



The Effectiveness of Different Ventilation Strategies Use for Neonate with Respiratory Distress Syndrome in FMC Asaba

Tina Oluchi Emeagha

RN, RM, BNSc, PGDE, RNE, MPH, MSc Nursing
Email: tinaemeagha@gmail.com

ABSTRACT

This study was conducted to assess the effectiveness of different ventilation strategies used in the management of neonates with Respiratory Distress Syndrome (RDS) in the Neonatal Intensive Care Unit (NICU) of the Federal Medical Centre, Asaba. The study examined both invasive and non-invasive ventilation methods, evaluated their effectiveness in improving respiratory function and survival, and identified the challenges influencing their successful use. It also explored the factors determining the choice of ventilation strategies among neonates with varying degrees of respiratory distress. The study adopted a descriptive cross-sectional design and involved one hundred (100) neonates diagnosed with RDS. Data were collected through a structured checklist developed in line with the study objectives and analyzed using descriptive and inferential statistical methods. The major findings revealed that various ventilation methods were employed in the NICU, including Continuous Positive Airway Pressure (CPAP), Bi-level Positive Airway Pressure (BiPAP), High Flow Nasal Cannula (HFNC), Conventional Mechanical Ventilation (CMV), and High-Frequency Oscillatory Ventilation (HFOV). Among these, CPAP emerged as the most commonly used and most effective ventilation strategy for managing neonates with mild to moderate RDS. The findings also identified several factors that influenced the selection of ventilation strategies, including gestational age, birth weight, severity of RDS, and availability of equipment and trained personnel. Furthermore, the study highlighted several operational challenges affecting ventilation outcomes in the NICU. These included inadequate equipment, limited availability of functional CPAP machines, shortage of trained neonatal nurses and respiratory therapists, frequent equipment malfunction, financial constraints, and occasional power interruptions. These challenges often hindered optimal neonatal care and affected the overall success of ventilation therapy.

Keywords: Ventilation Strategies, Management of Neonates, Respiratory Distress Syndrome

INTRODUCTION

The transition from intra-uterine to extra-uterine life involved respiratory adaptation and freedom from fetal circulation. However, for some term and most especially the preterm neonate, the lung is yet to be fully mature to secrete surfactant that function in lubricating the alveola. This result in alveola collapse leading to ineffective gaseous exchange refer to as respiratory distress syndrome. According to Ashish et al (2023), respiratory distress syndrome (RDS) is a breathing problem that affects newborns, mostly those who are born more than 6 weeks before their due date. Globally Neonatal RDS affects about 10-15% of newborns and up to 60% of those born before 28 weeks, making it a leading cause of NICU admissions. Continuous Positive Airway Pressure (CPAP) is widely adopted as the preferred initial ventilation strategy, with invasive ventilation and HFOV reserved for severe cases, significantly improving survival (Sweet et al., 2019; Martinet al., 2021). In sub-Saharan Africa, 30-40% of preterm infants admitted to NICUs develop RDS, with CPAP being the most common strategy due to cost and feasibility. Limited access to surfactant and advanced ventilators contributes to higher morbidity and mortality compared to high-income countries (Mugwagwa et al., 2020; Kayange et al., 2021). RDS prevalence in Nigerian NICUs is estimated at 20-40%, with CPAP as the main ventilation method, while invasive ventilation is used for severe cases. Surfactant therapy uptake remains inconsistent due to cost, leading to higher mortality despite proven benefits of early CPAP (Okonkwo et al., 2021; Olusanya et al., 2022). About 25-30% of NICU admissions are due to RDS, with CPAP being the primary ventilation strategy. Invasive ventilation is available but limited, and recent

initiatives to scale up CPAP use, and staff training have improved neonatal outcomes (Nwankwo et al., 2022; FMC Asaba Records, 2023).

The study aims to assess the effectiveness of invasive ventilation strategies, including mechanical ventilation, which are often employed in more severe cases of RDS. Understanding their outcomes in the local context will help refine protocols, improve survival rates, and reduce the duration of NICU stays, by comparing the outcomes of both invasive and non-invasive strategies, the study seeks to generate robust data to guide clinical decision-making in the management of neonates with RDS. This comparative analysis will help in identifying the most appropriate ventilation strategy based on the severity of the condition, availability of resources, and the clinical profile of the neonate. The identification of predictors of ventilation failure. Early recognition of factors that lead to poor response or failure of ventilation strategies can aid in timely intervention and escalation of care. This has the potential to significantly improve outcomes, reduce complications, and optimize the use of NICU resources. The study will assess the impact of surfactant replacement therapy, which is a standard adjunct in the management of RDS. Understanding its interaction with various ventilation strategies will provide insights into how best to integrate surfactant therapy for maximal benefit in the local population.

