“Wake Up, Get Up, and Get Out Early”
ICU-Acquired Weakness and Early Rehabilitation in the ICU

Eddy Fan MD, FRCPC
Critical Care Medicine
Mount Sinai Hospital and University Health Network
Assistant Professor of Medicine
Interdepartmental Division of Critical Care Medicine
Department of Medicine, University of Toronto
Disclosures/COI

• No relevant financial relationships with commercial interests

• Funding Support
  – Hospira Corporation (TWH Delirium QI Project)

• I have consent to show the patient photos used in this presentation
There are More ICU Survivors

• Early recognition and aggressive treatment of critical illness in intensive care units (ICU) has led to improved survival in these patients
  – Increasing numbers of ICU survivors have resulted in discovery of significant morbidity among these patients
  – Shift in focus from short-term to long-term outcomes
Table 3. Ability to Exercise and Return to Work and Health-Related Quality of Life among Patients with the Acute Respiratory Distress Syndrome during the First 12 Months after Discharge from the ICU.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>3 Months</th>
<th>6 Months</th>
<th>12 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance walked in 6 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. evaluated</td>
<td>80*</td>
<td>78†</td>
<td>81‡</td>
</tr>
<tr>
<td>Median — m</td>
<td>281</td>
<td>396</td>
<td>422</td>
</tr>
<tr>
<td>Interquartile range — m</td>
<td>55–454</td>
<td>244–500</td>
<td>277–510</td>
</tr>
<tr>
<td>Percentage of predicted value¶</td>
<td>49</td>
<td>64</td>
<td>66</td>
</tr>
<tr>
<td>Returned to work — no./total no. (%)¶</td>
<td>13/83 (16)</td>
<td>26/82 (32)</td>
<td>40/82 (49)</td>
</tr>
<tr>
<td>Returned to original work — no./total no. (%)</td>
<td>10/13 (77)</td>
<td>23/26 (88)</td>
<td>31/40 (78)</td>
</tr>
</tbody>
</table>
Weakness After ICU

• Multi-factorial etiology:
  – Development of critical illness neuromyopathy
  – Systemic inflammation (e.g., sepsis) is independently associated with muscle dysfunction
  – Bed rest associated loss of strength
    • (4 - 5%/wk) in healthy well-nourished subjects
  – Pre-existing weakness due to chronic disease

Berg HE et al., J Appl Physiol 1997;82:182-188.
Nerve and Muscle Damage Occurs Early in the ICU

- Neuropathic and myopathic changes can be detected within 2-3 days
- Loss of muscle thickness is most dramatic in the first 2-3 weeks
- May be accentuated by ICU exposure (sedation/neuromuscular blockade)

*Fig. 1.* Muscle layer thickness changes in group A, from the first (after a random length of stay) to the second measurement (after 28 days) in both thighs.

“What is bad? Everything that arises from weakness.”
Friedrich Nietzsche
Prospective cohort study (103 pts)
- 40% of activities done with ETT, including sit on bed, chair, and walking

14 adverse events in 9 pts (<1% activities)
- Fall to knees, orthostatic hypotension, desaturation, nasal feeding tube removal

Ambulation by RICU day 3 (mean)
- Majority of patients could ambulate >100 ft at RICU discharge

• PT/OT started early (median 1.5 days), while patients were on MV
  – Coordinated with DIS
• Significant improvement in:
  – Independent function at hospital discharge (35 vs. 59%, p=0.02)
  – ICU delirium (2 vs. 4 days, p=0.02)
  – Duration of MV (3.4 vs 6.1 days, p=0.02)

Intervention
• PROM
• AAROM
• AROM
• Bed Mobility
• Transfers (sitting)
• Sitting balance
• ADLs
• Transfers (standing)
• Ambulation

Early Activity is Beneficial

• Early activity is safe and feasible
  – Also demonstrated in other settings (i.e., ventilator-dependent LVAD pts in CSICU)

• Early rehabilitation improves patient outcomes
  – Shorter duration of delirium
  – Decreased MV duration
  – Improved functional outcomes at hospital discharge

Perme CS et al., Tex Heart Inst J 2006;33:130-133.
Barriers

Sustainability
At least 1 potential barrier to mobilization during MV was present in 89% of patient encounters

- ALI
- Vasoactive medications
- Delirium
- Renal replacement therapy
- Obesity (BMI ≥ 30)
Exposure to rehabilitation in JHH MICU is low
  - PT and OT in 17% and 20% of ARDS pts
    • Less than 70% of that at 2 peer hospitals
  - Many barriers to early activity in the MICU
    • Nearly 75% of ALI patients were comatose or delirious
    • Bed rest was default level of activity on admission

