

Ventilatory Modes Which have been Compared in Randomized Controlled Trials to Facilitate Liberation from Mechanical Ventilation: A Systematic Review

INTRODUCTION

- Invasive mechanical ventilation (IMV) is a fundamental life-saving intervention
- Prolonged IMV is associated with significant risks of morbidity and mortality; however premature extubation and extubation failure are associated with increased duration of IMV, increased LOS, and increased mortality
- Safe and timely liberation from IMV is an important goal for clinicians and patients, as 40% of the time on IMV is dedicated to weaning
- No RCT- or guideline-based consensus exists regarding the optimal ventilatory mode for gradual weaning from IMV.

OBJECTIVES

1. To characterize and describe the ventilatory modes that have been studied in randomized controlled trials (RCTs) to facilitate liberation of critically ill patients from IMV
2. Following this, to perform a multiple-comparison network meta-analysis (NMA) to examine direct and indirect comparisons of studied ventilatory modes

METHODS

We searched MEDLINE, EMBASE, PubMed, and Cochrane Library from inception until January 2023 without language restrictions. Title/abstract and full-text screening was done in duplicate.

Inclusion Criteria

- Parallel-group RCTs involving adults (≥18 years old) in the ICU undergoing IMV for ≥24 hours
- Part of WIND Group no wean, 2 (1–7 days) or 3 (≥7 days), or the corresponding ICC groups 2 (difficult weaning) and 3 (prolonged weaning)
- Comparing two or more assisted ventilatory modes

Exclusion Criteria

- Comparisons of ventilatory modes for conducting SBTs (e.g. PSV vs T-piece)
- RSBI vs no RSBI
- Invasive vs non-invasive ventilation
- Tracheostomized patients

Required/Recorded Outcomes

- Mortality
- Weaning success or duration
- Duration of IMV
- Duration of acute care
- Use of non-invasive ventilation or high-flow nasal cannula
- Adverse events (self-extubation, VAP, arrhythmia, pneumothorax)
- Sedation requirements
- Failed liberations from extubation
- Time from randomization to extubation
- Need for tracheostomy
- Patient-Ventilatory Asynchrony Index

