Prevalence of Bacterial Infection Isolated from Blood Cultures and Patterns of Antibiotic Resistance and Sensitivity in Pediatrics Department of ZMC during (2019-2020)

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معدل انتشار العدوى البكتيرية المعزولة من مزارع الدم وأنماط مقاومة وحساسية المضادات الحيوية في قسم طب الأطفال بمركز زليتن الطبي خلال (2019-2020)

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Abstract

Background: Sepsis is a damage of tissues resulting from the body response to the infection, and considered the second major cause of mortality among neonates and leads to more than one million neonates every year. Sepsis is a body response to an infection leads to damage the tissues, and considered the second major cause of mortality among neonates and leads to more than one million neonates every year.

The aim of this study was to retrospectively identify the microorganisms isolated from blood cultures that cause sepsis in Zliten Medical Center(ZMC), which is important for the treatment of patients. A blood culture is the most common test for diagnosis and treatment.

Method: A retrospective cross-sectional study of all bacteria isolated in blood cultures obtained from the patients in the department neonatal and pediatric of the (ZMC). Manually review records in the microbiology lab at (ZMC) for information on the types of bacteria that cause bloodstream infections in newborns and children, the most common pathogens and antibiotic sensitivity of each pathogen.

Results: During the study period, 32 positive samples were collected. *K. pneumonia* 8(25%), *A. baumannii* 6(18.75%), *E. coli* 4(12.5%), *S. aureus* 3 (9.37%), and *P. aeruginosa* 2(6.25%) were the commonly isolated organisms causing neonatal sepsis, followed by other microorganisms. All these microorganisms were highly resistant to common antibiotics like Ciprofloxacin and Gentamicin (53%), Imipenem (47%), Cefoxitin (41%), and least resistance to Amikacin (13%) and Colistin (3%). were the most sensitivity to Amikacin (56%), Nitrofurantoin (31%), Colistin (19%), Imipenem and Levofloxacin (16%), and least sensitivity to Meropenem and Gentamicin (6%).

Conclusions: In this study, most common isolated microorganisms were *K. pneumoniae*. In addition, it should be kept in mind may be cause of sepsis is *A. baumannii*, *E. coli*, *S. aureus* and other microorganisms. The microorganisms isolated were highly resistant to common antibiotics Ciprofloxacin and Gentamicin and least resistance to Colistin, and most sensitivity to Amikacin, and least sensitivity to Meropenem and Gentamicin.

Keywords: *Antimicrobial resistance, Bacteria Isolates, Blood culture, Bloodstream infection, Neonatal sepsis, Sensitivity.*

الملخص

الخلفية: الإنتان هو حالة قد تكون مهددة للحياة تحدث عندما تتسبب استجابة الجسم للعدوى في إتلاف أنسجته، والإنتان هو السبب الرئيسي الثاني للوفيات بين الولدان، مما يؤدي إلى وفاة أكثر من مليون مولود سنويًا. كان الهدف من هذه الدراسة هو التعرف بأثر رجعي على الكائنات الحية الدقيقة المعزولة من مزارع الدم التي تسبب الإنتان في مركز زليتين الطبي (ZMC)، وهو أمر مهم لعلاج المرضى. تعتبر مزرعة الدم هي الاختبار الأكثر شيوعًا للتشخيص والعلاج.

الطريقة: دراسة مقطعية بأثر رجعي لجميع البكتيريا المعزولة في مزارع الدم التي تم الحصول عليها من المرضى في قسم حديثي الولادة والأطفال في مركز زليتن الطبي (ZMC) مراجعة السجلات يدويًا في معمل الأحياء الدقيقة في مركز زليتن الطبي للحصول على معلومات حول أنواع البكتيريا التي تسبب التهابات مجرى الدم عند حديثي الولادة والأطفال، ومسببات الأمراض الأكثر شيوعًا وحساسية المضادات الحيوية لكل مُمْرِض.

