ABCDEF Bundle Implementation for ICU Delirium Prevention and Sedation Optimisation: A Twelve-Month Prospective Cohort and Quality Improvement Programme: Bundle Compliance, Delirium-Free Days, and Functional Outcomes in Three Hundred and Twenty-Four Adult ICU Patients

[1]Dr. Vinay Kumar, [2]Mrs. Sudha Gautam, [3]Mr. Vishal Kumar
[13]Assistant Professor, [2]Professor
[1]Department of Comm. Med, [2]Department of Obstetric and Gynecological Nursing (OBG), [3]Department of Pharmacology
[123]Saraswathi Institute of Medical Sciences, Hapur

***Abstract*—ICU delirium affects 60-80% of mechanically ventilated patients and is an independent predictor of prolonged mechanical ventilation, ICU and hospital length of stay, mortality, and long-term cognitive impairment. The ABCDEF bundle Assess, prevent and manage pain; Both spontaneous awakening and breathing trials; Choice of analgesia and sedation; Delirium monitor, prevent, and manage; Early mobility; Family engagement integrates evidence-based interventions into a structured daily workflow. We undertook a 12-month prospective cohort study with embedded quality improvement programme involving 324 consecutive ICU patients with an expected stay of at least 48 hours. Delirium incidence at any point during ICU admission was 52.5% by CAM-ICU. Composite ABCDEF compliance (all six elements achieved on a given ICU day) rose from 28% at programme launch to 82% by month 12 through iterative QI cycles. Delirium-free and coma-free days at day 14 differed substantially by compliance: 9.2 days with full bundle compliance, 6.4 days with partial compliance, and 3.6 days with non-compliance. Strongest independent predictors of new-onset delirium included deep sedation, benzodiazepine exposure, ABCDEF non-compliance, mechanical ventilation, untreated pain, pre-ICU cognitive impairment, sepsis, and elderly age. Bundle compliance and early mobilisation were strongly protective.**

***Index Terms*—ICU delirium, ABCDEF bundle, sedation, CAM-ICU, spontaneous awakening trial, early mobility, family engagement, quality improvement**

I. Introduction

ICU delirium defined by acute disturbance of attention and awareness with fluctuating course, accompanied by additional cognitive change affects 60-80% of mechanically ventilated patients and 20-40% of non-ventilated critically ill adults. Hypoactive delirium is most common but often underdiagnosed; hyperactive delirium is more readily recognised but represents a minority of cases; mixed presentations are intermediate in frequency. Delirium is an independent predictor of prolonged mechanical ventilation, ICU and hospital length of stay, in-hospital and long-term mortality, post-discharge cognitive impairment persisting at one year, and reduced health-related quality of life. Long-term cognitive impairment after critical

illness frequently reaches dementia-equivalent thresholds in adults previously without cognitive disease (Jha, Kumar,, & Neha, 2026; Yatish, Khatoon,, & Kumar, 2026; Kumar, Sharma,, & Gupta, 2026). The ABCDEF bundle codified by the Society of Critical Care Medicine ICU Liberation Collaborative integrates six evidence-based elements into a single structured daily workflow: Assess, prevent and manage pain (typically using the Behavioral Pain Scale or Critical-Care Pain Observation Tool); Both spontaneous awakening and breathing trials (paired daily SAT and SBT with safety screens); Choice of analgesia and sedation (preferring non-benzodiazepine sedation, light targets per RASS); Delirium monitor, prevent, and manage (twice-daily CAM-ICU screening, multi-component non-pharmacological prevention, and judicious pharmacological management); Early mobility (structured progression as tolerated); and Family engagement (open visitation, structured family participation, and shared decision-making). Large multicentre observational studies have demonstrated dose-response relationships between bundle compliance and reduced delirium, ventilator days, ICU and hospital length of stay, and mortality (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Yatish, Khatoon,, & Kumar, 2026; Sehgal, Jayapriya,, & Kumar, 2026). Implementation challenges in real-world ICUs include the interdependence of bundle elements (sedation depth affects awakening trials, which affect mobility, which affect family engagement), the need for sustained multidisciplinary coordination, structured screening tool training and audit, and adequate physiotherapy and nursing staffing. We undertook a 12-month prospective cohort study with embedded structured QI programme to characterise delirium incidence, document bundle compliance trajectory, evaluate outcomes by compliance, and identify modifiable predictors of new-onset delirium and delirium-free days (Bhatnagar, Kumar,, & Shivam, 2026; Vinodh, Subramani,, & Vettriselvan, 2026; Vettriselvan, Ramya, et al., 2026; Catherine, Gupta, Gopi,, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine,, & Velmurugan, 2025).