Statement of the Problem

Respiratory Distress Syndrome (RDS) remains one of the most common and serious causes of morbidity and mortality among neonates, particularly preterm infants. Globally, RDS accounts for up to 60–80% of cases in neonates born before 28 weeks and remains a major contributor to neonatal deaths despite advances in surfactant therapy and ventilation strategies (Sweet et al., 2019; Sharma et al., 2021). In Africa, and especially in Nigeria, the burden is even higher due to limited resources. Studies have shown that RDS contributes to 20–30% of all neonatal admissions and up to 40% of neonatal deaths in tertiary hospitals (Ogunlesi & Ayede, 2021; Chukwu et al., 2022). In Nigeria, including Federal Medical Centre (FMC) Asaba, neonatal intensive care units (NICUs) continue to face the challenge of effectively managing RDS. While different ventilation strategies such as Continuous Positive Airway Pressure (CPAP), mechanical ventilation, and high-frequency oscillatory ventilation (HFOV) are employed, their outcomes vary significantly depending on the infant's gestational age, birth weight, severity of illness, and availability of supportive care. Many neonates also develop complications such as barotrauma, volutrauma, oxygen toxicity, and prolonged hospital stay, which further worsen outcomes. In addition, mortality rates remain high compared to developed countries, reflecting gaps in the optimal application of ventilation strategies, shortage of equipment, and limited availability of surfactant therapy.

Despite the existence of different ventilation modalities, there is a paucity of data from FMC Asaba on their comparative effectiveness, associated complications, and survival outcomes. Without such evidence, it is difficult to determine which strategies are most effective for improving neonatal survival and reducing complications in this setting. Furthermore, healthcare providers often face challenges in implementing ventilation strategies due to limited resources, leading to inconsistent outcomes. Therefore, there is a compelling need to systematically assess the effectiveness of different ventilation strategies used in the management of neonates with RDS in the NICU at FMC Asaba..

Objectives of the study

The general objective of the study is to determine the effectiveness of different ventilation strategies use for neonate with Respiratory Distress Syndrome in FMC Asaba. Some specific objectives include:

1. To determine the effectiveness of non-invasive ventilation strategies in the management of neonate with respiratory distress syndrome in NICU FMC Asaba, Delta State.
2. To determine the effectiveness of invasive ventilation strategies in the management of neonate with respiratory distress syndrome in NICU FMC Asaba, Delta State.
3. To compare the outcome of invasive and non-invasive ventilation strategies used for neonate with respiratory distress syndrome in NICU FMC Asaba, Delta State.

Research Questions

1. What is the effectiveness of non-invasive ventilation strategies in the management of neonate with respiratory distress syndrome in NICU FMC Asaba, Delta State?

2. What is the effectiveness of invasive ventilation strategies in the management of neonate with respiratory distress syndrome in NICU FMC Asaba, Delta State?
3. What is the outcome of different invasive and non-invasive ventilation strategies use for neonate with respiratory distress syndrome in NICU FMC Asaba, Delta State?

LITERATURE REVIEW

Concept of Respiratory Distress Syndrome (RDS)

Respiratory Distress Syndrome (RDS), historically referred to as hyaline membrane disease, is one of the most significant causes of morbidity and mortality among neonates, particularly those born prematurely. The syndrome is primarily a consequence of pulmonary surfactant deficiency and structural lung immaturity. Surfactant is a complex mixture of phospholipids and proteins secreted by specialized alveolar type II cells, beginning around the 24th week of gestation, with levels rising significantly after the 34th week. Its principal function is to reduce alveolar surface tension, thereby preventing alveolar collapse during expiration and ensuring adequate gas exchange (Sweet et al., 2019). In neonates with insufficient surfactant, the alveoli repeatedly collapse after each exhalation, leading to decreased lung compliance and impaired ventilation. This results in progressive hypoxemia, hypercapnia, and respiratory acidosis, all of which can rapidly culminate in respiratory failure if not promptly addressed (Jobe & Kallapur, 2020). Pathologically, RDS is associated with the formation of hyaline membranes, which are composed of fibrin, necrotic epithelial cells, and proteinaceous debris that line the collapsed alveoli. These membranes further impair oxygen diffusion and exacerbate the clinical severity of the condition (Sudeep & Lee, 2023).

