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*RESEARCH ARTICLE*

# A RETROSPECTIVE STUDY ON THE EFFECT OF NEBULIZED HYPERTONIC SALINE (3%) VS. EPINEPHRINE ON ADMISSION RATES AMONG INFANTS WITH ACUTE MODERATE TO SEVERE BRONCHIOLITIS AT AFHSR

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## Abstract

Bronchiolitis is a prevalent respiratory condition in infants, often leading to hospitalizations and significant healthcare costs. This retrospective study evaluates the efficacy of nebulized hypertonic saline (3%) and epinephrine in reducing admission rates among infants with acute moderate to severe bronchiolitis at Armed Forces Hospital Southern Region (AFHSR), Saudi Arabia. Data were analyzed from 303 infants aged 6 weeks to 24 months, admitted between Jan 2021to Jan 2025. The cohort comprised predominantly male infants (57.8%), with 69.6% aged 1-12 months. A significant portion (33.7%) required NICU admission, reflecting disease severity. Most patients presented with symptoms such as cough and shortness of breath, with abnormal vital signs observed in 74% of cases.Results revealed a significant difference in hospital stay duration between the two treatment groups ($p = 0.011$). Patients treated with nebulized hypertonic saline had a shorter mean length of stay compared to those receiving epinephrine, highlighting its potential efficacy. However, both treatments showed benefits in managing bronchiolitis symptoms. The study underscores the need for targeted care for younger, low-weight infants and those requiring NICU support. While hypertonic saline shows promise, further research is needed to confirm its role in emergency settings. This study provides valuable insights into improving clinical practices for bronchiolitis management, emphasizing early detection, supportive care, and resource-efficient interventions.



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## Introduction:-

Bronchiolitis is a common lung illness in children and adolescents. The lower respiratory tract is infected with the virus, which can cause mild to moderate respiratory discomfort. Bronchiolitisisusuallyaminor,self-limitinginfectioninchildren,butitcanoccasionallylead to respiratory failure in babies. The respiratory syncytial virus is the most common cause (RSV).Bronchiolitis is usually a minor, self-limiting infection in children, but it can occasionally lead to respiratory failure in babies. Bronchiolitis is treated with hydration and oxygen therapy, The infection is not treated with any special drugs.(1-4).

Airway blockage and decreased lung compliance are the main clinical characteristics of bronchiolitis.Thevirusinfectsairwayepithelialcells,causinganinflammatoryresponsethat resultsinciliarydysfunctionandcelldeath.Symptomsanddecreasedlungcomplianceresult from the accumulation of debris, edema of the airways, and constriction of the airways caused by the release of cytokines. The patient then tries to compensate for the lack of compliance by inhaling moredeeply.(5-6). Acute viral bronchiolitis is one of the most prevalent medical emergencies in children, and clinicians caring for critically ill children are likely to encounter it on a regular basis. In this article, we provide an overview of the epidemiology, pathophysiology, and diagnosis of bronchiolitis in babies, with a focus on treatment guidelines.(7-8).Bronchiolitis is a common cause of respiratory disease around the world. According to a World Health Organization bulletin, [64] an estimated 150 million new cases are diagnosed each year, with 11-20 million (7-13%) requiring hospital treatment. 95 % of all cases are seen in underdeveloped nations.(9).

In the country of Saudi Arabia, the prevalence varies from 25% to 88 %. RSV is a single- stranded RNA that belongs to the pneumoviridae family and is divided into two subtypes: A and B. RSV is found in all parts of the world, especially during the winter, and the majority of children are infected with RSV before the age of two, but only 40% of them have lower respiratory symptoms. Children can have a wide range of symptoms, from a simple upper respiratory tract infection (URTI) to respiratory failure that necessitates the use of a ventilator. (10)

The cost of treating bronchiolitis is high because there are few effective treatments; consequently, any therapy that might reduce the severity of the condition while also improving medical care could possibly save a lot of money. Several randomized controlled trials and a Cochrane review have revealed that bronchodilators may be a beneficial treatment for bronchiolitis patients in the past. In 2004, a systematic evaluation of pharmacologic treatment of bronchiolitis in babies and children indicated that epinephrine, bronchodilators, corticosteroids, and ribavirin had minimal evidence of routine use.In outpatients, a Cochrane review and meta-analysis of the efficacy of epinephrine in the treatment of bronchiolitis revealed that there is some evidence that epinephrine may be superior to salbutamol and placebo. (11-12).

