



Antibiotic Susceptibility testing of Gram Negative pathogens responsible for causing Neonatal septicemia.

Dr. A. Daisy Jean Marie^{1*}, Dr. R. Hymavathi², Dr. M. Sailaja³.

¹Post Graduate, Department of Microbiology, Government Medical College, Anantapuram, Andhra Pradesh, India.

²Associate Professor, Department of Microbiology, Government Medical College, Anantapuram, Andhra Pradesh, India.

³Associate Professor, Department of Microbiology, Government Medical College, Anantapuram, Andhra Pradesh, India.



Correspondence:

A. Daisy Jean Marie.

Dr. A. Daisy Jean Marie, Post Graduate, Department of Microbiology, Government Medical College, Anantapuram, Andhra Pradesh, India.

Email: dmairie703@gmail.com

Received: 18-07-2026

Revised: 30-07-2026

Accepted: 11-08-2026

Published: 27-08-2026

Abstract

Background: Neonatal septicemia is a systemic critical life challenging disease caused by bacterial, viral or fungal origin, manifesting with clinical features related to hemodynamic changes and responsible for severe morbidity and mortality. The prevalence of multidrug resistance (MDR) is increasing day by day poses significant challenges to clinicians. The aim of this study was to know the gram-negative bacteria responsible for neonatal infections in this region and its antibiotic sensitivity pattern. **MATERIALS AND METHODS:** Neonates less than 28 days of life suspected to have sepsis were selected in this Cross-sectional observational study. All blood cultures were inoculated into blood culture bottles, loaded in automated method - BACT/ALERT 3D culture system (BioMerieux). Processing and identification of the colonies was done as per the standard guidelines. Antibiotic susceptibility testing of all isolates was done by Vitek2 compact system. **RESULTS:** The total number of microorganisms isolated in the blood cultures was as Staphylococcus aureus (9%), Coagulase Negative Staphylococci (27.9%), Enterococcus faecium (9%), Escherichia coli (4.6%), Klebsiella pneumoniae (4.6%), Klebsiella aerogenes (4.6%), Pseudomonas aeruginosa (9%), Acinetobacter baumannii (9%), Serratia marcescens (4.6%), Candida albicans (4.6%), Non albicans Candida (13.7%). All the gram negative isolates of Neonatal sepsis were sensitive to penems, cotrimoxazole and resistant to remaining antibiotics. **CONCLUSION:** A scrupulous monitoring and implementation of infection control practices, antibiogram and epidemiology of the health care system definitely reduce this burden on community.

Keywords: Neonatal sepsis, Gram negative bacteria, Antibiotics.



This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).

INTRODUCTION

Sepsis in newborns or neonatal sepsis is a serious medical condition that occurs when a baby younger than 28 days old has a life-threatening response to an infection. Bacterial infections are the most common cause of neonatal sepsis. Neonatal sepsis can affect any baby. But premature babies develop sepsis more often than full-term babies because their immune systems are immature. Babies born prematurely don't have antibodies to protect them against certain bacteria. That's because they are born before they can receive the antibodies from their mother [1].

Two types of sepsis were classified for Neonatal septicemia. Sepsis which occurs within the first 72 hours of life is defined as Early-onset sepsis, Escherichia coli and Group B Streptococcus are usual pathogens as they get transmits from mother's birth canal before or during delivery. Sepsis that develops after 72 hours of life is considered as Late-Onset Sepsis, in this condition usually the bacteria acquired from either hospital or community environment [2,3].

Neonatal sepsis ranks third among the causes of neonatal death following prematurity and intrapartum-related complications [4]. In the late neonatal period (7-27 days), the most common cause of death was sepsis, with a rate of 37.2% [5].

