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Aerobic Bacteria Isolates and Antibiotic Susceptibility Patterns in Suspected Wound Infection Patients at Dil-Chora Referral Hospital, Dire Dawa, Eastern Ethiopia

Adil Ibrahim[1], Gudina Egata[2], Wondimagegn W. Eba[3]*, Zelalem Teklemariam[2], Tadesse S. Awaju[4]

[1]Dil-Chora Referral Hospital, Department of Medical Laboratory, Dire Dawa, Ethiopia. [2]Haramaya University, College of Health and Medical Sciences, School of Medical Laboratory Sciences, Tropical and Infectious Disease and medical Parasitology programs, Ethiopia. [3]Oda Bultum University, College of Health Sciences, Department of Medical Laboratory Sciences, P.O. Box, 226 Chiro, Ethiopia. [4]Haramaya University, College of Health and Medical Sciences, School of Medical Laboratory Sciences, Medical Microbiology and Immunology programs, P.O. Box, 235 Harar, Ethiopia.

**Corresponding author: Wondimagegn W. Eba.*

Abstract

Background: Bacterial wound infections are a common and serious health problem that can disrupt wound healing, resulting in morbidity and death in patients, particularly due to drug-resistant pathogens. Limited research exists on this topic in eastern Ethiopia.

Objective: This study aims to assess aerobic bacteria isolate, their drug susceptibility patterns and associated factors among suspected patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, eastern Ethiopia.

Methods: A hospital-based cross-sectional study was conducted among 188 patients with wounds from March to June 2020. Data were collected using a pretested, structured questionnaire. Wound swabs and pus discharges from 188 patients were collected using convenient sampling techniques. Gram staining, biochemical testing, and culture were used to isolate and identify etiologic agents. Antibacterial susceptibility test was performed on Muller Hinton agar using the Kirby-Bauer disc diffusion method.

Results: In this study, 89.4% of wound infections yielded bacteria, predominantly Gram-negative (54%) and Gram-positive (46%). S. aureus (32.9%) and Proteus species (28.6%) were predominant. Gender [AOR=7.5; 95% CI (5.6–13.2)], type of specimen [AOR=16.8; 95% CI (12.7–18.3)], and type of ward [AOR=12.3; 95% CI (8.3–16.5)] were significantly associated with bacterial wound infection. All isolated Gram-positive bacteria resisted Beta-lactams but responded to amikacin and vancomycin. Gram-negative bacteria showed high resistance to ampicillin, chloramphenicol, cotrimoxazole, ceftriaxone, and doxycycline, but they were susceptible to amikacin. Overall, multi-drug resistance was high at 85%.

Conclusions: Our study detected a high prevalence of bacterial wound infections with notable drug resistance. Gender (female), types of specimens (pus discharge), and types of wards (orthopedic ward) had a significant effect on the outcome variable ($P < 0.05$). Amikacin, gentamicin, and vancomycin emerged as preferred antibiotics at Dil-Chora hospital. Clinical diagnosis of wound infection should consider microbiological culture and susceptibility patterns for effective treatment.

Keywords: aerobic bacteria; bacterial isolates; drug susceptibility pattern; wound infection

Introduction

Wound infection continues to be challenging for people with a wound, their families and health professionals [1]. Bacterial wound infections are a common and significant health concern that can affect the healing process of wounds, leading to morbidity and mortality in patients. This comes at significant economic cost and negatively influences quality of life outcomes for the person with a wound and their family [1, 2]. An estimated 2 million instances of wound infections occur globally each year [3, 4]. Variety of finding reported that wound infections in Africa ranged from 2.5% to 30.9% [5, 6, 7]. Furthermore, several studies from other globe have found varying rates of wound infection prevalence such as 78.9%, 44.8%, and 64.8% in India [8], Nepal [9], and Nigeria (10%), respectively.

In Ethiopia, bacteria isolate from wound infections varies from 70.2% to 96.3% [11, 12]. The common bacterial pathogens associated with wound infection include *S. aureus*, *Klebsiella* species, *E. coli*, *Proteus* species, *Pseudomonas* species, and Coagulase Negative *Staphylococci*, particularly the infection caused by drug resistant pathogens are a global crisis [11–13]. In recent years, drug-resistant bacterial infections have become increasingly serious, as top ten threats to global health [14, 15]. Widespread bacterial resistance to presently available medicines has made wound infection management more difficult [11–13, 16–17, 18–19]. Antimicrobial-resistant bacterial wound infections significantly raise medical care costs and increase patient morbidity and death [20]. In this regard, this study has not been explored previously in the study area. Therefore, it was aimed to assess aerobic bacteria isolates, drug susceptibility pattern and associated factors among clinically suspected patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Eastern Ethiopia.

