

**ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCE
DEPARTMENT OF MEDICAL LABORATORY SCIENCE**



Bacterial profile, antimicrobial susceptibility pattern and associated risk factors among septicemia suspected pediatrics patients at Zewuditu Memorial Hospital, Addis Ababa, Ethiopia

A thesis submitted to department of Medical Laboratory Science, College of Health Science, Addis Ababa University in partial fulfillment of the requirements for the degree of masters in Clinical Laboratory Sciences (Diagnostic and Public Health Microbiology specialty)

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Project Submission form

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List of abbreviation

AAPHREMCP: Addis Ababa Public Health Research & Emergency Management Core Process

AAU:	Addis Ababa University
AOR:	Adjusted Odds Ratio
ART:	Anti-Retroviral Therapy
BF:	Blood Film
BSI:	Blood Stream Infection
CBC:	Complete Blood Count
CI:	Confidence Interval
CLSI:	Clinical and Laboratory Standards Institute
CONS:	Coagulase Negative Staphylococci
DST:	Drug Susceptible Test
EOS:	Early Onset of Sepsis
HIV:	Human Immune Deficiency Virus
IPD:	Inpatient Department
LBW:	Low Birth Wight
LOS:	Late Onset of Sepsis
MDR:	Multi Drug Resistance
MMC:	Myelomeningocele
NICU:	Neonatal Intensive Care Unit
OPD:	Outpatient Department
COR:	Crud Odds Ratio
SPSS:	Statistical Package for Social Sciences
SOP:	Standard Operational Procedures
TSB:	Trypto Soya Broth
WHO:	World Health Organization
ZMH:	Zewuditu Memorial Hospital

Operational definitions

Sensitivity (S): Zone of inhibition radius is wider than, equal to, or not more than 3mm smaller than the control.

Intermediate (I): Zone of inhibition radius is more than 3mm smaller than the control but not less than 3mm.

Resistant (R): No zone of inhibition or zone radius measure 2mm or less than the control.

Septicemia: -defined as the presence of bacteria in the blood/bacterial blood stream infection.

Nosocomial infection: -refers to hospital acquired infection which is occurring within 48 hours or more after admission.

Community acquired infection: - refers to an infection acquired in the community which is occurring 48 hours or more before admission.

Multi Drug Resistance: - bacterial resistance for three or more antibiotics.

Abstract

Introduction: Septicemia defined as the presence of bacteria in the blood and is often associated with severe infections. It causes great impact in terms of mortality, morbidity and increased in healthcare cost. There are many risk factors of septicemia among different patient groups.

Objectives: The study was designed to assess bacterial profile, antibiotic susceptibility pattern and associated risk factor of pediatrics septicemia at Zewuditu Memorial Hospital, Addis Ababa, Ethiopia.

Methods: A hospital based cross sectional study design; conducted at Zewuditu Memorial Hospital from June 5, 2016 to March 8, 2017. A total of 309 study participants who were suspected for septicemia recruited. Socio-demographic and clinical data were collected from each patient. Blood was drawn aseptically and inoculated at bedside on Tryptone Soya Broth. Gram stain was performed and the specimen was sub cultured every other day on to blood agar, chocolate agar and MacConkey agar plates. For culture positive; colony characteristics and Biochemical tests used for species identification. All the isolate tested for susceptibility by using Kirby-Bauer's disk diffusion method. All data entered to EPIINFO version 3.5.1 and then exported to SPSS statistical software version 20 for data analysis. Multiple Logistic regression analysis was used to see the association between dependent and independent variables.

Results: Out of 309 samples, 113(36.5%) showed bacterial growth, 84(74.3%) gram positive and 29(25.3%) gram negative bacteria. Commonly isolated organisms were *Staphylococcus aureus* 57(50.4%), *Coagulase negative Staphylococci* 25(22%) and *Klebsiella pneumoniae* 21(18.5%). Birth weight, underlying chronic disease, congenital anomalies, neutrophil percentage, source of infection and age of the pediatrics were associated with positive blood culture. Both Gram positive and negative bacteria showed resistance for commonly prescribed antibiotics. Clindamycin was the most effective antibiotic for gram positive bacteria while for gram negative bacteria cefotetan and ceftriaxone were effective drugs for gram negative bacteria.

Conclusion: The pattern of organism that cause pediatrics septicemia changes over time and in geographical location. High prevalence of antimicrobial resistance was noted in this study, especially in gram negative bacteria. Moreover multi-drug resistance of the isolate was surprisingly high (89.3%).

Keyword: septicemia, bacteriological profile, antimicrobial susceptibility pattern, blood culture

1. Introduction

1.1 Background

Septicemia is defined as the presence of bacteria in the blood and is often associated with severe infections, the alternative names (Blood poisoning, Bacteremia with sepsis, systemic inflammatory response syndrome) [1]. Pediatrics with septicemia present with poor activity, fever, vomiting, chills, difficulty in breathing, tachycardia, malaise, refusal of feeds or lethargy hypothermia, respiratory distress, abdominal distension, jaundice, toxicity and eventually the extreme form being-shock [2]. Blood stream infections range from self-limiting infections to life threatening sepsis that requires rapid and aggressive antimicrobial treatment [3]. It is a common condition in children with a resultant of high morbidity and mortality [4, 5].

Varieties of bacteria have been found to cause blood stream infection in children. These includes; *Staphylococcus spp*, *Streptococcus spp*, *Enterobacter spp*, *E.coli*, *Pseudomonas spp*, *Klebsiella pneumoniae*, *Enterococcus spp*, *Neisseria meningitides*, *Salmonella spp*, *Moraxella catarrhalis*, and *Haemophilus influenzae* [6, 7].

Bacteriological culture to isolate the etiologic agent and knowledge about sensitivity pattern of the isolates remain the main stay of definitive diagnosis and management of BSI [8]. Early treatment with antibiotics is possible with the help of certain indirect markers such as neutropenia (<1800 cells/mm³), leucopenia (<5000 cells/mm³), band cells, micro ESR and C-reactive protein (CRP). All these investigations are collectively known as sepsis screen and aids in early diagnosis of neonatal sepsis in the absence of negative blood cultures [9].

The choice of antibiotic therapy is best guided by the knowledge of etiologic agent. This, however, is usually not immediately possible. Thus, it is customary to initiate treatment with an empirical choice of antibiotic(s) that is informed by the epidemiology of causative agents and sensitivity patterns in a given locality [10].

Several risk factors have been identified both in the neonates and children, which make them susceptible to infections which points to the need for bacteriological monitoring in the pediatric wards. In neonates there are early onset of sepsis (EOS) which is usually related to peripartum factors i.e. acquisition of the infectious agent during or after delivery and late onset sepsis (LOS)

is usually acquired in the newborn nursery, neonatal intensive care unit or in the community[11,12,13]. The risk factors for neonatal septicemia include premature rupture of membrane, prolonged rupture, prematurity, Urinary Tract Infection, poor maternal nutrition, low birth weight, birth asphyxia and congenital anomalies [14]. The risks of children septicemia include; serious injury, chronic antibacterial therapy, malnourishment, chronic medical problems, and immunosuppressant drug therapy. Polymicrobial sepsis occurs in high risk patients and is associated with catheters, changing pattern of antimicrobial usage, gastrointestinal diseases, neutropenia, malignancy, overstay in intensive care units, increased use of steroids and immunomodulators, and human immunodeficiency virus (HIV) infections [15].

1.2. Statement of the problem

Blood stream infection (BSI) remains one of the most important causes of morbidity and mortality throughout the world [16]. The mortality rate due to bacteremia ranging from 20-50% worldwide [17]. The World Health Organization (WHO) estimates that 85% of newborn deaths are due to infections including sepsis, pneumonia and tetanus. Worldwide, 76% (4.6 million) of the under five deaths occur due to undiagnosed invasive bacterial infections. Moreover, bacterial culture to diagnose bacterial infection is not routinely done in most of the primary and secondary health facilities and these made the problem more complicated in developing countries [18].

In 2000-2003 report, the world health organization estimated that neonatal sepsis and pneumonia are responsible for about 1.6 million deaths each year, mainly in developing countries. Rates of hospital –acquired neonatal infections 3-20 times higher in developing than developed countries. Culture-proven neonatal sepsis is associated with increased mortality rates, morbidity and prolonged hospital stays, both the human and fiscal costs of this disease are high [19]. On the other hand among infants identified with sepsis, 40% die and the biggest toll being in developing countries. Also neonatal septicemia continues to be a major health problem with up to 323 of every 1000 neonates seen in clinics presenting with clinical symptoms [20]. It is estimated that up to 20% of neonates develop sepsis and approximately 1% die of sepsis related causes [21]. In US, out of 17,136,365 children (19 years old or less) and 899,000 live births in the seven states, the annual incidence of BSI was 0.56 /1,000 children or 42,364 cases per year. The incidence was highest in infants (5.16 /1,000) and fell dramatically in older children (0.2/1,000) [22].

Common etiologic agent for pediatrics blood stream infection (BSI) has been identified in developed country (Europe and USA) as *S. aureus* and *E.coli*. Whereas, in developing country like in sub-Saharan Africa, *S.aureus*, *Klebsiella spp* and *Salmonella spp* are the commonest etiologic agent of pediatrics blood stream infection [23].

The epidemiology of pediatric bloodstream infection (BSI) in Africa is poorly documented. Despite there are few published descriptions of community-acquired sepsis in African children, data on hospital-acquired BSI are extremely limited. It is estimated that healthcare-associated BSI may be responsible for 25000 deaths in African children annually. Overall, incidences rates of healthcare-associated infection in developing countries are thought to be at least double that of

high-income settings [24].Septicemia remains the leading cause of morbidity and mortality among children less than 5 years of age in sub-Saharan Africa. Its definitive diagnosis depends on the blood culture positivity, but in most cases only 50% of all positive blood culture represents true blood stream infection [25]. One in every six African children dies before the age of five years. The World Health Organization (WHO) ranks the major causes of mortality in African children younger than five years as neonatal causes among which the entity "sepsis" contributes a quarter (26%), pneumonia (21%), malaria (18%) diarrhea (16%) and HIV-infection (6%) [6].

One of the more alarming recent trends in infectious diseases is the increasing frequency of antimicrobial resistance among microbial pathogens causing nosocomial and community acquired infections. Numerous classes of antimicrobial agents have become less effective as a result of the emergence of antimicrobial resistance, often as a result of selective pressure of antimicrobial usage [26]. Especially, patients with gram negative septicemia due to ESBL-producing organisms had a significantly higher fatality rate than those with non-ESBL isolates (71% versus 39%) [27]. In South Africa, Tygerberg Children's referral Hospital the overall antimicrobial resistance rates were high (70% in hospital vs 25% in community-acquired infections); hospital-acquired infection, infancy, HIV-infection and Gram negative sepsis were associated with resistance [25]. In Nigeria the outcome of treatment of neonatal septicemia has remained poor due to MDR, with reports of mortality of 33 to 41% from two tertiary hospitals in the country [28]

In Ethiopia data on community acquired and nosocomial pediatric septicemia are so limited to infer the magnitude nationally. Three studies conducted in Ethiopia indicated that, the overall prevalence of septicemia among septicemia suspected pediatric and the predominant etiologic agent were 13%, *CONS*, *pneumoniae* [2]; 27.9%, *S.aureus* & *S.maecese* [37] and 32.1%, *K.ozaen* & *S.aureus* [38] respectively. Also regarding to multi-drug resistance a study conducted by Negussie et al; 2015 was observed in most of the isolates (92.7%) [37].

The reason why we conducted this study on pediatric patients is to determine the changing pattern of etiologic agent and their DST. Since the epidemiology varies in time and place, it needs a regular inspection and customization for a given locality. Moreover, assessing the impact and prevalence of nosocomial septicemia in the study settings will help us to know where we are and what we have to do.

1.3. Significance of the study

As septicemia is a life threatening emergency, the knowledge of epidemiological and antimicrobial susceptibility pattern of common pathogens in a given area helps to inform the choice of antibiotics. Predominance of either the gram positive or gram negative bacterial isolates is influenced by geographical location and changes in time; so also the antibiotic susceptibility pattern influenced by location and time. The determination of the bacterial profile and their antibiotic sensitivity pattern could guide in the infection control and rational use of antibiotic in this locality. So, understanding these variables would help to prioritize resources and plan strategies for decreasing the mortality associated with bloodstream infection.

Additionally this study could help us to identify the associated risk factors of pediatrics septicemia and thereby to take effective measure on those risks factors. Since today's government policy has been focused on under five children health improvement, the study could help as one of the valuable input to the policy makers. The study could also serves as a reference material being as base line for related study.

Therefore, this study was undertaken to analyze the various organisms causing pediatrics septicemia, their antibiotic resistance patterns and associated risk factors at Zewuditu Memorial Hospital, as it would be a useful guide for clinicians initiating the empiric antibiotic therapy.

2. Literature review

Since blood stream infection (septicemia) being one of the challenging problem, many research have been done in the world. These researches showed the prevalence of septicemia etiologic agent and their antimicrobial pattern has been changed from place to place and from time to time. So, it needs to update epidemiological data and information regarding to the etiologic agents and their AST for a given place and time.

2.1 Septicemia

A retrospective study conducted in Nigeria Tertiary Hospital by Nwadioha et al., 2010 on “A review of bacterial isolates in blood cultures of children with suspected septicemia”. From total of 3840 blood culture samples, 700 (18.2%) were culture positive. Gram negative bacteria were 69.3% and gram-positive were 30.7%. Bacterial isolates according to age groups; Neonates (<28days), infants (> 28 days to < 1 year) and Children (1 year to <15 years) were 25.7, 17.4 and 12.7%, respectively. The commonest bacterial isolates were *E. coli* (44.3%), *S. aureus* (28.6%) and *Klebsiella* species (14.3%) [28].

A cross sectional study conducted by Prabhu et al., 2010 in India, on “Bacteriologic Profile and Antibigram of Blood Culture Isolates in a Pediatric Care Unit”. Out of the 185 cultures, 81 (44%) were culture positive, 28 (35%) of the culture isolates were Gram negative bacilli, 52 (64%) of the isolates were Gram positive cocci. The most frequently isolates were *S.aureus* 41(51%) and followed by *CONs* and *K.pneumoniae* 10 (12%) each [29].

Another cross-sectional study conducted by Mezal 2015 in Iraq on “Bacteremic Infants and Children in Basrah with Its Antibiotics Susceptibility”. Of the 170 blood samples, 150 (88.2%) were positive for bacteremia. Among the positive cultures 61(40.7%) were gram positive, 87(58 %) were gram negative and 2(1.3) were *C.albicans*. The most frequently isolates were *K. pneumoniae* (34.6%), *S. aureus* (18%), and *E. coli* (17.3%)[30].