Clinical manifestations in neonates may be asymptomatic, leading to sudden death without any prior indications. In preterm infants, hypothermia is a prevalent symptom, whereas term infants may present with a range of signs including fever, diarrhoea, vomiting, abdominal distension, jaundice, and episodes of apnoea accompanied by cyanosis [6]. The risk of infection is higher in babies who are born prematurely or have a low birth weight. Other risk factors include a mother developing an infection of the amniotic membranes (chorioamnionitis) or the mother's water breaking prematurely (prolonged rupture of membranes) [7].

Bacterial pathogens responsible for Neonatal septicemia are Group B Streptococci, Escherichia coli, Listeria monocytogenes, Coagulase Negative Staphylococci, Staphylococcus aureus, Enterococci, Klebsiella species, Enterobacter species, Pseudomonas species, Salmonella species, Haemophilus influenzae, Neisseria meningitidis and Streptococcus pneumoniae [8-10].

Infections and antimicrobial resistance are the major problems globally, especially in India. The prevalence of multidrug resistance (MDR) is increasing day by day. MDR is defined as Gram negative isolates resistant to any three of the five antibiotic classes (extended-spectrum cephalosporins, carbapenems, aminoglycosides, fluoroquinolones and piperacillin-tazobactam). In Gram positive isolates the resistance is expressed in terms of MRSA (Methicillin Resistant Staphylococcus aureus) indicated by resistance to ceftiofur. Neonatal sepsis poses significant diagnostic challenges due to its presentation with non-specific clinical signs and symptoms. It can be defined through clinical assessment and/or microbiological testing, which may include positive results from blood cultures and/or cerebrospinal fluid analysis [11].

Timely identification and effective treatment of Neonatal Septicemia can significantly reduce both morbidity and mortality rates [12]. The isolation of bacterial pathogens from blood cultures is considered the gold standard for diagnosis; however, a significant proportion of patients present with negative cultures. A negative culture result is insufficient to definitively exclude the presence of an infection. Additionally, there is a notable absence of sensitive diagnostic markers, leading to a reliance on clinical judgment for diagnosis [13]. The aim of this study was to know the gram-negative bacteria responsible for neonatal infections in this region and its antibiotic sensitivity pattern.

MATERIALS AND METHODS

Study design: Cross sectional Observational study.

Period of study: 18 months from March 2023 to August 2024.

Place of study: Government General Hospital & Government Medical College, Anantapuramu.

Study population: A total of 100 Neonates less than 28 days old were included in the study. Written informed consent for participation was obtained either from parents or guardians.

Ethical consideration: Approval was obtained from the Institutional Ethical Committee before the beginning of the research.

Inclusion criteria:

Neonates less than 28 days of life suspected to have sepsis.

Neonates attending Paediatric department with symptoms of septicemia, Government General Hospital, Anantapuramu.

Exclusion criteria:

Age more than 28 days of life.

Age less than 28 days of life without symptoms of neonatal septicemia.

Patient already started on antibiotics.

Sample Collection:

Before venepuncture, the septum of the bottles was disinfected by rubbing with an alcohol swab. Under aseptic precautions, one to 2 milliliters of peripheral blood were collected in BACT/ALERT PF plus blood culture bottle.

Sample processing:

Following inoculation into blood culture bottles, loaded in automated method - BACT/ALERT 3D culture system (BioMerieux). The bottle should be treated as soon as feasible for the following reasons after the automated blood culture bottle provides a positive signal: Direct gram stain, Subcultures was done on MacConkey and 5% Blood agar plates, Colony identification and Antimicrobial Susceptibility Testing are performed from subculture plates by VITEK 2 system. Blood culture bottles showing no growth on subculture after 7 days of incubation were reported as negative.

Antibiotic susceptibility testing:

The procedure for VITEK 2 system was as follows:

1. For testing one isolate, take 2 un-sensitized tubes and label it with ID (identification) and AST (antimicrobial susceptibility).
2. Take 3ml suspension solution of half normal saline from dispenser.

