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Bacteriological Profile of Wound Sepsis and Antimicrobial Pattern of Isolates at Federal Medical Centre, Bida, Niger State, Nigeria

O. A. Akobi[1*], H. E. Inyinbor[1], E. C. Emumwen[1], E. C. Akobi[2] and E. F. Emumwen[3]

[1]Department of Medical Microbiology, Federal Medical Centre, Bida, Niger State, Nigeria.
[2]Department of Nursing Services, Federal Medical Centre, Bida, Niger State, Nigeria.
[3]Health Centre Clinic, Federal Polytechnic Bida, Niger State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author OAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HEI and ECE managed the analyses of the study. Authors ECA and EFE managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The study was aimed to identify etiology of bacteria associated with wound infections and antimicrobial susceptibility profile of the isolated organisms in the community.

Study Design and Methodology: It is a retrospective study; data was obtained from Medical Microbiology department register from May 2005 through October 2007 and was exempted from ethical approval. Swab samples were collected from 408 patients between age groups 0 through 75 years from out patients and inpatients admitted in the wards for various injuries such as burns, post surgical wound, fracture and ulcer wound. Samples were cultured within 1hour on macConkey agar, blood agar and chocolate agar, and incubated at 37°C for 18-24hours overnight. Data was coded and computed using SPSS 16.0 and p-value 0.05 was considered statistical significant.

Results: Out of 408 swab samples, 338 (82.8%) yielded positive culture, overall highest isolates

**Corresponding author: E-mail: oliverant2006@yahoo.com;*

was found within age groups 31-40 years with 69(94.5%) growth followed by 21-30 years 61(85.9%) and the least growth was found in 51-60years 27(77.1%) and 0-10years 88(77.2%), and statistically not significant (p-value 0.814, mean age =11.34, median =12.00, mode =12 and S.D±4.361). The highest single isolates was *Staphylococcus aureus* 122(42.5%) followed by *Escherichia coli* 108(37.6%), *Pseudomonas aeruginosa* 28(9.8%), *Proteus* species 15(5.2%) and lowest isolates were *Candida albicans* 3(1.0%), *Clostridium* species 2(0.7%), Coagulase negative *Staphylococcus* 2(0.7%) and *Streptococcus* species 2(0.7%).

Escherichia coli and *Staphylococcus aureus* had the most prevalent polymicrobial isolates with 28(54.9%) followed by *Escherichia coli* and *Proteus* species 8(15.7%).

Staphylococcus aureus the highest prevalent single isolates was susceptible to Ceftriazone 75(61.5%), Ciprofloxacin 71(58.2%), Ofloxacin 68(55.7%) and Clindamycin 83(68.0%).

Conclusion: The incidence rate of wound sepsis in the studied population is 338(82.88%) with incriminating single isolate of *Staphylococcus aureus* 122(42.5%). This is a serious burden to our patients which call for serious attention among stake holders.

Recommendation: Stake holders need to educate patients visiting hospital community on the danger of wound sepsis, and first aid treatment before visiting tertiary health care to reduce morbidity and mortality incidence rate.

Keywords: Sepsis; infection; susceptibility; antimicrobial.

1. INTRODUCTION

Chronic wound infection occurs in individual with an increased risk of bacteria invasion as a result of poor local factors such as arterial insufficiency, veinous hypertension, trauma and systemic disease like diabetic mellitus and rheumatoid arthritis [1].

Wound infection is important in the morbidity and mortality of patients irrespective of its cause; its delay healing and is associated with prolonged hospital stay thereby increasing cost of healthcare services [2]. It may occur as a result of exposure of subcutaneous tissue following a loss of skin integrity; wound provides a warm, moist, and nutritious environment that is favorable for microbial colonization and proliferation.

Wound colonization is most frequently poly-microbial, involving numerous microorganisms that are potentially pathogenic; wounds are at risk of becoming infected [3]. In western world, studies on wound infections are focused on surgical sites infections because other types of wound infections are not problematic [4] while in developing countries such as Africa continent, other types of wound infections are major causes of morbidity and mortality among the patients [5,6]. The incidence rate of different bacterial infected wounds varies, it exists inter-institutionally and intra institutionally [7]. Bacterial infections in burn and wound patients are similar and are difficult to control [8]. Wound infection constitutes major barrier to healing and have an adverse effect on the patient's quality of life as well as on the healing rate of the wound.

