and analysis

Data were gathered using structured closed questionnaires, supplemented by on-site observations. The scores were then converted into percentages to provide a clear representation of each hospital's adherence to the established standards. Data analysis was conducted using Microsoft Excel and SPSS version 25, ensuring that the results were presented in clear tables and charts.

Ethical considerations

Strict measures were implemented to protect the confidentiality of the data, with all electronic data stored in password-protected files to ensure compliance with privacy protocols.

Results

Total IPCAF score

The total IPCAF scores for each hospital are presented in Table 2. The hospitals' compliance with the basic standards were calculated in percentage as shown in Figure 1. The HMY and INO hospitals stood out with high scores, reaching an "advanced" level with respective scores of 565.5 and 550.5 points, demonstrating a high level of compliance with the established standards at 70.69% and 68.81%. In contrast, HAS was below the "basic" level with a score of 370.5 points, indicating significant gaps in the implementation of IPC practices. Table 3 presents the descriptive statistics for each component, including the median and IQR.

Table 2. Total Infection Prevention and Control Assessment Framework (IPCAF) scores and compliance percentages for each hospital.

Hospital	Score	Percentage (%)
HMSRO	483.0	60.38
HIS	489.5	61.19
MS	407.5	50.94
HAS	370.5	46.31
HEY	473.5	59.19
HER	440.5	55.06
HMY	550.5	68.81
INO	565.5	70.69

Table 3. Median and IQR for each component.

Component	Median	IQR
CC1	58	16,25
CC2	56,25	8,13
CC3	42,5	28,75
CC4	26,25	28,13
CC5	65	1,25
CC6	64	11,25
CC7	65	2,5
CC8	79	10,63

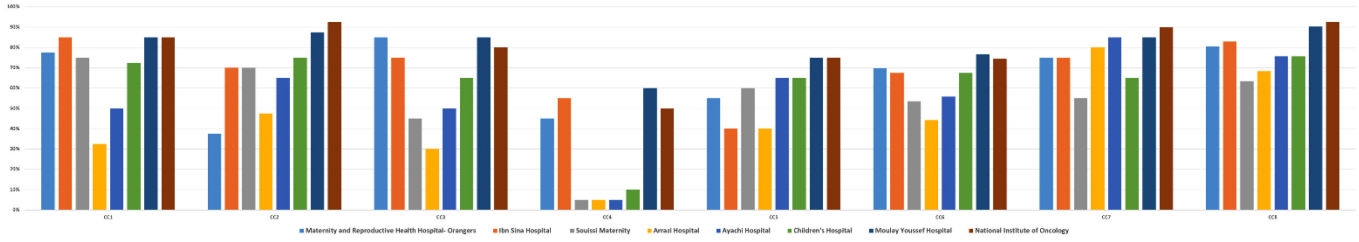
Principal component 1: IPC programs

Analysis of the results of principal component 1 (PC1) of the IPCAF assessment carried out in 8 hospitals revealed considerable variability in performance. One hospital scored around 30, reflecting very limited implementation of structured IPC programs.

Hospitals HEY, HE, HMSRO, and MS scored between 50 and 60, indicating that while key elements of IPC programs were in place, further efforts were required to achieve optimal standards.

At the higher end of the spectrum, two hospitals (HMY, INO) scored above 70, indicating that IPC

Figure 1. Compliance percentages of hospitals with IPCAF core component standards.



programs were well structured and the governance mechanisms were strong.

The lowest total score observed was 33 and the highest was 73, highlighting significant disparities in how PCI programs are implemented and maintained.

Overall, while a few hospitals demonstrated advanced capacity in core component 1, many others remained at a basic or inadequate level, reinforcing the need for targeted support, capacity building, and standardization of IPC programs across all healthcare facilities.

Principal component 2: IPC guidelines

The analysis of IPCAF core component 2 (CC2) scores, which assessed the development, dissemination, and use of IPC guidelines across hospitals revealed notable disparities in their performance. CC2 is a critical component that reflects a hospital's ability to adopt standardized, evidence-based IPC practices, adapt them to local resources, and ensure staff involvement and regular training.

The INO hospital scored the highest with a score of over 60, testifying to the efforts made to adapt the guidelines to their local context and actively involve the relevant stakeholders in their implementation.

On the other hand, 2 of the 8 hospitals surveyed (HAS, MS) scored below 50, indicating significant gaps in alignment with international standards for critical care.

