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HIGH-FLOW NASAL CANNULA VERSUS NON-INVASIVE VENTILATION IN ADULTS WITH ACUTE HYPOXEMIC RESPIRATORY FAILURE AN UPDATED SYSTEMATIC REVIEW AND QUANTITATIVE DESCRIPTIVE SYNTHESIS

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ABSTRACT

High-flow nasal cannula and non-invasive ventilation are widely used to support adults with acute hypoxemic respiratory failure while attempting to avoid invasive ventilation. HFNC offers heated humidified high flow, stable inspired oxygen, washout of nasopharyngeal dead space, and modest positive pressure; NIV provides greater pressure support and positive end-expiratory pressure but can be less tolerated and may risk injurious tidal volumes or delayed intubation. Objective: To evaluate the effectiveness, safety, and implementation implications of the specified noninvasive respiratory-support strategy in adults with acute hypoxemic respiratory failure. Methods: This PRISMA 2020-aligned updated systematic-review draft maps PubMed-indexed and publisher-verified evidence available through 29 August 2026. Comparative trials, evidence syntheses, and relevant Saudi/GCC implementation studies were extracted. Heterogeneous populations, comparators, and outcome definitions precluded a new pooled meta-analysis; published estimates are displayed descriptively. Results: Nine core reports were mapped. Comparative syntheses generally found no clear difference between HFNC and NIV in intubation or mortality, with low-certainty and heterogeneous evidence. In COVID-19 AHRF, pooled intubation was similar (RR 1.01, 95% CI 0.85–1.20), while NIV improved PaO2/FiO2 more. A Saudi cohort found HFNC failure and intubation in 66%, with high SOFA and low ROX associated with failure. Conclusion: HFNC and NIV appear similarly effective for many adults with acute hypoxemic respiratory failure, but confidence is limited and neither strategy is universally superior.

KEYWORDS: Acute Hypoxemic Respiratory Failure; Respiratory Therapy; Noninvasive Respiratory Support; Intubation; Mortality; Patient Safety; Systematic Review.

1. INTRODUCTION

High-flow nasal cannula and non-invasive ventilation are widely used to support adults with acute hypoxemic respiratory failure while attempting to avoid invasive ventilation. HFNC offers heated humidified high flow, stable inspired oxygen, washout of nasopharyngeal dead space, and modest positive pressure; NIV provides greater pressure support and positive end-expiratory pressure but can be less tolerated and may risk injurious tidal volumes or delayed intubation.

Respiratory therapists are central to patient selection, device setup, interface optimization, oxygen titration, monitoring, adherence support, secretion management, escalation, and prevention of delayed intubation. Evidence must therefore be interpreted as both a treatment-effect question and an implementation-and-monitoring question.

2. METHODS

2.1. Design And Eligibility

The review was structured according to PRISMA 2020. Eligible reports involved adults with acute hypoxemic respiratory failure and evaluated the intervention/comparator in the title. Outcomes included intubation, mortality, treatment escalation, oxygenation, tolerance, adverse events, and length of stay. Pediatric-only studies and studies without evaluable clinical or physiologic outcomes were excluded.

2.2. Search And Appraisal

PubMed concepts combined acute hypoxemic respiratory failure, the intervention terms, intubation, mortality, randomized trial, systematic review, Saudi Arabia, and Gulf/GCC terms. Randomized trials should be appraised with RoB 2 and non-randomized studies with ROBINS-I. Current certainty labels are provisional until duplicate independent assessment.

2.3. Synthesis

Study characteristics and results were summarized narratively. Published meta-analytic estimates were retained with their original effect measures and confidence intervals. They were not recombined because doing so would mix different review populations, comparators, and estimands.

3. RESULTS

3.1. Evidence Profile

The evidence map includes 9 reports. Figure 1 describes the mix of evidence syntheses, randomized/controlled studies, and observational or implementation evidence.