Another retrospective study conducted in Saudi Arabia by Abo-Shadi et al., 2012 on “Antimicrobial Resistance in Pathogens Causing Pediatrics Bloodstream Infections in a Saudi Hospital” of 11968 blood cultures 728 (6.1%) were positive blood culture. Gram-positive, Gram-negative and yeast accounted for 63.8%, 31.6% and 4.6% of the total isolates, respectively. *CONs*

were the most prevalent Gram-positive isolates (44%); while *S. marcescens* and *K. pneumoniae* were the most common Gram-negatives [31].

Another retrospective study conducted in Nepal by Karkiet al., 2010 on “Bacteriological Analysis and Antibiotic Sensitivity Pattern of Blood Culture Isolates in Kanti Children Hospital among”. A total of 9856 blood samples cultured; 414(4.2%) were positive samples. The most frequently isolated bacteria were *S. aureus* 269 (65%), *E. coli* 121(29.3%) and *K. pneumoniae* 13 (3.1%) [32].

Another study conducted in Nigeria, Calabar by Meremikwuet al., 2005 on “Bacterial isolates from blood cultures of children with suspected septicaemia”. Bacteria were isolated in 552 (45.9%) of the 1,201 patients studied. The most frequent isolates were *S aureus* (48.7%) and *Coliforms* (23.4%)[33].

A Prospective study conducted in Nigeria by Uzodimma et al., 2013 on “Bacterial Isolates from Blood Cultures of Children with Suspected Sepsis in an Urban Hospital in Lagos”. From the total of 100 blood culture, 35(35%) were culture positive. About half of the study subjects (52%) were infants and 90% were under five. The highest culture positive rate was among the neonates (41%). From the culture positive, 28(80%) were gram positive and 7(20%) were gram negative. The most frequent isolates were *S.aureus* 23(65.7%), *Streotococcus spp* 5(14.2%) and *Klebsiella spp* 4(11.4%)[34].

A cross sectional study conducted in India by Murty et al., 2007 on “Blood cultures in pediatric patients: A study of clinical impact”. From 107 children, 26 (24.30%) blood cultures were positive. The culture positivity rate was observed to be highest in neonates (52.63%). Administration of empirical antibiotics was already initiated by the time of collection of sample for culture in 71 (66.35%) of the cases. Of these, only 6 (8.45%) had positive cultures with delayed growth. Beyond four days (unless with specific indication like enteric fever) may be unnecessary for issuing a negative culture report. Repeated isolation of doubtful pathogens confirms true bacteraemia. Early culture report increases therapeutic compliance [35].

A cross-sectional study conducted in Kenya by Ngarutya et al., on “The prevalence of bacterimia in the severely malnourished children aged 2 to 59 months at Mbagathi District Hospital,

Nairobi”. The overall prevalence of bacteraemia was 30 % (27) with *S. aureus* accounting for 21.1 % (19); *S. typhi* 4.4 % (4); *S. epidermidis* 3.3 % (3) and *E. fecalis* 1.1 % [36].

Across sectional study conducted in Ethiopia by Nigusse et al., 2015 on “Bacteriological Profile and Antimicrobial Susceptibility Pattern of Blood Culture Isolates among Septicemia Suspected Children”. Out of 201 blood culture 56(27.9%) were culture positive (29 gram negative, 26 gram positive and 1 *candida spp*). Most frequently isolated bacteria were *S. aureus* 13 (23.2%), *S. marcescens* 12(21.4%) and *CONs* 11 (19.6%)[37].

Another prospective cross sectional study conducted in Ethiopia by Gebrehiwot et al., 2012 on “Predictors of positive blood culture and death among neonates with suspected neonatal sepsis in Gondar University Hospital, Northwest Ethiopia”. A total of 181 neonates (99 male and 82 female) admitted to neonatal unit with clinical features of sepsis were studied. 122 (67.4%) of them were of EOS and 59 (32.6%) with LOS based on clinical parameters. Out of the clinically suspected cases there were 39 (32%) and 19 (32.2%) culture proven early and late onset neonatal sepsis cases respectively [38].

2.2 Risk factors

A retrospective cross sectional study conducted in Uganda by Mugalu et al., 2006 on “Aetiology, risk factors and immediate outcome of bacteriologically confirmed neonatal septicaemia”. Factors significantly associated with neonatal septicaemia were male sex, history of convulsions, hypoglycaemia, lack of antenatal care, late onset sepsis and umbilical pus discharge [20]

Another retrospective study conducted in Nepal by Karkiet al., 2010 on “Bacteriological Analysis and Antibiotic Sensitivity Pattern of Blood Culture Isolates”. The rate of isolation was highest among newborns (265/414: 64%) followed by 1 -11 months of age (114/414:27.5%). The overall rate of isolation reduced with increasing age and the overall growth positive rate was relatively higher in males 63.3% as compared to females (36.7%) [32].

A cross-sectional study conducted in Kenya by Ngarutya et al., on “The prevalence of bacterimia in the severely malnourished children aged 2 to 59 months at Mbagathi District Hospital, Nairobi”. Children with diarrhea and vomiting were more likely to have bacteraemia [36].

A cross sectional study conducted in Ethiopia by Nigusse et al., 2015 on “Bacteriological Profile and Antimicrobial Susceptibility Pattern of Blood Culture Isolates among Septicemia Suspected Children”. From the clinical features lethargy were rule out sepsis. Also Weight at enrollment was significantly statistically associated with septicemia [37].

A cross sectional study conducted in Ethiopia by Gebrehiwot et al., 2012 on “Predictors of positive blood culture and death among neonates with suspected neonatal sepsis”. Failure to suck, meconium stained liquor, PROM , lethargy, seizure and fast breathing were significantly associated risk factor and symptoms with positive blood culture in neonatal sepsis [38].

A cross-sectional prospective study conducted in India by Premalatha et al., 2014 on “The Bacterial Profile and Antibiogram of Neonatal Septicemia in a Tertiary Care Hospital”. Prematurity, LBW and respiratory distress syndrome were strongly associated with blood culture proven sepsis [39].

A prospective observational study conducted by Zakariya et al., 2012 on “Risk factors and outcome of *K. pneumoniae* sepsis among Newborns”. Neonates with birth weight \leq 2.5 Kg and hospital delivered babies were at higher risk of infection by *K. pneumonia* [40].

2.3 AST Pattern

A retrospective study conducted in Nigeria Tertiary Hospital by Nwadioha et al., 2010 on “A review of bacterial isolates in blood cultures of children with suspected septicemia”. The predominantly isolated gram negative bacteria, *E. coli* was sensitive to ceftriaxone and Ciprofloxacin and gram positive bacteria, *S. aureus* was sensitive to cefuroxime, ceftriaxone and clindamycin by 90% each. In the absence of antibiotic susceptibility report, ceftriaxone should be considered as a first choice of antibiotics for empirical treatment of septicemia [28].

A cross-sectional study conducted by Mezal, 2015 in Iraq on “Bacteremic Infants and Children in Basrah with Its Antibiotics Susceptibility”. Both Gram negative and Gram-positive bacteria were susceptible to gentamycin, chloramphenicol and carbanicillin. *K. Pneumoniae* had higher susceptibility to colistin sulphate (88.5%) and lower susceptibility to ampicillin and cloxacillin. *S.aureus* had higher susceptibility to gentamycin (88.9%) and ampicillin (81.5%) and lower susceptibility to colistin sulphate. *E. coli* was highly susceptible to gentamycin (80.8%) and less susceptible to ampicillin and ampicloxo[30].

Another retrospective study conducted in Saudi Arabia by Abo-Shadi et al., 2012 on “Antimicrobial Resistance in Pathogens Causing Pediatrics Bloodstream Infections in a Saudi Hospital”. Gram-positive bacteria were mostly sensitive to cephalothin (82.3%) and vancomycin (72.2%), while Gram-negative bacteria were mostly sensitive to ciprofloxacin (93%) and piperacillin/tazobactam (92.9%). There was appreciable resistance to commonly used antibiotics; and continued monitoring of antibiotic resistance is of great importance to ensure the proper use of antibiotics and to detect any increasing trends in resistance [31].

Another retrospective study conducted in Nepal by Karkiet al., 2010 on “Bacteriological Analysis and Antibiotic Sensitivity Pattern of Blood Culture Isolates in Kanti Children Hospital among”. *S. aureus* was most sensitive to chloramphenicol (88.8%), amikacin (87.5%) and ofloxacin (76.5%) and least sensitive to cloxacillin, ampicillin and penicillin. *E coli* were most sensitive to amikacin (74.7%) and ofloxacin (69.9%) and least sensitive to cephalexin, gentamycin and ampicillin. *K. pneumoniae* was most sensitive to amikacin (91.7%) and ofloxacin (87.5%), chloramphenicol (81.8%) and least sensitive to cotrimoxazole and gentamycin. It was 100% resistant to ampicillin and erythromycin. This highlights the variable nature of antibiotic susceptibility patterns both in

time and location around different geographical locations and within the same country as well [32].

Another study conducted in Nigeria, Calabar by Meremikwuet al., 2005 on “Bacterial isolates from blood cultures of children with suspected septicaemia”. *Staphylococcus aureus* was 100% susceptible to ceftriazone, cefuroxime and azithromycin. *Coliforms* were most susceptible to ceftazidime (78.8%), ceftriaxone (83.3%), cefuroxime (76.5%) and azithromycin (92.9%). *Coliforms* and *S. aureus* showed high levels of resistance to such commonly used antibiotics as ampicillin, chloramphenicol and cotrimoxazole [33].

A Prospective study conducted in Nigeria by Uzodimma et al., 2013 on “Bacterial isolates from blood cultures of children with suspected sepsis in an urban Hospital in Lagos”. The most frequent isolates were *S.aureus*, *Streptococcus spp* and *Klebsiella spp*. Both gram positive and gram negative bacterial isolates showed highest susceptibility to quinolones (77.1% and 75% respectively). Both Gram positive and Gram negative organisms showed resistance to amoxicillin- clavulanic acid and gentamicin[34].

A cross-sectional study conducted in Kenya by Ngarutya et al., 2015 on “The prevalence of bacterimia in the severely malnourished children aged 2 to 59 months at Mbagathi District Hospital, Nairobi”. Both gram positive and negative bacteria showed resistance for ampicillin and cotrimoxazole. Most of the isolates were sensitive to amoxicillin, gentamycin, and chloramphenicol [36].

A cross sectional study conducted in Ethiopia by Nigusse et al., 2015 on “Bacteriological Profile and Antimicrobial Susceptibility Pattern of Blood Culture Isolates among Septicemia Suspected Children”. The highest degree of resistance in *S. aureus* was seen against penicillin and ampicillin. *CONS* isolates were 100% resistant to ampicillin, 81.8% to penicillin and cotrimoxazole each. *S. marcescens* was found to be 100% resistance to ampicillin, on the other hands it was 100% sensitive to ciprofloxacin and nalidixic acid. For *Klebsiella spp*, ampicillin, gentamicin and ceftriaxone, the common empirically used agents for sepsis, were 100% resistance. Among the tested antibiotics the highest degree of resistance was seen against penicillin, ampicillin, gentamicin, tetracycline and cotrimoxazole. Multidrug resistance was observed among 92.7% (51 of 55) of Gram positive and Gram negative bacterial isolates [37].

3. Objectives

3.1. General objectives

To assess the bacteriological profile, associated risk factors and antimicrobial susceptibility pattern among septicemia suspected pediatrics patient who visited Zewuditu Memorial Hospital from June 5, 2016 to March 8, 2017.

3.2. Specific objectives

To identify bacteriological profile of septicemia suspected pediatrics patient.

To determine the antimicrobial susceptibility pattern of commonly isolated blood stream infecting bacteria in pediatrics patients.

To identify risk factors associated with septicemia in pediatrics patients.

4. Hypothesis

There is no difference in the bacterial profile and AST on this study and the study conducted in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia by Nigussie et al.

5. Materials and methods

5.1. Study area

The study was conducted in Zewuditu Memorial Hospital which is located in Kirkos Sub City, Addis Ababa, Ethiopia. It was built and operated by the 7th day Adventist church, but was nationalized during the Derg regime in 1976. It is administered under Addis Ababa city administration health bureau. It provides medical service mainly to the resident's of Addis Ababa and parts of the country who are referred to. The hospital has 6 wards accommodating 188 beds. Now a day, the hospital has 486 health care professionals with different levels and filed of training and 242 supportive staffs. Based on the 2014/2015 annual report the hospital provides service for 89,785 outpatients, 9163 inpatient, 3507 deliveries and 245,340 laboratory investigations. It accommodates 65 beds for pediatrics (25 NICU and 40 pediatrics wards) and provided service for 8950 outpatient and 2760 inpatient pediatrics. It is one of PEPFAR Ethiopia's largest and comprehensive HIV care and treatment sites; based on the 2014/2015 annual report it provided ART service for more than 25,000 patients. It was selected as the location for the first of a series of pilot HIV programs in July 2003; Ethiopia's first ART program started at Zewuditu Memorial Hospital with the support of CDC Ethiopia.

5.2. Study design and study period

A hospital based cross-sectional study was conducted from June 5, 2016 to March 8, 2017.

5.3. Population

5.3.1 Source Population

All pediatrics patients who visited Zewuditu Memorial Hospital during the study period.

5.3.2. Study population

All Pediatrics patientswho suspected of having septicemia.

5.4. Variables of the Study

5.4.1Independent variables:

Age, sex, underlying chronic disease, congenital anomalies, nutritional status, indwelling medical devise, weight, length of hospital stay, per-individual monthly income, hospital ward.

5.4.2 Dependant variables:

Bacterial profile and Antimicrobial susceptibility pattern.

5.5. Inclusion and exclusion criteria

Inclusion criteria

Patients less than or equal to 14 years old.

Patient's family or care-givers who agreed to participate and give informed consent.

Exclusion criteria

Patients who are taking antibiotics for the last two weeks during data collection.

5.6. Sample size determination and Sampling

5.6.1. Sample size determination

The sample size was calculated based on single sample size estimation. The value of p taken as 27.9%(0.279) from the previous study conducted by Niguse et al., 2015 on Bacteriological Profile and Antimicrobial Susceptibility Pattern of Blood Culture Isolates among Septicemia Suspected Children in Selected Hospitals, Addis Ababa, Ethiopia [37]. Considering 95% confidence interval, 5% margin of error and 27.9 % proportions, the sample size was calculated using the following standard formula.