النتائج: خلال فترة الدراسة تم جمع 32 عينة إيجابية (25%) 8 *K. pneumonia*، (18.75%) 6 *A. baumannii*، (12.5%) 4 *E. Coli*، (9.37%) 3 *S. aureus* و(6.25%) 2 *P. aeruginosa* هي الكائنات الحية المعزولة الشائعة المسببة الإنتان الوليدي، تليها الكائنات الحية الدقيقة الأخرى. كل هذه الكائنات الحية الدقيقة كانت شديدة المقاومة للمضادات الحيوية الشائعة مثل Ciprofloxacin و Gentamicin (53٪)، Imipenem (47٪)، Cefoxitin (41٪)، وأقل مقاومة Amikacin (13٪) و Colistin (3٪). كانت أكثر حساسية Amikacin(56٪)، Nitrofurantoin (31٪)، Colistin (19٪)، Imipenem و Levofloxacin (16٪)، وأقل حساسية لكل من Meropenem و Gentamicin (6٪).

الاستنتاجات: في هذه الدراسة، كانت الكائنات الحية الدقيقة المعزولة الأكثر شيوعا هي *K. pneumoniae*. بالإضافة إلى ذلك، يجب أن يؤخذ في الاعتبار أن الإنتان قد يكون سببه *A. baumannii*, *E. coli*, *S. aureus* والكائنات الحية الدقيقة الأخرى. وكانت الكائنات الحية الدقيقة المعزولة شديدة المقاومة للمضادات الحيوية الشائعة Ciprofloxacin و Gentamicin وأقل مقاومة Colistin. وهو الأكثر حساسية Amikacin، والأقل حساسية Meropenem و Gentamicin.

الكلمات الدالة: مقاومة مضادات الميكروبات، عزل البكتيريا، مزرعة دم، عدوى مجرى الدم، الإنتان الوليدي، الحساسية.

1. Introduction

A dysregulated host response to infection can result in sepsis, a potentially fatal organ failure. Sepsis is a leading cause of morbidity and mortality in hospitalized patients. In non-medical literature, sepsis and bloodstream infection are frequently used synonymously, despite the fact that they refer to distinct ideas. A pathogenic organism that causes sickness in the bloodstream is referred to as a bloodstream infection. Usually, the growth of a pathogenic organism in culture or the growths of an unusual organism along with infection-related symptoms are used to determine it. A bloodstream infection, like any other infection, might ultimately result in a dysregulated immune response; however, sepsis is not an inevitable consequence of a bloodstream infection. If the organism is a bacterium, the condition is known as bacteremia (Huerta and Rice, 2019).

Although there is no universally accepted definition, neonatal sepsis is the term used to characterize a widespread bloodstream infection of bacterial, viral, or fungal origin that is linked to hemodynamic abnormalities as well as other clinical symptoms and indications (Wójkowska-Mach et al., 2019).

More than a million newborns die from sepsis each year, making it the second leading cause of death in this age group (Murthy et al., 2019). The systemic reaction to infection known as sepsis is characterized by shock, tachycardia, tachypnea, and either hyper- or hypothermia. This illness poses a serious risk to life for people of all ages, but it is most dangerous for newborns (Mahallei et al., 2018).

Neonatal sepsis, or illness caused by systemic bacterial infection, is a major cause of pediatric morbidity and mortality. The most typical early indicators of sepsis in babies are tachypnea, fever or hypothermia, lethargy, or recent reports of inadequate feeding. The two types of neonatal sepsis early and late onset are distinguished by their respective modes of acquisition and, consequently, onset times. Early onset sepsis (EOS) is the result of vertical bacterial transmission from the mother during the perinatal period. Late onset sepsis (LOS), in contrast, results from postnatal environmental exposure to pathogenic bacteria (Kim et al., 2020). Differentiating between early-onset sepsis (EOS) and late-onset sepsis (LOS) lacks fundamental criteria (Wójkowska-Mach et al., 2019).

