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A Quality Improvement Evaluation of a Primary As-Needed Light Sedation Protocol in Mechanically Ventilated Adults

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Objectives: First, to implement successfully a light-sedation protocol, favoring initial as-needed (prioritizing as-needed) boluses over continuous infusion sedation, and second, to evaluate if this protocol was associated with differences in patient-level sedative requirements, clinical outcomes, and unit-level longitudinal changes in pharmacy charges for sedative medications.

Design: Retrospective review comparing patients who received the prioritizing as-needed sedation protocol to similar patients eligible for the prioritizing as-needed protocol but treated initially with continuous infusion sedation.

Setting: Thirty-two bed medical ICUs in a large academic medical center.

Patients: A total of 254 mechanical ventilated patients with a target Riker Sedation-Agitation Scale goal of 3 or 4 were evaluated over a 2-year period. Of the evaluable patients, 114 received the prioritizing as-needed sedation protocol and 140 received a primary continuous infusion approach.

Interventions: A multidisciplinary leadership team created and implemented a light-sedation protocol, focusing on avoiding initiation of continuous sedative infusions and prioritizing prioritizing as-needed sedation.

Measurements and Main Results: Overall, 42% of patients in the prioritizing as-needed group never received continuous infusion sedation. Compared with the continuous infusion sedation group, patients

treated with the prioritizing as-needed protocol received significantly less opioid, propofol, and benzodiazepine. Patients in the prioritizing as-needed group experienced less delirium, shorter duration of mechanical ventilation, and shorter ICU length of stay. Adverse events were similar between the two groups. At the unit level, protocol implementation was associated with reductions in the use of continuous infusion sedative medications.

Conclusions: Implementation and use of a prioritizing as-needed protocol targeting light sedation appear to be safe and effective. These single-ICU retrospective findings require wider, prospective validation.

Key Words: critical care; delirium; implementation; intensive care unit; mechanical ventilation; sedation

Every year in the United States, more than 750,000 patients develop acute respiratory failure requiring invasive mechanical ventilation (MV) in the ICU, resulting in significant morbidity and mortality (1). Many MV patients receive continuous infusions (CIs) of IV analgesics and sedatives; exposure to high doses of CI sedation is associated with worse outcomes (2, 3). Minimizing sedation in the ICU has proven to be safe and to facilitate more rapid liberation from MV (3–9).

Guidelines encourage ICU clinicians to minimize sedation by interrupting sedative infusions on a daily basis (10). A complementary approach is to avoid initiating CI sedation in the first place. Indeed, an “as-needed” (PRN) bolus sedation strategy might better match the pharmacokinetics of analgosedative medications to the dynamic condition of ICU patients (11). In a single-center study, management without CI sedation resulted in shorter duration of MV (12). There was no mortality benefit in a subsequent NONSEDA multicenter trial, although this trial was limited by significant crossover between arms (13).

In an effort to improve outcomes and reduce costs at a local level, we designed and implemented a light sedation protocol favoring PRN boluses over CI sedation in a tertiary-care medical ICU (MICU). In order to understand better the impact of this

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“PRN protocol” and potential for dissemination to other ICUs in our health system, we evaluated whether the PRN protocol was associated with differences in patient-level sedative administration and secondary clinical outcomes, in addition to unit-level longitudinal changes in pharmacy charges.

MATERIALS AND METHODS

Design and Setting

We performed a retrospective quality improvement (QI) evaluation with two components: 1) a comparative cohort analysis of sedative use and clinical outcomes among patients eligible for the PRN protocol who were treated with a primary as-needed approach, compared with contemporaneous patients who were eligible for the PRN protocol but treated primarily with CI sedation and 2) a before-and-after analysis comparing unit-level pharmacy charges before and after implementation of the PRN protocol. The intervention occurred in the 32-bed MICU of UPMC Presbyterian Hospital, a large academic ICU with residents and fellows, standard 1:2 nurse-to-patient staffing, daily interprofessional rounding including two integrated unit-based pharmacists, and a closed intensivist-staffing model.

Data Sources

We obtained patient-level data by prospectively screening the UPMC electronic health record (EHR) (Cerner PowerChart, Cerner Corporation, Kansas City, MO). These data included demographic information, sedation goals, medication administration, and clinical outcomes. We obtained ICU-level data from existing QI reports, including monthly counts for MV days and monthly pharmacy charges for fentanyl, propofol, and midazolam.