The sample size $n = z (\alpha/2)^2 p (1-p) / d^2$

$Z (\alpha/2) = 1.96$ At 95% confidence interval Z value ($\alpha = 0.05$) = 1.96

p = Proportion of occurrence of the event to be studied 27.9 (0.279)

d = Margin of error at (5%) (0.05)

$n = (1.96)^2(0.279)(1-0.279)/(0.05)^2 = 309$

5.6.2. Sampling procedures

Convenience sampling techniques were employed to include study participants who meet the inclusion criteria until the required sample size is achieved.

5.7. Data collection procedures

5.7.1. Demographic characteristics and exposure to risk factors

Data collectors (experienced nurse and laboratory technologist) were identified, trained and informed to collect the data as per the pre-structured questionnaire. The purpose of the study as well as any related harm and benefit were explained to the study participants accordingly. Demographic data and potential risk factor of pediatric septicemia including presence of chronic disease, indwelling medical device, birth weight, pre-sample antibiotic history, length of hospital stay and per-individual monthly income data were collected by reviewing different medical

records and interview. Data on nutritional status of the mothers and pediatrics collected based on their clinical diagnosis. Since antibiotic drug treatment before taking the blood sample could compromise the culture result, those who were taking antibiotics in the last two weeks excluded from the study. But after taking the blood sample, the prescribed antibiotics were recorded.

5.7.2. Specimen collection and transportation

Using a pressure cuff, locates a suitable vein in the arm. Deflate the cuff while disinfecting the vein puncture site. The antiseptic preparations are Iodophor or Iodine tincture followed by 70% Isopropyl alcohol. Iodophors require 1-2 minutes of contact time for maximum antiseptic effect [41, 42]. On the basis of our patient age we collect 3-5 ml of blood for pediatrics. For neonates and infants the sample was taken by experienced nurse or medical doctor following the above aseptic technique. After collection, 2-3 ml of the sample was inoculated at the bed side on trypto soya broth (TSB) and 1-2ml poured into EDTA tube for CBC and blood film and then transported to the microbiology and hematology laboratory within 5-10 minutes.

5.7.3. Specimen Processing

The sample which is collected by EDTA tube used for CBC test and BF for malaria screening. CBC was done by using automated hematology analyzer (cell dyn 1800). For the screening of malaria we used 10 % giemsa staining technique on thick blood film for 10 minutes applied.

Isolation and identification

After the sample has been collected aseptically, it was inoculated at bed-side on TSB and incubated at 37°C for up to 7 days or until growth detected. Bottles observed macroscopically daily for visible evidence of bacterial growth such as hemolysis, turbidity, gas production, or formation of discrete colonies [41]. Regardless of the state of bacterial growth subcultures were made after 24 hr, 48 hr, 72 hr and finally at the 7th days onto Blood agar, and MacConkey agar, then incubated aerobically at 37°C for 24 h and Chocolate agar incubated at 37°C for 48 h at 5-10% CO₂[41, 42]. Gram stain was performed for macroscopically positive blood samples. For those having growth on the subcultured media, by isolating the pure colony biochemical tests preceded. Based on the colonial morphological characteristics and biochemical test result we identified the etiologic agent. For gram positive bacteria coagulase, catalase and manitol salt agar and for gram negative indole, citrate utilization, triple sugar iron, urea, manitole, oxidase and

motility test were performed and the organisms identified as per the standard procedures[42] (see annex 1) and the result reported accordingly(see annex 1).

Antimicrobial susceptibility test

Antimicrobial susceptibility testing's performed for isolated organisms on Kirby-Bauer's disk diffusion on MHA according to Clinical and Laboratory Standards Institute guideline (CLSI 2016) [43]. Since fastidious microorganisms like *N.meningitids* was need supplemented 5% sheep blood for DST. Antibiotic discs for antimicrobial susceptibility test were used for the bacteria isolated. Accordingly for *staphylococcus spp.* cefoxitin(30µg), clindamycin (2µg), ciprofloxacin(5µg), erythromycin(15µg), claritromycin (30 µg), chloroamphenicol (30µg), gentamicin (10µg),tetracycline(30µg), cotrimoxazole (5µg) and penicillin(10µg) used. For *Enterobacteriaceae*, cotrimoxazole (5µg), ampicillin(10µg), gentamycin (10µg), amoxillin-clavulanate (30µg), cefepim (30µg), cefotaxime (30µg), cefotetan(30µg), cefuroxime(30µg), ciprofloxacin(5µg), ceftraxion(30µg), ceftazidime(30µg), tetracyclin(30µg) and chloramphenicol used. For Viridians group, chloroamphenicol(30µg),clindamycin (2µg),erythromycin(15µg) and vancomycin(30µg) used. For *S.millieri*, chloroamphenicol(30µg), clindamycin (2µg),erythromycin(15µg),penicillin(10µg),ampicillin(10µg) and vancomycin(30µg) used. For *N.meningitids*, chloroamphenicol(30µg), ciprofloxacin(5µg), cotrimoxazole (5µg), vancomycin(30µg) andceftraxion(30µg) used.

5.8 Data management and Quality control

Data quality was ensured through use of standardized data collection materials, pretesting of the questionnaires, proper training before the start of data collection and intensive supervision during data collection by the principal investigator. For laboratory analysis pre-analytical, analytical and post-analytical stages of quality assurances that are incorporated in standard operating procedures (SOPs) of the microbiology laboratory of Addis Ababa public health research and emergency management core process was strictly followed. In addition, well-trained and experienced laboratory professionals have participated in the laboratory analysis procedure.

5.8.1. Pre-analytical phase

First we asked the participant verbally and by written consent for their willingness and then we fill all the information on the preformed questionnaire. Labeling the bottlewith patient's

identification number and then aseptically drawn by using sterile syringe. Following collection, specimens transported to the microbiology laboratory within 5-10 minutes.

5.8.2. Analytical phase

All materials, equipment and procedures were adequately controlled. Quality control of culture media was done for sterility test and the ability to grow the control bacteria strains. To standardize the inoculum density of bacterial suspension for the susceptibility test, a barium sulfate (BaSO₄) turbidity standard, equivalent to a 0.5 McFarland standard had been used and standard reference strain of American type culture collection (*S. aureus* (ATCC-25923), *E. coli* (ATCC-25922) and *P. aeruginosa* (ATCC-27853)) were used as Control bacteria strains for both media and antibiotics discs. Standard operating procedure (SOPs) of the microbiology laboratory of Addis Ababa public health research and emergency management core process was strictly followed and the results were checked by the senior microbiologist.

5.8.3. Post-analytical phase

The results were recorded with the patients' identification number. In order to avoid the errors in the results of the test, the reporting was repeatedly checked and evaluated by the head of the department before the results were given to the caregiver. Appropriate action(s) was taken when a result has serious patient or public health implications.

Every laboratory test results were interpreted based on the SOPs of Addis Ababa public health research and emergency management core process and 2016 CLSI guidelines.

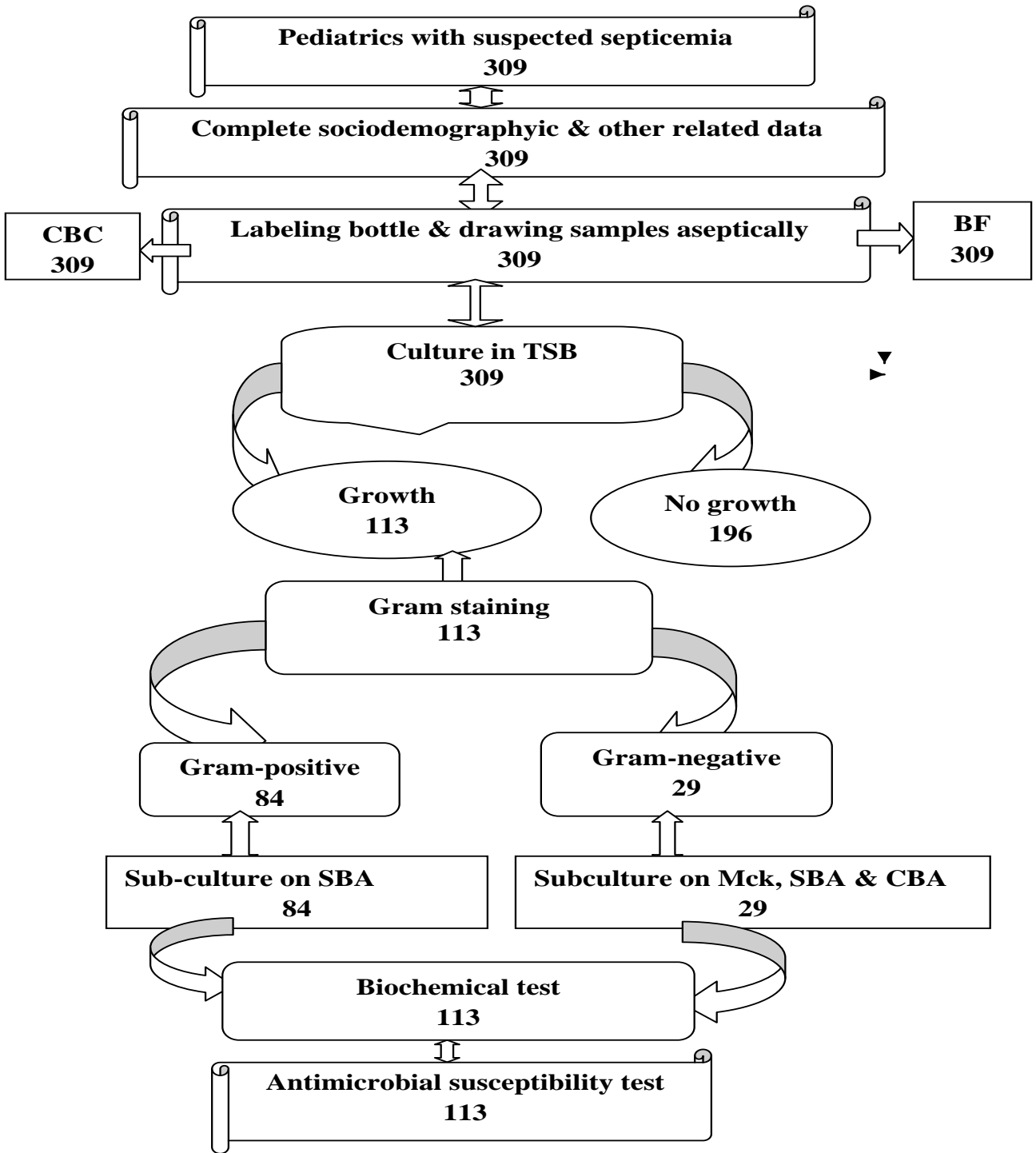


Figure 1 Work flow of the study

5.9. Data Processing and Analyses

Data entry was done with EPIINFO version 3.5.1 and exported to SPSS statistical software version 20 for analyses. The descriptive statistics were calculated & logistic regression analyses were used to see the relation between dependent variable and independent variables. The association was assessed by using chi-square test. Variables that showed a significant association were selected for further analyses. In all cases, P-value less than 0.05 considered as statistically significant. The strength of the association was interpreted using an odds ratio in a 95% confidence interval. Finally, the results presented on words, charts, graphs and tables.

5.10. Ethical consideration

This research project was approved by “DRERC” of the Department of Medical Laboratory Sciences, CHS, School of Allied Health Science, AAU and Addis Ababa Health Beuro research review committee. To conduct the study, permission was obtained from ZMH and AAPHREMCP. Study subjects recruited after they become informed about the objectives and use of the study and then after they gave informed consent. Minimal risk associated with the process of sampling; it was the same as taking specimen for culture and sensitivity in the routine laboratory. For all confirmed septicemia the responsible clinician of the study subjects informed. All the information contained within the study was kept confidential.

6. Results

6.1 Socio-demographic characteristics

During the study period, there was 309 study participant of which 169(54.7%) were male. The mean age was 390 ± 888 days, ranges 1- 5110 days. (See table 1).

Table 2 Cross tabulation of monthly income per individual and number of sisters and/or brothers with age group in sex of septicemia suspected pediatrics at Zewuditu Memorial Hospital.

Variables		Age group								
		<29 days			29-364 days			1-14 year		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Monthly income per individual in Ethiopian birr	<500	13	9	22	10	9	19	6	8	14
	500-999	31	24	55	24	28	52	17	16	33
	1000-1499	16	9	25	16	10	26	7	6	13
	1500-1999	8	6	14	4	3	7	7	4	11
	≥ 2000	2	5	7	6	1	7	2	2	4
Number of sisters and brothers	0-1	48	39	87	40	38	78	17	20	37
	2-3	15	14	29	19	12	31	20	16	36
	≥ 4	7	0	7	1	1	2	2	0	2

In this study, 26(8.4%) of the study participant was preterm birth (gestational age < 37 weeks). Moreover, 49(15.9%) of participant was LBW (<2.5kg) (see table 2).

Table 2. Gestational age and BW by sex in age groups at Zewuditu Memorial Hospital.

Variables		Age group								
		<29 days			29-364 days			1-14 year		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Gestational age(weeks)	<37	7	5	12	2	9	11	1	2	3
	≥ 37	63	48	111	58	42	100	38	34	72
Birth weight(kg)	<2.5	16	10	26	7	10	17	3	3	6
	≥ 2.5	54	43	97	53	41	94	36	33	69

Out of 309 patients investigated for blood stream infections, the commonest clinical finding was fever 206(66.7%) (auxiliary temp>37.5 °C) and the least observed jaundice 11(3.6%). (Fig. 2).