AUTHORS

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RESULTS

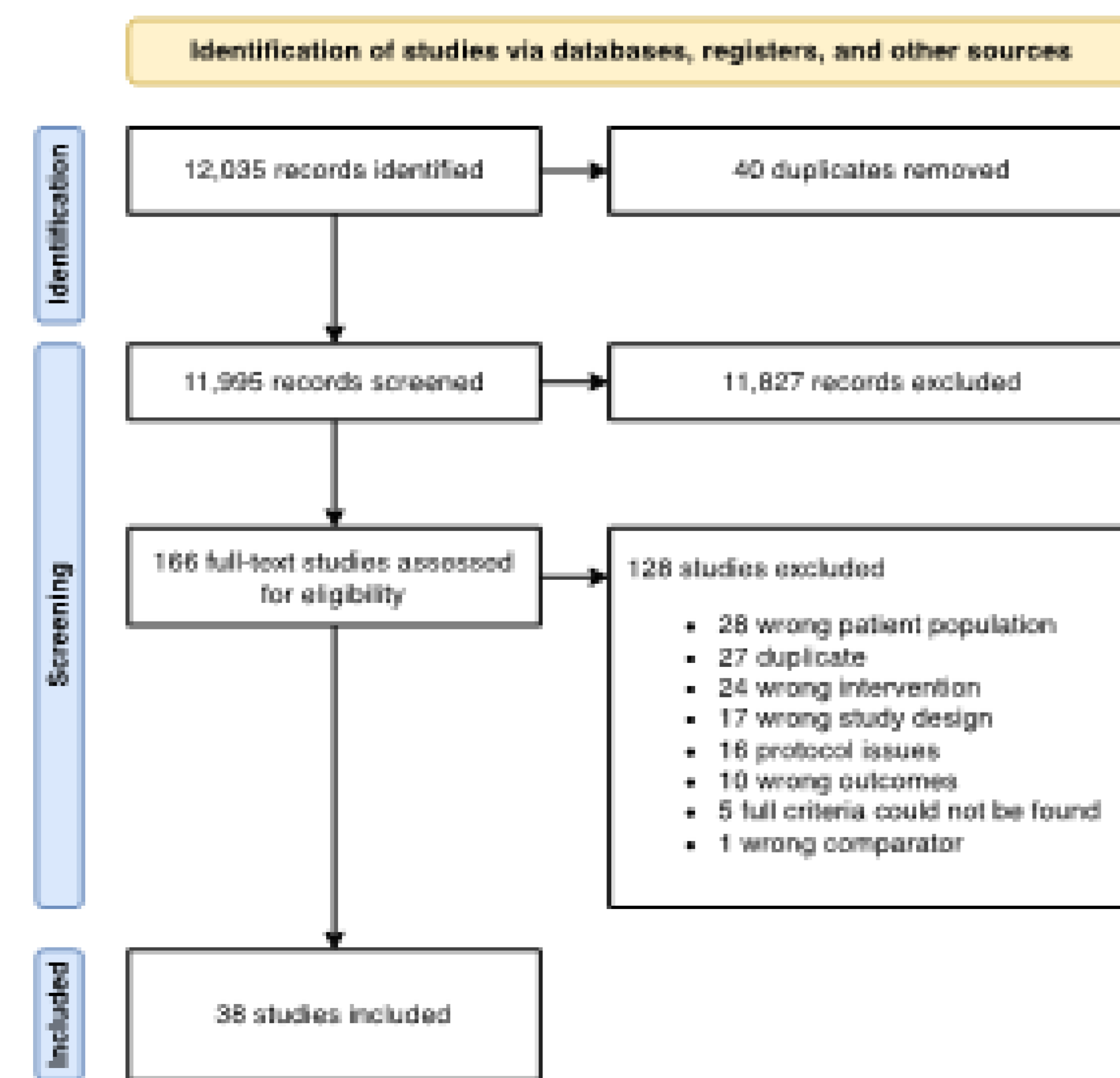


Figure 1: PRISMA Diagram. Out of 12,035 initial citations captured, 38 eligible RCTs were included in our study, published between 1989 to 2022. Trials had a median size of 72 patients.

Ventilator Mode	RCT Arms (%)	Sum of N
Pressure support ventilation (PSV)	27 (36%)	1047
Synchronized intermittent mandatory ventilation (SIMV/IMV)	12 (16%)	344
SmartCare™	7 (9%)	292
Adaptive support ventilation (ASV)	5 (7%)	288
Neurally-adjusted ventilatory assist (NAVA)	5 (7%)	181
Assist-control ventilation (ACV)	4 (5%)	219
T-piece	4 (5%)	123
Proportional assist ventilation (PAV)	3 (4%)	185
Proportional assist ventilation plus (PAV+)	2 (3%)	77
Volume support ventilation (VSV)	2 (3%)	80
Proportional support ventilation	1 (1%)	43
INTELLIVENT®-ASV®	1 (1%)	40
Airway pressure release ventilation (APRV)	1 (1%)	32
Total	74	2911

Table 1: Ventilatory modes studied in RCTs for weaning from mechanical ventilation. 13 unique modes of ventilation were studied across 38 eligible RCTs identified. PSV, SIMV, and SmartCare™ were the most examined modes. Between different trial arms using the same ventilatory mode for weaning from IMV, there was important variability in initial ventilator settings (*not shown*) and weaning strategies (Fig. 2)

