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The Role of Healthcare Workers in Promoting Adherence to Infection Control Measures During Pandemics: A Systematic Review.

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ABSTRACT

Introduction: Healthcare workers (HCWs) play a crucial role in preventing infections during a pandemic, but the alarming rates of occupational infections (19.1% MERS, 12.5% COVID-19) in Saudi Arabia (KSA) reflect a very high failure rate of infection prevention and control (IPC) adherence.

Objective of Study: The purpose of this systematic review is to critically examine and appraise the current evidenced-based knowledge on healthcare workers (HCWs) facilitating adherence to infection control measures (ICMs) during pandemics, in particular within healthcare settings in Saudi Arabia.

Research Methods: This systematic review integrated studies out of KSA, focusing on compliance differences across profession (nurses and physicians), barriers to adherence (workload, inadequate resources), and the effectiveness of multicomponent interventions. The data in this review also captures adherence to the interventions resulting in a reduction of Healthcare Associated Infections (HAIs).

Conclusion: Although we found moderate IPC adherence, the adherence rates for HCWs working in institutions, was influenced due to high workloads, and inadequate staffing, and reflected a general gap in compliance with nurses in practice, as compared to physicians. Multicomponent intervention strategies are useful and effective in increasing hand hygiene compliance (from 50.17% to 71.75%) while also demonstrating a solid negative correlation in HAI rates. Overall, the study found that HCW adherence may be one of the strongest contributors, while still needing structure and support, on patient safety and the need for ongoing tailored education.

Keywords: Healthcare workers, Infection control, Pandemic, Saudi Arabia.

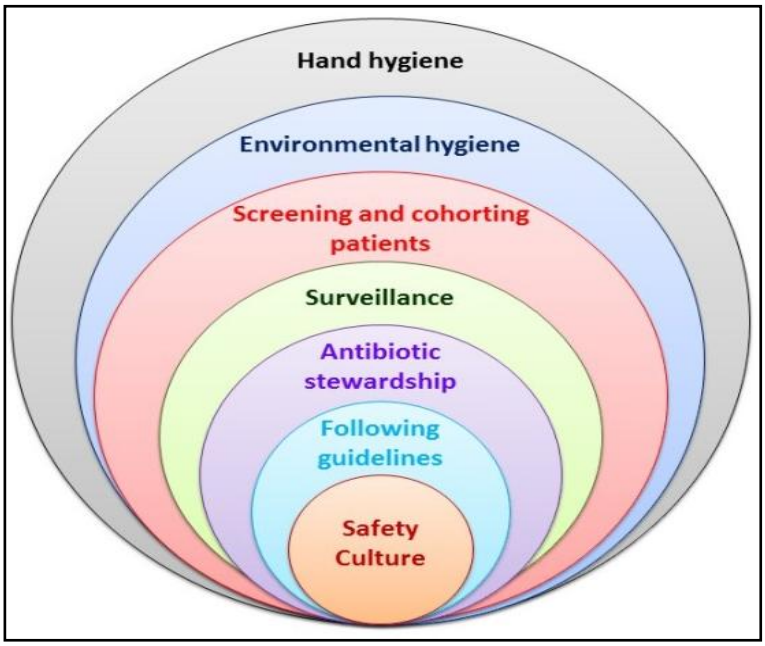
1. INTRODUCTION

The world has had some outbreaks of respiratory pathogens that had devastating effects on the health systems due to their fast spread across the globe and they include Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome Coronavirus (MERS-CoV) and Coronavirus Disease 2019 (COVID-19). **[1]** Healthcare workers (HCWs) become the focus of this scenery as the first line of defense, and also an exceedingly vulnerable population prone to infection. The corrective use of infection prevention and control by the HCWs is the main non-pharmaceutical method to limit the transmission of diseases in the clinical setting. The problem of adherence failures is one of the leading causes of nosocomial transmission escalating the dynamics of outbreaks and influencing the continuation of healthcare services. **[2]**