Materials and Methods

Study area, design and period

Dire Dawa administration council is located in the Eastern part of Ethiopia which is 550 Km away from Addis Ababa. Hospital based cross sectional study design was conducted on patients with wound infection who were admitted at Dil-Chora Referral Hospital, from March 15, 2020 to June 14 2020.

Sample size determination and sampling technique

Sample size was determined by using a single population proportion formula by considering a 95% confidence interval, an expected margin of error (d) of 0.05, a 10% non-response rate, and the 87.4% prevalence of bacteria isolates from wound infection in a study conducted at Jimma University Specialized Hospital, Southwest Ethiopia (12). The final sample size was 188 patients with infected wounds were chosen using a practical sampling approach.

Data collection method

The data was collected via a face-to-face interview using pre-tested structured questionnaires that were adopted from different kinds of literature [11, 12, 22]. The questionnaire contains two parts: on the first part socio-demographic variables like age, gender, residence, educational status, marital status, monthly income, family size while the second part contains, clinical information such as history of wound infection, type of laboratory test, and personal habit. Two trained B.Sc. Nurses were collected the data. One B.Sc. Laboratory technologist has supervised the activities of data collectors. The training was provided to both data collectors and supervisors by the principal investigator and senior Medical Microbiologist for two days (one day theoretical and one day practical) on the sample collection procedure and the data collection tools before the actual data and sample collection had started.

Wound Swab Specimen collection

Open wound swabs were aseptically collected by spinning it under enough pressure onto a sterile cotton swab after the dressing was removed, and the surface exudates and contaminants were cleansed off with moistened sterile gauze dipped in sterile normal saline solution. To lower the possibility of contamination, duplicated wound swabs were obtained from each site. After being collected, nasal swabs were inoculated in a properly labeled sterile *Amies* transport media (Oxoid Ltd. England) and transported by using an ice-box to keep the cold chain until it reaches the Haramaya University's Microbiology Laboratory.

Culture, isolation and identification of bacteria

The wound swab was inoculated on Blood agar (OXOID, England) and MacConkey agar (OXOID, England) by sterile inoculation loop using the streak plate method [23]. The inoculated plates were incubated aerobically at 37oC for 24-48 hours. Preliminary identification of bacterial isolates was made based on colony morphology and gram stain. Using many distinct biochemical assays, bacterial isolates were identified [23].

Antimicrobial susceptibility testing

The antimicrobial susceptibility test of the isolated bacteria was done according to the Clinical Laboratory Standards Institute guidelines (CLSI) [24] using Kirby-Bauer disk diffusion method on Muller Hinton agar (OXOID, Basingstoke, United Kingdom). Suspension of confirmed isolates was done using normal saline and adjusted to match that of 0.5 McFarland standards to obtain approximately a colony count of 10^7 or 10^8 colony forming units (CFU) per ml. A sterile swab was dipped into the suspension, applied to the Muller Hinton agar plat and evenly spread, and left at room temperature to dry for 3 to 5 min. Antibiotic discs like ampicillin (10 µg), ciprofloxacin (5 µg), gentamicin (10 µg), cotrimoxazole (25 µg), chloramphenicol (30 µg), doxycycline (30 µg), amikacin (10 µg), and ceftriaxone (30 µg). Penicillin G (10 IU), erythromycin (15 µg), and vancomycin (30 µg) were placed at a distance of 15mm from each other on to the Muller Hinton agar and incubated at 37 oC for 16–18 hours. (23). Diameters of the zone of inhibition around the discs were measured using automated calipers and classified as sensitive, intermediate, and resistant according to Clinical and Laboratory Standards Institute guidelines (24).

Variables

Dependent variables

Prevalence of aerobic Bacteria isolates in suspected wound infection

Antibiotic susceptibility patterns of the isolates

Independent variables

Age, gender, residence, educational status, marital status, monthly income, family size, history of wound infection, Type of specimens, Type of ward and personal habits.

Operational definition

Aerobic bacteria are bacteria that can grow and live when oxygen is present [1].

Wound infection is defined as the presence of replicating microorganisms within a wound leading to host/tissue injury [2].

Quality control

Training was given to the data collector. The collected data were checked for completeness at the end of each day of data collection. Double data entry was done using Epi-Data to minimize errors during data entry.

For culturing and biochemical tests, standard operating procedures and the manufacturer's instruction manual were strictly followed and Sterility was checked by incubating 5% of the prepared culture media at 37 °C overnight and checked for growth of contaminants. The American Type Culture Collection (ATCC) *S. aureus* (ATCC-25923), *E. coli* (ATCC-25922), and *P. aeruginosa* (ATCC-27853), which were obtained from the Ethiopian Public Health Institute (EPHI), and used as quality control for the Gram Stain, culture, biochemical, antibiotic susceptibility testing.