Canadian Survey

• PT and MDs in Canadian academic ICUs
• Incidence of ICUAW under-recognized by clinicians
• Common barriers included
  – Lack of guidelines and insufficient equipment (institutional)
  – Medical instability and oversedation (patient)
  – Limited staffing, RN safety concerns, delayed recognition to start early mobility (provider)
Bed rest: a potentially harmful treatment needing more careful evaluation

- 39 studies of 15 different conditions (n=5777)
  - In 24 trials of bed rest following medical procedure, no outcomes improved significantly
    - 8 worsened significantly (LP, spinal anesthesia, radiculopathy, cardiac catheterization)
  - In 15 trials of bed rest as primary treatment, no outcomes improved significantly
    - 9 worsened significantly (acute LBP, labor, pre-eclampsia, MI, acute infectious hepatitis)

“When I make rounds in critical care units these days ... I see ... paralyzed, sedated patients, lying without motion, appearing to be dead, except for the monitors that tell me otherwise.

This was not the case in past.... When we started our ICU in 1964, patients who required mechanical ventilation were awake and alert and often sitting in a chair ... these individuals could interact ... they could feel human ....

By contrast, patients with induced coma ... cannot even maintain muscular tone ... and muscle atrophy begins.

The requirements of high acuity care and available pharmacologic therapy has led to the present situation. The awake and alert patient who is anxious or depressed requires a great amount of interaction with the health care team.... Understanding of the delicate machine/patient interface seems to be lost these days; thus the requirement of sedation and paralysis.”
### Patient Comfort: Components & **Daily** Assessment

<table>
<thead>
<tr>
<th>Pain</th>
<th>Sedation</th>
<th>Delirium</th>
</tr>
</thead>
</table>
| • 0-10 Scale & VAS Scale  
• Subjective & physiologic indicators | Sedation Assessment Scale  
(e.g., RASS, SAS, MAAS) | Confusion Assessment Method - ICU  
(CAM-ICU) |

**SLEEP promotion:** optimize environment; relaxation Tx; drug Tx

ICAP Study – Sedation & Delirium Status

### RASS and CAM-ICU Data

<table>
<thead>
<tr>
<th></th>
<th>13 ICUs, 4 hospitals (n=520)</th>
<th>JHH MICU pts (n=144)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RASS</td>
<td>ICU Days</td>
</tr>
<tr>
<td>Agitated</td>
<td>+1 to +4</td>
<td>259</td>
</tr>
<tr>
<td>Alert and calm</td>
<td>0</td>
<td>1474</td>
</tr>
<tr>
<td>Lightly sedated</td>
<td>-1 to -2</td>
<td>1777</td>
</tr>
<tr>
<td>Moderately sedated</td>
<td>-3</td>
<td>869</td>
</tr>
<tr>
<td><strong>Deeply sedated</strong></td>
<td><strong>-4 to -5</strong></td>
<td><strong>2724</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>7103</strong></td>
</tr>
<tr>
<td></td>
<td>CAM-ICU</td>
<td>ICU Days</td>
</tr>
<tr>
<td>Patient delirious</td>
<td></td>
<td>2353</td>
</tr>
<tr>
<td>Patient not delirious</td>
<td></td>
<td>1245</td>
</tr>
<tr>
<td>N/A (deeply sedated)</td>
<td></td>
<td>2724</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6322</td>
</tr>
</tbody>
</table>

N/A (deeply sedated)
Lorazepam Is an Independent Risk Factor for Transitioning to Delirium in Intensive Care Unit Patients

Prevalence and Risk Factors for Development of Delirium in Surgical and Trauma Intensive Care Unit Patients

Pandharipande PP et al., J Trauma 2008;65:34-41.
Effect of Sedation With Dexmedetomidine vs Lorazepam on Acute Brain Dysfunction in Mechanically Ventilated Patients

The MENDS Randomized Controlled Trial

Pandharipande PP et al., JAMA 2007;298:2644-2653.
A protocol of no sedation for critically ill patients receiving mechanical ventilation: a randomised trial