Infected wounds are likely to be more painful, hypersensitive and odorous, resulting in increased discomfort and inconvenience for the patient [9]. The prevalent organisms associated with wound infection include *Staphylococcus aureus* which account for 20-40% and *Pseudomonas aeruginosa* 5-15% of the nosocomial infection, with infection mainly following surgery and burns. Other pathogens such as Enterococci and members of the Enterobactericae have been implicated, among immuno-compromised patients and following abdominal surgery [10]. Also, Godebo et al. [11] and Mulu et al. [12] stated that *Staphylococcus aureus*, *Kelbsiella* species, *Escherichia coli*, *Proteus* species, *Streptococcus* species, Enterobacter species, *Pseudomonas* species and Coagulase negative *Staphylococci* were common pathogens in wound infection.

In addition, Arturson [13] said infection causes 50% to 60% of deaths in burn patients in spite of intensive therapy with antibiotics both topically as well as intravenous, and wound can be infected by a variety of microorganisms ranging from bacteria to fungi and parasites [14]. Post-surgical wound infections are hospital acquired and vary from one geographical area to the other [15]. The emergence of high anti-microbial resistance among bacterial pathogens made the treatment of post-operative wound infections challenging [16]. The situation is serious in developing countries due to irrational prescriptions of antimicrobial agents [17].

The emergence of drug resistant pathogens like Methicillin Resistant *Staphylococcus aureus* (MRSA) and Extended Spectrum Beta Lactamase (ESBL) leading to treatment failure [18]. The study was aimed to identify etiology of bacteria associated with wound sepsis and antimicrobial susceptibility profile of the isolated organisms in the community.

2. MATERIALS AND METHODS

2.1 Study Population

The research was a retrospective study; data were collated from May, 2005 through October 2007 from Medical Microbiology department register and exempted from ethical approval. Swab samples of four hundred and eight (408); female 191 and male 217 swab specimen were collected aseptically from different categories of patients both out-patient and in-patients from various wound site such as burns, ulcer, post operative wound and fracture wound, submitted to Medical Microbiology department for routine analysis. Subjects were between age groups 0 through 75 years old.

2.2 Analysis, Characterization and Identification of Bacteria from Swab Samples

Swab samples were submitted for routine, gram stain, culture and sensitivity. Samples were cultured within 1 hour of submission on Mac Conkey agar, Blood agar and Chocolate agar according to Chessbrough [19]. Samples were further gram stained directly to classify staining reaction [19]. The bacterial isolates were characterized based on colonial morphology, growth on selective media and enriched media, and biochemical tests which include Gram's reaction, indole tests, methyl red, voges-proskauer, citrate utilization, motility, endospore, utilization of carbohydrates such as glucose, sucrose, mannitol, lactose and fructose, oxidase, catalase, coagulase and starch hydrolysis test [20]. Antimicrobial susceptibility test by disc diffusion methods according to clinical laboratory standard guidelines [21]. The antimicrobial disc used include Clindamycin (5 mcg), Streptomycin (10 mcg), Gentamycin (10 mcg), Ceftriazone (30 mcg), Erythromycin (5 mcg), Ofloxacin (5 mcg), Augmentin (30 mcg), Ciprofloxacin (5 mcg), Ampicillin (10 mcg), Tetracycline (5 mcg), Cotrimoxazole (10 mcg), Azythromycin (30 mcg) and Pefloxacin (5 mcg). Susceptibility to antibiotics was measured by the method of Baker and Breach [22]. When the antibiotic agent was 16 mm or higher, it was recorded susceptible, and resistance when less than 16 mm. The susceptibility plates were incubated aerobically for 18-24 hrs and zones of inhibition were recorded. Data was coded, computed and analyzed using SPSS version 16.0 and p values ≤0.05 was considered to be statistically significant.

3. RESULTS

Table 1, showed four hundred and eight (408) patients enrolled; a total of three hundred and thirty eight 338(82.8%) yielded significant growth of isolates, and 70(17.2%) had sterile culture. Out of 338 (82.8%) positive culture, overall highest positive culture was found within age groups 31- 40 years with 69(94.5%) growth followed by 21-30 years 61(85.9%) and the least growth was found in 0-10years 88(77.2%) and 51- 60 years 27(77.1%).

