Objectives

- Discuss the evidence surrounding early mobility and rehabilitation in the ICU.
- Apply the knowledge-to-action framework to early physical therapy with patients with critical illness.
- Discuss practical strategies to measure implementation success.

Why is early rehabilitation in the ICU important?

- By 2026, the anticipated need for mechanical ventilation will increase by 80% Outlook. Med. 2005;38(3):574-579.
- Long-term physical disability (6 minute walk) persists up to 5 years post-ICU JAMA. 2011; 364(14):1293-1304.
- Lower levels of physical fitness are directly associated with all-cause mortality and cardiovascular disease JAMA. 1989; 262(17):2395-2401.

Prospective 9-month follow-up study of 95 mechanically ventilated patients

Setting: 5 French ICUs (2 surgical, 3 medical)
Population: Adult patients mechanically ventilated >7 d
Outcomes: ICU-Acquired Paresis: MRC Sumscore (<48/60)
- 3 upper (shoulder abduction, elbow flexion, wrist extension)
- 3 lower (hip flexion, knee extension, ankle dorsiflexion)
Clinical Course
- 7 Days M
- Awake
- Weekly for 1st month
- Manual muscle testing for ICU-acquired paresis
- Monthly until resolution of ICUAP or 9 months
Results: Incidence of ICUAP = 25.3% [16.9, 35.2]

Prospective 1 and 5-year follow-up study of 109 ICU survivors

Setting: 4 Canadian ICUs
Population: Adult patients with ARDS
Outcomes: 6 minute walk test
- Primary — 6 minute walk test
- Pulmonary function tests
- Health-related quality of life
Clinical Course
- 3 months
- 6 months
- 12 months
- 60 months
6 minute walk distance
- N=83 281 m 49% predicted
- N=82 286 m 64% predicted
- N=83 422 m 66% predicted
- N=64 436 m 76% predicted

RCT of early PT/OT in the ICU

Primary Outcome: Independent functional status @ hospital discharge (6 ADLs + independent walking)
Medical ICU
- Daily interruption of sedation + Early OT/PT
N=49
59% (29/49)
p=0.02
- N=55
35% (19/55)
Lenert 2009; 373: 1874-82
**Randomization**
- Contamination: None
- Cointerventions: No

**Enrolled**

**Analysis**
- Blinding: Concealment by patients randomized
- Outcome: Randomization
- Assessors: Randomized

**Outcome**

**Intervention**
- PROM: Median start 100%
- AROM: Median start 100%
- Bed Mobility: Median start 100%
- Transfers (sitting): Median start 100%
- Transfers (standing): Median start 100%
- Ambulation: Ambulation as appropriate

**Median time to start therapy (d)**
- Intervention: 1.5 [1.0 to 2.1]*
- Control: 7.4 [6.0 to 10.9]

**Median duration of therapy (h/d)**
- During MV: 0.32 [0.17 to 0.48]*
- During no MV: 0.21 [0.08 to 0.33]

* = p<0.01

0.32 h/d = 19.2 minutes

**Primary outcome:**
- 6 minute walk distance @ hospital discharge (x=50 m)

**RCT of cycling in the ICU**
- Primary outcome: 196 m [126-329m] N=26 p<0.05
- 143 m [37-226m] N=32

**Are the patients similar to yours?**

**Methodological Critical Appraisal**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Schweickert et al. (early rehab)</th>
<th>Burtn et al. (cycling)</th>
</tr>
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<tbody>
<tr>
<td>Randomization</td>
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</tr>
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</tr>
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<td>✓</td>
</tr>
<tr>
<td>Enrolled patients contributing to primary outcome analysis</td>
<td>100% (23 died and assigned scores of 0)</td>
<td></td>
</tr>
<tr>
<td>Cointerventions</td>
<td>No imbalances</td>
<td></td>
</tr>
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<td>Contamination</td>
<td>None</td>
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**Are the patients similar to yours?**

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<tr>
<th>Criteria</th>
<th>Schweickert et al. (early rehab; N=49)</th>
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<td># centers</td>
<td>2 in USA</td>
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**Patients receiving early rehab had less ICU and hospital delirium**

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<tr>
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<th>Intervention N=49</th>
<th>Control N=55</th>
<th>p value</th>
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<tr>
<td>ICU delirium (days)</td>
<td>2.0 [0.0 to 6.0]</td>
<td>4.0 [2.0 to 7.0]</td>
<td>0.03</td>
</tr>
<tr>
<td>Time in ICU with delirium (%)</td>
<td>33% [0 to 58]</td>
<td>57% [33 to 69]</td>
<td>0.02</td>
</tr>
<tr>
<td>Hospital delirium (days)</td>
<td>2.0 [0.0 to 6.0]</td>
<td>4.0 [2.0 to 8.0]</td>
<td>0.02</td>
</tr>
<tr>
<td>Hospital days with delirium (%)</td>
<td>28% (26)</td>
<td>41% (27)</td>
<td>0.01</td>
</tr>
</tbody>
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**Burtin et al., Crit Care Med. 2009. 37(9): 2499-2505.**

**Methodological Critical Appraisal**

It’s about receiving therapy while on mechanical ventilation

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**0.32 h/d = 19.2 minutes**

Lancet 2009; 373: 1874-82

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**RCT of cycling in the ICU**

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Implementing the research in your setting

