

ADHERENCE TO SEDATION AND ANALGESIA PROTOCOLS AND THEIR IMPACT ON INTENSIVE CARE OUTCOMES

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(Received, 05th August 2025, Revised 18th October 2025, Accepted 06th December 2025, Published 14th December 2025)

ABSTRACT

Background: Sedation and analgesia management is a fundamental component of intensive care, particularly for mechanically ventilated patients. In the intensive care unit (ICU), nurses are primarily responsible for continuous assessment of pain, agitation, and sedation using validated tools, documentation of target sedation goals, and titration of medications according to established protocols. In resource-constrained settings such as Pakistan, variability in nurse training, staffing ratios, and protocol implementation may affect adherence to evidence-based practices and, in turn, patient outcomes. **Objective:** To evaluate adherence to sedation and analgesia protocols in a tertiary care ICU and to determine their impact on clinical outcomes. **Study Design:** Observational analytical study. **Settings:** Intensive Care Unit, Nishtar Hospital, Multan, Pakistan. **Duration of Study:** January to June 2025. **Methods:** Ninety adult ICU patients receiving sedation and/or analgesia were enrolled. Adherence was measured using a composite score that incorporated documentation of sedation assessment with the Richmond Agitation-Sedation Scale (RASS), pain assessment using CPOT or NRS, clearly defined sedation targets, consistent dose titration, and daily sedation interruption when clinically indicated. Based on overall scores, patients were categorized into high, moderate, or low adherence groups. Primary outcomes were ICU mortality and ICU length of stay. Secondary outcomes included duration of mechanical ventilation, incidence of delirium, ventilator-associated pneumonia, and re-intubation. Multivariable logistic regression was performed to adjust for age, APACHE II score, mechanical ventilation status, and vasopressor use. **Results:** The mean age of participants was 51.6 ± 15.2 years, and 62.2% were male. High adherence to sedation and analgesia protocols was observed in 48.9% of patients, moderate adherence in 31.1%, and low adherence in 20.0%. Compared with low adherence, high adherence was associated with shorter median duration of mechanical ventilation (3 vs 6 days, $p < 0.001$), reduced ICU length of stay (4 vs 9 days, $p < 0.001$), lower incidence of delirium (20.5% vs 50.0%, $p = 0.019$), and decreased ICU mortality (6.8% vs 27.8%, $p = 0.028$). After adjustment for potential confounders, high adherence remained independently associated with lower ICU mortality (adjusted odds ratio 0.21, 95% CI 0.05–0.89) and reduced delirium (adjusted odds ratio 0.30, 95% CI 0.10–0.92). **Conclusion:** Structured, nurse-led adherence to sedation and analgesia protocols was independently associated with improved ICU outcomes, including lower mortality, reduced delirium, and shorter mechanical ventilation duration. Strengthening nurse training, standardized documentation, and consistent protocol implementation may improve critical care outcomes in tertiary care hospitals in Pakistan.

Keywords: Analgesia, Conscious Sedation, Critical Care, Intensive Care Units, Patient Outcome Assessment

INTRODUCTION

In modern intensive care units (ICUs), the management of sedation and analgesia is a pivotal aspect of patient care, particularly for those requiring mechanical ventilation. The implementation of well-defined sedation and analgesia protocols is crucial as these guidelines aim to optimize patient comfort, prevent complications, and enhance overall outcomes (1-3). Sedation is not merely a comfort measure; it significantly impacts physiological stability and the effectiveness of mechanical ventilation. The inappropriate management of sedation and analgesia can lead to oversedation, which is associated with increased risks of mechanical ventilation complications, longer ICU stays, and higher morbidity and mortality rates (4-7).

Recent studies underscore the quantifiable benefits of adhering to sedation protocols. For example, Zuber et al. reported that adherence to quality indicators for sedation, analgesia, and delirium management in Germany resulted in significant reductions in length of stay and costs associated with ICU care (6). Furthermore, Puttiteerachot et al. demonstrated that the use of structured protocols can significantly reduce mechanical ventilation duration and improve patient comfort in pediatric populations (8). These findings highlight the crucial role of structured protocols in mitigating the adverse effects of ICU stays, particularly in mechanically ventilated patients. Despite the documented benefits of protocol adherence, implementation varies across settings. Wang et al. indicated that barriers to effective protocol

implementation include a lack of staff training and resources, as well as cultural differences in perceptions of sedation (7-9). Additionally, it has been noted that adherence inconsistencies occur not only due to individual clinician practices but also to systemic challenges within healthcare institutions (10). This variability indicates a pressing need for continuous education and reinforcement of sedation strategies among ICU staff, including doctors and nurses.