3. Prepare the inoculum suspension in the ID tube using sterile swab to transfer a sufficient number of morphologically similar single isolated colonies from pure culture and calibrate the turbidity of ID tube.
4. Transfer 145 µl (for GNB) and 280 µl (for GPC and YST) from ID tube to AST tube.
5. Place ID card in ID tube and AST card in AST tube in cassette.
6. Fill in blank cassette worksheet with required information for data entry.
7. Age of suspension must not exceed 30 minutes before inoculating card and loading the cassette.
8. Place the cassette into the chamber and run the cycle
9. After completion of the fill cycle, remove cassette from the filler Station and close the fill door. The load door unlocks.
10. Open the load door, place the cassette into station and close it.
11. After processing of test cards unload the cassette as a blinking, blue indicator LED at the load/unload station indicates that an empty cassette is at the station.
12. Remove the cassette from the instrument.

Interpretation: Antimicrobial susceptibility will be done as per Clinical and Laboratory Standard Institute M100, 34 th Edition for bacterial isolation 65.

In case of fungal isolation, antifungal susceptibility will be done as per Clinical and Laboratory Standard Institute, M27 68.

Definitions [14]:

Suspected sepsis: Regardless of whether there is a clinical symptom or not, the presence of sepsis risk factors in the baby or findings suggesting sepsis in follow-up.

Clinical sepsis: Clinical and laboratory findings are present, but the failure to show the causative microorganism.

Proven sepsis: Clinical and laboratory findings are present, and demonstration of the pathogenic microorganism in cultures taken from the sterile field.

Statistical Analysis:

After receiving report of blood cultures, all the data along with the patient details were entered into structured predesigned proforma. Later, the results were transferred into spread excel sheet to evaluate and tabulate the results.

RESULTS

Neonatal septicaemia population who were enrolled in this study as per the inclusion criteria was further analyzed to notify the blood culture positive risk factors and its antibiogram. Among 100 blood samples received at Microbiology department, 22 (22%) samples were shown positive blood culture and 78 (78%) samples were found to be negative (Fig1).

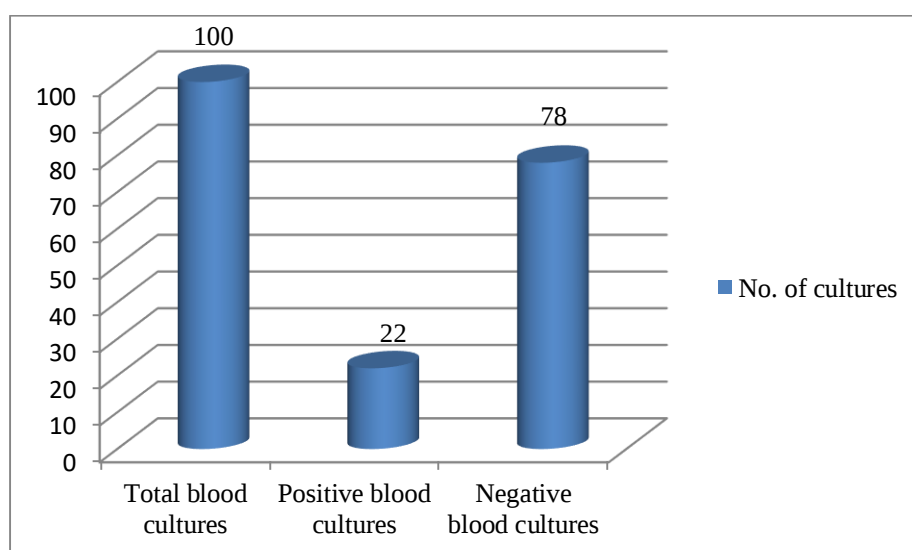


Fig 1. Showing the blood culture positivity rate

In the present study, based on the age distribution of the cases, out of 22 positive blood culture cases, Early Onset Neonatal Sepsis contributes 14 (63.6%) cases and Late Onset Sepsis about 8(36.4%) cases. In the present study, based on the Gender-wise distribution of samples, 59.1% was Females and 40.9% were Males. The number of female cases was higher than males.

