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Critical Care Medicine
OFFICIAL JOURNAL OF THE SOCIETY OF CRITICAL CARE MEDICINE

Impact of a clinical pharmacist-enforced intensive care unit sedation protocol on duration of mechanical ventilation and hospital stay *

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Issue: Volume 36(2), February 2008, pp 427-433

Publication Type: [Clinical Investigations]

Publisher: © 2008 Lippincott Williams & Wilkins, Inc.

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There was no financial support for this study. The authors have not disclosed any potential conflicts of interest.

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Keywords: intensive care unit, pharmaceutical services, guidelines, propofol, midazolam, lorazepam

DOI:
10.1097/01.
CCM.0000300275.63811.
B3

ISSN:
0090-
3493

Accession: 00003246-200802000-00009

Objective: While the use of a protocol to guide sedation and analgesia therapy in the intensive care unit has been shown to improve patient outcomes, compliance is often poor. We hypothesized that a formal, consistent intervention by pharmacists to promote adherence to our institution's sedation guidelines would improve clinical outcomes. The purpose of this study was to document the impact of daily pharmacist interventions on clinical outcomes of intensive care unit patients prescribed continuous sedative therapy.

Design: Before-after study.

Setting: Two medical intensive care units (total of 18 beds) at a university medical center.

Patients: Patients were 156 mechanically ventilated patients prescribed a continuous infusion of sedative medication while in the medical intensive care unit.

Interventions: In the retrospective group, data were collected on all mechanically ventilated patients receiving continuous sedative infusions over a 3-month period. In the prospective group, a pharmacist evaluated all mechanically ventilated patients on continuous sedation daily and made recommendations to adhere to the institution's previously approved sedation guidelines.

Measurements and Main Results: Data were collected for 78 control and 78 intervention patients. The groups were well matched in terms of baseline demographics. The mean duration of mechanical ventilation was reduced from 338 ± 348 hrs (14 days) in the pre-intervention group to 178 ± 178 hrs (7.4 days) in the postintervention group ($p < .001$). Durations of both intensive care unit stay (380 ± 325 hrs vs. 238 ± 206 hrs, $p = .001$) and hospital stay (537 ± 350 hrs vs. 369 ± 274 hrs, $p = .001$) were also significantly reduced in the post intervention group.

Conclusions: The institution of a daily pharmacist-enforced intervention directed at improving sedation guideline adherence resulted in a

significant decrease in the duration of mechanical ventilation in patients receiving continuous sedation.

The Society of Critical Care Medicine has developed guidelines for the use of sedatives and analgesics in critically ill patients that promote the proper management of pain, anxiety, and delirium. In addition to providing recommendations on agent selection, the guidelines stress the need to both set and titrate to a sedation goal using any number of validated scales and incorporating daily "sedation holidays" to minimize oversedation (1, 2).

In 2002, Boston Medical Center set forth to update our institutional sedation practices, largely basing our guidelines on the 2002 Society of Critical Care Medicine document. The guidelines were developed by a multidisciplinary team, including critical care physicians, nurses, and pharmacists, and were approved by the Critical Care and Pharmacy and Therapeutics Committees at the hospital. Highlights of this guideline (Appendix 1) include first setting a goal sedation score using the Sedation Agitation Score (SAS) (3) and then titrating to the goal by first identifying the etiology of agitation (pain, anxiety, or delirium). Active down-titration of sedatives by 25% every 4 hrs in the case of oversedation was substituted for daily interruptions. Analgesic agents of choice were fentanyl in hemodynamically unstable patients and morphine or hydromorphone in patients requiring intermittent pain management. Sedative agents of choice were propofol for neurologic patients and patients whose anticipated length of intubation was <48 hrs and lorazepam in patients with anticipated longer term intubations. Also, intermittent dosing was preferred over continuous infusions when possible.

Once approved, an aggressive educational initiative was undertaken to educate all critical care nurses, attending physicians, and house staff. This education included a formal lecture, provision of the guidelines in written form, and yearly review via nursing competency days.

Despite this implementation strategy, an audit 1 yr after the guidelines were introduced demonstrated poor compliance in the areas of setting and titrating to set sedation goals and using intermittent bolus dosing preferentially over continuous infusions.

Previous studies have documented the benefits of closely adhering to sedation guidelines and the role of a pharmacist in assisting with these aims. Devlin et al. (4) evaluated two groups of consecutive patients who required mechanical ventilation and who were receiving continuous sedation. The investigators found that there was a trend toward a shorter weaning time and decreased sedation costs in the group that was managed according to the pharmacist-enforced sedation guidelines. Brook et al. (5) evaluated critically ill patients who required mechanical ventilation and compared outcomes of patients whose sedation was managed by a nursing-implemented protocol with patients

whose sedation was managed by the traditional nonprotocol approach. The investigators found that the duration of mechanical ventilation was significantly shorter for the patients whose sedation was managed by the nursing-implemented protocol than for those patients who were not managed by the protocol.