The Kingdom of Saudi Arabia (KSA) provides a unique and valuable case study due to its exposure to the two severe threats of pandemics: MERS-CoV that has been endemic since 2012, and the subsequent massive reaction to COVID-19. The consequential longitudinal data regarding the subject of the behavioral adaptation of HCW and institutional learning was achieved due to this dual-pandemic experience. **[11], [5]** The historical issues could be interpreted as high HCW-related infection rates (19.1% of MERS and 12.5% of all COVID-19 cases were) that occurred in retrospective national studies in Saudi. The high levels indicate the necessity to address the factors of low adherence and institutional protection failures. The causes of infection transmission among HCWs included institutional IPC measures, lack of awareness/training, and non-adherence to the personal protective equipment (PPE). This systematic review aims at identifying a synthesis of the available evidence that shall be applied in providing an empirical basis on the prevailing gap between the national IPC policy requirements and the actual adherence practices on the part of the HCWs in KSA. **[7], [4]**

Pandemic Preparedness Frameworks

Saudi Ministry of Health (MoH) and Public Health Authority (PHA) have developed high level and comprehensive guideline on the way to address infectious respiratory diseases. These guidelines are concerned with appropriate conduct of Standard Precautions (SP) and Transmission-Based Precautions (TBP). **[5], [12]** The key requirements that the HCWs and the facilities must have are the immediate isolation of suspected or confirmed patients in well-ventilated rooms, a sound environmental cleaning and order of donning and doffing PPE, i.e. gowns, high-level efficiency mask usage, and use of goggles or face shield. These formal standards are extremely robust one can observe in the detailed steps of dealing with the exposure of HCW. To demonstrate the case, there are national recommendations regarding the identification, tracing and risk assessment of HCWs who have been exposed to the MERS-CoV. The healthcare facilities must follow-up on all the staff who either had a protected (wore PPE correctly) or unprotected contact. The Infection Control Team is left to decide upon the HCW returning to duty after a detailed risk assessment. Furthermore, high risk procedures are subject to special precautions such as the aerosol-generating procedures (AGPs), which involves the airborne precautions. **[8]** Such detailed and specific guidelines are the evidence of the fact that KSA collaborates with a sound theoretical framework of IPC. This means that the perceived occurrences of non-compliance are rarely described by the lack of written rules but rather caused by the problem of implementation, lack of resources, organizational culture, or training deficit.



Source: https://infectionsinsurgery.org/7-strategies-to-prevent-healthcare-associated-infections/

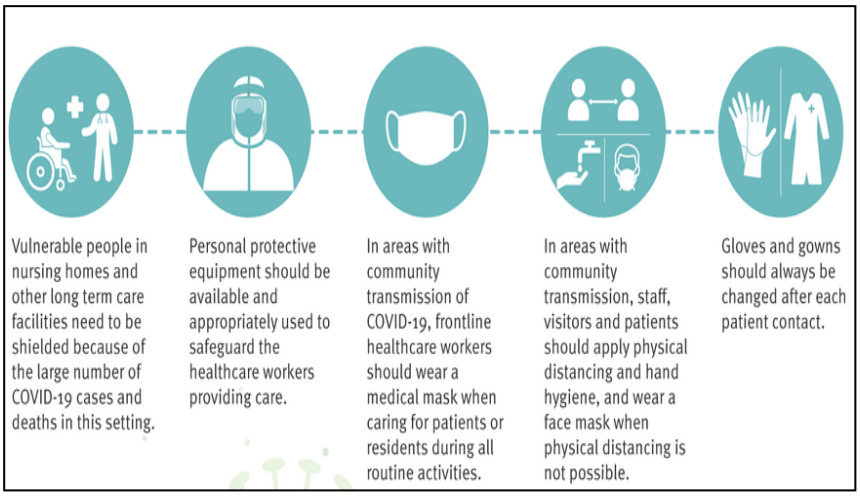
Figure 1: Strategies to Prevent Healthcare related Infections

Enforcement Mechanisms

Notably, these surveillance actions ought to lead to the real change of the organization. The healthcare facilities will be forced to formulate and effectively implement corrective action plans depending on the audit recommendations, which will increase the compliance with the national and international IPC standards. **[9]** The regulatory bodies of KSA can impose formal penalties on non-conforming companies and individuals other than internal quality control. These sanctions can either be financial in which case private health institutions can be fined or even warned, close down of institutions and revocation of license. Physicians, nurses and technicians have been put under punishment schemes whenever they fail to comply. Such punitive element brings out stronger evidence that compliance is not only hoped to be an attractive practice, but it is a duty that is anticipated of a professional. Indeed, the combination of formal auditing policies and legal punishment into the working system can be considered a powerful forcing factor in streamlining and supporting the moderate-to-good compliance rates of the KSA healthcare industry. **[3], [7]**