In the present study, based on the weight of the neonatal cases, 68.2% cases were low birth weight and 31.8% cases were normal weight cases. High positivity rate was observed in the low-birth-weight cases than normal weight neonates, in this study. In this study, based on the gestational age of the mother, preterm delivery cases contributed to 54% and term delivery cases contributed 46% sepsis in the neonates. In this study, based on the mode of delivery, normal vaginal delivery (NVD) contributed more neonatal sepsis than LSCS (Table 1).

Table 1. Risk factors evaluation among neonatal septicemia patients

	Positive cases	Percentage
Age		
<3 days (EOS)	14	63.6%
>3-28 days (LOS)	8	36.4%
Gender		
Female	13	59.1%
Male	9	40.9%
Birth Weight		
Low Birth weight	15	68.2%
Normal weight	7	31.8%
Gestational age		
Pre term delivery	12	54.5%
Term delivery	10	45.4%
Type of delivery		
Normal vaginal delivery	14	63.6%
C-section	8	36.4%

In the present study, based on the isolation of micro-organisms, 10 (45.4%) Gram Positive Organisms, 8 (36.4%) Gram Negative bacteria, 4 (18.2%) *Candida* species were isolated from blood culture.

In this study, the total number of microorganisms isolated in the blood cultures was as *Staphylococcus aureus* (9%), *Coagulase Negative Staphylococci* (27.9%), *Enterococcus faecium* (9%), *Escherichia coli* (4.6%), *Klebsiella pneumoniae* (4.6%), *Klebsiella aerogenes* (4.6%), *Pseudomonas aeruginosa* (9%), *Acinetobacter baumannii* (9%), *Serratia marcescens* (4.6%), *Candida albicans* (4.6%), *Non albicans Candida* (13.7%) (Table 2).

Table 2. Various pathogens isolated from study population

S.No	Organisms	Positive cases	Percentage
1	<i>Staphylococcus aureus</i>	2	9%
2	<i>Coagulase Negative Staphylococcus</i>	6	27.30%
3	<i>Enterococcus faecium</i>	2	9%
4	<i>Escherichia coli</i>	1	4.6%
5	<i>Klebsiella pneumoniae</i>	1	4.6%
6	<i>Klebsiella aerogenes</i>	1	4.6%
7	<i>Pseudomonas aeruginosa</i>	2	9%
8	<i>Acinetobacter baumannii</i>	2	9%
9	<i>Serratia marcescens</i>	1	4.6%
10	<i>Candida albicans</i>	1	4.6%
11	<i>Candida Non Albicans</i>	3	13.7%

In this study, Antimicrobial Susceptibility Pattern for Gram Negative Bacteria, were done by VITEK 2 COMPACT System. It consists of one case of *Escherichia coli*, one *Klebsiella pneumoniae*, one *Klebsiella aerogenes*, one *Serratia marcescens*, two *Pseudomonas aeruginosa*, two *Acinetobacter baumannii* (Table 3). All the gram negative isolates of Neonatal sepsis were sensitive to penems, cotrimoxazole and resistant to remaining antibiotics.

Table 3. Antibiotic sensitivity percentage of Gram Negative bacilli

	BC-114	BC-163	BC-132	BC-183 & 166	BC-149 & 115	BC-180
Antibiotic	<i>Esch.coli</i>	<i>K.pneumoniae</i>	<i>K.aerogenes</i>	<i>P.aeruginosa</i>	<i>A.baumannii</i>	<i>S.marcescens</i>
Amoxicillin	≥32	≥32	≥32	-	-	≥32
Clavulanic acid	(R)	(R)	(R)			(R)