These facilities had difficulties in implementing protocols, organizing structured staff training, and ensuring consistent monitoring of implementation. Five hospitals in particular (HIS, HMOSR, HEY, HE, HM) scored around 55, reflecting difficulties in ensuring regular training programs and effective monitoring of guideline implementation.

Only 2 hospitals reported organizing regular training on IPC practices for the staff. The remaining hospitals had no structured programs and reported limited training opportunities, hindering the consistent application of IPC guidelines. These findings underline the need to strengthen human capital skills, encourage staff commitment, and consolidate monitoring systems, to ensure consistent and effective implementation of IPC guidelines across all facilities.

Principal component 3: IPC education and training

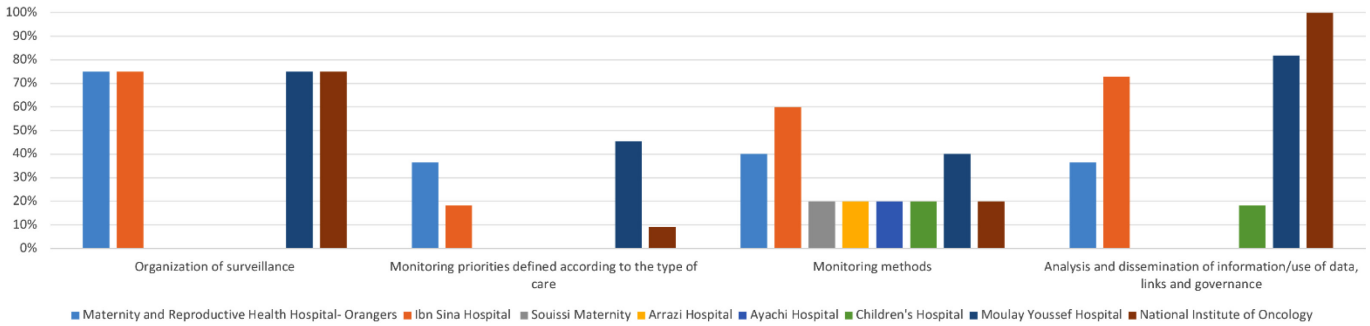
The evaluation of IPCAF core component 3 (CC3), which assesses the education and training of healthcare workers in IPC, revealed significant variation in performance across the hospitals. This component measures the extent to which hospitals provide structured and ongoing IPC training for their staff.

Two hospitals (HMY, INO) achieved good results, with scores of 75 or more, reflecting the implementation of comprehensive and regular IPC training programs. These hospitals organized structured training sessions, integrated with continuing professional development and adapted to the changing needs of staff.

All hospitals confirmed the presence of IPC experts to oversee these training sessions. Seven out of 8 hospitals also involved non-expert staff, such as nurses or doctors, in the training process. Only one hospital did not benefit from this type of involvement, which could limit the effectiveness and scope of its training initiatives.

The majority of hospitals used interactive and engaging training methods, such as e-learning, simulation, and bedside teaching, to enhance the learning experience for staff. However, only half of facilities regularly evaluated the effectiveness of their training programs, which is essential to ensure that IPC knowledge is properly assimilated and applied. In addition, in half of the hospitals, IPC training was integrated into the clinical teaching of other specialties,

Figure 2. Compliance percentages of hospitals with the surveillance of HAI guidelines.



OS: Organization of surveillance; PSDS, priorities of surveillance defined according to care type; MS, surveillance methods; ADIDLG, analysis and dissemination of information.

notably surgery. Finally, all hospitals offered IPC training for patients and their families.

Principal component 4: surveillance of HAIs

Analysis of core component 4 (CC4) of the IPCAF tool, which assesses surveillance of HAIs, revealed significant disparities between the hospitals evaluated (Figure 2).

Two hospitals (HMY, INO) stood out for their strong integration of surveillance mechanisms into their IPC programs, with scores above 50. These hospitals paid particular attention to infection monitoring and the ongoing evaluation of implemented prevention strategies.

HIS, on the other hand, had a partially structured surveillance program, with a score of around 45. Although some elements of HAI surveillance had been introduced, the hospital did not yet have a complete, integrated system, which limited its effectiveness.

The other 5 hospitals (HMOSR, HEY, HAS, HE, MS) showed worrying results, with low scores ranging from 20 to 25. These performances reflect major shortcomings in the organization of surveillance and adherence to established standards in these hospitals.

