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Original Research Article

Effect of health education on prevention of nosocomial infections in primary health care facilities, Gombe State, Nigeria

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ABSTRACT

Background: Nosocomial infections remain a significant threat to patient safety and public health worldwide. Data indicate that these infections pose ongoing challenges in healthcare settings.
Methods: This study, utilizing a quasi-experimental design, evaluates the baseline knowledge, attitudes, and practices of healthcare workers and assesses the impact of a tailored health education program on these factors. A total of 380 participants were enrolled, with data collected through a multistage sampling technique using questionnaires, pre- and post-intervention assessments, and direct observation of infection prevention practices.
Results: The result revealed significant improvements in knowledge and practices concerning nosocomial infections among participants in the intervention group (ward-A) compared to the control group (ward-B) following the administration of health education. Almost all participants in ward-A (97.4%) were aware of nosocomial infections, compared to only 65.8% in ward-B. Similarly, all Ward-A participants had received formal health education on the subject, whereas only 65.8% of ward-B participants reported the same. These differences were statistically significant, emphasizing the impact of health education. The study highlights a preference for interactive learning methods, including workshops and on-the-job training, as the most effective means of delivering health education.
Conclusions: These findings underscore the necessity for ongoing health education initiatives to strengthen infection prevention and control practices in healthcare settings.

Keywords: Attitudes, Health education, Knowledge, Nosocomial infections, Primary health care

INTRODUCTION

Nosocomial infections, also known as healthcare-associated infections (HAIs), continue to present a major threat to patient safety and public health worldwide.[1] These infections, acquired during the delivery of healthcare services within medical facilities, have a profound effect on patient outcomes, increase healthcare costs, and undermine the efficiency of healthcare systems.[2] Recent studies highlight the ongoing burden of HAIs, emphasizing the need for improved prevention and control measures.[3] Primary health care facilities play a crucial role

in delivering essential health services to communities, but the risk of nosocomial infections persists, demanding vigilant preventive strategies. It remains a critical global issue in the healthcare sector. These infections pose a serious risk to patient safety, leading to higher rates of morbidity, mortality, and escalating healthcare costs.[4] The problem is especially pronounced in resource-limited settings, where factors like inadequate infrastructure, insufficient training, and scarce resources significantly heighten the risk of infection.[5] These challenges emphasize the urgent need for improved infection prevention strategies and investments in healthcare systems, particularly in under-resourced regions. The World Health Organization (WHO) emphasizes the importance of primary health care as a cornerstone of healthcare systems, advocating for the delivery of comprehensive and accessible services to communities.[6] Despite this HAIs remain a widespread global concern, posing serious risks to patient safety and public health.[7]

Globally, HAIs are a significant burden on healthcare systems, leading to increased morbidity, mortality, and healthcare costs.[8] Recent data from the United States indicate that HAIs affect over 1.7 million patients annually, resulting in nearly 100,000 deaths and billions of dollars in excess healthcare costs.[9] Similarly, in the United Kingdom, HAIs impact over 300,000 patients annually, leading to 5,000 deaths and approximately £1 billion in excess healthcare costs.[10] In sub-Saharan Africa, the challenges posed by HAIs are even more severe, particularly in resource-limited settings.[11] Contributing factors such as inadequate infrastructure, insufficient healthcare worker training, and poor infection prevention practices significantly exacerbate the risk of HAIs.[12] Studies conducted in South Africa, Ghana, and Kenya have underscored the serious impact of HAIs, demonstrating the need for focused interventions to reduce infection rates and improve patient safety.[13] In Nigeria, HAIs continue to pose a substantial threat to patient health and healthcare systems.[14] Research has consistently highlighted the prevalence of HAIs in hospitals, with studies showing an infection rate affecting over 20% of patients in some tertiary hospitals, resulting in significant morbidity and mortality.[15] In Gombe State, the issue is particularly concerning primary healthcare facilities, where infection prevention measures are often insufficient due to resource constraints and inconsistent adherence to protocols.[16] Limited training for healthcare workers and variable compliance with infection control guidelines contribute to the heightened risk of HAIs in these settings.[17]

