## Exploring Respiratory Therapists' Perspectives on High-Frequency Oscillatory Ventilation in Neonatal Care: A Qualitative Study

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## Abstract

**Background:** High-Frequency Oscillatory Ventilation (HFOV) is a critical intervention for neonates with severe respiratory distress syndrome in neonatal intensive care units (NICUs). Despite its clinical importance, the experiences of respiratory therapists (RTs), who play a pivotal role in administering HFOV, are not well-documented in the literature.

**Objective:** This qualitative study aimed to explore respiratory therapists' experiences and challenges in using HFOV, focusing on their perspectives to better understand the practical aspects of its application in neonatal care.

**Methods:** Semi-structured interviews were conducted with 15 respiratory therapists in a large tertiary hospital's NICU. Thematic analysis was employed to identify key themes and subthemes related to the use of HFOV.

**Results:** The study revealed four main themes: the efficacy of HFOV in managing neonatal respiratory distress, the complexity and challenges of using HFOV, the need for specialized training and education, and the importance of interdisciplinary collaboration. Participants noted the effectiveness of HFOV in improving oxygenation and reducing lung injury but highlighted the need for continuous vigilance and skill to manage its complexities.

**Conclusion:** The findings emphasize the necessity for comprehensive training programs and enhanced team communication to support RTs in the effective use of HFOV. Addressing these needs can lead to improved neonatal outcomes and more efficient use of HFOV in NICUs.

# Keywords: High-Frequency Oscillatory Ventilation, neonatal care, respiratory therapists, qualitative study, respiratory distress syndrome

## Introduction

**Background:** High-Frequency Oscillatory Ventilation (HFOV) is a specialized form of mechanical ventilation used primarily in neonatal intensive care units (NICUs) for infants with severe respiratory distress syndrome (RDS) and other pulmonary dysfunctions. Unlike conventional mechanical ventilation, HFOV maintains lung recruitment by delivering small tidal volumes at very high rates, minimizing lung injury associated with large volume changes (Pillow, 2005). This technique is particularly advantageous in managing very low birth weight infants who are susceptible to airway damage due to the fragility of their pulmonary structures (Greenough, 2003).

**Importance of HFOV in Neonatal Respiratory Care:** HFOV is recognized for its efficacy in improving oxygenation and reducing the risks of ventilator-induced lung injury, which are critical concerns in the management of neonatal respiratory failure (Courtney et al., 2002). The precise control of oxygenation and ventilation it offers makes HFOV a preferred option in cases where conventional ventilation fails to maintain adequate alveolar ventilation or when it poses a high risk of barotrauma (Mukerji et al., 2015).

**Respiratory Therapists' Role:** Respiratory therapists (RTs) play a pivotal role in the administration of HFOV. They are not only responsible for setting up and monitoring the ventilator but also for making adjustments based on the infant's respiratory status, interpreting complex clinical data, and ensuring that the ventilation supports are optimally delivered without compromising patient safety (Anderson, 2003). Their expertise and experiences are vital for the successful implementation of HFOV strategies in neonatal care.

**Research Gap:** Despite the clinical importance of HFOV and the critical role of RTs in its administration, there is limited qualitative research exploring the experiences and challenges faced by these professionals while using HFOV in NICUs. Most existing studies focus on clinical outcomes and efficacy rather than on the perspectives of the therapists themselves, who play a fundamental role in the day-to-day management of this sophisticated ventilation technique (Brown and DiBlasi, 2011).

**Study Objective:** This study aims to fill the gap in the literature by qualitatively exploring respiratory therapists' experiences and challenges in using HFOV for neonates with severe respiratory distress syndrome. It seeks to understand their perspectives, the complexities they encounter, and the support they require to optimize the use of this technology in clinical practice.

## Literature Review

**High-Frequency Oscillatory Ventilation: Principles and Application in Neonatal Care:** High-Frequency Oscillatory Ventilation (HFOV) is distinguished by its delivery of very small tidal volumes at extremely high frequencies, typically ranging from 8 to 15 Hz, which is much higher than the natural breathing frequency of neonates. This method reduces the risk of volutrauma and barotrauma while maintaining optimal lung recruitment and minimizing the fluctuations in alveolar pressure (Froese and Kinsella, 2005). HFOV is particularly beneficial for neonates with heterogeneous lung diseases such as respiratory distress syndrome (RDS) and bronchopulmonary dysplasia, where it helps in achieving uniform ventilation and reducing the incidence of chronic lung disease (Bateman et al., 2016).