Intervention

We leveraged an existing interprofessional QI group to iteratively develop and implement a sedation strategy encouraging early use of PRN medication rather than initial CI sedation for appropriate MV patients. We began piloting the intervention in October 2015, revised and continued testing throughout much of calendar year 2016, and completed universal nursing education on the finalized protocol in January–March 2017. The full PRN protocol is included as Supplemental Digital Content (SDC Fig. S1, <http://links.lww.com/CCX/A415>).

Patients

Patients were eligible for inclusion if they were MV for at least 24 hours, with a goal of 3 or 4 on the Riker Sedation Assessment Scale (SAS) (14). A list of eligibility exclusions is provided in the supplement; these represented situations where a PRN-first approach could be harmful or clinically inappropriate. We assigned patients to the PRN-first group if treating clinicians attempted to use bolus sedation prior to initiation of CI. Patients who were assigned to the PRN group who eventually required CI sedation per the MICU PRN protocol were still considered to be in the PRN sedation group. The full details are provided in the supplement.

Variables

Patient-Level Variables. We reviewed patient records to collect data on baseline characteristics, including age, sex, weight, modified Sequential Organ Failure Assessment score within 24 hours of MICU admission (modified to exclude Glasgow Coma Scale) (15), and admitting diagnosis. We also evaluated clinical outcomes including duration of MV, ICU length of stay (LOS), mortality, and adverse events. MV was defined as time of intubation to time of extubation or removal of ventilatory support for 48 hours for patients with tracheostomies (9). Adverse events were evaluated during ICU admission. Details of the medication data collection are provided in the supplement. We obtained data on Riker SAS (14) and Intensive Care Delirium Screening Checklist (ICDSC) scores (16) as recorded by bedside nurses from the EHR. At our institution, sedation scores are charted every 2 hours if on CI sedation and ICDSC scores are charted twice per nursing shift. We classified Riker scores into three categories—sedated (Riker 2 or lower), goal (Riker 3 or 4), and agitated (Riker 5 or higher). Riker SAS scores were evaluated during the MV period. Sedatives, antipsychotic requirements, and ICDSC scores were evaluated from intubation to ICU discharge, death, or 30 days, whichever came first.

Unit-Level Variables. We used existing reports to capture monthly data on the number of charges for sedative infusions and the total number of patient-days of MV. We normalized monthly sedation charges by dividing by the monthly MV days, to account for the fact that variation in sedative use could simply reflect differences in the number of patient-days requiring sedation for MV. We conducted this separately for each of three medications: fentanyl, propofol, and midazolam. Dexmedetomidine and ketamine are alternative sedatives that are used infrequently in our unit. As such, we did not analyze unit-level data for these medications.

Analysis

Patient-Level Analysis. We characterized differences between patients treated with a primary CI sedation versus PRN protocol using standard summary statistics. We analyzed differences in sedative use and clinical outcomes between the two groups using Mann-Whitney *U* for continuous variables and Fisher exact test for nominal data.

We analyzed differences in sedation level between the groups using mixed-effects logistic regression. We ran three separate models in which the dependent variables were indicators for a sedated Riker, a goal Riker, and an agitated Riker. The exposure was an indicator for treatment with the PRN protocol. We included a patient-specific random effect to account for the fact that there were differences in the number of Riker scores collected for different patients, because institutional standards require more frequent charting of Riker scores while on CI sedation.

We examined the ICDSC scores for each patient to determine the percentage of delirium-free and coma-free days (DFCFD) for each cohort. A detailed description of the DFCFD outcome and analysis is provided in the supplement.

We conducted a sensitivity analysis excluding patients with a transition to comfort measures (CMO), because CMO practices

often involve the administration of CI analgesics—outside the context of analgo-sedation for a MV patient. We also examined trends in protocol adoption in eligible patients over time, the details of which are presented in the supplement.

Unit-Level Analysis. We analyzed changes in unit-level pharmacy charges over time using a before-and-after approach. We fit negative binomial linear regression models in which the dependent variable of interest was the monthly number of charges for a given medication (fentanyl, propofol, or midazolam). The independent variable of interest was admission period—prior to versus after the intervention. The output of the model is an incidence rate ratio (IRR), which estimates the incidence of exposure to CI sedation in before versus after the PRN sedation protocol.