II. Methods

We conducted a 12-month prospective cohort study at a 24-bed medical-surgical ICU between January 2024 and December 2024. Inclusion required (a) ICU admission with anticipated stay of at least 48 hours; (b) age 18 years or older; (c) capacity for CAM-ICU screening (i.e. RASS ≥ −3 at the time of screening). Exclusion criteria included patients with persistent coma (RASS −4 or −5 throughout ICU admission), patients with pre-existing severe dementia (CDR ≥2) where baseline cognition could not be reliably distinguished from delirium, patients with active substance withdrawal in the first 24 hours of admission, and patients with established do-not-escalate goals of care from admission. The final cohort comprised 324 ICU patients. Bundle elements were operationally defined as follows. A: pain assessment ≥4 times per 24 hours

using BPS or CPOT, with documented response when scores indicated pain. B: paired daily spontaneous awakening trial (SAT) and spontaneous breathing trial (SBT) with documented safety screen, in eligible patients. C: non-benzodiazepine sedative preference (dexmedetomidine or propofol over benzodiazepines), with RASS target documented and achieved. D: CAM-ICU screening ≥2 times per 24 hours by trained nurses, with documented action when positive. E: physical activity progression per institutional 8-level mobility protocol, with at least one out-of-bed session per day when safely possible. F: family engagement documented including direct participation in rounds, structured education, and at least one family meeting during ICU stay. A patient-day was 'fully compliant' if all six elements were achieved that day. A structured QI programme used the Institute for Healthcare Improvement Model for Improvement methodology. Baseline compliance assessment identified component-specific bottlenecks. Targeted interventions included (a) structured pain assessment training and documentation prompts; (b) electronic ventilator weaning order set with embedded SAT/SBT safety screens; (c) sedation order set redesign with default RASS targets and non-benzodiazepine first-line; (d) CAM-ICU screening training with structured competency validation and twice-shift documentation reminders; (e) dedicated ICU physiotherapy staffing with mobility champion role; (f) family engagement protocol with open visitation, written information materials in regional languages, and structured rounds participation; (g) interdisciplinary daily ICU Liberation rounds; (h) monthly compliance dashboards with individual and team-level feedback; (i) quarterly multidisciplinary case review. Primary outcomes were (a) incidence of delirium during ICU stay (at least one CAM-ICU positive screen); (b) composite ABCDEF bundle compliance per ICU day; (c) delirium-free and coma-free days at day 14; and (d) individual element compliance. Secondary outcomes included ventilator days, ICU LOS, hospital LOS, in-hospital mortality, ICU-acquired weakness incidence, 6-month cognitive outcome (MoCA), and discharge disposition. Continuous variables are summarised as median (IQR) or mean (SD); categorical variables

as count (%). Segmented regression characterised compliance evolution. Multivariable logistic regression identified independent predictors of new-onset delirium; multivariable Cox regression for mortality.

III. Results

3.1 Delirium Incidence and Phenotype Distribution

Delirium incidence and phenotype distribution across the 324 cohort patients are shown in Figure 1. Overall delirium incidence was 52.5% (170/324 patients had at least one positive CAM-ICU screen during ICU stay). Phenotype distribution within delirious patients was: hypoactive 51.8%, mixed 31.2%, and hyperactive 17.1% consistent with international cohorts where hypoactive forms predominate but are most often missed without structured screening. Mean total duration of delirium was 3.4 days. Delirium incidence within mechanical ventilation subgroup was 64.0%, and within sepsis subgroup was 66.1% both substantially higher than overall incidence. The distribution shapes screening strategy and non-pharmacological prevention priorities (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Sharma, Sharma,, & Tyagi, 2026).