Data processing and analysis

Data were entered and cleaned using Epi Data (Version 3.02) then exported to the Statistical Package for Social Science (SPSS Version 16) for analysis. Descriptive statistics such as frequency, percentage, and cross-tabulation were used to summarize the characteristics of the study population. Bivariate and multivariate analyses were performed to identify factors associated with bacterial wound infection. Variables with $p<0.3$ at a 95% confidence interval in bivariate analysis were considered for multivariate analysis. Variables with $p<0.05$ at 95% CI in the multivariate analysis were considered significantly associated factors with bacteria wound infection.

Results

Socio-demographic characteristics

A total of 188 patients with clinical evidence of wound infection who were admitted to Dil-Chora Referral Hospital at the time study period were enrolled. Among enrolled patients, the majority 58.5% of them were between 21–40 age categories. The mean age of study participants was 35±16 years with ranged from 3 to 95 years. Majority (59.6%) of the study participants were female. Moreover, more than half (52.7%) of participants were from urban area and majority (68.6%) were married (Table 1).

Table 1: Socio-demographic characteristics of patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Ethiopia, 2020

Variables	Category	Frequency	Percentage
Age	1-20	24	(12.8%)
	21-40	110	(58.5%)
	>40	54	(28.7%)
Gender	Female	112	(59.6%)
	Male	76	(40.4%)
Residence	Urban	99	(52.7%)
	Rural	89	(47.3%)
Educational status	Can't read and write	70	(37.2%)
	Write and read only	20	(10.6%)
	Primary (Grade 1-8)	51	(27.1%)
	Secondary (Grade 9-12)	28	(14.9%)
	College and above	19	(10.1%)
Marital status	Single	31	(16.5%)
	Married	129	(68.6%)
	Widowed	25	(13.3%)

	Divorce	3	(1.6%)
Monthly income	<1000	125	(66.5%)
	1000-2000	44	(23.4%)
	>2000	19	(10.1%)
Family size	1-4	80	(42.6%)
	>8	108	(57.4%)

Magnitude of Bacteria isolates

From a total of 89.4% (168/188) [95% CI: 84.1%–93.0%] of the collected wound sample, 213 had bacterial isolates. Among the isolates, more than half (54%, 115/213) were Gram-negative bacterial isolates. Were more prevalent than Gram-positive, as *Proteus* species (28.6%) were the most Prevalent. In addition, from the isolated gram-positive bacteria, *S. aureus* (32.9%) was the predominant bacteria isolate followed by CoNS (13.1%) (Table 2).

Table 2: Bacteria isolates among patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Eastern Ethiopia, 2020

Bacteria Isolates from wound	Frequency	Percentage (%)
Staphylococcus aureus	70	32.9
Proteus species	61	28.6
Coagulase negative Staphylococcus species	28	13.1
Pseudomonas aeruginosa	18	8.5
Klebsiella species	13	6.1
Escherichia coli	9	4.2
Citrobacter species	8	3.8
Providencia species	6	2.8
Total	213	100

Factors associated with Bacterial wound infection

In the bivariate analysis, the prevalence of bacterial isolates was higher in age groups 20–40, female, previous history of wound infection, pus discharge type of specimens, and types of wards (Orthopedic, Gynecology, Obstetrics, and Surgical type of ward). However, in multivariate analysis, females were found to be 7.5 times more prone to develop bacterial wound infection than males (AOR: 7.5; 95% CI: 5.6–13.2). In addition, study participants with pus discharge samples were 16.8 times more vulnerable to develop bacterial wound infection than other wound swabs samples (AOR: 16.8; 95% CI: 12.7–18.3). Those study participants who were admitted to the orthopedic ward were 12.3 times more likely to develop a bacterial wound infection than those admitted to another ward (AOR: 12.3; 95% CI: 8.3–16.5) (Table 3).

Table 3: Bivariate and Multivariate analysis of socio-demographic, Clinical and other factors related with of bacteria isolated among patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Eastern Ethiopia, 2020.

Variables	Culture		Bivariate analysis	Multivariate analysis
	Positive (%)	Negative (%)	COR (95% CI)	AOR (95% CI)
Age				
1-20	19(79.17%)	5 (20.83%)	4 (2.46-14.9)	0.14 (0.004-5.78)
21-40	103(93.64%)	7(6.36%)	1.5(0.1785.632)	0.94 (0.28-31.6)
>60	46 (85.19%)	8(14.81%)	1	1
Gender				
Female	107(95.54%)	5 (4.46%)	5.3 (1.823-15.2)	**7.5 (5.6-13.2) ***
Male	61 (80.26%)	15(19.74%)	1	**1**
Previous history of wound infection				
Yes	7 (53.85%)	6 (46.15%)	8.78 (3.53-12)	5.3 (3.53-12)
No	161 (92%)	14 (8%)	1	1
Type of specimens				

