Pak Heart J 2024:57(02)
ISSN:0048-2706 E-ISSN:2227-9199

Cross-Sectional Analysis of Infection Control Knowledge and Practices Among Community Healthcare Workers

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ABSTRACT

Background: Community healthcare workers (CHWs) play a vital role in infection control, particularly in underserved areas. However, their knowledge and adherence to infection control practices can vary due to limited resources and training. This study aims to assess the infection control knowledge and practices among CHWs in Al-Ahsa, Saudi Arabia.

Methods: A cross-sectional study was conducted with 200 CHWs affiliated with King Faisal University. Data were collected using a structured, self-administered questionnaire, which included demographic information, infection control knowledge, and self-reported practices. Descriptive statistics and bivariate analyses were performed to examine relationships between demographic characteristics and infection control knowledge and practices.

Results: The mean knowledge score was 65.7% (SD = 12.4), with high knowledge observed in hand hygiene practices but lower scores in PPE use and waste disposal. Self-reported practice scores averaged 72.3% (SD = 15.7), with strong adherence to hand hygiene but inconsistent PPE usage. Key barriers identified included lack of PPE (42%), time constraints (35.5%), and insufficient training (30.5%). Bivariate analysis showed that higher education and more than five years of experience were significantly associated with better infection control practices ($p < 0.05$).

Conclusion: While CHWs in Al-Ahsa demonstrate moderate infection control knowledge and reasonable adherence to recommended practices, gaps remain, particularly in PPE use and waste disposal. Addressing these gaps through structured training, resource provision, and institutional support is essential for improving infection control in community healthcare settings.

Keywords: Infection control, community healthcare workers, knowledge, practices, personal protective equipment

introduction

Infection control is a fundamental component of healthcare delivery, aimed at preventing healthcare-associated infections (HAIs) that can compromise patient safety, healthcare workers' (HCWs) health, and overall public health. Community healthcare workers (CHWs), who are often the first point of contact in public health systems, play a crucial role in promoting infection prevention and control (IPC) practices, especially in underserved and high-risk communities [1]. Despite the critical importance of CHWs in infection control, research on their knowledge and adherence to IPC guidelines remains limited, especially in low-resource settings [2,3].

The global burden of HAIs is considerable, with estimates suggesting that hundreds of millions of patients worldwide are affected each year, leading to increased morbidity, mortality, and healthcare costs [4]. In settings with limited healthcare infrastructure, HAIs pose an even more significant challenge due to factors such as high patient-to-staff ratios, limited IPC resources, and inconsistent adherence to protocols [5]. Given these challenges, effective infection control practices are essential in preventing disease transmission, not only within clinical settings but also within the broader community. Therefore, ensuring that CHWs possess adequate IPC knowledge and practice appropriate measures is critical for minimizing infection risks across different levels of healthcare delivery [6].

Community healthcare workers are integral to healthcare in many countries, particularly in rural and underserved areas where healthcare access is often limited [7]. Their responsibilities include health education, vaccination, basic curative care, and the promotion of hygiene and sanitation practices, all of which involve elements of

infection control [8]. However, studies suggest that CHWs frequently face challenges in accessing IPC training, resources, and support, which can hinder their ability to implement recommended practices effectively [9,10]. Moreover, unlike HCWs in hospital settings who often undergo formal IPC training, CHWs may not receive structured or standardized IPC education, leading to gaps in both knowledge and practice [11].

Research indicates that knowledge deficits and inconsistent practices among CHWs may stem from multiple factors, including limited formal training, high workloads, and inadequate supervision [12]. For instance, a study conducted in low-income countries demonstrated that many CHWs had limited knowledge of standard precautions, such as hand hygiene, use of personal protective equipment (PPE), and waste disposal [13]. This gap in IPC knowledge can lead to improper practices that increase the risk of infection transmission, affecting both the CHWs and the communities they serve [14]. Addressing these gaps through targeted training and resource provision is essential to improve IPC outcomes and mitigate the spread of infectious diseases [15].

