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Economics in Sedation: Responsible Use of the ICU Budget

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- Pharmacy
- ICU
- Healthcare System
ICU sedation economics: It’s all about perspective

"Oh. Sorry for yelling. I thought you were much farther away."
Pharmacy Drug Budget

The Top “10” List

August 2011
Expenditure ($) by Medication

#1 Oncologic A
#2 Antithrombotic A
#3 Anti-infective A
#4 Erythropoetin

#32 Propofol
#223 Midazolam
ICU Sedation Drug Acquisition Costs Vary Widely Between Agents

Lorazepam 3mg/

hr:

$35

Midazolam 5mg/

Tufts Medical Center 2010 Pricing
Pharmacy Budget

October 2011
Expenditure ($) by Medication

#1 Oncologic A
#2 Antithrombotic A
#3 Anti-infective A
#4 Dexmedetomidine ??
#56 Propofol
#226 Midazolam
Influence of Sedation Practices on Health Care Costs

- ICU costs account for more than 1/3 of total inpatient costs
- Incremental cost of mechanical ventilation = $1522 per day

Medication is a relatively small part of ICU budget.
Use of Continuously Infused Sedatives in the ICU Remains High

Substantial Administrative Pressure to Decrease

↑ RN:Patient ratio
- Impact on level of patient wakefulness?
- Impact on RN compliance to a daily interruption protocol?
- Impact on compliance with delirium screening?

Barrier to hiring additional ICU-based staff
- Critical care pharmacist – development and support of sedation protocols
- PT/OT – early mobilization
- RT – compliance with SBT protocol

Medication is a relatively small part of ICU budget
ICU Budget

Duration of mechanical ventilation
Length of ICU stay
Line infections/VAP
Patient safety
Patient and family satisfaction
ICU Budget

- Duration of mechanical ventilation
- Length of ICU stay
- Line infections/VAP
- Patient safety
- Patient and family satisfaction

- Avoidance of coma
- Avoidance of delirium
- Post-hospital costs of care
- Patient functionality
- Patient long term outcome
ICU drug costs

ICU non-drug costs

↑ return to productivity for ICU survivors = ↑ tax revenue
ICU Sedation: It’s a Balancing

Patient Comfort and Ventilatory Optimization

Oversedation
Influence of Sedation Practices on Health Care Costs: Undersedation

- Tachycardia \(\rightarrow\) myocardial ischemia
- Use of neuromuscular blockers
  - Prolonged neuromuscular weakness common
  - Median $66,713 in additional costs (1995 costs)
- Short and long-term psychological effects
- Cost of device removal
  - 10 patients removed 42 devices (GI/vascular)
  - 74% were “significantly agitated” within 2 hr
  - Total $7606 or $181/event (1997 costs)
  - Annual cost at 42-bed ICU > $250,000

Sedation-induced Coma Is Associated with Higher Mortality

- N=274 patients evaluated throughout MICU admission
  - 32% unarousable
  - 21% no spontaneous motor activity
- Little variation over 24 hours in LOC, motor activity, or drug dose given
- RN perception of adequacy of sedation q4h:
  - Appropriately sedated 83%
  - Undersedated 14%
  - Oversedated 2.6%

Oversedation in ICU Remains Common

Costs of Oversedation in the ICU

↑ Duration of Mechanical Ventilation:

- Ventilator-associated pneumonia:
  - Mean ICU LOS of 6.1 additional days (95% CI, 5.32-6.87)
  - Additional cost of evaluating and treating a patient with VAP = $10,019
- Venous thrombosis:
  - Incremental cost per event = $3,000 (in 2000 $)

↑ Use of Head CT/Neurology Consult

↑ Potential for sedation-related adverse events and withdrawal

- Propofol-related infusion syndrome
- Lorazepam-related propylene glycol toxicity

↑ Potential for PTSD

ICU Delirium Associated with Higher Cost of Hospital Care


ICU Cost

Hospital Cost

$0

$10,000

$20,000

$30,000

$40,000

$50,000

$9,014

$14,730

$41,836

$13,332

$22,346

$27,106

Never Delirium (n=41)

Ever Delirium (n=183)

All p≤0.002
Continuous Infusions of Benzodiazepines: Prolonged Duration of

- Infusions utilized:
  - 26% lorazepam alone
  - 42% lorazepam + fentanyl
  - 24% fentanyl alone
  - 2% propofol