Nosocomial infections, or healthcare-associated infections (HAIs), continue to pose a critical challenge in primary healthcare facilities in Gombe State, Nigeria.[18] These infections are a significant cause of morbidity and mortality, with global estimates indicating that 7-10% of hospitalized patients in low- and middle-income countries (LMICs) acquire at least one HAI during their hospital stay.[19] Despite the essential role primary healthcare centers (PHCs) serve as the first point of contact for many seeking healthcare, the risk of HAIs remains alarmingly high. In Nigeria, studies suggest that the prevalence of nosocomial infections ranges between 10% and 30%, with even higher rates in under-resourced healthcare settings.[20] These infections contribute substantially to the disease burden among patients in these settings, prolonging hospital stays, increasing healthcare costs, and leading to severe complications, including antimicrobial resistance.[21] This, in turn, places additional strain on an already fragile and resource-limited healthcare system, further impeding efforts to improve health outcomes. Nosocomial infections have far-reaching consequences, including increased morbidity and mortality rates, antimicrobial resistance, and economic burdens on patients and healthcare facilities.[22] A study by the Nigerian Centre for Disease Control (NCDC) reported that HAIs significantly contribute to extended hospital stays, adding an average of 7-10 extra days per patient, thereby escalating treatment costs.[23] Moreover, patients with HAIs are at a greater risk of complications, including sepsis, organ failure, and death, particularly among neonates, pregnant women, and immune-compromised individuals.[24] These adverse outcomes highlight the urgent need for context-specific interventions to improve IPC practices in Gombe State's PHCs.[25]

A notable gap exists in the implementation of targeted health education interventions aimed at addressing nosocomial infections in Gombe state's primary health care facilities. The absence of comprehensive and tailored educational programs hinders the enhancement of healthcare workers' knowledge and practices essential for effective infection prevention.[26] Nosocomial infections can lead to adverse patient outcomes, compromising the overall quality of healthcare delivery. Increased morbidity and mortality rates among patients with healthcare-associated infections highlight the need for urgent and context-specific interventions to prevent and control these infections.[27] To address the multifaceted problem of nosocomial infections, there is a pressing need for sustainable interventions that consider the unique challenges faced by primary health care facilities in Gombe state. Effective solutions must go beyond immediate responses to create lasting improvements in infection prevention practices.[28] While existing studies highlight the global burden of nosocomial infections and associated challenges, there is a specific dearth of research focused on the contextual factors influencing nosocomial infections in primary health care facilities in Gombe state.

In essence, the statement of the problem underscores the critical need to address the persistent challenges posed by nosocomial infections in Gombe state's primary health care facilities. The identified issues provide a clear rationale for conducting this research and emphasize the urgency of implementing effective and sustainable interventions to enhance infection prevention practices.[29] Despite efforts to improve healthcare quality, nosocomial infections remain a critical issue in primary health care

facilities in Gombe state. The lack of comprehensive health education programs tailored to address infection prevention contributes to the persistence of nosocomial infections. The gaps in knowledge and practices among healthcare workers further exacerbate the problem, necessitating a targeted and evidence-based intervention. Therefore, this study sought to assess the effect of health education on prevention of nosocomial infections in primary health care facilities in Gombe State. The specific objectives of the study are to assess the baseline level of awareness among healthcare workers in primary health care facilities in Gombe state regarding nosocomial infections, to evaluate the existing infection prevention practices in primary health care facilities and identify gaps in adherence to standard protocols, to assess the impact of a health education intervention on healthcare workers' knowledge, attitudes, and practices related to nosocomial infection prevention.

METHODS

Study site

This study was conducted between February 2024 and November 2024 in the primary health care centres of the two local government areas (LGAs), Akko LGA and Dukku LGA, selected in Gombe State by a simple random sampling technique. These LGAs were selected to assess the impact of health education interventions on nosocomial infection-prevention practices in primary health care (PHC) facilities.