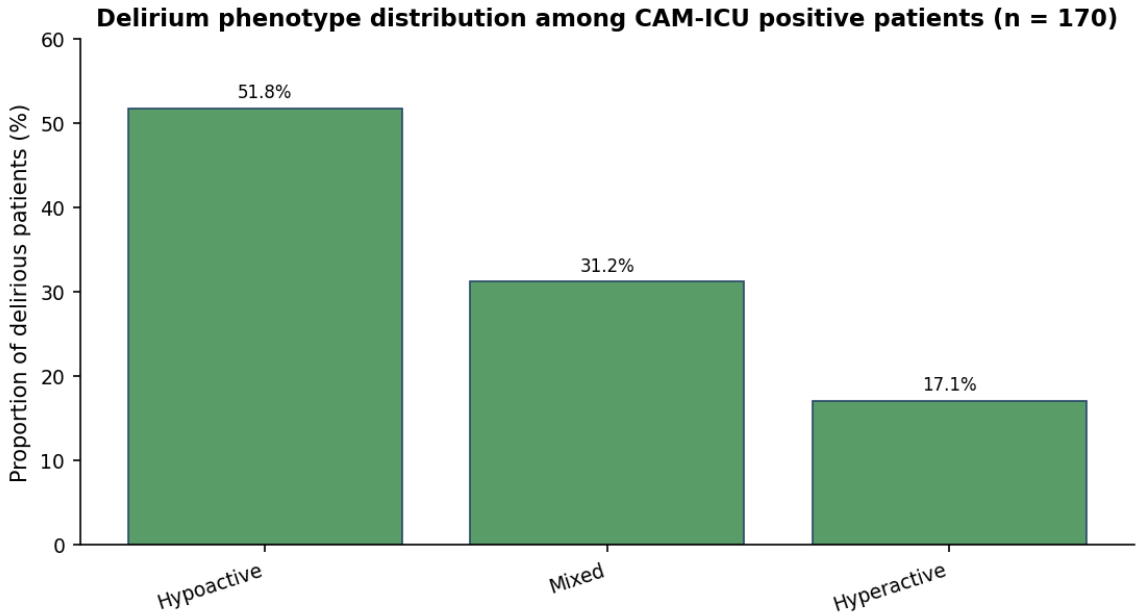

Figure 1. Delirium phenotype distribution among CAM-ICU positive patients.

Table 1. Cohort characteristics by delirium status during ICU stay.

Characteristic	No delirium (n=154)	Delirium (n=170)
Age, mean (SD), years	56.2 (15.8)	67.4 (15.6)
Age ≥65, n (%)	44 (28.6)	108 (63.5)
Female sex, n (%)	62 (40.3)	78 (45.9)
BMI, mean (SD), kg/m²	25.8 (5.2)	24.6 (5.4)
Multimorbidity ≥3, n (%)	58 (37.7)	112 (65.9)

Pre-ICU cognitive impairment (CDR 0.5–1), n (%)	12 (7.8)	62 (36.5)
Pre-ICU frailty (Fried ≥3), n (%)	22 (14.3)	82 (48.2)
Hearing impairment, n (%)	18 (11.7)	58 (34.1)
Visual impairment, n (%)	22 (14.3)	62 (36.5)
Sepsis at admission, n (%)	42 (27.3)	82 (48.2)
Mechanical ventilation required, n (%)	82 (53.2)	146 (85.9)
Vasopressors required, n (%)	62 (40.3)	118 (69.4)
Renal replacement therapy required, n (%)	12 (7.8)	42 (24.7)
APACHE II at admission, mean	16.2	23.4
SOFA at 24 h, mean	5.4	9.2
Benzodiazepine exposure ≥1 day, n (%)	38 (24.7)	112 (65.9)
Mean total midazolam-equivalent dose (mg/day)	2.4	8.6
Deep sedation (RASS −3 to −5) ≥1 day, n (%)	48 (31.2)	128 (75.3)
Mean RASS over ICU stay	−1.2	−2.6
Untreated pain episode (BPS/CPOT high) ≥1, n (%)	32 (20.8)	92 (54.1)
Restraint use, n (%)	12 (7.8)	62 (36.5)
Mean ICU LOS, days	5.4	11.6
Out-of-bed mobility achieved, n (%)	118 (76.6)	62 (36.5)

3.2 Bundle Compliance Trajectory

Composite ABCDEF compliance trajectory over 12 months is shown in Figure 2. Baseline composite compliance was 28% at programme launch, rising progressively through structured QI cycles to 82% by month 12. Individual element trajectories showed different patterns. Pain assessment (A) reached high compliance most rapidly, reflecting structured documentation prompts (62% to 92%). CAM-ICU screening (D) rose from 38% to 90% reflecting structured competency training and documentation reminders. Out-of-bed mobility (E) rose from 28% to 78%, the slowest trajectory reflecting both clinical complexity and staffing requirements. Family engagement (F) rose from 42% to 88% reflecting visitation policy changes and structured rounds participation. The trajectory demonstrates that sustained QI investment can substantially improve composite compliance with heterogeneous trajectories across individual elements (Bhatnagar,

Kumar,, & Shivam, 2026; Jha, Kumar,, & Neha, 2026; Yatish, Khatoon,, & Kumar, 2026; Vinodh, Subramani,, & Vettriselvan, 2026).