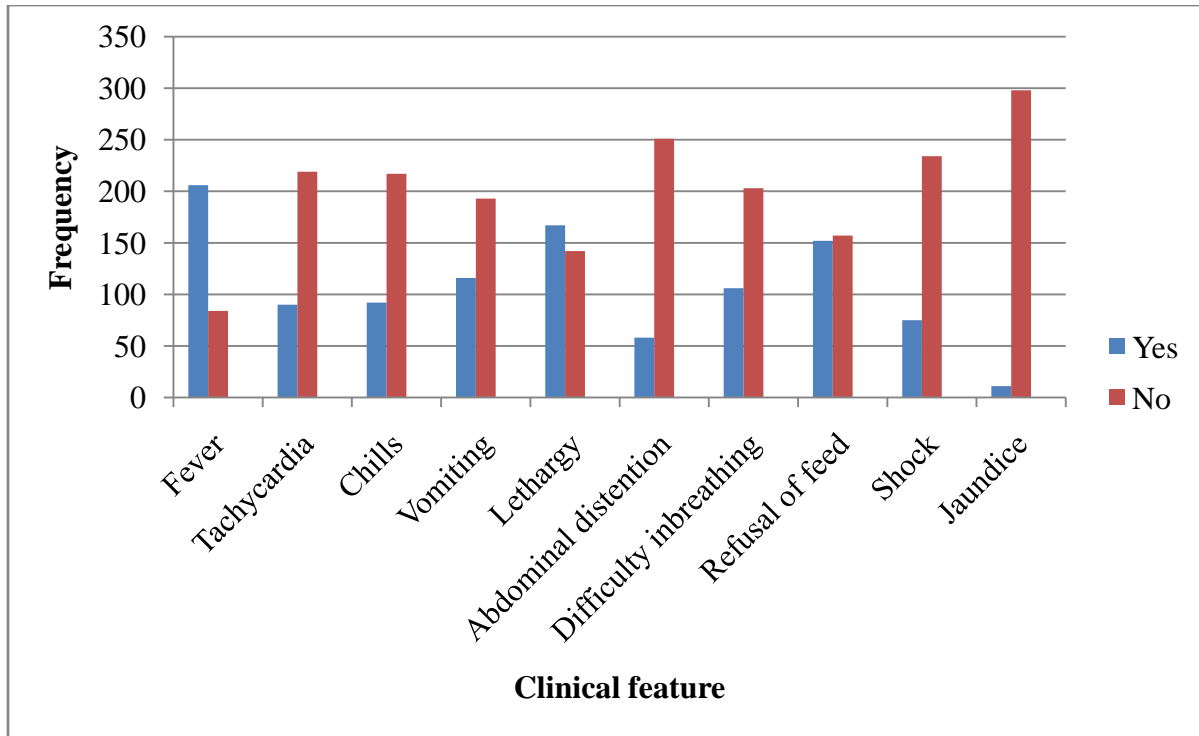


Figure 2 Bar graph showing frequency of clinical features seen in septicemia suspected pediatrics at Zewditu Memorial Hospital.

As shown in Table 3, in binary logistic regression there was a statistical significant difference between septicemia in pediatrics with fever compared to those without septicemia [COR: 2.5, 95% CI: 1.469-4.269,P=0.001]. Also shock in pediatrics were more likely septicemic compared to those without shock [COR: 1.75, 95% CI; 1.031-1.97, P =0.038]. Fever was common among bacterimic (78.7%) compared to non bacterimic (59.6%) pediatrics. Similarly 30.9% bacterimic pediatrics was in shock compared to 20.4% of non bacterimic.

Table 3 Clinical feature of septicemia and positive blood culture at Zewuditu Memorial Hospital.

Clinical feature	Total N(%)	Bacterimic N=113	Non- bacterimic 196	COR (95% CI)	p-value
Fever	206(66.7)	98(78.7)	117(59.6)	2.504(1.469-4.269)	.001
Lethargy	167(54)	61(54)	106(54)	1.004(.631-1.598)	.987
Refusal of feeding	152(49.2)	50(44.2)	102(52)	1.367(.859-2.177)	.187
Vomiting	116(37.5)	43(37.2)	73(37.2)	.966(.599-1.558)	.888
Difficulty breathing	106(34.3)	40(33.6)	66(33.6)	.927(.570-1.507)	.758
Chills	92(29.80)	28(24.8)	64(32.6)	1.544(.913-2.612)	.105
Tachycardia	90(29.1)	34(30.1)	56(28.6)	.929(.559-1.544)	.777
Shock	75(24.3)	35(30.9)	40(20.4)	1.75(1.031-2.970)	.038
Abdominal distention	58(18.8)	19(16.8)	39(19.9)	1.229(.671-2.251)	.504
Jaundice	11(3.5)	4(35.4)	7(3.6)	.682(.203-2.288)	.535

The majority of the pediatrics 251(81.2%) were inpatient (IPD and NICU) and the remaining was outpatient (OPD and Emergency). Body temperature of the study participant as shown below, about 133(43%) children had hyperthermia, 73(23.6%) had hypothermic and the remaining was febrile.

When we look the duration of admission, only 35(11.3%) of the pediatrics admitted for more than 10 days. The average duration of admission was 6.5 days with range of 0-42 days. From the total case, 161(52.1%) had nosocomial infection, and 48 (47.9%) had community acquired infection(see table 4).

As shown in table 4, using binary logistic regression model, there was a statistical significant difference between septicemia in pediatrics with sex ($p=0.03$), age ($p<0.001$), birth weight ($p<0.001$), gestational age(0.003), ward type ($p=0.002$), body temperature($p=0.006$) and type of infection(nosocomial/community acquired) ($p=0.001$) compared to those without septicemia. Neonates were five times more likely to develop septicemia than children (1-14 yr). The pediatrics who are admitted to NICU had high chance of being bacterimic compared to those who visited OPD with [COR: 5.574, 95%CI, 1.844-16.854, $P=0.002$].

Table 4 Socio-demographic characteristics and back ground information with septicemia at Zewuditu Memorial Hospital.

Variable	Total	Bacterimia (N=113)	Nobacterimia (N=196)	COR (95% CI)	P-value
Sex					
Male	169	71(62.8)	98(50)		
Female	140	42 (37.2)	98(50)	.592(.369-.950)	.03
Age					
1-14 yr	75	12(10.6)	63(32.1)		.000
29-364 days	111	41(36.3)	70(35.7)	3.075(1.485-6.367)	.000
<29 days	123	60(53.1)	63(32.1)	5.000(2.455-10.184)	.000
Monthly income Per individual(EB)					
>=2000	18	5(4.4)	13(6.6)		.237
1500-1999	32	7(6.2)	25(12.7)	.728(.193-2.750)	.640
1000-1499	64	28(24.8)	36(18.4)	2.022(.644-6.345)	.227
500-999	140	50(44.2)	90(45.9)	1.444(.487-4.287)	.508
<500	55	23(20.4)	32(16.3)	1.869(.585-5.975)	.292
Number of sister & brother					
0-1	202	81(71.7)	121(61.7)		.113
2-3	96	27(23.9)	69(35.2)	.585(.345- .990)	.046
>=4	11	5(4.4)	6(3.1)	1.245(.368- 4.215)	.725
Gestational age					
>=37 weeks	283	96(85)	187(95.4)		
<37 weeks	26	17(15)	9(4.6)	3.679(1.581-8.562)	.003
Birth weight					
>=2.5 kg	260	81(71.7)	179(91.3)		
<2.5 kg	49	32(28.3)	17(8.7)	4.160(2.184-7.922)	.000
Ward visited					
OPD	29	4(3.5)	25(12.7)		.002
IPD	111	35(30.1)	76(38.8)	2.878(.931-8.900)	.066
NICU	140	66(58.4)	74(37.7)	5.574(1.844-16.854)	.002
Emergency	29	8(7)	21(10.7)	2.381(.628-9.030)	.202
Length of hospital stay in days					
>10	274	95(84.1)	179(91.30)		
<10	35	18(15.9)	17(8.3)	.501(.247-1.017)	.056
Clinical onset					
48hr before admission	148	39(34.5)	107(54.6)		
48hr after admission	161	74(65.5)	89(45.4)	2.281(1.413-3.683)	.001
Body temperature(°C)					
36.5-38.5	103	31(27.4)	72(36.8)		.006
<36.5	73	20(17.7)	53(27)	1.141(.587-2.218)	.697
>38.5	133	62(54.9)	71(36.2)	2.314(1.249-4.289)	.008

In this study, 40(12.9%) children had underlying chronic disease. The predominantly occurred were pneumonia 21(6.8%) followed by post-operative wound infection 6(1.9%), skin infection and anemia 5(1.6%) each.

As shown below in figure 4, majority of the study group 230 (74.4%) had different kind of indwelling medical device, of which intravenous device were the most widely used 115(50%).

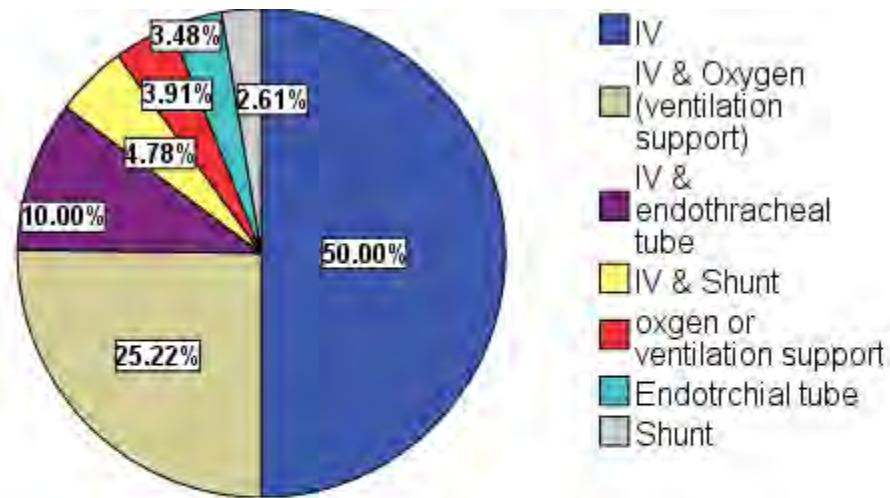


Figure 3 Proportion of indwelling medical device in septicemia suspected Pediatrics at Zewuditu Memorial Hospital.

Based on the clinical diagnosis, 33(10.7%) were malnourished but the mother's nutritional status was good 305(98.7%).

From the total studied participant, 106(34.3%) had congenital malformation, of which 54 had hydrocephalic, 42 had Myelomeningocele (MMC) and the remaining 10 were both hydrocephalic and MMC coexisted.

Regarding to malaria infestation, none of the studied patients had blood parasite of malaria. This might be due to hypo-endemicity of the study area for malaria.

Since majority of the studied participant incapable to produce their own detectable antibody before the age 18 months, only 51(16.5%) of the children HIV status known. Out of 51, 2(3.9%) of them had positive result for HIV.

The mean WBC count, Neutrophil(%), Platelet count and Hemoglobin measurement were 13.3 ± 5.65 , $46.95 \pm 11.75\%$, 375 ± 158 and 14.4 ± 3.1 mg/dl respectively. Majority of the studied

participants CBC parameter result was in the normal range. Neutrophilia associated with positive blood culture [AOR: 6.854, 95%CI, 2.640-17.793, p<0.001] (see table 6).

Table 5 Risk factors and some CBC parameter result with septicemia at Zewuditu Memorial Hospital.

Variables	Total N(%)	Bacterimia N=113	Nobacterimia 196	COR (95% CI)	p-value
Congenital anomalies					
No	203	48(42.4)	155(79)		
Yes	106	65(57.5)	41(20.9)	5.119(3.082-8.504)	.000
Underlying chronic Disease					
No	269	86(76.1)	183(93.4)		
Yes	40	27(23.9)	13(6.6)	4.419(2.174-8.985)	.000
Nutritional status					
Non-malnourished	276	95(84.1)	181(92.3)		
Malnourished	33	18(15.9)	15(7.7)	2.286(1.103-4.739)	.026
Indwelling device use					
No	79	16(14.2)	63(32.1)		
Yes	230	97(85.8)	133(67.9)	2.872(1.564-5.274)	.001
WBC($10^9/L$)					
<5	10	5(4.4)	5(2.5)		.009
5-20	270	90(79.6)	180(91.8)	.611(.144-2.602)	.505
>20	29	18(15.9)	11(5.6)	.306(.138-.674)	.003
Hgb (mg/dl)					
<11	41	19(16.8)	22(11.2)		.494
11-19	246	86(76.1)	160(81.6)	.677(.355-1.289)	.235
>19	22	8(7.1)	14(7.1)	1.063(.250-2.039)	.530
Neutrophil count (%)					
30-60	244	70(61.9)	174(88.8)		.000
<30	21	13(11.5)	8(4.1)	4.039(1.604-10.170)	.003
>60	44	30(26.5)	14(7.1)	5.327(2.665-10.645)	.000
Platlet no.($10^9/L$)					
<150	155	6(5.3)	14(7.1)		.015
150-400	20	69(61.1)	86(43.9)	1.872(.684-5.127)	.222
>400	134	38(33.6)	96(49)	.924(.331-2.581)	.880

As shown above in table 5, in binary logistic regression there was a statistical significant difference between septicemia in pediatrics with congenital anomalies, underlying chronic disease, nutritional status of the pediatrics, indwelling medical device and majority of CBC parameter compared to those without septicemia.

6.2 Predictor of positive blood culture

Findings of the multivariable logistic regression analysis to identify independent predictors of bacteraemia are shown below (table 6). Seven out of the 16 risk factor that showed significant association with bacteraemia in the univariate analysis, namely age, birth weight, source infection (nosocomial/community acquired), underlying chronic disease, congenital anomalies and neutrophil percentage were significantly associated with bacteraemia in the adjusted analyses.

Table 6 Multivariable regression analyses of predictors of septicemia in pediatrics at Zewuditu Memorial Hospital.

