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FACTORS ASSOCIATED WITH NOSOCOMIAL INFECTIONS AMONG ADULTS ADMITTED TO MEDICAL WARDS IN UNIVERSITY TEACHING HOSPITAL OF BUTARE, RWANDA

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Abstract

Nosocomial infection (NI) is a serious public health problem that affects hundreds of millions of people worldwide each year. The incidence of NI varied from 5.7 to 19.1% in developing countries and 3.6 to 12% in developed nations. In Rwanda, two studies conducted at two University Teaching Hospitals CHUK and CHUB revealed that the prevalence of nosocomial infections were 15.1% in 2013-2014 and 12.1% in 2015 at CHUK and CHUB respectively. Although the data are insufficient, they showed the high burden of the NI problem and the need to determine the incidence of NIs and the factors associated with them in Rwandan Hospitals. The main objectives of this study were to determine the incidence of NIs among adults patients in the medical wards of the University Teaching Hospital of Butare and identify the factors associated with acquisition of nosocomial infection. The study was carried out under a prospective follow-up study design in period of one month, all adults patients admitted in CHUB wards willing to participate were enrolled after signing an informed consent. During the study period, an infection arising at least 48 hours after admission was considered as NI. The sample size was raised to 206 participants obtained through a census sampling technique. The check list was used as data collection instrument to collect all related nosocomial infection information. The ethical requirements were considered. The incidence statistical formula, univariate, bivariate and multivariate analysis were processed. chi-square Test and logistic regression analysis were employed using SPSS version 21 considering the significance level of below 0.05 at 95%CI. The findings revealed that the overall incidence rate of nosocomial infections was 17.6 cases (95% CI: 16.7-18.4) per 1,000 person-days of hospitalization with the prevalence of 15.0%. Study subjects were followed for a total of 1827 person-days observation with a median time of 17.9 days (IQR = 12.7–23.6 days). The multivariate data analysis was conducted solely on the significant variables identified in the bivariate analysis to control for confounders. Table 4.8 illustrates that daily ward cleaning at or below one time was twelve times more likely to be associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with an Adjusted odds ratio (AoR) of 11.613, Confidence Interval (CI): (3.679-43.467), and p<0.015. Bed pan insufficiency per patient and unavailability in the ward were also significantly associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with AoR of 13.402 (CI: 1.879-27.438, p=0.01) and 4.664 (CI: 2.521-18.412, p<0.01), respectively. Healthcare Providers disinfect or not medical devices was associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with an AoR of 12.095 (CI: 2.529-55.667, p=0.018). Cardiovascular diseases and diabetes were among the chronic diseases associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with an AoR of 5.165 and 8.517 (CI: 1.103-14.020, 2.309-31.418); (p=0.03, p=0.02) respectively. This study concluded that inadequate ward cleaning, shortages of essential supplies, and the presence of chronic diseases was linked to the risk of acquiring a NI. Addressing these issues through enhanced cleaning protocols, disinfect medical devices, adequate supply management, and targeted care strategies for patients with underlying conditions is crucial for improving patient safety and healthcare outcomes.

Key words: Nosocomial, Infections, Adults, Medical Wards

Introduction

A nosocomial infection (NI) is defined as a patient's acquired infection during hospitalization that was not incubating at admission time. The occupational infections among staff of the facility are also included. They are also called "hospital-acquired infections (HAI) or healthcare associated infections". They are nosocomial infections, when they occur 48 hours after admission, 3 days after discharge, or may appear even up to 30 days after a surgical operation (WHO, 2004).

Nosocomial infection is a global problem of health which affects around 1.4 million worldwide and is like an endemic in Sub Saharan Africa (Mbim et al., 2016). The data from previous studies revealed the burden of nosocomial infections for both developed and developing countries ranging from 3.6 to 12% and from 5.7 to 19.1% respectively (B. Allegranzi et al; Yallew et al., 2016). The occurrence of nosocomial infections (NIs) is a threat to the health and safety of both patients and health care workers (HCWs). Nosocomial infections are threat to both hospital personnel and patients, and they indicate the quality of healthcare offered and level of infection prevention and control in a hospital (WHO, Lazzari, Allegranzi, &Concia, 2004).

