CHEST Online Supplement

The Effect of a Quality Improvement Intervention on Sleep and Delirium in Critically Ill Patients in a Surgical ICU

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CHEST® Online Supplement

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e-Appendix 1. Supplemental Methods

1. Daily Sleep/Wake Intervention Bundle Checklist

Text Section and Item Name	Section or Item Description	Location in Manuscript (Page)
Title and Abstract		
1. Title	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patient- centeredness, timeliness, cost, efficiency, and equity of healthcare)	Page 1
2. Abstract	a. Provide adequate information to aid in searching and indexing b. Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local 2roject2, methods, interventions, results, conclusions	Page 4
Introduction	**Why did you start?**	
3. Problem Description	Nature and significance of the local problem	Page 5
4. Available Knowledge	Summary of what is currently known about the 2roject2, including relevant previous studies	Page 5
5. Rationale	Informal or formal frameworks, models, concepts, and/or theories used to explain the 2roject2, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work	Page 6
6. Specific Aims	Purpose of the 2roject and of this report	Page 5, 6
Methods	**What did you do?**	
7. Context	Contextual elements considered important at the outset of introducing the intervention(s)	Pages 5, 6
8. Intervention(s)	a. Description of the intervention(s) in sufficient detail that others could reproduce it b. Specifics of the team involved in the work	Pages 6, 7, 8
9. Study of the Intervention(s)	a. Approach chosen for assessing the impact of the intervention(s) b. Approach used to establish whether the observed outcomes were due to the intervention(s)	Pages 7, 8, Supplement
10. Measures	a. Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability b. Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost c. Methods employed for assessing completeness and accuracy of data	Pages 7, 8
11. Analysis	a. Qualitative and quantitative methods used to draw inferences from the data b. Methods for understanding variation within the data, including the effects of time as a variable	Pages 8, 9, 10
12. Ethical Considerations	Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential 2roject2o(s) of interest	Page 7
Results	**What did you find?**	
13. Results	a. Initial steps of the intervention(s) and their evolution over time (e.g., time-line diagram, flow chart, or table), including modifications made to the intervention during the 2roject b. Details of the process measures and outcome c. Contextual elements that interacted with the intervention(s) d. Observed associations between outcomes, interventions, and relevant contextual elements e. Unintended consequences such as unexpected benefits, problems, failures, or costs associated with the intervention(s) f. Details about missing data	Pages 10, 11, 12
Discussion	**What does it mean?**	
14. Summary	a. Key findings, including relevance to the rationale and specific aims b. Particular strengths of the project	Page 12-15

2. SQUIRE Checklist

Text Section and Item Name	Section or Item Description	Location in Manuscript (Page)
Title and Abstract		
1. Title	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patient- centeredness, timeliness, cost, efficiency, and equity of healthcare)	Page 1
2. Abstract	c. Provide adequate information to aid in searching and indexing d. Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions	Page 4
Introduction	**Why did you start?**	
3. Problem Description	Nature and significance of the local problem	Page 5
4. Available Knowledge	Summary of what is currently known about the problem, including relevant previous studies	Page 5
5. Rationale	Informal or formal frameworks, models, concepts, and/or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work	Page 6
6. Specific Aims	Purpose of the project and of this report	Page 5, 6
Methods	**What did you do?**	
7. Context	Contextual elements considered important at the outset of introducing the intervention(s)	Pages 5, 6
8. Intervention(s)	a. Description of the intervention(s) in sufficient detail that others could reproduce it b. Specifics of the team involved in the work	Pages 6, 7, 8
9. Study of the Intervention(s)	a. Approach chosen for assessing the impact of the intervention(s) b. Approach used to establish whether the observed outcomes were due to the intervention(s)	Pages 7, 8, Supplement
10. Measures	d. Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability e. Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost f. Methods employed for assessing completeness and accuracy of data	Pages 7, 8
11. Analysis	a. Qualitative and quantitative methods used to draw inferences from the data b. Methods for understanding variation within the data, including the effects of time as a variable	Pages 8, 9, 10
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Results	**What did you find?**	
13. Results	g. Initial steps of the intervention(s) and their evolution over time (e.g., time-line diagram, flow chart, or table), including modifications made to the intervention during the project h. Details of the process measures and outcome i. Contextual elements that interacted with the intervention(s) j. Observed associations between outcomes, interventions, and relevant contextual elements k. Unintended consequences such as unexpected benefits, problems, failures, or costs associated with the intervention(s) l. Details about missing data	Pages 10, 11, 12
Discussion	**What does it mean?**	
14. Summary	a. Key findings, including relevance to the rationale and specific aims b. Particular strengths of the project	Page 12-15