Recent global health crises, such as the COVID-19 pandemic, have further underscored the importance of IPC knowledge and practices among CHWs. The pandemic revealed significant gaps in IPC preparedness across healthcare systems worldwide, particularly in community and primary care settings where resources and training were often inadequate [16]. The World Health Organization (WHO) and other public health entities have called for enhanced IPC measures across all levels of healthcare, emphasizing the role of CHWs in implementing these strategies effectively to curb the spread of infectious diseases [17,18]. This renewed focus highlights the need to assess and strengthen IPC competencies among CHWs to ensure a resilient and safe healthcare workforce.

Despite the recognized importance of IPC knowledge and practices, there is a paucity of data on the specific needs and challenges faced by CHWs in various settings. Understanding these factors can provide insights into how to improve IPC training and resources tailored to CHWs, ultimately leading to better patient outcomes and safer healthcare environments [19]. Furthermore, there is an increasing recognition of the role of ongoing education and support in sustaining effective IPC practices over time, particularly in settings that face recurrent infectious disease outbreaks [20].

This study aims to fill this knowledge gap by conducting a cross-sectional analysis of IPC knowledge and practices among CHWs. By assessing the current state of IPC understanding and adherence among CHWs, this study will contribute to the existing body of knowledge and inform future interventions aimed at enhancing IPC practices at the community level. In addition, this research seeks to identify specific barriers faced by CHWs, which can help shape policies and training programs designed to improve IPC adherence among frontline healthcare providers.

Method

Study Design

This study employed a cross-sectional design to evaluate infection control knowledge and practices among community healthcare workers (CHWs) in Al-Ahsa, Saudi Arabia. The cross-sectional design was selected to capture a snapshot of CHWs' infection control knowledge and practices at a specific point in time, allowing for an assessment of both strengths and gaps in infection prevention practices within the community healthcare context.

Setting and Participants

The study was conducted in Al-Ahsa, a region in eastern Saudi Arabia known for its active healthcare initiatives, through community health facilities affiliated with King Faisal University. These facilities provide primary and preventive health services and serve as a critical point of access to healthcare for a diverse population, particularly in rural and underserved communities. Community healthcare workers participating in the study included a wide range of roles, such as community health assistants, outreach workers, and health educators, who provide frontline healthcare services outside of traditional hospital settings.

Inclusion criteria required that participants be actively employed in a community health role, directly involved in patient care, and have at least one year of experience in the field to ensure adequate exposure to infection control practices. Exclusion criteria included healthcare workers not involved in direct patient care (e.g., administrative staff) and those with less than one year of experience. This focus on experienced CHWs was intended to enhance the reliability of the study findings by including individuals with substantial exposure to infection control scenarios.

Sample Size and Sampling Method

The sample size was calculated based on previous studies that evaluated infection control knowledge and practices among healthcare workers. Using power analysis with an anticipated prevalence of adequate infection control knowledge at 50% (for maximum sample size), a 95% confidence interval, and a 5% margin of error, a target sample size of 200 CHWs was determined to provide sufficient power for meaningful analysis.

A systematic random sampling approach was used to select participants. Eligible CHWs were identified through facility records provided by healthcare facilities affiliated with King Faisal University. From this list, every nth individual (based on a random starting point) was invited to participate until the target sample size was achieved. This sampling method ensured that the sample was representative of the CHWs operating in Al-Ahsa, allowing for generalization of findings to similar settings.

Data Collection

Data collection was conducted over a one-month period. A structured, self-administered questionnaire was distributed to the participants at their respective workplaces. The questionnaire was designed to be completed within 15-20 minutes, minimizing disruption to participants' daily responsibilities.

The questionnaire was divided into three main sections:

1. **Demographic Information**: This section collected data on age, gender, level of education, years of experience, and specific roles within the healthcare facility. These variables were intended to provide insight into how demographic factors might influence infection control knowledge and practices.
2. **Infection Control Knowledge**: This section included 15 multiple-choice questions assessing knowledge of infection control principles based on World Health Organization (WHO) guidelines, including hand hygiene, use of personal protective equipment (PPE), sterilization techniques, and safe waste disposal. Example questions included: "What is the minimum time recommended for hand washing with soap and water?" and "What is the correct order for donning PPE?" Knowledge scores were calculated as the percentage of correct responses, with higher scores indicating better knowledge.
3. **Infection Control Practices**: This section contained 10 self-reported items on practices related to infection control in daily interactions with patients. Topics included frequency of hand hygiene, adherence to PPE protocols, sterilization of equipment, and safe disposal of hazardous waste. Responses were on a Likert scale ranging from "always" to "never," allowing for quantification of practice adherence. Practice scores were derived based on frequency of adherence to recommended practices, with higher scores reflecting more consistent IPC practices.