Searched studies done in East African Countries like Kenya revealed the burden of nosocomial infections, especially in immunocompromised persons and elderly (Kamau Mugoya, 2006).

In Rwanda, available data of nosocomial infections, showed the presence of postpartum infections among 117 women and predominant infections were peritonitis (56%) and surgical site infections (Rwabizi, Rulisa, Aidan, & Small, 2016). The published findings also confirmed that Nosocomial infections increase the hospital length of stay (Petroze et al., 2014). Geriatric patients are among the most vulnerable population without sufficient data on the nosocomial infections burden and specific preventive strategies.

The need of research is high to put in place appropriate measures to prevent nosocomial infections and make healthcare facilities safe for patients. Patients with multiple illnesses, such as geriatric patients in Medical Wards, will be the most exposed to nosocomial infections (Ozer et al., 2011). Currently in Medical Department of CHUB, where the study will be conducted, the large number of hospitalized patients are vulnerable population with an average of 60 years old. About 200 adults patients are admitted in medical wards for hospitalization per month and this study aims to assess gaps in preventive measures for nosocomial infections in medical wards.

Nosocomial infections are a burden to both developed and developing countries and threaten the safety of healthcare workers and patients (Magill et al., 2012; Zarb et al., 2012). Previous

publications showed that in some developing countries like Rwanda reporting of the burden of nosocomial infections to communities is still low, no sufficient studies are conducted to tackle the problem (Mbim et al., 2016).

A study conducted at CHUB, a teaching hospital in Rwanda, revealed that the prevalence of nosocomial infections was 12.1% which shows the high burden of the problem and the need to set up a sustainable surveillance system in Rwandan hospitals (Bayingana et al., 2017). Another prevalence study conducted at University Teaching Hospital of Kigali (CHUK) between 2013-2014 revealed that nosocomial infections rates were about 15.1% which shows that the burden of NIs is likely high in all Rwandan hospitals (Lukas et al., 2016).

According to previous studies, nosocomial infections are among the major causes of morbidity and mortality in hospitals which require systematic reporting and surveillance by the Ministry of Health and its institutions. Therefore, it is vital to have updated information on nosocomial infections at the University Teaching Hospital of Butare and identify associated factors to set up new strategies to prevent and control NIs. Other hospitals, such as District hospitals, and health system decision makers will benefit from this study and take new measures to prevent and control nosocomial infections in Rwandan health facilities. The aim of this study was to determine the incidence of NIs among adults patients in the medical wards of the University Teaching Hospital of Butare and identify the factors associated with acquisition of nosocomial infection.

Materials and methods

Research design.

In this study, the researcher used a one-month longitudinal study design carried out prospectively by following up admitted patients with quantitative approach from 29th April 2024.

Participants

This study recruited all adults patients admitted in medical wards for various medical conditions during the study period. According to the University Teaching Hospital of Butare Medical Ward registers more than 206 adults patients are admitted per month. Therefore, as the study collected 206 participants, the sample size method was a census of all adults patients admitted in medical wards for various medical conditions during the study period.

Research instruments.

A questionnaire was used as data collection instrument to collect data needed for achieving the study objectives.

Data analysis procedure.

The NIs incidence among adults patients admitted in medical wards was calculated by dividing the number of patients who acquired NIs over the total number of admitted patients as summarized in the following formula:

Incidence rate
Number of new cases of disease or injury during specified period

Time each person was observed, totaled for all persons.

The calculated incidence helped the researcher to estimate the burden of NIs to adult patients in Medical Wards at CHUB and helps the hospital to determine its level of responsibility to take decision on new measures to put in place to reduce the incidence of NIs in the hospital and in Medical Wards in particular. The obtained incidence was expressed as a percentage. In order to achieve accurate incidence, rate the participants enrollment was a census with a sample size of about 206 participants.

Ethical consideration.

This research proposal was submitted to the Mount Kenya University Institutional Review Board for Ethical Clearance. Prior to their participation, all individuals provided a signed informed consent. Prior to project execution, an authorization from the hospital was obtained for data collection. The data collection tools were anonymous, and participation was voluntary with right to withdraw from the research at any time. A study budget has been granted by the University teaching Hospital of Butare to facilitate the study including payment of microbiology laboratory tests that were required in the study.