Thomas Strøm, Torben Martinussen, Palle Toft

<table>
<thead>
<tr>
<th></th>
<th>No sedation (n=55)</th>
<th>Sedation (n=58)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days without mechanical ventilation</td>
<td>13.8 (11.0); 18.0 (0–24.1)</td>
<td>9.6 (10.0); 6.9 (0–20.5)</td>
<td>0.0191*†</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>13.1 (5.7–--)‡</td>
<td>22.8 (11.7–--)‡</td>
<td>0.0316*§</td>
</tr>
<tr>
<td>Hospital</td>
<td>34 (17–65)</td>
<td>58 (33–85)</td>
<td>0.0039*§¶</td>
</tr>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>12 (22%)</td>
<td>22 (38%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Hospital</td>
<td>20 (36%)</td>
<td>27 (47%)</td>
<td>0.27</td>
</tr>
<tr>
<td>Drug doses (mg/kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propofol (per h of infusion)**</td>
<td>0 (0–0.515)</td>
<td>0.773 (0.154–1.648)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Midazolam (per h of infusion)</td>
<td>0 (0–0)</td>
<td>0.0034 (0–0.0240)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Morphine (per h of mechanical ventilation)</td>
<td>0.0048 (0.0014–0.0111)</td>
<td>0.0045 (0.0020–0.0064)</td>
<td>0.39</td>
</tr>
<tr>
<td>Haloperidol (per day of mechanical ventilation)</td>
<td>0 (0–0.0145)</td>
<td>0 (0–0)</td>
<td>0.0140</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>16 (29%)</td>
<td>17 (29%)</td>
<td>0.98</td>
</tr>
<tr>
<td>Ventilator-associated pneumonia</td>
<td>6 (11%)</td>
<td>7 (12%)</td>
<td>0.85</td>
</tr>
</tbody>
</table>
Early Physical Medicine and Rehabilitation for Patients with Acute Respiratory Failure: A Quality Improvement Project

• 7-month prospective before/after QI project
  – MV ≥ 4 days in 16-bed medical ICU
• Multifaceted QI intervention
  – Change default MICU admission activity level from “bed rest” to “as tolerated”
  – Change in sedation practice from continuous infusions to “as needed” bolus doses
  – Establishing and disseminating simple guidelines for PT/OT consultation
  – Develop safety guidelines for rehab eligibility

### Early Physical Medicine and Rehabilitation for Patients With Acute Respiratory Failure: A Quality Improvement Project

**Dale M. Needham, MD, PhD, Radha Korupolu, MBBS, MS, Jennifer M. Zanni, PT, MSPT, Pranoti Pradhan, MBBS, MPH, Elizabeth Colantuoni, PhD, Jeffrey B. Palmer, MD, Roy G. Brower, MD, Eddy Fan, MD**

<table>
<thead>
<tr>
<th></th>
<th>Control Period (May-Aug 2006)</th>
<th>QI Period (May-Aug 2007)</th>
<th>Relative Change</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical and Occupational Therapy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of consultations</td>
<td>215</td>
<td>548</td>
<td>✈154%</td>
<td>0.04</td>
</tr>
<tr>
<td>Total number of treatments</td>
<td>210</td>
<td>810</td>
<td>✈286%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Data for MICU Patients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of admissions</td>
<td>262</td>
<td>314</td>
<td>✈20%</td>
<td>0.55</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td>23.3%</td>
<td>21.0%</td>
<td>↓10%</td>
<td>0.02</td>
</tr>
<tr>
<td>MICU average length of stay, days</td>
<td>7.0</td>
<td>4.9</td>
<td>↓30%</td>
<td>0.03</td>
</tr>
<tr>
<td>Hospital average length of stay, days</td>
<td>17.2</td>
<td>14.1</td>
<td>↓18%</td>
<td></td>
</tr>
</tbody>
</table>

Decreased length of stay estimated to translate into a net financial benefit of $4.3 million (USD)

1. Establish a sense of urgency
2. Creating a powerful guiding coalition
3. Creating a vision
4. Communicating the vision
5. Empowering others to act on the vision
6. Planning for and creating short-term wins
7. Consolidating improvements and producing still more change
8. Institutionalizing new approaches
Sustainability

• A multifaceted, multidisciplinary team approach can lead to mobility culture
  – ICU delirium, physical rehabilitation, and functional mobility were markedly improved

• Creation of a hospital-funded Critical Care Physical Medicine and Rehabilitation Program to sustain these efforts

• MEASURE YOUR SUCCESS
  – Power of positive anecdotes for local change
Quality Improvement into Practice

56 year-old MICU patient on Day 4 of mechanical ventilation via an oral endotracheal tube.

Unlike before QI project, he is not deeply sedated or delirious.

He is alert, sitting in chair, and writing notes to communicate.
PARADIGM SHIFT

Eduard E. Vasilevskis, MD; E. Wesley Ely, MPH, MD, FCCP; Theodore Speroff, PhD; Brenda T. Pun, RN, MSN, ACNP; Leanne Boehm, RN, MSN, ACNS-BC; and Robert S. Dittus, MPH, MD
“Nothing is more powerful than an idea whose time has come.”
Victor Hugo

QUESTIONS?

efan@mtsinai.on.ca

Learn how we are improving ICU patients’ outcomes at our Outcomes After Critical Illness and Surgery (OACIS) website: www.hopkinsmedicine.org/OACIS