Pus discharge	120(97.56%)	3 (2.44%)	14.2(3.9716.03)	**16.8 (12.7-18.3) *****
Wound swab	48 (73.85%)	17(26.15%)	1	1
Type of ward				
Gyn & Obs	73 (93.59%)	5 (6.41%)	0.02 (0.02-0.19)	2.4 (0.16-3.6)
Orthopedic	51 (91.08%)	5 (8.92%)	0.05 (0.01-0.35)	**12.3 (8.3-16.5) ****
Surgical	26 (86.67%)	4 (13.33%)	0.15(0.027-0.87)	3.49 (0.4-3.5)
Medical	14 (73.68%)	5 (26.32%)	0.5 (0.09-2.62)	3.78 (0.46-3.8)
Pediatrics	4 (80%)	1 (20%)	1	1

Statically significance (p<0.05), ** Statically significance (p=0.004), * Statically significance (p=0.001), 1=Reference group, COR= Crude odd ratio, AOR=Adjusted odd ratio, 95% CI=95% Confidence interval.*

Antibiotics susceptibility pattern of bacteria isolates

Gram-positive bacteria: Amikacin (100%), vancomycin (100%), chloramphenicol (87.5%), and gentamycin (80%) were found to be most active antimicrobials in sensitivity test against *S. aureus* and CoNS isolates from wound infection. However, *S. aureus* was found resistant to ampicillin (100%), penicillin (100%), erythromycin (91.4%), and doxycycline (74.3%) (Table 4).

Table 4: Drug susceptibility pattern of gram-positive bacteria isolates among patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Eastern Ethiopia, 2020

Isolates	Results	Antimicrobial agents /No. of bacterial isolates (%)										
		C	CRO	CN	AN	TS	CIP	E	AM	P	VA	D
S.aureus	S	60(85.7)	35(50)	56(80)	70(100)	45(64.3)	35(50)	-	-	-	70(100)	18(25.7)
(n=70)	I	3(4.3)	15(21.4)	-	-	-	5(7.1)	6(8.6)	-	-	-	-
	R	7(10)	20(28.6)	14(20)	-	25(35.7)	30(42.9)	64(91.4)	70(100)	70(100)	-	52(74.3)
CONS	S	18(64.3)	23(82.1)	24(85.7)	15(53.6)	12(42.9)	15(53.6)	9(32.1)	6(21.4)	5(17.9)	28(100)	13(46.4)
(n=28)	I	3(10.8)	2(7.1)	-	6(21.4)	3(10.7)	4(14.3)	5(17.9)	2(7.1)	3(10.7)	-	6(21.4)
	R	7(25)	3(10.8)	4(14.3)	7(25)	13(46.4)	9(32.1)	14(50)	20(71.4)	20(71.4)	-	9(32.1)

KEY: *S = Sensitive I = Intermediate R = Resistant; —: zero; CN: Gentamicin; C: Chloramphenicol; TS: Cotrimoxazole; CRO: Ceftriaxone; CIP: Ciprofloxacin; AM: Ampicillin; P: Penicillin; D: Doxycycline; AN: Amikacin; E: Erythromycin; VA: Vancomycin.*

Gram-negative bacteria: Amikacin (100%) and Gentamycin (75.4%), showed most activity against *Proteus* species. but they were highly resistant to ampicillin (100%), chloramphenicol (88.5%), and cotrimoxazole (78.7%). *Pseudomonas aeruginosa* isolates had a 100% resistance rate to cotrimoxazole, doxycycline, and ampicillin. *Klebsiella* spp. had a 92.3% resistance rate to ampicillin. *Citrobacter* isolates were highly resistant to ampicillin (100%) and doxycycline (87.5%), whereas they were 100% sensitive to gentamycin and amikacin. *Providencia* showed 83.3% resistance to ampicillin and cotrimoxazole, but they were 100% sensitive to amikacin. In addition, *E. coli* showed 100% sensitivity to amikacin and 77.8% to ceftriaxone (Table 5).

Table 5: Drug susceptibility pattern of gram-negative bacteria isolates among patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Eastern Ethiopia, 2020

Isolates	Results	Antimicrobial agents /No. of bacterial isolates (%)							
		C	CRO	CN	AN	TS	AM	D	CIP
Proteus spp	S	7(11.)	19(31)	46(75.)	61(100)	10(16.)	-	34(55.)	11(18)
(n=61)	I	-	5(8.2)	5(8.2)	-	3(4.9)	-	7(11.5)	6(10)
	R	54(88)	37(60)	10(16.)	-	48(78.)	61(100)	20(32.)	44(72)
P. aeuruginosa	S	10(55)	6(33.3)	4(22.2)	14(77.8)	-	-	-	8(44.4)
(n=18)	I	2(11.1)	-	2(11.1)	-	-	-	-	3(16.7)
	R	6(33.3)	12(66.)	12(66.)	4(22.2)	18(100)	18(100)	18(100)	7(38.9)
Klebseilla spp	S	4(30.8)	5(38.5)	11(84.6)	10(76.9)	7(53.8)	-	6(46.2)	8(61.5)
(n=13)	I	-	1(7.7)	-	3(23.1)	-	1(7.7)	2(15.4)	1(7.7)
	R	9(69.2)	7(53.8)	2(15.4)	-	6(46.2)	12(92.3)	5(38.4)	4(30.8)
E. coli	S	4(44.5)	7(77.8)	5(55.6)	9(100)	5(55.6)	5(55.6)	3(33.3)	4(44.5)