Neonatal sepsis requires antibiotic therapy, in a way that initial supportive measures and empirical antibiotic therapy are recommended to be immediately taken and provided in suspected neonatal sepsis cases after sampling for laboratory evaluations. The incidence of sepsis and its pathogens varies across places and time periods (Mahallei et al., 2018).

The most frequent pathogens causing bloodstream infections (BSI) were *Escherichia coli*, *Staphylococcus* aureus, and *Klebsiella* pneumonia (Tian et al., 2018). Because of the high mortality and morbidity rates associated with BSI, it is important to identify the microorganisms causing sepsis as a way to effectively treat the patient. The most useful test for diagnosis and treatment is blood culture. Blood culture is

an important diagnostic technique that helps identify the microbes causing bacteremia and is useful in helping to direct the course of treatment. To take preventative measures against infections, develop empirical treatment protocols, and start the right treatment, it's critical to ascertain the diversity of bacteria growing in blood cultures and their susceptibilities to antibiotics (Metin et al., 2020).

In different hospital units, different microorganisms can cause sepsis, and Pediatric sepsis is a major public health concern, and robust surveillance tools are needed to characterize its incidence, outcomes, and trends, and identification of microorganisms causing sepsis is important for the treatment of the patient. And the lack of uniform, international prevention programs results in high newborn morbidity and insufficient postnatal prevention of late-onset infections, and the most frequent observed infection in neonatal wards is bloodstream infection, and appropriate use of antibiotics for is crucial most. So, the aim of this study was to retrospectively identify the microorganisms isolated from blood cultures that cause sepsis in (ZMC), which is important for the treatment of patients (Metin et al., 2020).

2. Materials & Methods

2.1. Research Design

A retrospective cross-sectional study.

2.2. Study Population and Sampled

All the patients in the neonatal and pediatric department of the ZMC who were suspected of having a bloodstream infection (sepsis) during the study period and blood samples were taken from them and sent to the center's microbiology laboratory.

2.3. Sample Size

A number of 162 blood cultures were collected from newborns and children suspected of having a bloodstream infection.

2.4. Study Procedures

Manually reviewed records in the microbiology lab at ZMC for information about the types of bacteria that cause bloodstream infections in newborns and children. The sample for this study was blood samples taken from children suspected of having a bloodstream infection in the neonatal and pediatric department of ZMC.

2.5. Statistical Analysis of Data

Descriptive statistical analysis using Microsoft Excel.

2.6. Ethical of Study

Administrative permission to access the data was obtained through the director of Zliten Medical Center.

3. Results

During the study period, the total collected samples were 154 blood cultures from pediatric and neonatal who were suspected for blood stream infection. From all processed clinical samples, 32/154 (21%) were culture positive for invasive bacterial infection and 122/154 (79%) were culture negative. The highest positivity rate, 27/32 (84.3%) was recorded among the department group of newborn.

3.1. Bacteria Isolates

The total positive samples were 32 samples; gram negative bacteria the isolated were; *K.pneumonia* 8(25%), *A.baumannii* 6(18.75%), *E. coli* 4(12.5%), while *P. aeruginosa* 2(6.25%) were the least isolate found, and gram positive *S. aureus* 3(9.37%) and others bacteria 9(28.12%). From the isolated, gram-negative bacteria 23(72%) were more prevalent than gram-positive bacteria 9(28%). Others were 3 samples gram-negative bacteria and 6 samples gram-positive bacteria.

A total of 154 cases had growth of organisms, which were tested for sensitivity pattern by standard laboratory methods, remaining (32)21% cases were culture negative. Among the culture grown cases, samples (122)79% were gram-positive organisms as depicted in Figure (1).

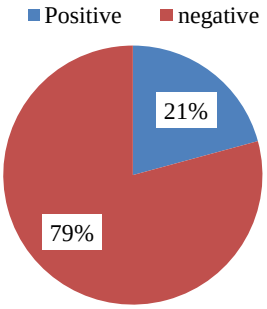

Figure 1. Percentage of bacteria isolated

Figure (2) Isolated pathogen in blood cultures from neonatal presenting with and without clinical sepsis *Klebseilla pneumonia* (8) 25%, *Acinetobactor baumannii* (6)19%, *E. coli* (4)13%, *staphyloccus aureus* (3)9%, *Pseudomonus* (2)6%, and others (9)28%.

