IMPLEMENTATION OF ICU BUNDLES AND THE IMPACT ON PAIN, AGITATION, AND DELIRIUM IN CRITICALLY ILL PATIENTS IN THE ICU

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DISCLOSURE STATEMENT

• IRB status: exempt

• Co-investigators:
  – Heidi Simons PharmD, BCPS
  – Tom Richardson PharmD, BCPS, AQ-ID
  – Julie Petre PharmD, BCPS

• Conflicts of interest: none

• Project sponsorship: none
LEARNING OBJECTIVES

• Using the SPH Ventilator Bundle Scoring tool, assess adherence to guideline recommendations for the management of mechanically ventilated patients in the ICU

• Given a patient case, formulate an optimal medication regimen of sedation and analgesia, including starting doses and titration parameters, for a ventilated patient using a hospital protocol

• Understand the observational components needed to calculate RASS, CPOT, and CAM-ICU scores, and be able to titrate sedation and analgesia given a calculated RASS or CPOT score

• Identify areas of patient care improved by implementing ICU bundles for mechanically ventilated patients
BACKGROUND – ST. PETER’S HEALTH

• Rural, community hospital
  – 123 beds
  – 8 bed ICU
• Service population: 97,000
• Providers
  – Hospitalist-run
  – No intensivist or pulmonologist on site
  – Tele-health with University of Utah
2018 GUIDELINES

- Society of Critical Care Medicine Clinical Practice Guideline Update in 2018 for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep Disruption in Adult Patients in the ICU\(^1\)

- Key recommendations
  - Multidisciplinary team approach: provider education, protocols and order forms, ICU checklists
  - Routine pain assessment; analgesia prior to sedation
  - Routine sedation assessment; light sedation (vs deep sedation)
  - Regular delirium assessment using a valid tool
BACKGROUND - PAIN

• Most common memory for ventilated patients
• Pain first approach
  – Pain control before initiation of sedative
    • Sedation can mask pain response
  – Reduced sedative use
BACKGROUND - SEDATION

• Depth of sedation and long-term outcomes\(^4\)
  – Lighter sedation associated with:
    • Decreased time on ventilator
    • Shortened ICU length of stay
    • Shortened hospital length of stay
    • Improved mortality
  – Independent of severity of illness or other confounding factors

• Continuous infusion benzodiazepines
  – Increased incidence of delirium\(^5\)
  – Difficult to titrate
  – Unpredictable pharmacokinetics in critically ill
BACKGROUND - DELIRIUM

• Rapidly reversible versus persistent
  – Easily assessed with daily awakening
• Benzodiazepines associated with increased risk
• No recommended treatment¹
  – Prevention is key
PURPOSE

• Implement ventilator bundles, update provider order sets, and implement hardwired assessment documentation to increase adherence to guideline recommended interventions for mechanically ventilated patients in the ICU
METHODS – STUDY DESIGN

• Single center prospective cohort study
  – St. Peter’s Health, Helena, Montana

• Interventional quality improvement project
  – Rural community hospital
  – Non-intensivist managed ICU
## METHODS – INCLUSION AND EXCLUSION CRITERIA

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubated &gt; 24 hours</td>
<td>Indication for deep sedation</td>
</tr>
<tr>
<td>Age &gt; 18</td>
<td>Intubated &lt;24 hours or anticipated transfer to another facility</td>
</tr>
<tr>
<td>Ability to tolerate light sedation</td>
<td>Exclusion by provider’s professional opinion</td>
</tr>
</tbody>
</table>
METHODS – STUDY GROUPS

• Control group: Retrospective review of ventilated patients from November 1, 2016 to October 31, 2017
• Interventional group: Ventilated patients from December 1, 2018 to April 10, 2019
  – Following protocol implementation
METHODS - INTERVENTION

• Updated provider order sets
  – Continuous infusion benzodiazepines removed
  – Explicit titration parameters added
  – Analgesia pre-checked
  – Sedation interruption order added

• New protocol for ventilator management
  – Explicit titration parameters
  – Required assessment and documentation of pain and sedation
ANALGESIA

Fentanyl 25 mcg IV bolus, increase by 25 mcg every 10 minutes PRN pain

CPOT ≤ 2
Pain controlled, reassess in 4 hours

CPOT > 2
OR > 3 doses in 1 hour

Start fentanyl 25 mcg/hr infusion, increase by 25 mcg/hr every 30-60 minutes
Maximum 200 mcg/hr infusion

