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Infection Control in Healthcare Settings Challenges and Solutions for Improved Care Quality: A Systematic Review

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ABSTRACT

Background: Healthcare-associated infections (HAIs) are a significant global challenge affecting morbidity, mortality and healthcare costs. Effective infection prevention and control (IPC) programs are essential. The healthcare system in Saudi Arabia is rapidly changing and has specific challenges related to the context of mass gathering (Hajj/Umrah) and high dependency on expat healthcare workers.

Objective: This study aims to assess barriers that inhibit effective infection prevention and control (IPC) in order to better understand; the issue of infection prevention and control in kingdom and the impact of IPC on culturally appropriate practices in the provision of care, which may lead to HAI and other adverse outcomes.

Methods: This present study follows a systematic review method (e.g., search strategy, databases included, inclusion/exclusion criteria, quality assessment tool like PRISMA. Focus on mostly original research (qualitative and quantitative) and review articles published on topic in the context of Saudi Arabia.

Conclusion: Saudi Arabia has demonstrated its ability to enact a national effort of high significance (e.g. the CLABSI reduction campaign and ASPs) at the national level, but sustaining these advances and achieving world-class HAI rates will depend on continuing to address its existing substantial gaps: optimizing the IPC workforce and addressing compliance gaps among front-line healthcare workers..

Keyword: Infection Control, Healthcare-Associated Infections, Saudi Arabia, IPC Challenges, IPC Solutions, Hospital-Acquired Infections, Community engagement

1. INTRODUCTION AND BACKGROUND

Healthcare-associated infections (HAIs) refer to infections that patients receive while receiving treatment in a healthcare environment and represent a substantial and preventable public health crisis around the globe. [1] They are a common cause of prolonged morbidity, subsequent disability, and mortality, substantially impairing health systems. The World Health Organization (WHO) estimates that hundreds of millions of patients worldwide experience an HAI every year, and the percentages tend to be even higher in low and middle-income countries. The costs associated with HAIs are staggering, covering the increased length of stay in hospitals, additional interventions, and the use of higher-level, expensive antimicrobial agents. [2] The four distinct types are the most common, reported as central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI), and ventilator-associated pneumonia (VAP), and are considered useful indicators of the quality of care patients receive. The Kingdom of Saudi Arabia (KSA) is more focused on ensuring a world-class healthcare system in line with the vision of Saudi Vision 2030, therefore effective surveillance, control, and eradication of HAI is not only clinical, but a national objective. [5]

Infection Prevention and Control

Infection Prevention and Control (IPC) is the basis for patient safety, quality healthcare, and is an evidence-based discipline that is bias free and takes great vigilance and comprehensive systems, in the area of IPC. Effective IPC programs are based on five pillars of care:

Standard precautions, this includes proper hand hygiene and appropriate personal protective equipment (PPE); [3]

Surveillance, this means ongoing systematic collection and analysis of data about hospital-acquaires infections (HAIs); [4]

Education and training for all healthcare works (HCWs);

Antimicrobial stewardship to reduce resistance; and

Occupational health of healthcare workers.

This is recognize by the establishment of the General Directorate of Infection Prevention and Control (GDIPC) within the Saudi MOH to advocate for standardized polices with nation wide campaigns. However, studies consistently show how the gap remains between ideals of knowledge of IPC practices at the bedside, with increased deficiencies adding complexities with increased clinical workload.