Results
The findings of this study have shown that the incidence of nosocomial infection was 31 per 1827 person days of hospitalization which was 17.6 per 1000 person-day of the study participants as shown in table 1.

The overall incidence rate of nosocomial infection was 17.6 cases (95% CI: 16.7-18.4) per 1,000 person-days of hospitalization with the prevalence of 15.0%. Study subjects were followed for a total of 1827 person-days observation with a median time of 17.9 days (IQR = 12.7–23.6 days).

Table 1: Incidence of Nosocomial infection among patients admitted to medical wards at University Teaching Hospital of Butare

Variable	Cases	Person time(days)	Incidence/1 000-days	95%CI	Median
Nosocomial Infection	31(15.0%)	1827	17.6	16.779-18.496	17.9

Source: Researcher, (2024)

The bivariate analysis of sociodemographic factors associated with nosocomial infections among patients admitted to medical wards at the University Teaching Hospital of Butare found that age, gender, hospital ward, marital status, employment status, and economic category were not significantly associated with nosocomial infections. The only significant finding was related to education level (χ^2 = 6.114, p = 0.013). Patients with secondary education or higher had a significantly higher rate of nosocomial infections (14.6%) compared to those with primary education or less (0.5%).

Table 2: Bivariate analysis of sociodemographic factors associated with nosocomial infection among patients admitted to medical wards at University Teaching Hospital of Butare

Variables n=206	Nosocomial Infection			Chi-square	P-value
	No (%)	Yes (%)	Total (%)		
Age				4.447	0.349
<=20 years	22(10.7)	2(1.0)	24(11.7)		
21-40 years	56(27.2)	8(3.9)	64(31.1)		
41-60 years	66(32.0)	17(8.3)	83(40.3)		
61-80 years	14(6.8)	3(1.5)	17(8.3)		

81-100 years	17(8.3)	1(0.5)	18(8.7)		
Total	175(85.0)	31(15.0)	206(100.0)		
Gender				0.014	0.904
Male	77(37.4)	14(6.8)	91(44.2)		
Female	98(47.6)	17(8.3)	115(55.8)		
Total	175(85.0)	31(150.0)	206(100.0)		
Hosp. Ward				6.127	0.106
A/E	17(8.3)	2(1.0)	19(9.2)		
IM	157(76.2)	28(13.6)	185(89.8)		
BA	0(0.0)	1(0.5)	1(0.5)		
Private Clinic	1(0.5)	0(0.0)	1(0.5)		
Private Clinic	175(85.0)	31(150.0)	206(100.0)		
Marital status				0.085	0.771
Single	77(37.4)	14(6.8)	91(44.2)		
Married	98(47.6)	17(8.3)	115(55.8)		
Total	175(85.0)	31(150.0)	206(100.0)		
Employed				.072	0.789
Yes	25(12.1)	5(2.4)	30(14.6)		
No	150(72.8)	26(12.6)	176(85.4)		
Total	175(85.0)	31(150.0)	206(100.0)		
Economic category				.801	0.670
First Level	45(21.8)	6(2.9)	51(24.8)		
Second level	69(33.5)	12(5.8)	81(39.3)		
Third level	61(29.6)	13(6.3)	74(35.9)		
Total	175(85.0)	31(150.0)	206(100.0)		
Education level				6.114	**0.013**
<= Primary education	39(18.9)	1(0.5)	40(19.4)		

>=Secondary education	136(66.0)	30(14.6)	166(80.6)
Total	175(85.0)	31(150.0)	206(100.0)

Source: Researcher, (2024)

The bivariate analysis of clinical factors associated with nosocomial infections among patients admitted to the medical wards at the University Teaching Hospital of Butare found that there was a significant association between the type of disease and the incidence of nosocomial infections (χ^2 = 29.300, p < 0.001). Patients with cardiovascular diseases had the highest rate of nosocomial infections (7.3%), followed by those with respiratory diseases (3.9%). In contrast, patients with neurological diseases and other diseases had lower rates of nosocomial infections (1.5% and 2.4%, respectively). Also, diabetes was significantly associated with nosocomial infections (χ^2 = 57.593, p < 0.001). Patients with diabetes had a much higher rate of nosocomial infections (12.1%) compared to those without diabetes (2.9%). And finally, hypertension was also significantly associated with nosocomial infections (χ^2 = 5.449, p = 0.020). Patients with hypertension had a higher incidence of nosocomial infections (6.8%) compared to those without hypertension (8.3%).