CPOT ≤ 2
Pain controlled, reassess in 4 hours

SEDATION

Propofol 5 mcg/kg/min
OR
Dexmedetomidine 0.4 mcg/kg/hr
OR
Midazolam 1 mg IV bolus

RASS < -1
Stop infusion until RASS -1 to 1
Restart infusion at 50% of previous rate

RASS -1 to 1
Reassess in 4 hours

RASS > 1
Propofol: increase by 10 mcg/kg/min every 10 minutes
Maximum 75 mcg/kg/min
OR
Dexmedetomidine: increase by 0.2 mcg/kg/hr every 30 minutes
Maximum 1.5 mcg/kg/hr
OR
Midazolam increase by 1 mg every 10 minutes
Maximum 10 mg bolus
METHODS – OUTCOMES

• Primary outcome
  – Adherence to guideline recommended interventions for mechanically ventilated patients in the ICU following implementation of an updated ventilator protocol
    • Unique scoring tool developed at St. Peter’s Health to measure adherence

• Secondary outcomes
  – Length of time on ventilator
  – Length of ICU stay
  – Length of hospital stay
  – Benzodiazepine use
<table>
<thead>
<tr>
<th>Guideline Recommendation</th>
<th>Intervention</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Management of pain for adult ICU patients should be guided by routine pain assessment and pain should be treated before a sedative agent is considered. We suggest using an assessment-driven, protocol based, stepwise approach for pain and sedation management in critically ill adults.”</td>
<td>Analgesia-first sedation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pain assessment with goal CPOT &lt; 2 or documentation of subjective pain assessment if CPOT not applicable</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Change in dose using protocol titration algorithm</td>
<td>1</td>
</tr>
<tr>
<td>“We suggest using light sedation (vs deep sedation) in critically ill, mechanically ventilated adults. We suggest using either propofol or dexmedetomidine over benzodiazepines for sedation in critically ill, mechanically ventilated adults.”</td>
<td>Sedation titrated to a RASS score of -1 to 1 after maximization of pain control</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Propofol or intermittent benzodiazepines used over continuous infusion benzodiazepines</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Daily sedation interruption, with sedation restarted at 50% of dose as appropriate</td>
<td>2</td>
</tr>
<tr>
<td>“Critically ill adults should be regularly assessed for delirium using a valid tool.”</td>
<td>Daily delirium assessment using CAM-ICU, including proper documentation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Documentation indicating limited noise and light pollution during nighttime hours</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Early mobilization through physical therapy consult</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
STUDY SUBJECTS

Patients Screened
N = 86

Control group
N = 49

Excluded
N = 9
Ventilated < 24 hours
N = 8
Transferred to tertiary facility
N = 1

Included in final analysis
N = 41

Interventional group
N = 37

Excluded
N = 19
Ventilated < 24 hours
N = 17
Transferred to tertiary facility
N = 1
Required deep sedation
N = 1

Included in final analysis
N = 18
# BASELINE CHARACTERISTICS

<table>
<thead>
<tr>
<th></th>
<th>Control Group (N=41)</th>
<th>Interventional Group (N=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Median Age (years)</strong></td>
<td>62</td>
<td>57</td>
</tr>
<tr>
<td><strong>Sex (male)</strong></td>
<td>21 (51%)</td>
<td>9 (50%)</td>
</tr>
<tr>
<td><strong>Median APACHE-II Score</strong></td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td><strong>Reason for Intubation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Event</td>
<td>6 (15%)</td>
<td>3 (17%)</td>
</tr>
<tr>
<td>Infection</td>
<td>8 (19%)</td>
<td>3 (17%)</td>
</tr>
<tr>
<td>Respiratory Cause</td>
<td>16 (39%)</td>
<td>7 (39%)</td>
</tr>
<tr>
<td>Substance Abuse</td>
<td>6 (15%)</td>
<td>4 (22%)</td>
</tr>
<tr>
<td>Trauma</td>
<td>3 (7%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (5%)</td>
<td>1 (5%)</td>
</tr>
</tbody>
</table>
# PRIMARY OUTCOME