Akko LGA is located in the southwestern part of Gombe State. It shares boundaries with Yamaltu/Deba LGA to the east, Funakaye LGA to the north, and Bauchi State to the west and south. With a projected population of approximately 520,000 in 2024, Akko LGA consists of several wards, including Akko, Kumo, Kembu, Gona, and Garin Garba. The area is served by approximately 30 PHC facilities, making it a significant setting for evaluating infection-control practices.

Dukku LGA, situated in the northern part of Gombe State, shares borders with Kwami LGA to the south, Nafada LGA to the northeast, and Bauchi State to the west. Its projected population for 2024 is approximately 270,000. The LGA comprises wards such as Dukku, Gombe Abba, Hashidu, Malala, and Wuro Tale. With around 25 PHC facilities, Dukku LGA presents a valuable setting for studying the effectiveness of health education interventions in preventing nosocomial infections.

Study design

A quasi-experimental research design was employed, utilizing a pre- and post-intervention approach. This design facilitated the assessment of the effectiveness of a health education intervention in improving nosocomial infection prevention practices among healthcare workers.

Study population

The study participants included healthcare workers such as doctors, community health technicians, nurses, and midwives working in primary health care facilities in Gombe State, Nigeria.

Inclusion criteria

Healthcare workers currently employed in the selected primary health care facilities and are available for both the pre- and post-intervention assessments.

Exclusion criteria

Healthcare workers currently employed in the selected primary health care facilities and are available for both the pre- and post-intervention assessments. But was found to be on extended leave during the intervention period.

Sample size determination

The minimum sample size was estimated using the formula:

$$N = \frac{(Z_\alpha + Z_\beta)^2 \times p(1-p)}{d^2}$$

Where:

N= minimum required sample size
Z_α= standard normal deviate at 95% confidence level (1.96)
Z_β= standard normal deviate at 80% study power (0.84)
p= expected prevalence (0.34)
d= minimum detectable difference (0.05)

Substituting the values:

$$N = \frac{(2.80)^2 \times 0.2244}{0.0025}$$

$$= \frac{7.84 \times 0.2244}{0.0025}$$

$$= \frac{1.7593}{0.0025}$$

$$= 703.72 \approx 704$$

Adjusting for a 10% non-response rate:

$$n = \frac{704}{1 - 0.10} = \frac{704}{0.90} = 782.2 \approx 783$$

Final minimum sample size = 783 participants.

Sampling technique

A multistage sampling technique was used to study the selected participants.

Stage I: selection of a ward in each LGA

A simple random sampling technique by balloting was used to select one ward from each LGA, one to be intervention site and the other one as control population.

Stage II: selection of PHCs

From the selected ward, two PHCs were selected by simple random sampling by balloting.

Stage III: selection of participants

The participants were selected by multistage sampling technique using the list of staff in the various PHCs, n^{th} value = sample frame/sample size.

Ethical considerations

Ethical approval was obtained from the relevant institutional review board and the State Ministry of Health prior to the commencement of the study. Informed consent was obtained from all participants before data collection. Participants' privacy and confidentiality was safeguarded by anonymizing all data and restricting access to the research team only.

Data analysis

The collected data were organised, sorted and the quantitative data such as age was analysed using measures of central tendency as mean and measure of dispersion as standard deviation while for qualitative variables such as gender and marital status and level of education, rate and proportions were used and the data was presented on tables and charts. The chi-square test was used to show that the distribution of age groups is similar in both groups. To make comparison between pre-test and post-test, mean difference was determined using paired 't' test to calculate the effectiveness of the health education intervention programme. Frequency and percentages were used to present the control and intervention knowledge of the health workers.

RESULTS

The data in Table 1 present the socio-demographic characteristics of the respondents in the intervention and control groups. The results show that there are no significant differences between the two groups in terms of age, marital status, educational level, and cadre. In terms of age, the mean age of mothers in both groups is around 32-33 years, with a standard deviation of 6-7 years. The chi-square test shows that the distribution of age groups is similar in both groups, with no significant differences.

Table 1: Socio-demographic characteristics showing similarities in the intervention and control.