We fit two of these unit-level models with separate exposure terms: one in which the exposure was the number of MV patients per month and one in which the exposure was the number of patient-days of MV per month. The exposure term accounts for the fact that variation in the number of sedation charges can simply result from variation in the number of patients or patient-days of MV. Using an exposure term of patient-days of MV provides a conservative estimate of changes in sedation use, because it accounts for the fact that patients with fewer days of MV may have less CI sedation exposure.

We excluded a washout period of 3 months prior to and 3 months after the initial pilot testing in October 2015, so the pre-intervention period was January 2014 to July 2015 and the post-intervention period was January 2016 to December 2017. Although the formal nursing education did not begin until January 2017, we included unit-level data from 2016 in the postintervention period, because we had prospectively observed significant early adoption throughout the unit during the iterative process of piloting the PRN protocol.

To illustrate visually longitudinal changes in sedation practices, we created statistical process control (SPC) charts, which are a QI tool used to illustrate short- and long-term shifts in quality measures (17, 18).

We conducted two sensitivity analyses evaluating whether our findings could be affected by temporal trends, which can confound before-and-after studies. First, we ran models with an independent variable for MONTH/12, evaluating for the presence of baseline annualized monthly trends in sedation use. Because time-by-period interactions introduce multicollinearity, we did not include this time term in the primary analysis (19). Second, we repeated the before-and-after analysis, restricting time periods to 12 months on either side of the washout.

Analyses were performed using Stata 15.1 (StataCorp, College Station, TX) and SPSS, version 25 (IBM, Armonk, NY). All tests were two-tailed, and we considered a *p* value of less than 0.05 to be statistically significant. The intervention evaluated in this study was designated as a QI by UPMC, as its primary intention was to improve patient care within the UPMC system. Our use of patient records to evaluate the impact of the intervention was reviewed and approved by the UPMC QI Committee (project number 692) under the authority of the University of Pittsburgh institutional review board. We adhered to reporting standards for QI studies outlined in SQUIRE 2.0 (20).

RESULTS

Among 1011 MV patients, 254 were deemed potentially eligible for the PRN protocol. Full details of patient selection are provided in **SDC Figure S2** (<http://links.lww.com/CCX/A415>). Of the potentially eligible patients, 140 received CI sedation primarily and 114 received the PRN protocol. Patients who received the PRN protocol were similar to those who were treated with a primary CI sedation strategy with the exception that patients in the PRN group were older than the control group (67 vs 58 yr, *p* < 0.001), (**Table 1**). Adoption of the protocol increased over time (**SDC Fig. S3**, <http://links.lww.com/CCX/A415>).

Compared with patients treated with a primary CI strategy, those treated with the PRN protocol received significantly less total fentanyl equivalents (227 vs 1,306 µg, *p* < 0.001), propofol (523 vs 1,290 mg, *p* < 0.001), and midazolam equivalents (2.6 vs 3.9 mg, *p* = 0.026) per day of MV. Total sedatives were almost 6- and 2.5-fold lower for fentanyl and propofol, respectively, in the PRN group than the control group. In the PRN group, 42% of patients did not require any continuous sedation during their intubation period (**Table 2**). There was no difference in the use of antipsychotics between the two groups. Post-extubation sedative requirements were similar, with the exception of less fentanyl equivalents in the PRN group (**SCD Table S1**, <http://links.lww.com/CCX/A415>). Treatment with the PRN protocol was associated with a higher percentage of DFCFDs during MV and over ICU duration, compared with the control group (50% vs 33%, *p* = 0.001 and 70% vs 40%, *p* = 0.003, respectively) (**SDC Fig. S4**, <http://links.lww.com/>

TABLE 1. Summary of Patient Demographics from All MICU Patients Included Over the Two-year Period