Factors Relevant to Saudi Arabia

The Kingdom of Saudi Arabia provides a distinctly challenging infection prevention and control environment. Its rapidly modernizing health system and vast networks of hospitals confront significant challenges exacerbated by the demographic and cultural context of the Kingdom. [5] Of particular note is the challenging annual Hajj and Umrah pilgrimages of millions of international visitors within large-scale mass gatherings poses an unprecedented and repeated public health challenge to both importing and sharing communicable infectious disease. To this point, some of the healthcare workforce itself is international and from diverse educational backgrounds. These contextual factors contribute to diversity and community, but also divergence in practice in relation to adherence to standardized infection prevention and control protocols, thus requiring deeply standardized practice that can impartially and diplomatically acknowledge and embark on practice consistency. [6] The rapid and widespread growth in health services across the Kingdom is also complicated by logistical factors, including at times staying ahead of the local ability to train and credential practitioners incoming to deliver specialized infection control practitioners into the global flow of health care delivery to contribute meaningfully to communities of care while establishing sustainable programmatic activities. [7], [2]

The Kingdom of Saudi Arabia is taking steps in modernizing health care systems within the paraments of Vision 2030. Infection Prevention and Control (IPC) is a focus area for change. However, implementation for IPC programs becomes complex when considering such constraints as limited isolation units, overcrowded emergency departments, inconsistent complying with hand hygiene and poor antimicrobial stewardship. [4], [9] Advanced culture, behavior change, and a lack of exploration within curriculum creates a gap with compliance within IPC practices especially in peripheral and rural health systems. Outbreaks of recent nature, including MERS-CoV and CoVID-19, has exposed system weaknesses, creating awareness for the importance of systems that have strong IPC systems in place. The experience has resurrected many changes in necessary policy for systems and created opportunities for advancements with electronic surveillance systems, AI alerts, and automated disinfection. [8] However, these practices may not sustain or be scalable even when strongly evaluated and cannot embed into routine practice without programs to support them. [6]

There is a good volume of research conducted in the KSA related to individual IPC components (e.g., hand hygiene compliance rates, specific CLABSI reduction outcomes); however, it is strategically important to have an integrative synthesis that considers both the general structural and behavioral issues, and evaluates effective and proven national and local regard solutions to analyze. This review provides a single and evidence-based guiding document for policymakers, hospital leaders, and IPC committees.

The objective of this study was to conduct a systematic review of evidence regarding challenges and solutions related to IPC in health care in Saudi Arabia. A review was conducted analyzing peer-reviewed literature from 2015-2024 in order to highlight emergent barriers to effective implementation of IPC and strategies to overcome these barriers while mapping these approaches to national vision transformation. This research provides useful information for policymakers, hospital administrators and researchers who want to improve health care quality, reduce health care associated infections, and improve the resilience of the health system in the Kingdom.

2. OBJECTIVE OF STUDY

This study aims to assess barriers that inhibit effective infection prevention and control (IPC) in order to better understand; the issue of infection prevention and control in kingdom and the impact of IPC on culturally appropriate practices in the provision of care, which may lead to HAI and other adverse outcomes.

3. RESEARCH QUESTIONS

The details mentioned in the above given introduction and background part along with the search of secondary data, following research questions have appeared:

Q1. What barriers have been identified as factors affecting the implementation of infection prevention and control (IPC) in Kingdom of Saudi Arabia (KSA) health contexts?

Q2. What evidence-based strategies or interventions with the aim of improving compliance with IPC and reducing healthcare-associated infections (HAI) in the KSA have been identified?

Q3. To what extent does infrastructure, behavioral, education and policy barriers affect the effectiveness of IPC programs in hospitals and clinics across KSA?

4. RESEARCH METHODOLOGY

Research Design

This current research utilizes an exploratory research design and the systematic review process to assess the literature available based on Infection Prevention and Control (IPC). The study itself will focus on the issues and challenges encountered in infection prevention and control, for example, the researcher will explore solutions to the issue of infection, specifically with regards to infection prevention and control. The study, overall, is based on health care facilities in Saudi Arabia. The reporting system for the current study is based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which is defined below; in addition, the PRISMA guidelines offer a degree of transparency, reproducibility, and methodological rigor.