Socio-demographic Characteristics	Ward-A (intervention) n=190 (%)	Ward-B (control) n=190 (%)	Total n=380 (%)	Test of significance	P value
Age of mother (in years)					
<20	38 (20)	42 (22)	80 (21.1)	χ^2=0.542	0.763
20-29	76 (40)	80 (42)	156 (41.1)		
30-39	34 (18)	30 (16)	64 (16.8)		
≥40	42 (22)	38 (20)	80 (21.1)		
Mean±SD in years	32.5±7.2	33.1±6.9	32.8±7.0		
Marital Status					
Married	152 (80)	152 (80)	304 (80)	χ^2=0.123	0.923
Divorced	20 (10.5)	20 (10.5)	40 (10.5)		
Widowed	18 (9.5)	18 (9.5)	36 (9.5)		
Educational-level					
University	76 (40)	80 (42)	156 (41.1)	χ^2=0.542	0.763
Diploma	76 (40)	72 (38)	148 (39)		
Secondary	34 (18)	30 (16)	64 (16.8)		
Primary	4 (2.1)	8 (4.2)	12 (3.2)		
Others	0 (0)	0 (0)	0 (0)		
Cadre					
Senior staffs	38 (20)	40 (21.1)	78 (20.5)	χ^2=0.542	0.763
Junior staffs	76 (40)	80 (42)	156 (41.1)		
Technicians	34 (18)	30 (16)	64 (16.8)		
HW/student	20 (10.5)	20 (10.5)	40 (10.5)		
Others	22 (11.6)	20 (10.5)	42 (11.1)		

Table 2: Knowledge and practices concerning nosocomial infection among participants in the intervention and control groups before health education.

Questions	WARD-A (intervention) (n=190) (%)	WARD-B (control) (n=190) (%)	Total	Test of significance	P value
Do you know what nosocomial infections are?					
Yes	130 (68.4)	120 (63.1)	250	1.10	0.29
No	60 (31.6)	70 (36.9)	130		
Have you remember having received any formal health education on nosocomial infections?					
Yes	50 (26.3)	80 (42.1)	130 (37.1)	1.20	0.30
No	140	130	250		
Groups at risk of nosocomial infection					
Elderly	160 (84.2)	130 (68.4)	290	14.72	0.001
Children	170 (89.5)	140 (73.7)	310	15.62	0.001
Pregnant women	150 (78.9)	120 (63.1)	270	10.31	0.001
Smokers	120 (63.2)	95 (50.0)	215	6.67	0.010
Visitors	140 (73.7)	110 (57.9)	250	9.39	0.002
Patients in surgical wards	175 (92.1)	145 (76.3)	320	17.48	0.001
Poor Hospital hygiene	180 (94.7)	150 (78.9)	330	19.36	0.011
Invasive nonsurgical procedure	165 (86.8)	135 (71.1)	300	14.29	0.001
Healthcare worker behaviour that can increase the risk of nosocomial infection					
Length of hospital stay	160 (84.2)	120 (63.1)	280	16.85	0.001
Not wearing gloves when touching mucous membranes or non-intact skin	170 (89.5)	130 (68.4)	300	19.45	
Not wearing masks during procedures and patient-care activities	165 (86.8)	125 (65.8)	290	17.23	
Not wearing gloves and masks during invasive nonsurgical procedures	175 (92.1)	140 (73.7)	315	20.37	
Which of the following are preventive measures against nosocomial infections?					
Fully disinfecting skin and equipment	180 (94.7)	140 (73.7)	320	22.47	
Washing hands occasionally	90 (47.4)	120 (63.1)	210	7.32	0.007
Wearing protective equipment like face masks and gloves	180 (94.7)	150 (78.9)	330	15.74	0.001
Regularly changing urinary catheters, and removing them as soon as possible	170 (89.5)	130 (68.4)	300	19.45	0.001
Patients wearing goggles while in the surgical ward	140 (73.7)	110 (57.9)	250	9.39	0.002
Prescribing antibiotics only when demanded by the patient	90 (47.4)	100 (52.6)	190	0.53	0.465
Do you believe all hospital-acquired infections are preventable?					
Yes	160 (84.2)	120 (63.1)	280	16.85	0.001
No	30 (15.8)	70 (36.9)	100		
Do you understand how infections are spread in the hospital?					
Yes	170 (89.5)	130 (68.4)	300	19.45	0.07
No	20 (10.5)	60 (31.6)	80		
What are the potential modes of spread of hospital-acquired infections?					
Airborne	175 (92.1)	140 (73.7)	315	20.37	
Dirty beds	180 (94.7)	150 (78.9)	330	19.36	
Unsterilized equipment	170 (89.5)	130 (68.4)	300	19.45	
Improper wound dressing	160 (84.2)	120 (63.1)	280	16.85	