HCW Adherence Levels and Variance

The overall levels of self-reported compliance to IPC measures among the KSA HCWs can be described as overall satisfactory/moderate-to-good. In a study conducted after the pandemic, adherence was moderate or good in 88.4 percent of the HCWs. Similarly on the same measure in defining Standard Precautions (SP), most of the participants (90.1) registered 75 percent compliance on the scale implemented. Also, HCWs showed responsiveness to crisis: More adherence to infection control practices was expressed by HCWs during the acute phase of the COVID-19 pandemic. **[13], [14]**



Source: https://www.ecdc.europa.eu/en/publications-data/infographic-infection-prevention-and-control-primary-care

Figure 2: Measures for Risk Minimization During Pandemic

One more examination of the adherence reveals that there is a significant heterogeneity related to the profession and demographics. It was always observed that the status of a nurse was the key predictor of adherence increment. Professional group comparisons showed that nurses perform better with regard to hygienic practices and IPC protocols as compared to physicians. The performance of the nurses in terms of cross-infection prevention among persons was less than that of doctors in one study (76.8% mostly poor adherence, vs. 87.8% doctors), and the performance levels were below the optimal in most cases. **[6], [3]** The occurrence of such gap suggests that compliance levels may have negative correlation with professional seniority or positive correlation with the distance to intensive direct patient care and rate of institutional auditing. Most likely the nurses will be more willing to generate higher standards because they can be given the primary task of maintaining IPC standards and being immediately supervised and monitored. **[8]** The specified tendency also implies the necessity to possess stricter, and uncompromising auditing instruments that would enable one to concentrate on the compliance of physicians and senior staff, in particular.

The situation is particularly high in Jordan with Saudi Arabia. As the vision 2030 rapidly changes the healthcare sector in the Kingdom, additional investments are made in developing infrastructure, digital health, and developing the workforce. However, the system has its specifics, including the multiethnicity of the working population, the geographic variation in the access to healthcare, and the regular appearance of mass events, including Hajj and Umrah which contribute to the risk of the contagion of an infectious disease. The COVID-19 pandemic demonstrated that Saudi Arabia has the best examples of responsiveness in terms of applying the infection control measures but the irregularity of HCW compliance rates across the institutions and regions reveals the significant gaps in training, communication, and resource allocation. **[2], [11], [16]**

The systematic review proposed will provide a summary of the existing evidence on the influence of HCWs on the facilitation

of compliance with ICMs during pandemics (especially in Saudi Arabia). It explains HCW compliance determinants such as behavior and attitude, organizational support and policy implementation, and specifies the strategy interventions that are effective in increasing compliance. The objective of the review is to inform the national health policy, institutional preparedness, and contribute to the international discourse on pandemic resilience through the synthesis of the outcomes of the recent studies. Lastly, policy frameworks and empowerment of HCWs with special care are needed to safeguard the health of the population in case of an emergency.

2. OBJECTIVE OF STUDY

The purpose of this systematic review is to critically examine and appraise the current evidenced-based knowledge on healthcare workers (HCWs) facilitating adherence to infection control measures (ICMs) during pandemics, in particular within healthcare settings in Saudi Arabia.

3. RESEARCH METHODOLOGY

Research Question

Main research question of the present study is:

Q1. What is the knowledge, attitude, and practice (KAP) of healthcare workers in Saudi Arabia related to infection control measures during a pandemic?

Q2. What institutional, cultural, and systemic systems factor into healthcare workers' adherence to infection prevention protocols in Saudi healthcare contexts?

Q3. How effective are training programs, policy adherence, and resource availability in improving healthcare workers' compliance during a pandemic?

Research Design

With a systematic review design according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to promote rigor and transparency, this review focuses on peer-reviewed literature published between 2019-2025 on healthcare workers' adherence to infection control guidelines during pandemics in Saudi Arabia. An extensive search strategy utilized the following international databases: PubMed, Scopus, and Web of Science, as well as appropriate local databases, using predetermined inclusion and exclusion criteria. Papers were screened and assessed, and emergent themes were analyzed to identify the knowledge, attitudes, and practice elements, as well as institutional factors, that impacted compliance. This design allows for a structured, evidence-informed understanding of the role of healthcare workers and contributes to policy and practice and pandemic preparedness.