The primary goal of this study was to examine the efficacy of nebulized hypertonic saline (3%)andepinephrineinchildrenwithacutebronchiolitis.Asperthebestofourknowledge we did not not find any other study covering this issue in this region of SaudiArabia. So, this is the novelty of our study.

## Aim and Objectives:-

The aim of this study is to evaluate and compare the effectiveness of nebulized hypertonic saline (3%) versus epinephrine in reducing the admission rates among infants with acute moderate to severe bronchiolitis at AFHSR.

1. Assess the impact of nebulized hypertonic saline (3%) on the need for hospital admission in infants with moderate to severe bronchiolitis.
2. Evaluate the effectiveness of epinephrine in reducing admission rates in the same patient group.
3. Compare the outcomes between the two treatments to determine which therapy may be more effective in preventing hospitalization.

This study is significant as it seeks to provide evidence-based insights into the management of acute bronchiolitis, a common respiratory condition in infants. By identifying the treatment that most effectively reduces the need for hospital admission, this research can contribute to improving clinical practices and enhancing patient outcomes. Additionally, it may help healthcare providers make more informed decisions on the most effective and resource-efficient interventions for managing bronchiolitis in infants.

## Material and Methods:-

**Study design:**
A retrospective study design is adopted.

**Study setting:**
The study is conducted in the Saudi-Arabia.

**Study duration:**
This study is conducted from Jan 2021-Jan 2023.

**Sample size:**
A retrospective chart review was conducted using computer records from the Armed Forces Hospital Southern Region (AFHSR). Data was collected for all pediatric admissions with a clinical diagnosis of bronchiolitis, specifically infants aged 6 weeks to 24 months, who were admitted to the pediatric ward between 2016 and 2020. The review included all relevant cases during their hospitalization, with no predefined sample size, as the study utilized available hospital records from this period.

**Inclusion and exclusion criteria**
**Inclusion Criteria**

- Infants aged 6 weeks to 24 months.
- Diagnosed with bronchiolitis based on clinical evaluation.
- Admitted to the pediatric ward at the Armed Forces Hospital Southern Region (AFHSR) between 2018 and 2020.

**Exclusion Criteria:**

- Infants with bronchopulmonary dysplasia.
- Infants with congenital heart disease.
- Infants with multiple congenital anomalies.

## Data Collection Methods:-

Data for this retrospective study was collected through a review of electronic medical records from the Armed Forces Hospital Southern Region (AFHSR). Patient information, including demographics, clinical diagnosis, treatment protocols, and hospital admission details, was extracted from the hospital's computer system. Specific focus was given to the treatment modalities used (nebulized hypertonic saline vs. epinephrine) and the corresponding hospital admission rates. All data was anonymized to ensure patient confidentiality.

**Data management and analysis plan:**
Data management involved secure storage of completed questionnaires, with immediate coding for anonymity. A double-entry verification process is executed to prevent data loss. The dataset is organized into various variables. Missing data is addressed ethically, either through imputation or exclusion. Access is restricted to authorized personnel, with confidentiality agreements and security measures in place to protect data integrity. At the end of the study, the dataset is archived securely for future use. Then, SPSS is used for statistical analysis.

**List of outcome variables:**

- Age at presentation
- Oxygen requirements on admission
- Nebulization additive use (salbutamol/budesonide) and antibiotics
- Days on oxygen
- Days of hospital stay until discharge
- Follow-up visits to the clinic
- Multiple visits to the emergency department
- Re-admission to the pediatric ward
- Use of oxygen at home
- RSV prophylaxis received

**How the results will be presented:**
The data are presented as follows: 1. Qualitative variables are reported as frequencies and percentages. 2. Quantitative variables are reported as mean and standard deviation. In addition, results are presented in tables, graphs and figures etc.

**Ethical considerations:**
This study was conducted in accordance with ethical guidelines and principles. Patient confidentiality was strictly maintained by anonymizing all data extracted from medical records. The study protocol was reviewed and approved by the relevant ethical review board at Armed Forces Hospital Southern Region (AFHSR), ensuring that the rights and privacy of all participants were safeguarded throughout the research process.