Ticarcillin	≥128 (R)	≥128 (R)	≥128 (R)	-	-	16 (S)
Piperacillin/ Tazobactam	≥128 (R)	≥128 (R)	≥128 (R)	≤4 (S)	≥128 (R)	-
Cefalotin	≥64 (R)	≥64 (R)	≥64 (R)	-	-	≥64 (R)
Cefoxitin	≥64 (R)	≥64 (R)	≥64 (R)	-	-	16 (R)
Cefixime	≥4 (R)	≥4 (R)	≥4 (R)	-	-	≤0.25 (S)
Ceftazidime	≥64 (R)	≥64 (R)	≥64 (R)	16 (I)	≥64 (R)	≤1 (S)
Ceftriaxone	≥64 (R)	≥64 (R)	≥64 (R)	-	≥64 (R)	≤1 (S)
Ertapenem	≤0.5 (S)	≥8 (R)	≤0.5 (S)	-	-	≤0.5 (S)
Amikacin	≥64 (R)	16 (R)	≥64 (R)	≥64 (R)	-	≤2 (S)
Gentamicin	≤1 (S)	≤1 (S)	≥16 (R)	≥16 (R)	≥16 (R)	≤1 (S)
Ciprofloxacin	≥4 (R)	≥4 (R)	1 (R)	≥4 (R)	≥4 (R)	≤0.25 (S)
Ofloxacin	≥8 (R)	4 (I)	2 (S)	≥8 (R)	-	≤0.25 (S)
Trimethoprim/ Sulfamethoxazole	≤20 (S)	≤20 (S)	≥320 (R)	≤20 (S)	≤20 (S)	≤20 (S)
Cefepime	-	-	-	16(I)	≥32 (R)	-
Meropenem	≤ 1(S)	≤ 1(S)	≤ 1(S)	≤2(S)	≥8 (R)	≤ 1(S)
Colistin	≤ 1(S)	≤ 1(S)	≤ 1(S)	≤2(I)	≤2(I)	≤ 1(S)

Among 100 blood samples received at Microbiology department, 22 (22%) samples were shown positive blood culture and 78 (78%) samples were found to be negative. Prevalence of Neonatal septicemia in other studies is mentioned in Table 4.

Table 4. Various studies showing the prevalence of Neonatal Septicemia

Place of the Study	Prevalence	Year of the Study	Reference
Jaipur	40.4%	2024	Surjeet SS et al [15]
West Bengal	24.1 %	2019	Das M et al [16]
Andhra Pradesh	35.2 %	2018	Kurma, et al [17]
Odisha	25.8 %	2017	Mohakud et al [18]
Maharashtra	30 %	2015	Santosh Kotgire et al [19]
Telangana	24.27 %	2015	Reddy KV et al [20]
Western India	26.6 %	2015	Muley et al [3]
Tamil Nadu	26.6%	2015	Kumar et al [21]
Andhra Pradesh	22%	2023	Present study

DISCUSSION

In the present study, based on the age distribution of the cases, out of 22 positive blood culture cases, Early Onset Neonatal Sepsis contributes 14 (63.6%) cases and Late Onset Sepsis about 8(36.4%) cases. Early-onset sepsis accounted for 68 cases (70.1% of sepsis cases), while late-onset sepsis comprised 29 cases (29.9% of sepsis cases) as per Surjeet et al [15]. Kumar S et al [22] noted maternal age >30 years (aOR = 3.017, CI: 1.238 to 7.352; P < 0.015), maternal UTI in the third trimester of pregnancy (aOR = 5.435, CI: 2.647 to 11.158; P < 0.0001), and PROM (aOR = 2.911, CI: 4.67 to 33.73, P < 0.004) as significant predictors of EONS. According to a similar study by Muley et al [3] LOS was roughly 33.3% and EOS was