Search Strategy

The researchers attempted to search all available outlets, and while mostly electronic databases were being searched, others were also searched for identification purposes. Some of the electronic databases are:

PubMed

Web of Science

SCOPUS

Saudi Digital Library

Saudi Medical Journals

Google Scholar (for Grey literature and related reports)

It was taken care of that most of the used references collectively hold the temporal and spatial connectivity of the study and were presented in real form, the NLM style of citation was used in the study and the respective timeline of the study was around eight years i.e. from 2019 to 2025.

Types of Studies Included

In Saudi Arabia, we have included this review with empirical studies that have been peer-reviewed which have been based on healthcare workers' compliance to infection control practices during pandemics. We did not exclude any studies based on design; thus, all forms of cross-sectional surveys, qualitative interviews, mixed-methods studies, or observational studies in hospital, primary care or public health contexts were included in the review. Studies were included that were linked to healthcare worker behaviour and acceptable surrounding influences on compliance, it was also relevant if the study was an intervention efforts related to infection control practices. All studies had to be published in English and be published from 2019 onwards to provide relevancy and timeliness with the context of the global pandemic outbreak of COVID-19, and other new forms of infectious risks.

Prticipants

The studies included in this systematic review were largely of healthcare workers (HCWs) in a variety of public health and clinical contexts in Saudi Arabia, representing a diverse range of nationalities and professions, including physicians, nurses,

infection-control practitioners, allied health professionals, and administrative staff, engaged in some aspect of the pandemic response. The studies included HCWs who were either Saudi nationals or migrants, consistent with the multinational workforce in the Kingdom's healthcare system. Participants in the studies worked in tertiary hospitals, primary care centers, and emergency departments. One study specifically studied HCWs in high-risk settings (e.g., ICUs and COVID-19 isolation wards).

Keywords

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

("healthcare workers" OR "medical staff" OR "nurses" OR "physicians") AND ("infection control" OR "infection prevention" OR "ICMs") AND ("compliance" OR "adherence" OR "implementation") AND ("pandemic" OR "COVID-19" OR "MERS-CoV") AND ("Saudi Arabia" OR "Kingdom of Saudi Arabia" OR "KSA").

Data Management

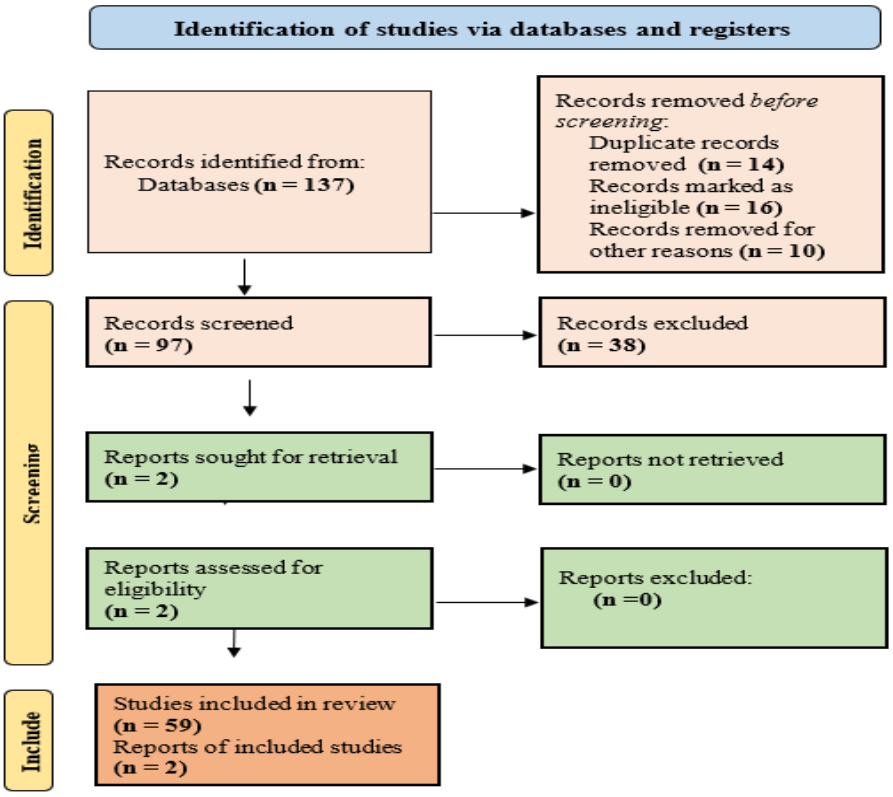
Each study that was identified was systematically organized using a reference management software package (EndNote, Mendeley, etc.) to manage citations, handle duplicates, and facilitate screening. Title and abstract details were screened independently by dual reviewers, who subsequently screened full-text based on predetermined inclusion/exclusion criteria. Reviewers extracted descriptive variable information using a standardized data extraction form, including the study design, demographics of participants, infection control strategies under study, and the outcomes rates for healthcare worker adherence. When required, any disagreements were resolved with reviewers reaching consensus or calling in a third reviewer to make the final decision.