Search Strategy

A trail of secondary data had been followed to get the clear vision of research objective and the the basic point in question related to IPC. As per the demand of study, most of the information search was based on the electronic avenues, some of the important avenues are mentioned below:

PubMed

SCOPUS

Web of Science

Medline

Google Scholar for related aspects of Grey Literature

Here it is important to mention that most of the references used in the study are particularly focused on the research objectives and specifically related to the timeline of the study i.e. 2015 to 2024. All the spatial and temporal aspects were given equal importance while synthesizing the collected studies. One of the important condition was fulfilled in the process that all the processed studies were published either in English or Arabic.

Types of Studies Included

The respective types of studies included are as follows:

Generally review studies that include reasons and prevention from infections in different healthcare facilities, including identification, ways and means to prevent the same and other associated factors in different healthcare facilities of Saudi Arabia,

Researcher had also included some of the cross sectional studies to find the present development, different technological aspects and major concerns; as far as IPC is concerned.

c. Some live case studies were also included in this present study to assess the best and worst case scenarios related to infections in healthcare system.

Then few of the intervention focused studies were also included here for the relationship of factors in respect of IPC in and outside of Saudi Arabia/MEA region, then some of the international studies were included to present the global prospects.

Prticipants

This study is systematic review because it did not involve human participation, and was based on data from published research, conducted in a range of healthcare settings in Saudi Arabia. The included studies describe some facets of different types of healthcare professionals (physicians, nurses, infection control practitioners, and administrators) and institutional data from public and private hospitals, primary care centers, and specialized cleaning institutions. The included studies report on the experiences, practices and challenges for frontline healthcare professionals and decision-makers to enact, inform and think about infection prevention and control (IPC) processes within the healthcare system of Saudi Arabia related to infection prevention and control.

Keywords

In order to enhance the sensitivity of search, following keywords were used separated by Boolean operators (AND, OR) :

“Infection control,” “healthcare-associated infections,” “Saudi Arabia,” “IPC challenges,” “IPC solutions,” “hospital-acquired infections”.

Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Type of Studies	Only the studies from the journals of national and international repute were included, based in the Saudi Arabian healthcare facilities.	Studies based in other western countries were excluded, then the editorials and opinion based articles were also excluded. .
Theme	Most of the included studies were based on issues, challenges, hurdles and solutions related to IPC.	Studies not including the theme of infection in healthcare facilities were excluded.
Language	Studies in English or Arabic language were included.	Studies in languages other than English and Arabic were excluded.
Access	Studies with full fledged access were included	Some of the studies lacking access to complete articles were excluded.