The marital status of the respondents is also similar in both groups, with the majority being married (80% in both groups). The chi-square test also shows that there are no significant differences in the distribution of marital status.

The educational level of the respondents is also similar in both groups, with the majority having completed a university degree (40% in both groups). The chi-square test shows that there are no significant differences in the

distribution of educational levels. The cadre of the respondents is also similar in both groups, with the majority being senior public servants or intermediate public servants (40% in both groups). The chi-square test shows that there are no significant differences in the distribution of cadres.

The results showed that the intervention and control groups are similar in terms of socio-demographic characteristics, which is an important consideration in quasi-experimental designs. This ensures that any differences in outcomes between the two groups can be attributed to the intervention rather than pre-existing differences between the groups.

Table 3: Knowledge and practices concerning nosocomial infection among participants in the intervention and control groups after administration of health education.

Question	Ward-A (intervention) (n=190) (%)	Ward-B (control) (n=190) (%)	Total (n=380) (%)	Test of significance	P value
Do you know what nosocomial infections are?					
Yes	185 (97.4)	125 (65.8)	310 (81.6)	5.42	0.020
No	5 (2.6)	65 (34.2)	70 (18.4)		
Have you received any formal health education on nosocomial infections?					
Yes	190 (100)	125 (65.8)	315 (82.9)	50.34	0.001
No	0 (0)	65 (34.2)	65 (17.1)		
Groups at risk of nosocomial infection					
Elderly	190 (100)	135 (71.1)	325 (85.5)	24.10	0.001
Children	190 (100)	145 (76.3)	335 (88.2)	23.62	0.001
Pregnant women	185 (97.4)	130 (68.4)	315 (82.9)	18.45	0.001
Smokers	175 (92.1)	100 (52.6)	275 (72.4)	15.90	0.001
Visitors	180 (94.7)	115 (60.5)	295 (77.6)	20.14	0.001
Patients in surgical wards	190 (100)	150 (78.9)	340 (89.5)	30.02	0.001
Healthcare worker behavior that can increase the risk of nosocomial infection					
Length of hospital stay	185 (97.4)	125 (65.8)	310 (81.6)	25.63	0.001
Not wearing gloves when touching mucous membranes or non-intact skin	190 (100)	135 (71.1)	325 (85.5)	30.01	0.001
Not wearing masks during procedures and patient-care activities	185 (97.4)	130 (68.4)	315 (82.9)	28.15	0.001
Not wearing gloves and masks during invasive nonsurgical procedures	190 (100)	140 (73.7)	330 (86.8)	32.21	0.001
Preventive measures against nosocomial infections					
Fully disinfecting skin and equipment	190 (100)	145 (76.3)	335 (88.2)	36.10	0.001
Washing hands occasionally	100 (52.6)	125 (65.8)	225 (59.2)	10.72	0.005
Wearing protective equipment like face masks and gloves	190 (100)	155 (81.6)	345 (90.8)	20.81	0.001
Regularly changing urinary catheters, and removing them as soon as possible	185 (97.4)	135 (71.1)	320 (84.2)	25.14	0.001
Patients wearing goggles while in the surgical ward	175 (92.1)	115 (60.5)	290 (76.3)	18.74	0.001
Prescribing antibiotics only when demanded by the patient	95 (50.0)	100 (52.6)	195 (51.3)	1.01	0.315
Do you believe all hospital-acquired infections are preventable?					
Yes	180 (94.7)	130 (68.4)	310 (81.6)	26.45	0.001
No	10 (5.3)	60 (31.6)	70 (18.4)		
Understanding modes of spread of hospital-acquired infections					
Airborne	185 (97.4)	140 (73.7)	325 (85.5)	31.17	0.001
Dirty beds	190 (100)	150 (78.9)	340 (89.5)	32.62	0.001
Unsterilized equipment	190 (100)	140 (73.7)	330 (86.8)	30.01	0.001
Improper wound dressing	185 (97.4)	130 (68.4)	315 (82.9)	28.15	0.001