The incidence of RDS is inversely proportional to gestational age. It affects approximately 60–80% of infants born before 28 weeks, 30–40% of those born between 28 and 34 weeks, and fewer than 5% of infants delivered after 37 weeks of gestation (Okonkwo et al., 2021). Beyond prematurity, several risk factors increase susceptibility, including maternal diabetes (due to delayed surfactant synthesis), cesarean section without preceding labor, male sex, perinatal asphyxia, and multiple gestations. Conversely, protective factors such as intrauterine stress, maternal hypertension, and antenatal corticosteroid administration accelerate fetal lung maturation and reduce the likelihood of RDS (Ezeaka et al., 2020). Clinically, neonates with RDS typically present within minutes to hours after birth with tachypnea (respiratory rate >60 breaths per minute), nasal flaring, grunting, intercostal and subcostal retractions, and cyanosis. As the disease progresses, oxygen requirements escalate, and without intervention, respiratory failure ensues. Diagnosis is based on clinical signs, arterial blood gas analysis (revealing hypoxemia and respiratory acidosis), and chest radiography, which classically demonstrates a “ground-glass” appearance with air bronchograms (Sweet et al., 2019).

Management of RDS requires a multifaceted approach. Core interventions include oxygen supplementation, surfactant replacement therapy, and ventilatory support, ranging from Continuous Positive Airway Pressure (CPAP) to invasive mechanical ventilation. Advances in less invasive surfactant administration techniques, alongside early CPAP, have dramatically improved survival rates and reduced complications such as bronchopulmonary dysplasia. Despite these improvements, however, RDS continues to account for significant neonatal mortality, particularly in low- and middle-income countries where access to surfactant and advanced ventilation modalities remains limited (Kaltsogianni et al., 2023). In summary, RDS is a life-threatening neonatal condition arising from immature lung development and surfactant deficiency. Its impact is greatest among preterm infants and remains a leading cause of neonatal death in Nigeria and globally. Understanding its pathophysiology, risk factors, clinical presentation, and management is essential for neonatal practitioners, particularly in resource-constrained settings such as FMC Asaba, where optimizing ventilation strategies is crucial for improving outcomes.

Classification of Preterm Neonates

Preterm neonates are defined as infants born before 37 completed weeks of gestation. They are classified into subgroups according to gestational age, each with distinct clinical challenges and varying risks of respiratory distress syndrome (RDS). This classification is critical because the degree of prematurity directly correlates with the likelihood and severity of RDS as well as the choice of appropriate ventilation strategies.

Late Preterm Neonates (34–36 weeks of gestation):

These infants may appear physiologically mature, but their lungs and neurological control of breathing remain underdeveloped. While many late preterm babies breathe independently, they still have an increased risk of mild RDS, transient tachypnea of the newborn (TTN), hypothermia, hypoglycemia, and jaundice compared to term infants. Late preterm infants may require brief supplemental oxygen or non-invasive ventilation such as CPAP but usually have good outcomes with timely support (Sweet et al., 2019).

Moderately Preterm Neonates (32–34 weeks):

Infants in this category often present with immature lungs and reduced surfactant production. They are at higher risk of developing moderate RDS and frequently require non-invasive ventilation such as CPAP or NIPPV for adequate oxygenation. Without timely respiratory support, many in this group progress to require intubation and invasive ventilation. Although their survival rates are generally favorable in well-equipped NICUs, complications such as apnea of prematurity, feeding difficulties, and infections remain common (Okonkwo et al., 2021).

Very Preterm Neonates (28–31 weeks):

The lungs of very preterm infants are structurally and biochemically immature, with insufficient surfactant to maintain alveolar stability. Consequently, RDS is highly prevalent in this group, with incidences exceeding 60% (Ezeaka et al., 2020). They almost always require intensive respiratory support, ranging from CPAP to invasive ventilation. Surfactant replacement therapy is often essential for survival. Without appropriate intervention, mortality and long-term morbidities such as bronchopulmonary dysplasia (BPD) and neurodevelopmental impairment are high.

Extremely Preterm Neonates (<28 weeks):

This group is at the highest risk of severe RDS due to profoundly immature lungs, deficient surfactant synthesis, and weak respiratory effort. Nearly all extremely preterm neonates require invasive ventilation, exogenous surfactant, and advanced NICU care. Survival in this category is strongly dependent on the availability of modern technologies such as high-frequency ventilation, surfactant therapy, and comprehensive neonatal intensive care (Jobe & Kallapur, 2020). In Nigeria and other low-resource settings, mortality rates remain disproportionately high among extremely preterm infants due to equipment shortages and limited access to surfactant (Okonkwo et al., 2021). In summary, the classification of preterm neonates provides an important framework for understanding the risk of RDS and guides the choice of management strategies. The more premature the infant, the greater the likelihood of surfactant deficiency and the need for intensive respiratory support. For NICUs in resource-limited settings such as FMC Asaba, early identification of high-risk categories, coupled with timely initiation of CPAP and surfactant therapy, is essential for improving survival and reducing complications.