3. Sleep quality improvement intervention implementation

The sleep quality improvement (QI) intervention was modeled from a previous published effort.[1] The ICU sleep QI team was led by one physician (JET) and one nurse practitioner student (AD), who was a senior nurse within the CVICU. Additionally, the team consisted of a nurse director who previously was a senior nurse in the SICU (JB), and 6 additional sleep champions from the two ICUs. Sleep champions included experienced nurses and aids. The team was advised by a delirium QI expert (BK).

The team began meeting and planning study implementation >12 months prior to QI start. First, modifications to the previously published effort were made based on identification of barriers to sleep identified through a Plan-Do-Study-Act (PDSA) process.[2] As the 2018 Pain, Agitation/Sedation, Delirium, Immobility, and Sleep (PADIS) had not yet been published,[3] we collaborated with an ICU sleep expert (BK) who provided detailed input and feedback on candidate interventions. Based on prior sleep and delirium efforts, a bundled approach was adopted to facilitate the delivery of multiple similar interventions (i.e., turning off lights and televisions) simultaneously. The PDSA process was vital for fine-tuning non-pharmacological interventions, for example in identifying that baths and room restocking were occurring at night and should be conducted during daytime hours. The PDSA process was also used to evaluate ICU medications often prescribed for sleep. As prior interventions demonstrated that melatonin, trazodone, antipsychotics, propofol, and opiates were often given to patients for sleep, our effort involved gathering information regarding use of these common ICU medications. As candidate interventions were identified, they were evaluated for feasibility via conversations with ICU nurses, senior aids and physicians.

Once data collection began, fliers to introduce the QI intervention were distributed throughout the unit. The QI intervention involved demonstrating an interest in ICU patients' sleep quality without introducing best practices for sleep or encouraging behavior modification. Over the weekend preceding intervention implementation, the study team held lunchtime and evening education sessions for staff in both ICUs to introduce the idea of improving the sleep environment. During these meetings the QI checklist was introduced. At the start of the intervention, emails went out to all ICU staff and physicians to introduce the QI intervention and asynchronously provide educational materials. Additional emails were sent from nursing managers and medical directors of each ICU.

To facilitate intervention implementation, a prompting checklist was provided to all staff providing recommendations with specific interventions to facilitate sleep. Throughout the intervention period, sleep champions arrived early for most day shifts (7-8am) in order to talk to night shift nurses about overnight issues that prevented successful implementation of sleep interventions, to encourage completion of forms, and bring feedback to the team. During the intervention period, the sleep QI team held weekly meetings and frequent informal meetings to discuss barriers to implementation, feedback, and review completion rates of interventions and forms. The sleep QI effort was also discussed at weekly interdisciplinary conferences for each Unit along with monthly nurse education sessions.

4. Model Selection

a. Primary Outcome: Pre- versus Post-Intervention Delirium

Delirium rate was summarized for each patient for their first admission. Secondary analyzes, including the joint modeling and sensitivity analyses, were at the admission level. Among 646 patients, there were 720 encounters, of which 705 contained at least one day with a delirium assessment. Fourteen encounters involved inter-unit transfers and were adjudicated with manual chart review and assigned to "CVICU." As missing data was minimal, we used case-wise deletion for our multivariable model, yielding 695 encounters for inclusion in our multivariable model.

The primary outcome was the percentage of ICU days patients experienced at least one delirium episode, out of the total days with a delirium assessment (exposure days, i.e. days with delirium divided by total ICU days delirium assessed), up to 14 days. Absolute days with delirium is reported in **Table 2**. Encounters with more than 14 exposure days were truncated after day 14. As described in the main text, we used a simple multivariable linear regression model to estimate the absolute difference in the mean percentage of days with delirium comparing the post- and pre-intervention period, with and without adjustment for *a priori* specified patient characteristics. While binomial regression is more common for modelling these types of data, this approach would counter our goal of weighing each encounter equally regardless of length of ICU stay, a variable that could potentially be associated with delirium status.

Due to a skewed outcome distribution, 95% confidence intervals for the unadjusted and adjusted absolute difference were estimated using a bootstrap procedure based on sampling the patients with replacement 2,000 times and computing the bias-corrected and accelerated 95% confidence interval (BCa CIs). P-values came from a generalized estimating equations (GEE) model under an independence correlation structure with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity).[4,5]

b. Sensitivity Analysis: Joint Frailty Model for Delirium

Delirium was also modeled as a recurrent event using a joint frailty model, where termination of exposure by either death or ICU discharge was modeled simultaneously (terminal event), as has been advocated for assessment ICU delirium.[6] For each day with delirium assessment (exposure day), if at least one assessment was positive, then that day was recorded as an event. Days with no assessment were considered non-exposure days and were excluded, and for each encounter, the patient was observed until death or discharge from the ICU, or was censored after 14 assessment days. For encounters with recurrent and terminal event on the same day, the death/discharge event was moved to the next half day, as we assumed the patient experienced delirium before death/discharge. Covariates were included if they were associated with the outcome in univariate analysis below the level of 0.1. Hazard functions were assumed to follow a Weibull distribution. These analyses were conducted using the R *frailtypack* package.[7]

5. Data Sharing

To facilitate research reproducibility, replicability, accuracy and transparency, the datasets generated and/or analyzed during the current study, and the associated analytic code, will be made available indefinitely, following publication, to anyone who wishes to access the data for analysis, on the Open Science Foundation[8] (OSF) repository, DOI 10.17605/OSF.IO/27RSP at [https://osf.io/27rsp]. Data were de-identified in accordance with Section 164.514 of the Health Insurance Portability and Accountability Act (HIPAA).

e-Appendix 2. Supplemental Results

e-Table 1. Implementation of Sleep Quality Improvement Interventions	N=932 patient day/nights[a]
Variable	
Blinds raised	797 (93%)[b]
Caffeine avoided after 3pm	497 (59%)
Less than 50% of day shift spent napping	496 (70%)
Room lights dimmed	851 (93%)
Room curtain closed	845 (93%)
Warm bath before 10pm	564 (63%)
Unnecessary alarms prevented	874 (96%)
Room temperature optimized	888 (98%)
Pain appropriately contained	831 (92%)
Television off	696 (77%)
Estimated number of nurse interruptions between 10pm-7am	
0-5	239 (47%)
6-10	185 (37%)
>10	81 (16%)
Eye masks offered and accepted	19 (2%)
Earplugs offered and accepted	22 (3%)
Hallway lights dimmed	884 (99%)
Effort to decrease noise	800 (93%)
Eyeglasses, hearing aids applied	346 (40%)
Mobility / upright chair position daily	495 (58%)
Minimize RN interruptions after 22:00	765 (86%)
Medication given for sleep	
hydromorphone	1 (0.1%)
fentanyl	10 (1%)
oxycodone	13 (1%)
haloperidol	10 (1%)
quetiapine	48 (5%)
propofol	11 (1%)
melatonin	147 (16%)
Nurse station quiet	867 (97%)
Stop sign placed on patient's door	823 (93%)

[a] Per filtering, excludes data from washout period and from patients who overlapped periods

[b] Checklist items were considered negative if not filled out.

Sensitivity Analysis

e-Table 2. Joint Frailty Model for ICU Delirium and Death/ICU discharge[a]

Variable	Hazard Ratio (95% CI)	*P* value
Delirium		
Intervention vs. Pre-Intervention	0.79 (0.62 to 0.99)	0.043
SICU vs. CVICU	2.50 (1.09 to 5.72)	0.030
Admission Category vs. Cardiology		
Trauma/General Surgery	0.79 (0.33 to 1.88)	0.60
Cardiothoracic Surgery	1.62 (1.13 to 2.31)	0.008
Coma at first ICU assessment vs. None	2.06 (1.57 to 2.71)	<0.001
Death or ICU discharge		
Intervention vs. Pre-Intervention	0.90 (0.74 to 1.09)	0.26
Age, per year	1.11 (1.01 to 1.22)	0.033
Charlson Comorbidity Index, per point	0.85 (0.76 to 0.94)	0.002
Admission Category vs. Cardiology		
Trauma / General Surgery	1.07 (0.83 to 1.39)	0.59
Cardiothoracic Surgery	0.73 (0.56 to 0.96)	0.026
Coma at first ICU assessment vs. None	0.71 (0.55 to 0.91)	0.007

Abbreviations: ICU = intensive care unit, CI = confidence interval, SICU = surgical intensive care unit, CVICU = cardiovascular intensive care unit

[a] For each day with delirium assessment (exposure day), if at least one assessment was positive, then that day was recorded as an event. Delirium modeled as a recurrent event, with termination of exposure by death or ICU discharge modeled simultaneously (terminal event). Days with no assessment were considered non-exposure days and were excluded, and for each encounter, the patient was observed until death or discharge from the ICU, or was censored after 14 assessment days. For encounters with recurrent and terminal event on the same day, the death/discharge event was moved to the next half day, as we assumed the patient experienced delirium before death/discharge. Covariates were included if they were associated with the outcome in univariate analysis below the level of 0.1. Hazard functions were assumed to follow a Weibull distribution.

e-Table 3. Adjusted risk of delirium, using all exposure days[a]

Variable	Coefficients (95% CI)	*P*-value	Bootstrap CI
Intervention vs. Pre-Intervention	-4.7% (-8.8 to -0.5)	0.03	-4.7% (-9.0 to -0.8)
Age, per year	0.2% (0.0 to 0.3)	0.01	
Female vs. Male Sex	1.7% (-2.7 to 6.0)	0.46	
Other vs. White Race	6.4% (0.2 to 12.5)	0.04	
Charlson Comorbidity Index, per point	0.6% (-0.2 to 1.4)	0.11	
Home sleep medication, Yes vs. No	-2.8% (-7.4 to 1.8)	0.23	
SICU vs. CVICU	3.1% (-7.6 to 13.8)	0.57	
Admission category vs. General/Trauma Surgery			
Cardiology	-6.1% (-16.8 to -4.6)	0.26	
Cardiothoracic Surgery	-3.3% (-14.0 to 7.4)	0.55	
Coma at first ICU assessment vs. None	20.6% (13.7 to 27.5)	<0.001	

Abbreviations: CCI = Charlson Comorbidity Index, SICU = surgical intensive care unit, ICU = intensive care unit, CVICU = cardiovascular intensive care unit

[a] Values represent percentage of days with a positive delirium assessment during an admission, among all days of the ICU stay that delirium was assessed. *P* values calculated using linear regression with generalized estimating equations (GEE) under an independence correlation structure and with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity). 95% confidence intervals estimated using bootstrap percentile method with 2,000 samples. Delirium percentage data missing for 7 (2%) and 8 (2%) of pre-intervention and intervention patients, respectively.

e-Table 4. Adjusted risk of delirium, up to 7 days exposed[a]

Variable	Coefficients (95% CI)	*P*-value	Bootstrap CI
Intervention vs. Pre-Intervention	-4.9% (-9.3 to -0.6)	0.03	-4.9% (-9.3 to -0.5)
Age, per year	0.1% (0.0 to 0.3)	0.046	
Female vs. Male Sex	2.5% (-2.1 to -7.0)	0.29	
Other vs. White Race	7.7% (1.2 to 14.1)	0.02	
Charlson Comorbidity Index, per point	0.8% (0.0 to 1.6)	0.07	
Home sleep medication, Yes vs. No	-2.3% (-7.2 to 2.6)	0.36	
SICU vs. CVICU	3.4% (-7.2 to 14.0)	0.53	
Admission category vs. General/Trauma Surgery			
Cardiology	-7.4% (-18.0 to 3.2)	0.17	
Cardiothoracic Surgery	-2.9% (-13.6 to 7.7)	0.59	
Coma at first ICU assessment vs. None	23.3% (15.9 to 30.7)	<0.001	

Abbreviations: CCI = Charlson Comorbidity Index, SICU = surgical intensive care unit, ICU = intensive care unit, CVICU = cardiovascular intensive care unit

[a] Values represent percentage of days with a positive delirium assessment during an admission, among the first 7 days of the ICU stay that delirium was assessed. *P* values calculated using linear regression with generalized estimating equations (GEE) under an independence correlation structure and with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity). 95% confidence intervals estimated using bootstrap percentile method with 2,000 samples. Delirium percentage data missing for 7 (2%) and 8 (2%) of pre-intervention and intervention patients, respectively.

e-Table 5. Adjusted risk of delirium, up to 21 days exposed[a]

Variable	Coefficients (95% CI)	*P*-value	Bootstrap CI
Intervention vs. Pre-Intervention	-4.7% (-8.9 to -0.6)	0.03	-4.7% (-8.8 to -0.7)
Age, per year	0.2% (0.0 to 0.3)	0.02	
Female vs. Male Sex	1.8% (-2.6 to 6.2)	0.42	
Other vs. White Race	6.7% (0.5 to 13.0)	0.04	
Charlson Comorbidity Index, per point	0.7% (-0.1 to 1.5)	0.11	
Home sleep medication, Yes vs. No	-2.8% (-7.4 to 1.8)	0.23	
SICU vs. CVICU	3.0% (-7.7 to 13.7)	0.58	
Admission category vs. General/Trauma Surgery			
Cardiology	-6.3% (-17.0 to 4.4)	0.25	
Cardiothoracic Surgery	-3.0% (-13.7 to 7.8)	0.59	
Coma at first ICU assessment vs. None	21.0% (13.9 to 27.9)	<0.001	

Abbreviations: CCI = Charlson Comorbidity Index, SICU = surgical intensive care unit, ICU = intensive care unit, CVICU = cardiovascular intensive care unit

[a] Values represent percentage of days with a positive delirium assessment during an admission, among the first 21 days of the ICU stay that delirium was assessed. *P* values calculated using linear regression with generalized estimating equations (GEE) under an independence correlation structure and with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity). 95% confidence intervals estimated using bootstrap percentile method with 2,000 samples. Delirium percentage data missing for 7 (2%) and 8 (2%) of pre-intervention and intervention patients, respectively.

e-Table 6. Adjusted risk of delirium *or coma*, up to 14 days exposed[a]

Variable	Coefficients (95% CI)	*P*-value	Bootstrap CI
Intervention vs. Pre-Intervention	-5.4% (-9.5 to -1.4)	0.001	-5.4% (-9.3 to -1.2)
Age, per year	0.1% (0.0 to 0.2)	0.15	
Female vs. Male Sex	1.0% (-3.3 to 5.2)	0.65	
Other vs. White Race	6.8% (0.8 to 12.9)	0.03	
Charlson Comorbidity Index, per point	0.8% (0.0 to 1.6)	0.04	
Home sleep medication, Yes vs. No	-4.0% (-8.6 to 0.7)	0.09	
SICU vs. CVICU	2.7% (-7.4 to 12.8)	0.60	
Admission category vs. General/Trauma Surgery			
Cardiology	-6.9% (-17.0 to 3.3)	0.19	
Cardiothoracic Surgery	-3.9% (-14.0 to 6.2)	0.45	
Coma at first ICU assessment vs. None	42.9% (37.1 to 48.7)	<0.001	

Abbreviations: CCI = Charlson Comorbidity Index, SICU = surgical intensive care unit, ICU = intensive care unit, CVICU = cardiovascular intensive care unit

[a] Values represent percentage of days with a positive delirium or coma assessment during an admission, among the first 7 days of the ICU stay that delirium/coma were assessed. *P* values calculated using linear regression with generalized estimating equations (GEE) under an independence correlation structure and with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity). 95% confidence intervals estimated using bootstrap percentile method with 2,000 samples. Delirium/Coma percentage data missing for 2 (1%) and 2 (1%) of pre-intervention and intervention patients, respectively.

e-Table 7. Joint frailty model for ICU delirium *or coma* and death/ICU discharge[a]		
Variable	**Hazard Ratio (95% CI)**	***P* value**
Delirium		
Intervention vs. Pre-Intervention	0.83 (0.68 to 1.01)	0.06
SICU vs. CVICU	2.28 (1.10 to 4.73)	0.03
Admission Category vs. Cardiology		
Trauma/General Surgery	0.73 (0.34 to 1.56)	0.42
Cardiothoracic Surgery	1.43 (1.06 to 1.91)	0.02
Coma at first ICU assessment vs. None	3.25 (2.57 to 4.10)	<0.001
Death or ICU discharge		
Intervention vs. Pre-Intervention	0.92 (0.76 to 1.11)	0.38
Age, per year	1.11 (1.01 to 1.22)	0.04
Charlson Comorbidity Index, per point	0.84 (0.75 to 0.93)	<0.001
Admission Category vs. Cardiology		
Trauma / General Surgery	1.08 (0.83 to 1.40)	0.57
Cardiothoracic Surgery	0.74 (0.56 to 0.97)	0.03
Coma at first ICU assessment vs. None	0.54 (0.41 to 0.72)	<0.001