In addition to sedation guidelines clearly being beneficial, it has also been demonstrated that patients placed on a continuous infusion of sedative medication have longer durations of mechanical ventilation. Kollef and others (6) evaluated 242 consecutive intensive care unit (ICU) patients requiring mechanical ventilation and found that the administration of continuous sedation was associated with an increased duration of mechanical ventilation, even when other potential confounding variables were accounted for (age, severity of illness, mortality, indication for mechanical ventilation, use of chemical paralysis, presence of a tracheostomy). Given that intermittent bolus therapy is the preferred method for ICU sedation, improving compliance by promoting this practice may affect patient outcomes.

It is clear that guideline-based sedation practices produce better outcomes and that patients placed on continuous infusions have a longer duration of mechanical ventilation. Pharmacists have previously demonstrated their impact on clinical outcomes in the ICU (7, 8) and are ideally positioned to ensure optimal sedation and analgesia pharmacotherapy. The purpose of this study was to document the impact of daily pharmacist interventions on clinical outcomes of ICU patients prescribed continuous sedative therapy.

METHODS

The institutional review board at Boston Medical Center provided expedited approval of the protocol before data collection began. Informed consent was waived by the institutional review board based on minimal risk to the patient and the fact that the study was following previously published best practice guidelines (1). Baseline data were collected on 78 control patients over a 3-month period and were prospectively collected until 78 patients were included in the intervention group.

Patients were included in the study if they were admitted to the medical ICU (MICU), were mechanically ventilated, were receiving continuous sedation, and were >=18 yrs of age. Patients were excluded from the study if they did not meet all of the inclusion criteria. All patients enrolled were admitted to one of two medical ICUs located at the same hospital.

This study was designed as a before-after study. There were two treatment arms: sedation according to the guidelines without pharmacist intervention (before) vs. sedation according to the guidelines with active pharmacist input (after). The patients were divided into before and after groups based on their MICU admission date. Beginning in February 2004, the prospective interventions began, and patients who met

inclusion criteria from that time forward were included in the intervention group. Likewise, all patients who met inclusion criteria who were admitted to the MICU in the 3 months preceding the prospective intervention phase were included in the control group.

Mechanical ventilation was managed by the critical care team at Boston Medical Center, and there was no single ventilator management protocol in place due to the heterogeneity of the patients admitted to the MICU. Once patients met the following criteria, a spontaneous breathing trial leading to extubation was performed: awake and responsive, able to cough/clear secretions, off vasopressors, absence of significant fever or minute volume <10 L/min, positive end-expiratory pressure <=5 cm H_2O, Pao_2/Fio_2 ratio >=200 or oxygen saturation >90% on <=0.5 Fio_2, and frequency/tidal volume ratio (Rapid Shallow Breathing Index) <=100.

Patients were identified in both groups through reports specifying patients on one of three continuous infusions of sedatives (midazolam, lorazepam, or propofol). In the before group, the list was run to cover 3 months so that a total of 78 patients could be collected. In the intervention group, the list was run daily, and the study pharmacist intervened on all patients receiving continuous sedative medications in the MICU. The intervention patients were managed according to the pharmacist-instituted intervention where the pharmacist conveyed recommendations to both the nurses and physicians regarding the sedation plan for the patient, titrating to the established SAS (3) goal, and identifying pain and delirium (9). Additional recommendations were made for changes in sedation based on organ function or length of sedation and appropriate laboratory monitoring when necessary (e.g., serum triglycerides, serum osmolarity).

The pharmacists involved in the study were either current pharmacy residents or residency trained pharmacists. All pharmacists involved completed 1 month of training before study involvement, which included reviewing all pertinent literature, completing patient assessments, and reviewing eligible patients with the study investigators. Pharmacists involved in the study were given a standard intervention form from which to make their recommendations (Appendix 2). The pharmacist assessed sedated patients daily during MICU rounds and then made sedation interventions where appropriate. Patients who were not seen during MICU rounds were assessed after rounds, and recommendations were made to physicians and nurses at that time. All interventions made by the pharmacist were verbal and were recorded in the pharmacy information system at the hospital.