In Pakistan, the context of sedation management is complicated by limited healthcare resources and variable training among ICU personnel. Meraj et al. emphasized that in resource-limited settings, the lack of trained practitioners, combined with high patient volumes, exacerbates the challenges of effectively implementing sedation protocols (9). Consequently, these factors can lead to delayed pain management interventions, resulting in prolonged patient discomfort and extended hospital stays, which are detrimental to patient outcomes (11). Notably, adherence to these evidence-based practices is essential, especially in high-stress environments such as ICUs, where optimal sedation and analgesia can significantly improve recovery trajectories and overall healthcare outcomes.

The rationale for this study stems from the pressing need to assess the adherence to sedation and analgesia protocols and their subsequent impact on patient outcomes within the Pakistani healthcare system. As the prevalence of mechanical ventilation grows, understanding the relationship between protocol adherence and clinical outcomes becomes more critical, particularly given resource constraints. It is

essential to contextualize these findings within the unique functionalities of healthcare delivery in Pakistan, where enhanced training, adherence to protocols, and effective sedation management can meaningfully contribute to patient recovery, reduce complications, and improve the overall efficiency of ICU care.

METHODOLOGY

This observational analytical study was conducted in the intensive care unit of Nishtar Hospital in Pakistan over six months from January to June 2025. Adult patients aged 18 years or older admitted to the ICU and receiving sedation and/or analgesia as part of routine care were assessed for adherence to the unit’s sedation and analgesia protocols and for key intensive care outcomes. Patients with an ICU stay of less than 24 hours, those admitted for palliative end-of-life care only, and patients with incomplete clinical records precluding assessment of protocol adherence were excluded. A sample size of 90 was selected to allow stable estimation of adherence prevalence and to examine associations with common ICU outcomes, while accounting for local admission volumes and feasibility within the study period.

Data were collected using a structured proforma from medical records, bedside charts, medication administration logs, and nursing documentation. Baseline variables included age, gender, admission category (medical/surgical/trauma), comorbidities, primary diagnosis, need for invasive mechanical ventilation, vasopressor use, and severity of illness at admission, measured using APACHE II and SOFA scores documented within the first 24 hours. Protocol adherence was evaluated using a composite adherence score based on predefined indicators aligned with standard ICU sedation-analgesia care processes: documentation of sedation assessment using a validated sedation scale (e.g., RASS) at the recommended frequency, documentation of a target sedation goal, documentation of pain assessment using an appropriate pain scale (e.g., CPOT for non-communicative patients or NRS for communicative patients), timely titration of sedative/analgesic infusions according to protocol after assessments, and performance of daily sedation interruption or sedation-lightening trials among eligible mechanically ventilated patients. Where delirium monitoring was part of unit practice, delirium screening documentation was also captured. Each indicator was coded as adherent or non-adherent using prespecified operational definitions, and an overall adherence category was derived by summing indicators and classifying patients into high, moderate, or low adherence based on the percentage of indicators met.

Primary outcomes included ICU mortality and ICU length of stay. Secondary outcomes included duration of mechanical ventilation, delirium during ICU stay, ventilator-associated pneumonia, unplanned extubation, and re-intubation within 48 hours. Delirium was defined based on documented clinical diagnosis or, when available in the record, validated tool documentation. Ventilator-associated pneumonia and other complications were defined using standard clinical documentation and antibiotic initiation patterns consistent with unit criteria. Outcomes were abstracted by trained data collectors and cross-verified by a second reviewer to reduce misclassification.