Scheduled Intermittent Lorazepam vs. Propofol With Daily Interruption in MICU

<table>
<thead>
<tr>
<th></th>
<th>Lorazepam</th>
<th>Propofol</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 64</td>
<td>N = 68</td>
<td></td>
</tr>
<tr>
<td>Ventilator days (median)</td>
<td>8.4 (4.6 to 14.7)</td>
<td>5.8 (3.5 to 10.3)</td>
<td>0.04</td>
</tr>
<tr>
<td>ICU LOS</td>
<td>10.4 (6.7 to 16.8)</td>
<td>8.3 (5.2 to 15.2)</td>
<td>0.20</td>
</tr>
<tr>
<td>APACHE II</td>
<td>22.9 ± 7.7</td>
<td>20.7 ± 7.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Daily sedation dose</td>
<td>11.5 (3.8 to 22.7) mg</td>
<td>24.4 ± 16.3 mcg/kg/min</td>
<td>_</td>
</tr>
<tr>
<td>Morphine dose (mg/day)</td>
<td>10.7 (5.4 to 25.8)</td>
<td>31.6 (16.2 to 71.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Use of haloperidol</td>
<td>12%</td>
<td>9%</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Intermittent Lorazepam vs Propofol (DIS in both arms)

DIS = Daily Interruption of Sedation

Propofol Is More Cost–Effective Than Intermittent Lorazepam

- Use of propofol associated with lower total costs ($45,631 vs $52,009)
- Three more ventilator–free days with propofol
- Propofol was less costly or more effective in 94% of the 1000 simulations

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MENDS: Dexmedetomidine vs Lorazepam

- Double-blind RCT of dexmedetomidine (0.15 – 1.5 mcg/kg/hr) vs lorazepam (1–10 mg/hr) infusion titrated to sedation goal (using RASS) established by ICU team
- No daily interruption
- Dexmedetomidine resulted in more time spent within sedation goals than lorazepam

\( P = 0.011 \)

\( P = 0.086 \)

\( P < 0.001 \)

## MENDS Trial: Cost of Care

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Lorazepam (Median, IQR)</th>
<th>Dexmedetomidi (Median, IQR)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacy</td>
<td>20.6 (10,42)</td>
<td>27.4 (16,46)</td>
<td>0.15</td>
</tr>
<tr>
<td>Respirator</td>
<td>2.9 (2,6)</td>
<td>3.5 (2,7)</td>
<td>0.35</td>
</tr>
<tr>
<td>ICU cost</td>
<td>59.5 (36,92)</td>
<td>61.4 (37,108)</td>
<td>0.32</td>
</tr>
</tbody>
</table>

SEDCOM Trial

Time to Extubation

Time to ICU Discharge

A Cost Minimization Analysis of a Clinical Trial Dexmedetomidine vs. Midazolam

• Assumed equal sedation efficacy
  – Cost minimization analysis
• Compared costs of care between groups and selected the therapy generating the lowest cost
• Economic analysis performed post-hoc and from the institutional perspective
• Costs were estimated from multiple

**SEDCOM Cost of Care**

- Median drug costs
  - Dex $1166
  - Midazolam $60

- Total ICU patient savings with Dex: $9679
  - Reduced ICU stay
  - Reduced MV

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† p ≤ 0.01, * 0.01 < p < 0.05
(based on median regression model for each cost component, comparing DEX to MID, controlling for patient race, hospital type, size, geographical location and teaching status)

# p<0.05 when equivalent analysis was done on unadjusted cost.
SEDCOM Trial: Prevalence of Delirium

dexmedetomidine versus midazolam, $P < 0.001$

Remifentanil Analgo-Sedation vs. Conventional Sedation: UltiSAFE

Markov model: Probability to move between remifentanil to conventional sedation group up to a maximum of 28 days

Drug costs + ICU costs from a hospital perspective

Average 28 day total costs:

- Remifentanil: € 15,626
- Conventional sedation: € 17,100

95% CI € 2163 to 5110

Rozendaal FW et al. ICM 2009; 25:291

Paradigm Shift in the Outcomes Being Evaluated in Clinical Research

### Outcomes During ICU Stay
- Time spent within sedation goal
- Episodes of agitation
- Episodes of agitated–related events
- Delirium
  - Prevalence of delirium
  - Days spent with delirium
- Duration of mechanical ventilation
- Duration of ICU stay
- ICU mortality

### Outcomes After ICU Stay
- Disposition and functionality
- Cognition/Dementia
- Sleep quality
- ICU memories/PTSD
- Quality of life
- Depression
- Executive function

Girard TD et al. Crit Care Med 2010; 38:1513-1520
Skrobik Y. Lancet. 2010 Nov 27;376(9755):1805-7
The Cost Implications of Many Outcomes Related to the Administration of Sedation

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Summary

• ICU sedative choice has an influence on ICU cost of care but this very much depends on the perspective of the analysis

• The influence of sedative choice on ICU and post–ICU costs related to coma, delirium and the other psychologic sequelae of critical illness remains unclear.

• Both propofol and dexmedetomidine are more cost–beneficial than benzodiazepines when ICU costs are considered.

• The cost–effectiveness of propofol vs. dexmedetomidine remains unclear.