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NURSE-LED SEDATION PROTOCOLS AND DELIRIUM SCREENING TOOLS, CAM-ICU, ICDSC IN MECHANICALLY VENTILATED PATIENTS

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Abstract

Nurse-led sedation (NLS) protocols and structured delirium screening improve outcomes in mechanically ventilated adults by standardizing targets for light sedation and enabling early detection of delirium. We systematically synthesized original studies evaluating (1) NLS/protocol-directed sedation and (2) bedside delirium screening using CAM-ICU or ICDSC in ventilated ICU patients. Nine primary studies met criteria: two randomized/controlled comparisons of sedation strategies and seven observational before-after or implementation studies. Across studies, NLS protocols commonly reduced sedative exposure and, in several cohorts, shortened ventilation or improved ventilator-free days, with neutral effects on safety. A nurse-implemented protocol lowered ventilator-associated pneumonia from 15% to 6% and halved median ventilation duration (8 to 4.2 days). In an RCT, a nurse-implemented algorithm outperformed daily sedation interruption, with shorter ventilation and faster organ-failure recovery. For delirium screening, implementation of CAM-ICU/ICDSC improved nurses' diagnostic performance and agreement with reference assessors, while large-scale implementation showed feasibility without adverse effects on length of stay. Overall, NLS protocols and routine CAM-ICU/ICDSC screening appear safe and practicable and are associated with reduced ventilation time and improved process outcomes, while effects on delirium incidence and mortality are heterogeneous. These findings align with guideline targets for light sedation and routine delirium monitoring.

Keywords: Nurse-Led Sedation; Protocol-Directed Sedation; CAM-ICU; ICDSC; Mechanical Ventilation; Delirium; Ventilator-Associated Pneumonia.

INTRODUCTION

Delirium affects a substantial proportion of mechanically ventilated patients and is linked

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to mortality, prolonged ventilation, and long-term cognitive impairment (Ely et al., 2001). Validated bedside tools—the Confusion Assessment Method for the ICU (CAM-ICU) and the Intensive Care Delirium Screening Checklist (ICDSC)—enable routine detection and are recommended for all adult ICU patients (Ely et al., 2001; ICU Delirium site summary of PADIS guidance). Contemporary sedation guidance emphasizes light sedation with titration and daily awakening when appropriate, in preference to deep continuous sedation (Pearson & Patel, 2020; Olsen et al., 2020). These approaches aim to reduce iatrogenic coma, facilitate spontaneous breathing, and lessen delirium risk.

Nurse-led or protocol-directed sedation (NLS) leverages nurses' continuous bedside presence to titrate sedatives/analgesics toward predefined targets (e.g., RASS), potentially reducing drug exposure and variability. Meta-analytic data suggest NLS can shorten ventilation duration and ICU length of stay and reduce delirium and ventilator-associated pneumonia compared with usual care (Qi et al., 2021). In parallel, integrating structured delirium screening (CAM-ICU or ICDSC) into nursing workflow can improve detection and inter-rater agreement, a prerequisite for timely non-pharmacologic and pharmacologic responses (Gesin et al., 2012).

Effects in individual studies vary by ICU type, staffing, education, and the specific algorithm (nurse-driven titration, criteria for infusion initiation, daily sedation interruption). Practice also continues to evolve with strategies such as "no/very-light" sedation in selected patients (Olsen et al., 2020). We therefore synthesized original studies of NLS and bedside delirium screening (CAM-ICU, ICDSC) in mechanically ventilated adults, focusing on patient-centered outcomes (ventilator-free days, VAP, delirium, length of stay) and implementation/safety.

METHODS

Protocol and question. Following PRISMA principles, we asked: among mechanically ventilated adult ICU patients, do nurse-led sedation protocols and/or routine delirium screening with CAM-ICU/ICDSC improve clinical and process outcomes versus usual care or alternative strategies?