Data were analyzed using SPSS. Continuous variables were assessed for distribution and summarized as mean ± standard deviation for normally distributed data and median with interquartile range for non-normally distributed data. Categorical variables were summarized as frequencies and percentages. Comparisons across adherence categories were performed using the chi-square or Fisher’s exact test for categorical variables and the one-way ANOVA or Kruskal–Wallis test for continuous variables, as appropriate. For adjusted analyses, multivariable logistic regression was used for binary outcomes (mortality and delirium), and linear regression (or generalized linear models where appropriate) was used for continuous outcomes (ICU

length of stay and ventilator days). Clinically relevant covariates were included a priori, including age, gender, admission type, APACHE II score, mechanical ventilation, and vasopressor use. Effect sizes were reported as adjusted odds ratios with 95% confidence intervals for logistic models and adjusted beta coefficients with 95% confidence intervals for continuous outcomes. A two-sided p-value of <0.05 was considered statistically significant.

RESULTS

Ninety adult patients admitted to the intensive care unit during July–December at a tertiary care hospital in Pakistan were studied. The mean age was 51.6 ± 15.2 years (range: 18–82), and 56 (62.2%) were male. Most admissions were medical (48.9%), followed by surgical (31.1%) and trauma-related (20.0%). Baseline severity was moderate, with median APACHE II and SOFA scores of 18 (IQR 14–23) and 7 (IQR 5–10), respectively.

Table 1: Baseline demographic and clinical characteristics of the study population (n = 90).

Characteristic	Category	n (%) / Mean ± SD / Median (IQR)
Age (years)	—	51.6 ± 15.2
Gender	Male	56 (62.2)
	Female	34 (37.8)
Admission type	Medical	44 (48.9)
	Surgical	28 (31.1)
	Trauma	18 (20.0)
APACHE II score	—	18 (14–23)
SOFA score	—	7 (5–10)
Mechanical ventilation	Yes	65 (72.2)
	No	25 (27.8)
Vasopressor use	Yes	38 (42.2)
	No	52 (57.8)
ICU length of stay (days)	—	5 (3–9)
Comorbidity burden	≥1 comorbidity	61 (67.8)
	Diabetes mellitus	34 (37.8)
	Hypertension	39 (43.3)
	Chronic kidney disease	12 (13.3)
Primary diagnosis (top)	Sepsis/septic shock	28 (31.1)
	Post-operative care	20 (22.2)
	Acute respiratory failure	16 (17.8)
	Trauma/polytrauma	18 (20.0)
	Other	8 (8.9)

Overall adherence to sedation and analgesia protocols was categorized as high in 44 (48.9%), moderate in 28 (31.1%), and low in 18 (20.0%) patients based on a composite adherence score derived from documented target sedation assessment (RASS), pain assessment (e.g., CPOT/NRS), daily sedation interruption when eligible, and timely titration according to protocol. Documentation compliance was highest for pain assessment (77.8%) and lowest for daily sedation interruption among eligible ventilated patients (46.2%).

Patients in the high-adherence group had better ICU outcomes than those in the low-adherence group, including shorter mechanical ventilation duration, shorter ICU length of stay, lower delirium frequency, and lower ICU mortality. Median ventilator days were 3 (IQR 2–5) in high adherence versus 6 (IQR 4–9) in low adherence (p < 0.001). ICU length of stay was 4 (IQR 3–7) versus 9 (IQR 6–13) days, respectively (p < 0.001). Delirium occurred in 9 (20.5%) patients with high adherence compared with 9 (50.0%) with low adherence (p

= 0.019). ICU mortality was 6.8% in the high-adherence group versus 27.8% in the low-adherence group (p = 0.028).

In multivariable analyses adjusted for age, gender, admission type, APACHE II score, mechanical ventilation, and vasopressor use, high adherence remained independently associated with lower odds of ICU mortality and delirium and a shorter ICU stay. Compared with low adherence, high adherence was associated with reduced odds of ICU mortality (adjusted odds ratio [aOR] 0.21, 95% CI 0.05–0.89, p = 0.034) and delirium (aOR 0.30, 95% CI 0.10–0.92, p = 0.035). High adherence was also associated with a shorter ICU length of stay

(adjusted β = -2.1 days, 95% CI = -3.6 to -0.7, p = 0.004) and fewer ventilator days (adjusted β = -1.6 days, 95% CI = -2.9 to -0.3, p = 0.017).

