INTRODUCTION

Newborns with a systemic infection that frequently results in considerable morbidity and mortality are at risk for neonatal sepsis, a serious global health issue.1 Numerous factors, including the type of pathogenic bacterial infections that vary among health-care settings, affect the incidence and outcomes of newborn sepsis.2 This variety emphasizes how crucial it is to comprehend these diseases’ epidemiology and resistance patterns to enhance newborn outcomes and optimize treatment approaches.3

The growing problem of antibiotic resistance, which reduces the efficacy of traditional treatments and calls for a more focused approach to antibiotic management, adds to the burden of newborn sepsis.4 This problem is...
especially severe in resource-constrained environments, where the choice of empirical antibiotics could not be in line with local patterns of resistance, which could result in less-than-ideal results.

**Aims and objectives**
The aim of this study is to compare the bacterial pathogens responsible for neonatal sepsis and the outcomes of their treatments across three distinct hospital settings: A government teaching tertiary care hospital, a private teaching hospital (Gems Hospital Ragolu), and a private hospital (Dwaraka Sai Children Hospital).

**MATERIALS AND METHODS**

**Study design and setting**
This research is structured as a comparative observational study; the study is conducted at Government Medical College Srikakulam, incorporating cases from its associated tertiary care hospital, alongside comparisons with a private teaching hospital (Gems Hospital Ragolu) and a private hospital (Dwaraka Sai Children Hospital).

**Study period**
The study spans a full year, from January 2023 to December 2023, making it possible to evaluate patterns of antibiotic resistance and seasonal fluctuations in sepsis cases.

**Population**
The study population consists of 100 neonates diagnosed with sepsis, with participants equally distributed among the three hospital settings (approximately 33 neonates per setting).

**Inclusion criteria**
Neonates diagnosed with sepsis within the first 28 days of life.

Neonates admitted to one of the three study hospitals during the study period.

**Exclusion criteria**
Neonates with congenital infections.

Neonates transferred from other hospitals where antibiotic treatment was initiated.

**Sample size calculation**
The sample size for this comparative observational study was determined based on preliminary estimates of the treatment success rate variance among the different hospital settings. Assuming an 80% overall treatment success rate from prior literature, with an expected 15% difference in success rates between any two hospital types, and aiming for a power of 80% to detect this difference at a significance level of 0.05, the sample size was calculated using a two-sided Chi-square test for equality of proportions. Considering potential loss to follow-up and incomplete data, we estimated a 10% increase in the required sample size, resulting in approximately 33 neonates per hospital setting (100 neonates in total). This calculation ensures sufficient statistical power to discern clinically relevant differences in treatment outcomes, antibiotic resistance profiles, and pathogen prevalence among the study hospitals.

**Data collection**

**Identification of bacterial pathogens**
Blood cultures are conducted on neonates suspected of sepsis to identify bacterial pathogens.

**Antibiotic sensitivity testing**
Antibiotic sensitivity profiles of the isolated pathogens are determined to guide treatment decisions and analyze resistance patterns.

**Treatment outcome measures**
Data on treatment success rates, mortality, length of hospital stay, and incidence of complications are collected and analyzed.

**Statistical analysis**
Data will be analyzed using statistical software. Descriptive statistics will summarize demographic and clinical characteristics. Comparative analyses, such as Chi-square tests for categorical variables and ANOVA for continuous variables, will be used to compare outcomes across hospital settings. A P<0.05 will be considered statistically significant.

**Ethical considerations**
The study protocol was approved by the Institutional Ethics Committee, GEMS Medical College, Srikakulam Andhra Pradesh, India (IEC/GEMS/2023/16). The study was conducted in accordance with ethical guidelines and standards. Informed consent was obtained from all participants.

**RESULTS**

**Study population and demographics**
One hundred newborns from three different hospital settings in Srikakulam were included in this study: Gems Hospital Ragolu, a private teaching hospital, Government General Hospital, a government teaching tertiary care hospital, and Dwaraka Sai Children Hospital, a private hospital. The gestational age of the neonates ranged from 28 to 42 weeks, with a mean of 37.5 weeks. With 51 men and 49 women taking part in the study, the gender distribution was almost equal (Table 1).
Incidence of bacterial pathogens

In 70% of the newborn cases, bacterial infections were found. The detected pathogens were categorized as follows:

Sixty percent of the cases contained Gram-positive bacteria, with the most common species being *Staphylococcus aureus* (22%) and *Streptococcus agalactiae* (Group B *Streptococcus*, 18%).

Forty percent of the illnesses were caused by Gram-negative bacteria, of which the most common were *Escherichia coli* (15%) and *Klebsiella pneumoniae* (12%).

There was no significant difference in the incidence rate of bacterial pathogens between the various hospital settings (P>0.05) (Table 2).

Antibiotic sensitivity patterns

Among the bacterial isolates, resistance to gentamicin (40%) and ampicillin (65%) was especially high.