Variable	Total N	Bacterima N=113	Nobacterimia N=196	AOR (95% CI)	COR	p-value
Sex (Female)	140	42 (37.2)	98(50)	.569(0.296-1.093)	.592	.090
Age						
1-14 yr	75	12(10.6)	63(32.1)			.022
29-364 days	111	41(36.3)	70(35.7)	3.334(1.119-9.935)	3.07	.031
<29 days	123	60(53.1)	63(32.1)	9.667(1.85-50.56)	5.00	.007
Gestational age						
<37 weeks	26	17(15)	9(4.6)	2.518(0.794-7.984)	3.68	.117
Birth weight						
<2.5 kg	49	32(28.3)	17(8.7)	4.094(1.639-10.229)	4.2	.003
Ward visited						
OPD	29	4(3.5)	25(12.7)			.328
IPD	111	35(30.1)	76(38.8)	.481(0.094-2.471)	2.88	.381
NICU	140	66(58.4)	74(37.7)	.316(0.041-2.420)	5.57	.316
Emergency	29	8(7)	21(10.7)	1.330(0.213-8.298)	2.38	.760
Infection source						
Nosocomial	163	74(65.5)	89(45.4)	2.120(1.014-4.434)	2.28	.046
Body temperature						
36.5-38.5	103	31(27.4)	72(36.8)			.780
<36.5	73	20(17.7)	53(27)	1.073(0.403-2.854)	1.14	.888
>38.5	133	62(54.9)	71(36.2)	1.339(0.500-3.588)	2.31	.561
Fever	225	98(86.7)	127(64.8)	1.693(0.644-2.639)	2.50	.461
Shock	75	35(30.9)	40(20.4)	1.304(0.644-2.639)	1.75	.461
Underlying disease	40	27(23.9)	13(6.6)	3.540(1.254-9.996)	4.42	.017
Indwelling device	270	97(85.8)	133(67.9)	1.344(0.581-3.105)	2.87	.490
Congenital anomalies	106	65(57.5)	41(20.9)	3.808(1.937-7.487)	5.12	.000
Nutritional status						
Malnourished	33	18(15.9)	15(7.7)	1.978(0.681-5.741)	2.28	.210
WBC($10^9/L$)						
<5	10	5(4.4)	5(2.5)			.168
5-20	270	90(79.6)	180(91.8)	.196(.030-1.285)	.610	.089
>20	29	18(15.9)	11(5.6)	1.546(.037-2.519)	1.64	.270
Neutrophil (%)						
30-60	244	70(61.9)	174(88.8)			.000
<30	21	13(11.5)	8(4.1)	2.798(0.857-9.131)	4.04	.088
>60	44	30(26.5)	14(7.1)	6.854(2.640-17.793)	5.33	.000
Platlet($10^9/L$)						
<150	20	6(5.3)	14(7.1)			.062
150-400	155	69(61.1)	86(43.9)	2.292(.627-8.381)	1.87	.210
>400	134	38(33.6)	96(49)	1.082(.945-3.479)	.924	.908

6.3 Bacterial profile of septicemic pediatrics

Out of 309 studied participant, 113(36.6%) had bacterial growth of which 72 were male and 41 were female. From culture positive, 84(74.3%) gram positive and 29(25.7%) gram negative. From the positive isolate, 74pediatrics had nosocomial infection and 39had community acquired infection.

The predominantly isolated bacteria was *S.aureus* 57(50.4%) and followed by *CONS* and *K.pneumoniae*,25(22.1%) and 21(18.6%) respectively. Since *CONS* are normal flora of the skin and causes contamination of sample, for the interpretation of culture result we consider clinical history, presence of indwelling medical device, congenital anomalies and underlying chronic disease.

Bacterial isolation based on age classification as shown in (Table 7) the number of isolation of each bacteria was inversely proportional with the age of pediatrics. The predominance of bacterial isolation based on age classification didn't vary. The majority of the bacteria 60 (53.1%) were isolated from neonate. The isolation of *CONS*was very high among neonate 19/25(76%). Regardless of sex; *S.aureus* , *K.pneumoniae* and *E.coli* isolated from all age group but *CONS* isolated only from neonate and infant.

Majority of the bacteria isolated from in patient, NICU (66) and IPD (35). Similarly, 51/57 (89.4%) of the isolated *S.aureus* and 24/25(96%) of *CONS* were recovered from in patient. Except emergency, in all wards the count of isolated bacteria of male was higher than female. In all ward the predominant bacteria was *S. aures* but for those female who were admitted to NICU the predominant bacteria was *CONS*.

K.pneumoniae was recovered from all wards among male pediatrics patient but for female, it was not recovered from outpatient.

Except IPD, *E.coli* was recovered from all wards with predominantly isolated from NICU (3/5) (see table 7).

Table 7 Distribution of isolated organism with sex, age and ward of septicemia suspected pediatrics at Zewuditu Memorial Hospital.

Variables		Organisms isolated								
Sex	Age	<i>S.aureus</i>	<i>CONs</i>	<i>K.pneumonia</i>	<i>E.coli</i>	<i>Acinitobacter</i>	<i>Viridians group</i>	<i>S.millieri</i>	<i>N.meningococcus</i>	Total
Male	<29	22	11	4	2	0	0	0	0	39
	29-364	14	4	7	1	0	0	0	1	27
	365-5110	3	0	1	0	1	0	0	0	5
	Total	39	15	12	3	1	0	0	1	71
Female	<29	5	8	7	1	0	0	0	0	21
	29-364	8	2	2	0	1	0	1	0	14
	365-5110	5	0	0	1	0	1	0	0	7
	Total	18	10	9	2	1	1	1	0	42
Male	Ward									
	OPD	1	0	1	1	0	0	0	0	3
	IPD	13	2	5	0	1	0	0	1	22
	NICU	24	12	4	2	0	0	0	0	42
	Emergency	1	1	2	0	0	0	0	0	4
Total	39	15	12	3	1	0	0	1	71	
Female	OPD	1	0	0	0	0	0	0	0	1
	IPD	7	2	2	0	1	1	0	0	13
	NICU	7	8	7	1	0	0	1	0	24
	Emergency	3	0	0	1	0	0	0	0	4
	Total	18	10	9	2	1	1	1	0	42

6.4 Antibiotic resistance pattern of the isolates.

After the patient given blood sample, the frequent empirically prescribed antibiotics were ceftraxion 177(57.3%), gentamycin 125(40.5%), ampicillin 95(30.7%) and cloxacillin and clindamycin 89(28.8%) each. The least frequently prescribed were cotrimoxazol and cefotaxim 8(2.6%) each and chloramphenicol 7(2.3%). To increase the synergistic effect of the drugs, ceftriaxon was prescribed in combination with other antibiotics. Most of the time, it was given with clindamycin(70 times), cloxacillin (54 times), ampicillin (28 times) and gentamycin (25 times).

According to our finding, 89.3% of the bacterial isolates showed multi drug resistance (resistance for 3 or more drugs) *Enterobacteriaceae* showed 100% MDR (see table 8).

Table 8 Multi drug resistance (MDR) level of the bacterial isolate from blood among septicemia suspected pediatrics at Zewuditu Memorial Hospital.

Variables	<i>s. aureus</i> (57)	<i>CONS</i> (25)	<i>Viridians grou</i> (1)	<i>S. milleri</i> (1)	<i>K. pneumonia</i> (21)	<i>E. coli</i> (5)	<i>Acinobacter</i> (2)	<i>N. meningitides</i> (1)	Total(113)
Resistance for 3 or above antibiotics N (%)	51 89.4%	22 88%	0(0%)	0	21 100%	5 100%	2 100%	0	101 89.3%
Resistance for <3 antibiotics N(%)	6 10.6%	3 12%	1 100%	1 100%	0	0	0	1 100%	12 10.7%

The overall antibiotics resistance was 67.9% (see table 9). From the antibiotics tested for both gram positive and negative (95.5% of the bacterial isolate), high resistance was seen against cotrimoxazole (91.8%) and low resistance was seen for chloramphenicol (50.4%). From the bacterial isolates, poor antibiotic sensitivity was seen for *K.pneumoniae* with 73.7% resistivity and good sensitivity was seen for *S.millieri* (16.6% resistance).

The most frequently isolated bacteria were *S.aureus* which has showed resistance for cotrimoxazole, penicillin, gentamycin, oxacillin, tetracycline and erythromycin. The second predominantly isolated bacterium, *CONS*, also had resistance to penicillin, cotrimoxazole, oxacillin, erythromycin, gentamycin, tetracycline and clarytromycin. For gram positive bacteria clindamycin has showed high sensitivity with 86% and 92% for *S.aureus* and *CONS* respectively. Subsequently, chloramphenicol has showed 50.87% and 56% sensitivity for *S.aureus* and *CONS* respectively.

The most commonly isolated gram negative bacteria; *K.pneumoniae* was resistant for many of the antibiotics. It has showed resistance for ampicillin (100%), cotrimoxazole (90.5%), gentamycin (71.4%), chloramphenicol (62%), tetracycline (85.7), cefepime (81%), amoxicillin(85.7%), cefixime (90.7%), ceftazidime (85.7) and cefuroxime(76.2%). *K.pneumoniae* had a good response for cefotetan, ciprofloxacin and ceftraxion(see table 9).

Table 9 Antimicrobial resistance levels of bacterial isolates from blood among septicemia suspected pediatrics at Zewuditu Memorial Hospital.

ANTIBIOTICS	<i>S. aureus</i> (57)	CONS (25)	<i>s. milleri</i> (1)	<i>Viridians strept.</i> (1)	<i>K. pneumoniae</i> (21)	<i>E. coli</i> (5)	<i>Acinetobacter</i> (2)	<i>Neisseria meningitidis</i> (1)	Total (113)
CHL	28(49.13)	11(44)	0(0)	0(0)	13(62)	3(60)	NA	0(0)	50.4
CLN	8(14)	2(8)	0(0)	1(100)	NA	NA	NA	NA	13
ERY	41(72)	22(88)	1(100)	1(100)	NA	NA	NA	NA	77.3
P	46(80.7)	24(96)	0(0)	NA	NA	NA	NA	NA	84.3
GEN	46(80.7)	21(84)	NA	NA	15(71.4)	1(20)	2(100)	NA	77.2
CLM	36(63.2)	19(76)	NA	NA	NA	NA	NA	NA	67
TE	42(73.7)	21(84)	NA	NA	18(85.7)	4(80)	1(50)	NA	78.2
OXA	44(77.2)	23(92)	NA	NA	NA	NA	NA	NA	81.7
CPR	28(49.13)	13(52)	NA	NA	10(47.6)	3(60)	0(0)	1(100)	49.5
COT	50(87.7)	24(96)	NA	NA	19(90.5)	5(100)	2(100)	1(100)	91.8
AMP	NA	NA	0(0)	NA	21(100)	4(80)	2(100)	NA	93.1
VAN	NA	NA	0(0)	0(0)	NA	NA	NA	0(0)	0
CFP	NA	NA	NA	NA	17(81)	3(60)	1(50)	NA	75
CTT	NA	NA	NA	NA	7(33.3)	1(20)	NA	NA	30.7
AMC	NA	NA	NA	NA	18(85.7)	4(80)	2(100)	NA	85.7
DOX	NA	NA	NA	NA	NA	NA	2(100)	NA	100
CRO	NA	NA	NA	NA	10(47.6)	3(60)	0(0)	0(0)	44.8
CXM	NA	NA	NA	NA	19(90.5)	5(100)	NA	NA	92.8
CAZ	NA	NA	NA	NA	16(76.2)	5(100)	1(50)	NA	78.5
CRX	NA	NA	NA	NA	18(85.7)	5(100)	NA	NA	88.4
Total	64.7	72	16.6	50	73.6	70.7	70.8	40	67.9

NA-not applicable, CHL-Chloramphenicol, CLN-Clindamycin, ERY-Erythromycin, P-Penicillin, GEN-Gentamycin, CLM-Clarithromycin, TE-Tetracyclin, OXA-Oxacilin, CPR-Ciprofloxacin, COT-Cotrimoxazole, AMP-Ampicillin, VAN-Vancomycin, CFP-Cefepime, CTT-Cefotetan, AMC-Amoxicillin clavulinate, DOX-Doxycyclin, CRO-Ceftriaxon, CXM-Cefixime, CAZ-Ceftazidime, CRX-Cefuroxim.

7. Discussion

Prompt diagnosis and effective treatments are necessary to prevent complications and to reduce mortality from BSI. On the basis of prior knowledge of common causative agents and their susceptibility to prescribed antibiotics, empiric therapy is started and later changed according to the final culture and susceptibility result. The result of this study demonstrated that the profile of microbial isolates causing septicemia, associated risk factor of pediatrics septicemia and their susceptibility pattern to most commonly used antimicrobial agents.

During the study period, from 309 study participant the number of male were more than female with, 169 (54.7%) and 140 (45.3%) respectively which was consistent with previous studies in Ethiopia [2, 37], Nigeria [4, 25, 33], Tanzania [6], Iran [23] and Kenya [36]. In relation to septicemia with sex, in our study the positivity rate among male was higher (42%) than female (30%), but in another study done in Ethiopia [37], the positive rate was comparable in sex (male 27.3% vs females 28.6%). Sex hadn't statistical significant with septicemia whereas the study done in Uganda [20], sex was significantly associated with septicemia.

Based on clinical age classification, bacterial septicemia was 48.8% for neonate, 36.9% for infant and 16% for children which was comparable with the study done in India 56%, 31% and 13% respectively [5]. This high rate septicemia among neonate (48.8%) was relatively similar with the study done in Iran 43.3% [23] and India 52.6% [35] but quite smaller than other study done in India 82.3% [39] and relatively larger than the study of India 39.9% [9] and Ethiopia 32.1% [10]. Based on the study we did, age group of the pediatrics were statistically significant with septicemia ($p=0.022$) but in another study done in Ethiopia [2] didn't had statistical significance difference ($p=0.695$). In contrary, another study done in Nigeria [25], the highest proportion of septicemia was seen in children than neonate. This high positive rate among neonate may be due to poor immune response at early age of pediatrics or high incidence of congenital anomalies with the age decreasing (48.8% neonate, 34.2% infant and 10.6% children had congenital abnormality) or due to high usage of indwelling medical device with the decreasing age of the pediatrics (100/123 (81.3%) neonate, 92/111 (82%) infant and 38/75 (50.6%) children) were used. In this study, 10.6% of the pediatrics was malnourished which was somewhat lower than the study of Tanzania (15.5%) [6]. The nutritional status of the pediatrics was not associated with septicemia in multi logistic regression.

Fever was frequently observed (72.8%) clinical feature which was comparable with the study done in Nigeria 85% [34] but quite higher than the study done in Ethiopia (47.8%) in which tachypnea (51.7%) was the predominant clinical feature [37]. Subsequently, lethargy (54%), refusal of feeding (49.2%), vomiting (37.5%), difficulty in breathing (34.3%), chills (29.8%), tachycardia (29.1%), shock (24.3%), abdominal distention (18.8) and jaundice (3.5%) of the study participant were showed such clinical manifestation. Fever and shock showed association with septicemia in binary logistic regression but not on multi logistic regression. A study done in Nigeria [36], vomiting and diarrhea were associated with septicemia but not in ours.

As we had seen in a univariate logistic regression, indwelling device were significant for septicemia ($p=0.001$) but not in multivariate. In a cross tabulation, those who had not indwelling medical device, the prevalence of bacterial septicemia were relatively low (20.2%) compared to those who had indwelling medical device (36.8%). Moreover, those who had a single indwelling medical device had a low percentage of bacterial growth 31.8% (44/138) compared to those who had multiple indwelling device 43.8% (43/98). This is because of the bacteria could get more access point of entry to the blood stream. It indicates how much indwelling medical devices were exposing factor for pediatrics septicemia. In this study 66.9% (207) of the studied participants used IV device which is comparable with other study (64.2%) [37].

Congenital abnormality was highly associated with positive blood culture [AOR: 3.8, 95%CI, 1.937-7.487; $p<0.001$]. The most frequently seen congenital anomalies in our locality were Hydrocephalic and Myelomeningocele (MMC). This is because of the study site is one of the referral center nationally for such cases. These cases allow the patient for prolonged admission and the procedure used to manage such abnormality with the poor immune response of the pediatrics favored for these significant associations.