66.7%. An increase in early-onset sepsis indicates that the immune system is still maturing during the first few days of life. Das M et al [16] found that 39% of cases were related to Late Onset Sepsis and 61% were related to Early Onset Sepsis. In the present study, based on the weight of the neonatal cases, 68.2% cases were low birth weight and 31.8% cases were normal weight cases. High positivity rate was observed in the low birth weight cases than normal weight neonates, in this study. Surjeet SS et al [15] observed the mean birth weight was 2402 ± 693 grams, with 139 neonates (57.9%) classified as low birth weight (<2500 grams). Kurma et al [17] found that sepsis was present in 73.2% of low birth weight neonates and 26.8% of normal weight neonates at Government General Hospital, Guntur Medical College, Guntur, Andhra Pradesh. Similar findings were found in a study conducted by Ghosh T et al. at the Department of Microbiology, Burla, which found that 39% of newborns of normal weight and 61% of babies of low birth weight had septicemia [6]. In this study, based on the gestational age of the mother, preterm delivery cases contributed to 54% and term delivery cases contributed 46% sepsis in the neonates. Surjeet SS et al [15] did a study in Jaipur on Neonatal sepsis noted 62.5% preterm babies with septicemia.

In this study, based on the mode of delivery, normal vaginal delivery (NVD) contributed more neonatal sepsis than LSCS. Kumar S et al [22] 102.62.8% of neonates were vaginally delivered (62.8% in cases and 62.8% in control), 85.89% were term gestation (84.6% in cases and 87.2% in control), and 82.69% of neonates (78.20% in cases and 87.2% in control) had normal birth weight. In this study, the total number of microorganisms isolated in the blood cultures was as *Staphylococcus aureus* (9%), *Coagulase Negative Staphylococci* (27.9%), *Enterococcus faecium* (9%), *Escherichia coli* (4.6%), *Klebsiella pneumoniae* (4.6%), *Klebsiella aerogenes* (4.6%), *Pseudomonas aeruginosa* (9%), *Acinetobacter baumannii* (9%), *Serratia marcescens* (4.6%), *Candida albicans* (4.6%), *Non albicans Candida* (13.7%). Kumar S et al [22] found *Pseudomonas aeruginosa* was the most frequent organism (gram negative) isolated from a blood sample in suspected sepsis (41.02%) followed by *Klebsiella pneumoniae* (16.66%).

A similar study was done by Das M et al [16] shown that *Klebsiella* species were commonly isolated bacteria among Enterobacterales, which was about 22%. *Escherichia coli* contributed about 9.8%, *Enterobacter cloacae* 2.4%. A similar study done by Gamit et al shown that *Klebsiella* species was most commonly isolated among Gram Negative bacteria, it was about 17.33% [23]. Surjeet SS et al [15] observed *Klebsiella pneumoniae* was the most frequently isolated pathogen (15 cases, 45.5%), followed by *Coagulase-negative Staphylococcus* (7 cases, 21.2%). Other isolated organisms included *Escherichia coli* (4 cases, 12.1%), *Pseudomonas aeruginosa* (3 cases, 9.1%), *Enterococcus* (2 cases, 6.1%), *Acinetobacter baumannii* (1 case, 3.0%), and *Staphylococcus aureus* (1 case, 3.0%). All the gram negative isolates of Neonatal sepsis were sensitive to penems, cotrimoxazole and resistant to remaining antibiotics. According to the current study, 75% of Trimethoprim/Sulfamethoxazole and 75% of Gentamicin are sensitive to Enterobacterales. Even the Beta Lactam with Beta Lactamase Inhibitors and also Cefoxitin has shown resistant, so there is a high multi drug resistant strains such as Extended Spectrum Beta Lactamase, AmpC betalactamase, Carbapenemase are present in this study. A similar study done by Gamit et al [23] shown that 90% resistant to Imipenem, 97% resistant to Ampicillin, finding are similar to our study. A similar study done by Muley et al [3] observed that Enterobacterales shown more resistant towards Ampicillin, third generation Cephalosporins. There was good sensitivity among Gentamicin, Ciprofloxacin.