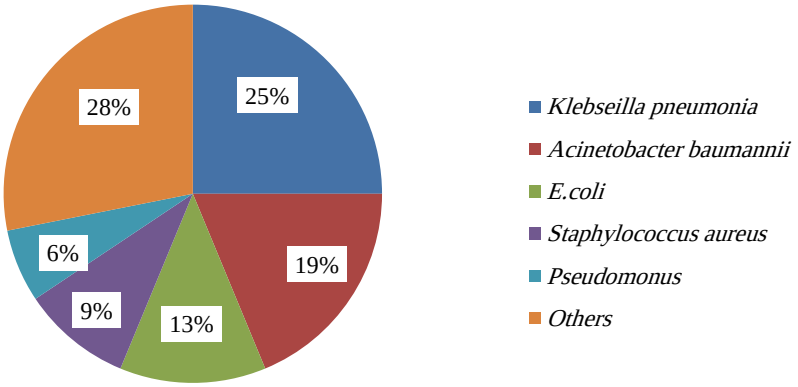

Figure 2.Percentage of each isolated pathogen to the total number of pathogens that isolated from blood culture

3.2. Antibiotic Resistance Pattern of Gram Negative

Figure (3) Studies across different regions consistently identify, *K.pneumoniae* recorded the high resistance almost for all common antibiotics like Ceftazidime and Cefuroxime (88%), and Ampicillin, Ceftriaxone, Gentamicin, and Cephalothin (75%), least resistance to Ciprofloxacin (50%). *A.baumannii* recorded highest resistance to Ampicillin, Augmantin, Ciprofloxacin, Imipenem, Meropenem and Ceftriaxone (100%), and Cephalothin (83%), least resistance to Amikacin and Trimethoprim-Sulfamethoxazole (67%). In contrast *P.Aeruginosa* and *E. coli* highest resistance to Ampicillin, Augmantin and Cephalothin (100%) and (50%) respectively.

