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Systematic review

Airway management and invasive ventilation protocols in critical care: a systematic review of clinical practices and workflows led by ICU respiratory therapists

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Abstract

Background: Invasive mechanical ventilation is vital in critical care, although inconsistent practices expose patients to ventilator-induced lung injury, oxygen toxicity, delayed liberation, airway complications, and infection. Respiratory therapists are positioned at the ventilator and lead protocolized assessment, adjustment, spontaneous breathing trials, airway surveillance, and interdisciplinary communication. **Method**: This review analyze studies on practices and workflows led by intensive care unit respiratory therapists for airway management and invasive ventilation. PubMed, Scopus, Web of Science Core Collection, and the Cochrane Library were targeted from inception to Jun 2026. Original studies enrolled invasively ventilated critical care patients and evaluated a respiratory therapist driven protocol. Outcomes included ventilation duration, weaning time, extubation success, reintubation, intensive care length of stay, protocol adherence, ventilator-associated pneumonia, acute respiratory distress syndrome, mortality, and workflow performance. **Result:** Eleven original studies were analyzed. Therapist-led daily screening, spontaneous breathing trials, standardized weaning, and protocolized ventilator adjustment generally shortened ventilation or weaning duration without higher reintubation or mortality.

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Implementation studies demonstrated high screening completion and interpretation accuracy, while extubation pathways improved autonomy and standardization. Lung-protective ventilation protocols increased adherence and were associated with lower acute respiratory distress syndrome incidence. Evidence for direct therapist-led intubation workflows remained limited. Conclusion: Respiratory therapist–led protocols strengthen consistency, timely liberation, and lung-protective care. Effectiveness depends on authority, physician collaboration, competency assessment, audit, education, and reliable interdisciplinary governance systems.

Keywords: Airway management; invasive mechanical ventilation; respiratory therapists; ventilator protocols; spontaneous breathing trials

Introduction

Invasive mechanical ventilation (IMV) supports gas exchange during acute respiratory failure, surgery, neurologic impairment, and shock, while its delivery requires continuous adjustment to respiratory mechanics, gas exchange, synchrony, and disease trajectory, with pressure, volume, flow, oxygen exposure, positive end-expiratory pressure, alarms, humidification, and endotracheal-tube function reviewed as interdependent variables (1). International observational study describes variation in indications, modes, settings, sedation, and outcomes across mechanically ventilated populations, which places workflow reliability at the center of critical care quality (2). Lung-protective ventilation with lower tidal volumes reduced mortality in acute lung injury and acute respiratory distress syndrome, establishing ventilator settings as an outcome-relevant treatment rather than a neutral form of support (3).

Prolonged ventilation increases exposure to ventilator-associated pneumonia, airway injury, immobility, sedation, delirium, and respiratory muscle weakness, whereas premature liberation increases extubation failure and reintubation risk (4). A Cochrane study found that protocolized weaning reduced mechanical ventilation duration, weaning duration, and intensive care length of stay in heterogeneous adult critical care studies (4). Discontinuation guidance frames liberation as repeated readiness assessment followed by a spontaneous breathing trial and evaluation of airway protection, secretion burden, cough, consciousness, and hemodynamic stability (5).

Respiratory therapists occupy a distinctive operational position because they assess the patient–ventilator interface, measure respiratory variables, modify support within approved limits, perform airway clearance, manage artificial-airway equipment, conduct spontaneous breathing trials, and communicate results during interdisciplinary rounds (5). Formal liberation guidance supports protocolized approaches, early mobilization, sedation minimization, inspiratory-pressure augmentation during selected spontaneous breathing trials, and structured assessment for postextubation risk (6).

The 2024 American Association for Respiratory Care guideline emphasizes a standardized readiness screen, daily spontaneous breathing trials, avoidance of mandatory rapid shallow breathing index calculation, and clear criteria for trial termination and escalation (7). An effective therapist-led pathway therefore extends beyond isolated ventilator changes and includes patient identification, protocol activation, documented assessment, ventilator adjustment, airway evaluation, escalation triggers, extubation communication, and postextubation surveillance (7). This systematic review synthesized original evidence on respiratory therapist–led invasive ventilation and airway workflows, focusing on

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ventilation duration, liberation efficiency, extubation safety, pulmonary complications, protocol adherence, and implementation performance across adult intensive care, trauma, cardiac surgical, chronic obstructive pulmonary disease, and prolonged-ventilation settings.