In terms of human resources, the majority of facilities reported shortages, notably the absence of staff specifically dedicated to HAI surveillance, compromising the rigor and sustainability of the actions taken. In addition, none of the hospitals provided training in epidemiology or infection surveillance, revealing a critical need for skills reinforcement in this area.

With regard to data collection and analysis, only two hospitals (HMY, INO) had set up data quality control mechanisms, while the others had no standardized procedures guaranteeing the reliability of surveillance information.

Finally, 5 hospitals disseminated monitoring results on a regular basis, while the others did so only sporadically, which limits the impact of these data on improving IPC practices.

Principal component 5: multimodal strategies for implementing IPC interventions

The analysis of core component 5 (CC5) of the WHO IPCAF tool, which assesses the implementation of multimodal strategies for IPC, revealed notable variability in performance across the evaluated hospitals. Two facilities achieved a score of 70 indicating effective and structured implementation of multimodal strategies. Five others obtained 65, reflecting partial but progressing implementation. In contrast, one hospital recorded a score below 50, highlighting major gaps in the operationalization of such strategies.

The majority of hospitals reported active use of multimodal strategies, with scores ranging from 50 to 100 across different subcomponents. However, significant disparities were observed in the depth and consistency of implementation.

Evaluation of resources and practices

Nearly all hospitals (7 out of 8) incorporated resource and practice evaluation into their strategies, with an average score of 50. This included uninterrupted availability of infrastructure and supplies, along with monitoring adherence to best clinical practices (ergonomics, accessibility, optimal placement of invasive devices, etc.).

Education and training

Education and training were integrated to varying degrees. Six hospitals relied on traditional formats (written materials, oral communication, e-learning), while two facilities enhanced these efforts through interactive methods such as simulation-based training and bedside teaching. Specific initiatives were also introduced to strengthen communication between IPC teams and clinical departments, such as case presentations with feedback sessions.

Safety culture and leadership

Although efforts to instill a safety culture were observed across all hospitals, this component remained partially implemented. Nevertheless, hospital leadership and clinical champions showed visible commitment through role modeling, promoting adaptive approaches and reinforcing an organizational culture that supported IPC, care quality, and patient safety.

Multidisciplinary approach and collaboration

Multidisciplinary teams were present in all evaluated hospitals, playing an active role in IPC decision-making processes. Additionally, all facilities reported regular collaboration with quality and safety management teams, demonstrating a strong commitment to the cross-cutting integration of IPC initiatives.

Principal component 6: monitoring and feedback of IPC practice audits

The analyses of core component 6 (CC6) of the IPCAF tool, which focuses on the monitoring and

feedback of IPC practice audits, revealed heterogeneous approaches among the hospitals that were evaluated. Five hospitals (HMY, INO, HE, HMOSR, HIS) reported scores with a range from 65 to 75, while two others (HAS, HEY) obtained lower scores (between 45 and 50).

The hospitals that had structured this component better, generally showed a clearer process of monitoring, including defined objectives, targets, and activities. However, the quality and formalization of these plans varied. While 6 hospitals scored 7.5–10 in this area, others lacked a defined plan and where not evaluated as a consequence (they received no score).

All hospitals had designated staff responsible for monitoring and reporting IPC audits, thereby meeting this organizational requirement. Some common practices, such as hand hygiene, environmental cleaning, and waste management, were consistently monitored, with perfect scores (5/5). Conversely, disinfection and sterilization processes were only partially monitored. Other critical areas, such as antimicrobial consumption surveillance and monitoring of multidrug-resistant organisms (MDROs), were frequently neglected, with most hospitals scoring zero.

Self-assessment of hand hygiene practices using the WHO model was found to be infrequent, with an average score of 2.5/5. Feedback to IPC teams and service managers remained limited. However, all hospitals conducted annual communication of surveillance data (score 10/10) and promoted a "no-blame" culture. The assessment of patient safety culture, however, was entirely absent, with all hospitals scoring zero in this domain.

These findings highlight considerable variability in the structuring of IPC audits and point to key areas requiring improvement, particularly in the monitoring of preventive practices, and the integration of safety culture assessments.