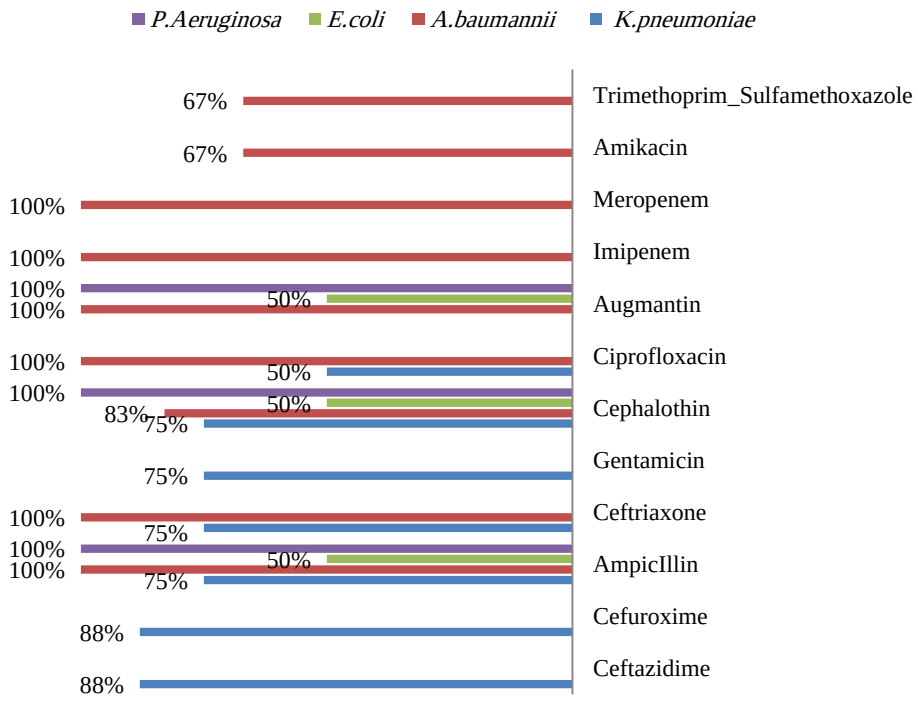

Figure 3. Antimicrobial resistance patterns of gram negative bacteria

3.3. Antibiotic Sensitivity Pattern of Gram Negative

The findings from our study highlight the prevalence of (Figure 4), *K.pneumoniae* recorded the high sensitive for Amikacin (88%) and Nitrofurantoin (75%), and least sensitive to Trimethoprim-Sulfamethoxazole (50%). *A.baumannii* recorded highest sensitive for Colistin (100%), and least sensitive to Amikacin (33%). In contrast *P.Aeruginosa* and *E. coli* sensitive to Ciprofloxacin (100%) and (50%) respectively, and was *E. coli* highest sensitive to Amikacin and Imipenem (75%) (present in Figure 4).

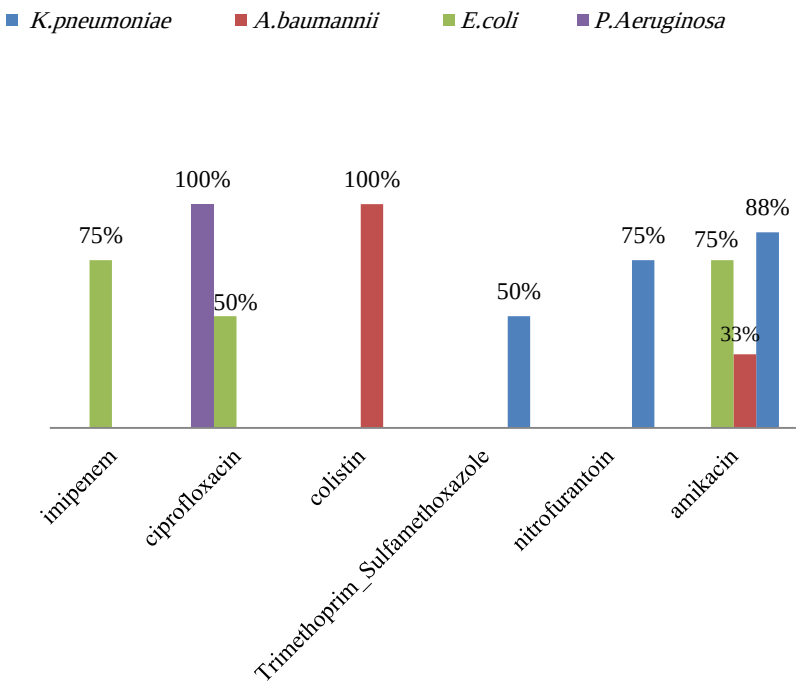

Figure 4. Antimicrobial sensitivity patterns of gram negative bacteria

3.4. Antibiotic Resistance Pattern of Gram Positive

The sensitivity of Gram-positive bacterial species isolated from blood cultures to various antibiotics in Children's Zliten medical Center. Each bar represents the number of bacterial isolates that are sensitive to the corresponding Antibiotic resistance summaries of gram positive bacterial isolates, *S. aureus* show highest resistances about (67%) for Penicillin and Erythromycin, and about (33%) for Tetracycline and Colistin (present in Figure 5).

3.5. Antibiotic Sensitivity Pattern of Gram Positive

The distribution of antimicrobial-resistant phenotype among Gram-positive organisms by bacterial species and tested antimicrobial agents is reported *S. aureus* recorded the high sensitivity almost for all common antibiotics to Amikacin (100%) and about (67%) for Vancomycin, Imipenem and Cefoxitin (present in Figure 6).