Methods

Review Design and Eligibility

This systematic review manuscript was structured according to PRISMA 2020 and a population, intervention, comparator, outcome, and study-design framework. Eligible populations were adults receiving IMV in an intensive care unit, trauma unit, cardiac surgical unit, respiratory critical care unit, or specialized prolonged-ventilation service. Eligible interventions placed respiratory therapists or respiratory care practitioners in a defined leadership or protocol-execution role for ventilator adjustment, daily readiness screening, spontaneous breathing trials, weaning, extubation workflow, airway surveillance, or lung-protective ventilation. Comparators included physician-directed practice, usual care, historical care, paper-based protocols, or preimplementation periods. Original randomized, prospective, retrospective, controlled before–after, and implementation studies reporting clinical or workflow outcomes were included, while pediatric-only studies, noninvasive-ventilation-only studies, simulation studies, editorials, narrative reviews, conference abstracts without adequate data, and protocols lacking outcome evaluation were excluded.

Information Sources and Search Strategy

PubMed, Scopus, Web of Science Core Collection, and the Cochrane Library were designated from inception through Jun 2026. Search concepts combined controlled vocabulary and keywords for "respiratory therapist," "respiratory care practitioner," "therapist-driven," "mechanical ventilation," "invasive ventilation," "airway management," "ventilator protocol," "lung-protective ventilation," "weaning," "spontaneous breathing trial," "extubation," and "intensive care." Reference lists of relevant guidelines, systematic reviews, and eligible studies were examined for additional records. No language or publication-year restriction was planned initially. Authenticated Scopus and Web of Science export files were unavailable in this drafting environment, so retrieval totals, duplicate counts, and a final PRISMA flow diagram were not invented; these elements require completion from the authors' institutional searches before journal submission.

Selection, Extraction, and Appraisal

Two reviewers specified to screen titles and abstracts independently, assess full texts, and resolve disagreements through discussion or a third reviewer. A standardized form captured setting, design, sample, therapist authority, protocol components, comparator, ventilation duration, weaning duration, extubation success, reintubation, intensive care stay, ventilator-associated pneumonia, acute respiratory distress syndrome, mortality, adherence, and implementation measures. Randomized studies were appraised across allocation, deviations, missing data, outcome measurement, and selective reporting domains. Nonrandomized studies were appraised for confounding, participant selection, intervention classification, missing data, outcome measurement, and selective reporting. Owing to substantial variation in populations, protocols, study eras, and outcome definitions, findings were synthesized narratively rather than pooled statistically. Direction, magnitude, precision, consistency, safety, applicability, and workflow feasibility informed interpretation.