Process-level analysis indicated that meeting both key documentation elements—sedation target and pain assessment—was associated with clinically meaningful differences in outcomes. Patients with both elements documented (n = 49) had lower delirium (22.4% vs 45.1%, p = 0.028), fewer ventilator days (median 3 vs 5, p = 0.006), and lower ICU mortality (10.2% vs 23.5%, p = 0.091, trend).

Table 2: Protocol adherence indicators and overall adherence category (n = 90)

Indicator	Eligible n	Adherent n (%)
Sedation assessment documented at recommended frequency	90	62 (68.9)
Pain assessment documented at recommended frequency	90	70 (77.8)
Target sedation goal documented (e.g., RASS target)	90	54 (60.0)
Dose titration consistent with protocol after assessment	90	58 (64.4)
Daily sedation interruption performed (if eligible)	52	24 (46.2)
Delirium screening documented (if per unit policy)	90	39 (43.3)
Overall adherence category	—	High 44 (48.9); Moderate 28 (31.1); Low 18 (20.0)

Table 3: Intensive care outcomes by adherence category.

Outcome	High (n = 44)	Moderate (n = 28)	Low (n = 18)	p-value
Ventilator days, median (IQR)*	3 (2–5)	4 (3–7)	6 (4–9)	<0.001
ICU length of stay (days), median (IQR)	4 (3–7)	6 (4–10)	9 (6–13)	<0.001
Delirium, n (%)	9 (20.5)	9 (32.1)	9 (50.0)	0.019
Unplanned extubation, n (%)	1 (2.3)	1 (3.6)	2 (11.1)	0.169
Ventilator-associated pneumonia, n (%)	4 (9.1)	4 (14.3)	5 (27.8)	0.083
Re-intubation within 48 h, n (%)	2 (4.5)	2 (7.1)	3 (16.7)	0.159
ICU mortality, n (%)	3 (6.8)	4 (14.3)	5 (27.8)	0.028

*Among mechanically ventilated patients.

Table 4: Multivariable models assessing the independent impact of adherence on ICU outcomes

Outcome	Measure	High adherence (n=44)	Moderate adherence (n=28)
ICU mortality	aOR (95% CI), p	0.21 (0.05–0.89), 0.034	0.44 (0.12–1.64), 0.220
Delirium	aOR (95% CI), p	0.30 (0.10–0.92), 0.035	0.58 (0.22–1.55), 0.280
ICU length of stay (days)	Adjusted β (95% CI), p	-2.1 (-3.6 to -0.7), 0.004	-1.0 (-2.6 to 0.6), 0.210
Ventilator days	Adjusted β (95% CI), p	-1.6 (-2.9 to -0.3), 0.017	-0.8 (-2.1 to 0.5), 0.230

Table 5: Outcomes by completion of core protocol documentation elements

Outcome	Both documented (n = 49)	One/none documented (n = 41)	p-value
Ventilator days, median (IQR)*	3 (2–6)	5 (3–8)	0.006
ICU length of stay, median (IQR)	5 (3–8)	7 (4–11)	0.012
Delirium, n (%)	11 (22.4)	19 (45.1)	0.028
ICU mortality, n (%)	5 (10.2)	10 (24.4)	0.091

*Among mechanically ventilated patients

DISCUSSION

The results of our study on adherence to sedation and analgesia protocols among ICU patients demonstrate significant disparities in outcomes by level of adherence. Comparing our findings with the existing literature highlights both confirmations of earlier studies and introduces novel insights into the importance of structured sedation management, particularly within the Pakistani healthcare context. Our study encompassed 90 ICU patients with a mean age of 51.6 years, predominantly medical admissions (48.9%), followed by surgical (31.1%) and trauma-related (20.0%) cases. The median APACHE II score of 18 (IQR 14–23) reflects a moderate severity profile, consistent with previous literature indicating similar severity scores in ICU settings (12, 13). Notably, the prevalence of comorbidities among our cohort (67.8% with at least one comorbidity)

mirrors findings from Wu et al., in which a high burden of comorbidities was associated with increased mortality (14). This underscores the need for tailored sedation and analgesia protocols that account for underlying medical conditions.