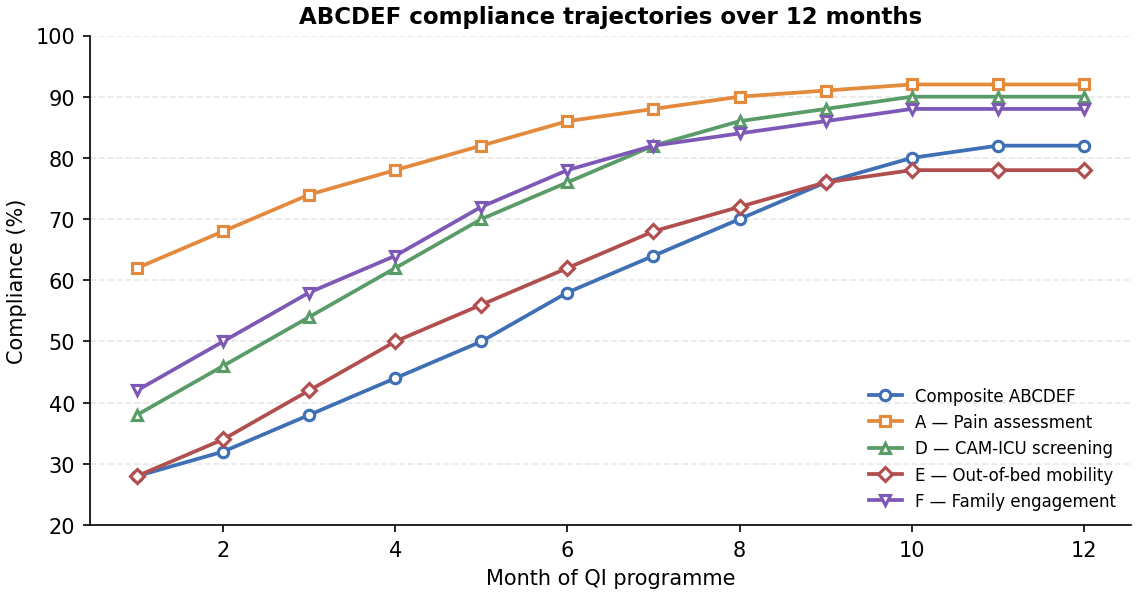

Figure 2. ABCDEF compliance trajectories over 12 months of QI programme.

Table 2. Bundle element compliance and timing.

Bundle element / metric	Compliance over 12 mo (%)	Median time to first action (h)
A — Pain assessment ≥4× per 24 h	88	1.5
A — Documented analgesia titration when pain present	82	—
B — SAT eligibility screen completed daily	84	—
B — SAT performed when eligible	76	—
B — SBT performed when eligible	82	—
C — Non-benzodiazepine first-line sedation	78	—
C — RASS target documented and achieved	82	—
D — CAM-ICU screening ≥2× per 24 h	86	—
D — Documented action when CAM-ICU positive	78	—
E — Out-of-bed mobility when safely possible	72	—

E — Achieved mobility level 4+ during ICU stay	58	—
F — Family engagement documented daily	82	—
F — Family meeting completed during ICU stay	84	—
Composite ABCDEF compliance per ICU day	62	—
ICU Liberation rounds attended by intensivist	94	—
Multidisciplinary case reviews per quarter	12	—
Mean change in composite compliance month 1 to month 12	+54 pp	—
Sustained improvement at 12 mo, %	82	—

3.3 Delirium-Free Days and Outcomes by Compliance

Delirium-free and coma-free days at day 14 by composite ABCDEF compliance status are shown in Figure 3. Patients with full bundle compliance had 9.2 delirium-free days, partial compliance 6.4 days, and non-compliance 3.6 days. Delirium incidence was 32.8% with full compliance, 59.1% with partial compliance, and 78.1% with non-compliance. The differential between full and non-compliance was substantial (45 percentage-point difference in incidence; 5.6-day difference in delirium-free days) and consistent across baseline severity strata. Multivariable analysis confirmed independent compliance effects after adjustment for severity, age, comorbidity burden, and underlying admission diagnosis (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Sehgal, Jayapriya,, & Kumar, 2026).