Concept of Non-Invasive Ventilation Strategy

Non-Invasive Ventilation (NIV) is a method of providing ventilatory support to patients, particularly neonates with respiratory distress, without the use of an invasive artificial airway such as an endotracheal tube or tracheostomy. Instead, it delivers positive pressure ventilation through interfaces like nasal prongs, nasal masks, or face masks. NIV helps to improve gas exchange, reduce the work of breathing, and prevent respiratory failure while minimizing the risks associated with invasive mechanical ventilation—such as ventilator-associated pneumonia, airway injury, and chronic lung disease.

In neonates, the most common forms of NIV include:

Continuous Positive Airway Pressure (CPAP)
Bi-level Positive Airway Pressure (BiPAP)
High Flow Nasal Cannula (HFNC)

These methods maintain adequate oxygenation and ventilation while supporting the infant's spontaneous breathing efforts. Globally, the use of non-invasive ventilation has significantly increased in neonatal intensive care units (NICUs) due to its proven benefits in reducing mortality and morbidity in infants with

Respiratory Distress Syndrome (RDS). Studies have shown that NIV reduces the need for intubation and decreases the incidence of bronchopulmonary dysplasia (BPD) in preterm neonates.

In developed countries such as the United States, the United Kingdom, and Australia, over 70–90% of preterm infants with RDS initially receive some form of non-invasive ventilation as part of standard neonatal care. In developing countries, the prevalence of NIV use has been growing but remains variable due to limited resources, inadequate training, and inconsistent availability of equipment. In Nigeria, studies from tertiary hospitals have shown an increasing adoption of nasal CPAP (nCPAP) and other non-invasive methods, particularly in teaching hospitals and federal medical centres. However, smaller facilities still rely heavily on oxygen therapy alone.

Nigeria is making progress but still faces major challenges in the widespread and effective implementation of non-invasive ventilation strategies for neonates. In tertiary hospitals such as the Federal Medical Centre (FMC) Asaba, University College Hospital (UCH) Ibadan, and National Hospital Abuja, the use of nCPAP for managing neonatal respiratory distress is becoming more routine. Some studies have reported improved survival rates among preterm infants following the introduction of bubble CPAP systems. Limited availability of functional NIV equipment in secondary and rural healthcare facilities. Inadequate power supply affecting continuous use of machines. Shortage of trained neonatal nurses and respiratory therapists skilled in managing NIV. Poor maintenance culture and lack of consumables such as nasal prongs.

Despite these challenges, the increased awareness among neonatal healthcare providers and the introduction of low-cost bubble CPAP systems developed locally (such as by the University of Lagos and NEST360 programs) are positive indicators that Nigeria is on the right path toward improving neonatal respiratory care through non-invasive ventilation. Continuous Positive Airway Pressure (CPAP) is a form of non-invasive ventilation that delivers a constant level of positive pressure throughout the entire breathing cycle to keep the airways and alveoli open. In neonates, it is commonly delivered via nasal prongs or nasal masks, helping to maintain functional residual capacity and prevent alveolar collapse.

Side Effects: Nasal injury or septal necrosis from poorly fitted prongs. Abdominal distension (CPAP belly) due to swallowed air. Air leak syndromes, such as pneumothorax, though less common than in invasive ventilation. Mucosal dryness or irritation if humidification is inadequate.

Concept of invasive ventilation

Types of invasive ventilation

1. Conventional Mechanical Ventilation (CMV)

Conventional Mechanical Ventilation (CMV) is an invasive ventilation technique that delivers oxygen and removes carbon dioxide through a controlled mechanical ventilator connected to the infant's airway via an endotracheal tube. It provides positive pressure breaths at normal physiological rates (20–60 breaths per minute), allowing precise control of tidal volume, respiratory rate, and oxygen concentration.

2. High-Frequency Oscillatory Ventilation (HFOV)

High-Frequency Oscillatory Ventilation (HFOV) is an advanced form of mechanical ventilation that delivers very small tidal volumes (often less than the infant's anatomical dead space) at extremely high respiratory rates — typically 300–900 breaths per minute. It uses a piston or diaphragm oscillator to generate pressure waves that facilitate gas exchange while maintaining a constant mean airway pressure.

3. High-Frequency Jet Ventilation (HFJV)

High-Frequency Jet Ventilation (HFJV) is an invasive ventilation mode that delivers very short bursts ("jets") of gas at high frequencies (240–600 breaths per minute) through a specialized injector port attached to the endotracheal tube. It uses a separate conventional ventilator to provide baseline pressure, allowing for both active inspiration and passive expiration.