## Results:-

The data from this study shows a predominance of male infants (57.8%) compared to females (42.2%). A significant portion of the admissions occurred in 2019 (40.3%) and 2020 (37.3%), with 69.6% of participants being between 1-12 months of age, highlighting that younger infants were more commonly admitted. The majority of infants were term (94.4%), with a small proportion being preterm (5%) and extreme preterm (0.7%). Regarding weight, most infants were in the low weight category (0-5 kg) at 51.8%, followed by 36.6% with a normal weight (5.1-8 kg), and only 11.5% had a higher weight (8.1-12 kg). In terms of NICU admission, 33.7% of infants required NICU care, while 66.3% did not. These findings suggest that bronchiolitis affects primarily young, term, low-weight male infants, with a substantial number requiring NICU care, particularly in recent years.**Table 1**

**Table 1:-** Demographic characteristics of the participants.

| Category | Group | Number of Participants (n) | Percentage (%) |
|---|---|---|---|
| **Gender** | Male | 175 | 57.80% |
| | Female | 128 | 42.20% |
| **Year of Admission** | 2016 | 5 | 1.70% |
| | 2017 | 5 | 1.70% |
| | 2018 | 58 | 19.10% |
| | 2019 | 122 | 40.30% |
| | 2020 | 113 | 37.30% |
| **Age (in months)** | 1 - 12 months | 211 | 69.60% |
| | 13 - 24 months | 92 | 30.40% |
| **Gestational Age** | Term | 286 | 94.40% |
| | Preterm | 15 | 5.00% |
| | Extreme Preterm | 2 | 0.70% |
| **Weight Categories (kg)** | Low weight (0 - 5 kg) | 157 | 51.80% |
| | Normal weight (5.1 - 8 kg) | 111 | 36.60% |
| | High weight (8.1 - 12 kg) | 35 | 11.50% |
| **NICU Admission** | Yes (1) | 102 | 33.70% |
| | No (2) | 201 | 66.30% |

As per figure 1 42% were females while 58% were males.