Management of Collected Information

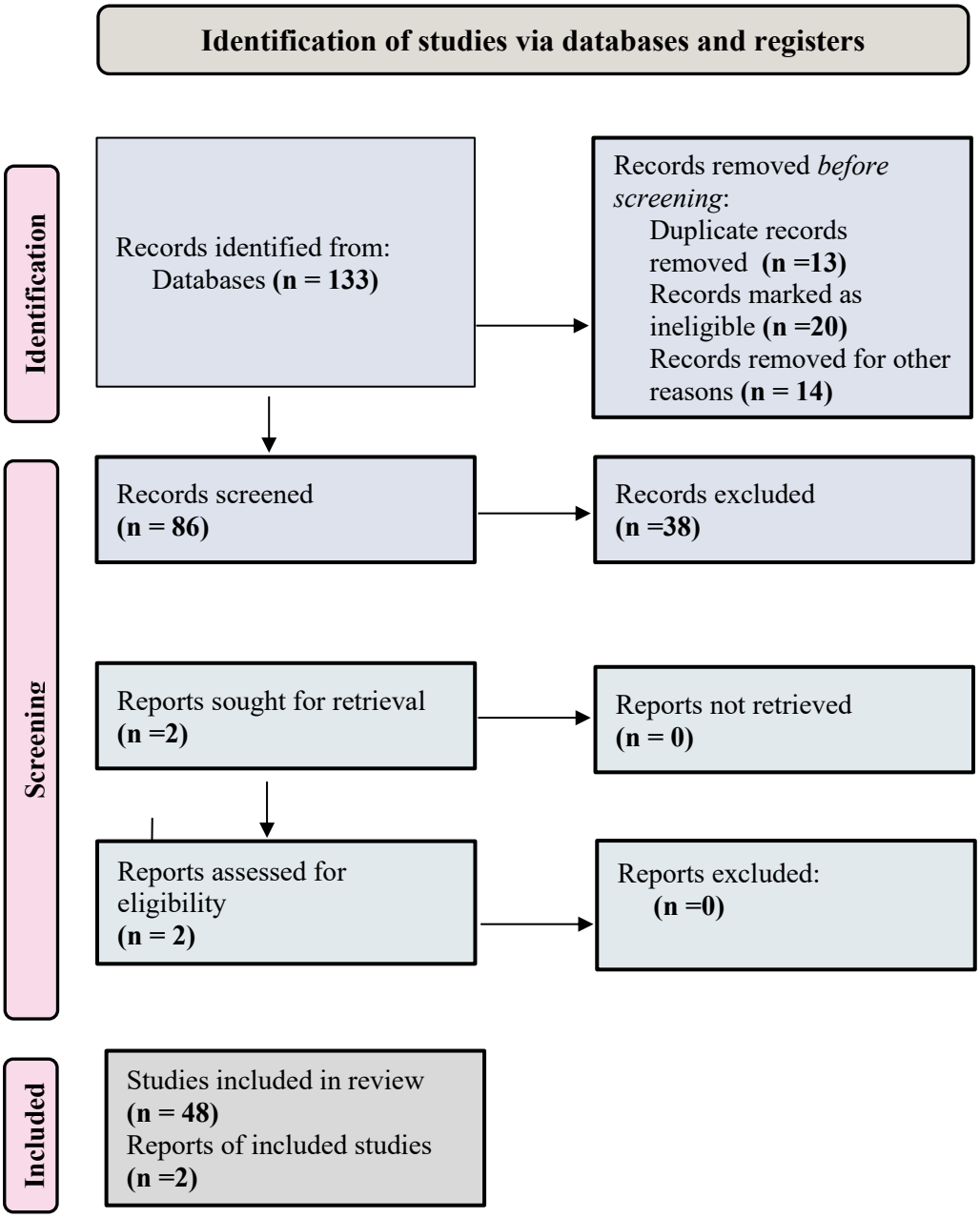
Data management for this systematic review adhered to PRISMA guidelines to ensure transparency, reproducibility and fidelity to the systematic review process. All articles idenitifed in the search process were imported into a reference manager (EndNote or Zotero) for organization and duplicates removal initially. At a later stage of data management a standard data extraction sheet was developed to extract standard variables such as; study design, study context, IPC barriers, suggested changes and outcomes of the study. Screening of articles and the data extraction was completed independently by two reviewers, and any conflicts were resolve via consensus.

5. RESULTS

A total of 133 research studies were identified, all of them were based on the reports regarding identification, challenges, issues, prevention and after effects of infections generated from healthcare facilities. From all the selected studies , 13 were removed because of duplication of records, references and location and 20 studies were marked as ineligible, as not including the concept of IPC, not including KSA or MEA region and 9 other studies were excluded due to some unforeseen issues.

Then 86 records were saved for screening, then in the screening process 38 records were further removed on the basis of

exclusion criteria stated above. Total studies finalized for review were 86. Two reports were included in the study.



Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71 https://creativecommons.org/licenses/by/4.0/

Various studies showed that, although health care workers in Saudi Arabia in general were familiar with the necessity for IPC, there were considerable deficiencies in hygiene practices and knowledge. [9], [5] For instance, in a cross-sectional study in Riyadh, 62% of nurses, despite having received training, reported adherence to hand hygiene practices. Compliance levels were lower in emergency departments, and by non-specialized nurses. Many hospitals, particularly peripheral hospitals, have infrastructure deficits that affect IPC practices, including ward overcrowding, lack of single occupancy isolation rooms, and institutional ventilation infrastructures that have not been updated over time. One study in Jeddah in 2022 found forty percent of facilities studied reported inadequate space for patient isolation to limit potential for cross contamination during outbreaks. [12], [13], [9]