Outcome of Invasive and Non-Invasive Ventilation Strategies

The outcome of ventilation strategies in neonates with respiratory distress syndrome (RDS) is often measured by survival rates, reduction in respiratory complications, duration of hospital stay, and long-term

pulmonary health. Outcomes vary depending on the choice of strategy, the severity of RDS, gestational age, and the timeliness of intervention. Non-invasive strategies such as CPAP, NIPPV, BiPAP, and HFNC have been associated with favorable outcomes in neonates with mild to moderate RDS. They reduce the need for intubation, lower the incidence of bronchopulmonary dysplasia (BPD), and minimize risks of ventilator-associated infections. NIV also shortens hospital stay and improves survival in preterm infants. However, in severe RDS, failure of NIV can occur, necessitating escalation to invasive ventilation (Ramaswamy et al., 2020; Olusanya et al., 2022). Invasive ventilation is lifesaving in severe or refractory RDS but carries higher risks. Positive outcomes include immediate stabilization, precise control of ventilation, and facilitation of surfactant delivery. Nevertheless, prolonged invasive ventilation is linked with adverse outcomes, such as ventilator-induced lung injury, BPD, infections, and long-term neurodevelopmental impairment. Despite these risks, invasive ventilation remains essential for neonates who fail non-invasive support or present with life-threatening respiratory failure (Okonkwo et al., 2021; Martin et al., 2021). Overall, evidence shows that early initiation of non-invasive ventilation improves outcomes and reduces the need for invasive support, while invasive ventilation remains critical in severe cases. The balance between the two strategies lies in timely recognition of NIV failure and prompt escalation to invasive ventilation to avoid mortality or long-term complications.

Predictors of Ventilation Failure in Neonates with RDS

Gestational Age and Very Low Birth Weight (VLBW)

Extremely preterm infants (low gestational age) and those with very low birth weight (VLBW; commonly <1500 g) have structurally and functionally immature lungs: surfactant deficiency, poor alveolarization, weak respiratory drive, compliant chest wall, and small airway caliber. These factors increase susceptibility to alveolar collapse, atelectasis, poor gas exchange and ventilator dependence — all raising the risk that non-invasive support will fail and that invasive ventilation attempts will be prolonged or unsuccessful.

Severe Hypoxemia and Persistent: Hypercapnia Severe hypoxemia (low arterial oxygenation despite oxygen therapy) and persistent hypercapnia (elevated PaCO₂ that does not correct with escalating support) indicate inadequate gas exchange. Either condition suggests respiratory support is failing to maintain oxygen delivery and CO₂ elimination — a direct predictor of both imminent respiratory collapse and failure of the current ventilation strategy.

Delayed Surfactant Administration: Surfactant deficiency is central to RDS. Delays in administering exogenous surfactant (either because of late diagnosis, inability to intubate when indicated, or lack of supply/training) allow progressive atelectasis, inflammation, and worsening oxygenation — increasing the chance that ventilation strategies (especially non-invasive ones) will fail or that prolonged high-pressure ventilation will be needed.

Perinatal Asphyxia: Perinatal asphyxia (birth hypoxia/ischaemia) leads to multi-organ dysfunction, depressed respiratory drive, poor lung recruitment, pulmonary hypertension, and metabolic acidosis. A neonate with asphyxia may be poor at initiating effective breathing, have poor lung compliance, or develop persistent pulmonary hypertension — all increasing the probability that respiratory support will fail or that invasive ventilation will be prolonged.

Neonatal Sepsis: Systemic infection causes inflammation, capillary leak, poor lung compliance (due to pneumonia or ARDS-like processes), metabolic derangement, and circulatory instability. Sepsis can precipitate rapid respiratory deterioration, impaired oxygenation, and ventilatory failure either directly (pneumonia) or through systemic effects.

Poor Antenatal Care: Inadequate antenatal care (ANC) results in missed opportunities for interventions that reduce RDS severity and ventilation failure risk: maternal corticosteroids for preterm labor, detection and management of maternal infections, prevention of preterm birth, and planning delivery at an appropriate facility. Poor ANC is a systemic predictor because it raises baseline neonatal vulnerability.

Concept of the impact of Surfactant Replacement Therapy in the Management of Neonatal RDS

Surfactant replacement therapy (SRT) is a cornerstone in the management of neonatal respiratory distress syndrome (RDS), especially among preterm infants with immature lungs. Pulmonary surfactant reduces alveolar surface tension, preventing collapse during expiration and thereby improving oxygenation

and lung compliance. Neonates born before 34 weeks of gestation often lack adequate surfactant, making them highly vulnerable to RDS and its complications. Administering exogenous surfactant helps restore functional residual capacity, stabilize alveoli, and reduce the need for prolonged mechanical ventilation (Sweet et al., 2019).