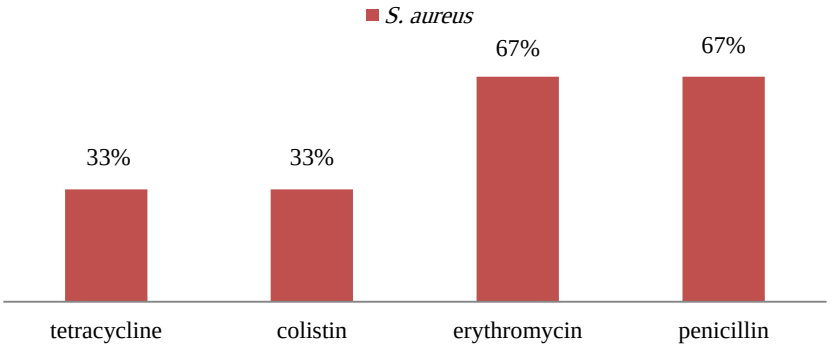

Figure 5. Antimicrobial Sensitivity patterns of gram positive bacteria

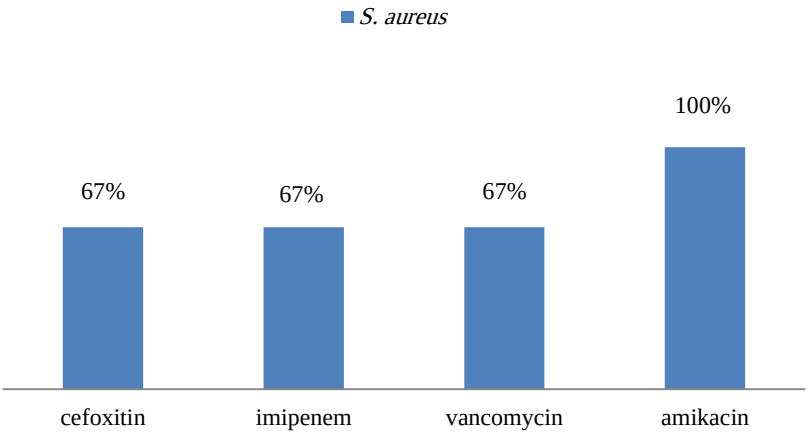

Figure 6. Antimicrobial Sensitivity patterns of gram positive bacteria

3.6. Patterns Antibiotic Resistance and Sensitive for All Samples

All these microorganisms were highly resistant to common antibiotics as shown in Figure (7); like Ciprofloxacin and Gentamicin (53%), Imipenem (47%), Cefoxitin (41%), and least resistance to Amikacin (13%) and Colistin (3%); where the most sensitivity to Amikacin (56%), Nitrofurantoin (31%), Colistin (19%), Imipenem and Levofloxacin (16%), and least sensitivity to Meropenem and Gentamicin (6%).