Instrument Validity and Reliability

The questionnaire was adapted from standardized and validated infection control assessment tools previously used in healthcare research. To ensure cultural relevance and applicability to community healthcare settings in Al-Ahsa, the instrument was reviewed and modified by a panel of experts from King Faisal University, including specialists in public health, infection control, and community healthcare.

To test the reliability and clarity of the questionnaire, a pilot study was conducted with 20 CHWs from facilities not included in the main study. Feedback from the pilot participants was used to refine questions for clarity and cultural appropriateness. The reliability of the knowledge and practice sections was confirmed with a Cronbach's alpha of 0.85 and 0.82, respectively, indicating high internal consistency and reliability of the instrument.

Ethical Considerations

The study protocol received ethical approval from the Institutional Review Board (IRB) at King Faisal University (IRB approval number: [insert approval number]). Informed consent was obtained from all participants, who were informed of the study's purpose, their voluntary participation, and their right to withdraw at any time without penalty. To protect confidentiality, all collected data were anonymized, with no identifying information recorded. Data were securely stored, accessible only to the research team, and used solely for the purposes of this study.

Data Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 26. Descriptive statistics were used to summarize demographic data and responses to knowledge and practice items, with frequencies, percentages, means, and standard deviations reported as appropriate. Knowledge and practice scores were computed, and cutoffs were established to categorize participants as having "adequate" or "inadequate" knowledge and practices.

To explore associations between demographic factors (such as age, education, and years of experience) and infection control knowledge and practices, bivariate analysis was conducted using chi-square tests for categorical variables and independent t-tests for continuous variables. Further, logistic regression analysis was applied to identify predictors of adequate infection control knowledge and practices among CHWs, controlling for potential confounding variables. Statistical significance was set at a p-value of <0.05.

Results

Participant Characteristics

A total of 200 community healthcare workers (CHWs) participated in the study. The mean age was 34.5 years (SD = 7.2), with ages ranging from 22 to 57 years. The sample was predominantly female (n = 142, 71%), and most participants had a college degree or higher education (n =

126, 63%). The mean years of experience in community healthcare was 8.3 years (SD = 3.4). Table 1 presents a detailed breakdown of the demographic characteristics of the participants.

Table 1. *Demographic Characteristics of Community Healthcare Workers (N=200)*

Characteristic	n	%
Age (Mean ± SD)	34.5 ± 7.2	
Gender		
- Female	142	71.0
- Male	58	29.0
Education Level		
- College or higher	126	63.0
- High school	74	37.0
Years of Experience	8.3 ± 3.4	

Infection Control Knowledge

The mean knowledge score among CHWs was 65.7% (SD = 12.4). Knowledge of hand hygiene protocols was generally high, with 81% (n = 162) correctly identifying the recommended handwashing time. However, only 47.5% (n = 95) were aware of the correct order for donning PPE, and 42% (n = 84) accurately answered questions on safe waste disposal practices. Table 2 provides a summary of the responses to individual knowledge items.

Table 2. *Infection Control Knowledge Items among Community Healthcare Workers (N=200)*

Knowledge Item	Correct Responses (n)	%
Hand hygiene duration	162	81.0
PPE donning order	95	47.5
Proper waste disposal	84	42.0
Surface sterilization methods	113	56.5
Overall mean knowledge score (Mean ± SD)	65.7 ± 12.4	

Self-Reported Infection Control Practices

The mean practice score was 72.3% (SD = 15.7), with high compliance reported for hand hygiene (87%, n = 174) and use of gloves (76.5%, n = 153) when performing procedures. However, adherence to other practices, such as mask-wearing during patient interactions (54.5%, n = 109), was comparatively lower. Table 3 summarizes self-reported infection control practices.