Variable	Prioritizing As-Needed (n = 114)	Control (n = 140)	<i>p</i>
Age, yr	67 (59–75)	58 (49–66)	< 0.001
Gender, Female	54 (47)	64 (46)	0.790
Weight, kg	81 (67–104)	82.8 (63.4–110.5)	0.962
Medical ICU diagnosis			
Respiratory	78 (68)	100 (71)	0.330
Sepsis (nonrespiratory)	22 (19)	18 (13)	
Cardiovascular	7 (6)	10 (7)	
Gastrointestinal	1 (1)	6 (4)	
Other	6 (5)	6 (4)	
Sequential Organ Failure Assessment score	5 (3–8)	5 (3–8)	0.352
Pao ₂ /Fio ₂ ratio	115 (78–220)	124.5 (88–177.5)	0.596

Data are represented as median (interquartile range) or *n* (%). MICU diagnosis was obtained via electronic health record extraction and review. Sequential Organ Failure Assessment (SOFA) score was calculated based on worst lab values within 24 hours of MICU admission.

TABLE 2. Sedative Administration

Variable	PRN (n = 114)	Control (n = 140)	p
Number of CIs ^a			
0	48 (42)	0 (0)	< 0.001
1	47 (41)	63 (45)	
≥ 2	19 (17)	77 (55)	
Fentanyl			
Number of patients on CI fentanyl (%)	51 (45)	108 (77)	< 0.001
Total PRN, µg	450 (200–800)	450 (200–1,150)	0.379
Duration of CI, hr	30.1 (18–76.7)	84.6 (46.3–134.2)	< 0.001
Fentanyl equivalents from other opioids	125 (60–250)	246.7 (66.7–850)	0.096
Total fentanyl equivalents per MV day ^b	226.8 (118.8–716.5)	1,305.5 (467.7–2,567.5)	< 0.001
Propofol			
Number of patients on CI propofol (%)	26 (23)	88 (63)	< 0.001
Duration of CI, hr	13.1 (6.5–18)	47 (21.3–74.3)	< 0.001
Total mg per MV day	523.4 (187.1–1,552.6)	1,289.8 (604.8–2,912.2)	0.006
Dexmedetomidine			
Number of patients on CI dexmedetomidine (%)	6 (5)	32 (23)	< 0.001
Duration of CI, hr	41.7 (22.6–62.9)	45.9 (24.7–72)	0.719
Total µg per MV day	694.2 (133.7–1,434.4)	394.3 (106–807)	0.471
Ketamine			
Number of patients on CI ketamine (%)	4 (4)	14 (10)	0.052
Duration of CI, hr	22.6 (6.6–33.3)	81.8 (40.7–96.8)	0.019
Total mg per MV day	42.6 (17.6–215.9)	254.6 (102.1–1,018)	0.071
Midazolam			
Number on CI midazolam (%)	4 (4)	14 (10)	0.051
Total PRN, mg	10 (4–24)	14 (6–31)	0.025
Duration of CI, hr	2.4 (1.5–14)	44 (30.4–70.5)	0.008
Equivalents from other benzodiazepines ^c	4 (2–30)	12 (4–30)	0.056
Total equivalents per MV day	2.6 (1.2–6.6)	3.9 (1.7–8.0)	0.026
Antipsychotics ^d (haloperidol equivalents)			
Total, mg	10 (5–30)	8.5 (2–29)	0.697
Total per MV day, mg	1.5 (0.7–4.9)	1.3 (0.4–2.9)	0.207

CI = continuous infusion, MV = mechanical ventilation, PRN = prioritizing as-needed.

Data are represented as median (interquartile range) or n (%).

^aDefined as any continuous sedative (fentanyl, propofol, midazolam, ketamine, and dexmedetomidine) administered during the intubation period.

^bNonfentanyl opioids included hydromorphone, methadone, morphine, oxycodone, or fentanyl patch.

^cNonmidazolam benzodiazepines included alprazolam, chlordiazepoxide, clonazepam, diazepam, or lorazepam.

^dTypical and atypical antipsychotics including aripiprazole, haloperidol, olanzapine, quetiapine, and risperidone.