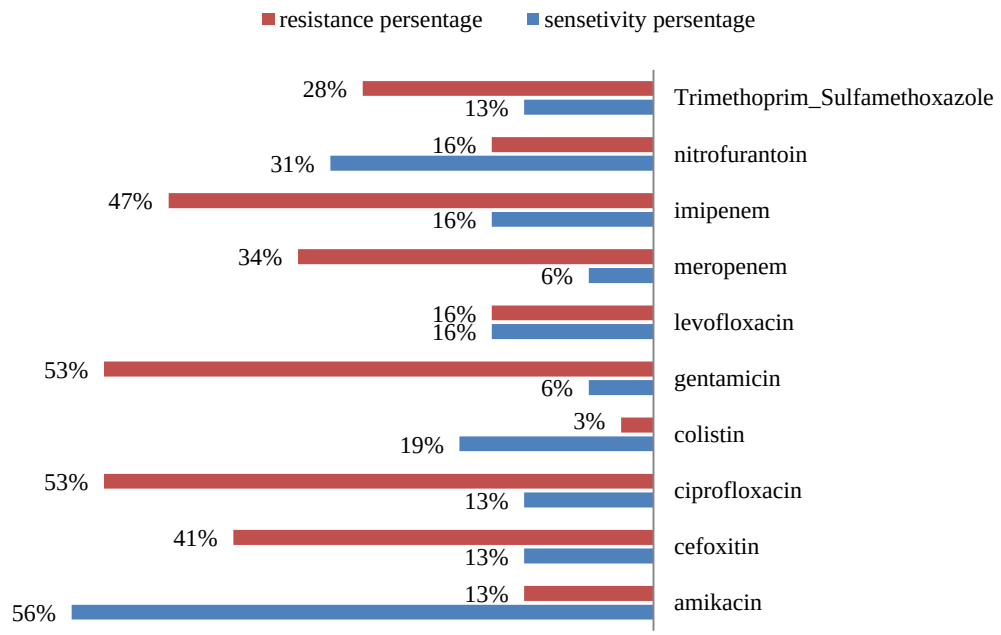

Figure 7. Percentage of antimicrobial patterns for all pathogens isolated

4. Discussion

Infections of bloodstream are the common infections in pediatric patients and one of the most serious and potentially life-threatening infectious diseases. It reducing morbidity and mortality requires early diagnosis and treatment.

Antimicrobial therapy has to be empirically admitted in most circumstances for these patients. The accuracy in predicting the pathogen and antimicrobial resistance patterns is crucial for successful therapy (Metin et al., 2020). For this reason, it is necessary to know the microorganisms that grow in the hospital. Growing microorganisms vary according to hospitals.

In the current study, 32 blood culture were positive from obtained from the patients in neonatal and pediatric departments who were suspected for blood stream infection, of (ZMC) from 1 January 2019 until 31 December 2020. The highest percentage of the bacteria the isolated was *K.pneumonia* (25%), *A.baumannii* (18.75%), *E. coli* (12.5%), *P. aeruginosa* (6.25%), and *S. aureus*(9.37%).

K.pneumoniae recorded the high resistance to Ceftazidime and Cefuroxime (88%), and least resistance to Ciprofloxacin (50%), and, high sensitive for Amikacin (88%), and least sensitive to Trimethoprim-Sulfamethoxazole (50%).

A.baumannii recorded highest resistance to Ampicillin, Augmentin, Ciprofloxacin, Imipenem, Meropenem, and Ceftriaxone (100%), and least resistance to Amikacin and Trimethoprim-Sulfamethoxazole (67%), and high sensitive for Colistin (100%), and least sensitive to Amikacin (33%).

P.Aeruginosa and *E. coli* highest resistance to Ampicillin, Augmantin and Cephalothin (100%) and (50%)%) respectively. Also, *P.Aeruginosa* sensitive to Ciprofloxacin (100%), and was *E. coli* highest sensitive to Amikacin and Imipenem (75%).

S. aureus show highest resistances about (67%) for Penicillin and Erythromycin, and recorded the high sensitivity to Amikacin (100%).

The result agreed with previous conduct study in Southern Ethiopia (2019-2020), demonstrated that 116 were culture positive, that showed, *K.pneumonia* (21.4%), *S. aureus* (17.9%), *P. aeruginosa* (7.76%), and *E. coli* (5.17%). *K.pneumoniae* recorded the high resistance to Ampicillin (84%), and least sensitive to Cefotaxime (36%). *P.Aeruginosa* and *E. coli* highest resistance to Ampicillin (33.3%) and (66.6%) respectively. Also, *P.Aeruginosa* and *E. coli* least resistance to Amikacin (33.3%) and Ceftriaxone (33.3%) respectively. *S. aureus* highest resistance about (71.4%) for Penicillin and Erythromycin (Alemayehu et al., 2019).