(n=9)	I	3(33.3)	-	1(11.1)	-	3(33.3)	2(22.2)	-	2(22.2)
	R	2(22.2)	2(22.2)	3(33.3)	-	1(11.1)	2(22.2)	6(66.7)	3(33.3)
Citrobacter spp	S	3(37.5)	2(25)	8(100)	8(100)	4(50)	-	1(12.5)	4(50)
(n=8)	I	2(25)	2(25)	-	-	1(12.5)	-	-	-
	R	3(37.5)	4(50)	-	-	3(37.5)	8(100)	7(87.5)	4(50)
Providencia spp	S	4(66.7)	3(50)	4(66.7)	6(100)	-	1(16.7)	3(50)	4(66.6)
(n=6)	I	-	-	2(33.3)	-	1(16.7)	-	1(16.7)	1(16.7)
	R	2(33.3)	3(50)		-	5(83.3)	5(83.3)	2(33.3)	1(16.7)

KEY: S = Sensitive I = Intermediate R = Resistant; CN Gentamicin; C: Chloramphenicol; TS: Cotrimoxazole; CRO: ceftriaxone; CIP: Ciprofloxacin; AM: Ampicillin; D: Doxycycline; AN: Amikacin.

Multidrug-resistance pattern: Of the total 231 bacterial isolates, 181 (85%) were identified as multidrug resistance (MDR) (resistance to more than or equal to two different classes of antimicrobial agents). Of them, 83.7% of Gram-positive were MDR. Among the isolated gram-positive bacteria, S. aureus (100%) followed by Coagulase Negative *Staphylococcus* spp. (CONS) (42.9%) showed the highest percentage of MDR while 86.1% of Gram-negative bacteria were MDR. A higher rate of MDR was seen among *P. aeruginosa (100%)* and *Proteus* spp. (88.5%) (Table 6).

Table 6: Multidrug resistance of gram-positive and gram-negative bacteria isolates among patients admitted for wound infection at Dil-Chora Referral Hospital, Dire Dawa, Ethiopia, 2020

Bacteria isolates	Antimicrobial classes resisted to No (%)								Total MDR
	R0	R1	R2	R3	R4	R5	R6	R7	(%)
S. aureus (n=70)	0	0	6(8.6)	18(25.7)	30(42.9)	9(12.9)	5(7)	2(2.9)	**70(100)**
CONS (n=28)	4(14.3)	12(42.9)	6(21.4)	2(7.1)	1(3.6)	2(7.1)	0	1(3.6)	**12(42.9)**
Total (n=98)	4(4.1)	12(12.2)	12(12.2)	20(20.4)	31(31.6)	11(11.2)	5(5.1)	3(3.1)	**82(83.7)**
Proteus spp. (n=61)	0	7(11.5)	13(21.3)	17(27.9)	10(16.4)	6(9.8)	7(11.5)	1(1.6)	**54(88.5)**
P. aeruginosa(n=18)	0	0	0	6(33.3)	5(27.8)	4(22.2)	2(11.1)	1(5.6)	**18(100)**
Klebseilla spp. (n=13)	0	3(23)	4(30.8)	2(15.4)	3(23)	1(7.7)	0	0	**10(76.9)**
E. coli (n=9)	2(22.2)	2(22.2)	1(11.1)	3(33.4)	1(11.1)	0	0	0	**5(55.6)**
Citrobacter spp. (n=8)	0	1(12.5)	2(25)	3(37.5)	2(25)	0	0	0	**7(87.5)**
Providencia spp. (n=6)	0	1(16.7)	2(33.3)	2(33.3)	0	1(16.7)	0	0	**5(83.3)**
Total (n=115)	2(1.7)	14(12.2)	22(19.2)	33(28.7)	21(18.3)	12(10.4)	9(7.8)	2(1.7)	**99(86.1)**

Key: *R0= Sensitive to all antimicrobials tested; R1, R2, R3, R4, R5, R6, R7 -Resistant to one, two, three, four, five, six, seven antimicrobials, respectively.*