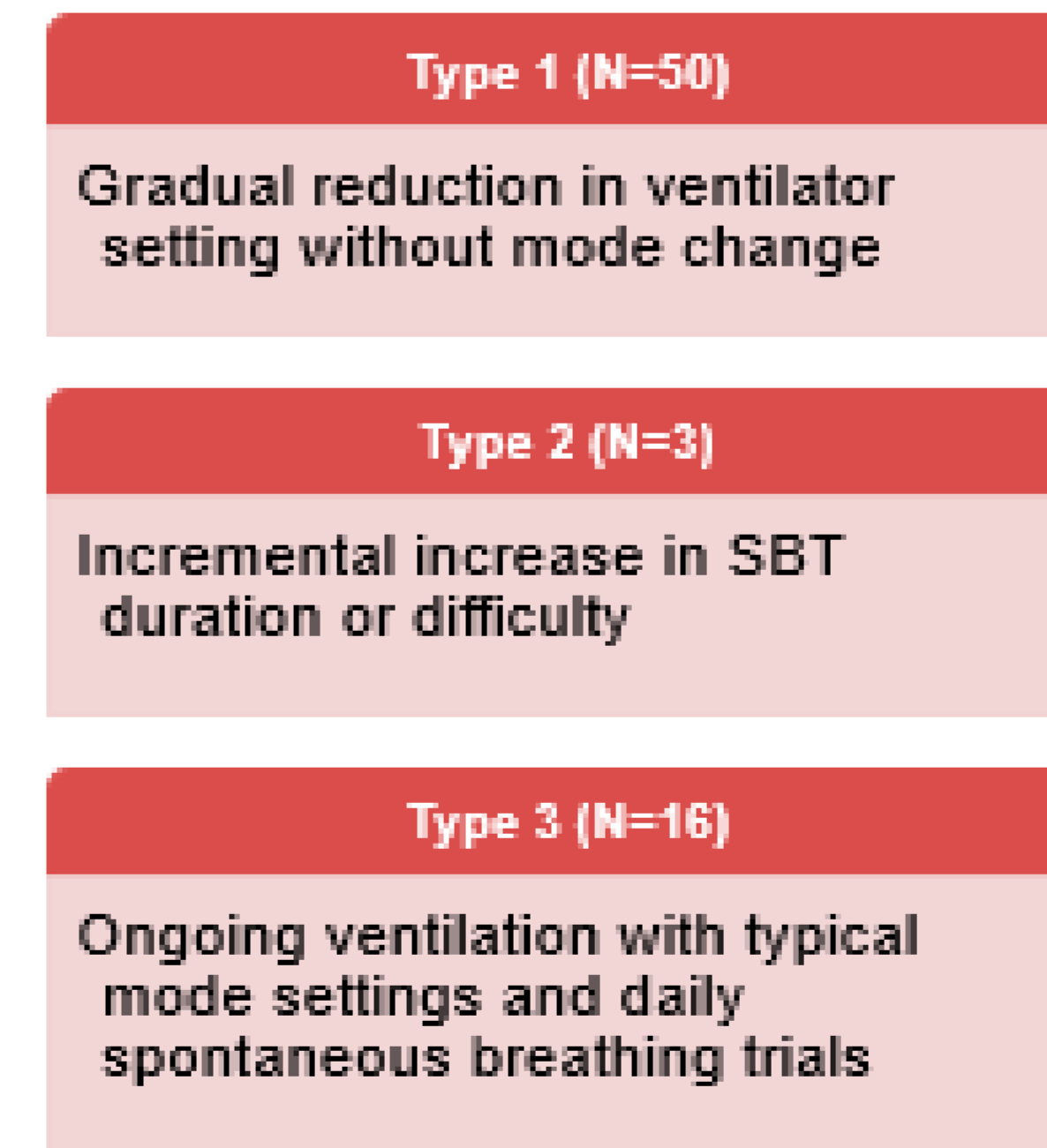


Figure 2: Classifications of strategies for weaning from mechanical ventilation.
• Example of Type 1: Initial PSV 15/5 cm H₂O, with decreases in support by 2/1 cm H₂O every 30-60 minutes until inspiratory PS ≤ 7cm H₂O.
• Example of Type 2: Increasingly prolonged T-piece SBTs once-daily or twice-daily with assisted ventilation in between, until 120-minute SBT achieved.
• Example of Type 3: Daily SBT at PS 5-7 cm H₂O, PEEP 5 cm H₂O for 30-120 minutes with PSV ventilatory mode in between.

CONCLUSION

1. Pressure support ventilation and synchronized intermittent mandatory ventilation are the most studied ventilatory modes for weaning from mechanical ventilation
2. There is important variability in ventilatory modes, settings, and strategies reflecting the real-world practice variability and uncertainty regarding the optimal approach
3. We plan to perform a multiple-comparison network meta-analysis to generate best effect estimates for clinically relevant outcomes such as ICU mortality, weaning success, re-intubation or tracheostomy, duration of mechanical ventilation, acute care and hospital LOS, and weaning duration.

ACKNOWLEDGEMENTS

Many thanks to all the hard-working clinicians and researchers who have worked on this project from inception to its current state.