Eligibility. Included were original studies (randomized, quasi-experimental, before-after, or prospective implementation) in adult ICUs where (a) sedation was protocolized and explicitly nurse-driven/titrated, and/or (b) delirium was routinely screened using CAM-ICU or ICDSC by bedside staff; and that reported at least one of: ventilator-free days/duration, ICU/hospital length of stay, delirium incidence or agreement, VAP, extubation failure, mortality, or safety. We excluded pediatric-only cohorts, purely pharmacologic drug-vs-drug sedation trials without a nurse-driven protocol, and non-ICU settings.

Identification and selection. We used the set of articles you provided as the seed corpus and screened titles/abstracts and full texts for eligibility. Where necessary, we verified details on PubMed/PMC/publisher sites and cross-checked reference lists to ensure each study met criteria and to capture outcomes consistently.

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Nine original studies met inclusion for the Results; eight additional items (validation papers, reviews, guidelines) informed the Introduction/Discussion. Data extraction. Two domains were captured: (1) study/setting (design, ICU type, sample), intervention (NLS features; CAM-ICU/ICDSC details), comparator, and (2) outcomes (ventilation duration or ventilator-free days, ICU/hospital LOS, delirium incidence/diagnostic agreement, VAP, extubation failure, mortality, sedative/analgesic exposure, and safety signals). When exact numbers were unavailable from abstracts, we report direction and significance per the authors.

Risk of bias and synthesis. Given heterogeneity of designs (RCTs vs before-after) and outcomes, we undertook a structured narrative synthesis with tabulation. Randomization/early stopping, secular trends, and concomitant bundle elements were considered when interpreting effects. Implementation studies were appraised for confounding and measurement bias typical of quality-improvement designs. We did not perform meta-analysis due to design/outcome variability across the nine studies.

RESULTS

Study overview

Nine original studies met criteria: two randomized/controlled comparisons of sedation strategies (de Wit et al., 2008; Quenot et al., 2007), five before-after or implementation studies of nurse-driven sedation algorithms (Arias-Rivera et al., 2008; Chan et al., 2010; Kaplan et al., 2019; Frade-Mera et al., 2023; plus Quenot's controlled before-after), and two implementation studies focused on delirium screening performance using CAM-ICU/ICDSC (van den Boogaard et al., 2009; Gesin et al., 2012). One mixed-methods study specifically examined CAM-ICU use during daily sedation stops (Steinseth et al., 2018). Settings included medical, surgical-trauma, and mixed ICUs. Sample sizes ranged from 30 paired assessments (Steinseth et al.) to 423 patients (Quenot et al.).

Table 1: Included study characteristics

Study (year)	Setting/Design	n	Intervention (vs comparator)	Primary outcomes captured
Quenot et al. (2007)	11-bed MICU; prospective controlled before-after	423	Nurse-implemented titration protocol every 3h (vs physician-directed usual care)	VAP incidence; MV duration; extubation failure; mortality
Arias-Rivera et al. (2008)	Mixed ICU; before-after	356	Nurse-implemented sedation algorithm (vs pre-implementation usual care)	MV duration; extubation success; doses; LOS
de Wit et al. (2008)	RCT, MICU	74 (stopped early)	Nurse-implemented algorithm vs daily sedation interruption (DSI)	Time to successful extubation; organ failure trajectory; safety
Chan et al. (2010)	8-bed MICU; before-after	188	Nurse-driven protocol with DSI (vs pre)	MV duration; ICU LOS; safety (e.g., unplanned

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				CT for coma, device events)
van den Boogaard et al. (2009)	3 ICUs; prospective implementation	282	CAM-ICU implementation + sedation training (vs baseline)	ICU/hospital LOS; MV duration; analgesic/sedative use; safety
Gesin et al. (2012)	STICU; phased implementation study		ICDSC + multifaceted education (vs no tool/minimal ed)	Nurse knowledge; agreement (κ) with expert
Steinseth et al. (2018)	Mixed-methods; MV during daily sedation stops	30 paired assessments (15 pts)	CAM-ICU applied by ICU nurses; interviews	Nurse agreement/experiences; barriers
Kaplan et al. (2019)	SICU; retrospective before-after	132	Nursing-driven analgesia-sedation protocol with infusion-initiation criteria (vs pre)	Ventilator-free days at day 28 (VFD28); sedative/analgesic exposure; delirium; LOS
Frade-Mera et al. (2023)	Med-surg ICU; cohort (historical vs prospective)	242	Nurse-guided analgosedation monitoring protocol (vs pre)	Sedative doses/frequency; MV time; VAP; LOS; mortality

Effects of nurse-led sedation protocols

Ventilation duration / ventilator-free days.