Principal component 7: workload, staffing, and bed occupancy

The evaluation of component CC7 of the IPCAF framework, concerning workload, staffing, and bed occupancy, highlighted variability among the hospitals assessed (Figure 3). Two hospitals (HMY, INO) reported scores of 70 and 60, reflecting a well-structured approach in this area. Four others (HE, HMOSR, HIS, MS) had scores between 72.5 and 75, indicating a good level of organization. In contrast, HAS and HEY scored lower (60 and 57.5), with the lowest score recorded at 47.5.

With regards to human resources, the staff compliance reached 66.67 in the best-performing hospital, while others reported scores as low as 33.33. The nurse-to-patient ratio was fully respected in several hospitals (15/15), whereas some did not meet this standard (0/15). Staff adjustment based on workload was implemented in half of the hospitals (10/10), while the rest lacked any such system (0/10).

Bed occupancy rates also varied significantly. Some hospitals achieved full compliance (100), while others reported lower rates (64.29). The one-patient-per-bed standard was generally respected. However, the management of patients in corridors remained an issue in one hospital, which scored 5/15, reflecting localized overcrowding in certain departments.

Principal component 8: built environment, materials, and equipment for IPC at healthcare facilities

The comparative analysis highlighted significant differences in the management of infrastructure and equipment dedicated to IPC among the evaluated hospitals, as illustrated in Figure 4. Three hospitals (HMY, INO, HMOSR) achieved the highest scores, ranging from 85 to 90, while the other facilities scored between 75 and 80, particularly concerning access to water, hand hygiene and sanitation facilities, electrical

Figure 3. Compliance with staffing and bed occupancy guidelines across hospitals.

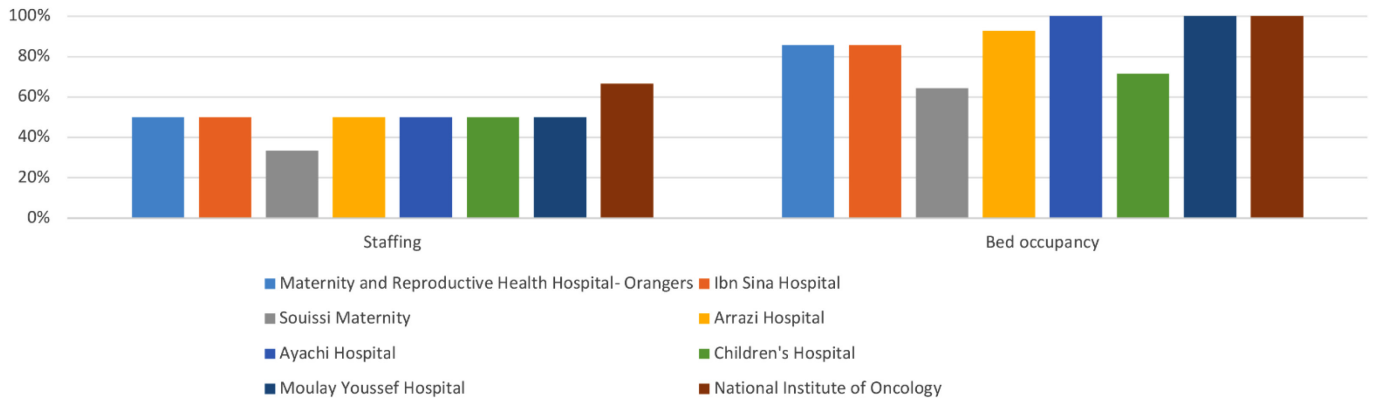
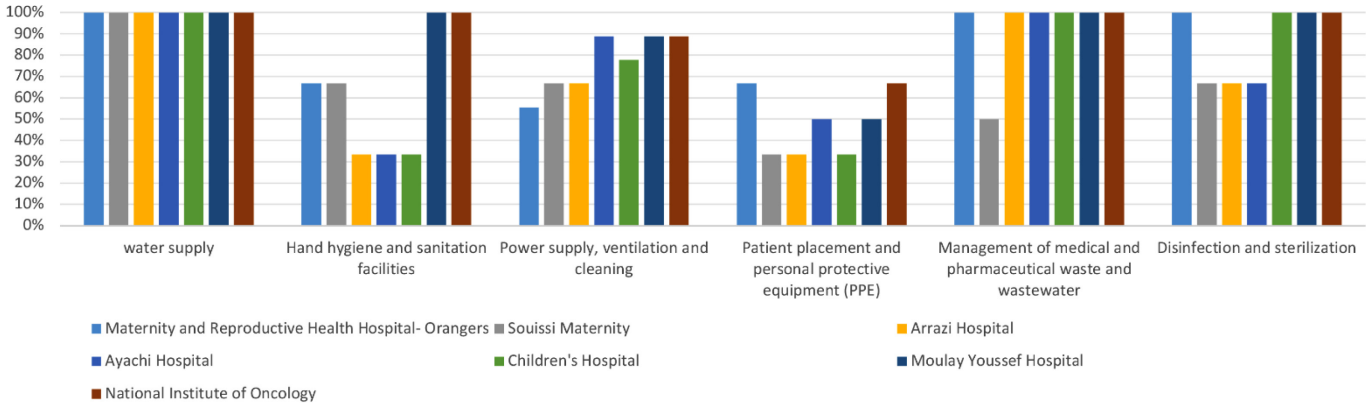