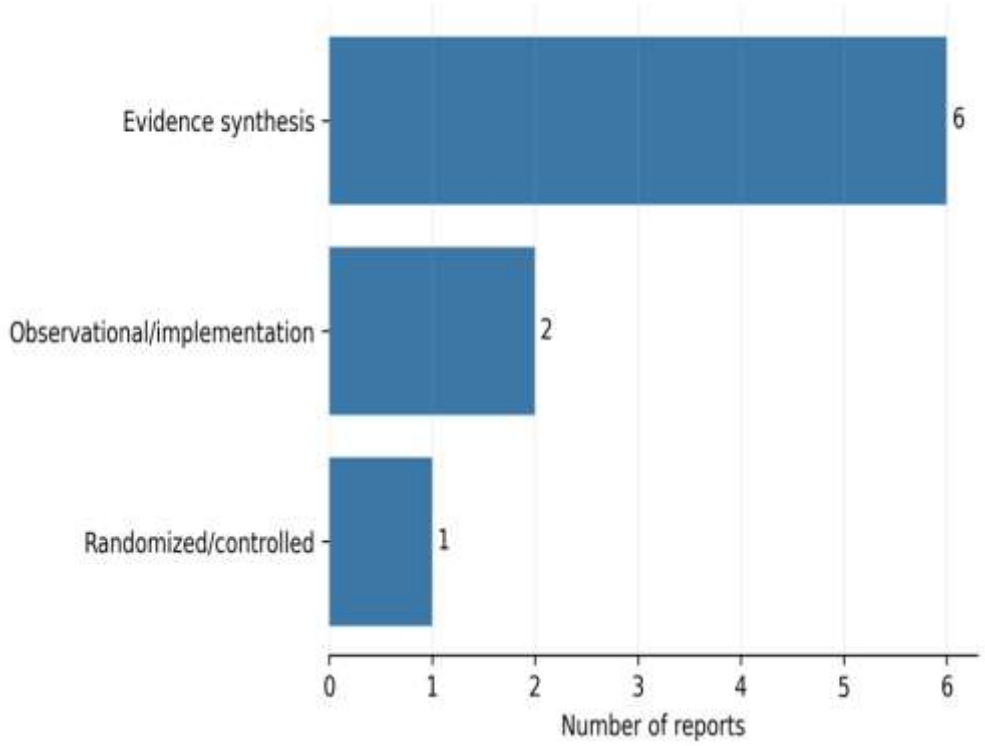

Figure 1: Distribution of Mapped Evidence by Study Type

3.2 Study Characteristics

Table:

Study	Setting	Design	Sample	Key finding
Frat et al. (2015)	France/Belgium	Multicenter RCT	310	Intubation did not differ significantly overall; HFNC had lower 90-day mortality than comparator groups in secondary analyses.
Lee et al. (2016)	International	Systematic review	18 studies	HFNC improved comfort and oxygenation; comparative clinical outcomes were uncertain.
Rochwerg et al. (2019)	International	Systematic review/meta-analysis of RCTs	9RCTs; 2,093 patients	Intubation RR 0.85 (0.74–0.99); mortality RR 0.94 (0.67–1.31).
Alnajada et al. (2021)	Qatar	Randomized pilot trial	Pilot sample	HFNC reduced early escalation to NIV; small pilot and short follow-up.
Alshahrani et al. (2021)	Saudi Arabia	Prospective cohort	44	29 (66%) required intubation; high SOFA and low ROX were associated with failure.
Beran et al. (2022)	International	Systematic review/meta-analysis	19 studies; 3,606 patients	No difference in intubation (RR 1.01, 0.85–1.20) or LOS; NIV produced greater PaO2/FiO2 improvement.
Ovtcharenko et al. (2022)	International	Systematic review/meta-analysis	8 RCTs/observational studies	Mortality RR 0.86 (0.48–1.56); evidence was low certainty and did not establish superiority.
Chaudhuri et al. (2023)	International	Systematic review/network meta-analysis	Randomized evidence	HFNC and NIPPV appeared similarly effective for intubation; mortality remained uncertain.
Kunder et al. (2025)	International	Systematic review	12 studies	Most studies showed comparable intubation effectiveness; heterogeneity limited strong conclusions.

3.3. Clinical And Implementation Findings

Evidence comparing HFNC directly with NIV did not establish consistent superiority for intubation or mortality. NIV generally produced a larger short-term improvement in PaO2/FiO2, whereas HFNC may offer better comfort and continuity. Outcomes depend strongly on phenotype, interface, settings, clinician experience, crossover, and escalation thresholds. The Saudi cohort emphasized the need for early ROX assessment and recognition of high SOFA score as markers of HFNC failure.