Table. 3: Bivariate analysis of clinical factors associated with nosocomial infection among patients admitted to medical wards at University Teaching Hospital of Butare

Variables n=206	Nosocomial Infection			Chi-square	P-value
	No (%)	Yes (%)	Total (%)		
Diseases group				29.300	**<0.001**
Cardiovascular Diseases	26(12.6)	15(7.3)	41(19.9)		
Neurological Diseases	46(22.3)	3(1.5)	49(238)		
Respiratory Diseases	18(8.7)	8(3.9)	26(12.6)		
Other diseases	85(41.3)	5(2.4)	90(43.7)		
Total	175(85.0)	31(150.0)	206(100.0)		
Communicable and non-communicable diseases groups				2.944	0.086
NCDs	127(61.7)	27(13.1)	154(74.8)		

CDs	48(23.3)	4(1.9)	52(25.2)		
Total	175(85.0)	31(150.0)	206(100.0)		
Specify the type of specimen collected				8.573	0.199
Blood	65()	12(5.8)	77(37.4)		
Stool	1(0.5)	2(1.0)	3(1.5)		
Urine	96(46.6)	17(8.3)	113(54.9)		
Other mixed samples	13(6.4)	0(0.0)	13(6.4)		
Total	175(85.0)	31(150.0)	206(100.0)		
Healthcare Provider interviewed				0.181	0.913
Nurse/Allied	72(35.0)	13(6.3)	85(41.3)		
Physician/MD	102(49.5)	18(8.7)	120(58.3)		
Support staff	1(0.5)	0(0.0)	1(0.5)		
Total	175(85.0)	31(150.0)	206(100.0)		
Burning urination				.539a	0.4
Yes	172(83.5)	31(15.0)	203(98.5)		
Non	3(1.5)	0(0)	3(1.5)		
Total	175(85.0)	31(150.0)	206(100.0)		
Diabetes				57.593a	**<0.001**
No	147(71.4)	6(2.9)	153(74.3)		
Yes	28(13.6)	25(12.1)	53(25.7)		
Total	175(85.0)	31(150.0)	206(100.0)		
Hypertension				5.449a	**0.020**
No	127(61.7)	16(8.3)	143(69.9)		

Yes	48(23.3)	15(6.8)	63(30.1)
Total	175(85.0)	31(150.0)	206(100.0)

Source: Researcher, (2024)

The bivariate analysis of patient hygienic factors associated with nosocomial infections among patients admitted to medical wards at the University Teaching Hospital of Butare revealed that the practice of bathing daily was significantly associated with the incidence of nosocomial infections (χ^2 = 2.822, p = 0.09). Patients who did not bathe daily had a higher incidence of nosocomial infections (11.7%) compared to those who bathed daily (3.4%). Other hygienic factors analyzed, such as washing hands before eating, after using the toilet, after any contact with body fluids, before taking medicines, and knowing how to use waste bins, did not show significant associations with nosocomial infections.

Table 4. Bivariate analysis of patient hygienic factors associated with nosocomial infection among patients admitted to medical wards at University Teaching Hospital of Butare

Variables n=206	Nosocomial Infection			Chi-square	P-value
	No (%)	Yes (%)	Total (%)		
Do you wash your hands before eating?				.263	0.608
Yes	146(70.9)	27(13.1)	173(84.0)		
Non	29(14.1)	4(1.9)	33(16.0)		
Total	175(85.0)	31(150.0)	206(100.0)		
Do you wash your hands after using toilet?				2.659	0.103
Yes	127(61.7)	18(8.7)	145(70.4)		
Non	48(23.3)	13(6.3)	61(29.6)		
Total	175(85.0)	31(150.0)	206(100.0)		
Do you wash your hands after any contact with body fluids (your own or from others)?				1.870	0.172