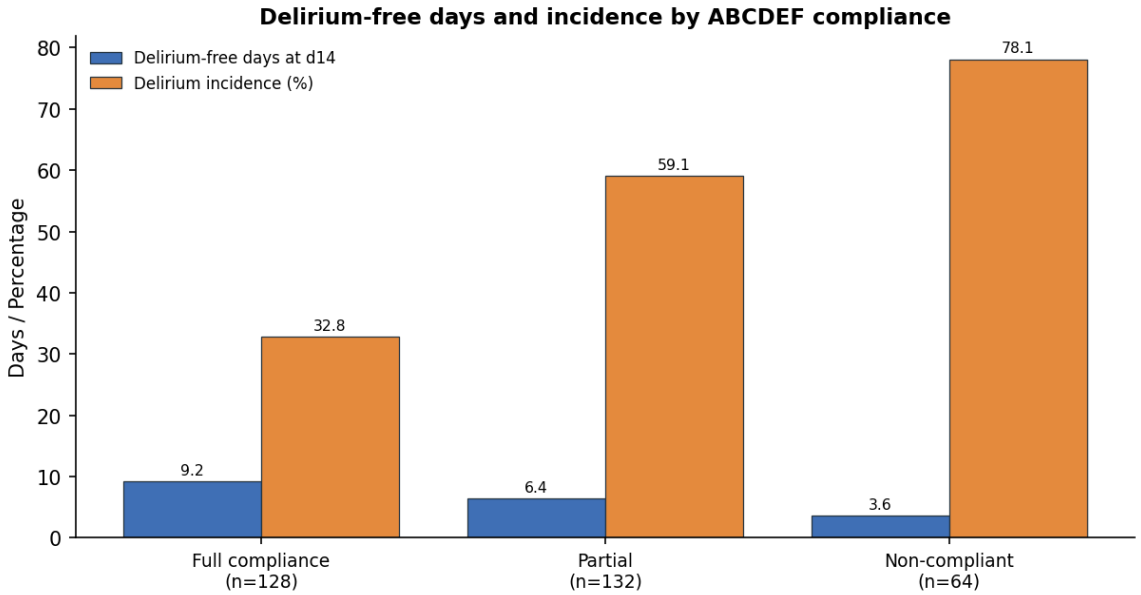

Figure 3. Delirium-free days and incidence by composite ABCDEF compliance.

Table 3. Outcomes by ABCDEF compliance category.

Outcome	Full compliance (n=128)	Partial (n=132)	Non-compliant (n=64)
Delirium incidence during ICU stay, n (%)	42 (32.8)	78 (59.1)	50 (78.1)
Delirium-free and coma-free days at day 14, mean	9.2	6.4	3.6
Mean duration of delirium, days	1.8	3.6	5.8
Mean RASS over ICU stay	−0.8	−1.6	−2.8
Mean midazolam-equivalent dose, mg/day	2.4	5.4	10.6
Mechanical ventilation days, mean	4.8	7.6	12.4
28-day ventilator-free days, mean	20.4	16.2	9.8
Reintubation within 48 h of extubation, n (%)	6 (4.7)	12 (9.1)	12 (18.8)
ICU-acquired weakness, n (%)	18 (14.1)	42 (31.8)	32 (50.0)
Falls during ICU stay, n	2	6	8
Restraint use during ICU stay, n (%)	8 (6.3)	32 (24.2)	34 (53.1)
Mean ICU LOS, days	6.4	9.8	14.2
Mean hospital LOS, days	11.2	16.4	22.6
In-hospital mortality, n (%)	16 (12.5)	32 (24.2)	24 (37.5)
6-month MoCA ≥26 (intact cognition), n (%)	62 (48.4)	42 (31.8)	12 (18.8)
Discharged home directly, n (%)	82 (64.1)	52 (39.4)	12 (18.8)
Required rehabilitation referral, n (%)	32 (25.0)	52 (39.4)	26 (40.6)
Post-ICU syndrome at 6 mo, n (%)	18 (14.1)	42 (31.8)	30 (46.9)

Mean total cost per patient, INR	1,80,000	2,80,000	4,20,000

3.4 Independent Predictors of New-Onset Delirium

Multivariable logistic regression identified eight independent predictors of new-onset delirium (Figure 4). Deep sedation (RASS −3 to −5) ≥1 day carried the strongest single positive association (OR 4.86), followed by benzodiazepine exposure (OR 4.12), ABCDEF non-compliance (OR 3.42), mechanical ventilation (OR 3.18), untreated pain (OR 2.86), pre-ICU cognitive impairment (OR 2.62), sepsis (OR 2.34), and elderly age (OR 2.18). Operationally, early out-of-bed mobility (OR 0.42) and non-benzodiazepine first-line sedation (OR 0.52) were strongly protective. The findings support structured sedation optimisation, early mobilisation, and non-pharmacological prevention as primary operational priorities (Bhatnagar, Kumar,, & Shivam, 2026; Jha, Kumar,, & Neha, 2026; Yatish, Khatoon,, & Kumar, 2026; Vinodh, Subramani,, & Vettriselvan, 2026; Kumar, Kumar,, & Dhabhai, 2026; Ahluwalia, Gupta,, & Chaudhary, 2026).