3.4. Selected Quantitative Estimates

Figure 2 displays selected published relative effects and their 95% confidence intervals. The figure does not contain a newly pooled estimate and should not be interpreted as one meta-analysis.

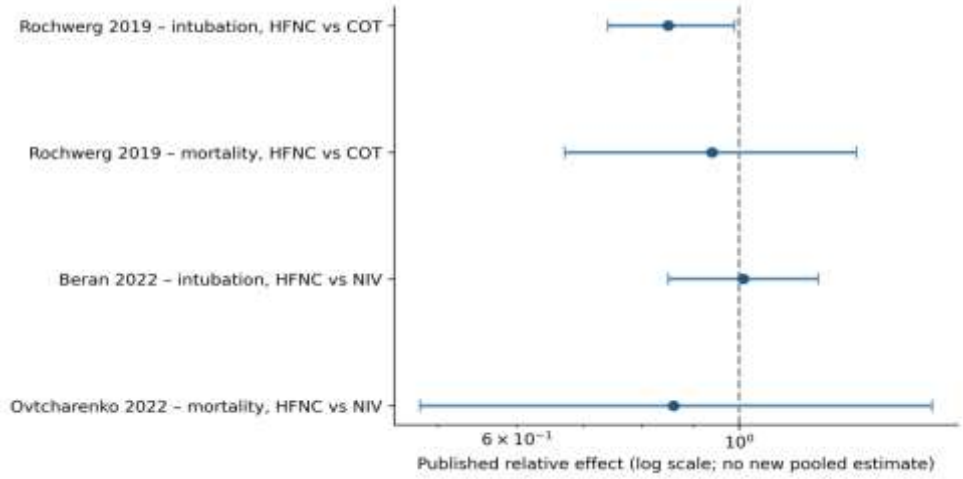

Figure 2: Selected Published Effect Estimates; No New Pooled Estimate.

3.5. Certainty And Risk of Bias

Certainty varied from moderate to low. Key

limitations included open-label interventions, variable adherence or crossover, heterogeneous interfaces and oxygen targets, evolving co-interventions, single-center regional cohorts, inconsistent escalation criteria, and limited power for mortality. Physiologic improvement should not be equated with prevention of intubation or death.

4. DISCUSSION

HFNC and NIV appear similarly effective for many adults with acute hypoxemic respiratory failure, but confidence is limited and neither strategy is universally superior. Device selection should be individualized by respiratory mechanics, oxygenation, work of breathing, tolerance, hemodynamics, and local monitoring capability

Saudi and GCC evidence is useful for operational context but remains insufficient for definitive comparative effectiveness. Multicenter regional studies should standardize eligibility, initiation thresholds, monitoring intervals, failure criteria, escalation pathways, adverse-event reporting, and patient-centered outcomes.

4.1. Practice Implications

- Use phenotype-based selection rather than one universal device.
- Document baseline severity, work of breathing, gas exchange, mental status, and hemodynamics.
- Reassess early and serially using clinical response plus validated measures such as the ROX index for HFNC.
- Optimize cannula or mask interface, humidification, flow/pressure, FiO2, leak, synchrony, and skin protection.
- Apply predefined failure and intubation criteria to prevent harmful delay.

4.2. Strengths And Limitations

This draft integrates recent international and Saudi/GCC evidence and provides an auditable workbook. It does not claim completed duplicate screening, full database coverage, final risk-of-bias adjudication, or original pooled meta-analysis. Those steps are mandatory before journal submission.

5. CONCLUSION

HFNC and NIV appear similarly effective for many adults with acute hypoxemic respiratory failure, but confidence is limited and neither strategy is universally superior. Clinical use should be protocolized, closely monitored, and coupled with timely escalation when predefined failure criteria are met.

Declarations

Ethics Approval: Not applicable because the review uses published, aggregated evidence and does not recruit participants or use identifiable patient-level data. PRISMA 2020 is a reporting guideline, not an approving ethics body.

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Competing Interests: The authors declare no competing interests.

Author Contributions: Finalize using CRediT after confirming substantive contributions.

Data Availability: The evidence-extraction workbook accompanies this draft; final search exports, screening records, extraction forms, and risk-of-bias assessments should be retained.

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