In our study, gestational age was not significantly associated with septicemia ($p=0.117$) as the study done in Baghdad [1], Sudan ($p=0.984$) [12] and Ethiopia ($p=0.695$) [38] but in another study done in India [39] gestational age was strongly associated with positive blood culture. For this difference, the possible reason might be difference in ANC follow up, percentage of health facility based delivery and the care and treatment of the preterm.

Birth weight of the pediatrics has a great influence for their well-being. Due to low birth weight, many of the pediatrics suffer from high range of morbidity and mortality. Thus, they need special attention and care for their survival. In our study, birth weight was associated with septicemia which is line with the study done in India, Iraq and Ethiopia [19, 38 and 39]. Pediatrics with low birth weight (<2.5 kg) were four times more likely to develop septicemia than normal birth weight.

In this study, from the positive cases 74(65.5%) of them were due to nosocomial infection. It was comparable with the study of Saudi hospital (63%) [31]. It has been significantly associated with septicemia ($p=0.046$). Similarly the study done in South Africa referral hospital [24], nosocomial infection was statistically significant for positive blood culture.

In this study, malaria were not obtained on the blood film microscopy, but in the study conducted in Tanzania [15], a positive malaria slide was predictor of septicemia ($p<0.001$). This difference might be due to hypo-endemicity of malaria in our locality.

From the total studied participant, 40(12.9%) had underlying chronic disease, out of which 27(67.6%) were culture positive. As a result, underlying chronic disease was significantly associated with septicemia. Since such underlying disease compromised the immunological barrier of the pediatrics and allow the patient for extra admission and then exposed for nosocomial infection. Those who had chronic disease were three times more likely developed septicemia than those who are free from underlying chronic disease which was statistically significant ($p=0.017$).

Additionally in this study, in binary logistic regression, hyperthermic ($>38.5^{\circ}\text{C}$) were statistical significant but not in multi logistic regression. Also neutrophil percentage was significantly associated with septicemia ($p<0.001$), those who had high percentage of neutrophil ($>60\%$) (neutrophilia) were six times more likely developed septicemia than normal neutrophil percentage(30-60%). On the same manner, neutrophil percentage and hyperthermic were predictor of septicemia in the study conducted in Tanzania [15] with $p<0.001$ for both. But a study done in Ethiopia, neutrophil percentage was not associated with septicemia ($p=0.489$) [37]. This difference might be due to the difference in acuteness or chronicness of the case. Because of

neutrophilia occurred in acute infection than chronic infection. Our report indicates that neutrophilia (>60%) give a clue for empiric treatment of septicemia until culture result obtained.

In this study, culture positivity rate was 36.5% which is quite similar to the study done in Nigeria (35%) [34] and Uganda (37%) [20]. But it was high compared to the study done in Ethiopia (27.9%) [37], Tanzania (6.6%) [15], South Africa (5.5%) [24], Nigeria (11.5%)[25] and low compared to the study done in India(43.7%) [29] and Iraq (88.2%) [30]. For this difference, many factors might be contribute like difference in the study time and place, infection prevention policy of the facilities, the exclusion of clients who take antibiotics for the last two weeks and age of the participant.

Although in most studies the predominant etiologic agent for BSI was gram negative [10, 25, 28] but in our study the predominant agent was gram positive like the study done in India [29] and Saudi Arabia [31]. In this study, the predominant gram positive bacteria was *S. aureus* and gram negative bacteria was *K.pneumoniae* which is in line with the study done in India [14] , Tanzania [6] and Nigeria [25] but in other studies, the predominant gram positive isolate was *CONs*[2,31] and gram negative was *E.coli* [28,32].These observed differences could be attributed to several factors like underlying clinical conditions, virulence factors of the bacterial pathogens and the immune status of the patients.

Now a day, multi drug resistance is a big challenge worldwide, especially in developing country due to resource shortage, poor health service setup and irrational use of antibiotics. In our study, most of the isolates showed multiple drug resistance. Antimicrobial resistance levels for the gram positive and gram negative isolates ranges from 0-100% which was comparatively similar with the study findings in Ethiopia [2]. As we had seen in this study, multi-drug resistance (resistance for 2 and above drugs) was 89.3 % which is comparable with the study done in Ethiopia [2, 37] with 89.1% and 92.7% respectively but the study done in South Africa, Johannesburg [11] was relatively low (32.5%).This difference might be due to difference in antibiotic prescription policy, misuse and inappropriate usage of the antibacterial agents, infection prevention policy, resource and capacity. As a result such difference might cause for the transcription of a very high resistance gene pool which in turn results for this high multi-drug resistance of the bacteria [2].

The antimicrobial susceptibility pattern was done based on the SOPs of AAPHECP which is customized from CLSI 2016 guideline. There were drugs which tested for their response against only gram positive or gram negative. Also there were antibiotics which tested for both gram positive and negative bacteria. The better antibiotics for both gram negative and positive were ciprofloxacin with 50.5% sensitivity but these figure were high (80%) in previous study [28]. whereas chloramphenicol (50.4%), gentamycin (77.2%), tetracyclin (78.2) and cotrimoxazole (91.8%) were showed resistance for both. This was similar with the study of Nigeria [25]. The result indicates the gradual increment of drug resistance when we compared with previous study done in Ethiopia and Nigeria [2, 28].

In our study, the most effective antibiotic against *S.aureus* was clindamycin (86% sensitivity) which was comparable with the study of Nigeria [28](90%), India (70%) [5] and Iran [23]. But resistance was seen in the study of Baghdad [1] (60% resistance). Another option for the treatment of *S.aureus* was ciprofloxacin(50.87% sensitivity) but the study of Iran [23] was showed higher sensitivity pattern (80%) for ciprofloxacin. Additionally chloramphenicol was showed 50.87% sensitivity. But *S.aureus* was resistance for cotrimoxazole(87.7%), penicillin and gentamycin (80.7% each), oxacillin (77.2%), tetracyclin (73.7%) which was similar to other study of Ethiopia [37].

The second predominant gram positive bacteria, *CONs* were highly sensitive for clindamycin (92%) like the study of India and Iran [5, 23] and moderately sensitive for chloramphenicol (56%). Whereas it was highly resistance for cotrimoxazole (96%) and erythromycin (88%) this is in line with the study of Nigeria [4]. Moreover, *CONs* were resistance for penicillin (96%), oxacillin (92%), and gentamycin (84%). *Streptococcus viridian* was sensitive for chloramphenicol and vancomycin but resistance to clindamycin and erythromycin. *S.milleri* was sensitive for chloramphenicol, clindamycin, penicillin, ampicillin, and vancomycin. But it was resistance for erythromycin. Even though, clindamycin was effective for the treatment of gram positive; it was prescribed empirically after sample collection only for 28.8% of the study participant. On the other hand gentamycin was prescribed empirically for 40.5% of the pediatrics, but it was not effective for the treatment of both gram positive and gram negative, except for *E.coli*.

In our study, cefotetan was effective (69.2%) for the treatment of gram negative but in the study of Trinidad [16] effective antibiotics was ciprofloxacin. Ceftraxion was moderately sensitive (55.2%) for gram negative but in other study conducted in Uganda [20]ceftraxion was 100% sensitivity. Additionally, ciprofloxacin (51.7%) were showed moderate sensitivity for gram negative. Commonly empirically prescribed antibiotics, ampicillin and cotrimoxazole showed high percentage of resistance (93.1%) for gram negative which was in line with the study of Uganda and India [20, 29]. Even though, ampicillin was empirically prescribed for 30.7% of the peditrics, 100% resistance was seen by *K.pneumoniae*. Additionally, *K.pneumoniae* was highly resistance for cotrimoxazole which was comparable with the previous study done in Tanzania and Iraqi [15, 19]. Except ceftraxion,cephalosporins were resisted by *K.pneumoniae* but in other study done in India they were sensitive for *K.pneumoniae*[14, 28]. *K.pneumoniae* was sensitive for ciprofloxacin,which is similar with the study of Nigeria [28].

The second most common isolated gram negative bacteria, *E.coli* , was effectively treated with gentamycin and cefotetan. In contrary, it was 100% resistance for many of the cephalosporins and cotrimoxazole. But in the study of Uganda [20], it was showed high level of sensitivity (100%) for cephalosporin (ceftraxion and ceftazidim). Resistance of *Enterobacteriaceae* for cephalosporins were also shown in the study of Lahore [8].This high rate of resistance for cephalosporins could be due to the abundant usage of 3rd generation cephalosporins in the hospital [8].

Acinetobacter was 100% resistance for, gentamycin, cotrimoxazole, ampicillin, amoxillin-cavulinate and doxycyclin. But it was 100% sensitive for ciprofloxacin and ceftraxion which was comparable with the study of Iran [23].

The main forces driving the increase in antimicrobial resistant of bacteria were poor infection control practices and inappropriate use of antibiotics. Specific antibiotic utilization strategies like antibiotic restriction, combination therapy and antibiotic cycling may help to decrease or prevent the emergence of resistance.

8. Limitation

To increase the sensitivity and specificity we don't use two sided sample due to difficulty in sampling in pediatrics

We didn't try to isolate anaerobic bacteria and fungi due to lack of the set up in the working area.

9. Conclusion

In this study, the overall prevalence of septicemia was 36.5%. Gram positive was the commonest causative agent of pediatric septicemia than gram negative. The predominantly isolated gram positive and negative bacteria were *S.aureus* and *K.pneumoniae* respectively. Birth weight, underlying chronic disease, congenital anomalies, neutrophil percentage, type of infection (nosocomial/community acquired) and age of the pediatric were predictor of septicemia. Majority of the isolate showed high resistance for most of the antibiotics and also the multi drug resistances of the isolate were extremely high. In conclusion, the result of our study emphasizes the need for continuous evaluation of local antibiotic sensitivity patterns of pathogens for the formulation of a rational antibiotic policy.

10. Recommendation

Regular and continuous surveillance of bacteria and their AST pattern must be studied. Based on the findings, each facility must be customized their own rational antibiotics use.

Even though the government is working to improve the health of under-five pediatrics, this study indicates that the government still has a big assignment in antenatal care and postnatal care service which helps for the improvement of pediatrics health. Mothers who had not regular ANC and PNC follow up couldn't detected for early sign and symptom of infection and it will results for further complication like septicemia.

Because of high incidence of septicemia has found in NICU and in Inpatient department (IPD), special attention has to be given regarding to infection prevention control, antibiotic prescription policy, and supply and logistic.

Epidemiological surveillance studies on a countrywide basis are required to provide useful information to guide practice and policies on rational use of anti-microbial agents.

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Annexes

Annex 1: English version of participant information sheet, assent, consent & questionnaire

I. Participant information sheet

Department of Medical Laboratory Science, Collage of Allied Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

Title of the Research Project: Bacteriological Profile, Antimicrobial Susceptibility Pattern and Associated Risk factor of Septicemia Suspected Pediatrics at Zewuditu Memorial Hospital, Addis Ababa, Ethiopia.

First of all I would like to thank you in advance for your cooperation and consent in participation in this study. Please read or listen when it is read for you about the general information of the study. If you have any question regarding the study please ask freely.

Background information

Background: Pediatrics septicemia causes high morbidity and mortality worldwide especially in developing country. Several risk factors have been identified both in the neonates and children, which make them susceptible to infections. Therefore the knowledge of the causative agents of pediatrics septicemia and antimicrobial susceptibility pattern will be helpful in the control and selection of empiric antimicrobial therapy.

Aim of the study

The purpose of this study is to determine Bacteriological Profile, Antimicrobial Susceptibility Pattern and Associated Risk factor of Septicemia among pediatrics(less than or equal to 14) at Zewuditu Memorial Hospital, Addis Ababa, Ethiopia.

Benefits for participants

Study participants will not have any financial incentives or other inducements from participating on this study. However, based on the diagnosis result you will be treated accordingly. Most importantly, the result of the study will be beneficial to design effective prevention and control measure for pediatrics septicemia. Hence, you are indirectly benefiting other patients and the society in this respect.

Risks and complication

There are no anticipated risks to your participation. As routine laboratory procedure blood sample will be taken once from your peripheral vein. During sample collection you may feel some discomfort but this does not produce serious pain.

Confidentiality

There is no sensitive issue that you will be asked related with your social desirability but any information that is obtained in connection with this study and that can be identified with you will remain confidential. Participants will not be prohibited to stop or withdraw at any time from the study. Only interested participants can retrieve their own lab result using their code number. The information collected about you will be coded using numbers. No personal information will be disclosed to third party or will not appear in any report from this study.

Assurance of Principal Investigator

I put my signature below to confirm you that I take over the responsibility for the scientific ethical and technical conduct of the research project and for provision of progress reports for all stakeholders of the research project.

Daniel Tsega(PI)

Signature: _____ Date: _____

Note: If you have any questions about this study, you should feel free to ask now or anytime throughout the study by contacting

PI Address: Daniel Tsega: Department of Medical Laboratory Sciences, Collage of Allied Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

E-mail: danitsega03@gmail.com Mobile-0913308205

Department of medical laboratory sciences, CHS, AAU, Tel-0112755170

II. Assent form

We are doing this research to find out more about pediatrics blood stream infection and the choice that you have to take part in it is up to you. We would still take good care of you no matter what you decide. We want you to ask us any questions that you have any time. If you decide to be in the research, you may need a needle poke so we could test some of your blood. We would ask you to read questions on a piece of paper. Then you would mark your answers on the paper. A person on the research team would ask you questions. Then you would say your answers out loud. We will look at your past doctor visits and use information about your care. Some of the questions might be hard to answer. You can say 'no' to what we ask you to do for the research at any time and we will stop. This research will not help you and you would not be paid. But we hope it will help other kids who have disease like you do. It is also OK to say yes and change your mind later. You can stop being in the research at any time. If you want to stop, please tell the researcher. Take the time you need to make your choice. If you want to be in the research after we talk, please sign below. We will write our name too. This shows we talked about the research and that you want to take part. I _____ hereby give my consent for giving of the requested information and blood for this study

Participant code _____ Signature _____ date _____

50. Consent form

I have been informed about the study which plans to determine the Bacteriological Profile, Antimicrobial Susceptibility Pattern and Associated Risk factor of Septicemia Suspected Pediatrics at Zewuditu Memorial Hospital. The objective and the application of the study were briefly explained to me. Moreover, I have been well informed of my right to refuse information, decline to cooperate and drop out of the study if I want and none of my actions will have any bearing at all on my child's overall health care. It is therefore with full understanding of the situation that I agreed to give the informed assent voluntarily to the researcher to give my child's blood for the mentioned study. I agreed that the specimen would be tested for septicemia. I have had the opportunity to ask questions about the project and received clarification to my satisfaction in a language I understand. I was also informed that results for the analysis of blood will be given to the Doctor who follow my child and that I may ask the information if I want.