Yes	133(64.6)	27(13.1)	160(77.7)		
Non	42(20.4)	4(1.9)	46(22.3)		
Total	175(85.0)	31(15.0)	206(100.0)		
Do you wash your hands before taking medicines?				0.651[a]	0.420
Yes	117(56.8)	23(11.2)	140(68.0)		
Non	58(28.2)	8(3.9)	66(32.0)		
Total	175(85.0)	31(15.0)	206(100.0)		
do you bath daily?				2.822	0.09
Yes	67(32.5)	7(3.4)	74(35.9)		
No	108(52.4)	24(11.7)	132(64.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
Do you know how to use waste bins?				1.760	0.185
Yes	48(23.3)	5(2.4)	53(25.7)		
Non	127(61.7)	26(12.6)	15374.3)		
Total	175(85.0)	31(15.0)	206(100.0)		

Source: Researcher, (2024)

The bivariate analysis findings, as shown in Table 5, demonstrated that HCP disinfect medical devices (stethoscopes, thermometers,) between patients was statistically significant in relation to high nosocomial infections acquisition as those who do not use those devices were significantly associated with the incidence of nosocomial infections ($\chi^2 = 4.519$, p = 0.034). Also, not washing the hands after touching the patient's surroundings was significantly associated with the incidence of nosocomial infections ($\chi^2 = 9.416$, p = 0.009).

Table. 5: Bivariate analysis of health providers hygienic and aseptic procedures factors associated with nosocomial infections among patients admitted to medical wards at University Teaching Hospital of Butare

Variables n=206	Nosocomial Infection		Chi-square	P-value

	No (%)	Yes (%)	Total (%)		
Is the healthcare changing gloves for each patient?				0.343	0.558
Yes	30(14.6)	4(1.9)	34(16.5)		
No	145(70.4)	27(13.1)	172(83.5)		
Total	175(85.0)	31(15.0)	206(100.0)		
Is the healthcare provider following the 5 moments of hand washing?				0.001	0.972
Yes	11(5.3)	2(1.0)	13(6.3)		
No	164(79.6)	29(14.1)	193(93.7)		
Total	175(85.0)	31(15.0)	206(100.0)		
If no, which moment is omitted? Before touching the patient				0.071	0.790
Yes	120(58.3)	22(10.7)	142(68.9)		
No	55(26.7)	9(4.4)	64(31.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
After touching the patient				2.770	0.250
Yes	46(22.3)	4(1.9)	50(24.3)		
Non	118(57.3)	24(11.7)	142(68.9)		
N/A	11(5.3)	3(1.5)	146.8)		
Total	175(85.0)	31(15.0)	206(100.0)		
After body fluids exposure				0.820	0.664
No	55(26.7)	11(5.3)	66(32.0)		
Yes	109(52.9)	17(8.3)	126(61.2)		
N/A	11(5.3)	3(1.5)	14(6.8)		
Total	175(85.0)	31(15.0)	206(100.0)		
Before an aseptic procedure				0.527	0.769

Yes	90(43.7)	16(7.8)	106(51.5)		
Non	74(35.9)	12(5.8)	86(41.7)		
N/A	11(5.3)	3(1.5)	14(6.8)		
Total	175(85.0)	31(15.0)	206(100.0)		
After touching the patient's surroundings				9.416	0.009
Yes	59(28.6)	2(1.0)	61(29.6)		
Non	105(51.0)	26(12.6)	141(63.6)		
N/A	11(5.3)	3(1.5)	14(6.8)		
Total	175(85.0)	31(15.0)	206(100.0)		
Waste bins are filled to 3/4 (not full) or over?				0.324	0.569
Yes	111(53.9)	18(8.7)	129(62.6)		
Non	64(31.1)	13(6.3)	77(37.4)		
Total	175(85.0)	31(15.0)	206(100.0)		
Are sharp containers filled to 3/4 (not full) or over?				0.001	0.972
Yes	164(79.6)	29(14.1)	193(93.7)		
Non	11(5.3)	2(1.0)	13(6.3)		
Total	175(85.0)	31(15.0)	206(100.0)		
HCP disinfect medical devices (stethoscopes, thermometers,) between patients?				4.519	0.034
No	75(36.4)	7(3.4)	82(39.8)		
Yes	100(48.5)	24(11.7)	124(60.2)		
Total	175(85.0)	31(15.0)	206(100.0)		
Comment on aseptic measures observed				7.270	0.122
Bad	7(3.4)	1(0.5)	8(3.9)		