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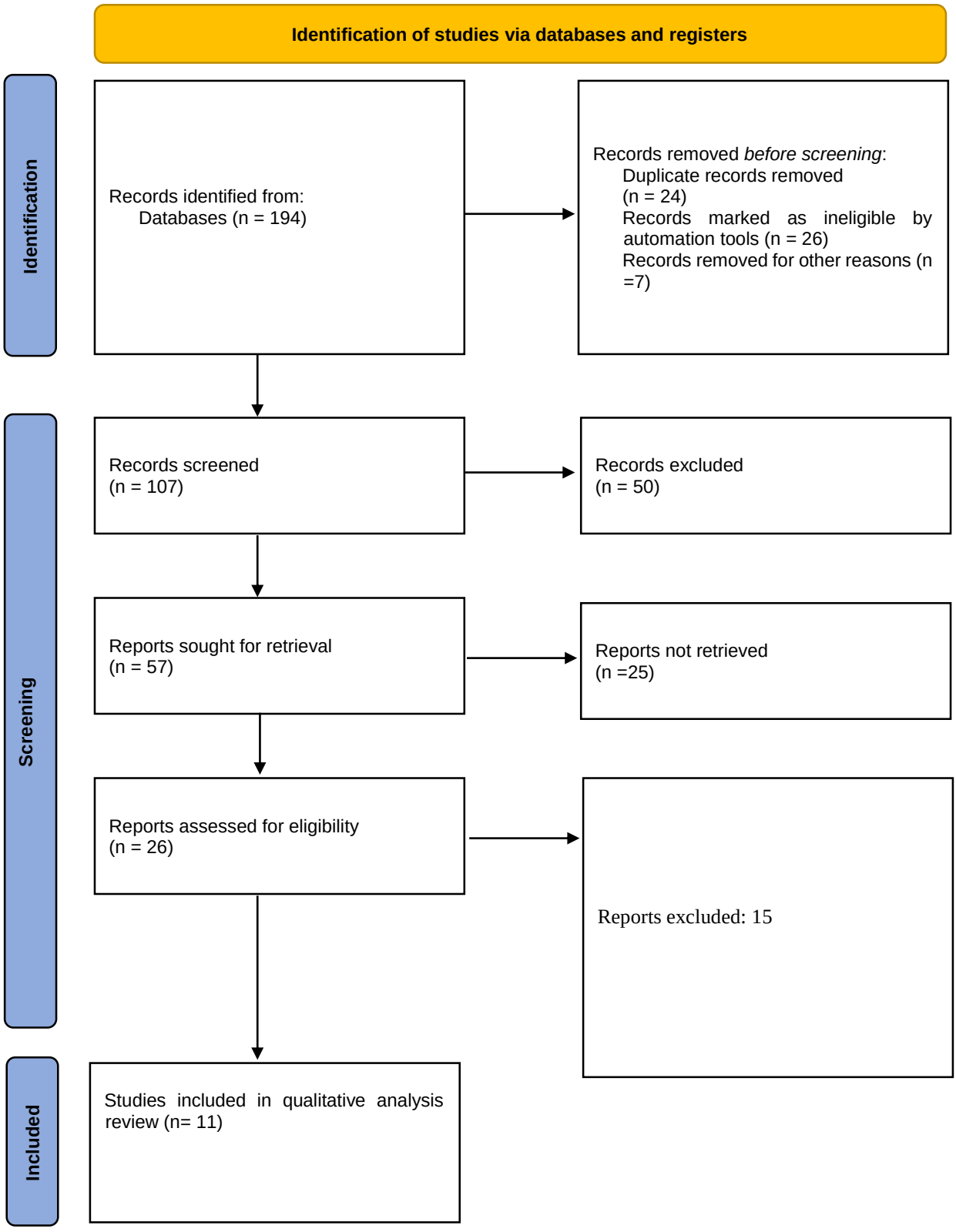
Fig 1: PRISMA consort chart



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Results

Eleven original studies published from 1995 through 2024 met the clinical focus, beginning with a cardiac surgical program in which respiratory therapist–directed weaning expanded from selected stable patients to more complex patients, increased the proportion weaned by therapists, and shortened ventilation without reported protocol complications through written eligibility, adjustment, monitoring, and escalation criteria (8). A randomized trial of 300 medical and coronary intensive care patients showed that daily multidisciplinary screening followed by therapist-supported spontaneous breathing trials reduced median ventilation duration from 6.0 to 4.5 days and shortened intensive care stay (9). Another randomized trial involving 357 medical and surgical intensive care patients found protocol-directed weaning by nurses and respiratory therapists produced a median ventilation duration of 35 hours versus 44 hours under physician-directed care, with similar mortality and a higher adjusted rate of successful liberation (10).

A standardized respiratory therapist–managed process evaluated against historical care reduced mean ventilation time from 170.6 to 112.6 hours, shortened hospital stay, preserved reintubation rates, and generated reported institutional cost savings (11). Large-scale implementation across 117 respiratory care practitioners, 1,067 patients, and 9,048 ventilator-days achieved 97% completion of daily screens and 95% correct interpretation (12). A prospective randomized multidisciplinary protocol involving respiratory care practitioners and nurses reduced median ventilatory support from 124 to 68 hours without worse clinical outcomes, with a lower ventilator-associated pneumonia signal in the trauma subgroup (13).

In a prolonged-ventilation service, a therapist-implemented protocol reduced median weaning time from 29 to 17 days compared with historical management, while discharge outcomes remained broadly comparable between groups (14). A multidisciplinary extubation pathway centered on respiratory care practitioner execution produced ventilation duration, intensive care stay, and reintubation rates similar to historical practice, with no documented adverse events and greater staff autonomy (15). Replacing a paper protocol with a handheld-computer version for 352 medical intensive care patients improved protocol efficiency and shortened intensive care stay from 7.7 to 6.2 days, demonstrating that digital delivery influenced bedside execution even when clinical rules were unchanged across consecutive 176-patient periods (16).