Our findings revealed that overall adherence to sedation and analgesia protocols was categorized as high in 48.9% of patients. This contrasts with findings from Liang et al., who reported higher adherence rates in certain ICU settings due to the implementation of structured care bundles (15). In our study, documentation compliance for pain assessment was notably higher (77.8%) than for daily sedation interruption (46.2%), highlighting an area for improvement. Consistently low adherence to daily sedation interruption among eligible patients has been documented in other studies, pointing to systemic issues that may contribute to reduced protocol compliance (12, 16).

The implications of high versus low adherence are striking. Patients in the high-adherence category demonstrated significantly reduced median ventilator days (3 vs. 6 days, $p < 0.001$) and lower ICU mortality (6.8% vs. 27.8%, $p = 0.028$), aligning with previous research that has emphasized that adherence to sedation and analgesia guidelines is associated with improved clinical outcomes (17, 18). For instance, studies have shown that effective sedation management can mitigate the risks of delirium and ICU length of stay (13, 19).

Our results indicate that patients in the high-adherence group not only had shorter mechanical ventilation durations but also a markedly lower incidence of delirium (20.5% vs. 50.0%, $p = 0.019$). These findings are corroborated by recent investigations that link optimal sedation practices with reduced delirium rates, thereby improving overall ICU quality and patient safety (20, 21). Specifically, National guidelines emphasize the need for regular delirium assessments as part of comprehensive sedation management (22). The significant difference in delirium incidence across adherence levels supports recommendations for robust monitoring and intervention strategies (14, 16).

Moreover, multivariable analyses showed that high adherence to sedation protocols was associated with reduced odds of ICU mortality (aOR 0.21, 95% CI 0.05–0.89), mirroring studies advocating adherence to guidelines to enhance survival among critically ill patients (21). This is critical, as managing sedation effectively can ultimately lead to decreased opioid use and improved pain control, as noted by recent literature (23).

Our process-level analysis indicated that documenting both sedation goals and pain assessments was associated with meaningful differences in outcomes. Specifically, patients with both documentation elements had significantly fewer ventilator days and lower delirium rates (22.4% vs 45.1%, $p = 0.028$). Similar observations have been reported in studies examining best practices in sedation management, underscoring the importance of comprehensive documentation to ensure optimal care delivery (24, 25). Moreover, our findings concur with Dallı et al.'s assertion that improving compliance with the ABCDEF bundle components markedly enhances patient outcomes (26).

In Pakistan, unique healthcare challenges, including resource constraints and variable clinician experience, make it imperative to emphasize adherence to sedation and analgesia protocols (9, 10). Enhancing educational initiatives and systematic audits can promote adherence to sedation protocols. This approach is vital for improving ICU outcomes, particularly as indicators such as reduced mechanical ventilation days, lower mortality rates, and lower delirium prevalence are essential to patient recovery trajectories in a limited-resource setting.

Understanding the implications of our findings in the context of Pakistan underscores the need to develop tailored protocols; this is particularly crucial given the healthcare system's limited capacity amid higher patient loads. As evidenced by Meraj et al., local adaptations of international guidelines reflect the need for culturally relevant strategies to foster optimal clinical practices in sedation and pain management (9-11).

Our study highlights the critical relationship between adherence to sedation and analgesia protocols and improved patient outcomes in the ICU. By aligning local practices with established international guidelines and focusing on education and documentation, the quality of care for critically ill patients in Pakistan can be significantly enhanced.

CONCLUSION

High adherence to sedation and analgesia protocols was significantly associated with improved intensive care outcomes, including reduced mechanical ventilation duration, shorter ICU stay, lower delirium incidence, and lower ICU mortality. As nurses are central to sedation

assessment, pain monitoring, documentation, and medication titration, strengthening nurse-led protocol implementation and continuous education may enhance patient safety and recovery in resource-limited critical care settings. These findings support prioritizing structured sedation practices as an integral component of quality improvement initiatives in Pakistani tertiary care ICUs.

DECLARATIONS

Data Availability Statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned. (IRBEC-NMCU-023/25)

Consent for publication

Approved

Funding

Not applicable

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

SAJIDA PERVEEN (Head Nurse)

Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, and final approval of manuscript.

Manuscript drafting.

FARZANA YASMEEN

Manuscript revisions, critical input.

Data entry, data analysis, and article drafting.

MUHAMMAD AMER (Professor)

Conception of Study, Final approval of manuscript.

Study Design, Review of Literature.

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