Data were collected on prespecified variables, including Acute Physiology and Chronic Health Evaluation II score (10) on admission to the MICU, ICU admission diagnosis, in-hospital mortality, diagnostic mental status testing (defined as computed tomography/magnetic resonance imaging or a lumbar puncture performed due to a decreased/altered mental status of unknown etiology), tracheostomy placement, self-extubation, use of neuromuscular blocking agents, reintubation, and the use of physical restraints. SAS scores and compliance with documentation of SAS scores were collected on all patients while intubated. Compliance with SAS documentation was assessed by looking at the total number of opportunities

for documentation in a day (6) and dividing that number by the number of scores actually documented. Pharmacist interventions on all postintervention patients were also recorded.

The primary outcome was the duration of mechanical ventilation, measured in hours. The secondary outcomes were length of ICU stay (measured in hours), length of hospital stay (measured in hours), and total doses of sedating agents. The duration of mechanical ventilation was recorded from emergency department and ICU flow sheets that designated at what time the patient was intubated and extubated, respectively. Total doses of sedating agents included all continuous and intermittent sedative and analgesic doses that were used while the patient was mechanically ventilated. Sedating agents were considered to be drugs in the following classes: propofol, benzodiazepines, opiates, neuroleptics, and barbiturates. For the purpose of comparison, all doses of benzodiazepines were converted to lorazepam equivalents, and all doses of opiates were converted to fentanyl equivalents using the same technique as applied by Cammarano et al. (11) (Table 1) We then calculated the total dose received while ventilated, the mean and median daily doses administered while ventilated, and the numbers of patients placed on different sedative regimens (propofol only, benzodiazepine only, propofol + benzodiazepine).

Table 1. Converted equivalents

Opioid conversion: 10 μg of fentanyl =	1 mg of morphine 0.2 mg of hydromorphone 2.5 mg of oxycodone 12 mg of codeine
Benzodiazepine conversion: 1 mg of lorazepam =	3 mg of midazolam 5 mg of diazepam 0.25 mg of clonazepam

Table 1. Converted equivalents

The necessary sample size required to detect a decreased duration of mechanical ventilation of 36 hrs with an [alpha] of .05 and a [beta] of .2 (80% power) was 78 patients in each group, for a total of 156 patients. Chi-square and Fisher's exact test were used to assess the nominal

variables, and the Student's *t*-test was used to assess all continuous variables. For all statistical tests, $p < .05$ was considered to be statistically significant.

RESULTS

Data were collected on 156 patients. All patients who met inclusion criteria and were managed by the sedation pharmacist were included, and no patients enrolled were lost to follow-up. Patient characteristics of each group are shown in Table 2. The two groups were well matched in terms of age, gender, and acuity of illness on admission. The reason for ICU admission was equivalent in all areas except drug/alcohol overdose, which was higher in the intervention group. (Table 2) The most common admitting diagnoses were chronic obstructive pulmonary disease and pneumonia.

Table 2. Patient characteristics

Characteristic	Control	Intervention	*p* Value
No.	78	78	
Male, n (%)	41 (52.6)	42 (53.8)	0.8725[a]
Age (yrs), mean ± SD	55.9 ± 17.0	57.3 ± 16.1	0.5982[b]
Race, n (%)			
White	41 (52.6)	37 (47.4)	0.6310[a]
African American	32 (41.0)	26 (33.3)	0.4075[a]
Other	5 (6.4)	15 (19.2)	0.0311[a]
APACHE II, mean ± SD	24.4 ± 7.3	22.7 ± 6.1	0.1166[b]
Admission diagnosis, n (%)			
Alcohol/drug overdose	6 (7.7)	15 (19.2)	0.0323[c]
CHF/pulmonary edema	5 (6.4)	3 (3.8)	0.7193[c]
COPD/asthma	21 (26.9)	12 (15.4)	0.1160[c]
GIB	4 (5.1)	5 (6.4)	1.0000[c]
Pneumonia and/or ARDS	11 (14.1)	18 (23.1)	0.2165[c]
Seizure	4 (5.1)	8 (10.3)	0.3683[c]
Sepsis	13 (16.7)	8 (10.3)	0.3484[c]
Trauma	5 (6.4)	2 (2.6)	0.4423[c]
Other[d]	9 (11.5)	7 (9.0)	0.7918[c]

APACHE, Acute Physiology and Chronic Health Evaluation; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; GIB, gastrointestinal bleeding; ARDS, acute respiratory distress syndrome.

[a]Chi-square test; [b]Student's *t*-test; [c]Fisher's exact test; [d]other: cardiac arrest (4); cerebrovascular accident (2); chronic liver disease (2); inflammatory myositis (1); nausea/vomiting (2); pancreatitis (2);

pleural effusion (1); syncope (1); total hip replacement (1).

Table 2. Patient characteristics

Outcomes.