**Respiratory Therapists' Expertise in Managing HFOV:** Respiratory therapists are central to the management of HFOV in neonatal intensive care units. Their expertise encompasses the setup, adjustment, and monitoring of the ventilator settings based on real-time assessments of the infant's respiratory status. The ability to interpret complex clinical data and make informed decisions about ventilator adjustments is critical for optimizing patient outcomes and requires a deep understanding of both the technology and neonatal physiology (Greenough, 2003).

**Clinical Outcomes Associated with HFOV Usage:** Clinical studies have demonstrated that when compared to conventional mechanical ventilation, HFOV can lead to improved oxygenation and reduced rates of ventilator-associated pulmonary injury in neonates with severe lung disease (Cools et al., 2015). However, the success of HFOV heavily depends on the precise management of ventilatory settings to avoid potential complications such as hypocarbia or hypoxemia, which could lead to adverse neurological outcomes (Courtney et al., 2002).

**Challenges Faced by Respiratory Therapists:** Despite the advantages, the use of HFOV presents challenges, particularly in maintaining optimal ventilation without causing injury. The complexity of the settings and the need for constant adjustments require RTs to have specific training and continuous education. Moreover, the critical role of RTs includes not only technical management but also communication with the multidisciplinary team to integrate respiratory management with overall patient care plans (Vento et al., 2014). **Need for Qualitative Insights:** There is a noted gap in qualitative research exploring the perspectives of respiratory therapists on the use of HFOV. Most existing research focuses on quantitative clinical outcomes rather than the experiential and procedural knowledge that therapists accumulate, which is crucial for understanding the barriers and facilitators in the effective use of HFOV (Brown and DiBlasi, 2011).

understanding the barriers and facilitators in the effective use of HFOV (Brown and DiBlasi, 2011). Qualitative studies are essential to capture the depth of clinical expertise, ethical considerations, and personal experiences of RTs in this specialized practice area.

## Methodology

This qualitative study aimed to explore the experiences and challenges faced by respiratory therapists (RTs) in using High-Frequency Oscillatory Ventilation (HFOV) for neonates with severe respiratory distress syndrome in a neonatal intensive care unit (NICU).

**Study Design:** The research adopted a qualitative descriptive approach, which is particularly well-suited for gaining a comprehensive understanding of the experiences of healthcare professionals in specific clinical contexts. This method allows for in-depth exploration of RTs 'perceptions, challenges, and strategies while using HFOV.

**Setting:** The study was conducted in the NICU of a large tertiary hospital known for its advanced neonatal care facilities. This unit routinely utilizes HFOV for neonates experiencing severe respiratory failure.

**Participants:** Participants were recruited using purposive sampling to ensure a wide range of experiences. Eligible participants included respiratory therapists who had at least one year of experience in neonatal care and had directly used HFOV in the NICU setting. A total of 15 respiratory therapists participated in the study.

**Data Collection:** Data were collected through semi-structured interviews, which were conducted in a private setting within the hospital to ensure confidentiality and comfort for the participants. Each interview lasted approximately 45 to 60 minutes. The interview guide included open-ended questions designed to elicit detailed responses about the participants 'experiences with HFOV, including:

- Description of their typical role and duties when using HFOV.
- Perceived advantages and disadvantages of HFOV in neonatal care.
- Challenges encountered in the use of HFOV and strategies employed to overcome these challenges.
- Training and support needs for effective use of HFOV.

Interviews were audio-recorded with the consent of the participants and later transcribed verbatim for analysis.

**Data Analysis:** Thematic analysis was employed to analyze the interview transcripts. This involved a rigorous process of coding and categorizing data into themes and subthemes. Initially, two researchers independently coded the first two transcripts to develop a codebook. Discrepancies were discussed and resolved by consensus. The remaining transcripts were then coded using this refined codebook. NVivo, a qualitative data analysis software, was used to facilitate the organization and retrieval of coded data segments.

## Rigor

To ensure the credibility and trustworthiness of the findings, several strategies were employed:

- **Triangulation:** Multiple analysts were involved in the data analysis process to provide different perspectives on the data.
- **Member checking:** Preliminary findings were shared with participants to verify the accuracy and resonance of the interpreted data with their experiences.
- Audit trail: Detailed documentation of all decisions made during the research process was maintained.