Results

A total of 137 research studies and one report was identified, all of them were based on the studies and reports related to the role of healthcare workers in promoting adherence to infection control measures during pandemics in Saudi Arabia. Out of these identified studies, 14 were removed because of duplication of records, references and location and 16 studies were marked as ineligible, as not including the above stated concept and 10 for some other unavoidable conditions.

Further 97 records were saved for screening, then in the screening process 38 records were further removed on the basis of exclusion criteria. Total studies finalized for review were 59. Two reports were also included in the study.

Several cross-sectional studies carried out in Saudi Arabia under the COVID-19 pandemic found out that HCWs expressed high awareness levels on the practice of infection control such as hand hygiene, PPE use, and patient isolation practices. **[4], [5]** These practices however were not followed in actual sense in what was practiced in different institutions and regions. Researchers repeatedly emphasized that formal training in infection prevention and control (IPC) of HCWs presented many opportunities to be compliant with the recommended practices. **[11]**



Specifically, Alqahtani et al. (2025) observed that HCWs working in Najran City who attended IPC workshops more frequently, overall scored higher on compliance than their peers working in Najran City who attended no structured training. **[2]** A separate study by Alshehari and Saeed (2024) presented the finding that institutional support (availability of PPE, leadership communication, and existence of infection control committees) could promote the culture of safety in conjunction with compliance of HCWs. Such barriers as shortages in PPE, inconsistent guidelines, excessive workload, and psychological stress were most likely to be reported. **[6]**

Histence of language barriers among the expatriate staff and lack of access to the updated protocols in the rural areas were also some of the factors that prevented successful implementation of ICMs. **[12]** It was observed that HCWs of strong professional responsibility and those that work in a team with high compliance rates had a higher likelihood of following ICMs on their own. Departmental leadership as well as peer modeling were very useful in solidifying positive behaviors. New data indicate that mobile apps, e-learning platforms, and real-time dashboards implemented during COVID-19 enhanced access of guidelines and self-monitoring tools among HCWs with access to technology, so the adherence rate in technologically outfitted organizations would increase. **[9], [3]**

These results highlight the multifactoriality of the nature of HCW compliance with infection control measures and emphasize the relevance of systemic, educational, and psychosocial interventions during preparedness in pandemic response.

4. DISCUSSION

Determinants of HCW Adherence

Institutional based systemic factors that are based on institution organization and management of resources are deep roots of barriers to steady IPC adherence. Workload, time limitations, and shortage of staffers continue to be mentioned as the main barriers. HCWs services are highly demanded with the result that the number of patients waiting is often longer than the capacity to manage them so that HCWs do not have time to perform full hand hygiene procedures or thoroughly put on and off of PPE. Moreover, physical material limitation is a direct hindrance to compliance. **[11], [10]**

The shortage of institutional resources to buy enough PPE and structural shortages, including the unavailability of handwashing facilities, are reported challenges. Availability of required tools and infrastructure is a direct limitation to HCW compliance; in the absence of available resources, failure to comply is a systemic error, rather than a behavioral decision. On the other hand, a high institutional support is a strong facilitator. Some of the main aspects are active leadership and management support, institutional IPC teams, sufficient resources, and monitoring and feedback systems. It is important to note that those institutions that had an established Antimicrobial Stewardship Program (ASP) team/unit were identified as key predictors of higher adherence. **[13]**

This association proposes that infection prevention is not a fee-standing compliance task, but is best optimized when it is combined into multi-disciplinary and broad-based quality assurance models and patient safety cultures. Availability of strong systems such as ASPs seems to support accountability and procedural compliance within the facility.