A large controlled before-after study (Quenot et al.) found the nurse-implemented protocol halved median ventilation from 8.0 (IQR 2.2–22.0) to 4.2 days (2.1–9.5) (p=0.001), a 52% relative reduction (Quenot et al., 2007). In a single-center RCT, nurse-implemented algorithmic titration outperformed daily sedation interruption, with the DSI arm experiencing longer ventilation; organ dysfunction improved more quickly in the algorithm arm (de Wit et al., 2008). A before-after MICU study (Chan et al.) showed no overall change in median MV (2 vs 2 days), but in patients ventilated >4 days, both MV and ICU LOS decreased (7→6 and 8→6 days, respectively) (Chan et al., 2010). In a SICU cohort, a nursing-driven protocol with explicit criteria for starting infusions increased VFD-28 (21 vs 14.5 days; p=0.04) (Kaplan et al., 2019). In Arias-Rivera et al., MV duration did not significantly change, but probability of successful extubation improved (details below) (Arias-Rivera et al., 2008).

Delirium, VAP, and complications.

Quenot et al. reported VAP reduction from 15% to 6% (p=0.005) and fewer extubation failures (13%→6%, p=0.01) with the nurse-led protocol; mortality was unchanged (Quenot et al., 2007). In the SICU protocol study (Kaplan et al.), delirium incidence did not differ between groups despite better sedation target adherence and lower benzodiazepine/opioid use (Kaplan et al., 2019). The Spanish cohort (Frade-Mera et al.) documented reduced sedative dosing (less midazolam/propofol) and lower VAP (25%→14%; p=0.02), with similar ventilation time medians (4.7 vs 4.1 days; p=0.33) and no significant differences in LOS or mortality (Frade-Mera et al., 2023). Chan et al. found

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no increase in adverse events and fewer head CTs for persistent coma after sedation cessation (4.5%→1.2%) (Chan et al., 2010).

Extubation success and sedation exposure.

Arias-Rivera et al. observed higher odds of successful extubation with the nurse-implemented algorithm, despite no significant reduction in MV duration; sedative doses were not significantly reduced (Arias-Rivera et al., 2008). Kaplan et al. showed substantial decreases in benzodiazepine and opioid infusion use and cumulative doses per ventilator-day in the protocol period (Kaplan et al., 2019).

Effects of routine delirium screening (CAM-ICU/ICDSC)

Diagnostic agreement and knowledge.

In a surgical-trauma ICU, implementing ICDSC with multifaceted education (didactic + bedside coaching) improved nurses' knowledge (mean 6.1/10 in baseline to 8.2/10 with education; p=0.001) and raised agreement with the expert rater from κ=0.40 (no tool) → 0.62 (tool + minimal education) → 0.74 (tool + multifaceted education) (Gesin et al., 2012). In a multicenter implementation study, routine CAM-ICU use across three ICUs increased structured assessments without prolonging LOS or MV, though early increases in sedative/analgesic days were noted during adoption; unplanned device removal did not increase (van den Boogaard et al., 2009). A mixed-methods study during daily sedation stops found variable nurse assessments and highlighted training and workflow barriers to reliable CAM-ICU use (Steinseth et al., 2018).

Link to patient outcomes.

While delirium screening itself is not a treatment, increased detection facilitates timely prevention/management consistent with bundles (SAT/SBT pairing, early mobilization). Screening accuracy depends on training and adherence; where education was robust, reliability improved markedly (Gesin et al., 2012). Population-level outcome shifts attributable solely to screening are harder to isolate, but studies did not signal harm, and screening is guideline-endorsed (ICU Delirium site summary of PADIS).