Table 3. *Self-Reported Infection Control Practices (N=200)*

Practice Item	Always (%)	Sometimes (%)	Rarely/Never (%)
Hand hygiene after patient contact	87.0	11.5	1.5
Use of gloves	76.5	18.0	5.5
Mask-wearing during interactions	54.5	27.0	18.5
Safe waste disposal	68.5	22.0	9.5
Mean practice score (Mean ± SD)	72.3 ± 15.7		

Knowledge and Practice Scores by Demographic Characteristics

Analysis by age group, education level, and years of experience revealed significant differences in infection control knowledge and practice scores. CHWs with higher education demonstrated higher knowledge scores (mean = 69.8%, SD = 10.9) compared to those with only high school education (mean = 59.5%, SD = 11.8, p = 0.03). Table 4 provides an overview of mean knowledge and practice scores stratified by demographic characteristics.

Table 4. *Infection Control Knowledge and Practice Scores by Demographic Characteristics*

Characteristic	Mean Knowledge Score (%)	Mean Practice Score (%)
Age: ≤ 35 years	63.2 ± 12.9	70.1 ± 14.5
Age: > 35 years	68.5 ± 11.6	74.5 ± 16.2
Education: High school	59.5 ± 11.8	68.7 ± 13.9
Education: College	69.8 ± 10.9	75.3 ± 16.5
Experience: ≤ 5 years	60.1 ± 12.4	69.2 ± 15.1
Experience: > 5 years	67.4 ± 13.1	74.8 ± 16.0

Correlation Between Knowledge and Practice Scores

A Pearson correlation analysis demonstrated a moderate positive correlation between knowledge and practice scores (r = 0.58, p < 0.001), suggesting that higher knowledge levels were associated with better infection control practices. Table 5 details the correlation analysis.

Table 5. *Correlation Between Infection Control Knowledge and Practice Scores*

Variables	r	p-value
Knowledge vs. Practice Scores	0.58	< 0.001

Barriers to Infection Control

Participants reported several barriers to implementing effective infection control practices. Lack of PPE (reported by 42%, n = 84), time constraints (35.5%, n = 71), and insufficient training (30.5%, n = 61) were among the most common barriers. Table 6 provides a breakdown of reported barriers.

Table 6. *Reported Barriers to Infection Control Practices*

Barrier	Frequency (n)	%
Lack of PPE	84	42.0
Time constraints	71	35.5
Insufficient training	61	30.5

Inadequate facility support	45	22.5
Limited access to hand sanitizers	33	16.5

Multivariate Analysis of Factors Associated with Adequate Infection Control Knowledge and Practices

A multivariate logistic regression analysis identified higher education level (OR = 1.75, 95% CI: 1.12–2.72, p = 0.02) and years of experience over five years (OR = 1.43, 95% CI: 1.01–2.04, p = 0.04) as significant predictors of adequate infection control knowledge and practices. Table 7 shows the adjusted odds ratios for factors associated with adequate knowledge and practice.

Table 7. *Multivariate Analysis of Factors Associated with Adequate Infection Control Knowledge and Practices*

Variable	Adjusted OR	95% CI	p-value
Higher Education	1.75	1.12–2.72	0.02
Experience > 5 years	1.43	1.01–2.04	0.04
Age > 35 years	1.12	0.79–1.60	0.27
Female gender	0.89	0.60–1.32	0.53

Discussion

The findings of this study provide valuable insights into the infection control knowledge and practices of community healthcare workers (CHWs) in Al-Ahsa, Saudi Arabia. The results reveal an overall moderate level of infection control knowledge among CHWs, with notable gaps in specific areas such as personal protective equipment (PPE) usage and waste disposal practices. These findings align with previous studies suggesting that CHWs often lack comprehensive infection control training compared to hospital-based healthcare workers, which can hinder their ability to implement effective infection control measures [21,22].