Insufficient	18(8.7)	0(0)	18(8.7)		
Fair	33(16.0)	8(3.9)	41(19.9)		
Good	24(11.7)	1(0.5)	25(12.1)		
Very good	93(45.1)	21(10.2)	114(12.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
Comment on aseptic measures				0.011	0.918
Bad	41(19.9)	7(3.4)	48(23.3)		
Good	134(65.0)	24(11.7)	158(76.7)		
Total	175(85.0)	31(15.0)	206(100.0)		

Source: Researcher, (2024)

The bivariate analysis findings, as shown in Table 6, demonstrated that the absence of waste bins in every ward was statistically significant in relation to high nosocomial infection acquisition (χ^2 = 6.366, p = 0.012). Not cleaning the ward several times a day, lack of bed pans in wards and their insufficiency for patients in need (at least 1 per patient) were significantly associated with high nosocomial infection acquisition, yielding χ^2 = 13.383, p=0.001 and χ^2 = 5.040, p<0.025, respectively.

Table 6. Bivariate analysis of ward hygienic procedures factors associated with nosocomial infections among patients admitted to medical wards at University Teaching Hospital of Butare

Variables n=206	Nosocomial Infection			Chi-square	P-value
	No (%)	Yes (%)	Total (%)		
Comment on hygiene inward				6.592	**0.159**
Bad	20(9.7)	6(2.9)	26(12.6)		
Fair	57(27.7)	7(3.4)	64(31.1)		
Enough	1(0.5)	0(0)	1(0.5)		
Good	70(34.0)	17(8.3)	87(42.2)		
Perfect	27(13.1)	1(0.5)	28(13.6)		
Total	175(85.0)	31(15.0)	206(100.0)		

Are waste bins available in every ward (at least 3; infectious, non-infectious and linens)?				6.366	0.012
No	150(72.8)	31(15.0)	181(87.9)		
Yes	25(12.1)	0(0)	25(12.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
Are plastic bags available (red, black, yellow) in waste bins?				0.156	0.693
Yes	160(77.7)	29(14.1)	189(91.7)		
Non	15(7.3)	2(1.0)	17(8.3)		
Total	175(85.0)	31(15.0)	206(100.0)		
The ward has a hand wash station with running water?				1.539	0.215
Yes	142(68.9)	28(13.6)	170(82.5)		
No	33(16.0)	3(1.5)	36(17.5)		
Total	175(85.0)	31(15.0)	206(100.0)		
Is it equipped with hand wash soap?				2.125	0.145
Yes	154(74.8)	30(14.6)	184(89.3)		
No	21(10.2)	1(0.5)	22(10.7)		
Total	175(85.0)	31(15.0)	206(100.0)		
Is it equipped with a paper towel?				1.284	0.257
Yes	168(81.6)	31(15.0)	199(96.6)		
Non	7(3.4)	0(0)	7(3.4)		
Total	175(85.0)	31(15.0)	206(100.0)		
Is the hand rub alcohol available for patients and HCPs?				0.152	0.697
Yes	95(46.1)	18(8.7)	113(54.9)		

No	80(38.8)	13(6.3)	93(45.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
Linens are changed on daily basis and as needed?				0.735	0.391
Yes	87(42.2)	18(8.7)	105(51.0)		
No	88(42.7)	13(6.3)	101(49.0)		
Total	175(85.0)	31(15.0)	206(100.0)		
How many times the ward is cleaned per day?				13.383	0.001
<=1 cleaning time	25(12.1)	13(6.3)	38(18.4)		
>=2 cleaning times	150(72.8)	18(8.7)	168(81.6)		
Total	175(85.0)	31(15.0)	206(100.0)		
Are bed pans available in wards?				13.334	0.001
Yes	107(51.9)	8(3.9)	115(55.8)		
No	68(33.0)	23(11.2)	91(44.2)		
Total	175(85.0)	31(15.0)	206(100.0)		
Are they sufficient for patients in need (at least 1 per patient)?				5.040	0.025
Yes	40(19.4)	1(0.5)	41(19.9)		
No	135(65.5)	30(14.6)	165(80.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
Comment on available bed pans hygiene				1.193	0.551
Bad	83(40.3)	18(8.7)	101(49.0)		
Fair	42(20.4)	6(2.9)	48(23.3)		
Good	50(24.3)	7(3.4)	57(27.7)		
Total	175(85.0)	31(15.0)	206(100.0)		
If yes, are Healthcare providers segregating generated wastes?				3.128	0.069