Table 2: Key quantitative outcomes (selected)

Study	Ventilation	VFD-28	VAP	Delirium	Extubation failure / success	Other
Quenot 2007	Median 8.0→4.2 days (p=0.001)	—	15%→6% (p=0.005)	—	Failures 13%→6% (p=0.01)	Mortality NS
Arias-Rivera 2008	No sig. change	—	—	—	↑ Probability of successful extubation	Sedative dose NS
de Wit 2008 (RCT)	DSI longer vs algorithm	—	—	—	—	Faster SOFA improvement in algorithm arm

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Chan 2010	Overall 2 vs 2 d; if MV > 4 d: 7→6 d	—	—	—	—	ICU LOS 3→2 d; ↓CT for coma 4.5%→1.2%
Kaplan 2019	—	14.5→21 days (p=0.04)	—	No difference	—	↓ benzo/opioid infusions & doses
Frade-Mera 2023	4.7→4.1 d (NS)	—	25%→14% (p=0.02)	—	Reintubation 15%→9% (NS)	↓ midazolam/propofol use
van den Boogaard 2009	No LOS/MV increase	—	—	Implementation feasible	—	Safety maintained
Gesin 2012	—	—	—	Nurse-expert κ 0.40→0.74	—	Knowledge +2.1 points
Steinseth 2018	—	—	—	Variable nurse CAM-ICU agreement	—	Training barriers identified

DISCUSSION

Our synthesis supports that nurse-led, protocol-directed sedation can improve key outcomes while maintaining safety, in line with guideline targets for light sedation and routine delirium monitoring. The most consistent benefits were reduced ventilation (or more ventilator-free days) and lower VAP in studies with frequent nurse titration and explicit criteria for initiating/withholding infusions (Quenot et al., 2007; Kaplan et al., 2019). These findings echo meta-analytic results showing NLS associated with shorter MV and ICU stays, with potential reductions in delirium and VAP (Qi et al., 2021).

Delirium screening is foundational: CAM-ICU and ICDSC are validated and recommended for routine use (Ely et al., 2001; ICU Delirium site). Implementation studies demonstrate that nurses' diagnostic performance improves with dedicated training and that unit-wide rollout is feasible without adverse safety signals (Gesin et al., 2012; van den Boogaard et al., 2009). Yet, mixed-methods work highlights practical barriers—documentation burden, variable familiarity during sedation stops—underscoring the need for ongoing education and workflow integration (Steinseth et al., 2018).

Evolving evidence favors lighter targets and minimizing benzodiazepines. A recent large RCT of non-sedation vs light sedation found no mortality benefit but reinforced feasibility of very light approaches in selected patients (Olsen et al., 2020). Reviews emphasize early light sedation using daily interruptions and/or nurse protocol algorithms to balance comfort with risks of oversedation (Pearson & Patel, 2020). Our included SICU study showed that simply raising the threshold to start continuous infusions (and titrating to target by nurses) increased ventilator-free time and reduced benzo/opioid exposure without increasing delirium—pragmatic levers for practice (Kaplan et al., 2019).

The heterogeneity across studies, ICU type, baseline sedation culture, education intensity, and bundled elements, likely explains variability for endpoints like LOS or

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delirium incidence. Screening alone will not lower delirium unless coupled with prevention/management bundles; conversely, NLS that reduces deep sedation indirectly mitigate delirium risk, as suggested by synthesized evidence (Qi et al., 2021). Implementation guidance and “how-to” resources (CIBS Center materials) can support sustained practice change (Brummel et al., 2013).

CONCLUSION

Across nine original studies, nurse-led sedation protocols consistently improved sedation processes and, in several cohorts, reduced ventilation duration or increased ventilator-free days without compromising safety; one large study also reduced VAP. Routine delirium screening using CAM-ICU/ICDSC improved nurses’ recognition and agreement with expert assessments and was feasible at scale. Effects on delirium incidence and length of stay were variable, reflecting implementation context. Integrating nurse-driven titration and standardized screening/education appears pragmatic and concordant with guideline targets for light sedation and early detection. Future multicenter trials should isolate the incremental impact of combined NLS + screening bundles.

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