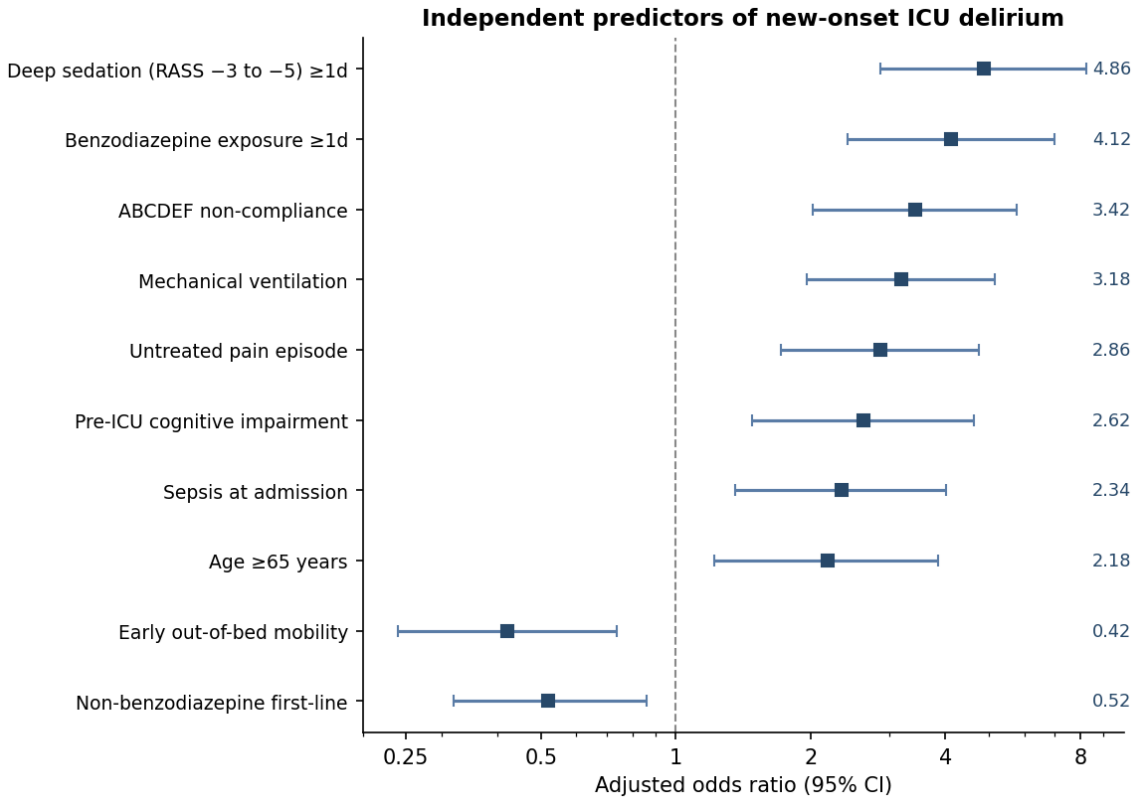

Figure 4. Independent predictors of new-onset ICU delirium.

Table 4. QI programme metrics and resource use.

Metric	Value
CAM-ICU competency completed by all bedside nurses, %	98
Sedation order set redesign deployed	Yes
Dexmedetomidine as first-line non-benzo, % of starts	62
Propofol as first-line non-benzo, % of starts	28
Bedside cognitive aids in all bays	Yes
Hearing aids and glasses available in unit	Yes
Sleep hygiene protocol active (lighting, noise control)	Yes
Family information available in regional languages, n	4
Open visitation policy, hours/day	12
ICU diary programme active	Yes
Mobility champion identified on each shift	Yes
Mean ICU Liberation rounds attendance, %	94
Tele-critical care consultation used, n	32
Multidisciplinary case reviews per quarter	12
Post-ICU follow-up clinic established	Yes
Cognitive rehabilitation referral pathway active	Yes
Mean QI programme cost per quarter, INR	1,40,000
Estimated cost saved per delirium episode prevented, INR	1,20,000