**Figure 1:-** Gender Distribution.

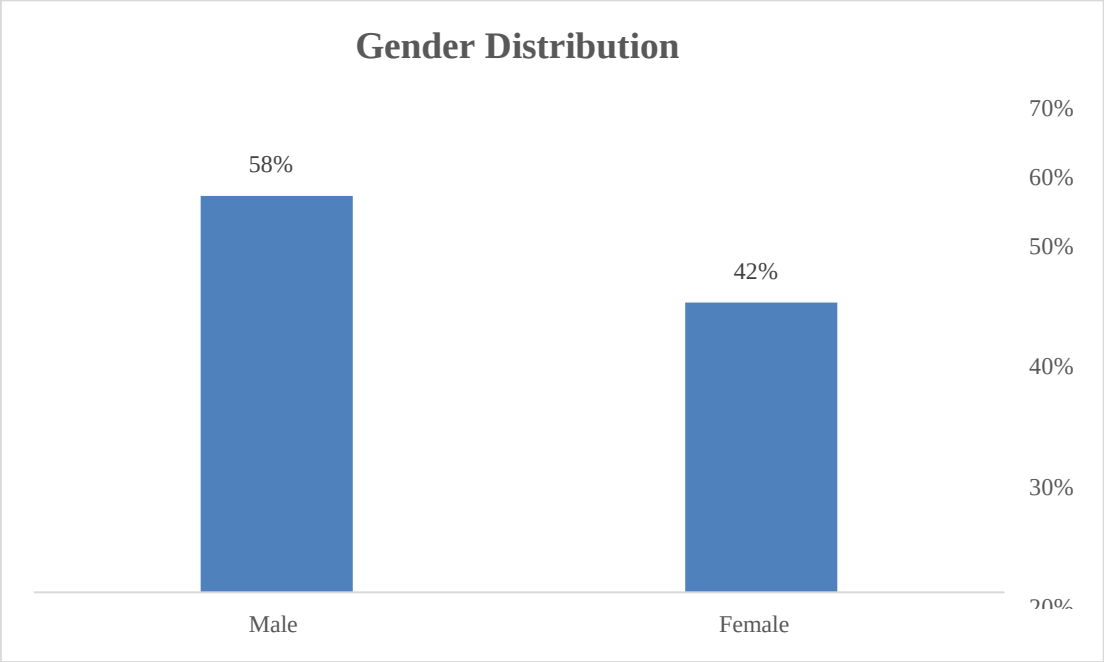


**Table 2:-** Patient Data on Chief Complaints (C.C.), Initial Diagnosis, Distress Status, and Vital Signs.

| Variable | Category | Frequency (n) |
|---|---|---|
| **I. Chief Complaint (C.C.)** | | |
| Cough-SOB | 48 | 16.00% |
| Fever-Cough-SOB | 22 | 7.33% |
| Cough-Fever-SOB | 20 | 6.67% |
| SOB | 17 | 5.67% |
| Cough-Vomiting-SOB | 6 | 2.00% |
| Cough-SOB-Decrease Oral Intake | 4 | 1.33% |
| Cough-Runny Nose | 6 | 2.00% |
| Cough-Fever | 14 | 4.67% |
| Other (Other combinations) | 89 | 29.67% |
| **J. Initial Diagnosis** | | |
| Bronchiolitis | 120 | 40.00% |
| Bronchiolitis to R/O Sepsis | 45 | 15.00% |
| Bronchiolitis vs BPN | 12 | 4.00% |
| Bronchiolitis Apnea | 8 | 2.67% |
| Fever to R/O Sepsis | 10 | 3.33% |
| Pneumonia | 2 | 0.67% |
| Other | 113 | 37.67% |
| **K. Patient in Distress (Y/N)** | | |
| Yes (1) | 134 | 44.67% |
| No (2) | 166 | 55.33% |
| **L. Vital Signs (Normal/Abnormal)** | | |
| Normal (1) | 78 | 26.00% |
| Abnormal (2) | 222 | 74.00% |