Yes	149(72.3)	30(14.6)	179(86.9)		
No	26(12.6)	1(0.5)	27(13.1)		
Total	175(85.0)	31(15.0)	206(100.0)		
Waste bins sealed/folded before transportation?				2.294	0.130
Yes	145(70.4)	29(14.1)	174(84.5)		
No	30(14.6)	2(1.0)	32(15.5)		
Total	175(85.0)	31(15.0)	206(100.0)		
Hospital stay.				0558	0.455
Two weeks Hospital stay	156(75.7)	29(14.1)	185(89.8)		
> Two weeks Hospital stay	19(9.2)	2(1.0)	21(10.2)		
Total	175(85.0)	31(15.0)	206(100.0)		

Source: Researcher, (2024)

The multivariate data analysis was conducted solely on the significant variables identified in the bivariate analysis to control for confounders. Table 7 illustrates that daily ward cleaning at or below one time was twelve times more likely to be associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with an Adjusted odds ratio (AoR) of 11.613, Confidence Interval (CI): (3.679-43.467), and $p<0.001$. Bed pan insufficiency per patient and unavailability in the ward were also significantly associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with AoR of 13.402 (CI: 1.879-27.438, p=0.004) and 4.664 (CI: 2.521-18.412, p<0.001), respectively. Cardiovascular diseases were among the chronic diseases associated with high nosocomial infection acquisition among hospitalized patients in CHUB, with an AoR of 5.165 (CI: 1.103-14.020, p=0.03).

Table 7. Multivariate analysis of factors associated with nosocomial infections among patients admitted to medical wards at University Teaching Hospital of Butare

Variables N=206	High Nosocomial infection incidence level among hospitalized patients in CHUB	P-value

	AoR	95%CI	
Education<= Primary education			
No	**Ref**		
Yes	**12.013**	1.125-27.771	**0.03**
Diabetes			
No	Ref		
Yes	8.517	2.309-31.418	**0.02**
Bed pans sufficiency			
Yes	Ref		
No	13.402	1.388-29.401	**0.01**
Bed pans Availability			
Yes	Ref		
No	4.664	1.326-16.404	**0.01**
HealthCare Provider Disinfect medical materials			
Yes	Ref		
No	12.095	2.529-55.667	**0.018**
Ward daily cleaning time < = Once			
No	Ref		
Yes	11.613	1.610-43.770	**0.015**
Diseases group			
Other diseases	Ref		
Cardiovascular diseases	5.165	1.148-23.236	**0.03**
Respiratory diseases	0.638	0.073-5.538	0.683
Neurological diseases	11.135	1.873-66.189	**0.008**

Source: Researcher, (2024)

Discussion

The study conducted at the University Teaching Hospital of Butare highlights several key sociodemographic traits associated with nosocomial infections among hospitalized patients. It shows that the majority of participants were female (55.8%), middle-aged (40.3% were between 41 to 60 years old), had primary-level education (46.1%), and were predominantly unemployed (83%). These findings suggest that nosocomial infections are more common among certain demographic groups, possibly due to differences in exposure, health behaviors, or access to healthcare resources.

Comparing this study with other similar studies, we find both similarities and differences. For instance, a study conducted in a hospital in Tanzania also found that a higher percentage of participants were females, though the proportion was slightly lower at around 52% (Mwakyusa, S. et al., 2018). In the same order of ideas, another retrospective cohort study done in Spain also were conducted on 56% of females while males were 44% (Al-Tawfiq&Tambyah, 2014). This suggests a consistent trend across different regions that females may be more susceptible to hospital-acquired infections, potentially due to factors such as increased hospitalization rates for conditions like childbirth or chronic illnesses (Mwakyusa, S. et al., 2018; Al-Tawfiq&Tambyah, 2014).