In this study *Pseudomonas aeruginosa* is sensitive to Piperacillin/Tazobactam, Meropenem, Trimethoprim/Sulfamethoxazole; intermediate to Ceftazidime, Cefepime and Colistin; resistant to Fluoroquinolones and Aminoglycosides. *Acinetobacter baumannii* isolates were resistant to all the antibiotics, intermediate to Colistin and sensitive to Trimethoprim/ Sulfamethoxazole, in the present study. A study done by Gupta S et al showed that two of the five isolates of *Acinetobacter* were resistant to Carbapenem. Every Non Fermenter isolate was susceptible to Colistin. While all three *Pseudomonas* were susceptible to Carbapenem, two were multidrug resistant and showed resistance to Aminoglycosides, Ceftazidime, and Piperacillin-Tazobactam [24]. Kumar S et al [22] concluded *Pseudomonas* was highly resistant to meropenem and piperacillin in the beta-lactam group but sensitive to penicillin and ampicillin. In non-beta-lactam group, *pseudomonas* was resistant to ceftazidime, cefepime, gentamycin, and ciprofloxacin. *Klebsiella* was resistant to ampicillin and sensitive to meropenem. Among non-beta-lactam antibiotics, it was resistant to cefepime and gentamycin and sensitive to cephalosporin and ciprofloxacin. A significant challenge is being faced by clinicians on managing neonates with septicemia. Along with maternal and neonatal risk factors even antimicrobial resistance is becoming major hurdle to improve the clinical outcome, causing significant mortality and morbidity. The high mortality rate of 16.5% signifies a serious nature of this condition [25]. The economic burden also a problem to health care system and to patients due to long term usage of antibiotics and prolonged hospital stay [26].

CONCLUSION

The prevalence of neonatal sepsis varies from 15-40% depending on the location. Premature birth babies, low birth weight babies were predominantly affected by septicemia. Early onset sepsis accounts for the majority of cases in many studies, which hints the clinicians to rule out the maternal and intrapartum risk factors at the earliest. Among Gram negative isolates, *Pseudomonas*, *Acinetobacter* and Enterobacterales were isolated which were sensitive to carbapenems, aminoglycosides and cotrimoxazole. Sustenance about early diagnosis, practicing infection control practices, regular antenatal care will

significantly aid in decreasing mortality rate. A scrupulous monitoring and implementation of infection control practices, antibiogram and epidemiology of the health care system definitely reduce this burden on community.