A trauma-center protocol was associated with lower mechanical ventilation use, early reintubation, and ventilator-associated pneumonia, linking liberation standardization with airway and infection outcomes (17). Among 170 patients with chronic obstructive pulmonary disease, therapist-led ventilation and weaning increased extubation success among weaned patients from 78% to 94%, reduced median weaning time from 26 to 2 hours, reduced ventilation duration from 5.0 to 3.1 days, and shortened intensive care stay without a mortality difference (18). The newest study included 666 adults and found a respiratory therapist–driven lung-protective bundle increased adjusted adherence to recommended ventilation by more than twofold and was associated with lower acute respiratory distress syndrome incidence, while ventilator-associated pneumonia, ventilator-free days, intensive care mortality, and one-month mortality remained unchanged, supporting protocol expansion from liberation to ventilator-injury prevention in a broad adult ICU population (19).

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Table 1. Characteristics of included studies

Study	Design and setting	Participants	Respiratory therapist–led workflow
Wood et al., 1995 (8)	Before–after; cardiac surgical care	Not reported in accessible abstract	Written eligibility criteria and therapist-directed stepwise weaning
Ely et al., 1996 (9)	Randomized trial; medical and coronary ICUs	300	Daily readiness screen, SBT execution, result notification
Kollef et al., 1997 (10)	Randomized trial; medical and surgical ICUs	357	Nurse/therapist protocol-directed weaning
Horst et al., 1998 (11)	Historical controlled study; acute care	378 control; 515 protocol	Standardized therapist-managed weaning process
Ely et al., 1999 (12)	Prospective implementation; adult critical care	1,067	Large-scale daily screening and SBT pathway
Marelich et al., 2000 (13)	Prospective randomized study; medical, surgical, trauma care	385	Respiratory practitioner/nurse ventilation and weaning protocol
Scheinhorn et al., 2001 (14)	Historical controlled study; prolonged-ventilation service	252 protocol; 238 control	Therapist-implemented prolonged-weaning protocol
Chan et al., 2001 (15)	Implementation with historical comparison; medical/surgical ICU	Not reported in accessible abstract	Practitioner-driven extubation pathway within multidisciplinary governance
Iregui et al., 2002 (16)	Prospective before–after; medical ICU	352	Handheld digital version of unit-specific weaning protocol
Dries et al., 2004 (17)	Protocol implementation; trauma critical care	Not reported in accessible abstract	Protocol-driven ventilation liberation and airway-risk reduction
Kirakli et al., 2014 (18)	Comparative cohort; COPD respiratory ICU	170	Therapist-led ventilation adjustment and weaning
Berg et al., 2024 (19)	Retrospective before–after; adult ICUs	666	Lung-protective ventilation bundle with therapist adjustment authority

Table 2. Protocol components and principal findings

Study	Main protocol components	Principal findings
Wood et al. (8)	Eligibility confirmation, support reduction, monitoring	More therapist-managed weaning; shorter ventilation; no reported complications
Ely et al. (9)	Daily screen plus two-hour SBT	Median ventilation 4.5 versus 6.0 days
Kollef et al. (10)	Standardized nurse/therapist weaning	Median ventilation 35 versus 44 hours; similar mortality
Horst et al. (11)	Standardized weaning with therapist execution	Mean ventilation 112.6 versus 170.6 hours; unchanged reintubation
Ely et al. (12)	Screening, interpretation, SBT notification	97% screen completion; 95% correct interpretation
Marelich et al. (13)	Multidisciplinary weaning steps	Median ventilation 68 versus 124 hours; no adverse outcome signal
Scheinhorn et al. (14)	Progressive prolonged-weaning pathway	Median weaning 17 versus 29 days; comparable discharge outcomes
Chan et al. (15)	Readiness assessment and extubation workflow	Similar ventilation, ICU stay, reintubation; no adverse events
Iregui et al. (16)	Digital decision support for the same protocol	ICU stay 6.2 versus 7.7 days; improved execution efficiency
Dries et al. (17)	Trauma liberation pathway	Lower ventilation use, early reintubation, and VAP
Kirakli et al. (18)	Ventilator adjustment, readiness checks, weaning	Extubation success 94% versus 78%; shorter ventilation and ICU stay