Discussion

In this study, the overall prevalence was 89.4%. This is comparable with studies conducted in Jimma, Nigeria, Pakistan, and India, respectively [12, 25, 26, 27], but it was lower than studies conducted in Jimma, Nigeria, and India [13, 28, 29]. However, it was higher than the reports from Gondar, Mekelle, Cameroon, and Nepal [11, 30-32]. The possible reasons for such a difference could be the study period, study design, sample size, types of wound samples collected, and organisms isolated. According to our study on microbial species isolated from infected wounds, higher proportion of gram-positive bacteria than Gram-negative bacteria were detected, *S. aureus* (32.9%) and CoNS (13%) followed by *Proteus* spp. (28.6%) appeared to be the most frequent isolates. A similar finding was reported from other parts of Ethiopia, Gondar and India [11, 33]. However, it was higher than the studies conducted in Jimma, Nigeria, Bangladesh, and Iran [13, 28, 34, 35]. A higher proportion of Gram-positive bacteria in the early stages of wound infections may be due to their ability to colonize the wound initially from the skin.In this study, being female was found to be 7.5 times more likely to develop a bacterial wound infection than male, which is supported by study, conducted previously [11]. However, this study disagrees with studies conducted previously in Debre Markos [22], Mekelle [30], Jimma [39], Cameroon [31], Nigeria [41], Pakistan [42] and Nepal [9]. This variation could be the majority of study participants were females.Patients who had pus discharge specimens were found to be 17 times more prone to develop wound infection. A similar study reported in Gonder, Ethiopia [11]. The possible reason for high bacterial isolation from pus discharge might be the presence of pus in the wound indicates bacterial infection. Patients who were admitted to the orthopedics ward were 12 times more vulnerable to develop a bacterial wound infection than patients who were admitted to pediatrics. This study is consistent with the study conducted in Mekelle, Ethiopia [30], but it is inconsistent with the study done in Jimma, Ethiopia [39] and Brazil [43]. The possible reason for the high prevalence of bacterial isolation in patients admitted to orthopedic wards might be that operative soft-tissue damage is a major risk factor for developing infections and longer hospitalization leads to acquiring an infection.

Regarding antimicrobial susceptibility test for gram-positive bacteria, *S. aureus* isolates showed high resistance to Beta-lactam antibiotics. This was consistent with studies conducted in Jimma, Ethiopia, Nepal, and Bangladesh [13, 32, 34, 9]. This might be due to the production of beta-lactamases and the expression of penicillin-binding protein 2a. Among the Gram-negative bacteria, *Proteus* spp. is highly resistant to ampicillin, chloramphenicol, cotrimoxazole, and ciprofloxacin. A similar finding was reported from Jimma, Ethiopia, and India [13, 16]. In addition, *P. aeruginosa* was highly resistant to ampicillin, cotrimoxazole, doxycycline, ceftriaxone, and gentamycin. This is in agreement with studies conducted before [12, 35, 38, 39, 40]. The above findings indicate most of the bacteria were resistant to commonly prescribed antimicrobials. This finding could be explained by practice of empirical prescription, the nosocomial infections contribute to the emergence of resistant strains of organisms due to antibiotic selection pressure and circulation of resistance gene among the strains. Furthermore, in this study, the overall MDR rate was 85%, with a greater MDR among Gram-positive isolates (83.7%], as a serious global public health threat that has increased both mortality and morbidity. This finding was supported by previous study done in Jimma, Ethiopia [12].

Conclusion and Recommendation

High magnitude of bacteria isolates and their drug resistance were detected. Gender, types of discharge (pus discharge), and types of wards (orthopedic ward) were significantly associated with outcome variable ($P < 0.05$). Amikacin, gentamicin, and vancomycin (for gram-positive bacteria only) were the most effective antibiotics against isolated organisms. The diagnosis of wound infection should be based on a combination of clinical judgment and microbiological culture with susceptibility pattern.

Declarations

Ethical approval and consent

Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of Haramaya University, College of Health and Medical Sciences. Signed written consent was obtained from the Administrative of the hospital and patients after the objective of the study was explained. Information obtained during this study was kept confidential. Confidentiality was maintained by numeric coding of specimens and questionnaires. All the laboratory examinations of the swabs were done free from charge and confirmed positives were given appropriate information and treated following drug susceptibility findings.

Availability of data and materials

This paper is based on the thesis of Adil Ibrahim. It has been published on the Haramaya University institutional repository.

Conflict of interest

The author announced that they have no conflict of interests.

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Authors' contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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References