<table>
<thead>
<tr>
<th></th>
<th>Control Group (N = 41)</th>
<th>Interventional Group (N = 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesia first sedation (N)</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>CPOT documented (N)</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Dose change documentation (N)</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>RASS documented (N)</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Continuous infusion benzodiazepines (N)</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Sedation interruption (N)</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>CAM-ICU documented (N)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Documentation of sleep hygiene (N)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Early mobilization (N)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Median Score</strong></td>
<td><strong>1</strong></td>
<td><strong>5</strong></td>
</tr>
<tr>
<td></td>
<td>Control Group (N = 41)</td>
<td>Interventional Group (N = 18)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Median hospital length of stay (days)</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Median ICU length of stay (days)</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Median time on ventilator (hours)</td>
<td>25</td>
<td>71</td>
</tr>
<tr>
<td>Continuous Infusion Benzodiazepine (N)</td>
<td>30</td>
<td>1</td>
</tr>
</tbody>
</table>
DISCUSSION

• Implementation of a multidisciplinary pain, agitation, and delirium protocol in is an effective way to improve adherence to guideline recommendations
  – Protocol adherence to guideline recommendations improved in 7 of 10 categories
    • 1/18 patients received continuous infusion benzodiazepines in the intervention group
    • Pharmacist intervention
  – Decreased ICU and hospital length of stay
    • Ventilator times increased
DISCUSSION

• Similar barriers as previous studies\textsuperscript{7,8}
  – Disruption in workflow, resistance to change
  – Increased pharmacy burden
• Challenges
  – Electronic healthcare record
  – Continuity of care upon transfer to tertiary facility
• Positive process changes
  – Interdisciplinary approach – increased involvement of pharmacist
  – No change in nurse, pharmacist, or physician FTE
  – Administrative rules expedited change
DISCUSSION

• Strengths
  – Baseline characteristics similar between groups
  – Leverage of electronic health record and administrative functions created process change
  – Multidisciplinary approach expedited change in culture

• Limitations
  – Single center study with small sample size
  – Inability to account for potential confounders
  – No statistical analysis
  – Short duration of study
FUTURE DIRECTION

• Improved assessments and documentation
  – Continued education on the importance of the use and consistent documentation of standardized assessment tools
  – Next step: consistent documentation of daily awakening trials, spontaneous breathing trials, and CAM-ICU scores

• Increased collaborative involvement
  – Future integration of intensivist management of critically ill patients in the ICU
  – Early physical therapy consult
CONCLUSIONS

• Multidisciplinary driven protocol for pain, agitation, and sedation provides several benefits for institutions
  – Improve patient outcomes for ventilated patients
  – Improves adherence to guideline recommendations and regulatory agency requirements
  – Can positively impact experience of ventilated patients in the ICU

• A uniquely developed scoring tool was an effective way to track adherence to guideline recommended interventions in an effort to improve the care of ventilated patients at St. Peter’s Health
ACKNOWLEDGEMENTS

• St. Peter’s Health ICU and ED nursing staff
  – Nurse champions: Carissa Hatling, Anne Gilbert, Ingrid Radke
• St. Peter’s Health hospitalist group
• Emergency department pharmacists
  – Bill Carr PharmD, BCPS
  – Stephanie Wuerffel PharmD, BCPS
QUESTIONS?

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<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial Expression</td>
<td>Relaxed, neutral</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Tense</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Grimacing</td>
<td>2</td>
</tr>
<tr>
<td>Body Movements</td>
<td>Absence of Movement</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Protection</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Restlessness</td>
<td>2</td>
</tr>
<tr>
<td>Muscle Tension</td>
<td>Relaxed</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Tense, rigid</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very tense/rigid</td>
<td>2</td>
</tr>
<tr>
<td>Compliance with Ventilator</td>
<td>Tolerating ventilator or movement</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Coughing but tolerating</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fighting ventilator</td>
<td>2</td>
</tr>
</tbody>
</table>
## RICHMOND AGITATION-SEDATION SCALE (RASS)