A study from Brazil presented a different sociodemographic profile, where the majority of participants were individuals who have done secondary school. Also, the study conducted in 2017 by El Chakhtoura, Bonomo and Jump concerned a majority of individuals who have done secondary school (51%) followed by 24% of participants who have studied until university (El Chakhtoura, Bonomo, & Jump, 2017). In contrast, the Butare study highlighted a higher representation of individuals without formal education or with primary education level, indicating potential socioeconomic disparities in healthcare access and infection control measures. This difference underscores the importance of contextual factors, such as economic conditions and healthcare system structures, in influencing infection risks (Santos, R. et al., 2017; (El Chakhtoura, Bonomo, & Jump, 2017).

In addition, this study identified several factors significantly associated with high nosocomial infection (HAI) acquisition among hospitalized patients. Daily ward cleaning at or below one time was found to be twelve times more likely to be associated with high nosocomial infection acquisition (Adjusted Odds Ratio, AoR = 12.645, CI: 3.679-43.467, $p < 0.001$) in CHUB. Bedpan insufficiency and unavailability in the ward were also significantly associated with high nosocomial infection acquisition, with Adjusted Odds Ratios of 7.180 (CI: 1.879-27.438, $p = 0.004$) and 6.813 (CI: 2.521-18.412, $p < 0.001$), respectively.

In a study conducted in a hospital in Ethiopia, poor sanitation and insufficient cleaning practices were identified as significant contributors to high nosocomial infection rates, paralleling the Butare study's findings on the impact of daily ward cleaning frequency. The Ethiopian study reported that wards cleaned less frequently than recommended had a significantly higher infection rate (AoR = 5.42, CI: 2.53-11.62, $p < 0.001$), underscoring the importance of rigorous and consistent cleaning protocols in preventing HAIs (Yallew et al., 2022). The same results were found by Naidu et al. in 2014 who revealed that nosocomial infections were commonly affecting patients admitted in improper settings (Naidu et al., 2014). The similarity in findings suggests that regardless of geographical location, inadequate cleaning practices remain a critical issue in healthcare facilities, often exacerbated by resource constraints and infrastructure challenges.

In contrast, a study from a tertiary care hospital in the United States identified different predominant risk factors, though some overlap existed. The U.S. study found that the use of invasive devices, such as catheters and ventilators, was a major risk factor for HAIs (AoR = 3.6, CI: 2.7-4.7, $p < 0.001$) (Magill et al., 2020). Also, in the retrospective cohort study done in Spain evoked above noted that using medical devices are associated with nosocomial infections (Al-Tawfiq & Tambyah, 2014). In general, the inserted catheters or tubes (urinary, nasogastric, central venous) and the long hospitalization for more than 7 days were the common factors associated with nosocomial infections (Al-Tawfiq & Tambyah, 2014).

The Butare study on factors associated with nosocomial infection acquisition among patients admitted to medical wards at the University Teaching Hospital of Butare provides valuable insights but is not without limitations. One notable limitation is the potential for selection bias (Dickersin, K.; Chan, S.; Chalmers, T. C.; et al. (2017). The study may not fully represent the entire patient

population due to its focus on a single hospital setting. This could limit the generalizability of findings to other hospitals with different demographics, healthcare practices, or resource availability.

The implications of the Butare study on factors associated with nosocomial infection acquisition among patients admitted to medical wards at the University Teaching Hospital of Butare are significant for healthcare practice and policy. Firstly, the study underscores the critical importance of robust infection control measures in healthcare settings, particularly focusing on daily ward cleaning practices, availability of essential supplies like bedpans and disinfectants, and proper disinfection of medical materials. These findings highlight actionable areas where hospitals can strengthen their infection prevention protocols to reduce the incidence of nosocomial infections and improve patient safety (Al-Tawfiq & Tambyah, 2014).

Conclusion

In conclusion, the findings from the study at the University Teaching Hospital of Butare (CHUB) underscore the critical importance of rigorous infection control measures in mitigating nosocomial infections among hospitalized patients. The study identified several key factors associated with increased infection risk, including inadequate daily ward cleaning, insufficient availability of essential supplies like bedpans and disinfectants, and the presence of chronic diseases such as diabetes, cardiovascular diseases, and neurological conditions. These findings emphasize the urgent need for healthcare facilities to prioritize comprehensive cleaning protocols, ensure sufficient availability of medical supplies, and implement targeted strategies for patients with underlying health conditions. By addressing these factors, hospitals can enhance patient safety, reduce the incidence of nosocomial infections, and improve overall healthcare outcomes.

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