Table 2, showed the frequency of isolates in relation to age. Our research showed two categories of isolates, single pure isolates 287(84.9%) table 2A, and mixed growth isolates 51(15.1%) Table 2B.

Table 2A: The highest single isolates was *Staphylococcus aureus* 122(42.5%) followed by *Escherichia coli* 108(37.6%), *Pseudomonas aeruginosa* 28(9.8%), *Proteus* species 15(5.2%) and lowest isolates were *Candida albicans* 3(1.0%), *Clostridium* species 2(0.7%), Coagulase negative *Staphylococcus* 2(0.7%) and *Streptococcus* species 2(0.7%). Also, a higher occurrence of single isolates was found within age groups 0-10 years with 77(26.8%) followed by 31-40 years 42(19.9%) and lowest isolates was in 61-70 years 7(2.4%).

Table 2B was a polymicrobial isolates; overall highest isolates was in age groups 0-10 years with 13(25.5%) followed by 31-40 years 11(21.6%) and least isolates was 61-70 years 2(3.9%). *Escherichia coli* and *Staphylococcus aureus* 28(54.9%) had highest mixed isolates followed by *Escherichia coli* and *Proteus* species 8(15.7%) and least isolates *Escherichia coli* and *Corynebacterium diptheriae* 1(2%), and *Proteus* species and *Klebsiella* species 1(2%).

Table 3A showed antimicrobial susceptibility pattern of the isolates; *Staphylococcus aureus* the highest prevalent isolate was susceptible to Ceftriazone 75(61.5%), Ciprofloxacin 71(58.2%), Ofloxacin 68(55.7%) and Clindamycin 83(68.0%), and least susceptible was Augmentin 5(4.1%) and Ampicillin 1(0.8%).

Second isolate *Escherichia coli* was susceptible to Ceftriazone 64(59.3%), Ciprofloxacin 59(54.6%) and Ofloxacin 55(50.9%) and least susceptible to Ampicillin 1(0.9%) and Augmentin 4(3.7%). *Pseudomonas aeruginosa* was susceptible to Ciprofloxacin 17(60.7%), Ofloxacin15 (53.6%) and Ceftriazone 15(53.6%) and least susceptible to Cotrimoxazole 1(3.6%) and Azithromycin 3(10.7%)

Table 3B depict the antimicrobial activities of mixed isolates; the most prevalent was *Escherichia coli* and *Staphylococcus aureus* with susceptibility to Ciprofloxacin 16(57.1%), Ofloxacin 11(39.3%) and lowest susceptible to Augmentin 1(3.6%) and Tetracycline 1(3.6%).

Table 1. Frequency of subjects in relation to age showing positive and negative culture

Age	Number of subjects	Positive subject	Negative subject
0-10	114	88(77.2%)	26(22.8%)
11-20	44	35(79.4%)	9(20.5%)
21-30	71	61(85.9%)	10(14.1%)
31-40	73	69(94.5%)	4(5.5%)
41-50	60	50(83.3%)	10(16.7%)
51-60	35	27(77.1%)	8(22.9%)
61-70	10	8(80%)	2(20%)
71-80	1	0	1(100%)
Total	408(100%)	338(82.8%)	70(17.2%)