While MERS-CoV outbreaks and COVID-19 outbreaks both acted as stimuli for IPC reform. Following the MERS outbreak, a post-MERS assessment revealed the need for the development of implementation of national IPC guidelines and mandatory reporting systems. During the COVID-19 outbreak, hospitals utilized electronic surveillance tools and AI-based alert systems to track infection clusters. [14], [7], [4] This made IPC monitoring more efficient to keep track of infectious risk, and escalation of risk factors for infectious disease and containment. Despite having national admission control practitioner (IPC)

training policy, studies have shown that behavioral resistance or avoidance (e.g., difficulty with wearing personal protective equipment (PPE), or improper glove wear) is still a concern. [3], [14]

A 2021 study conducted in Eastern Province, Saudi Arabia, found that 28% of healthcare workers reported they did not wear PPE because they were either uncomfortable or time-consuming. In regards to recent initiatives related to a 2030 vision, there are new smart disinfection systems, automated hand hygiene monitors, and electronic dashboards available for conducting and sustaining IPC audits. [15], [8], [3] Hospitals adopting technology as such reported a 15-25% decline in the rate of healthcare-associated infections; findings were reported over one year. [4]

6. DISCUSISON

Issues Related to Work Force

Here the term work force is related to the healthcare workers associated to patient care, surgeries, critical care and even in emergencies. This is one of the most important aspects while working on the IPC related components as the standard precautions are required to be followed. [16]

It is widely accepted that low adherence rates to core practices, such as hand hygiene and following standard precautions, are often blamed on low patient to nurse ratios, long hours, and related administrative duties. Stress and fatigue of HCWs are associated with sharp injuries and errors of omission or commission of procedure. [17]

While HCWs, in general, indicate that their knowledge of Infection Prevention and Control (IPC) principles are satisfactory or good, compliance/practice has often been reported as suboptimal, such as hand hygiene compliance rates under 90%. The implication is that training alone is insufficient to address obsticles to practice recommendations. [11], [18]

Many facilities, particularly those which are not metropolitan, do not have enough certified IPCs and trained staff; the lack of expertise in Infection Prevention and Control (IPC) is hindering full surveillance, investigation, and mentorship of staff. [7]

System Related Aspects

These issues are linked to the fundamental support and infrastructure required for a functioning IPC strategy.

The infrastructure challenges noted in some healthcare services (particularly in older care services and smaller facilities) related to isolation rooms or cleaning capacity or an investment in sterile and medical waste equipment. [18]

National electronic platforms are now being introduced, although primary studies in two countries, managing IPC, noted excellent evidence that surveillance programs were poorly developed and had data collection and analysis systems that were harmful and ineffective to rapidly identify outbreaks or assess impact intervention. [21], [8]

The levels of AMR (antimicrobial resistance) as a result of inappropriate antimicrobial prescribing, lack of local consideration of facilities for diagnosis with other NHS services, and stewardship was not actively being fulfilled, remained a critical systemic problem of common infections becoming untreatable. [15], [19]

Associated Risks

The persistent threat of introduction and spread of infectious disease during Hajj and Umrah requires annual resource mobilization, which creates some stress on routine IPC capacity. In this regard, there is a constant intrinsic need for readiness specific to KSA. [20]

The multinational workforce may lead to breakdowns in communication, misinterpretation of protocols, or variability in the implementation of IPC protocols between units and shifts. [17]

Strategical Framework

The literature identifies several successful interventions, in many cases, coming from the MOH and other national stakeholders.