Figure 4. Compliance percentages of hospitals to key IPC components.



supply, ventilation, and cleaning.

Regarding the availability of personal protective equipment (PPE), 6 hospitals reported good availability, whereas some others showed lower scores. Continuous electrical supply was ensured across all hospitals, while ventilation management exhibited more pronounced disparities. A system was in place for the management of medical and pharmaceutical waste in all evaluated hospitals.

Finally, the presence of services dedicated to disinfection, sterilization, and the availability of sterile medical devices varied considerably. Five out of 8 hospitals maintained strict standards in this area, while approximately 3 hospitals presented deficiencies in both availability and effective management.

Discussion

Assessment of IPC practices in Moroccan hospitals revealed significant disparities across institutions. While 6 hospitals had well-structured IPC organizations with active committees and dedicated teams, facilitating the implementation and monitoring of guidelines, hospitals like HAS and MS showed lower compliance rates (46.31% and 50.94%, respectively). This discrepancy is largely due to inadequate institutional support and limited leadership involvement, highlighting the crucial role of hospital leadership and governance in ensuring effective IPC implementation.

Regarding the adoption of IPC guidelines, hospitals like HIS, HMY, INO, and HEY achieved scores above 60%, demonstrating efficient adaptation of protocols to local resources. However, some hospitals struggled to apply these guidelines rigorously, with compliance rates under 50%, underscoring the importance of continuous staff training and practice monitoring.

Although all evaluated hospitals had IPC experts for training sessions, only half of them offered mandatory, ongoing training programs. The lack of a structured framework in certain hospitals, especially HAS and MS, hindered the consistent application of best practices.

International studies, such as those conducted in Germany, show that most hospitals achieve an "advanced" level of IPC, while others [13], such as in Mali, highlight significant gaps in hygiene, with basic IPC scores [14]. Similarly, significant gaps in training, surveillance, and infection control were found in Bangladesh [15]. In contrast, studies in Turkey and Rwanda show more advanced implementation of IPC [16,17], especially through certified specialists and surveillance programs; although some deficits in staffing and training persist.

IPC training is a critical and continuous challenge. Researchers found that only 27% of healthcare workers in Nepal had received IPC training, while almost all institutions in developed countries offered regular training [18]. Despite the presence of IPC experts in all hospitals in Morocco, only half provided continuous mandatory training, which may explain the low compliance in some facilities.

The surveillance of HAIs varied greatly in Moroccan hospitals. While hospitals like HMY (60%) and HIS (55%) had relatively strong monitoring systems, others like MS and HAS showed concerning scores (5–10%), indicating a major shortfall in terms of infection data collection, analysis, and action. The lack of specific epidemiological training in hospital limits the ability of teams to effectively identify and prevent infections. Research emphasizes that rigorous monitoring positively impacts infection reduction and early epidemic detection, but the absence of systematic surveillance in some hospitals exposes patients to preventable infections [19].

Furthermore, the link between understaffing and HAIs, is particularly relevant in Morocco [20]. Staff

burnout hampers the strict adherence to IPC protocols, underscoring the need for better human resource management to improve care quality.

Multimodal strategies, combining various interventions to enhance IPC adherence, were better integrated in hospitals like HMY and INO, which scored around 75%. However, other hospitals struggled with limited application of these strategies, often due to a lack of regular evaluations and structured tools like checklists and bundles. The collaboration with quality and safety leaders also remained insufficient in some hospitals, reducing the impact of implemented actions.