REFERENCES

1. Esteban A, Alia I, Ibañez J, Benito S, Tobin MJ. Modes of mechanical ventilation and weaning: A national survey of Spanish hospitals. The Spanish Lung Failure Collaborative Group. *Chest*. 1994;104(4):1188-93.
2. Burns KEA, Raftery S, Nissenbaum R, Rizvi L, Jones A, Balogh J, et al. International Practice Variation in Weaning Critically Ill Adults from Invasive Mechanical Ventilation. *Ann Am Thorac Soc*. 2018 Apr;15(4):494-502.
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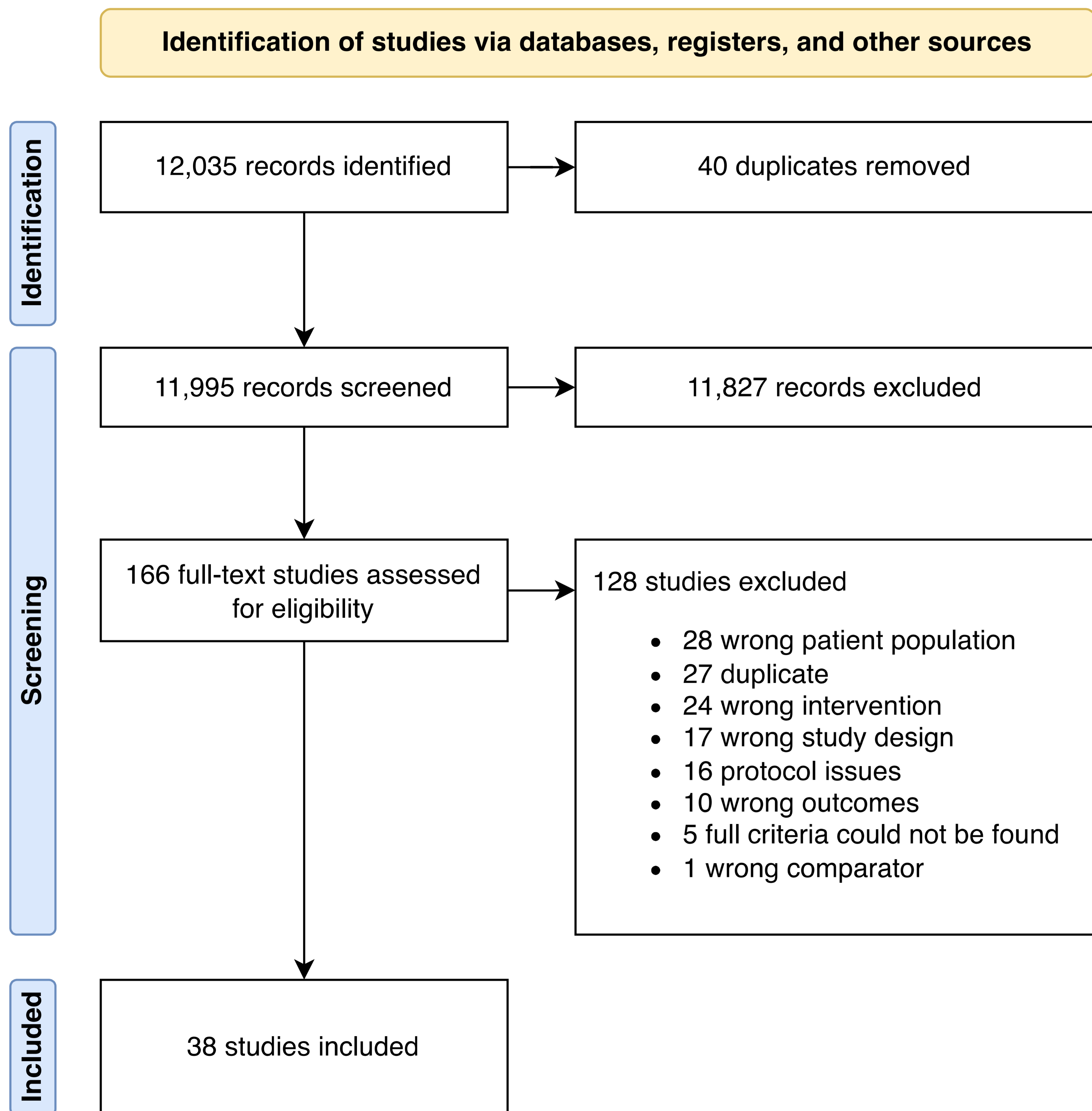


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Type 1 (N=50)

Gradual reduction in ventilator setting without mode change

Type 2 (N=3)

Incremental increase in SBT duration or difficulty

Type 3 (N=16)

Ongoing ventilation with typical mode settings and daily spontaneous breathing trials

Figure 2: Classifications of strategies for weaning from mechanical ventilation.

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