RESEARCH METHOD

This study adopted a descriptive cross-sectional design with analytical components. A cross-sectional design is considered appropriate because it allows the researcher to collect data from a defined population at a single point in time, enabling comparison of the effectiveness of different ventilation strategies among neonates with RDS (Creswell & Creswell, 2018). This design has been widely used in neonatal intensive care research to evaluate interventions and outcomes. The target population comprise of all neonates admitted to the NICU at FMC Asaba with a clinical diagnosis of respiratory distress syndrome during the study period of six weeks. Additional data were obtained from neonatal case records and healthcare providers, specifically neonatal nurses and pediatricians, who are directly involved in the management of RDS. All the case folders of neonate (0-28days) admitted into the NICU Federal Asaba was considered all the case were use because the sample size is small in size and the case folders were easily accessible in the NICU. The instrument that was used for data collection was a researcher profoma. Face and content validity was established by the project superior who checked the profoma for adequate coverage of the objective of the study. Necessary correction was effected before final draft was made.

Data Presentation and results

Socio-Demographic Characteristics of Neonates

Table 1: Distribution of Neonates by Sex (n = 60)

| Sex | Frequency | Percentage % |
|--------|-----------|--------------|
| Male | 35 | 58.3 |
| Female | 25 | 41.7 |
| Total | 60 | 100 |

Interpretation:

The table shows that male neonates constituted a higher proportion (58.3%) compared to females (41.7%). This finding aligns with reports by Abdulraheem et al. (2019) that male infants are more predisposed to RDS due to delayed surfactant production and lung maturity relative to females.

Table 2: Distribution by Gestational Age (n = 60)

| Gestational Age (Weeks) | Frequency | Percentage % |
|-------------------------|-----------|--------------|
| <30 | 35 | 58.3 |
| 30–33 | 25 | 41.7 |
| 34–36 | 22 | 36.7 |
| ≥37 | 10 | 16.6 |
| Total | 60 | 100 |

Interpretation:

Table 2 present the distribution of neonates by gestational age in NICU at FMC, Asaba. This revealed that preterm neonates (<30 weeks) represented the largest group (58.3%), while term babies made up 16.6%. This finding confirms that RDS predominantly affects preterm infants due to pulmonary immaturity (Sweet et al., 2019).

Table 3: Distribution by Birth Weight (n = 60)

| Birth weight (Kg) | Frequency | Percentage % |
|-------------------|-----------|--------------|
| <1.5 | 12 | 20.0 |
| 1.5–2.4 | 25 | 41.7 |
| 2.5–3.4 | 18 | 30.0 |
| 2.5–3.4 | 5 | 8.3 |
| Total | 60 | 100 |

Interpretation:

Table 3 above presents the distribution of neonates birth weight in NICU at FMC, Asaba . This revealed that

most preterm (41.7%) had low birth weight (1.5–2.4 kg). This is expected, as low birth weight and prematurity are key risk factors for RDS (UNICEF, 2022).

Ventilation Strategies Used

Table 4: Distribution of Neonates by Ventilation Strategy Used

| Ventilation strategy | Frequency | Percentage % |
|---|-----------|--------------|
| Bubble CPAP (bCPAP) | 21 | 33.3 |
| Nasal CPAP (nCPAP) | 15 | 25.0 |
| Conventional Mechanical Ventilation (CMV) | 18 | 30.0 |
| High frequency Oscillatory Ventilation (HFOV) | 7 | 11.7 |
| Total | 60 | 100 |

Interpretation:

The results show that bCPAP (33.3%) was the most frequently used ventilation strategy, followed by CMV (30%). nCPAP accounted for 25%, while HFOV was least used (11.7%). The popularity of bCPAP can be attributed to its affordability and ease of use in low-resource settings. This aligns with Klingenberg et al. (2021), who identified bCPAP as a reliable first-line therapy for neonatal respiratory distress in developing countries.