## **Ethical Considerations**

The study received approval from the ethics committee. Informed consent was obtained from all participants, who were assured of their anonymity and the confidentiality of their responses. Participants were also informed of their right to withdraw from the study at any time without any consequences.

## Findings

The thematic analysis of the interviews with 15 respiratory therapists who regularly use high-frequency oscillatory ventilation (HFOV) in a neonatal intensive care setting revealed several key themes and subthemes. These encapsulate the challenges, benefits, and educational needs associated with the use of HFOV in managing severe respiratory distress in neonates.

## Theme 1: Perceived Benefits of HFOV

Subtheme 1.1: Effective Oxygenation and Ventilation

- **Participant 3:** "HFOV is incredibly effective when you're dealing with really stiff lungs. We see improvements in oxygenation almost immediately after switching from conventional modes."
- **Participant 7:** "The ability to achieve adequate gas exchange with minimal lung movement is a significant advantage, reducing further lung injury."

Subtheme 1.2: Prevention of Ventilator-Induced Lung Injury

• **Participant 5:** "With HFOV, I feel like we're protecting the lungs while giving them time to heal and respond to treatment, especially for those tiny preemies."

## **Theme 2: Challenges in Using HFOV**

Subtheme 2.1: Complexity of Management

- **Participant 4:** "The settings are quite complex compared to conventional ventilation. It's not just about setting it up but constantly tweaking it based on blood gases and patient response."
- **Participant 12:** "Sometimes it's like walking on a tightrope, balancing between optimal and excessive ventilation."

Subtheme 2.2: Monitoring and Adjustment Difficulties

- **Participant 9:** "You need to be very vigilant, checking the patient frequently to adjust settings based on their condition. It's time-consuming and mentally exhausting."
- **Participant 11:** "There's a steep learning curve. Initially, interpreting patient response can be quite challenging without extensive experience."

## Theme 3: Training and Educational Needs

Subtheme 3.1: Need for Comprehensive Training

- **Participant 2:** "Training for new staff is crucial. They need to understand not just the how, but the why of each setting adjustment, which isn't always covered adequately."
- **Participant 8:** "I learned a lot on the job, but structured simulations or workshops would have shortened my learning curve dramatically."

Subtheme 3.2: Ongoing Education and Support

- **Participant 6:** "Continuous education is needed. Treatment strategies evolve, and staying updated is crucial for maintaining proficiency with HFOV."
- **Participant 14:** "Support from more experienced therapists helped me tremendously. Peer learning sessions could benefit everyone, especially when new research or protocols come out."

## **Theme 4: Interdisciplinary Collaboration**

Subtheme 4.1: Communication with Healthcare Team

- **Participant 10:** "Effective use of HFOV requires great teamwork and communication, especially with neonatologists. We need to be on the same page regarding the care plan."
- **Participant 15:** "Daily rounds and updates with the entire care team, including RTs, nurses, and doctors, are vital to ensure everyone understands the ventilation strategy and what we're aiming for."

Subtheme 4.2: Role Recognition

- **Participant 1:** "Sometimes there's a gap in understanding what respiratory therapists bring to the table. More visibility and recognition of our role in managing these complex cases would improve collaboration."
- **Participant 13:** "When the team respects and understands the complexities of HFOV, workflow improves, and patient outcomes are better."

## Discussion

This qualitative study explored the experiences and challenges faced by respiratory therapists using High-Frequency Oscillatory Ventilation (HFOV) in neonatal intensive care units. The findings highlight both the complexities and the critical importance of RTs' roles in managing severe respiratory distress in neonates. The discussion below reflects on these findings, compares them with existing literature, and considers their implications for clinical practice and training.

**Efficacy and Challenges of HFOV:** Participants consistently noted the efficacy of HFOV in providing effective oxygenation and reducing the risk of ventilator-induced lung injury, a finding that aligns with the literature that supports its use in cases where conventional ventilation fails to prevent lung damage (Bateman et al., 2016). However, the complexity of managing HFOV settings poses significant challenges, particularly concerning the fine-tuning required to optimize patient outcomes without causing harm. This challenge is well-documented (Froese and Kinsella, 2005) and was echoed by participants who reported the need for vigilance and continuous adjustments based on patient response.

**Training and Educational Needs:** The findings underscore a critical gap in training for respiratory therapists in the nuances of HFOV. While RTs are often trained on the job, participants expressed a need for more comprehensive, structured training and ongoing education to enhance their understanding and skills. This need for specialized training is crucial, as highlighted by Greenough (2003), who argue that the complexity of HFOV demands a higher level of competency than that required for conventional ventilatory support. Enhancing training programs could include simulations and workshops focusing on the mechanics of HFOV, scenario-based learning, and the physiological implications of different settings.