I _____ hereby give my assent for giving of the requested information and my child's blood for this study.

Participant code: _____ Signature: _____ Date: _____

V. Questionnaire

Addis Ababa University Collage of Health Sciences, School of Allied Health Science Department of Medical Laboratory Science. Questionnaire for the demographic characteristics and assessment of risk factors of pediatrics septicemia who visited Zewuditu Memorial Hospital.

Patient Identification

Facility name _____ Year _____ Participant code _____

Participants address(Sub city) _____ Telephone _____ signature _____

Name of the ward _____ Block _____

Data collector name _____ date _____ signature _____

I. Socio- Demographic Characteristics of the Study participants.

1. Age _____
2. Sex 1) Male 2) Female
3. Monthly income per individual (in Ethiopian birr) _____
4. Number of Sisters and Brothers _____

II. Septicemia associated questions

5. Ward of the pediatrics
 1. OPD 2. IPD 3. NICU 4. Emergency
6. Date of admission (in the hospital)(dd/mm/yy) _____
7. When did the patient manifest the clinical future of septicemia?
 1. 48 hr before admission 2. 48 hr after admission
8. Clinical features of the pediatrics
 1. Fever
 2. Vomiting
 3. Chills
 4. Tachycardia
 5. Lethargy
 6. Abdominal distension
 7. Refusal of feeds
 8. Difficulty in breathing
 9. Jaundice
 10. Shock

9. Body temperature

1. $<36.5^{\circ}\text{C}$

2. $>38.5^{\circ}\text{C}$

10. Is there any underlying chronic disease (pneumonia, wound infection, anemia etc...)

1. Yes

2. No

11. If you say yes for "10" specify_____

12. HIV status of the pediatrics

1. Positive

2. Negative

13. Is there any indwelling medical device?

1. Yes

2.No

14. If you say yes for no.13, what kind of device?

1. Intravenous devices

3. Urinary catheters

5. Other

2. Endotracheal

4. Ventilator support

15. Antibiotics given after sampling_____

16. Nutritional status of the pediatrics?

1. Malnourished

2.Non malnourished

17. Nutritional status of the mother

1. Malnourished

2.Non malnourished

18. What is his/her birth weight?

1) $<2.5\text{ Kg}$

2) $> 2.5\text{ Kg}$

19. Gestational age

1) $<37\text{ weeks}$

2) $>37\text{ weeks}$

20. Is there any congenital a

1. Yes

2. No

IV. Laboratory Data

21. Date of specimen collection_____

22. BF result_____

23. CBC result_____

24. Platlet count_____

25. Neutrophil count_____

26. Hemoglobin result _____

27. Media used _____

28. Gram stains result _____

29. Biochemical test _____

30. Organism isolated _____

31. Drug susceptibility pattern

a. Sensitive to _____

b. Intermediate to _____

c. Resistance to _____

V. Comments _____

Name of principal investigator _____

Signature _____ Date _____

Annex 2: Procedure for specimen collection, processing and result interpretation

I. Laboratory procedure for collection and culturing of Blood

1. Using a pressure cuff, locate a suitable vein in the arm. Deflate the cuff while disinfecting the vein puncture site.
2. Wearing gloves, thoroughly disinfect the vein puncture site as follows:
 - Using 10% tincture of iodine and a circular action, swab the area beginning at the point.
 - Using 70% ethanol, cleanse an area about 50 mm in diameter. Allow to air-dry.
3. Lift back the tape or remove the protective cover from the top of the culture bottle(s). Wipe the top of the bottle using an ethanol-ether swab.
4. Using a sterile syringe and needle, withdraw about 1-2 ml of blood per culture for neonates, 2- 3 ml for infants aged 1 month to 2 years, 3-5 ml for older children.
5. Insert the needle through the rubber liner of the bottle cap and dispense accordingly
6. Into the trypto soya broth culture medium bottle.
7. Using a fresh ethanol-ether swab, wipe the top of each culture bottle and replace the tape or protective cover(s). Without delay, mix the blood with the broth.
Important: The blood must not be allowed to clot in the culture media because any bacteria will become trapped in the clot.
8. Clearly label each bottle with the name and number of the patient, and the date and time of collection.
9. As soon as possible, incubate the inoculated media. Protect the cultures from direct sunlight until they are incubated.

II. Laboratory procedure for Gram staining technique

1. Labeling the slides clearly with the date and patient's name and number.
2. Making of smears by spread evenly covering an area about 15-20mm diameter on a slide.
3. Drying of smears after making smears, the slide should be left in a safe place to air-dry, protected from flies and dust.
4. Fix the dried smear by using heat or alcohols (methanol).
5. Cover the fixed smear with crystal violet stain for 30-60 seconds.
6. Rapidly wash off the stain with clean water. If the tap water is not clean, use filtered water or clean boiled rainwater.

7. Tip off all the water, and cover the smear with lugol's iodine for 30-60 seconds.
8. Wash off the iodine with clean water.
9. Decolorize rapidly (few seconds) with 3% acetone alcohol. Wash immediately with clean water.
10. Cover the smear with neutral red or safranin stain for 2 minutes.
11. Wash off the stain with clean water
12. Wipe the back of the slide clean, and place in a draining rack for the smear to air-dry.
13. Examine the smear microscopically, first with the 40 X objective to check the staining and to see the distribution of materials and then with the oil-immersion objective to look for bacteria and cells.

Result

- Gram positive bacteria -----dark purple
- Gram-negative bacteria -----pale to dark red

III. Laboratory procedure for Biochemical testing

Biochemical tests for gram positive bacteria:

Gram-positive cocci were identified based on their gram reaction, catalase, coagulase and manitol salt agar tests results.

Catalase test

Catalase test to differentiate staphylococci which produce the enzyme catalase from streptococci which are non catalase producing.

Principle

Catalase acts as a catalyst in the breakdown of hydrogen peroxide to oxygen and water. An organism is tested for catalase production by bringing it into contact with hydrogen peroxide. Bubbles of oxygen are released if the organism is a catalase producer.

Procedure

1. Pour 2-3 ml of 3% hydrogen peroxide to a test tube
2. Using a sterile wooden stick take the test organism & immerse into the H_2O_2 solution.

3. Look for immediate bubbling

Interpretation

Active bubbling Positive catalase test

No bubbles Negative catalase test

Control

Positive catalase control: *Staphylococcus* species

Negative catalase control: *Streptococcus* species

Coagulase test

This test is used to identify *S. aureus* which produces the enzyme coagulase

Principle

Coagulase causes plasma to clot by converting fibrinogen to fibrin.

Procedure

1. Place a drop of physiological saline on two separate slides
2. Emulsify the test organism in each of the drop to make thick suspension
3. Add one drop of plasma to one of the suspensions and mix gently. Look for clumping of the organism within 10 seconds

Interpritation

Clumping within 10 secs *S. aureus/ S.lugdnesis*

No clumping within 10 secs No bound coagulase

Controls

Positive coagulase control: *Staphylococcus aureus/ S.lugdnesis*

Negative coagulase control: *Escherichia coli*.

Manitol salt agar test

Principle

Enzymatic Digest of Casein, Enzymatic Digest of Animal Tissue, and Beef Extract provide the nitrogen, vitamins, and carbon in Mannitol Salt Agar. D-Mannitol is the carbohydrate source. In high concentrations, Sodium Chloride inhibits most bacteria other than staphylococci. Phenol Red is the pH indicator. Agar is the solidifying agent. Bacteria that grow in the presence of a high salt concentration and ferment mannitol produce acid products, turning the Phenol Red pH indicator from red to yellow. Typical pathogenic staphylococci ferment mannitol and form yellow colonies

with yellow zones. Typical non-pathogenic staphylococci do not ferment mannitol and form red colonies.

Procedure

Inoculate specimen on medium as a primary isolation or inoculate isolated colonies onto medium for differentiation.

Incubate at 37°C for 24 hour.

Look for colony morphology.

Result

Positive: yellow colony and may have a yellow halo around the colony.

Negative: no growth of bacteria (*E.coli*) or growth with colorless or pink colony (*CONs*)

Biochemical test for gram negative bacteria

Identification of gram negative bacteria will be based on their test result with a series of biochemical tests.

Indole test:

Principle

The test organism is cultured in a medium which contains tryptophan. Indole production is detected by Kovac's or Ehrlich's reagent which contains 4 (p)-dimethyl aminobenzaldehyde.

This reacts with the indole to produce a red coloured compound. Kovac's reagent is recommended in preference to Ehrlich's reagent for the detection of indole from enterobacteria.

Method

1. Inoculate the test organism in a bijou bottle containing 3 ml of sterile tryptone water.
2. Incubate at 35–37 °C for up to 48 h.
3. Test for indole by adding 0.5 ml of Kovac's reagent. Shake gently. Examine for a red colour in the *surface layer* within 10 minutes.

Interpretation

Red surface layer Positive indole test

No red surface layer Negative indole test

Urease test (Christensen's (modified) urea broth):

Principle

The test organism is cultured in a medium which contains urea and the indicator phenol red. When the strain is urease producing, the enzyme will break down the urea (by hydrolysis) to give ammonia and carbon dioxide. With the release of ammonia, the medium becomes alkaline as shown by a change in colour of the indicator to pink-red.

Procedure

1. Inoculate heavily the test organism in a bijou bottle containing 3 ml sterile Christensen's modified urea broth.
2. Incubate at 35–37 °C for 3–12 h (preferably in water bath for a quicker result).
3. Look for a pink colour in the medium.

Interpretation

Pink colour Positive urease test

No pink colour Negative urease test

Triple Sugar Iron (TSI) Agar Slant

Principle

TSI agar tests are used to determine whether gram negative bacilli utilize glucose and lactose or sucrose fermentatively and produce hydrogen sulfide. It contains 1% lactose, 1% sucrose and 0.1% glucose and peptone. Phenol red and ferrous sulphate serves as an indicator for acidification of medium and H₂S production.

Procedure

1. Using a sterile inoculating needle, stab the butt of the TSI agar slant twice then streak back and forth along the surface of the agar with the organism.
2. Incubate at 37°C for 18 to 24 h.
3. Look for the color change and gas production.

Interpretation

If acid slant–acid butt (yellow–yellow): glucose and sucrose and/or lactose fermented.

If alkaline slant–acid butt (red–yellow): glucose fermented only.

If alkaline slant–alkaline butt (red–red): glu^cose not fermented.

The presence of black precipitate (butt) indicates hydrogen sulfide production, and

Presence of splits or cracks with air bubbles indicates gas production.

Manitol test

Principle

The test organism is cultured on a medium which contains manitol. The microbe can ferment the carbohydrate (sugar) manitol as a carbon source. If manitol fermented to produce acid end product, the ph indicator phenol red changes to yellow.

Procedure

1. Inoculums from pure colony inoculated in a test tube of manitol broth.
2. Incubate at 35-37 °C for 24 hr
3. Look for yellow colour in the medium

Interpretation

Yellow colour.....Positive manitol test

Red colourNegative manitol test

Citrate utilization test using Simmon's citrate agar

Principle

The medium contains citrate as the sole source of carbon and inorganic ammonium salt as the sole source of nitrogen. Bacteria that can grow on this medium produce an enzyme, citrate-permease, capable of converting citrate to pyruvate. Pyruvate can then enter the organism's metabolic cycle for the production of energy. Growth is indicative of utilization of citrate, an intermediate metabolite in the Krebs cycle.

Procedure

1. Streak the slant back and forth with light inoculums picked from the center of a well isolated colony.
2. Incubate aerobically overnight at 35–37 °C for up to 4-7days.
3. Observe a color change from green to blue.

Interpretation

Blue. Positive citrate test

Green. Negative citrate test

Controls

A positive citrate test reaction is obtained with *Klebsiella pneumoniae* and a negative reaction with *Escherichia coli*.

Motility Test (using motility agars):

Principle

Motility agar will be prepared and inoculated with a straight inoculating needle making a single stab about 1-2cm down into the medium. The motility will be examined after 35°C for 24 hours. Motility will be indicated by the presence of diffuse growth (appearing as coloring of the medium) away from the line of inoculation. But if the bacteria are non-motile, the growth of the bacteria will be along the stab, diffusion will not occur.

Oxidase test

Principle

A piece of filter paper is soaked with a few drops of oxidase reagent. A colony of the test organism is then smeared on the filter paper. Alternatively an oxidase reagent strip can be used. When the organism is oxidase-producing, the phenylene diamine in the reagent will be oxidized to a deep purple colour.

Procedure

1. Place a piece of filter paper in a clean petri dish and add 2 or 3 drops of freshly prepared oxidase reagent.
2. Using a piece of stick or glass rod (not an oxidized wire loop), remove a colony of the test organism and smear it on the filter paper.
3. Look for the development of a blue-purple colour within a few seconds.

Interpretation

Blue-purple colour Positive oxidase test (within 10 seconds)

No blue-purple colour Negative oxidase test (within 10 seconds)

Controls

Positive oxidase control: *Pseudomonas aeruginosa*

Negative oxidase control: *Escherichia coli*

III. Laboratory procedure for Antimicrobial sensitivity testing

Procedure

Emulsify colonies of similar appearance in small volume of nutrient broth.

Match the turbidity of the suspension against the turbidity standard which has a similar appearance to an overnight broth culture.

1. With a sterile swab take sample from the suspension (squeeze the swab against the side of the test tube to remove the excess fluid).
2. Spread the inoculum evenly over the Muller-Hinton agar plate with the swab
3. Using a similar inoculation technique, inoculate an overnight broth culture of the Control organism evenly across the upper and lower third of the plate.
4. Using a sterile forceps or needle ,place the antimicrobial disc on the inoculated plate
5. Incubate the plate aerobically at 35 °C for 18-24 hours.
6. Read the tests after checking that the bacterial growth of the test and control organism is neither too heavy nor too light.
7. Measure the radius of the inhibition zone. Interpret result based on the inhibition zone.

Sensitivity (S): Zone of radius is wider than, equal to, or not more than 3mm smaller than the control.

Intermediate (I): Zone radius is more than 3mm smaller than the control but not less than 3mm.

Resistant (R): No zone of inhibition or zone radius measure 2mm or less.