The duration of mechanical ventilation was significantly decreased in the intervention patients compared with the control patients (Table 3). Intervention patients also had a significantly shorter ICU and hospital length of stay. Other indicators of adequate sedation and patient severity of illness were also similar between groups. There was no difference in terms of hospital mortality, percentage of patients requiring mental status testing, tracheostomy, self-extubation, reintubation, and the percentage of patients placed on physical restraints.

Table 3. Patient outcomes

Outcome	Control	Intervention	*p* Value[a]
No.	78	78	
Ventilator duration (hrs), mean ± SD	338.4 ± 344.7	178.1 ± 177.9	0.0004[a]
Ventilator duration (days), median	8.9	5.3	
ICU LOS (hrs), mean ± SD	380.2 ± 324.6	237.6 ± 205.9	0.0021[a]
ICU LOS (days), median	10.6	7.0	
Hospital LOS (hrs), mean ± SD	536.5 ± 349.7	368.5 ± 273.6	0.0010[a]
Hospital LOS (days), median	19.8	11.8	
SAS evaluation (%)	68.8 ± 18.9	70.0 ± 19.1	0.6938[a]
Mortality, n (%)	14 (17.9)	12 (15.4)	0.8299[b]
MS testing, n (%)	15 (19.2)	15 (19.2)	1.0 000[b]
Tracheostomy, n (%)	10 (12.8)	3 (3.8)	0.0788[c]
Self-extubation, n (%)	8 (10.3)	3 (3.8)	0.2096[c]
Reintubation, n (%)	9 (11.5)	8 (10.3)	0.7972[b]
Physical restraints, n (%)	47 (60.3)	48 (61.5)	0.8697[b]
Propofol <48 hrs duration, n (%)	23 (43.4)	31 (47.0)	0.2388[b]
Paralytics, n (%)	17 (21.8)	14 (17.9)	0.6882[b]

ICU, intensive care unit; LOS, length of stay; SAS, Sedation Agitation Scale; MS, mental status.
[a]Student's *t*-test; [b]chi-square test; [c]Fisher's exact test.

Table 3. Patient outcomes

When we evaluated the total dose of sedating medications received, the intervention group was found to receive less lorazepam equivalents when compared with the control group. This difference, however, was not seen when adjusted per day on the ventilator (Table 4). Propofol dose was not different between groups, while fentanyl equivalents were significantly lower in the intervention group (both in total dose and in dose per day on the ventilator). The total number of patients placed on haloperidol was not significantly different between groups (20 control vs. 17 intervention, average daily dose of 13.4 ± 64.3 mg in the control and 5.6 ± 15.7 mg in the intervention group, respectively, $p = .2996$). Neuromuscular blocking agent use was also evaluated. The number of patients receiving neuromuscular blocking agents in each group was not statistically significant (17 control vs. 14 intervention), and the median doses were also comparable (median vecuronium dose 29 vs. 32 mg, $p = .675$). Eight patients in the control group and six patients in the intervention group required repeated bolus dosing of neuromuscular blocking agents for ventilator or intracranial pressure management, while the remainder of patients who received neuromuscular blocking agents did so for intubation or to facilitate diagnostic testing (computed tomography/magnetic resonance imaging).

Table 4. Sedative doses

Dose	Control	Intervention	*p* Value
Lorazepam equivalents/ventilator day (mg/day), mean ± SD	74.8 ± 76.1	65.2 ± 114.1	0.5374[a]
Lorazepam equivalents/ventilator day (mg/day), median	48.3	26.7	
Propofol dose/ventilator day (mg/day), mean ± SD	962.6 ± 1514.0	844.0 ± 1130.7	0.5802[a]
Fentanyl equivalents/ventilator day (μg/day), mean ± SD	400.9 ± 1026.4	102.5 ± 327.9	0.0156[a]

[a]Student's *t*-test.

Table 4. Sedative doses

In addition to evaluating total dose of sedative medications, we also evaluated the overall sedative regimen that patients received while ventilated. We divided patients into one of three different regimens to ensure the control group did not receive a disproportionate type of regimen when compared with the intervention group. The three groups were defined as follows: propofol only, benzodiazepine only, and propofol + benzodiazepine. As demonstrated in Table 5, the groups were well matched in terms of baseline sedative regimen chosen.

Table 5. Sedative regimens

Sedative	Control	Intervention	*p* Value
Propofol only, n (%)	7 (9)	9 (12)	0.79[a]
Benzodiazepine only, n (%)	25 (32)	23 (29)	0.86[a]
Propofol + benzodiazepine, n (%)	46 (59)	46 (59)	1.00[a]

[a]Chi-square test.