**Interdisciplinary Collaboration:** Effective use of HFOV requires excellent communication and collaboration among the neonatal care team, as highlighted by participants and supported by Brown and DiBlasi (2011). This study reveals that while RTs play a vital role in patient care, there is sometimes a lack of recognition or understanding of their role from other team members. Enhancing interdisciplinary collaboration through regular team meetings, shared training sessions, and clear communication channels could improve both patient care and professional satisfaction for RTs.

#### **Implications for Practice**

The insights from this study have several implications for clinical practice:

- 1. Enhanced RT Training: There is a clear need for targeted educational initiatives to equip RTs with the necessary skills and knowledge to manage HFOV effectively.
- 2. **Standardization of Protocols:** Developing standardized protocols for the initiation and adjustment of HFOV could help reduce variability in care and improve outcomes.
- 3. **Team Integration:** Enhancing the integration of RTs into the neonatal care team and improving recognition of their specialized knowledge and skills are essential for optimizing the use of HFOV.

## Limitations

This study's findings must be considered in light of its limitations. The qualitative nature and small sample size may limit the generalizability of the results. Additionally, the study focused on a single clinical setting, which may not reflect experiences in other institutions or contexts.

## **Future Research**

Further research should aim to expand the understanding of HFOV in neonatal care by exploring larger, more diverse populations and including multiple centers. Quantitative studies could also be beneficial in assessing the impact of enhanced training and standardized protocols on patient outcomes.

## Conclusion

Respiratory therapists play a crucial role in the successful application of HFOV in neonatal care, navigating complex challenges to optimize care for neonates with severe respiratory distress. This study highlights the need for enhanced training, better integration into care teams, and greater recognition of RTs' roles, which are essential for improving outcomes in neonatal intensive care settings.

## References

- 1. Anderson, M. R. (2003). Update on pediatric acute respiratory distress syndrome. *Respiratory* care, 48(3), 261-278.
- 2. Bateman, S. T., Borasino, S., Asaro, L. A., Cheifetz, I. M., Diane, S., Wypij, D., & Curley, M. A. (2016). Early high-frequency oscillatory ventilation in pediatric acute respiratory failure. A propensity score analysis. *American journal of respiratory and critical care medicine*, *193*(5), 495-503.
- 3. Brown, M. K., & DiBlasi, R. M. (2011). Mechanical ventilation of the premature neonate. *Respiratory care*, *56*(9), 1298-1313.
- 4. Cools, F., Offringa, M., & Askie, L. M. (2015). Elective high-frequency oscillatory ventilation versus conventional ventilation for acute pulmonary dysfunction in preterm infants. \*Cochrane Database of Systematic Reviews\*, (3), CD000104.
- Courtney, S. E., Durand, D. J., Asselin, J. M., Hudak, M. L., Aschner, J. L., & Shoemaker, C. T. (2002). High-frequency oscillatory ventilation versus conventional mechanical ventilation for verylow-birth-weight infants. *New England Journal of Medicine*, 347(9), 643-652.
- 6. Froese, A. B., & Kinsella, J. P. (2005). High-frequency oscillatory ventilation: lessons from the neonatal/pediatric experience. *Critical care medicine*, *33*(3), S115-S121.
- 7. Greenough, A. (2003). Neonatal respiratory disorders (No. 438). CRC Press.
- 8. Mukerji, A., Singh, B., Helou, S. E., Fusch, C., Dunn, M., & Belik, J. (2015). Use of non-invasive high-frequency ventilation in the neonatal intensive care unit: a retrospective review. \*American Journal of Perinatology\*, 32(2), 171-176.
- 9. Pillow, J. J. (2005). High-frequency oscillatory ventilation: mechanisms of gas exchange and lung mechanics. \*Critical Care Medicine\*, 33(3 Suppl), S135-S141.
- Vento, G., Tana, M., Gianduzzo, A., Di Sarra, L., Querini, M., Di Mastrogiovanni, L., ... & Romagnoli, C. (2014). High-frequency oscillatory ventilation (hfov) in preterm infants: nursing management experience of a iii-level neonatal intensive care unit (nicu) at the catholic university of the sacred heart of rome. *Journal of Nursing Education and Practice*, 4(1), 62.