Annex 3: Amharic version of participant information sheet, assent, consent & questionnaire

I. የተሳታፊዎች የመረጃ ቅፅ

አዲስ አበባ ዩኒቨርሲቲ የጤና ሳይንስ ኮሌጅ የህክምና ላብራቶሪ ሳይንስ ዲፓርትመንት

አርዕስት:-

በአዲስ አበባ ከተማ በዘወዲቱ መታሰቢያ ሆስፒታል የህጻናት የደም ውስጥ በሽታ አምጭ ተህዋስያን ስርጭት፤ ለተለያዩ ጸረባክቴሪያ ያላቸው አይበገሬነትና የበሽታውን አጋላጭ ሁኔታዎችን ስለማጥናት

አጠቃላይ መረጃ:-

በጥናቱ በመሳተፍዎ ከልብ እያመሰገንን ከመወሰንዎ በፊት ይህን ቅፅ በትክክል አንብቡ ወይም ሲነበብልዎ በትክክል ያዳምጡ፤ እንዲሁም ግልጽ ያልሆነልዎትን ነገር በሙሉ በነፃነት ይጠይቁ

ስለጥናቱ መረጃ:-

የህጻናት የደም ውስጥ ተህዋስያን በሽታ በአለም አቀፍ ደረጃ በተለይም በታዳጊ ሀገራት ከፍተኛ የሆነ ህመምና ሞት ያስከትላል። በተደረጉ ጥናቶች የተለያዩ አጋላጭ ሁኔታዎች እንዳሉ ለማወቅ ተችሏል። ስለዚህ የበሽታውን አምጭ ተህዋስያን ስርጭትና ለጸረተህዋስያን ያላቸውን ግትርነት ማወቅ በሽታውን ለመቆጣጠርና ለመከላከል እንዲሁም ተገቢውን መድሃኒት ለማዘዝ ይረዳል።

የጥናቱ አላማ:-

በዘወዲቱ መታሰቢያ ሆስፒታል የህጻናት የደም ውስጥ በሽታ አምጭ ተህዋስያን (ባክቴሪያ) ስርጭት፤ ለተለያዩ ጸረባክቴሪያ ያላቸው ግትርነትና የበሽታው አጋላጭ ሁኔታዎችን ማጥናትና ማወቅ ነው

ጥናቱ ለተሳታፊዎች ያለው ጥቅም:-

በጥናቱ ለሚሳተፉ ፍቃደኛ ተሳታፊዎች ምንም ዓይነት የገንዘብ ክፍያ የለም፤ ነገር ግን በምርመራው ውጤት መሰረት የመታከም እድል ይኖራቸዋል። በተጨማሪም የጥናቱ ውጤት የደም ውስጥ ህመም ለመቆጣጠርና ለመከላከል ስለሚጠቅም በተዘዋዋሪ መንገድ ሌላ ህመምተኛ እንዲሁም ህብረተሰቡን የመጥቀም እድል ያገኛሉ።

በጥናቱ ተሳታፊዎች ላይ ያለው ጉዳትና ተዛማጅ ችግር

በዚህ ጥናት በመሳተፍ ሲደርስብዎ የሚችል አንድም ጉዳት አይኖርም ለዚህ ጥናት የሚያገለግል የደም ናሙና የሚወሰድ ሲሆን ከመጠነኛ የህመም ስሜት በስተቀር በጤናዎ ላይ ምንም ጉዳት አይደርስም።

የመረጃ ሚስጥራዊ አጠባበቅ

መረጃ በሚሰጡበት ወቅትም ሆነ ከዛ በኋላ ባሉት ጊዜያት ሙሉ በሙሉ ሚስጥራዊነቱ የሚጠበቅና መረጃውም የሚያዘው በስም ሳይሆን በመለያ ቁጥር ይሆናል። በጥናቱ ላይ እያሉ በፈለጉት ጊዜ የማቆም ወይም የማቋረጥ መብት አልዎት። የላብራቶሪ ውጤትዎን ማወቅ ከፈለጉ የመለያ ቁጥርን በመጠቀም በሚሰጥዎ የቀጠሮ ጊዜ መውሰድ ይችላሉ።

ጥናቱን የሚያካሄደው ሰው ማረጋገጫ

ለዚህ ጥናት ሃላፊነቱን ለመውሰድና፣ ማናቻውንም ጥናቱ የሚመለከቱ ጉዳይ ክትትል ለማድረግና ለሚመለከተው አካል መግለጫ ለመስጠት በፊርማዬ አረጋግጣለሁ።

ፊርማ ----- ቀን -----

ማንኛውንም ጥያቄ መጠየቅ ለሚሹ የሚቀጥለውን አድራሻዬን መጠቀም ይችላሉ።

ኢሜል danitsega03@gmail.com ተንቀሳቃሽ ስልክ 0913308205

የህክምና ላቦራቶሪ ሳይንስ ትምህርት ክፍል ስልክ: 0112755170

II. የፍቃደኝነት መጠየቂያ (ከ 7 ዓመት በላይ ለሆኑ ህፃናት)

ይህ ጥናት የህጻናት የደም ውስጥ በሽታ አምጭ ተህዋስያን ጥናት የሚገለጽ ሲሆን መሳተፍ ከፈለግህ/ሽ ምርጫው ባንተ/ች የሚወሰን ነው። ምንም አይነት ውሳኔ ብትወስን/ኚ ከዚህ በፊት የሚደረግልህ/ሽ እንክብካቤ አይቀንስም። በማንኛውም ሰአት ማንኛውንም ጥያቄ መጠየቅ ትችላለህ/ሽ። በጥናቱ ለመሳተፍ ከወሰነክ/ሽ ለምርመራ ጥቂት የደም ናሙና በመርፌ ክፍያ/ሽ ላይ ይወሰዳል። ወረቀቱ ላይ ለሰፈሩት ጥያቄዎች አንብቦህ/ሽ ተገቢውን ምላሽ ወረቀቱ ላይ ሙሉ/ይ። ከጥናት ቡድኑ አባል ለሚጠይቅህ/ሽ ድምፅህን/ሽን ከፍ አድርገህ/ሽ መልስ ስጥ። ከዚህ በፊት የነበረውን የጤና መረጃህን/ሽን ለጥናቱ እንጠቀምበታለን። ምናልባት ለምትጠየቃቸው አንዳንድ ጥያቄዎች ምላሽ መስጠት ብትቸገር/ሪ ምንም አይነት ጉዳትና ችግር እንደማደረስብህ አናረጋግጥልሃለን። በማንኛውም ሰአት በጥናቱ አልሳተፍም የማለት መብት አለህ/ሽ። በዚህ ጥናት ምንም አይነት የገንዘብ ክፍያና የተለየ ጥቅም አታገኝም/ኚም ሆኖም ግን በዚህ የጥናት ውጤት እንዳንተ/ቺ የታመሙ ህጻናት ይጠቀማሉ። በማንኛውም ሰአት ጥናቱን ማቆም ትችላለህ/ያለሽ። ምርጫህን/ሽን ለማሳወቅ ጊዜ ወስደህ/ሽ አስብበት። በመጨረሻም ለመሳተፍ ከወሰነክ/ሽ ስምና ፊርማህን/ሽን ከታች ባለው ክፍት ቦታ ላይ አስፍር/ሪ።

እኔ ----- የተባልኩ ግለሰብ ይህን ሁሉ በመገንዘብ በምርምሩ ላይ መረጃና የደም ናሙና እንዲወሰድ ተስማምቻለሁ።

ፊርማ----- ቀን-----

III. የፈቃደኝነት ማረጋገጫ ቅጽ (ለቤተሰብ/አሳዳጊ)

በአዲስ አበባ ከተማ በዘወዲቱ መታሰቢያ ሆስፒታል የህጻናት የደም ውስጥ በሽታ አምጭ ተህዋስያን ስርጭት፤ ለተለያዩ ጸረባክቴሪያ ያላቸው አይበገሬነትና የበሽታው አጋላጭ ሁኔታዎችን ለማጥናት በሚል ርእስ ላይ በሚደረገው ጥናት ላይ ለመሳተፍ ሲሆን፤ የጥናቱ አላማና ጥቅም በሚገባ ተገልጿል። በመጠይቁ ላይ የሚሞላው የኔ ሙሉ መረጃም በሚስጥር እንደሚያዝ ተነግሮኛል።

በተጨማሪም በጥናቱ ውስጥ ልጄን አለማሳተፍ መብቴ እንደሆነና በማንኛውም ጊዜ ከጥናቱ በራሴ ውሳኔ መውጣት እንደምችልና በዚህም ምክንያት ምንም አይነት መጉላላት በልጄ ላይ እንደማይደርስ በሚገባ ተረድቻለሁ።

ስለሆነም ሁኔታውን በሚገባ በማጤን በፍቃደኝነት ልጄን በምርምሩ ላይ ለማሳተፍ ለተመራማሪው ፍቃደኝነቴን ሰጥቻለሁ። በተጨማሪም ልጄ የሚሰጠው የደም ናሙና ለተጠቀሰው ጥናት ብቻ እንደሚውል ተነግሮኝ ተስማምቻለሁ። ማንኛውም ያልገባኝ ንገር የመጠየቅ እድል ተሰጥቶኝ በሚገባኝ ቋንቋ መልስ አግኝቻለሁ።

በተጨማሪም የሁሉም የላብራቶሪ ምርመራ ውጤቶች በወቅቱ ክትትል ለሚያደርገው የጤና ባለሙያ እንደሚሰጥ እና ውጤቱን ማወቅ ከፈለኩ ማግኘት እንደምችል ተነግሮኛል።

እኔ ----- የተባልኩ ግለሰብ ይህን ሁሉ በመገንዘብ በምርምሩ ላይ ስለልጄ መረጃና የደም ናሙና እንዲወሰድ ተስማምቻለሁ።

ፊርማ ----- ቀን -----

V.መጠይቅ:

በአዲስ አበባ ኒሽርሲቲ የጤና ሳይንስ ኮሌጅ የሕክምና ላቦራቶሪ ዲፓርትመንት

የጤና ተቃራኒ ስም-----ዓ.ም-----የጥናቱ ተሳታፊ መለያ ቁጥር-----

አድራሻ:ክ/ከ-----ስልክ-----ፊርማ-----

የታየበት ክፍል-----ሀንጻ-----

የደም ናሙና የወሰደው ግለሰብ ስም-----ቀን-----ፊርማ-----

እባክዎን ለጥናቱ መሳካት ያግዘን ዘንድ ጥያቄዎችን በጥንቃቄ እንዲሞሉልን በትኩረትና እንጠይቃለን።

1. ዕድሜ-----

2. ጾታ 1)ወንድ 2)ሴት

3. ወርሀዊ ገቢ በሰው-----

4. የእህትናወንድምብዛት-----

5. የታየበት/የተኛበት ክፍል

1.ተመላላሽ ህክምና ክፍል

3.የህጻናት ፅኑ ህሙማን ክፍል

2.ተኝቶ ታካሚ ክፍል

4.ድንገተኛ

6.አልጋ የያዘበት ቀን-----

7. የበሽታው ህመምና ስሜት መታየት የጀመረው መቼ ነው

1. አልጋ ከመያዙ ከ 48 በፊት

2. አልጋ ከያዘ ከ 48 ሰዓት በኋላ

8. የበሽታው ገጽታ

1.ትኩሳት

5.መዘለፍለፍ

9.መልፈስፈስ/መዘለፍለፍ

2. ማስመለስ

6. የሆድ መነፋት

10.እራስን መሳት

3.ብርድብርድ ማለት

7.አለመመገብ

4.የልብምትመፍጠን

8.የአተነፋፈስችግር

9. የሰውነት ሙቀት መጠን

- 1. ከ 36.5 ሴንቲግሬድ በታች
- 2. ከ 37.5 ሴንቲግሬድ በላይ

10. ለብዙ ጊዜ የቆየ ተያያዥ በሽታ አለ

- 1.አዎ
- 2.የለም

11. ለአስረኛው ጥያቄ መልሱአዎ ከሆነ ምን-----

12. የ HIV ውጤት

- 1.ፖዘቲቭ
- 2.ኔጌቲቭ

13. ወደ ሰውነትህ የገባ/የተሰካ/የተለጠፈ የህክምና መሳሪያ አለ

- 1.አዎ
- 2.የለም

14. ለ 13 ኛው ጥያቄ መልሱ አዎ ከሆነ ምን አይነት መሳሪያ

- 1. የደም ቱቦ መርፌ
- 2. የአየር ቱቦ
- 3. የሽንት ማሸኛ ቱቦ
- 4.የአየር ማናፈሻ
- 5.ሌላ

15.የደም ናሙና ከተወሰደ በኋላ የተሰጠ ጸረ ተህዋሲያን-----

16. የህጻኑ የስርአተ ምግብ ሁኔታ

- 1. በምግብ እጥረት የተጎዳ
- 2. በምግብ እጥረት ያልተጎዳ

17. የእናትየዋ የስርአተ ምግብ ሁኔታ

- 1. በምግብ እጥረት የተጎዳች
- 2. በምግብ እጥረት ያልተጎዳች

18. ህጻኑ እንደተወለደ/ች የሰውነት ክብደት

- 1. ከ 2.5 ኪ.ግ በታች
- 2. ከ 2.5 ኪ.ግ በላይ

19. ከጽንሰት እስከ ውልደት ያለ እድሜ

- 1. ከ 37 ሳምንት በታች
- 2. ከ 37 ሳምንት በላይ

20. አብሮ የተወለደ የጤና ችግር አለ

- 1.አዎ
- 2.የለም

Declaration

This study is my original work, and has not been presented for a degree in any university or published anywhere.

Name: Daniel Tsega

Signature _____

Place _____

Date of submission _____

Advisors

This study has been presented with our approval as the advisors

1.Name:Kassu Desta (BSc, MSc, PhD fellow)

Signature _____

Place _____

Date of submission _____

2. Name: Dr. Yohanees Weldekidan (MD, MSc)

Signature _____

Place _____

Date of Submission _____

**ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES SCHOOL OF
ALLIED HEALTH SCIENCES DEPARTMENT OF MEDICAL LABORATORY
SCIENCES**

Bacterial profile, antimicrobial susceptibility pattern and associated risk factors among
septicemia suspected pediatrics patients at Zewuditu Memorial Hospital, Addis Ababa,
Ethiopia

Approved by the Examining Board

_____	_____	_____
Chairman, Dep. Graduate Committee	Signature	Date
_____	_____	_____
Advisor (Kassu Desta (PhD Fellow)	Signature	Date
_____	_____	_____
Advisor Yohannes W/kidan (MD, MSc)	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
_____	_____	_____
External Examiner	Signature	Date