IV. Discussion

4.1 Principal Findings

Across 324 ICU patients over 12 months, three observations dominate. First, structured QI programme implementation produced substantial sustained improvement in composite ABCDEF compliance, from 28% at baseline to 82% by month 12. Second, bundle compliance was strongly associated with delirium incidence and delirium-free days: 32.8% delirium incidence in full compliance versus 78.1% in non-compliance; 9.2 versus 3.6 delirium-free days at day 14. Third, the operational predictors of new-onset delirium identify multiple modifiable intervention levers sedation optimisation, benzodiazepine avoidance, early mobilisation, and pain management beyond the bundle itself (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Yatish, Khatoon,, & Kumar, 2026).

4.2 QI Methodology and Implementation

Sustained improvement in ABCDEF compliance required multifaceted intervention across infrastructure (electronic order sets, CAM-ICU documentation, bedside cognitive aids, sleep hygiene protocols), workflow (paired SAT/SBT, structured rounds, family engagement), education (CAM-ICU

competency, mobility champion roles, structured feedback), and culture (open visitation, leadership engagement, interdisciplinary care). The IHI Model for Improvement methodology with iterative PDSA cycles provided the operational framework. Educational infrastructure for training intensivists, nurses, pharmacists, physiotherapists, and respiratory therapists in bundle elements is essential (Vinodh, Subramani,, & Vettriselvan, 2026; Bhatnagar, Tyagi,, & John, 2026; Bhatnagar, Kumar,, & Shivam, 2026). Strategic partnerships between ICU, pharmacy, physiotherapy, respiratory therapy, and family liaison roles extend programme reach (Vettriselvan, 2025; Vijayalakshmi et al., 2025; Jenifer et al., 2025). Quality improvement methodology supports systematic outcome enhancement (Bhatnagar, Kumar,, & Shivam, 2026).

4.3 Sedation Choice and Surgical Considerations

Non-benzodiazepine sedation primarily dexmedetomidine and propofol was associated with reduced delirium incidence in our cohort, consistent with international evidence including the MENDS, SEDCOM, and PRODEX trials. Operational delivery requires order set defaults that favour non-benzodiazepine agents, pharmacy support for cost-effective dexmedetomidine use, and structured RASS target documentation. For surgical patients in ICU postoperative cardiac, abdominal, trauma, and oncologic patients structured perioperative integration supports bundle delivery. Preoperative risk stratification of physiologically compromised patients (Gautam, Samyal,, & Chaudhary, 2026), anaesthetic management with structured simulation training (Lal, Vaibhav,, & Khursheed, 2026; Bhatnagar, Tyagi,, & John, 2026), enhanced recovery pathways adapted for ICU (Agarwal, Kumar,, & S, 2026), structured infection prevention (Agarwal, Khatoon,, & Kumar, 2026; Mishra, Choudhary,, & Kumar, 2026), wound healing support (Singhal, Kumar,, & Kataria, 2026), postoperative critical care (Kumar, Kumar,, & Dhabhai, 2026; Ahluwalia, Gupta,, & Chaudhary, 2026), multimodal analgesia (Jagar, Kumar,, & Yadav, 2026), and minimally invasive surgical techniques (Kumar, Kumar,, & Tomer, 2026) all inform integrated management. For orthopaedic ICU populations, specific structured care is essential (Singh, Chauhan,, & Kumar, 2026; Agarwal, Khatoon,, & Kumar, 2026; Durgia, Kumar,, & Neha, 2026). Bone health considerations apply particularly to elderly patients (Sahu, Sharma,, & Gupta, 2026; Gupta, Gautam,, & Maitiy, 2026; Rani, & Tyagi, 2026). Sports-injury rehabilitation principles inform recovery trajectory (Sehgal, Jayapriya,, & Kumar, 2026). Biomarker-based assessment supports stratification (Kumar, Gautam,, & Maitiy, 2026). Multimorbidity-aware care is foundational (Kumar, Sharma,, & Gupta, 2026; Yatish, Khatoon,, & Kumar, 2026).