According to previous study conducted in Italy (2018-2019), 1228 positive BSIs were collected, the most common pathogens were *S. aureus* (19.1%), *E. coli* (15.9%), *K.pneumoniae* (12%), *A.baumannii* (7.4%), and *P.aeruginosa* (3.3%). *K.pneumoniae* recorded the resistance to Carbapenem (39.5%). *A.baumannii* was resistance to Aminoglycosides and Fluoroquiolones (48.4%). *P.Aeruginosa* resistance to Aminoglycosides and Fluoroquiolones (14.6%) and *E.coli* resistance to Carbapenem (11.7%). *S. aureus* highest resistances about (28.1%) for Oxacillin (Licata et al., 2021).

Also, previous study conducted in South East Ethiopia (2016-2017), bacterial growth was detected in 88 of blood cultures, that showed the highest percentage of the bacteria the isolated was *E. coli* (20.5%)and *S. aureus* (18%). *E. coli* highest resistance to Ampicillin (66.7%) and Gentamycin (55.6%). *S. aureus* resistance to Ampicillin (69%) (Sorsa et al., 2019).

5. Conclusion

Our findings emphasize the need of clinicians having access to up-to-date bacterial susceptibility data for routinely prescribed drugs. Most common isolated microorganisms were *K. pneumoniae*. In addition, it should be kept in mind may be cause of sepsis is *A. baumannii*, *E. coli*, *S. aureus*, and other microorganisms. The microorganisms isolated were highly resistant to common antibiotics Ciprofloxacin and Gentamicin and least resistance to Colistin; and most sensitivity to Amikacin, and least sensitivity to Meropenem and Gentamicin.

References

Alemayehu, T. A., Agegnehu, A. A., Ali, M. A., Mitiku, E. M., & Azerefegne, E. A. (2020). Under-five children's Bacterial Blood Stream Infection in Southern Ethiopia. *Research Square*, 1–8.

Huerta, L. E. & Rice, T. W. (2019). Pathologic difference between sepsis and bloodstream infections. *The Journal of Applied Laboratory Medicine*, 3(4), 654-663.

Kim, F., Polin, R. A., & Hooven, T. A. (2020). Neonatal sepsis. *BMJ.*, 371: m3672.

Licata, F., Quirino, A., Pepe, D., Matera, G., Bianco, A., & Collaborative Group. (2020). Antimicrobial resistance in pathogens isolated from blood cultures: a two-year multicenter hospital surveillance study in Italy. *Antibiotics*, 10(1), 1-13.

Mahallei, M., Rezaee, M. A., Mehramuz, B., Beheshtirooy, S., & Abdinia, B. (2018). Clinical symptoms, laboratory, and microbial patterns of suspected neonatal sepsis cases in a children's referral hospital in northwestern Iran. *Medicine*, 97(25), 1–5.

Metin, D., Muhammed Yusuf OA, Abdullah A, & Mustafa B. (2020). Microorganisms isolated from blood cultures in pediatrics clinic. *J Clin Microbiol Biochem Technol.*, 6(1), 1–3.

Murthy, S., Godinho, M. A., Guddattu, V., Lewis, L. E. S., & Nair, N. S. (2019). Risk factors of neonatal sepsis in India: A systematic review and meta-analysis. *PloS one*, 14(4), e0215683.

Sorsa, A., Früh, J., Stötter, L., & Abdissa, S. (2019). Blood culture result profile and antimicrobial resistance pattern: a report from neonatal intensive care unit (NICU), Asella teaching and referral hospital, Asella, south East Ethiopia. *Antimicrobial Resistance & Infection Control*, 8, 1-6.

Tian, L., Sun, Z., & Zhang, Z. (2018). Antimicrobial resistance of pathogens causing nosocomial bloodstream infection in Hubei Province, China, from 2014 to 2016: a multicenter retrospective study. *BMC public health*, 18(1), 1-8.

Wójkowska-Mach, J., Chmielarczyk, A., Strus, M., Lauterbach, R., & Heczko, P. (2019). Neonate bloodstream infections in organization for economic cooperation and development countries: An update on epidemiology and prevention. *Journal of Clinical Medicine*, 8(10), 1750.