Behavioral Influences

Adherence variance is also largely due to individual and professional factors. One of the key and the most common obstacles is poor IPC knowledge and training. In spite of the fact that lots of HCWs claim that they are trained, research indicates areas of weakness in training and general preparedness. Such shortages may give way to false perceptions, including the notion of some HCWs that gloves can replace handwashing in order to save time. There is also a contribution of psychosocial factors. **[16], [10]** Fear of new illnesses can impact the behavioral adherence; thus, a high level of anxiety with COVID-19 increased the risk of not attending hospital awareness activities among HCWs.

A positive attitude on the other hand like the assumption that washing hands is not difficult, will not only save lives, but will also help the patient and myself will make it easy to comply. Lastly, the implementation of preventive interventions, including vaccination, was found to be a possible behavioral impediment. **[9], [2]** This effect indicates that there is a possibility of risk compensation, in which the perceived risk mitigation suggested by vaccination can be the reason behind lower vigilance and a reduction in non-pharmaceutical IPC behavior. This is so complicated that behavioral intervention strategies cannot be limited to mere knowledge dissemination. Training should be both operative (scenario-based training), sustained (refresher training), and also should anticipate the risks of psychosocial concerns like anxiety management and compensatory behavioral risks of protective practices like immunization. **[7]**

Effectiveness of IPC Interventions

The direct IPC interventions show quantifiable effectiveness in enhancing HCW compliance in KSA. Multicomponent interventions, strategies that involve education and provision of resources, active monitoring, have shown important improvement. **[12]**

Indicatively, a multicomponent intervention in a university hospital showed that the mean Hand Hygiene (HH) compliance

increased significantly, which rose by a mean score of 50.17 to 71.75 (0.05). In another specific context (dental clinics), educational interventions were observed to raise compliance rates to up to 85 percent of cases. **[14], [17]** These statistics go on to support the idea that the identified compliance gaps can indeed be addressed successfully by means of planned, structured interventions, though they need to combat the knowledge and resource gaps, underlying problematic knowledge. An essential discovery made in the specific research conducted by KSA is the quantitative relationship between better HCW compliance and real patient safety improvements. **[12], [7]**

The same multicomponent HH intervention that increased compliance level by 50.17 to 71.75 also led to a statistically significant decrease in the rates of Healthcare-Associated Infection (HAI) (reducing it to 3.37 to 2.59 per 1,000 line days) and those of Catheter-Associated Urinary Tract Infection (CAUTI) (reducing it to 3.73 to 1.75). **[2], [16], [11]** The high occupational infection rates in HCWs are a sentinel critical measure of system failure that has always been high during both MERS (19.1) and COVID-19 (12.5). These high rates are the direct outcome of the insufficient regulation of IPC and the failure of the institutions, such as their weak institutional actions, insufficient level of awareness, and weak adherence to PPE. **[14]**

The lack of health safety among HCWs undermines the health of the staff and at the same time makes healthcare facilities potential centers of further outbreak transmission, which is a basic danger to the stability of the public health system. Thus, the prevention of the HCW infection rates via the optimal adherence implies two-fold necessity, which is essential to prevent healthcare workers and contain the outbreak of human health. **[15], [17]**

5. CONCLUSION

Healthcare workers in the Kingdom of Saudi Arabia generally demonstrate a moderate to satisfactory level of adherence to IPC measures, a behavioral pattern significantly shaped by the operational experience and painful lessons learned during the MERS-CoV and COVID-19 pandemics. However, this adherence remains highly vulnerable to resource constraints (workload and lack of supplies), professional variance (the adherence gap between nurses and physicians), and the inevitable decay of vigilance in non-crisis periods. The analysis has definitively established a causal, quantitative link between proactive HCW adherence and measurable reductions in Healthcare-Associated Infections, providing the necessary empirical mandate for targeted national policy investment. Future preparedness efforts must address these structural and behavioral vulnerabilities rather than assuming policy existence translates to flawless execution.

Future Scope of Study

This systematic review lays the groundwork for future empirical research on healthcare workers' adherence to infection control precautions during pandemics in Saudi Arabia. Future studies can be designed based on the identified gaps in the review such as, differences by region, little data in primary care and rural, and the unexplored role of digital health tools, employing longitudinal and interventional studies to track ongoing effectiveness of training, policy change, and technology advances. In addition, comparative studies within the Kingdom and regions will provide contextual challenges and context-related best practice. Integration of behavioral science frameworks and assessment of the psychosocial determinants of compliance will further enrich the inquiry

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