Changing from providing information to mandatory action oriented, competency-based training is one example where it demonstrated its effect, and studying training to improve practice results in better HCW knowledge, attitudes, and practices related to enhanced compliance. [11]

Training the trainer and staff on high-risk areas of care (e.g., ICU; Emergency Departments) and high-risk activity areas (e.g., central line insertion) resulted in changes in action that changed measurable outcomes. It was best practice training bundles that included multiple best practices were particularly effective training. [3], [9]

One example of a successful national intervention is the MOH CLABSI Reduction Initiative. This multimoddal intervention included centralization of leadership, compiling evidence-based guidelines, providing resources for staff and institutions, and providing real-time electronic surveillance and competition ("Go Green"). The outcome reported resulted in an almost 50% reduction of CLABSI in adult ICU participating in the initiative. These types of multi-faceted interventions speak to

engaging players at the core of the intersection and at the southern edge of being intentional with multi-stakeholder collaboration for the purpose of engaging in change. [16], [17]

Establishing a Standard IPC Structure: By establishing minimum standards for the organization of the IPC programs of these facilities (which includes formalising IPC committees and staffing at least 1 full-time IPC practitioner per 100 beds), it has established a strong foundation to develop sustainable IPC programs. [12]

The use of electronic surveillance platforms allows enabling timely completion and accurate processing and analysis of data, providing timely feedback to the clinical teams on their performance, which is essential in promoting a behavioral change in practice. [16]

Systematic reviews demonstrated that the implementation of ASPs in KSA was associated with an improvement in the use of antibiotics through education and audit and feedback strategies. Implementing ASPs is necessary to address the ongoing systemic issue of AMR. The systematic review also demonstrated a strong association between effective environmental cleaning and disinfection programs and decreasing the risk of HAIs, which importantly indicates that implementing evidence-based cleaning protocols is a realistic, measurable and feasible remedy for hospitals. [18], [22]

The literature documents the journey that Saudi Arabia is on as it transitions from an early stage, more focused on building basic awareness to the more current phase of systemic, national strategies driven by data. It is a definite strength to have a CLABSI reduction campaign; it exemplifies the effect of applying a multimodal approach via the use of standardized protocols, central accountability and performance accountability. This reflects best practices internationally; one can now draw a conclusion that adding hand sanitizer alone is ineffective, which means that success relies on changing the system, including policy, infrastructure, and culture. [23], [18] Despite strong commitment of national policy, perhaps the most long term barrier is still the human, i.e. the gap between HCW knowledge and practice; not only poor education, symptomatic of a deeper systemic problem, that is the eternal issue of inadequate staffing and heavy workloads. Also, when introducing an international workforce, it is important to include good and ongoing education and training along with the administrative buy-in (co-on payment; appropriate and safe nurse-to-patient ratios) to attempt to create reasonable and possible compliance. And then we need to shift from asking about ‘knowledge’ to observing and embedding ‘competent practice’ at the bedside. [24], [19]

These findings suggest a strong correlation between the successful implementation of IPC programs and well-trained ICPs, as a weak link in HAI prevention is the lack of advanced human resources for infection prevention and control. KSA needs to specifically focus on the professionalization of the ICP role by implementing accredited academic programs of study and career pathways for specialists in the infection disease and ICPs. [25]

7. CONCLUSION

Infection Prevention and Control in Saudi Arabis is a field that is evolving quickly, and while strong leadership from their government exists, there are significant challenges remaining. The country has demonstrated its ability to enact a national effort of high significance (e.g. the CLABSI reduction campaign and ASPs) at the national level, but sustaining these advances and achieving world-class HAI rates will depend on continuing to address its existing substantial gaps: optimizing the IPC workforce and addressing compliance gaps among front-line healthcare workers.

8. FUTURE SCOPE OF STUDY

The findings from this systematic review suggest several opportunities for future research and the development of policy with regards to infection prevention and control (IPC) in Saudi Arabian health care settings. First, further research may include longitudinal studies to assess the long-term impact of some of the technology-based interventions (e.g., AI-based surveillance, automated disinfection systems, electronic monitoring of compliance) examined in this review on healthcare-acquired infections (HAIs). Second, future research should examine IPC in other settings, such as rural clinics, long-term care, and home-based care, and where infrastructure and training may still have many missing pieces.

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