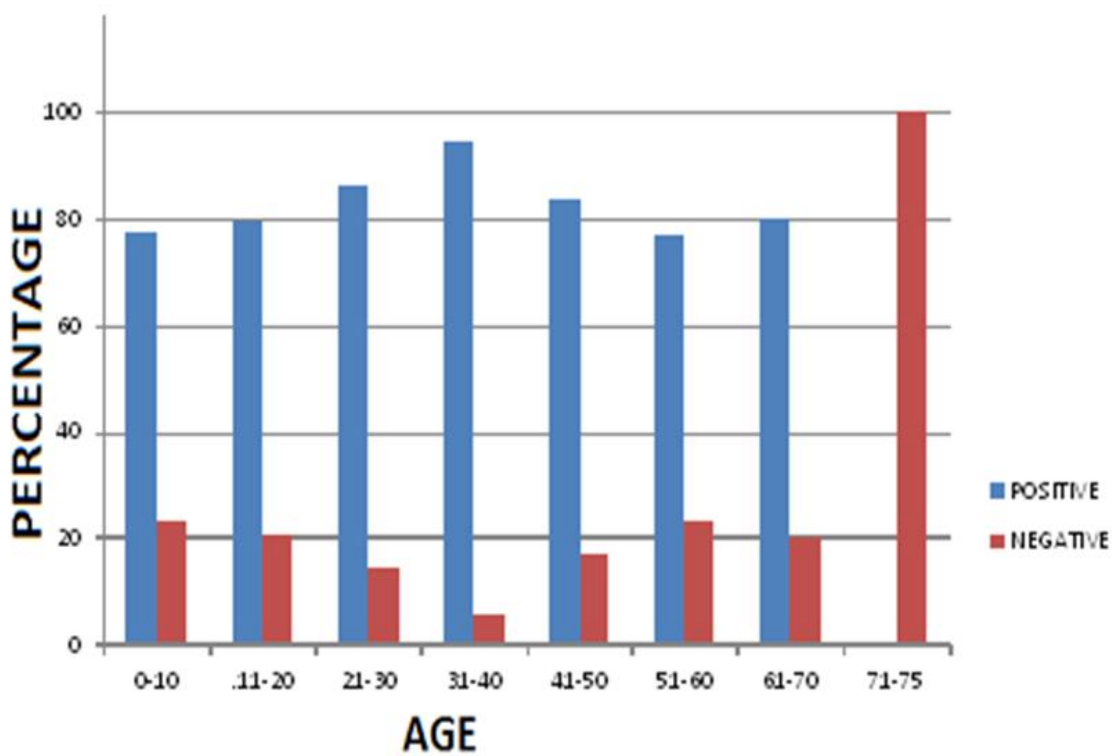

Fig. 1. Chart showing frequency of subjects in relation to age of positive and negative culture

Table 2A. Incidence rate of single isolates in relation to age distribution of subjects with wound infections

Isolates	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Total
S. aureus	36(29.5%)	18(14.8%)	20(16.4%)	19(15.6%)	15(12.3%)	12(9.8%)	2(1.6%)	0(-)	122(42.5%)
E. coli	18(16.7%)	11(10.2%)	24(22.2%)	25(23.1%)	18(16.7%)	7(6.5%)	5(4.6%)	0(-)	108(37.6%)
Klebsiella species	1(16.7%)	0(-)	1(16.7%)	3(50%)	1(15.7%)	0(-)	0(-)	0(-)	6(2.1%)
Proteus species	3(20%)	0(-)	4(26.7%)	5(33.3%)	3(20%)	0(-)	0(-)	0(-)	15(5.2%)
Pseudomonas aeruginosa	14(50%)	1(3.6%)	1(3.6%)	4(14.3%)	4(14.3%)	4(14.3%)	0(-)	0(_)	28(9.8%)
Streptococcus species	0(-)	0(-)	0(-)	1(50%)	1(50%)	0(-)	0(-)	0(-)	2(0.7%)
Coag.Neg. *Staphylococcus*	1(50%)	0(-)	1(50%)	0(-)	0(-)	0(-)	0(-)	0(-)	2(0.7%)
Clostridium species	1(100%)	0(-)	0(-)	0(-)	0(-)	0(-)	0(-)	0(-)	2(0.7%)
Candida albicans	3(100%)	0(-)	0(-)	0(-)	0(-)	0(-)	0(-)	0(-)	3(1.0%)
Total	77(26.8%)	30(10.5%)	51(17.8%)	57(19.9%)	42(14.6%)	23(8.0%)	7(2.4%)	0(-)	287(100%)

Table 2B. Incidence rate of mixed isolates in relation to age distribution of patients with wound infections

Isolates	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-75	Total
S. aureus & *E. coli*	5(17.9%)	3(10.7%)	9(32.1%)	5(17.9%)	3(10.7%)	2(7.1%)	1(3.6%)	0(-)	28(54.9%)
E. coli & *Proteus* species	3(37.5%)	1(12.5%)	0(-)	3(37.5%)	1(12.5%)	0(-)	0(-)	0(-)	8(15.7%)
P. aeruginosa &*S. aureus*	2(50%)	0(-)	0(-)	1(25%)	1(25%)	0(-)	0(-)	0(-)	4(7.8%)
P. aeruginosa &*E. coli*	1(33.3%)	0(-)	0(-)	1(33.3%)	0(-)	0(-)	1(33.3%)	0(-)	3(5.9%)
Proteus spp. & *Klebsiella* spp.	1(100%)	0(-)	0(-)	0(-)	0(-)	0(-)	0(-)	0(-)	1(2.0%)
E. coli & *Coryne*. *Diphtheria*	0(-)	0(-)	1(100%)	0(-)	0(-)	0(-)	0(-)	0(-)	1(2.0%)
Proteus spp. & *S. aureus*	1(16.7%)	1(16.7%)	0(-)	1(16.7%)	2(33.3%)	1(16.7%)	0(-)	0(-)	6(11.8%)
Total	13(25.5%)	5(9.8%)	10(19.6%)	11(21.6%)	7(13.7%)	3(5.9%)	2(3.9%)	0(-)	51(100%)

Table 3A. Percentage antimicrobial profile of isolated organisms from wound infections

Antibiotics	*P. aeruginosa* N=28	*S. aureus* N=122	*E. coli* N=108	*Kleb.* species N=6	*Proteus* species N=15	*Strept.* species N=2	Cog.Neg. *Staph* N=2	*Clostridium* species N=1
Ampicillin	NA	1(0.8%)	1(0.9%)	0(-)	0(-)	0(-)	0(-)	0(-)
Erythromycin	NA	48(39.3%)	NA	NA	NA	1(50%)	1(50%)	0(-)
Tetracycline	NA	45(36.9%)	18(16.7%)	2(33.3%)	0(-)	1(50%)	0(-)	0(-)
Augmentin	0(-)	5(4.1%)	4(3.7%)	2(33.3%)	0(-)	0(-)	0(-)	0(-)
Azythromycin	3(10.7%)	64(52.5%)	45(41.7%)	4(66.7%)	3(20%)	2(100%)	2(100%)	0(-)
Streptomycin	3(10.7%)	33(27.0%)	30(27.8%)	0(-)	6(40%)	2(100%)	0(-)	0(-)
Gentamycin	12(42.9%)	72(59.0%)	40(37.0%)	2(33.3%)	8(53.3%)	2(100%)	1(50%)	0(-)
Ciprofloxacin	17(60.7%)	71(58.2%)	59(54.6%)	3(50%)	9(60%)	2(100%)	1(50%)	0(-)
Ofloxacin	15(53.6%)	68(55.7%)	55(50.9%)	4(66.7%)	8(53.3%)	1(50%)	1(50%)	0(-)
Ceftriazone	15(53.6%)	75(61.5%)	64(59.3%)	4(66.7%)	10(66.7%)	2(100%)	1(50%)	0(-)
Cotrimoxazole	1(3.6%)	37(30.3%)	13(12.0%)	0(-)	3(20%)	1(50%)	0(-)	0(-)
Clindamycin	NA	83(68.0%)	NA	NA	NA	1(50%)	1(50%)	1(100%)
Pefloxacin	15(53.6%)	62(50.8%)	42(38.9%)	3(50%)	7(46.7%)	1(50%)	2(100%)	0(-)

NA= Not Applicable

Table 3B. Percentage antimicrobial susceptibility profile of mixed isolates from wound infections

Isolates	Amp.	Tet.	Aug.	Azm.	Strep.	Gen.	Cip.	Oflo.	Cro	Cot.	Pef.
E. coli & *S. aureus*	-	1(3.6%)	1(3.6%)	9(32.1%)	4(14.3%)	10(35.7%)	16(57.1%)	11(39.3%)	10(35.7%)	4(14.3%)	7(25%)
E. coli & *Proteus* spp.	-	-	1(12.5%)	1(12.5%)	2(25%)	4(50%)	4(50%)	6(75%)	4(50%)	1(12.5%)	3(37.5%)
P. aeruginosa & *S. aureus*	-	-	-	1(25%)	2(50%)	1(25%)	3(75%)	3(75%)	2(50%)	-	4(100%)
S. aureus & *Proteus* spp.	-	1(16.7%)	-	2(33.3%)	1(16.7%)	2(33.3%)	5(83.3%)	5(83.3%)	5(83.3%)	1(16.7%)	3(50%)
P. aeruginosa & *E. coli*	-	-	-	-	-	3(100%)	2(66.7%)	1(33.3%)	2(66.7%)	1(33.3%)	1(33.3%)
Kleb. Spp. & *Proteus* spp.	-	-	-	-	-	1(100%)	1(100%)	1(100%)	1(100%)	1(100%)	1(100%)
E. coli & *Coryn. diptheriae*	-	1(100%)	-	-	-	-	1(100%)	1(100%)	-	-	1(100%)

AMP- Ampicillin; Strep – Streptomycin;Cro- Ceftriazone; Tet – Tetracycline; Gen- Gentamycin; Cot- Cotrimoxazole; Aug – Augmentin; Cip- Ciprofloxacin; Pef- Pefloxacin; Azm-Azythromycin; Oflo- Ofloxacin

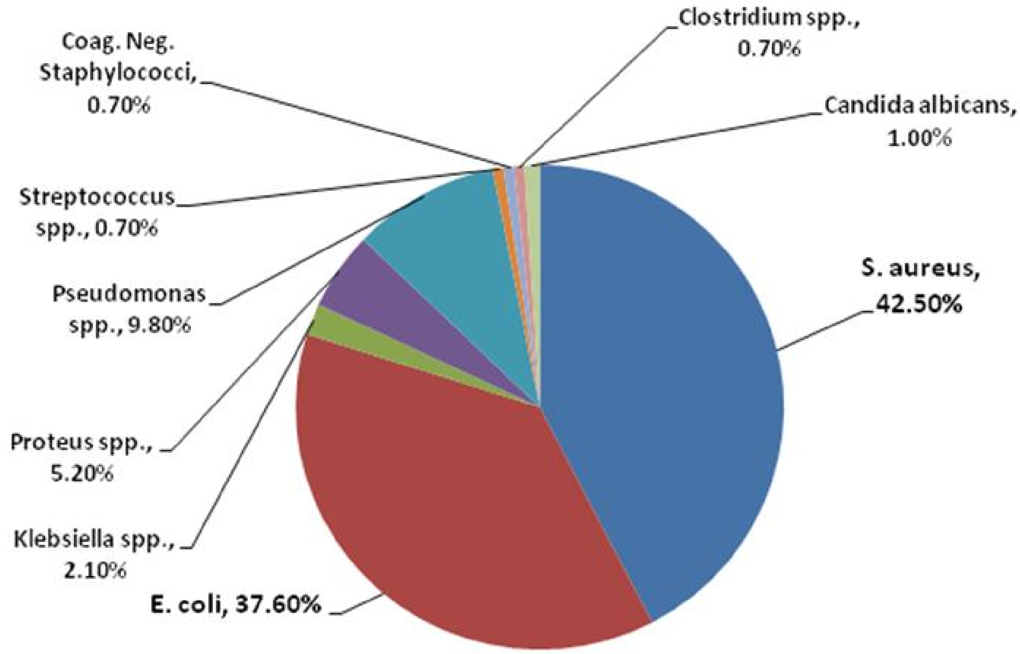

Fig. 2A. Depicts percentage frequencey of isolated organisms

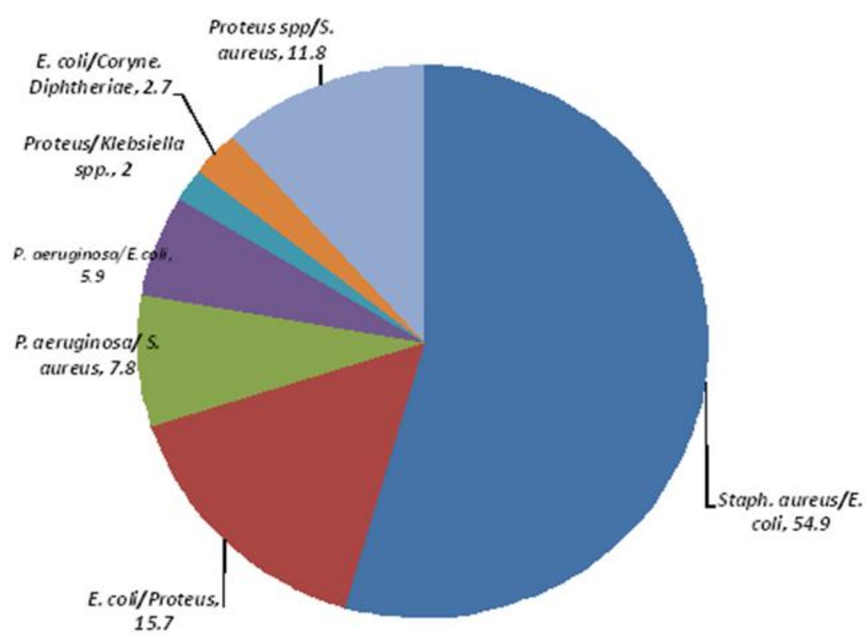

Fig. 2B. Chart showing polymicrobial isolate

4. DISCUSSION

Wound sepsis provides a moist, warm, nutritive environment conducive for microbial colonization, proliferation, and infection [23]. Sepsis is a major cause of morbidity and mortality among burn patients and sometimes results to opportunistic infection [24]. Out of 408 studied population, our research showed prevalence of (82.8%) wound infection among the patients, and (17.2%) had sterile culture, and statistically not significant (p-value =0.814, mean age =11.34, median =12.00, mode =12 and S.D±4.361). Our report is higher than Sewunet et al. [25] who reported (42%) sepsis among burn infected wound patients in Ethiopia. Also, Kyati et al. [26] reported (67.14%) and (32.85%) isolates in gram positive and gram negative isolates among post-surgical wound infection in Index Medical College hospital, India. But our report is similar to Aynalem et al. [27] who reported incidence of (83.9%) isolates among in-patients and out-patients attending university of Gondar referral hospital, NorthWest, Ethiopia. However, our report is lower than Lakshmi et al. [28] who reported (93%) burn infected wound in King Gorge hospital, India. According to survey report by Nosocomial Infection National Surveillance Service (NINSS), 2002, which covered the period of October 1997 through September 2001, indicated that the incidence of hospital acquired infection (HAI) related to surgical wounds is 10%. These infections complicate illness, and causes anxiety, increases patient discomfort and sometimes lead to death of our patients [29].

Highest overall isolates were found within age groups 31-40 years with (94.5%) isolates followed by 21-30 years (85.9%). Contrarily, Mama et al. [30] reported highest isolates of (89.5%) among age groups 45-59 years in Jimma university specialized hospital, South-West, Ethiopia.

Our research showed two categories of isolates in relation to age groups. Single isolates showed (84.9%) Table 2A and mixed isolates (15.1%) Table 2B. The highest single isolate was *Staphylococcus aureus* (42.5%) followed by *Escherichia coli* (37.6%). Our report is similar to Kyati et al. [26] who reported (58.6%), Damien et al. [31] reported (45.2%) in North Central, Nigeria and Aynalem et al. [27] reported (34%) of *Staphylococcus aureus* has the most prevalent organism. However, Sewunet et al. [25] reported Coagulase negative *Staphylococci* (42.8%) while Lakshmi et al. [28], Alharbi and Zayed [32] both reported *Pseudomonas* species (33.6%) and (36.14%) as the highest single isolates. Also, *Escherichia coli* and *Staphylococcus aureus* had highest mixed isolates of (54.9%) followed by *Escherichia coli* and *Proteus* species (15.7%). Mengesha et al. [33] reported multiple bacterial infections in post surgical wound infection (23.95%) with *Staphylococcus aureus* and *Proteus* species as most occurring isolate. The high prevalence rate of enterobacterial isolates in our study could reveal faecal contamination due to poor personal hygiene [34] or due to post procedural contamination [35].

We observed that the organisms isolated from all the wound infected patients both in-patients and out-patients were normal flora of the gastrointestinal tracts. According to Davis et al. [36] and Wormald [37] research, both observed that most important reservoirs for micro-organisms that colonized the burn wounds of newly admitted patients are from the gastrointestinal (GI) tracts of the patients. In addition, microorganisms can be transmitted from the hands of health care workers, by fomites and hydrotherapy water [38,39] and through the air [38].

Also, age groups 0-10years had the most prevalent single isolates (26.8%) while age groups 61-70 years had (2.4%) least isolates. Furthermore, the highest polymicrobial isolates was within 0-10 years (25.5%), followed by 31-40 years (21.6%). Gould [40] stated that within a community, health care acquired infections (HCAIs), can arise across a wide range of clinical conditions and affect patients of all ages. However, certain groups of patients are at an increased risk of infections including: elderly, very young, people with cancer, and other malignant diseases, people with impaired immunity, invasive devices, very ill and surgical patients.