Table 5. Sedative regimens

When analyzing the data with regard to benzodiazepine selection and dose, a trend toward increasing midazolam use was seen in the control group. Thirty-nine patients in the control group received midazolam compared with 30 patients in the intervention group. The average daily dose of midazolam in the control group was also significantly higher compared with the intervention group (87 mg/ventilator day vs. 12 mg/ventilator day, respectively, $p = .0012$).

Pharmacist interventions were also recorded in the intervention group and fell into one of the following seven categories (Table 6): 1) discontinuation of continuous sedation; 2) initiation of alternative agents for continuous sedation; 3) addition of bolus doses of sedating agents on an as-needed basis instead of a continuous infusion or on a scheduled basis; 4) decrease in the rate/dose of agents used for continuous sedation; 5) addition of outpatient psychiatric medications to the patient's regimen; 6) monitoring of laboratory variables (e.g., checking triglycerides on patients receiving propofol >48 hrs and serum osmolarity monitoring on patients receiving >4 mg/hr lorazepam); and 7) addition of adjustment bolus doses to benzodiazepine/opiate infusions to optimize titration. There were a total of 210 pharmacist interventions for the 78 intervention patients, with 192 (91%) of the interventions accepted.

Table 6. Pharmacist interventions

Pharmacist Intervention	No. (%)
Laboratory monitoring	13 (6)
Add outpatient psychiatric medication	9 (4)
Discontinue sedative agent	42 (20)
Add sedative agent	68 (32)
Add bolus agent dosing	22 (11)
Decrease infusion rate	37 (18)
Add as needed agents	19 (9)

Table 6. Pharmacist interventions

DISCUSSION

Despite evidence to support their use in the literature, sedation protocols/guidelines are not being implemented routinely. A recent survey of Canadian critical care practitioners demonstrated that only 29% of survey respondents used a sedation protocol or guideline and that sedation scoring systems were used only 49% of the time (12). Using a pharmacist not only to enforce protocols but also to educate practitioners in implementing protocols is a method that may improve sedation protocol adherence and subsequent outcomes.

This study compared sedated and mechanically ventilated patients whose sedation was managed according to a sedation protocol both with and without active pharmacist intervention. It was found that patients who were managed with active pharmacist interventions fared better in terms of clinical outcomes compared with those managed by the protocol alone. In fact, patients who were managed with pharmacist interventions were found to have a reduction in their duration of mechanical ventilation, in their ICU length of stay, and in their hospital length of stay. In addition, the total use of many sedating agents was decreased in the intervention group, most notably the use of midazolam and fentanyl.

A benefit of this process was that it focused on adherence to preset standards for sedation, rather than using new and unique sedation strategies. The process of a pharmacist spending time at the bedside with the nurse and medical team allowed for a more longitudinal educational process for all health professionals involved in patient care, and this education could be immediately and directly applied to patients. We believe that this process of education and application at the bedside allowed for a more comprehensive application of the protocol as well as improved understanding by bedside clinicians. It is not known if the results in this study would have been the same with a nurse-administered protocol. The treatment effect may have been related to the fact that the protocol was closely monitored, and future study could compare a pharmacist-enforced protocol with a nurse-driven protocol.

It is also important to comment on the algorithm in place at our institution, which mimics the Society of Critical Care Medicine guidelines in most ways except one. While daily interruptions of sedative medications have been advocated, due to physical constraints (inability of the nurses to visually monitor their patients at all times) of some of the ICUs not involved with the study at our hospital, this practice was not implemented. Instead, our protocol calls for active dose down-titration by 25% every 4 hrs in a patient who is oversedated in relation his or her SAS goal. This is especially important to mention because many times SAS goals were not being used to actively down-titrate infusions and were a source of many of the pharmacists' interventions. Documentation of the SAS was approximately 70% in both groups, leading us to conclude that documentation by itself is not a marker for protocol compliance.

When we are evaluating pharmacist interventions, several important aspects bear mention. The most common intervention was to add sedative medication. While this may seem counterproductive in terms of minimizing sedation, the intervention was often to add an analgesic to treat pain and/or haloperidol to treat suspected delirium. This action, by targeting the etiology of agitation, allowed for patients to be more accurately treated rather than increasing the dose of the current sedative (propofol, benzodiazepine infusion). We believe that this was one of the most important aspects of the intervention and its resultant effect on outcome. Another intervention category to note is the addition of outpatient psychiatric medications. This focused medication reconciliation (now mandated by the Joint Commission) performed by the pharmacist may have prevented withdrawal syndromes associated with many of these agents and may have treated underlying psychiatric disorders that can complicate the sedation issues with critically ill patients.