Abbreviations: ICU = intensive care unit, CI = confidence interval, SICU = surgical intensive care unit, CVICU = cardiovascular intensive care unit

[a] For each day with delirium assessment (exposure day), if at least one assessment was positive, then that day was recorded as an event. Delirium modeled as a recurrent event, with termination of exposure by death or ICU discharge modeled simultaneously (terminal event). Days with no assessment were considered non-exposure days and were excluded, and for each encounter, the patient was observed until death or discharge from the ICU, or was censored after 14 assessment days. For encounters with recurrent and terminal event on the same day, the death/discharge event was moved to the next half day, as we assumed the patient experienced delirium before death/discharge. Covariates were included if they were associated with the outcome in univariate analysis below the level of 0.1. Hazard functions were assumed to follow a Weibull distribution.

e-Table 8. Adjusted risk of delirium within the first 14 days exposed, excluding non-operative patients[a,b]

Variable	Coefficients (95% CI)	*P*-value	Bootstrap CI
Intervention vs. Pre-Intervention	-5.6% (-10.5 to -0.7)	0.03	-5.6% (-10.5 to -1.0)
Age, per year	0.1% (0.0 to 0.3)	0.10	
Female vs. Male Sex	2.5% (-2.6 to 7.7)	0.33	
Other vs. White Race	5.2% (-2.1 to 12.4)	0.16	
Charlson Comorbidity Index, per point	0.4% (-0.6 to 1.4)	0.44	
Home sleep medication, Yes vs. No	-2.5% (-8.1 to 3.1)	0.39	
SICU vs. CVICU	4.1% (-6.9 to 15.0)	0.47	
Admission category vs. General/Trauma Surgery			
Cardiothoracic Surgery	-1.6% (-12.5 to 9.2)	0.77	
Coma at first ICU assessment vs. None	20.6% (13.2 to 28.1)	<0.001	

Abbreviations: CCI = Charlson Comorbidity Index, SICU = surgical intensive care unit, ICU = intensive care unit, CVICU = cardiovascular intensive care unit

[a] Excluding cardiology patients who underwent invasive but non-surgical procedures necessitating ICU admission (i.e., coronary catheterization, intra-aortic balloon pump placement)

[b] Values represent percentage of days with a positive delirium assessment during an admission, among the first 14 days of the ICU stay that delirium was assessed. *P* values calculated using linear regression with generalized estimating equations (GEE) under an independence correlation structure and with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity). 95% confidence intervals estimated using bootstrap percentile method with 2,000 samples.

e-Table 9. Adjusted risk of delirium, within the first 14 days exposed, excluding avoidable coma[a,b]

Variable	Coefficients (95% CI)	*P*-value	Bootstrap CI
Intervention vs. Pre-Intervention	-4.8% (-9.0 to -0.6)	0.03	-4.8% (-9.1 to -0.8)
Age, per year	0.1% (0.0 to 0.3)	0.04	
Female vs. Male Sex	2.3% (-2.1 to 6.7)	0.30	
Other vs. White Race	6.3% (0.1 to 12.5)	0.048	
Charlson Comorbidity Index, per point	0.7% (-0.1 to 1.5)	0.08	
Home sleep medication, Yes vs. No	-2.4% (-7.1 to 2.3)	0.32	
SICU vs. CVICU	3.5% (-6.8 to 13.9)	0.50	
Admission category vs. General/Trauma Surgery			
Cardiology	-7.1% (-17.4 to 3.2)	0.18	
Cardiothoracic Surgery	-2.4% (-12.7 to 8.0)	0.66	
Coma at first ICU assessment vs. None	19.6% (12.5 to 26.7)	<0.001	

Abbreviations: CCI = Charlson Comorbidity Index, SICU = surgical intensive care unit, ICU = intensive care unit, CVICU = cardiovascular intensive care unit

[a] Excluding patients with coma on first ICU assessment who then achieved a SAS ≥2 during the first 48 hours of ICU

[b] Values represent percentage of days with a positive delirium assessment during an admission, among the first 14 days of the ICU stay that delirium was assessed. *P* values calculated using linear regression with generalized estimating equations (GEE) under an independence correlation structure and with robust Huber-White sandwich standard errors to account for variance across subjects (heteroscedasticity). 95% confidence intervals estimated using bootstrap percentile method with 2,000 samples.

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