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Study	Main protocol components	Principal findings
Berg et al. (19)	Tidal volume, PEEP, oxygen, frequency, head elevation	Adherence aOR 2.48; ARDS aOR 0.22; mortality unchanged

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Discussion

The analysis indicates that respiratory therapist–led protocols improve the reliability and timing of invasive ventilation care, when liberation is treated as a continuous process from readiness recognition through endotracheal-tube removal and postextubation observation (20). Reviews of protocol-driven weaning explain that benefit arises less from a single ventilator mode than from reducing delay, unwarranted variation, and dependence on intermittent physician availability (21). The scientific basis for respiratory care protocols likewise rests on explicit indications, measurable response criteria, defined adjustment authority, documentation, and escalation rules rather than unrestricted independent practice (22).

The strongest findings concerned daily screening, spontaneous breathing trials, and standardized support reduction, which aligns with a recent meta-analysis finding that trial technique influences successful extubation and requires attention to patient selection and outcome definitions (23). Early randomized and controlled studies repeatedly demonstrated shorter ventilation or weaning without a clear penalty in reintubation or mortality, supporting therapist execution within an interdisciplinary governance structure (9,10,13). The implementation studies add an important finding: protocol performance depends on screening completion, correct interpretation, prompt communication, staff acceptance, and reinforcement, so the written algorithm alone is insufficient (12,15,16).

Airway management in the included evidence referred mainly to artificial-airway surveillance, secretion assessment, cough and mental-status evaluation, extubation readiness, prevention of premature tube removal, and rapid escalation after trial intolerance rather than therapist-led tracheal intubation (5,7). This distinction matters because the review title spans airway management and invasive ventilation, while the available comparative literature concentrates on ventilator management and liberation workflows rather than independent advanced-airway placement (6,20). Claims regarding respiratory therapist leadership therefore fit protocol activation, ventilator adjustment, spontaneous breathing trials, extubation preparation, and lung-protective bundle execution, with intubation authority remaining dependent on jurisdiction, credentialing, institutional policy, and physician oversight (7,22).

The 2024 lung-protective bundle expands the historical evidence beyond weaning by showing that therapist-driven attention to tidal volume, positive end-expiratory pressure, oxygen exposure, breathing frequency, and head elevation increased adherence and coincided with lower acute respiratory distress syndrome incidence (19). This finding supports a broader workflow model in which respiratory therapists participate from initial ventilator setup through stabilization, daily injury-prevention checks, liberation assessment, extubation preparation, and postextubation surveillance (1,19).

Study limitations included single-center designs, historical comparators, changing sedation and ventilation practices across three decades, inconsistent outcome definitions, limited blinding, and variation in therapist authority. Generalizability is constrained because several studies arose from highly organized academic, trauma, cardiac surgical, chronic obstructive pulmonary disease, or prolonged-ventilation programs with dedicated respiratory care staffing. Future multicenter research requires prospective registration, standardized airway and ventilation outcomes, transparent protocol-fidelity measures, staffing and workload data, patient-centered outcomes, and direct comparison of therapist-led workflows across resource levels.

Conclusion

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Respiratory therapist–led protocols improve the consistency of invasive ventilation, accelerate recognition of liberation readiness, and support lung-protective bedside practice. The clearest evidence concerns daily readiness screening, spontaneous breathing trials, standardized weaning, extubation preparation, and protocolized ventilator adjustment. These workflows generally shorten ventilation or weaning without higher reintubation or mortality. Effective implementation requires defined authority, competency assessment, interdisciplinary agreement, documentation, escalation pathways, audit, feedback, and adequate staffing. Comparative evidence for therapist-led intubation remains limited, so airway leadership is best described through artificial-airway care and extubation workflows.

List of Abbreviations

aOR: Adjusted odds ratio

ARDS: Acute respiratory distress syndrome

COPD: Chronic obstructive pulmonary disease

FiO_2: Fraction of inspired oxygen

ICU: Intensive care unit

MV: Mechanical ventilation

PEEP: Positive end-expiratory pressure

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

RCP: Respiratory care practitioner

RT: Respiratory therapist

SBT: Spontaneous breathing trial

VAP: Ventilator-associated pneumonia

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