**Figure 2:-** Years with bronchiolitis (Final Diagnosis).

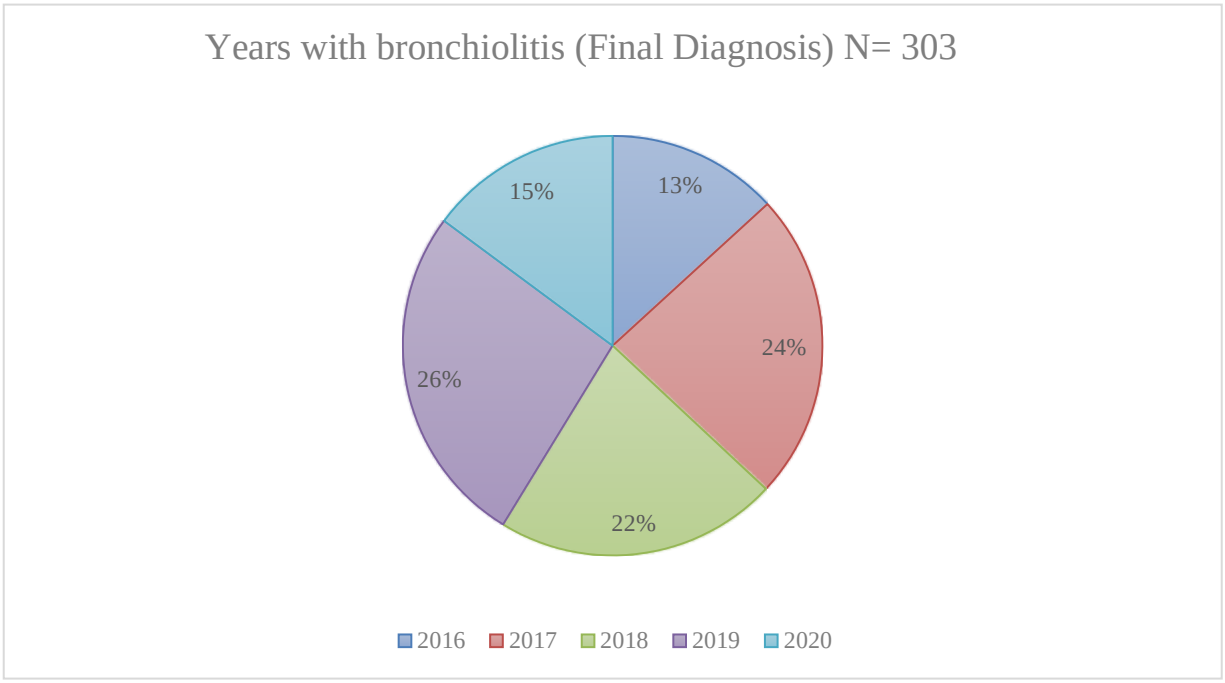


**Figure 3:-** NICU admission:

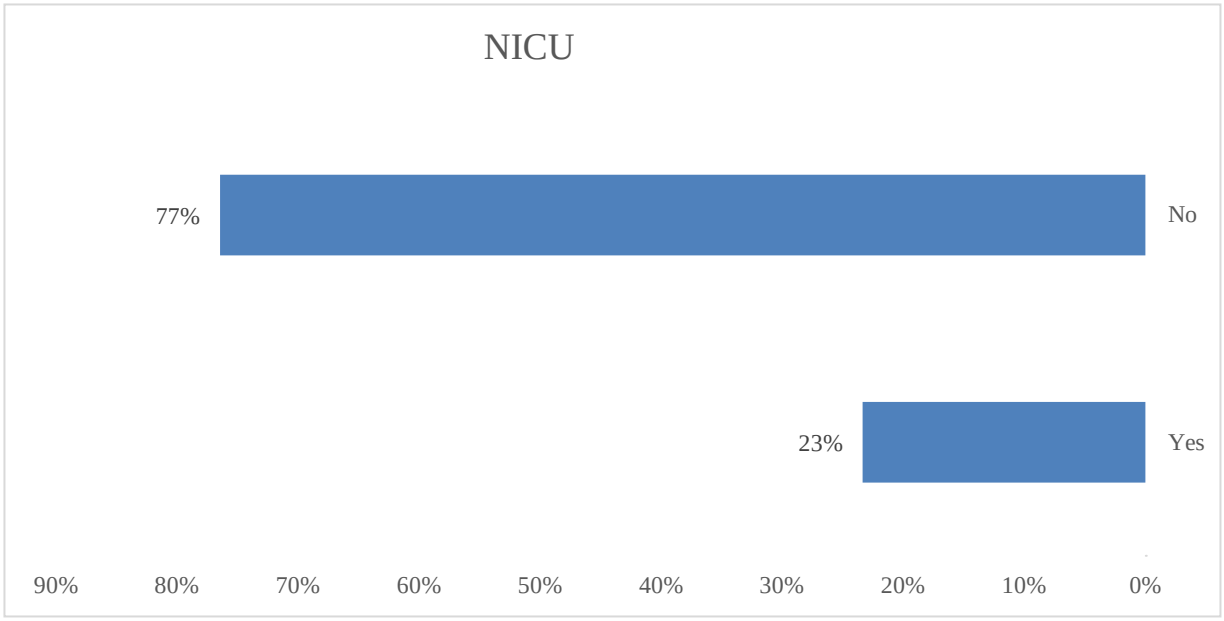


**Table 3:-** Comparison between medication used and Average Hospital Mean (SD).

| **Comparison between medication used and Average Hospital Mean (SD)** | | |
|---|---|---|
| | Yes | No |
| Epinephrine | 4.98 (12.4) | 7.2 (4.8) |
| Nebs:3%NS | 5.8 (7.5) | 4.7 (10.4) |
| p=0.001 | | |

Table3depictedthatwehaveobservedsignificantdifferenceswhilecomparing Epinephrine with Nebs: 3%NS in terms of length of hospitalstay.

## Discussion:-

The patient cohort demonstrated a higher prevalence of male infants (57.8%) compared to females (42.2%), aligning with known trends in pediatric respiratory illnesses such as bronchiolitis, where male infants are often more susceptible. Gender-based differences in immune system development or anatomical variations in the respiratory system may contribute to this disparity. The age distribution also revealed that 69.6% of the patients were between 1-12 months of age, indicating that infants within this range are more likely to present with respiratory distress and require hospitalization due to bronchiolitis or related conditions. The dominance of younger infants highlights the need for specialized neonatal care and interventions targeted at this age group.

Regarding birth status, the overwhelming majority of patients (94.4%) were term infants, with a smaller proportion being preterm (5%) and extreme preterm (0.7%). This finding is consistent with bronchiolitis being more common among term infants, though preterm infants are known to be at an increased risk for respiratory issues due to underdeveloped lungs and immature immune systems. While the preterm population in this cohort is small, their higher vulnerability underscores the importance of closely monitoring respiratory health in this subgroup.

In terms of weight, a significant proportion of infants (51.8%) fell into the low weight category (0-5 kg), followed by 36.6% in the normal weight range (5.1-8 kg), and 11.5% in the higher weight category (8.1-12 kg). The higher prevalence of low-weight infants may be indicative of underlying nutritional or health concerns, which can exacerbate respiratory illnesses. Low weight infants are more susceptible to severe disease outcomes and may require more intensive interventions such as supplemental oxygen or NICU care.