Table 4: Mean score, standard deviation, mean difference and paired "t" test of control and intervention.

Knowledge	Mean score	Std. deviation	Mean difference	t-test	P value
Control	1.269	0.479	0.555	16.20	0.001
Intervention	1.824	0.377			

Table 2 shows the comparison between the intervention group (ward-A) and the control group (ward-B) reveals significant differences in knowledge and practices concerning nosocomial infections before the administration of health education. While awareness of nosocomial infections was slightly higher in ward-A (68.4%) than ward-B (63.1%), the difference was not statistically significant. However, a marked disparity was observed in formal health education exposure, with 94.7% of ward-A participants having received prior education compared to 63.1% in ward-B, a statistically significant difference (p=0.031).

Ward-A participants demonstrated a stronger understanding of groups at risk for nosocomial infections, including the elderly, children, pregnant women, smokers, visitors, and patients in surgical wards. For instance, 84.2% of participants in Ward-A identified the elderly as a high-risk group compared to 68.4% in ward-B (p=0.001). Similar trends were seen across other at-risk groups, underscoring the intervention group's greater awareness.

Knowledge of healthcare worker behaviors that increase infection risk, such as failure to wear gloves or masks and prolonged hospital stays, was also higher in ward-A. For example, 89.5% of ward-A participants identified not wearing gloves as a risk factor, compared to 68.4% in ward-B (p=0.001). Similarly, awareness of preventive measures, such as disinfecting skin and equipment (94.7% in ward-A versus 73.7% in ward-B, p=0.001) and using protective equipment like masks and gloves (94.7% in ward-A versus 78.9% in ward-B, p=0.001), was significantly greater in the intervention group.

Belief in the preventability of hospital-acquired infections was stronger in ward-A (84.2%) compared to ward-B (63.1%) (p=0.001), and participants in ward-A showed better understanding of how infections spread. For example, 92.1% of ward-A participants identified airborne transmission as a mode of spread, compared to 73.7% in ward-B (p=0.001). Similar disparities were seen in other transmission modes, such as unsterilized equipment and improper wound dressing.

The analysis of the Table 3 reveals significant improvements in knowledge and practices concerning nosocomial infections among participants in the intervention group (ward-A) compared to the control group (ward-B) following the administration of health education.

A marked difference in general awareness was observed between the two groups. Almost all participants in ward-A (97.4%) were aware of nosocomial infections, compared to only 65.8% in ward-B. Similarly, all ward-A participants had received formal health education on the subject, whereas only 65.8% of ward-B participants reported the same. These differences were statistically significant, emphasizing the impact of health education.

Ward-A participants also demonstrated a better understanding of vulnerable groups at risk of nosocomial infections. High-risk groups such as the elderly, children, pregnant women, smokers, visitors, and surgical patients were more frequently identified by ward-A participants than by those in ward-B. For instance, 100% of ward-A participants recognized the elderly and children as at-risk groups, compared to 71.1% and 76.3%, respectively, in ward-B.

The intervention group showed increased awareness of healthcare worker behaviors that could increase infection risk. They were more likely to identify critical lapses, such as not wearing gloves or masks during patient care, as risk factors. Awareness of these behaviors was significantly lower in the control group, highlighting gaps in their understanding.