<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Overly combative, violent, immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very Agitated</td>
<td>Pulls or removes tubes or catheters; aggressive</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent, non-purposeful movement, fights ventilator</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious but movements not aggressive or vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert and Calm</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>Drowsy</td>
<td>Not fully alert, but sustained awakening (eye opening to <em>voice</em> and eye contact &gt;10 seconds)</td>
</tr>
<tr>
<td>-2</td>
<td>Light Sedation</td>
<td>Briefly awakens with eye contact to <em>voice</em> (&lt;10 seconds)</td>
</tr>
<tr>
<td>-3</td>
<td>Moderate Sedation</td>
<td>Movement or eye opening to <em>voice</em>, but no eye contact</td>
</tr>
<tr>
<td>-4</td>
<td>Deep Sedation</td>
<td>No response to voice, but movement or eye opening to <em>physical</em> stimulation</td>
</tr>
<tr>
<td>-5</td>
<td>Unarousable</td>
<td>No response to <em>voice or physical</em> stimulation</td>
</tr>
</tbody>
</table>
CONFUSION ASSESSMENT METHOD FOR THE ICU (CAM-ICU)

1. Acute Change or Fluctuating Course of Mental Status:
   - Is there an acute change from mental status baseline? OR
   - Has the patient’s mental status fluctuated during the past 24 hours?

   NO → CAM-ICU negative NO DELIRIUM

   YES → Inattention:
   - “Squeeze my hand when I say the letter ‘A’.”
   - Read the following sequence of letters: S A V E A H A A R T
   - ERRORS: No squeeze with ‘A’ & Squeeze on letter other than ‘A’
   - If unable to complete Letters → Pictures

   0 - 2 Errors → CAM-ICU negative NO DELIRIUM
   > 2 Errors

2. Inattention:
   - RASS other than zero
   - Delirium Present

3. Altered Level of Consciousness
   - Current RASS level
   - RASS = zero

4. Disorganized Thinking:
   - 1. Will a stone float on water?
   - 2. Are there fish in the sea?
   - 3. Does one pound weigh more than two?
   - 4. Can you use a hammer to pound a nail?
   - Command: “Hold up this many fingers” (Hold up 2 fingers)
   - “Now do the same thing with the other hand” (Do not demonstrate)
   - OR “Add one more finger” (If patient unable to move both arms)

   > 1 Error → CAM-ICU positive DELIRIUM Present
   0 - 1 Error → CAM-ICU negative NO DELIRIUM
# COMMON ANALGESICS

<table>
<thead>
<tr>
<th>Drug</th>
<th>Typical Dose</th>
<th>Pharmacokinetics</th>
<th>Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>20-100 mcg/hr</td>
<td>Half-Life: 1.5-6 hr</td>
<td>Nausea, constipation, respiratory depression, skeletal muscle rigidity with high bolus doses</td>
</tr>
<tr>
<td></td>
<td>Optional 50-100 mcg load</td>
<td>Rapid onset</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accumulates with infusion</td>
<td></td>
</tr>
<tr>
<td>Morphine</td>
<td>1-5 mg/hr</td>
<td>Half-life: 3-7 hr</td>
<td>Nausea, constipation, respiratory depression, hypotension, itch</td>
</tr>
<tr>
<td></td>
<td>Optional 2-5 mg load</td>
<td>Slower onset than fentanyl</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less accumulation than fentanyl</td>
<td></td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>0.5-2 mg/hr</td>
<td>Half-life: 1.5-3.5 hr</td>
<td>Nausea, constipation, respiratory depression</td>
</tr>
<tr>
<td></td>
<td>Optional 0.4-1.5 mg load</td>
<td>Significantly more potent than morphine</td>
<td></td>
</tr>
</tbody>
</table>
# COMMON SEDATIVES

<table>
<thead>
<tr>
<th>Drug</th>
<th>Typical Dose</th>
<th>Pharmacokinetics</th>
<th>Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>Bolus: 1-5 mg</td>
<td>Half-Life: 3-11 hr</td>
<td>Possible high risk of delirium than other sedatives,</td>
</tr>
<tr>
<td></td>
<td>Infusion: 1-5 mg/hr</td>
<td>Active metabolite accumulates</td>
<td>tolerance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Renal excretion of metabolites</td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td>50-200 mg/hr OR 1-3 mg/kg/hr</td>
<td>Half-life: 30-60 minutes after infusion</td>
<td>Hypotension, bradycardia, propofol infusion syndrome,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stored in fat, can prolong effects when infusion</td>
<td>hypertriglyceridemia, pancreatitis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stopped</td>
<td></td>
</tr>
<tr>
<td>Dexmedetomidine (Precedex)</td>
<td>0.2-1.5 mcg/kg/hr</td>
<td>Half-life: 2 hr</td>
<td>Hypotension, bradycardia, dry mouth, nausea</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No accumulation, no active metabolites</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES