Antimicrobial Susceptibility Pattern and Bacterial Isolates Profile in Septicaemia Suspected Patients Attending FMC. Yenagoa

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Abstract

Background: **Infection of the blood stream by bacteria represents a considerable public health problem and it is an important cause of morbidity and mortality in hospitalised patients. The aim of this study was to appraise the prevalence of bacterial isolates from septicaemia suspected patients and their antimicrobial susceptibility pattern amongst patients attending the Federal Medical Centre {FMC), Yenagoa.**

Methods: **Three hundred and thirty-five (335) blood samples were collected, cultured and processed following standard microbiological techniques as part of the routine clinical management of the patient with suspected septicaemia in the Medical Microbiology Laboratory of the Hospital. Antibiotic susceptibility testing was done on pure culture isolates employing disc-diffusion method for the commonly used antibiotics. The obtained data were analysed by using SPSS version 20 and the results were presented in tabular and graphical forms.**

Results: **Out of 335 blood cultured, 138(41.19%) were culture positive. 122(88.41%) were aerobic bacterial while 16(11.59%) were anaerobes. Of the aerobes, the gram negative and gram-positive bacteria constituted 67(54.90%) and 55(45.10%) of the culture isolates; respectively. The predominant aerobic bacteria isolated from the cultured blood were Coagulase negative staphylococci27(22.00%), followed by *S. aureus* 17(14.20%) and *Klebsiellapneumoniae*16 (13.05%), *Serretia marcescens* 15(12.35%) Acinetobacter spp 13(10.75%), *E.coli*and Enterococcus spp., 9 (7.19%) each, *Pseudomonas aeruginosa* and *Salmonella typhi* 7 (5.76%) each, and *Bacillus subtilis* 2(1.57%). Among the anaerobes, the most frequently isolated were *Bacteroides fragilis* 8(50.00%), *Clostridiumperfringens*4(25.00%), *Peptostreptococcus* spp. 2(12.50%), and *Fusobacterium* spp. 2(12.50%). All the isolates showed high rates of resistance to most antibiotics tested.**

Conclusions: **In the current study most of the pathogens isolated from blood culture presented high rate of resistance to most commonly antibiotics used to treat bacterial infections thus limiting therapeutic options. Therefore, routine bacteriological profile examination along with their antibiotic resistance patterns must be an essential component in the management of sepsis. A knowledge of these patterns is essential when local polices on the use of antibiotics are being formulated.**

Key words: **blood stream infections, bacterial profile, antimicrobial resistance pattern, anaerobes, Federal Medical Centre, Yenagoa**

I. INTRODUCTION

Bacteraemia is the presence of continuous or transient bacteria within the blood stream, while the dissemination of bacteria throughout the body with indication of systemic responses towards microorganism with variable severity is termed septicaemia[1, 2]. Septicaemia is a common cause of paediatric morbidity and mortality all over the world [3, 4].The high mortality rate varies between 20 and 70 percent[1]and it depends on several factors which includes: the virulence of the pathogen and host factor[5, 6].For the diagnosis of the aetiological pathogens of bacteraemia and septicaemia, the bacteriological culture method of isolation still remains the golden standard method [3, 7, 8].Organisms isolated from the bloodstream of patients with sepsis vary from area to area [9, 10, 11]. Globally, though depending on the onset of the sepsis, majority of the bacteraemia and septicaemia cases are caused by numerous pathogens involving coagulase negative staphylococci (CoNS), *Staphylococcus aureus*, *Streptococcus* spp., *Enterobacter* spp., *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella* spp., *Acinetobacter* spp., *Citrobacter* spp., and *Pseudomonas* spp. [2, 12, 13].

Once the pathogens thrived in the bloodstream, they poise potential threat to every organs of the body leading to life-threatening medical conditions, as such, information regarding urgent diagnosis, antimicrobial sensitivity pattern and treatment of such sepsis is instantaneously required [14],thus necessitating the conduct of this study.

The coherent use of antibiotics for varying microbiological pattern of septicaemia warrants the need for understanding the causative organisms and their antimicrobial susceptibility pattern [15, 16]. However, the unrestrained use of various potent and broad-spectrum antibiotics has led to emergence of resistant strains which has become a major problem in various

healthcare facilities. Therefore, understanding of common pathogens and their drug sensitivity pattern in a specific region demands the correct use of antibiotics. Due to constantly developing antimicrobial resistant patterns, there is need for continuous antimicrobial sensitivity surveillance. As this will assist physicians provide safe and effective empirical therapies, develop rational prescription programs and make policy decisions, and finally assess the effectiveness of all[3].

In the clinical management of sepsis, empirical antibiotic therapy should be unit-specific and determined by the prevalent spectrum of aetiological agents and their antibiotic sensitivity pattern[17, 18].The early signs and symptoms of septicaemia can vary from site to site[19].It is therefore important to carry out investigations to confirm sepsis for timely detection and identification of blood stream pathogens. Empirical antibiotic use is needed to eradicate the microbe that causes sepsis. However, many bacterial pathogens have become resistant to antibiotic regimens posing a serious public health concern with economic and social implications throughout the world. The number of immunocompromised people and bacterial drug resistance is on the increase in developing countries[20]. Unregulated over- the- counter sale of these antimicrobials, mainly for self-treatment of suspected infection, and to a lesser extent use of sub-therapeutic doses of antibiotics in animals are possible factors for the dissemination of drug resistant pathogens in the environment[21].

Therefore, this study was embark on to investigate bacterial profile of paediatric sepsis and their antimicrobial susceptibility pattern at Federal Medical Centre, Yenagoa, Nigeria.

II. MATERIALS AND METHODS

Study design and data collection

The study is a hospital based cross-sectional study that was performed at pediatric units of Federal Medical Centre in Yenagoa, Nigeria from June to November 2019. Sample size was determined based on past prevalence study among children suspected of septicaemia[1]. 335 children (≤ 12 years) who were admitted to either of the paediatric ward or examined at paediatric emergency OPD for sepsis were included in this study. A predefined data collection tool was used to extract all socio-demographic data and other relevant information which includes:clinical signs and symptoms of sepsis for each patient, weight, therapeutic management (e.g. application of indwelling medical device), hospitalization period, co-morbidities, and clinical outcome. Appropriate treatment was initiated after collection of blood and admitted children were followed until discharge or demise (which was considered as attributable to Bloodstream infections if it occurred during the phase of active infection or antibiotic treatment).

Blood culture and Identification of isolates

Aseptically, approximately 2–5 ml of blood was obtained after cleaning the venous site with 70% alcohol and subsequently by 10% povidone iodine solution. About 1–3 ml of venous blood were immediately inoculated into blood culture bottles containing Tryptone Soy Broth (TSB) (Oxoid, Hampshire, UK) and the remaining 1–2 ml blood was used for complete blood count.

Blood culture bottles were incubated at 37°C and inspected daily for presence of visible microbial growth for 7 days by observing visually for any of the following including visualization of discrete colonies, turbidity, haemolysis, gas production and/or coagulation of broth. Microbial growth were sub-cultured on 5% blood agar, chocolate agar and MacConkey agar plates and were incubated at 37°C for 18–24 h for bacterial isolation. The blood and MacConkey agar plates were incubated aerobically while chocolate agar was incubated in microaerophilic atmosphere (5–10% CO2) in an anaerobic jar [22, 23]. Identification of culture isolates were done according to standard bacteriological techniques and their characteristic appearance on their respective media, Gram smear technique, haemolytic activity on sheep blood and rapid bench tests such as catalase, coagulase and optochin tests for Gram positive bacteria were used and were verified to be *Staphylococcus aureus* on Staph identification 25E (BioMeriux, France).In respect to the of Gram-negative bacteria API20E (Biomerieux, France) was used and followed by serological identification for Salmonella species. The anaerobes were confirmed by using ID 32A (Biomerieux, France) identification test kit.

Antibacterial sensitivity

The Kirby-Bauer disc-diffusion method was used to test the susceptibility of the isolates on Iso-sensitest (Oxoid, England) agar according to procedures of Clinical Laboratory Standard Institute [24]. Discs tested included; Amikacin (10µg), Amoxicillin-clavulanic acid (30µg), Ampicillin, (10µg), Cefoxitin (30µg), Ceftriaxone (30µg), Chloramphenicol (30µg), Ciprofloxacin (5µg), Clindamycin (2µg), Erythromycin (15µg), Gentamicin (10µg), Imipenem (10µg), Metronidazole (50µg), Nalidixic acid (30µg), Nitrofurantoin (300µg), Penicillin (10U), Sulphamethaxazole/trimethoprim (25µg), Tetracycline (30µg) and Vancomycin (30µg). The reference strains used as control for disc diffusion testing were *S. aureus* (ATCC-25923), *and E. coli* (ATCC-25922).

III. RESULTS

Three hundred and thirty-five of septicaemic suspected patient's blood culture were processed routinely. Of these patients, 195 (58.21%) were females and 140 (41.79%) males. The median age of patients was 2.20months with age range 1 day – 120months. Mostpatients (39.5%) were neonates (i.e. < 28days) as revealed in figure 1. Bacteria were isolated in 138 (41.19%) of the 335 patients studied. Figure 2 shows the types of bacterial isolates. The rate of isolation was highest among

newborns (80/158: 50.63%). Essentially, the rate of isolation reduced with increase in age. Majority of the aerobic bacteria isolated from the cultured blood were Coagulase negative staphylococci 27(22.00%), then followed by *Staphylococcus aureus* 17(14.20%), *Klebsiella pneumoniae* 16 (13.05%), *Serretia marcescens* 15(12.35%) *Acinetobacter* spp 13(10.75%), *E. coli* and Enterococcus spp., 9 (7.19%) each, *Pseudomonas aeruginosa* and *Salmonella typhi*were 7 (5.76%) each, *Bacillus subtilis* 2(1.57%). While among the anaerobes, the most prominent isolates were *Bacteroides fragilis* 8(50.00%), *Clostridiumperfringens*. 4(25.00%), while the least were *Peptostreptococcus* spp. and *Fusobacterium* spp. with recovery rate of 2(12.50%) each.

Figure 3 shows the antimicrobial resistance levels for the isolated bacteria associated with septicaemia ranges from 0 to 100%. As shown, all (100%) of the isolates were resistance to ampicillin, while majority were resistant to penicillin 127(92.03%), followed by sulphamethaxazole-trimethoprim 113(81.88%), tetracycline 106(76.81%), ceftriaxone 93(67.39%), chloramphenicol 72(52.17%), cefoxitin 67((48.55%), erythromycin 59(42.75) and amoxicillin-clavulanic acid 57(41.30%). All the isolates were however susceptible to amikacin and clindamycin, majority were sensitive to metronidazole 5(3.62%), this is closely followed by nitrofurantoin 14(10.14%), gentamicin and vancomycin 21(15.22%) each, while nalidixic acid and imipenem were moderately sensitive with susceptibility profile of 31(22.46%) and 38(27.54%) respectively.

IV. DISCUSSION

Despite the advancements in diagnosis and therapeutic management, septicaemia in particular those that are of bacterial origins still remains a major cause of morbidity and mortality particularly among neonates in low income countries. With time, the aetiological agents of sepsis and their antibiotic susceptibility patterns has become varied periodically and from different locality. Thus, the identification of bacteria in blood has a vital contribution in diagnosis of a febrile patient; in order to established the presence of infection, aside from reassuring the physician about the chosen first-hand efficacious therapy, and to provide current knowledge on the local aetiologic patterns and antibiotic susceptibilities as this will guide the physician in the best management of the patient. Hence, therefore for the successful management of septicaemia in children, thus the need to conduct a study of bacteriological profile along with the antimicrobial susceptibility pattern as this will playa terrific role.

The outcome of this study showed the profile of microbial isolates associated with septicaemia and their susceptibility pattern to most prescribed antimicrobial agents in FMC, Yenagoa. In the present study, frequency of positive samples was 138(41.19%) of the 335. This outcome is comparable to the frequencies of 43.5% positive cultures previously reported in Nigeria and 48.2% in Brazil by Peterside *et al.* [12] and Chang *et al.* [25]respectively. However, this finding is inconsistent and higher than existing reports from other studies done in different parts of the world. For example, studies done in Uganda (17.1%) [26], Lahore (27.9%) [27], Benin-city, Nigeria (22%)[28], Tanzania (13.4%) [29], Nepal (4.2%)[13], Cameroon (28.3%) [30], and Ethiopia (27.9%)[1]. Contrary to this present report, higher prevalence rates have been recorded in previous Nigerian studies conducted about two decades ago as revealed in Calabar (50.6%) and Ile-Ife (55%) by Anita-Obong *et al.* [31] and Ako-Nai *et al.* [32] respectively. This reported variance apart from the advancement and improvement in medical practices as of today which includes infection prevention practice or the rise of multidrug resistant organisms for different reasons, might be due to difference in blood culture system, age of children, change in study sites and period of the studies. It may be also due to the evolving of several pathogens being as a nosocomial or community acquired. This obtained prevalence rate could however be considered as an underestimate as studies have documented that large number of bloodstream infections may be of more clinical sepsis and not microbiologically confirmed (blood culture positive) as reported [33].

In the present study, the patients that came in with suspected septicaemia were predominantly females 195(58.21%) while the male patients were 140 (41.79%) which is inconsistence with the results of study conducted were male patients were reported as the commonest[3, 12, 34]. The highest rate of bacterial growth was from neonates 80(57.97%) followed by the infants 28(20.29%), toddlers 24(17.39) and pre-schoolers 6(4.35%). These results agree with the studies of Karki *et al.*[13] and Naveed *et al.* [34] that also showed a decreasing trend in the frequency of positive cultures with increasing age. The elevated rate of bacterial isolation among the neonates as compared to other paediatric age groups may be related to immaturity of the immune system at birth; hence the neonates are more susceptible to infections [1].

The gamut of microorganisms that colonise the bloodstream has been investigated by several researchers. In our study, 122(88.41%) of the infections were caused by aerobic (67 [48.19%] Gram-negative, and 56 [40.22%] by Gram-positive bacteria), while 16 (11.59%) were anaerobic (10[7.24%] Gram-negative, and 6[4.35%] Gram-positive) bacteria. Contrary to this study, quite a few studies in diverse countries, e.g. Ethiopia (60.9% and 39.1%) Zimbabwe (71.9% and 28.1%) Addis Ababa Ethiopia (62.6% and 37.4%), have shown slightly higher prevalence of Gram-positive and lower prevalence of Gram-negative organisms, [21, 35, 36, 37] respectively. However, in support of this findings, Gram-negative bacteria have been reported as the commonest cause of bacteraemia in hospitalised febrile patients in developing countries in studies conducted in Nigeria (69.3% and 30.7%), Saudi Arabia (62.2% and 33.8%), Tanzania (69.7%, 30.3%) [19, 38, 39]. The possible explanation for the difference could be the difference in blood culture system, the study design,

geographical location, nature of patient population, epidemiological difference of the aetiological agents, and seasonal variation.

The prevalence of the organisms associated with septicaemia varied from different studies. In this study, the most predominant Gram-positive bacteria pathogens identified with septicaemia were CoNS 27(19.57%), followed by *S. aureus* 17(12.23%) representing 40.30% and 25.38% of the overall aerobic Gram-positive isolates respectively. Related to our findings, are previous studies conducted verifying CoNS as the most common cause of septicaemia[9, 29, 30, 33, 34, 40, 41, 42, 43, 44]. The role of CoNS in septicaemia initially was controversial, because they were considered as contaminating agents, nevertheless, several studies including the present onehas reported increasing incidence of infections of bloodstream due to CoNS [9, 40]. Worthy to note however, is that in children from whom multiple blood cultures could not be applied, the decision for CoNS as pathogen is relied on the observation of clinical features of sepsis, follow up the prognosis and also on the laboratory markers with corresponding time for positivity [45].

The most common Gram-negative bacteria as identified in this study were *Klebsiella pneumoniae* (11.59%),*Serratia marcescens* (10.85%), *Acinetobacter spp*. (9.42%), *E. coli* (6.52%), *Pseudomonas aeruginosa* and *Salmonella typhi* (5.07% each). As revealed, *Klebsiella pneumoniae* (11.59%) were the most predominantly identified Gram negative bacteria. This finding agrees with report from Kabul [46]. On the other hand, this is a lower finding when compared with other study on neonatal sepsis with 34.5% in Lahore, Pakistan [34].

As seen in the present study, *Serratia marcescen* has been reported as the second most predominant Gram-negative bacteria associated with septicaemia [1] though with higher frequencies than ours (21.4%).Evidence has it that *S. marcescens* can cause speedily spreading outbreaks of severe and potentially fatal infections in neonatal units. And has been associated as an important nosocomial pathogen, especially in Newborn, or Neonatal, Intensive Care Unit (NICU), and it may cause serious infections, including sepsis, meningitis, and pneumonia, with significant associated morbidity and mortality in new-borns[37, 47, 48].Reasons been that *S. marcescens* is an emerging healthcare associated pathogen in the area of NICU. Although the source of this bacteria is not investigated in our study as reported by other authors. *S. marcescens* may be transmitted to neonates through parenteral nutrition, skin cleansers, breast milk, breast pumps, soap and disinfectant dispensers, ventilators and air conditioning ducts or spread via contact with the patient during care [48, 49].Generally, the high prevalence of *S. marcescens* in this study suggests the evidence that organisms change periodically over time and the difference in diverse geographic areas that are associated with paediatric sepsis.

Salmonellosis is normally not considered in the differential diagnosis of neonatal sepsis because *Salmonella typhi* is considered as a rare cause of neonatal sepsis and that if it exists, it can present with life threating complications, thus leading to increase in neonatal mortality and morbidity. More confusing is that the clinical features of neonatal *Salmonella typhi* infections are not different to neonatal sepsis caused by other gram-negative organisms in this age group. The mode of transmission of neonatal *Salmonella typhi* is still debatable and has been hypothesized to be of both vertical and horizontal transmission from exogenous routes either by faecal contamination of lower birth canal or aspiration or ingestion of contaminated food as top feed or reports of oral suction in nursery leading to sepsis has been documented [50, 51, 52].However, some literature reviews of neonatal typhoid fever suggested that clinical forms of typhoid fever in infants, sepsis neonatorum and other asymptomatic faecal carrier are available [51, 53, 54, 55, 56].Septicaemia involving *Salmonella typhi* accounted for 7 (5.07%) in this current study and all seven *S. typhi* were isolated from neonates. Our study is similar with results reported by Negussie *et al*. [1] with prevalence of 5.4%. However, this finding is slightly lower when compared with earlier reported results of 8.6% in Ethiopia[40]. There was 100% (i.e. all seven) mortality among these patients. Though we are not proud with such fatality rate, but with deaths arising so rapidly in the septicaemic phase of the typhoid disease there appears not much more to be done except perhaps determination on initial parenteral therapy. It is the authors' opinion that typhoid in neonates is very much under diagnosed or misdiagnosed conditions because of the swiftness of its course in these young babies, and it is our strong belief supporting the suggestion made earlier[57] more than four decades ago, which has recently been supported by recent report [53]that the septicaemia of *S. typhi* origin should be considered high among the causes of fever and severe anaemia in young children in holoendemic malarial areas.

Understanding the role of anaerobic bacteria in neonatal bacteraemia and sepsis has risen in recent years, and the recovery of anaerobes in neonatal bacteraemia varies between 1.8% and 12.5%. Because of their delicate nature, anaerobic organisms are difficult to isolate from infectious sites, and are often ignored. Their exact incidence is difficult to determine because of the inconsistent use of adequate methods for their isolation and identification[58].In the present study, we observed that the prevalence rate of anaerobic bacteria was 11.59%. This is in line with existing prevalence rate that had attributed it to be between 1.8% and 12.5%. The most common anaerobic bacteria associated with septicaemia in the current study is *B. fragilis* with an isolation rate of 8(50.00%) of the total anaerobes but ranked 7th of the overall isolates with 5.80% coming closely behind *E. coli* and *Enterococcus* with isolation rates of 9(6.92%)each. Further subjecting the isolation rates between these organisms showed that statistically there is no significant difference (P>0.001).*Clostridium perfringens* 4(25.00%) is the second

most common anaerobic isolates with an overall isolation rate of 2.90%, while Fusobacterium spp., and *Peptostreptococcus* spp., were 2(12.50%) each. This present report supports the earlier reports [59]. Various reasons have been ascribed to be the predisposing factors that could result in anaerobic septicaemia among new-borns and these includes: perinatal maternal complications (especially premature rupture of membranes and chorioamnionitis), scalp abscess, prematurity, and necrotizing enterocolitis[59, 60, 61, 62, 63, 64, 65].

Aggressive antibiotic therapy to inhibit and stop the spread of the aetiologies of infections are central to the management of septicaemia. The appropriate antibiotic for is determined by numerous factors, including the antibiotic susceptibility of the infecting organism, the source of infection, the presence of endocarditis and/or other metastatic sites of infection, and patient factors, including underlying comorbidities, concurrent medication, and antibiotic allergies [66]. Empirical therapy is of critical importance in the treatment of septicaemia, because delaying antibiotic treatment, even by only few hours, has been shown to increase the risk of infection-related mortality and the duration of hospitalisation [67].Even though, the use of wrong first-line antibiotics can also have harmful effects, because it is associated with high in-hospital mortality[25, 68].As such the need for early initiation of appropriate more specific first-line antibiotics is of importance with respect to combating the increasing rates of septicaemia infection [25, 59, 69, 70]. Nonetheless, it is of extreme importance to investigate the antimicrobial resistance profile of isolates obtained from septicaemic patients for avoidance of complications associated with this condition. In the present study of the *in vitro* antimicrobial resistance profile of the aetiological agents of septicaemia has revealed that there is a growing rise of multi-drug resistant microbes (Table 1).

As highlightened, all the isolates were resistance to ampicillin and tetracycline, while the highest degree of resistance was seen against penicillin and sulphamethaxazole-trimethoprim (92.75% each), followed by amoxicillin-clavulanic acid 89.86%, ceftriaxone and cefoxitin(86.96% each), and chloramphenicol 52.17%. On the other hand the bacterial isolates demonstrated the highest susceptibility to amikacin and clindamycin (100%), meanwhile more susceptibility were shown to metronidazole and nitrofurantoin (96.38% each), gentamicin and vancomycin (84.78% each),nalidixic acid 77.54%, imipenem 72.46%, and ciprofloxacin 68.84%, while moderate susceptibility was demonstrated against erythromycin 57.25%.from this study, all the CoNS and *S. aureus* isolates demonstrated 100% resistance each to ampicillin, amoxicillin-clavulanic acid, ceftriaxone, penicillin, sulphamethaxazole-trimethoprim and tetracycline.This resistance contrasted with resistance patterns revealed by other studies [9, 12, 34].On the other hand, both staphylococci species (CoNS and *S. aureus*) demonstrated 100% susceptibility to amikacin, chloramphenicol, clindamycin, ciprofloxacin, imipenem, metronidazole, and nitrofurantoin. Higher susceptibility was however demonstrated by both isolates (CoNS:*S.aureus*) to erythromycin (81.48:70.59%), gentamicin (96.30:94.12%), nalidixic acid (92.59:88.24%), and vancomycin (92.59:88.24%). this outcome is comparable to those reported earlier [12, 34, 46, 71, 72].This study underscored the need for evaluation of the empirical antibiotics presently in use at the children's ward of the FMC since these isolated staphylococci organisms showed high susceptibility to these antimicrobial (amikacin, clindamycin, erythromycin, gentamicin, nalidixic acids and vancomycin) agents.

74.07%, and 58.82% were due to Cefoxitin (methicillin) resistant CoNS (MRCoNS) and *S. aureus* (MRSA) in the present study. In antagonism, a lower resistance of *S. aureus* and CoNS to Methicillin has been reported [34, 73].Nevertheless, similar MRSA resistance to the current study has also been reported to be as high as 42.5% in Bengal [74] and 56% in Turkey [75].There is necessity for early commencement of appropriate empirical therapy for combating the increasing rates of MRSA infection. As such, vancomycin that has been considered as the current "gold standard" for the treatment of MRSA infection was investigated and the low level of resistance of the isolated CoNS 7.41% and *S. aureus* 11.76% supports the fact that vancomycin could be used as an alternative therapy for suspected multidrug resistant staphylococci in our environment

For the other aerobic Gram-positive isolates *B.* subtilis, *and Enterococcus* spp.in this study, the *B. subtilis* were found to be 100% resistance to ampicillin, penicillin, tetracycline, sulphamethaxazole-trimethoprim, cefoxitin, while 50.00% showed moderate degree of resistance to amoxicillin-clavulanic acid. On the other hand, Enterococcus spp. also demonstrated 100% resistance to these drugs except for penicillin that it demonstrated 66.67% resistance to. however, both isolates demonstrated 100% suceptibilty to amikacin, clindamycin, gentamicin, metronidazole, nalidixic acid, nitrofurantoin, and vancomycin.

The patterns demonstrated by the aerobic Gram-negatives isolates from the present study towards the antimicrobial agents employed was terrifying. As emphasised, all exhibited 100% resistances to ampicillin, amoxicillin-clavulanic acid, cefoxitin, ceftriaxone, and tetracycline.For the isolated coliforms: *E. coli* and *K. pneumoniae*(*E. coli*: *K. pneumoniae*)in the current study, were both found to be of moderate resistance to erythromycin (66.67:62.65%), imipenem (66.67:56.25%), while low resistance was exerted to nalidixic acid (22.22:12.50%), gentamicin (22.22:18.75%) and vancomycin (33.33:12.50%). The resistances shown to carbapenem (imipenem) indicates they are carbapenem resistant strains. Despite they exhibited multidrug resistant, they still show highest susceptibility to amikacin, clindamycin, metronidazole and nitrofurantoin, as all (100%) did not show any resistant to these agents. Various studies have reported multidrug resistance among *E.coli* and klebsiella that are of septicaemic origins [14, 74, 76].

In addition to demonstrating 100% resistance to ampicillin, amoxicillin-clavulanic acid, cefoxitin, ceftriaxone, and tetracycline. All the seven isolated *Salmonella typhi* were also 100% resistant to ciprofloxacin, erythromycin, gentamicin, imipenem, nalidixic acid, sulphamethaxazole-trimethoprim and vancomycin in other ways they were71.43% each resistant to nitrofurantoin and metronidazole. This outcome corroborates various studies that indicts multidrug-resistant *S. typhi* in neonates septicaemia [55, 56, 77, 78], though the patterns displayed by the present study is considered the highest level of antibiotic resistant. No wonder the case fatality rate of the isolated *S. typhi* was 100%. This is because they were able to circumvent the actions of the commonly available empirical antibiotics except for amikacin and clindamycin.

The isolated *S. marcescens* was found to be 100% resistance to ampicillin, amoxicillin-clavulanic acid, cefoxitin, ceftriaxone, chloramphenicol, and tetracycline followed by erythromycin and penicillin (73.33% each). On the other hands it was 100% sensitive to amikacin, clindamycin, gentamicin, metronidazole, and nitrofurantoin, while higher susceptibility was shown to nalidixic acid (86.87%), ciprofloxacin (73.33%) and imipenem (60.00%).

In the present study, all the isolated Acinetobacter spp.were 100% resistance to ampicillin, amoxicillin-clavulanic acid, cefoxitin, ceftriaxone, chloramphenicol, and tetracycline. 84.62% and 61.54% of the Acinetobacter spp. showed resistance to penicillin and sulphamethaxazole-trimethoprim respectively. On the other hand, 100% of these isolates were sensitive to ciprofloxacin, gentamicin, metronidazole and vancomycin. Nevertheless, higher susceptibility was demonstrated against imipenem and nalidixic acid (84.62% each), and erythromycin (69.23%).

The resistance profile of the isolated *P. aeruginosa*reveals that all (100%) were resistant to ampicillin,amoxicillin-clavulanic acid, cefoxitin, ceftriaxone, chloramphenicol, ciprofloxacin, erythromycin, gentamicin, nalidixic acid, sulphamethaxazole-trimethoprimand tetracycline, while 71.43% were resistance to vancomycin. They were however susceptible 100% to amikacin, clindamycin, metronidazole and nitrofurantoin, this can be compared to result reported by Mohammad [76].

There is the need to treat patientswith anaerobic infection adequately because those who were inappropriately treated died from these infections [79], thus the use of proper antimicrobial agents are critical to successful resolution of septicaemia that are of anaerobic infectious origin.The antimicrobial resistance profile of the anaerobes isolated from the present study revealed that all (100%) were resistant to ampicillin, tetracycline and penicillin except for *B. fragilis* with 87.50% resistant to penicillin. As observed in this study, high resistances were exhibited by *B. fragilis*(62.50%), Peptostreptococcus spp. and Fusobacterium Spp. (50.00% each) to sulphamethaxazole-trimethoprim. All the anaerobes demonstrated 100% resistances to amoxicillin-clavulanic acid aside from *C. perfringens*(75.00%), while *B. fragilis* exhibited 37.50% resistant to nalidixic acids, all others were susceptible to this agent. Furthermore, the resistances as exhibited to cefoxitin was 75.00% and 50.00% to *B. fragilis* and *C. perfringens* respectively. On the other hand, all the anaerobic isolates displayed 100% suceptibilty to amikacin, clindamycin, ceftriaxone, chloramphenicol, ciprofloxacin, erythromycin, gentamicin, imipenem, metronidazole, nitrofurantoin, apart from penicillin that showed less susceptibility of 62.50% to *B. fragilis*. These patterns of antimicrobial resistance support the existing reports [60, 80, 81]. This study is in support of Wang *et al*. [60]that suggest metronidazole as still the most susceptible agent in management of septicaemia of anaerobic (e.g. *B. fragilis* group, Clostridium spp., Fusobacterium spp., and Peptostreptococcus spp.) infection.

V. LIMITATION OF STUDY

Failure of the study to ascertain the contribution of fungi infection to septicaemia in our environment was a limitation of this study.

VI. CONCLUSION

This study has pointed out the problem of bacterial aetiology for septicaemia among children in a tertiary healthcare centre. However, since the spectrum of pathogens, incidence of diseases, and antimicrobial susceptibility change over time and places, the data should be scrutinised unceasingly to allow proper clinical response and healthcare planning. This study highlights the variable nature of antibiotic susceptibility patterns. Therefore, it is worthwhile to always assess the resistance pattern of isolates to make a rational use of antibiotics. In addition, the recovery of *S. typhi* from this study thus indicates that enteric fever must be included in the differential diagnosis of temperature elevation in women with pregnancy so that neonates can be screened and managed appropriately and *Salmonella* infections should be considered in the differential diagnosis of sepsis neonatorum, especially in Salmonella endemic areas like ours. Furthermore, the early recognition of anaerobic bacteraemia and administration of appropriate antimicrobial therapy should be considered significant role in preventing mortality and morbidity in new-borns in our hospital setting.

VII. JUSTIFICATION AND CONTRIBUTION OF KNOWLEDGE TO STUDY

All isolated bacteria pathogens are multidrug resistant. *Salmonella* infections should be considered in the differential diagnosis of sepsis neonatorum, Anaerobic bacteria plays a vital role in septicaemia. Antibiotics such as amikacin, clindamycin, metronidazole, nitrofurantoin, gentamicin and vancomycin, nalidixic acid, imipenem, ciprofloxacin, and erythromycin should be considered as first-line drugs while awaiting laboratory results.

AUTHOR'S CONTRIBUTION

Abdulrashed B. Abdu: Designed the study, protocol writing, manuscript preparation, statistical analysis, John Egbagba: Protocol writing, sample collection, manuscript preparation Toloulope Alade: Sample collection, transportation and isolation. All authors read and approved the final manuscript

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ETHICAL CLEARANCE

Ethical clearance for the study was granted by the Ethics Review Board of Federal Medical Centre, Yenagoa

Figures and Tables

Figure 1. Age distribution and recovery of bacterial (blood culture positive) from patients with suspected septicaemia

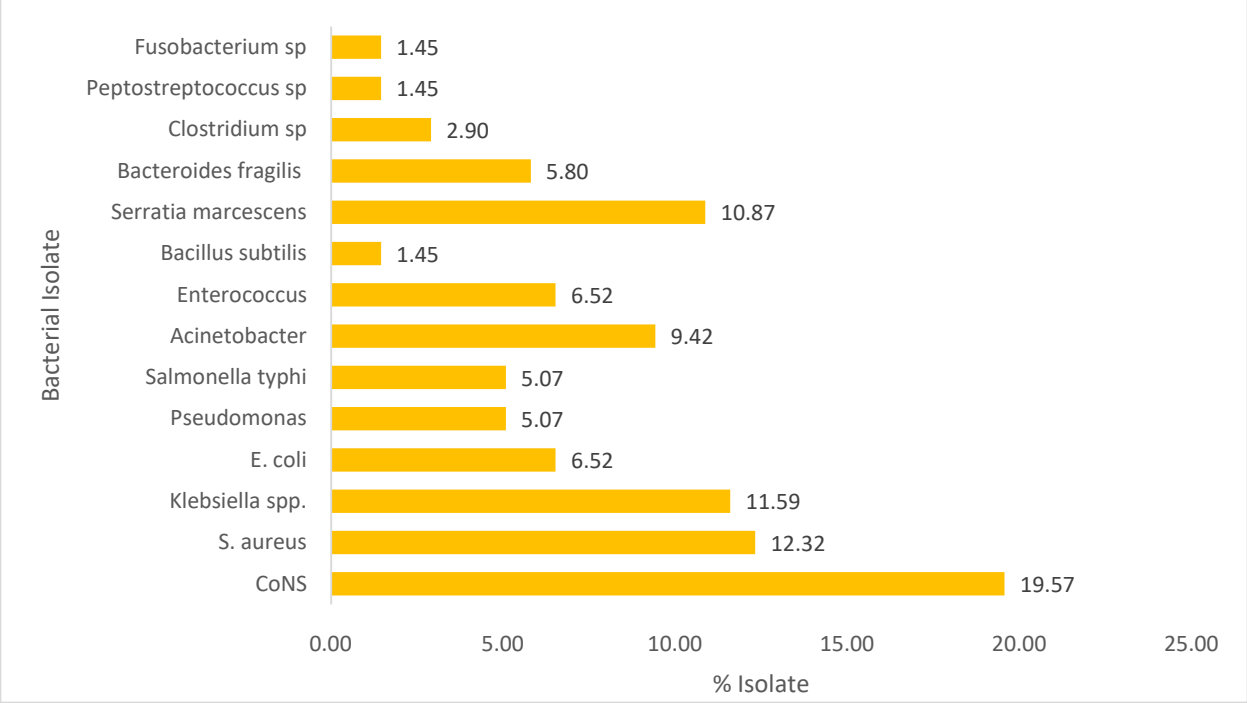

Figure 2. The types and pattern of bacterial isolates among the septicaemia subjects