CCX/A415). Compared with the control group, patients in the PRN protocol also had a shorter duration of MV (3.7 vs 4.8 d, $p = 0.014$) and shorter ICU LOS (6.6 vs 8.8 d, $p = 0.002$), without an increase in adverse events (**Table 3**). The sensitivity analysis excluding patients made CMO after extubation showed

similar results (**SDC Table S2**, <http://links.lww.com/CCX/A415>). Patients in the PRN protocol group were less likely to have sedated Riker scores (odds ratio 0.55, 95% CI [0.30–1.00], $p = 0.05$), but the overall rate of deep sedation was low, and there were no differences in the probability of agitated Riker

TABLE 3. Clinical Outcomes

Outcome	Prioritizing As-Needed	Control	<i>p</i>
Hospital LOS, d	13.9 (8.4–23.7)	17.1 (9.7–27.1)	0.073
Medical ICU LOS, d	6.6 (4.0–9.0)	8.8 (5.3–12.9)	0.002
MV time, d	3.7 (2.0–6.6)	4.8 (2.5–9.2)	0.014
Percentage of DFCCFD during MV	50 (24–86)	33 (3.6–66)	0.001
Percentage of DFCCFD during ICU admission	70 (30–90)	40 (20–70)	0.003
Adverse events	10 (9)	14 (10)	1.0
Line/tube pull	4 (4)	6 (4)	
Self-extubation	6 (5)	8 (6)	
Extubation outcome			
Stable	82 (72)	107 (76)	0.371
Reintubated within 48 hr	11 (10)	16 (11)	
Comfort measures only/terminal	21 (18)	17 (12)	
Tracheostomy	5 (4)	14 (10)	0.10
Hospital mortality	28 (25)	31 (22)	0.66

DFCCFD = delirium free coma free days, LOS = length of stay, MV = mechanical ventilation.

Data are represented as median (interquartile range) or *n* (%).

scores. Full details of the sedation score analyses are provided in the supplement (**SDC Table S3**, <http://links.lww.com/CCX/A415>).

In analyses of unit-level CI sedation use, implementation of the PRN protocol was associated with reductions in charges for all three sedative medications (**Table 4** and **Fig. 1**). Implementation of the PRN protocol was associated with a decreased incidence of the use of CI fentanyl (IRR 0.57, 95% CI [0.49–0.66], $p < 0.001$), propofol (IRR 0.72, 95% CI [0.62–0.84], $p < 0.001$), and midazolam (IRR 0.44, 95% CI [0.34–0.56], $p < 0.001$). Figure 1 depicts SPC charts for each medication, which visually illustrate shifts in sedative utilization normalized to ventilator days associated with the PRN sedation intervention.

In sensitivity analyses, there were no statistically significant longitudinal differences in pharmacy charges in the baseline period (Table 4). When the pre- and postimplementation periods were restricted to the 12 months before and after the washout, there was no longer a difference in propofol use.

DISCUSSION

We conducted a retrospective analysis of a QI initiative prioritizing as-needed (PRN) bolus sedation over CI sedatives. Patients who were treated with the PRN protocol received less total sedation, experienced less deep sedation, had less delirium, and were more rapidly liberated from MV. At a unit level, implementation of the PRN protocol was associated with significant reductions in CI sedation. These results indicate that a PRN protocol for light sedation in MV patients is associated with higher quality and lower

TABLE 4. Association Between Time Period and Sedation Incidence

Sedative	IRR (95% CI)	<i>p</i>
Primary analyses: shift with intervention		
Exposure: ventilated patients		
Fentanyl	0.57 (0.49–0.66)	< 0.001
Propofol	0.72 (0.62–0.84)	< 0.001
Midazolam	0.44 (0.34–0.56)	< 0.001
Exposure: patient-days of ventilation		
Fentanyl	0.64 (0.57–0.72)	< 0.001
Propofol	0.81 (0.70–0.94)	< 0.01
Midazolam	0.49 (0.39–0.61)	< 0.001
Sensitivity analyses		
Preintervention annual trend		
Fentanyl	0.93 (0.80–1.08)	0.36
Propofol	0.88 (0.67–1.15)	0.36
Midazolam	0.82 (0.64–1.04)	0.11
Restricted 12-mo time periods. Exposure: patient-days of ventilation		
Fentanyl	0.72 (0.61–0.84)	< 0.001
Propofol	0.92 (0.76–1.11)	0.37
Midazolam	0.56 (0.42–0.75)	0.001

IRR, incidence rate ratio.

costs, representing a potential high-value approach to managing patients with acute respiratory failure. Our findings have significant implications for patients, clinicians, and ICU administrators in the ICU liberation era (4, 5, 21) and may provide insight into the real-world implementation of PRN sedation protocols.

Several mechanisms might explain our observation that a PRN protocol for sedation was associated with less sedative use and better clinical outcomes. First, patients treated with the PRN protocol received less overall sedation, which may have reduced delirium and improved readiness for spontaneous breathing trials (SBTs) and ICU liberation (3). Second, CI sedation requires that nurses and respiratory therapists coordinate daily spontaneous awakening trials and SBTs, which can be a challenge in a busy unit; simply avoiding CI sedation may therefore remove one barrier to SBT completion and ventilator liberation (21). Evidence-based guidelines and observational data suggest that managing pain, agitation, and delirium facilitates ICU liberation (4, 6, 10). Although these guidelines recommend conducting daily interruptions of CI sedation and avoiding benzodiazepine infusions, our findings suggest that many MV patients can be managed with light sedation without initiating CI sedation. A PRN-based sedation approach allows for patient-driven treatment of underlying agitation, potentially avoiding unnecessary medication administration.

Our results are also important for what they do not demonstrate—namely, we observed no evidence that using as-needed

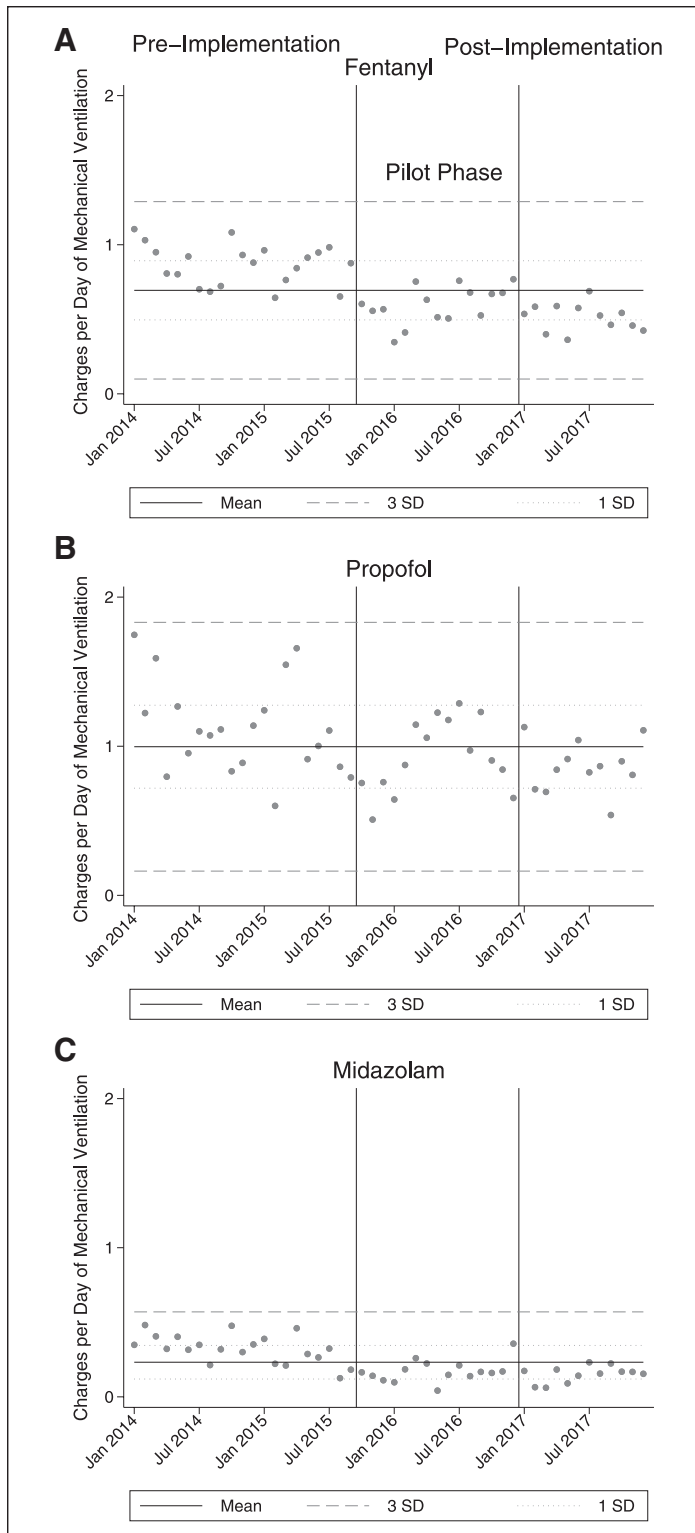


Figure 1. Changes in unit-level sedation use. Statistical process control charts illustrating changes in sedation utilization over time. Monthly sedation charges are normalized by dividing by the total number of mechanical ventilation days each month. *Hollow circles* indicate data points lying within the washout period, which were excluded from the calculations of shift in sedation use associated with the protocol. *Horizontal solid lines* represent mean for the entire study; *horizontal dashed lines* represent 1 and 3 SDs from the mean. *Vertical solid lines* demarcate the beginning of the pilot phase, followed by a nursing education demarcating the end of the pilot phase.

sedation strategy was associated with harm. This was particularly important, because nurses and physicians raised concerns regarding the potential for agitation and self-extubation during the development and pilot testing of our PRN protocol, and similar concerns are cited as a barrier to a light sedation strategy in other settings (21). Our findings are similar to those of randomized trials, which demonstrated that self-extubation is rare and not increased by a PRN-first sedation strategy (12, 13). Although our study lacked power to detect small differences in safety outcomes, the lack of differences is nevertheless reassuring that a PRN protocol for light sedation is not associated with major increases in the risk of agitation or self-extubation.