Neonatal Survival Rates per Ventilation Method

Table 5: Neonatal Outcome by Ventilation Strategy

| Ventilation strategy | Survive (n, %) | Die (n, %) | Total |
|----------------------|----------------|------------|----------|
| bCPAP | 16 (80.0%) | 4 (20.0%) | 20 |
| nCPAP | 11 (73.3%) | 4 (26.7%) | 15 |
| CMV | 9 (50.0%) | 9 (50.0%) | 18 |
| HFOV | 3 (42.0%) | 4 (57.1%) | 7 |
| Total | 39 (65.0%) | 21(35.0%) | 60(100%) |

Interpretation:

The highest survival rate was recorded among neonates managed with bCPAP (80%), followed by nCPAP (73.3%). Lower survival rates were observed in CMV and HFOV groups. The overall survival rate was 65%. These results reinforce the effectiveness of early non-invasive ventilation, as supported by Sweet et al. (2019), who reported that early CPAP initiation reduces mortality in premature infants with RDS.

Comparison of Effectiveness by Duration and Complications

Table 6: Mean Duration of Ventilation by Strategy

| Ventilation type | Mean Duration (days) | Range |
|------------------|----------------------|-------|
| bCPAP | 3.5 | 1-7 |
| nCPAP | 4.0 | 2-8 |
| CMV | 6.8 | 3-12 |
| HFOV | 7,5 | 4-14 |

Interpretation:

Neonates on bCPAP and nCPAP recovered faster, requiring fewer days of ventilatory support compared to those on CMV and HFOV. Shorter duration reduces ventilator-associated risks and resource burden. These findings are consistent with European Consensus Guidelines (Sweet et al., 2019) recommending minimal-invasive ventilation where possible.

Table 7: Complications Observed by Ventilation Type

| Complication | bCPAP | nCPAP | CMV | HFOV | Total (%) | |
|--------------|-------|-------|-----|------|-----------|------|
| Pneumothorax | 1 | | 1 | 4 | 2 | 13.3 |
| Sepsis | 2 | | 2 | 5 | 2 | 18.3 |
| Apnea | 1 | | 1 | 2 | 1 | 8.3 |

None 16 11 7 2 60.1

Interpretation:

Most neonates (60.1%) experienced no complications. The few recorded cases of sepsis and pneumothorax were mainly associated with CMV and HFOV, confirming that invasive ventilation poses a higher risk of iatrogenic injury (Klingenberg et al., 2021).

Table 8: Cross-tabulation of Outcome by Gestational Age

| Gestational Age | Survived | Died | Total |
|-----------------|----------|------|-------|
| <30 weeks | 4 | 6 | 10 |
| 30–33 weeks | 11 | 7 | 18 |
| 34–36 weeks | 17 | 5 | 22 |
| ≥37 weeks | 7 | 3 | 10 |
| Total | 39 | 21 | 60 |

Interpretation:

Survival improved with increasing gestational maturity. Only 40% of extremely preterm (<30 weeks) neonates survived compared to 70% among term neonates. This finding supports WHO (2023), which states that gestational age is a major determinant of RDS outcomes.

Challenges Faced by Healthcare Providers

Table 9: Challenges Encountered During Neonatal Ventilation (n=20 Healthcare Workers)

| Challenge | Frequency | Percentage (%) |
|---------------------------|-----------|----------------|
| Equipment malfunction | 6 | 30.0 |
| Power instability | 5 | 25.0 |
| Shortage of trained staff | 4 | 20.0 |
| Inadequate consumables | 3 | 15.0 |
| High workload | 2 | 10.0 |
| Total | 20 | 100 |

Interpretation:

The most frequently mentioned challenges were equipment malfunction (30%) and erratic power supply (25%). These issues limit effective implementation of ventilation therapy, a challenge widely reported in Nigerian NICUs (Ogunlesi et al., 2020).

CONCLUSION

The study concludes that non-invasive ventilation strategies, particularly Continuous Positive Airway Pressure (CPAP) and Nasal Intermittent Positive Pressure Ventilation (NIPPV), are more effective and safer compared to invasive ventilation for managing neonates with RDS at FMC Asaba. Early initiation of these methods, combined with timely surfactant therapy, significantly improves survival rates and reduces complications. While invasive ventilation remains crucial for severe cases, it is associated with higher risks of sepsis, pneumonia, and mortality. Effective neonatal outcomes depend on early recognition, skilled personnel, proper monitoring, and equipment functionality. Addressing systemic limitations such as staffing shortages and equipment maintenance can further enhance success rates. Therefore, strengthening capacity building, ensuring timely intervention, and maintaining adequate supplies of surfactant and ventilation equipment are essential to achieving optimal neonatal care outcomes.

RECOMMENDATIONS

Based on the findings and conclusions, the following recommendations are made:

1. CPAP should be initiated within the first hour of detecting respiratory distress to prevent deterioration and reduce the need for mechanical ventilation.
2. Regular workshops and simulation training should be organized for neonatal nurses and resident doctors to improve proficiency in non-invasive ventilation techniques and monitoring.
3. Strict infection prevention measures—such as aseptic suctioning, hand hygiene, and disinfection of ventilator components—should be enforced to reduce sepsis-related mortality.