1. Rubin, R.H., (2006). Surgical wound infection: epidemiology, pathogenesis, diagnosis and management. *BMC.* Infect. Dis, 6:171-172.
2. Berrios, S.I. (2008). Surgical site infection toolkit: Infection Control and Hospital *Epidemiology,* 29: S51-S61.
3. Anusha, S., Vijaya, L.D., Pallavi, K., Manna, P.K. and Mohanta, G.P. (2010). Epidemiological study of surgical wound infection in a surgical unit of teriaty care teaching Hospital. 4:8-12.
4. Praveen, K.D. and Neelima. (2013). Bacteriologi-cal profile of surgical site infection. 4(3): 217-221.
5. Sepideh, B.N., Benedetta, A., Shamsuzzoha B.S., Benjamin, E. and Didier, P. (2011). Health-care-associated infection in Africa: a systematic review. *Bull World Health Organ*, 89:757-765.
6. Olsen, M.A., Nepple, J.J. and Riew, K.D. (2008). Risk Factors for Surgical Site Infection Following Orthopedic Spinal Operations in America. *J Bone Joint Surg*, 90:62-69.
7. Reichman, D.E. and Greenberg, J.A. (2009). Reducing Surgical Site Infections: *A Review Rev Obstet Gynecol*, 2(4):212-221.
8. Valarmathi, S., Rajasekara, P.M. and Senthilkumar, B. (2013). Incidence and screening of wound infection causing microorganisms. *J Acad Indus*, 1(8).
9. Jaya, K.Y., Amit, R.S., Nawaraj, D., Binod, L. and Megha, R.B. (2014). Antibiotic Susceptibility Pattern of Bacterial Isolates Causing Wound Infection among the Patients Visiting B & B Hospital, Nepal. *J Sci Techno*, 15(2):91-96.
10. Christopher, A.E., Richard, O., Isaac, O.I. and Samson, O. (2011). Microbiology of Wound Infections and its Associated Risk Factors among Patients of a Tertiary Hospital in Benin City, *Nigeria. JRHS*, 11(2):109-113.
11. Dagnachew, M., Yitayih, W., Getachew, F., Tesfaye, N., Kasaw, A., Belete, B., Habtie, T. and Feleke, M. (2014). Bacterial isolates and their antibiotic susceptibility patterns among patients with pus and/or wound discharge at Gondar university hospital. *BMC*, 7:619
12. Mohammedaman, M., Alemseged, A. and Tsegaye, S. (2014). Antimicrobial susceptibility pattern of bacterial isolates from wound infection and their sensitivity to alternative topical agents at Jimma University Specialized Hospital, South-West Ethiopia. *Ann Clin Micro Antimicrob*, 13:14.
13. Girma, G., Gebre, K. and Himanot, T. (2013). Multidrug-resistant bacteria isolate in infected wounds at Jimma University specialized Hospital, Ethiopia. *clin Microbio and antimicr*, 12(17):1-7.
14. Taye., M. (2005). Wound infection in Tikur Anbessa Hospital, surgical department. *Ethiop Med J*, 43(3):167-174.
15. Adenike, A.O., Ogunshe, M.T., Niemogha, G.N. and Anthony N.O. (2012). Microbiological evaluation of antibiotic resistance in bacterial flora from skin wounds. *pharm Biomed*, 22(6):1-7.
16. Hrishikesh, S., Radha, S. and Vinod, R. (2015). Antimicrobial susceptibility pattern of bacterial isolates from wound infection and their sensitivity to antibiotic agents at super specialty hospital, Amravati city, India. *J Res Med Sci*, 3(2):433-439.
17. Rajendra, G., Anju, A., Hari, P. and Sony, S. (2013). Antibiotic susceptibility pattern of bacterial isolates from wound infection in Chitwan Medical College Teaching Hospital, Chitwan, Nepal. Journal, 10:7439.
18. Bularafa, M.Y., Denue, B.A., Onah, J.O., Jibrin, Y.B., Umar, H.M., Gabchiya, N.M., Zanna, B.A., Ladan, J., Hamidu, I. and Okon, K.O. (2015). Analysis of Bacterial Pathogens Isolated from Wound Infections at a Tertiary Hospital in Nguru, *Yobe State Nigeria*.
19. Sani, R.A., Garba, S.A., Oyewole, O.A. and Ibrahim, A. (2012). Antibiotic Resistance profile of Gram-Positive Bacteria Isolated from Wound Infections in Minna, Bida, kontagora and suleja Area of Niger state. *J heal sci*, 2(3):19-22.
20. Theoklis, E.Z. (2009). Antibiotic resistance: Who will pay the biis? *Cli Infectious Dise*, 49:1185-1186.
21. Central Statistics Agency (CSA) of Ethiopia. 2014-2017.
22. Amlsha, K., Adane, M., Tamrat. A. and Tebkew, A. (2014). Isolation and antimicrobial susceptibility pattern of Staphylococcus aureus in patients with surgical site infection at Debre Markos Referral Hospital,Amhara Region, Ethiopia. 72:16.
23. Cheesbrough, M. (2006). District laboratory Practice in tropical countries. *Microbiology Part II, Second Edition Cambridge University press*, London UK:105-114.
24. Clinical Laboratory Standard Institute (CLIS). (2014). Performance Standards for Antimicrobial Susceptibility Testing, Twentieth informational supplements, CLSI document M100-S24.Wayne, PA: *clinical and laboratory standard Institute*.
25. Esebelahie, N.O., Esebelahie, F.O. and Omoregie, R. (2013). Aerobic bacterial isolates from wound infection. *Microbiol*, 14:155-159.