Key Findings and Implications

One of the most significant findings in this study was the discrepancy between knowledge and practice scores among CHWs. Although a majority demonstrated reasonable knowledge of hand hygiene protocols, fewer respondents adhered to consistent PPE usage and waste management practices. This inconsistency suggests that knowledge alone may not suffice in ensuring proper infection control, as other factors like resource availability, workload, and organizational support also play crucial roles [23]. Similar studies in other settings have also reported that knowledge does not always translate into practice, particularly in resource-limited environments where CHWs may lack adequate PPE or training support [24,25].

The study's findings on PPE use further highlight the challenges CHWs face in adhering to infection control practices. Only about half of the participants reported always using masks during patient interactions, despite their awareness of its importance. This low adherence rate could be attributed to the limited availability of PPE, as noted in other low-resource settings where PPE shortages have been a persistent challenge [26]. The high proportion of CHWs who cited PPE shortages as a barrier emphasizes the need for increased institutional support to ensure the availability and accessibility of necessary infection control supplies [27].

Comparisons with Previous Studies

The knowledge scores observed in this study (mean = 65.7%) are comparable to findings from studies conducted among CHWs in similar settings, where infection control knowledge often falls within the moderate range due to limited formal training [28]. For example, a study conducted among CHWs in Ethiopia reported mean knowledge scores of 63%, with significant gaps in knowledge of PPE usage and waste disposal protocols [29]. Another study in Kenya found that CHWs had limited awareness of critical infection control practices, which were often attributed to a lack of structured training and continuous professional development opportunities [30]. These consistent findings across diverse regions underscore a universal need for improved training initiatives that address the specific infection control needs of CHWs.

Barriers to Effective Infection Control Practices

This study also identified several barriers to infection control, including lack of PPE, time constraints, and insufficient training, which have been cited as common challenges in the literature [31,32]. The lack of adequate training is particularly concerning, as research indicates that regular, hands-on training is essential for sustaining high standards of infection control practices [33]. Addressing these barriers requires a multi-faceted approach that involves not only increasing resource allocation but also implementing policies that prioritize infection control training and support for CHWs [34].

Recommendations for Policy and Practice

Based on these findings, targeted interventions are recommended to improve infection control practices among CHWs in Al-Ahsa. First, structured training programs should be developed, focusing on the critical aspects of infection control such as hand hygiene, PPE use, and waste management. These training programs should be implemented as part of CHWs' routine professional development to ensure ongoing reinforcement of best practices [35]. Moreover, the institution should prioritize the consistent provision of PPE and other infection control resources. Increased collaboration between healthcare institutions and governmental bodies can help address resource limitations and provide the necessary infrastructure to support CHWs in infection control [36].

Additionally, this study suggests that infection control policies should consider the specific working conditions and needs of CHWs in community settings. Given the high workload and time constraints reported by many participants, organizational support for time management and workload reduction could be beneficial. Such measures may include allocating sufficient staff to reduce individual workload or implementing flexible scheduling to allow CHWs adequate time to practice thorough infection control [37].

Limitations and Future Research

Several limitations should be considered when interpreting the findings of this study. The cross-sectional design limits causal inference, as the observed associations cannot determine the directionality of the relationships. Furthermore, the reliance on self-reported practices may introduce response bias, as participants might over-report adherence to infection control measures. Future studies should consider longitudinal designs and observational methods to capture a more accurate representation of infection control practices among CHWs. Additional research is also needed to explore the impact of specific training interventions on infection control knowledge and practice, particularly in low-resource community settings [38].

Conclusion

In summary, this study highlights the need for enhanced infection control training and resource allocation for CHWs in Al-Ahsa. While CHWs demonstrate a basic understanding of infection control principles, gaps in practice reveal the challenges they face in consistently applying this knowledge. Addressing these challenges requires a commitment to providing the necessary resources, training, and institutional support to empower CHWs in fulfilling their infection control responsibilities. By strengthening infection control practices in community settings, healthcare systems can better protect both CHWs and the communities they serve, contributing to improved public health outcomes.

Funding: This research was funded by Deanship of Scientific Research at King Faisal University, Saudi Arabia (KFU242293).

Acknowledgments: The authors acknowledge the Deanship of Scientific Research at King Faisal University for obtaining financial support for research, authorship, and the publication. of research (KFU242293)

Conflicts of Interest: The author declares no conflict of interest.

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