Treatment with the PRN protocol was not randomized, which creates some limitations inherent to observational data. Our patient-level analysis compared patients who were treated with the PRN protocol with those who were eligible but instead received primary CI sedation. Although it is likely that deviation from the PRN protocol reflected incomplete early adoption, it is also possible that there were other clinical factors driving a primary CI sedation strategy—an example of confounding by indication. Although patients in the PRN-first group were older, potentially creating a bias toward higher rates of delirium and prolonged LOS (22), we in fact observed the opposite. In addition, we are reassured by the fact that baseline illness severity was similar across groups and that patient-level differences in sedation use are supported by our data on changes in unit-level practice patterns.

Our findings of unit-level changes should be interpreted in the context of several additional limitations. Our analysis employed a before-and-after study design without a concurrent control, meaning that concurrent changes could confound the observed changes in sedation use. However, we evaluated for preexisting temporal trends, and we are not aware of any relevant changes within our ICU that occurred contemporaneously with our protocol implementation. Second, our unit-level analysis does not include patient-level risk adjustment, so may be confounded by differences in illness severity over time. However, SPC charts for fentanyl and midazolam support a relatively sudden shift in the time surrounding the implementation, which is not likely to be explained by case-mix differences. Finally, our evaluation was restricted to a single ICU in a single hospital, which may limit its generalizability.

Perhaps most notably, our observation of an association between PRN sedation and shorter duration of MV and ICU LOS conflicts with the recent NONSEDA multicenter randomized trial, which did not demonstrate improvements in these outcomes with a no-CI sedation strategy (13). Several aspects of the NONSEDA trial might explain this difference. First, the average doses of opioids and propofol were extremely low in both groups, meaning that there may have been insufficient differences in sedative dosing to expect a difference in outcomes. Second and perhaps relatedly, there was significant crossover (27%) from no sedation to light sedation, which reduces the likelihood of observing a difference. Finally, the NONSEDA trial occurred in units with 1:1 nurse-to-patient ratios, which may have allowed more frequent titration of sedative infusions in the light sedation group, contributing to the low cumulative sedative doses in patients treated with CI sedation. Conversely, we observed that a PRN-first sedation strategy is

feasible in a real-world ICU setting, including environments with higher nursing workloads.

CONCLUSIONS

In a retrospective evaluation of a protocol prioritizing a PRN-first strategy to achieve light sedation, we found that implementation of a PRN protocol was associated with patient-level decreases in medication administration, deep sedation, delirium, duration of MV, and ICU LOS; and unit-level reductions in pharmacy utilization of CI sedation. These results provide real-world data, suggesting that implementing a PRN protocol to achieve light sedation may be a safe and feasible way to reduce sedation use and improve outcomes in appropriately selected MV ICU patients.

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