REFERENCES

1. Murthy S, Godinho MA, Guddattu V, Lewis LE, Nair NS. Risk factors of neonatal sepsis in India: A systematic review and meta-analysis. *PloS one*. 2019 Apr 25;14(4):e0215683.
2. Paul VK. Ghai Essential Pediatrics. CBS publishers; 2019Pg. 163-165.
3. Muley VA, Ghadage DP, Bhore AV. Bacteriological profile of neonatal septicemia in a tertiary care hospital from Western India. *J Global Infect Dis* 2015;7:75-7.
4. Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality:an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151–61.
5. Oza S, Lawn JE, Hogan DR, Mathers C, Cousens SN. Neonatal cause-of-death estimates for the early and late neonatal periods for 194 countries 2000-2013. *Bull World Health Organ*. 2015;93:19–28.
6. Ghosh T, Jena S, Behera AR, Panigrahy S, Sethi RK. Microbial Profile of Neonatal Septicemia and its Antibiogram Prevalent in a Tertiary Care Hospital of Western Odisha. *J Indian Med Assoc*. 2022;120(8):17-22.
7. Odabasi IO, Bulbul A. Neonatal Sepsis. *Sisli Etfal Hastan Tip Bul*. 2020 Jun 12;54(2):142-158.
8. Camacho-Gonzalez A, Spearman PW, Stoll BJ. Neonatal infectious diseases: evaluation of neonatal sepsis. *Pediatr Clin NA m*. 2013;60:367–389.
9. Arora U, Devi P. Bacterial profile of blood stream infections and antibiotic resistant pattern of isolates. *JK Sci*. 2007;9:186–190.
10. Zakariya BP, Bhat V, Harish BN, Arun Babu T, Joseph NM. Neonatal sepsis in a tertiary care hospital in South India: bacteriological profile and antibiotic sensitivity pattern. *Indian J Pediatr*. 2011;78:413–417.
11. Mythri BA, Patil AB, Divya A, Mansabdar P, Sharon VA. Bacteriological profile and antibiogram of neonatal septicemia in a tertiary care hospital. *Indian Journal of Microbiology Research*. 2016;3(2):136-40.
12. Bhatt Sima K, Patel Disha A, Gupta Praveg, Patel Kiran, Joshi Gurudutt. Bacteriological Profile AndAntibiogram Of Neonatal Septicemia. *National Journal of Community Medicine Vol 3 Issue 2 April-June 2012*.
13. IKali A, Ramakrishnan K, Charles PMV, Srirangaraj S, Seetha KS. Microbial profile of neonatal sepsis and antibiotic resistance from a tertiary care hospital in South India. *Indian J Microbiol Res* 2019;6(1):57-60. *Indian Journal of Microbiology Research*, January-March, 2019;6(1):57-60.
14. Satar M, Arisoy AE, Çelik İH. *Türk Neonatoloji Derneği Yenidoğan Enfeksiyonları Tanı ve Tedavi Rehberi 2018*. [Accessed Apr 9 2020].
15. Surjeet SS, Vangala AR. Prevalence and Risk Factors of Neonatal Sepsis in a Tertiary Care Hospital. *Journal of Contemporary Clinical Practice*. 2024 Jan;10(1):155.
16. Das M, Das I, Saha S, Sanghamitra S. Clinical and bacteriological profile of neonatal sepsis: a prospective hospital-based study in a tertiary care hospital in eastern zone of West Bengal. *International Journal of Contemporary Pediatrics*. 2022 Nov;9(11):1056.
17. Kurma VR, Raju MS, Manchu T, Manchu K. Neonatal sepsis: Clinical spectrum, bacteriological profile and antibiotic sensitivity patterns in neonatal intensive care unit in a tertiary care Hospital. *Int J Contemp Med Res*. 2019;6(6):F1-48.
18. Mohakud NK, Mishra JP, Nayak MK, Mishra J, Pradhan L, Panda SS, Bahera MR, Pugulia R, Mishra J. Bacteriological profile and outcome of culture-positive neonatal sepsis in a special newborn care unit setting, Odisha. *Cureus*. 2022 May 31;14(5).
19. Kotgire S, Hatkar S. Neonatal septicaemia: Its bacteriological profile and antibiogram.
20. Reddy KV, Sailaja K, Ashok A, Poojitha K. Clinico-bacteriological Profile of neonatal sepsis in rural Tertiary Care Hospital. *International Journal of Contemporary Pediatrics*. 2017 Jul;4(4):1259-62.
21. Kumar DV, Mohan J, Rakesh PS, Prasad J, Joseph L. Bacteriological profile of neonatal sepsis in a secondary care hospital in rural Tamil Nadu, Southern India. *Journal of family medicine and primary care*. 2017 Oct 1;6(4):735-8.
22. Kumar S, Bhattacharya P, Kaur S, Ray P, Chattopadhyay N. Risk factors and etiology of early-onset neonatal sepsis in Northeastern part of India: Case-control study. *J Family Med Prim Care*. 2024 Jan;13(1):54-58.
23. Gamit SC, Patel RD, Pandya HB, Lakhani SJ. Bacteriological Profile and Antibiotic Susceptibility Pattern of Neonatal Septicemia in a Tertiary Hospital in Vadodara, Gujarat. *Journal of Pure & Applied Microbiology*. 2022 Mar 1;16(1).
24. Gupta S, Singh VK, Singhal S, Chowdhary P. Neonatal sepsis in a tertiary care hospital in Delhi, India: study of microbial profile and antimicrobial susceptibility pattern. *Int J Contemporary Pediatrics*. 2019 Mar;6(2):384-9.
25. Recognising neonatal sepsis. *Ausmed Learn*. 2024;12(3):156-63.
26. Neonatal sepsis: MedlinePlus medical encyclopedia. NIH. 2023;25(40):156-8.