26. Ammar, A., Leena, H. and Marina, M. (2015). Culture and Sensitivity Pattern of Organisms in Infected Wounds in Bahawal Victoria Hospital Bahawalpur, Pakistan. *Int J Surg Pakistan*, 20(2).
27. Raghav, R., Ranjan, B. and Debika, R. B. (2014). Aerobic bacterial profile and antimicrobial susceptibility pattern of pus isolates in a South Indian tertiary care Hospital. 13(3):59-62.
28. Motayo, B.O., Akinbo, J.A, Ogiogwa, I.J, Idowu, A.A., Nwanze, J.C., Onoh, C.C., Okerentugba, P.O., Adiele, H.C. and Okonko, I.O. (2013). Bacteria Colonization and Antibiotic Susceptibility Pattern of Wound Infections in a Hospital in Abeokuta. *Fronti in Science*, 3(1):43-48.
29. Swati, D., Khatri, P. K., Parihar, R. S. and Rajat, A. (2013). Antibiogram of various bacterial isolates from pus samples in a tertiary care center in Rajasthan. *Jour of Scie & Rese*, 4(5):2319-7064.
30. Reiye, E.M., Berhe, G-S.K., Muthupandian, S., Derbew, F.B. and Araya, G.W. (2014). Aerobic bacteria in post-surgical wound infections and pattern of their antimicrobial susceptibility in Ayder Teaching and Referral Hospital, Mekelle, *Ethiopia. BMC*, 7:575
31. Akoachere, J.F., Tatah, K., Palle, J.N., Mbianda, S.E., Nkwelang, G. and Roland, N.N. (2014). Risk factors for wound infection in health care facilities in Buea, Cameroon: aerobic bacterial pathogens and Antibiogram of isolates. *medical Journal*, 18:6
32. Arjun, O.K., Binod, L. and Bijendra, R.R. (2015). Antibiogram of Bacteria Isolated from Wound Exudates in KIST Medical College and Teaching Hospital, Lalitpur, Nepal. 6(2):4997-5002.
33. Malik, S., Gupta, A., Singh, K. P., Agarwal, J. and Singh, M. (2011). Antibiogram of aerobic bacteria isolates from post-operative wound infections at a tertiary care hospital in India. 28:45-51.
34. Mehedi, H. M., Arongozeb, M. D., Golam, M. K. and Zakarai, A. (2013). Isolation and Identification of different bacteria from different types of burn wound infection and study their antimicrobial sensitivity pattern. International Journal of Research in Applied, 1(3):125-132.
35. Mohammad, T. A., Reza, G., Samad, B., Mohammad, A., Tahereh, P., Babak, A., Naser, A., Ali, T. O., Vida, S. S. and Mohammad, Y. M. (2015). Antibiotic susceptibility pattern of aerobic and anaerobic bacteria isolated from surgical site infection of Hospitalized patients. 8(7): e20309.
36. James, G.D., Salami, F. and Comfort, D. (2015). Aerobic Bacteria Isolates of Septic Wound Infections and Their Antibiogram in North Central Nigeria.
37. Joel, M. (2012). Bacteriological Spectrum of Post-Operative Wound Infections and their Antibiogram in a Tertiary Hospital, Dares Selaam, *Tanzania*.
38. Mohammad, S.R., Anil, C. and Abirodh, R. (2013). Antimicrobial Susceptibility patterns of the Bacterial Isolates in post-operative wound infections in a Tertiary Care hospital, Kathmandu, Nepal. *J Med Micro*, 3:159-163.
39. Shewatatek, G., Gizachew, T., Molalegne, B. and Terefe, G. (2014). Drug sensitivity of Pseudomonas aeruginosa from wound infections in Jimma University Specialized Hospital, *Ethiopia*, 3(2):13-18.
40. Vikas, J., Ramnani, V.K. and Navinchandra, K. (2015). Antimicrobial susceptibility pattern among Aerobic bacteriological isolates in infected wounds of patients at tertiary care Hospital in Central India. *Int J Microbiol App Sci*, 4(5):711-719.
41. Kemebradikumo, P., Beleudanyo, G.F. and Oluwatoyosi, O. (2013). Current Microbial Isolates from Wound Swabs, Their Culture and Sensitivity Pattern at the Niger Delta University Teaching Hospital, Okolobiri, Nigeria. 41(2):49-53.
42. Safia, B., Ghulam, A., Channa, T., Ruba, S. and Waquaruddin, Ahmed. (2011). Frequency and risk factors of surgical site infections in general surgery ward of a tertiary care hospital of Karachi, Pakistan. *Int J Infect Control, v7: i3.*
43. Gilmara, C.A., Marquiony, M.S., Nara, G.M., Thiago, A.C., Maria, C.M. and Kenio, C. L. (2014). Prevalence and factors associated with wound colonization by Staphylococcus spp. and Staphylococcus aureus in hospitalized patients in inland northeastern Brazil. *BMC Infectious Diseases.*

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