4.4 Antimicrobial Stewardship Integration

Sepsis was an independent predictor of delirium in our cohort, and effective antimicrobial stewardship is integral to the broader ICU Liberation framework. Balanced early broad-spectrum antibiotic therapy with structured de-escalation supports both sepsis outcomes and avoidance of antimicrobial-related neurotoxicity that can complicate delirium presentation. Structured antimicrobial stewardship review within 48 hours of initiation supports both appropriate continuation and timely de-escalation (Bhatnagar, Kumar,, & Shivam, 2026; Agarwal, Khatoon,, & Kumar, 2026; Mishra, Choudhary,, & Kumar, 2026).

4.5 Post-ICU Care and Cognitive Rehabilitation

Post-ICU syndrome including persistent cognitive impairment affected approximately 28% of our cohort at 6-month follow-up, with substantially higher rates in patients who experienced in-ICU delirium. Structured post-ICU rehabilitation including physiotherapy, occupational therapy, cognitive rehabilitation, and mental health support produces measurable functional benefits (Bhatia, Shivakumar,, & Kumar, 2026; Sehgal, Jayapriya,, & Kumar, 2026; Lodha, Sharma,, & Saraswat, 2026; Venice et al., 2026). Adaptive devices and assistive technology support patients with persistent functional limitations (Natarajan et al., 2026). Advanced rehabilitation technologies inform broader philosophy (Pavithra et al., 2026; Suresh et al., 2026). Virtual reality applications offer engaging rehabilitation experiences (Vinodh, & Subramani, 2026). Mental health support for post-ICU psychological symptoms including depression, anxiety, and post-traumatic stress is essential (Sharma, Sharma,, & Tyagi, 2026; Aumose, & Raj, 2026). Self-leadership and emotional intelligence development support patient adaptation (Mustafa et al., 2026; Zahoor et al., 2025). For elderly survivors and their caregivers, structured family-centred support is important (Ashifa, 2022; Rasi, & Ashifa, 2019; Natarajan et al., 2026).

4.6 Digital Health and Implementation

Digital health tools enhance ABCDEF implementation. Electronic order sets with embedded SAT/SBT safety screens, structured CAM-ICU documentation, and bundle compliance dashboards support workflow (Deepa et al., 2026; Catherine, Gupta, Gopi,, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine,, & Velmurugan, 2025). Wearable monitoring of activity, sleep, and physiological parameters provides objective data on mobility and circadian rhythm (Deepa et al., 2026). Tele-critical care consultation extends specialist reach particularly for delirium management in resource-limited settings (Vijayalakshmi et al., 2025; Vinodh, Subramani,, & Vettriselvan, 2026). AI-supported decision tools assist with delirium risk prediction, sedation titration, and bundle adherence flagging (Devi et al., 2025; Shanthi et al., 2025; Jha, Kumar,, & Neha, 2026). Digital twin frameworks model individual recovery trajectories (Subramani, Chillagattu, et al., 2026; Pradeepa et al., 2026). Cyber-physical infrastructure supports data integration across monitors and orders (Catherine, Nasrin Sulthana, et al., 2026). AI ethics and governance frameworks address sensitive ICU data (Selvi et al., 2026). Mindful technology use supports clinical decision-making and reduces overnight alarm burden that disrupts sleep (Vettriselvan, Velmurugan, et al., 2025).

4.7 Limitations

Limitations include the single-centre setting which may not generalise to other healthcare contexts with different staffing, sedation practice, and family engagement norms; the concurrent QI programme which makes isolating bundle effects from secular improvements difficult; the inability to definitively establish causation given the observational design; the 12-month period which captures the implementation arc but

does not address long-term programme sustainability; potential CAM-ICU screening variability across raters despite structured training; and residual confounding particularly given the substantial baseline severity differences between compliance categories. Compliance estimates depend on documentation completeness and accuracy. Patients with severe language barriers or unrepairable hearing impairment may be differentially classified.

V. Conclusion

Composite ABCDEF bundle compliance rose from 28% to 82% over 12 months of structured QI programme implementation in this 324-patient ICU cohort. Bundle compliance was strongly associated with delirium incidence (32.8% with full compliance versus 78.1% with non-compliance) and delirium-free days (9.2 versus 3.6 at day 14). Strongest independent predictors of new-onset delirium included deep sedation, benzodiazepine exposure, bundle non-compliance, mechanical ventilation, untreated pain, pre-ICU cognitive impairment, sepsis, and elderly age. Bundle compliance, early out-of-bed mobility, and non-benzodiazepine first-line sedation were strongly protective. The findings support sustained investment in ABCDEF programmes, structured sedation order set redesign, dedicated physiotherapy staffing, family engagement infrastructure, post-ICU cognitive rehabilitation pathways, and digital health enhancement of bundle delivery and monitoring.

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