Vancomycin and cephalosporins (cefotaxime and ceftazidime), which had resistance rates of 15% and 25%, respectively, were shown to have a higher susceptibility.

Twenty percent of the isolates had multidrug-resistant organisms detected in them; the prevalence of these organisms was the same in both types of hospitals (P>0.05) (Table 3).

Treatment outcomes and hospital stay

Treatment for neonatal sepsis had an overall success rate of 80%. Notably, treatment success was 72% in the combined secondary care settings of Gems Hospital and Dwaraka Sai Children Hospital, while it was 88% in the tertiary care setting of Government General Hospital (P<0.05). Septic shock and multiorgan failure were the main reasons for the 10% fatality rate.

Compared to secondary care settings, where hospital stays lasted an average of 19 days, tertiary care settings had hospital stays that lasted 14 days on average (P<0.01) (Table 4).

Complications

Thirty percent of the cases had complications documented, with the most prevalent being respiratory distress syndrome at 8% and necrotizing enterocolitis at 4%.

In secondary care settings, there was a higher prevalence of problems, although the difference was not statistically significant (P>0.05) (Table 5).

DISCUSSION

The results of our investigation illuminated important facets of the management of newborn sepsis, demonstrating that 70% of the cases had bacterial infections identified. Significantly, the prevalence of Gram-positive bacteria increased, with the most prevalent species being *S. agalactiae* and *S. aureus*. This observation aligns with the global trend of Gram-positive bacteria becoming the primary cause of newborn sepsis, a noteworthy development that warrants consideration in the clinical management of this illness.\(^6,8\)

The observed resistance to widely prescribed antibiotics, such as gentamicin and ampicillin, highlights an increasing worry regarding antibiotic resistance, which presents a significant obstacle in the selection of appropriate empirical antibiotic regimens in newborn care settings.\(^9,10\)

Our data also showed that treatment success rates varied throughout hospital contexts, with tertiary care hospitals

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### Table 1: Study population and demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (n=100)</th>
<th>Government general hospital</th>
<th>Gems hospital</th>
<th>Dwaraka sai children hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of neonates</td>
<td>100</td>
<td>34</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Mean gestational age (weeks)</td>
<td>37.5</td>
<td>37.4</td>
<td>37.6</td>
<td>37.5</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>51</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Female</td>
<td>49</td>
<td>17</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

### Table 2: Incidence of bacterial pathogens

<table>
<thead>
<tr>
<th>Pathogen type</th>
<th>Overall (n=70) (%)</th>
<th>Government general hospital (%)</th>
<th>Gems hospital</th>
<th>Dwaraka sai children hospital (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram-positive bacteria</td>
<td>60</td>
<td>58</td>
<td>62</td>
<td>60</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>22</td>
<td>23</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td><em>Streptococcus agalactiae</em></td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Gram-negative bacteria</td>
<td>40</td>
<td>42</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>15</td>
<td>15</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>12</td>
<td>13</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>
showing noticeably superior results. This contrast emphasizes how important it is to have a strong health-care infrastructure and access to cutting-edge diagnostic and therapeutic options to improve sepsis outcomes. It also emphasizes how crucial it is to put in place thorough antimicrobial stewardship programs to direct the prudent use of antibiotics.

Our research confirms the body of literature by showing that the care setting has a major influence on newborn sepsis outcomes. The clear advantage of tertiary settings over secondary ones in terms of results can be ascribed to a number of things, such as easier access to specialist care, more sophisticated diagnostic equipment, and a wider array of treatment alternatives. These variations highlight the critical need for region-specific recommendations that allow for more individualized and successful treatment plans by accounting for local pathogen profiles and resistance patterns.

**Clinical implications**
The study emphasizes how important targeted antibiotic management is to achieving the best possible outcomes for newborn sepsis. To counter the growing wave of antibiotic resistance, hospitals – especially those in secondary care settings – must give top priority to implementing advanced care protocols, which include quick diagnostic methods and evidence-based antibiotic regimens.

Moreover, the discrepancy in treatment outcomes throughout hospital environments underscores the need for fortifying health-care frameworks, guaranteeing fair access to superior neonatal care, and cultivating partnerships between tertiary and secondary care facilities to exchange insights and assets.

**Limitations of the study**
The study's limitations include its observational design and the potential for selection bias given the hospital-based sampling. The findings may not be generalizable to all settings, especially where the distribution of bacterial pathogens and resistance patterns differ significantly.

**CONCLUSION**
This study highlights the difficulty in treating newborn sepsis and the important influence that antibiotic resistance and bacterial infections have on the course of treatment. To improve the prognosis of newborn sepsis worldwide, it advocates for a concerted effort to strengthen antimicrobial stewardship, upgrade health-care facilities, and implement advanced treatment techniques.

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**REFERENCES**
Radhika, et al.: Bacterial pathogens and treatment outcomes in neonatal sepsis

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