The predominant single isolate *Staphylococcus aureus* was susceptible to Ceftriazone (61.5%), Ciprofloxacin (58.2%), Ofloxacin (55.7%), Clindamycin (68%) and least susceptible to Ampicilin (0.8%). Our report contradict Aynalem et al. [27] who reported susceptibility pattern of *staphylococcus aureus* to Ceftriazone (79.5%), Ciprofloxacin (79.4%) and Penicilin (15.4%), Lakshmi et al. [28] reported Ofloxacin (73.9%), Mama et al. [30] reported susceptibility to Ceftriazone (85.17%) and Ciprofloxacin (96%). However, our report is higher than Mengesha et al. [33] who reported susceptibility of *Staphylococcus aureus* to Ceftriazone (10%) and Nazneen et al. [41] reported Fluoroquinolones (38.47%) in post operative wound infection.

The highest polymicrobial isolates; *Staphylococcus aureus* and *Escherichia coli* were both susceptible to Ciprofloxacin (57.1%), Ofloxacin (39.3%), Ceftriazone (37.5%) and Gentamycin (35.7%), and least susceptible to Cotrimoxazole (14.3%) and Augmentin (3.6%).

Our research showed polymicrobial multi-drug resistance isolates. According to W.H.O [42], which stated that emergence of resistance in microorganisms is due to indiscriminate use of antibiotics in general, and use of broad spectrum antibiotics. In addition, the spread of multidrug resistance organisms (MDROs) in health-care settings occurs mostly via health-care workers'(HCWs) contaminated hands, contaminated items, equipments and environment, often leading to outbreaks and serious infections especially in critically ill patients. Hand hygiene performance is the most important measure among standard precautions.

Enteric organisms are the predominant isolates in our research, and are ubiquitous organisms found in soil, water and vegetation, and are part of the normal intestinal flora of animals, and including humans. We suggest that hand hygiene advocate should not be limited to health care providers; it should be extended to our patients and their relations. This will help in the control of both community and hospital acquired infections. Lee et al. [43] stated in his research that good quality surveillance data on antimicrobial resistance (AMR), and the feasibility and impact of interventions based on hand hygiene promotion compliance are needed in low and middle income countries such as African continent. In addition, AMR is a cross cutting problem affecting global health care settings and our communities. The role of patients and the civil society in combating AMR is crucial at different levels and hand hygiene is one of the measures that can be practiced and advocated to control the menace. Chen et al. [44] advocated increase in hand hygiene in a hospital setting in Taiwan from 43.3% to 95.6%, there was 8.9% decrease in hospital acquired infections (HAIs) and a decline in blood stream infection caused by Methicillin Resistance *Staphylococcus aureus* (MRSA) and extensive drug resistance *Acinetobacter baumanii.* Al-Tawfiq et al. [45] in Saudi Arabia hospital, demonstrated increase in hand hygiene compliance from 38% in 2006 to 83% in 2011, there was significant reduction of MRSA infection from 0.42% to 0.08% and catheter associated urinary tract infection was reduced from 7.1% to 3.5%.

Also, Carboneau et al. [46] in U.S.A, advocated increase in hand hygiene from 65% to 82%, there was 51% decrease in hospital acquire MRSA cases during the 12 months period. According to Chen et al. [44] who stated that every US $1 spent on hand hygiene promotion could result in a US $23.7 benefit.

In addition, there should be in-service training for health care providers such as post graduate training, workshop and conferences, this will expose stake holders to modern facilities and equipments, research methodology and improve method of practice to foster good health care service delivery. This will invariably reduce medical tourism in African continent.

5. CONCLUSION

Overall prevalence rate of (82.8%) wound infection, and monomicrobial isolates of *Staphylococcus aureus* (42.5%), and polymicrobial isolates (15.1%) in the studied population is alarming. Policy makers need to advocate importance of hand hygiene in our communities and good sanitary disposal. This can be achieved through media in various indigenous languages, hand bills and periodic education of our patients on admission. Also, there is need to strengthen infection control units in our hospitals and government need to encourage research in health industry at all level.

6. LIMITATION

The outcome of our research is limited to sample size, there is need to carry out surveillance data of antimicrobial drug resistance, root cause and infection control in our community. This will enable policy makers to budget appropriately in terms of staff training, employments and research.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

DISCLAIMER

This manuscript title was presented in the conference.

Conference name: - 3rd International Conference on Wound Care, Tissue Repair & Regenerative Medicine.

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September 11-12, 2017 Dallas, Texas, USA (Yes; I presented part of the manuscript in the conference as a speaker).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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