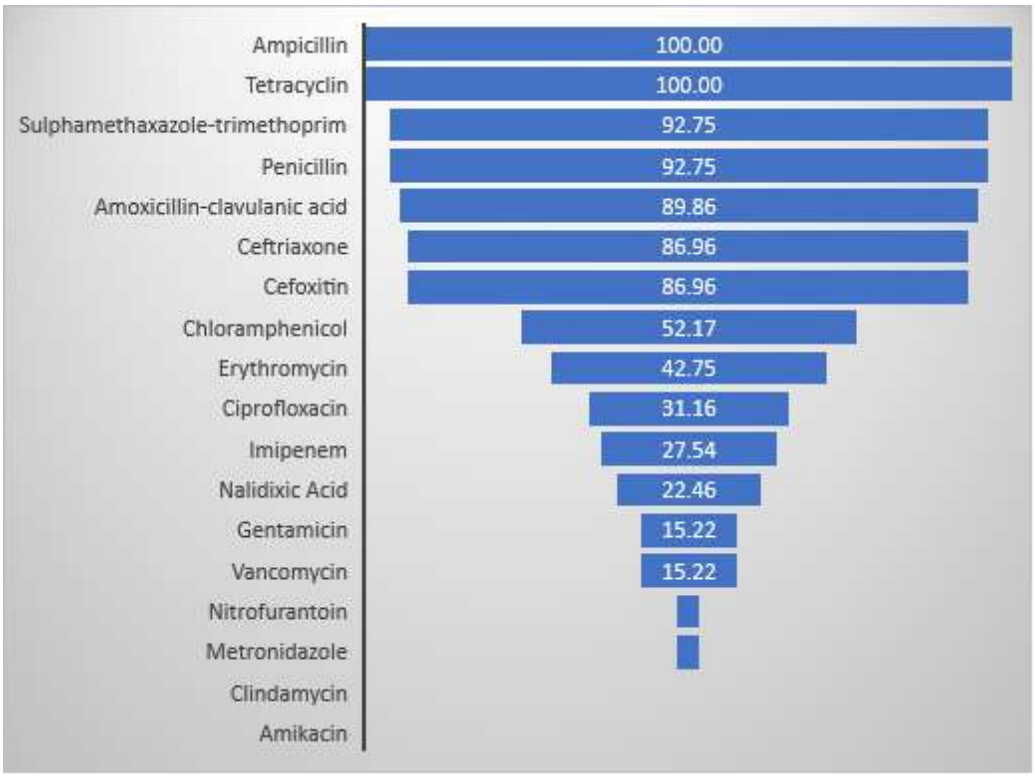

Figure 3. Antimicrobial resistance profile of septicaemic pathogens

Table 1. Antimicrobial resistance of individual bacteria pathogens isolated from blood culture during the study period

Antibiotics	Bacterial Isolates														
	CoNS	*S. aureus*	*K. pneumoniae*	*E. coli*	*P. aeruginosa*	*S. typhi*	*Acinetobacter* spp.	*Enterococcus* spp.	*B. subtilis*	*S. marcescens*	*B. fragilis*	*Peptostreptococcus* spp.	*C. perfringens*	*Fusobacterium* spp.	Total
No of isolates tested	**27**	**17**	**16**	**9**	**7**	**7**	**13**	**9**	**2**	**15**	**8**	**2**	**4**	**2**	**138**
	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	
Ampicillin	27 (100)	17(100)	16(100)	9(100)	7(100)	7(100)	13(100)	9(100)	2(100)	15(100)	8(100)	2(100)	4(100)	2(100)	138
Tetracycline	27(100)	17(100)	16(100)	9(100)	7(100)	7(100)	13(100)	9(100)	2(100)	15(100)	8(100)	2(100)	4(100)	2(100)	138
Penicillin	27(100)	17(100)	16(100)	9(100)	7(100)	7(100)	11(84.62)	6(66.67)	2(100)	11(73.33)	7(87.50)	2(100)	4(100)	2(100)	128
Sulphamethaxazole-trimethoprim	27(100)	17(100)	16(100)	9(100)	7(100)	7(100)	8(61.54)	9(100)	2(100)	15(100)	5(62.50)	1(50.00)	4(100)	1(50.00)	128
Amoxicillin-clavulanic acid	27(100)	17(100)	16(100)	9(100)	7(100)	7(100)	13(100)	9(100)	1(50.00)	15(100)	0(0)	0(0)	3(75.00)	0(0)	124
Cefoxitin	20(74.07)	10(58.82)	16(100)	9(100)	7(100)	7(100)	13(100)	9(100)	2(100)	15(100)	6(75.00)	2(100)	2(50.00)	2(100)	120
Ceftriaxone	27(100)	17(100)	16(100)	9(100)	7(100)	7(100)	13(100)	9(100)	0(0)	15(100)	0(0)	0(0)	0(0)	0(0)	120
Chloramphenicol	0(0)	0(0)	16(100)	9(100)	7(100)	7(100)	13(100)	5(55.56)	0(0)	15(100)	0(0)	0(0)	0(0)	0(0)	72
Erythromycin	5(18.52)	5(29.41)	10(62.50)	6(66.67)	7(100)	7(100)	4(30.77)	4(44.44)	0(0)	11(73.33)	0(0)	0(0)	0(0)	0(0)	59
Ciprofloxacin	0(0)	0(0)	16(100)	9(100)	7(100)	7(100)	0(0)	0(0)	0(0)	4(26.67)	0(0)	0(0)	0(0)	0(0)	43
Imipenem	0(0)	0(0)	9(56.25)	6(66.67)	7(100)	7(100)	2(15.38)	1(11.11)	0(0)	6(40.00)	0(0)	0(0)	0(0)	0(0)	38
Nalidixic Acid	2(7.41)	2(11.76)	2(12.50)	2(22.22)	7(100)	7(100)	2(15.38)	2(22.22)	0(0)	2(13.13)	3(37.50)	0(0)	0(0)	0(0)	31
Gentamicin	1(3.70)	1(5.88)	3(18.75)	2(22.22)	7(100)	7(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	21
Vancomycin	2(7.41)	2(11.76)	2(12.50)	3(33.33)	5(71.43)	7(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	21
Nitrofurantoin	0(0)	0(0)	0(0)	0(0)	0(0)	5(71.43)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5
Metronidazole	0(0)	0(0)	0(0)	0(0)	0(0)	5(71.43)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5
Amikacin	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0
Clindamycin	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0

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