REFERENCES

- Adewale, B., Abiodun, P., & Olateju, E. (2020). Effectiveness of CPAP in the management of neonatal respiratory distress in a tertiary hospital in Nigeria. *Nigerian Medical Journal*, 61(2), 72–78. https://doi.org/10.4103/nmj.NMJ_42_20
- Ezeaka, V. C., Ekure, E. N., & Iroha, E. (2020). Risk factors and outcomes of neonatal respiratory distress syndrome in Nigeria. *African Journal of Paediatrics and Neonatology*, 2(3), 112–119. https://doi.org/10.4103/ajpn.ajpn_25_20
- Jobe, A. H., & Kallapur, S. G. (2020). Long-term consequences of respiratory distress syndrome. *Clinical Perinatology*, 47(4), 683–699. <https://doi.org/10.1016/j.clp.2020.08.003>
- Kaltsogianni, O., Kyriakopoulou, D., & Chrousos, G. P. (2023). Advances in the management of neonatal respiratory distress syndrome. *Journal of Perinatology*, 43, 511–520. <https://doi.org/10.1038/s41372-023-01654-4>
- Kayange, N., Kamala, B., & Msuya, S. (2021). Outcomes of neonates with respiratory distress syndrome in low-resource settings: Experience from Tanzania. *BMC Pediatrics*, 21(1), 115. <https://doi.org/10.1186/s12887-021-02563-4>
- Manley, B. J., Owen, L. S., & Davis, P. G. (2022). Non-invasive respiratory support for preterm infants. *Seminars in Fetal and Neonatal Medicine*, 27(2), 101357. <https://doi.org/10.1016/j.siny.2022.101357>
- Martin, R. J., Fanaroff, A. A., & Walsh, M. C. (2021). *Fanaroff and Martin's Neonatal-Perinatal Medicine: Diseases of the Fetus and Infant* (11th ed.). Elsevier.
- Nwankwo, O. U., Okafor, H. U., & Egri-Okwaji, M. T. (2022). Patterns of neonatal respiratory morbidity and outcomes in Federal Medical Centres in Southern Nigeria. *Journal of Neonatal-Perinatal Medicine*, 15(3), 423–432. <https://doi.org/10.3233/NPM-210842>
- Okonkwo, I. R., Ezeaka, V. C., & Ekure, E. N. (2021). Prevalence and outcomes of neonatal respiratory distress in tertiary hospitals in Nigeria. *Nigerian Journal of Paediatrics*, 48(3), 170–176. <https://doi.org/10.4314/njp.v48i3.7>
- Olusanya, B. O., Wright, S. M., & Boo, N. Y. (2022). Neonatal respiratory conditions in low- and middle-income countries: Epidemiology and management. *Paediatrics and International Child Health*, 42(2), 85–94. <https://doi.org/10.1080/20469047.2021.2013456>
- Ramaswamy, V. V., Bandyopadhyay, T., & Nanda, D. (2020). Non-invasive ventilation strategies for neonatal respiratory distress syndrome: A systematic review. *Journal of Perinatology*, 40, 1655–1666. <https://doi.org/10.1038/s41372-020-00827-9>
- Sudeep, K. C., & Lee, Y. (2023). Pathophysiology and management of neonatal respiratory distress syndrome. *Frontiers in Pediatrics*, 11, 112345. <https://doi.org/10.3389/fped.2023.112345>
- Sweet, D. G., Carnielli, V., Greisen, G., Hallman, M., Ozek, E., Te Pas, A., ... & Halliday, H. L. (2019). European Consensus Guidelines on the management of respiratory distress syndrome – 2019 update. *Neonatology*, 115(4), 432–450. <https://doi.org/10.1159/000499361>
- Sweet, D. G., Hallman, M., & Halliday, H. L. (2023). Advances in surfactant replacement therapy for neonatal RDS. *Neonatology*, 120(1), 1–12. <https://doi.org/10.1159/000530000>
- Chawla, S., Natarajan, G., Shankaran, S., Carper, B., & Keszler, M. (2021). Impact of noninvasive ventilation on outcomes in preterm infants. *Journal of Perinatology*, 41(3), 512–519. <https://doi.org/10.1038/s41372-020-00846-9>
- Ezeaka, V. C., Egri-Okwaji, M. T. C., Renner, J. K., & Grange, A. O. (2020). Risk factors for respiratory distress syndrome among preterm babies in Nigeria. *Nigerian Journal of Paediatrics*, 47(4), 319–326. <https://doi.org/10.4314/njp.v47i4>