Preventive measures were also better recognized by ward-A participants. Practices such as fully disinfecting skin and equipment, wearing protective equipment like gloves and masks, and regularly changing urinary catheters were almost universally acknowledged in ward-A, while participants in ward-B were less consistent in their responses. Interestingly, occasional hand washing was reported more frequently in ward-B than in ward-A, suggesting incomplete understanding of comprehensive hygiene practices in the control group. The belief that hospital-acquired infections are preventable was more prevalent in ward-A (94.7%) compared to ward-B (68.4%). Additionally, ward-A participants had a clearer understanding of how infections spread, with higher awareness of modes such as airborne transmission, unsterilized equipment, and improper wound dressing.

Table 4 presents the mean score, standard deviation, mean difference, paired t-test, and p value for the control and intervention knowledge scores of the respondents.

The mean score for the control group was 1.269, with a standard deviation of 0.479, indicating that the respondents had a relatively low level of knowledge about nosocomial infections before the educational intervention.

The mean score for the intervention knowledge was 1.824, with a standard deviation of 0.377, indicating that the

respondents' knowledge of nosocomial infections has significantly improved after the educational intervention.

DISCUSSION

The findings of this study highlight the significant impact of health education on improving knowledge and practices concerning nosocomial infections among healthcare workers. The results demonstrate that participants in the intervention group (ward-A), who received health education, had notably greater awareness and better practices related to infection prevention compared to the control group (ward-B), which did not receive such training. Before the health education intervention, nearly the same proportion of participants in ward-A (68.4%) were aware of what nosocomial infections are, compared to those in ward-B (63.1%), difference not statistically significant (p=0.295). However, a substantial difference emerged when formal health education on nosocomial infections was assessed. A significantly higher percentage of ward-A participants (94.7%) had received formal health education compared to 63.1% in ward-B (p=0.031). This highlights the critical role that targeted educational interventions play in increasing awareness among healthcare workers.

One of the most pronounced differences between the two groups was observed in their understanding of high-risk groups for nosocomial infections. Ward-A participants demonstrated superior knowledge, identifying vulnerable groups such as the elderly, children, pregnant women, smokers, visitors, and surgical patients more frequently than those in the control group. For instance, 84.2% of ward-A participants identified the elderly as a high-risk group, compared to only 68.4% in ward-B (p=0.001). This finding is consistent with previous studies, which show that healthcare worker education improves the identification of at-risk populations.[30] Awareness of these groups is essential for implementing appropriate infection control measures and preventing hospital-acquired infections (HAIs). Healthcare worker behaviour, such as the improper use of personal protective equipment (PPE) and the duration of hospital stays, was another area where significant differences were observed. Ward-A participants were more likely to recognize behaviours that increase infection risk, including the failure to wear gloves or masks during patient care and prolonged hospital stays. For example, 89.5% of ward-A participants identified not wearing gloves as a risk factor, compared to 68.4% in ward-B (p=0.001). These findings align with literature suggesting that educating healthcare workers on infection prevention behaviours can significantly reduce the transmission of nosocomial infections.[31] Preventive measures were also more widely acknowledged by ward-A participants. Practices such as disinfecting skin and equipment, wearing PPE, and regularly changing urinary catheters were recognized by almost all participants in ward-A (94.7%), whereas the control group showed much lower recognition (73.7%, 78.9%, and 68.4%, respectively). This indicates that health education enhances compliance with infection control guidelines, which is critical for reducing the incidence of hospital-acquired infections. The belief that hospital-acquired infections are preventable was stronger among ward-A participants (94.7%) compared to ward-B (68.4%) (p=0.001). This is significant because it underscores the importance of not only increasing knowledge but also shaping the attitudes and perceptions of healthcare workers regarding the preventability of infections. When healthcare workers believe that infections are preventable, they are more likely to adopt best practices and adhere to infection control measures.[32]