It is likely that the improvements in clinical outcomes will translate into an economic benefit, given the reduction in use of hospital services (mechanical ventilation, ICU care, and overall hospital care) and the use of drug therapy. In addition, we observed a trend toward decreasing tracheostomy rates, possibly as a consequence of decreased duration of mechanical ventilation seen in the intervention group. While the economic benefits of this intervention were not investigated in this study, this would be an interesting analysis to pursue in the future. Based on the data presented here, a full-time pharmacist equivalent has been approved at our institution to ensure that all patients on continuous

sedation are appropriately managed.

This study has several limitations. The design (before/after) is clearly not as robust as a randomized prospective trial. The case matching of patients was not done by time of year, thus not accounting for seasonal variations in illness. With this in mind, all major potential confounding factors that would affect duration of mechanical ventilation (severity of illness, diagnosis on admission) were similar between groups with the exception of drug/alcohol overdose. While the difference was statistically significant between these groups, the small numbers would not affect the overall statistical outcome. Also, due to the complicated nature of alcohol withdrawal, there is a possibility that this difference would have favored the control group in terms of ICU length of stay. In addition, although the control patients were supposed to be completely managed without pharmacist interventions, it is possible that the regular pharmacist rounding with the team may have made some interventions on control patients. However, since the control data were collected retrospectively, there is no way to know exactly what interventions the pharmacists may have made. It is possible that any pharmacist interventions in the control group would have biased the data in favor of the controls. Given the results of the study, if there was any bias in the control group it did not appear to influence the overall results.

Another limitation encountered in the study was that more than one pharmacist evaluated the intervention patients during the course of the study. Since more than one pharmacist conducted the evaluations and made the sedation interventions, there may have been some disparity in the way that the intervention patients were managed. However, an attempt was made to overcome this problem by developing a standard algorithm by which all patients were evaluated. This algorithm clearly stated variables that should be monitored each day on all patients and suggested potential solutions to any problems that might be encountered. The use of the algorithm was explained to each pharmacist who participated in the intervention phase, and the importance of standardized evaluations was emphasized. While the potential still existed for some differences in the way that patients were evaluated, the use of the algorithm likely corrected many of these differences.

The final limitation of the study concerns the absence of standardized protocols for ventilatory management and weaning. We recognize that the lack of such protocols could bias the data in either direction. The time spent on mechanical ventilation could be increased (or decreased) in either or both groups and thus affect the comparison between groups, either increasing or increasing the difference between experimental or control groups. The heterogenicity of the patient population and practitioner habits makes it unlikely that one group was affected more than the other.

CONCLUSION

For mechanically ventilated medical ICU patients receiving continuous sedation, the process of a daily pharmacist intervention ensuring

protocol-driven sedation reduced the duration of mechanical ventilation. The shorter duration of mechanical ventilation also translated to decreased ICU and hospital lengths of stay in the intervention group as well as a reduction in selected sedative medications (fentanyl and midazolam). These improvements in clinical outcomes will likely translate to a benefit in economic outcomes.

ACKNOWLEDGMENTS

We thank John Devlin, PharmD, for his critical evaluation of the manuscript. We also thank the nursing staff in the medical intensive care units at Boston Medical Center for their efforts in making this study possible.

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APPENDIX 1. [Context Link]