Audit and monitoring of IPC practices are essential for continuous improvement. Hospitals like HMY and INO showed strong performance in this area (82.5% and 80%, respectively), indicating a solid evaluation culture. However, only half of the hospitals enrolled in this study were found to conduct regular audits and set specific improvement targets, highlighting the need for stronger evaluation processes and better follow-up on audit recommendations.

While all hospitals enrolled in this study ensured full access to water, other practices such as hygiene facilities and hand sanitation installations varied considerably. Only HMY and INO achieved full compliance, while others, like HAS and MS, scored as low as 33.3%. These infrastructure shortcomings hindered the rigorous application of IPC measures. Similarly, access to PPE and patient placement systems remained limited, with compliance rates ranging from 33% to 66%, exposing both healthcare workers and patients to higher risks of HAIs. Moreover, health professionals in Morocco showed inconsistent adherence to hygiene protocols. Significant gaps related to hand hygiene compliance (62.7% irregular adherence) and inconsistent use of gloves (79% non-systematic), further increased the risk of infections. The level of experience also influences IPC adherence, with more experienced staff (over 10 years) showing better compliance with protocols [21].

Conclusions

The assessment of IPC practices in Moroccan hospitals revealed significant gaps that would need urgent attention to reduce HAIs and improve patient outcomes. The primary challenge remained the inconsistency in leadership and governance across institutions. While many hospitals had a well-organized IPC program with an active committee and a dedicated team, there were institutions where compliance with IPC protocols was far below expectations. This issue is largely driven by inadequate institutional support and weak leadership involvement, highlighting the crucial role of hospital governance in ensuring that IPC strategies are prioritized and effectively implemented.

Although all hospitals had IPC experts to facilitate training, only some of them provided mandatory and ongoing education for healthcare workers. This lack of structured, continuous training hinders the consistent application of IPC measures, and ultimately impacts healthcare workers' ability to prevent infections. Additionally, while some hospitals had robust surveillance systems in place, others suffered from a lack of monitoring and data analysis, leading to poor infection tracking system and delayed responses to outbreaks. The absence of specific training in hospital epidemiology compounds this issue, as it prevents healthcare teams from effectively identifying and preventing infections.

Another critical challenge is the limited adoption of multimodal strategies to improve IPC adherence. While a few hospitals integrated multiple interventions to strengthen adherence to IPC protocols, many others did not fully implement such strategies, often due to a lack of regular evaluations, structured tools like checklists, and the absence of a comprehensive infection control framework. Infrastructure deficits also play a significant role in hindering the effectiveness of IPC measures. Although some hospitals met essential standards for hygiene facilities, hand sanitation stations, and personal protective equipment; others fell short in providing these critical resources. This discrepancy in infrastructure impacts the application of basic infection prevention practices and exposes both patients and healthcare workers to increased infection risks.

Furthermore, the failure to consistently adhere to fundamental hygiene practices, such as handwashing and proper glove usage, was a persistent problem. In addition, the link between understaffing and the increased incidence of HAIs is particularly relevant, as staff burnout and overwork further prevented the strict adherence to IPC protocols.

To address these gaps and improve IPC practices, it is vital to implement targeted interventions based on the WHO's core components of IPC programs. These interventions should focus on strengthening hospital leadership and governance, ensuring that hospital management is actively involved in IPC efforts and that adequate resources are allocated to these programs. There is also a need for a national initiative to standardize and enhance IPC training, ensuring that all healthcare workers receive continuous education on the latest infection prevention techniques. Improving surveillance systems and providing hospitals with the

necessary infrastructure, such as hand hygiene stations and PPE, is essential for effective infection control.

Finally, adopting multimodal strategies, conducting regular audits, and integrating checklists and bundles into daily practices will help ensure consistent adherence to IPC measures. Establishing baseline data through comprehensive audits and follow-up evaluations will enable hospitals to track their progress, identify areas for improvement, and foster a culture of continuous quality improvement.

By addressing these key gaps and investing in IPC training, leadership, infrastructure, and monitoring, Moroccan hospitals can make significant strides in reducing healthcare-associated infections and improving patient outcomes, ultimately raising the quality of care provided across the country.

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Authors' contributions

All authors, study conception and design; LM, FA, material preparation, data collection and analysis; LM, manuscript—first draft; all authors, manuscript review and comments. MZ, YS, supervision. All authors read and approved the final manuscript.

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Conflict of interest

No conflict of interest is declared.

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