Furthermore, ward-A participants had a better understanding of the modes of spread of nosocomial infections, such as airborne transmission, unsterilized equipment, and improper wound dressing. For instance, 92.1% of ward-A participants identified airborne transmission as a mode of spread, compared to 73.7% in ward-B (p=0.001). This greater awareness is crucial for improving infection control strategies and reducing the transmission of infections in healthcare settings. The post-test awareness and knowledge data show a substantial increase in awareness and knowledge after an educational intervention. Awareness of nosocomial infections jumps to 89.7%, and formal health education coverage rises to 79.2%. There is an enhanced understanding of at-risk groups, with significant increases in recognition of the elderly (87.1%) and patients in surgical wards (81.8%) as high-risk groups. Preventive practices and knowledge also improve markedly. For instance, understanding the importance of fully disinfecting skin and equipment increases to 84.4%, and the recognition of the need for protective equipment rises to 87.1%. These improvements align with findings from a meta-analysis by Brusaferro et al, which demonstrated the positive impact of educational interventions on healthcare workers' knowledge and practices related to infection prevention.[33]

The effectiveness of health education is evident, with 74% of respondents reporting improved understanding of nosocomial infections, and 36% acknowledging a change in their preventive practices. This suggests that while health education has a positive impact, there remains room for further improvement in influencing behaviour change. These findings are in line with a systematic review by Tshuma et al, which found that educational interventions can improve knowledge but may have limited impact on long-term behaviour change without additional reinforcement strategies.[34] The mean score for the pre-test knowledge was 1.269 (SD=0.479), indicating that the respondents had a relatively low level of knowledge about nosocomial infections before the educational intervention. The mean score for the post-test knowledge was 1.824 (SD=0.377), demonstrating a significant improvement in respondents' knowledge of nosocomial infections after the educational intervention. This improvement is consistent with findings from a meta-analysis by Ghazali et al, which showed that educational interventions can significantly enhance healthcare workers' knowledge of infection

prevention and control.[35] This preference aligns with recent literature emphasizing the importance of interactive and hands-on learning approaches in healthcare education.[36] A systematic review found that interactive methods, such as workshops and on-the-job training, were more effective in improving healthcare workers' performance compared to traditional didactic approaches.[37]

In the context of primary health care facilities, prevention practices such as hand hygiene, personal protective equipment (PPE) use, environmental cleaning, and proper waste management are crucial for reducing the risk of nosocomial infections.[38] Adherence to these practices can be influenced by various factors, including knowledge, attitudes, and beliefs about infection prevention, organizational culture, and resource availability.[39] The findings of this study underscore the importance of addressing these factors through comprehensive education and training programs. The analysis reveals a well-educated and healthcare-focused respondent pool with a significant improvement in awareness and knowledge of nosocomial infections post-education intervention. Despite this, gaps remain in formal training and the practical application of preventive measures. These findings are consistent with a recent systematic review by Price et al, which identified persistent gaps in healthcare workers' knowledge and practices related to infection prevention and control, even in high-income countries.[25]

Additionally, the implementation of continuous professional development programs, as suggested by Zaidi et al, could help maintain and improve healthcare workers' knowledge and skills in infection prevention over time.[36] These programs should be tailored to the specific needs and preferences of healthcare workers, as indicated by the preference for workshops and on-the-job training in this study. The use of simulation-based training, which has shown promise in improving infection control practices, could be explored as an additional educational strategy.[37] This approach allows healthcare workers to practice infection prevention techniques in a safe, controlled environment before applying them in real clinical settings. Furthermore, the low recognition of the importance of patient education (5.3%) in preventing nosocomial infections suggests a need for greater emphasis on patient involvement in infection prevention strategies. Recent studies have shown that patient engagement can play a crucial role in reducing healthcare-associated infections.[38]

The limitations of this study include the reliance on self-reported data, which may be subject to social desirability bias. Additionally, variations in the implementation of the intervention across different facilities may impact the consistency of the results.

CONCLUSION

This study showed that Health educational intervention has positive impact on healthcare workers' knowledge and awareness of nosocomial infections. The research reveals significant improvements in awareness and practices following targeted interventions. However, it also uncovers persistent knowledge gaps in specific areas of infection prevention and control (IPC), highlighting the need for ongoing, comprehensive education.

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