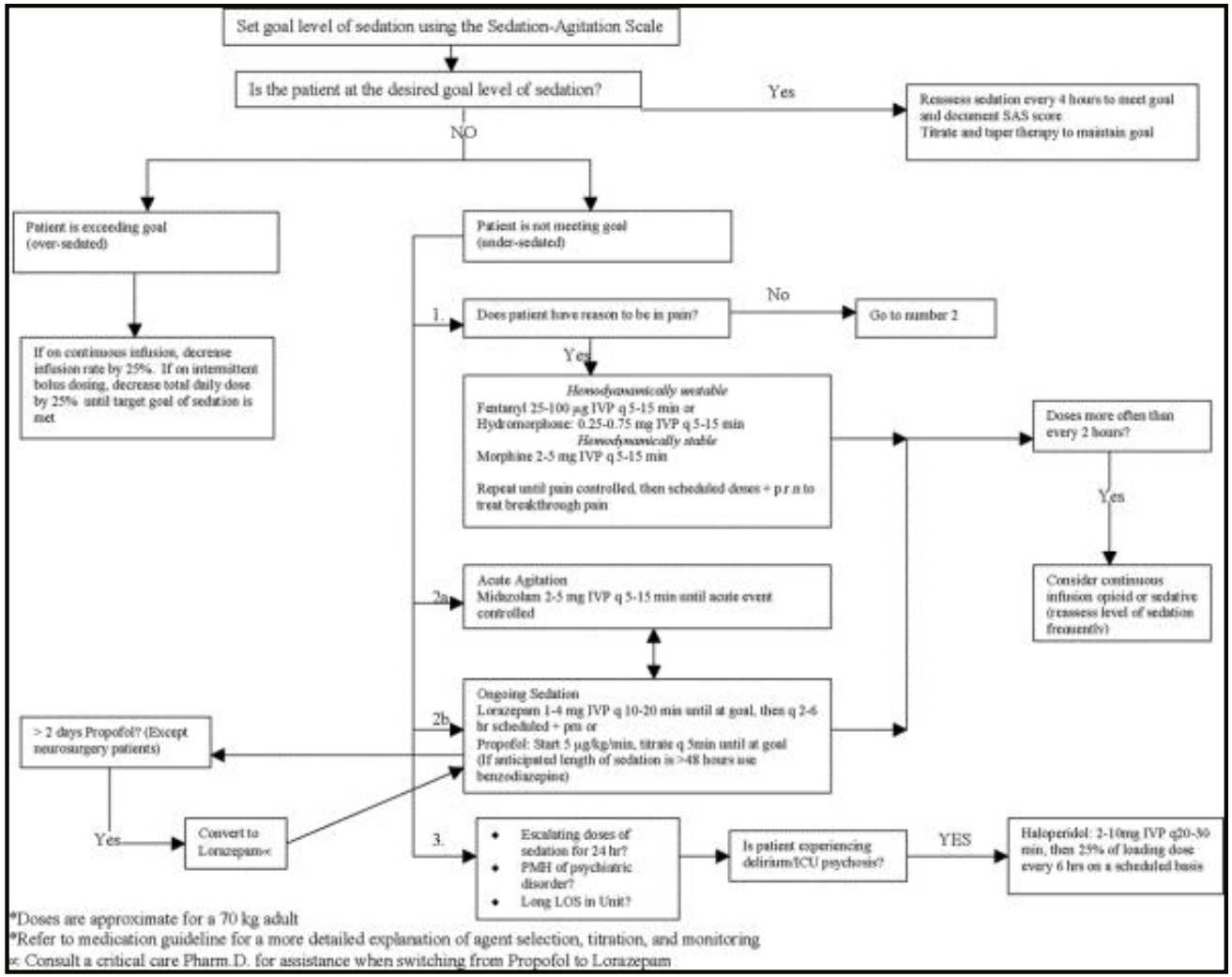

Figure. Highlights of Boston Medical Center Sedation Guidelines

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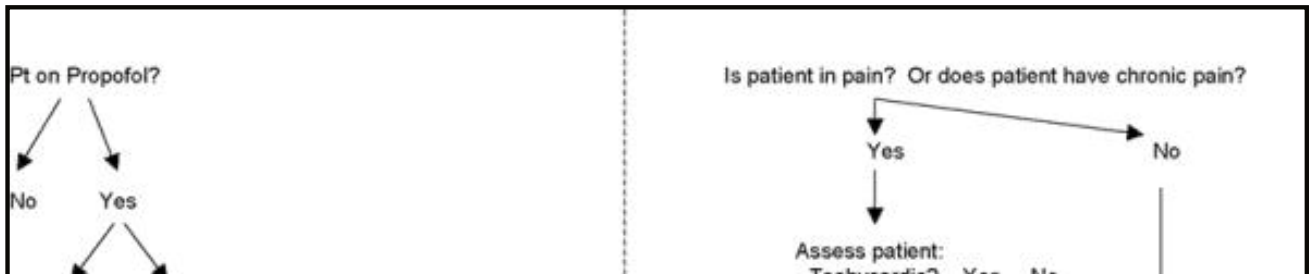
APPENDIX 2. [Context Link]