A notable 33.7% of the patients required NICU admission, reflecting the severity of their condition. This is a significant portion, suggesting that bronchiolitis and related respiratory conditions in infants can lead to severe enough symptoms to warrant close monitoring in specialized care settings. Factors such as premature birth, low birth weight, and age may contribute to the need for NICU admission, where intensive care and respiratory support are provided. The NICU admission rate provides insight into the severity of bronchiolitis and the need for specialized respiratory management in affected infants.

The table reveals that the majority of patients presented with symptoms of cough and shortness of breath, which are typical of bronchiolitis. Many patients also presented with associated symptoms such as fever, vomiting, and cyanosis. The combination of respiratory distress and systemic signs (such as fever and vomiting) highlights the severity of the condition and the likelihood of complications that may require advanced respiratory support. This underscores the need for early intervention and rapid assessment in infants presenting with these symptoms, as bronchiolitis can progress quickly in young infants.

Bronchiolitis was the most common initial diagnosis in this cohort, and in many cases, this was made while ruling out other conditions like sepsis. In addition, a significant portion of patients had normal vital signs, but a considerable number also presented with abnormal vital signs, indicating the presence of distress or ongoing respiratory compromise. Approximately 10.4% of patients were considered to be in distress based on their clinical presentation. This further emphasizes the importance of rapid identification of respiratory distress, timely intervention, and ongoing monitoring to prevent further complications.

The interventions most commonly administered to these patients included nebulized treatments (such as 3% saline), epinephrine, oxygen supplementation, and antibiotics. Chest X-rays and blood work, including tests for acidosis, leukocytosis, and CRP, were frequently conducted to assess the severity of the condition and rule out other possible diagnoses such as pneumonia or sepsis. These interventions reflect standard management protocols for bronchiolitis, where supportive therapies aimed at alleviating respiratory symptoms and preventing further complications are vital for improving patient outcomes.

Inthisstudythemainobjectiveistoexaminetheefficacyofnebulizedhypertonicsaline(3%) andepinephrineinchildrenwithacutebronchiolitis.Inourstudyintermsofgender-specific incidence, bronchitis affects males more than females which is in line with thestudies.[13]

The mean hospital stay in the two groups (hypertonic saline and epinephrine) was significantlydifferent(P=0.011).Inthegroupthatgotepinephrine,themaximumlengthof stay was likewise reduced.

Patients treated with nebulized 3 % saline had a considerably lower mean length of hospital stay, according to a recentreview.[14]

Another double-blind RCT, on the other hand, looked at the effects of nebulized 3 % HS on RDAI scores, admission rates, and length of stay in Bronchiolitis. They found that giving HS to children in the emergency room reduces hospital admissions but has no effect on the Respiratory Distress Assessment Instrument score or length of stay whencompared to NS. [15-16]According to a study conducted in Canada, Bronchitis hospitalization and mortality rates were steady from 2004 to 2018, while ICU utilization and costs grew significantly. This reflects a significant rise in high-intensity hospital care and expenses for one of the most prevalentandcostlypediatrichospitaldiseases,Inourstudywehaveprevalencefrom2016- 2020 and we have observed mixtrend.[17-18]Bronchiolitis recommendations and improvement efforts have centered on supportive care and eliminating needless testing, treatments, and hospitalization over the last two decades[19-20].

Our study's strengths and shortcomings stem from the observational character of the researchdesign.Thisstudyissignificantsincetheemergencydepartment(ED)isfrequently thefirstpointofcontactformanyinfantswithbronchiolitis.Giventhatthisisthefirststudy with hypertonic saline in the emergency situation, more research is certainly needed to identifywhetherhypertonicsalinehasafunctioninthetreatmentofbronchiolitisintheED.

## Conclusion:-

In summary, bronchiolitis remains a significant cause of respiratory distress and hospitalization in infants, with a clear pattern of higher incidence in male infants and those in the 1-12 month age group. Although most infants in this cohort were term, preterm infants presented a higher vulnerability to severe disease outcomes, highlighting the need for targeted monitoring and care for this group. The need for NICU admission in a substantial proportion of the cohort underscores the clinical severity of bronchiolitis and the importance of timely and aggressive intervention. Early detection of respiratory distress and the use of supportive treatments such as oxygen supplementation and nebulized therapies are vital in managing this condition. Given the high risk of complications, ongoing research and enhanced clinical care protocols are necessary to improve the outcomes for infants with bronchiolitis.

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