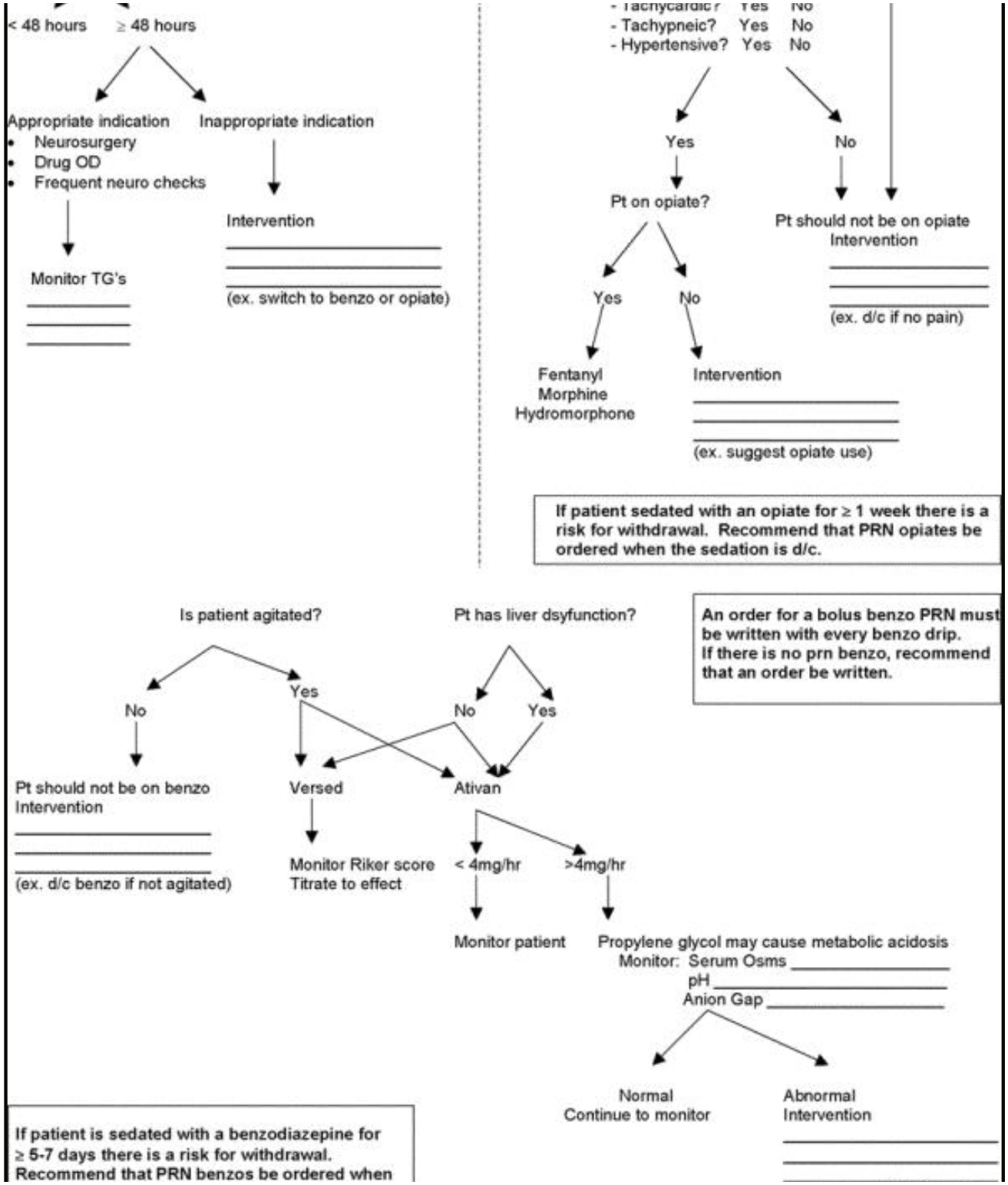

< 48 hours
≥ 48 hours
Appropriate indication
• Neurosurgery
• Drug OD
• Frequent neuro checks
Monitor TG's
Inappropriate indication
Intervention
(ex. switch to benzo or opiate)
- Tachypneic? Yes No
- Hypertensive? Yes No
Yes
No
Pt on opiate?
Yes
No
Fentanyl
Morphine
Hydromorphone
Intervention
(ex. suggest opiate use)
Pt should not be on opiate
Intervention
(ex. d/c if no pain)
If patient sedated with an opiate for ≥ 1 week there is a risk for withdrawal. Recommend that PRN opiates be ordered when the sedation is d/c.
Is patient agitated?
No
Yes
Pt should not be on benzo
Intervention
(ex. d/c benzo if not agitated)
Versed
Monitor Riker score
Titrate to effect
Pt has liver dsyfunction?
No
Yes
Ativan
< 4mg/hr
>4mg/hr
Monitor patient
Propylene glycol may cause metabolic acidosis
Monitor: Serum Osms
pH
Anion Gap
Normal
Continue to monitor
Abnormal
Intervention
An order for a bolus benzo PRN must be written with every benzo drip.
If there is no prn benzo, recommend that an order be written.
If patient is sedated with a benzodiazepine for ≥ 5-7 days there is a risk for withdrawal. Recommend that PRN benzos be ordered when

Figure. Sedation Intervention Form

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*See also p. 626. [Context Link]

Key Words: intensive care unit; pharmaceutical services; guidelines; propofol; midazolam; lorazepam

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Version: OvidSP_UI02.01.02.102, SourceID 40419