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<th>Burtin et al. (cycling)</th>
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</thead>
<tbody>
<tr>
<td>Expertise-Dependent</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Frequency of intervention (planned/actual)</td>
<td>Daily, until achieving independence or hospital discharge / 87%</td>
<td>5 days/wk / 4 days/wk</td>
</tr>
<tr>
<td>Intervention Details</td>
<td>No specific description of individualized tailoring</td>
<td>• 45% / 87% active cycling 1st / last ICU session</td>
</tr>
<tr>
<td>Adverse events</td>
<td>• 1 desaturation &lt;80% (0.2%)</td>
<td>• None of pre-specified</td>
</tr>
<tr>
<td></td>
<td>• 19/498 (4%) sessions terminated early</td>
<td>• 16/425 (4%) cycling sessions terminated early</td>
</tr>
<tr>
<td></td>
<td>• Dropouts: 1 Achilles tendon rupture, 2 cardiorespiratory instability</td>
<td>• Dropouts: 1 cycling sessions terminated early</td>
</tr>
</tbody>
</table>

Knowledge to Action Framework

- KT is legislated in Canada
- 2 key concepts
  - Knowledge Creation
  - Action
- Process is complex and dynamic, boundaries are fluid and permeable
- Key reference:

But, how EXACTLY do we implement knowledge at the bedside?

Translating evidence into practice: a model for large scale knowledge translation

Citation:

Quality improvement exemplar:

Rehabilitation Quality Improvement in an Intensive Care Unit Setting: Implementation of a Quality Improvement Model

Citation:

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

Citation:

Additional information:

mkho1@jhmi.edu / khome@mcmaster.ca
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1. Summarize the evidence:
RCT of early PT/OT in the ICU

**1º Outcome:**
Independent functional status at hospital discharge (FIM + independent walking)

**2º Outcomes:**
- # hospital days w delirium
- ICU / Hospital LOS
- Barthel Index score
- Functionally independent ADLs
- Distance walked without assistance
- ICU-acquired weakness
- ICU / Hospital hand grip

**Results**

<table>
<thead>
<tr>
<th>Primary Outcome of RCT</th>
<th>Intervention</th>
<th>Control</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td># hospital days w delirium</td>
<td>75 (73-75)</td>
<td>97 (97-100)</td>
<td>0.07</td>
</tr>
<tr>
<td>ICU / Hospital LOS</td>
<td>15 (31%)</td>
<td>27 (43%)</td>
<td>0.69</td>
</tr>
<tr>
<td>Barthel Index score at hospital discharge</td>
<td>75 (73-75)</td>
<td>95 (95-100)</td>
<td>0.05</td>
</tr>
<tr>
<td>ICU-acquired weakness</td>
<td>34 (23-72)</td>
<td>64 (46-78)</td>
<td>0.02</td>
</tr>
<tr>
<td>Ventilator-free days</td>
<td>4 (0-4-6)</td>
<td>8 (0-6-8)</td>
<td>0.03</td>
</tr>
<tr>
<td>Length of stay ICU (days)</td>
<td>5 (4-9-12)</td>
<td>7 (5-10-12)</td>
<td>0.14</td>
</tr>
<tr>
<td>Safety events during PT</td>
<td>3 (1-8)</td>
<td>14 (7-18)</td>
<td>0.02</td>
</tr>
<tr>
<td>Discharge to home</td>
<td>21 (43%)</td>
<td>13 (24%)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Lancet 2009; 373: 1874-82

2. Identify local barriers to implementation: understand the process and context of work

- Observe staff performing the interventions
- “Walk the process” to identify defects in each step of intervention implementation
- Enlist all stakeholders to share concerns and identify potential gains/losses associated with intervention implementation

Understanding barriers specific to the project is key to designing the correct KT intervention
(Shojania Health Affairs 2005)

3. Measure performance

- Select measures (process and/or outcome)
- Develop and pilot test measures
- Measure baseline performance

**Example performance measures (Table 2):**
- Staffing: Proportion of ICU patients with no therapy
- Sedation: Proportion of patients ever receiving narcotics or benzos
- Safety: Safety events during PT
- Benefits: ICU and Hospital LOS


4. Ensure all patients receive the interventions

- Implement the “Four Es” targeting key stakeholders from front line staff to executives
  - **Engage** Explain why the interventions are important
  - **Evaluate** Regularly assess for unintended consequences and unintended consequences
  - **Educate** Share the evidence supporting the interventions
  - **Execute** Design an intervention “toolkit” targeted to barriers, employing simplification, independent work, and reminders, and learning from mistakes

4. Ensure all patients receive the interventions: **Engage**

**Engage** stakeholders to understand why interventions important

- Invited patients to return to MICU to share stories (e.g. weakness, physical impairment)
- Share data regarding MICU performance vs peer hospitals
- Invite guest speakers to discuss their approach

4. Ensure all patients receive the interventions: **Educate**

**Educate** stakeholders of evidence supporting interventions

- QI research made available to staff via:
  - newsletter, posters, bulletin boards & invited speakers
- PT & OT educate RNs on interventions
- RT orient PTs to vent settings for ambulating patients
- 2 large group training sessions held with RRs
- 16 small group discussions with RNs by MICU physician

4. Ensure all patients receive the interventions: **Execute**

**Execute:** design an intervention “toolkit” targeted at barriers

- Tips: standardization, checks/reminders, & convenience
- Dedicated PT and OT in the MICU
- Simple guidelines for PT & OT MICU consult
- Coordinator screens patients & prompts MD for PT referral
- Patients screened daily by PT/OT for mobilization activity
- MICU tech assists PT & OT with patient mobilization

4. Ensure all patients receive the interventions: **Evaluate**

**Evaluate:** regularly assess performance & unintended problems

- Review performance measures at weekly meetings
  - # PT consults completed daily
  - % of treatments with “sitting at edge of bed” or greater
  - MICU & Hospital Length of Stay
- Discuss any problems that arise
- Brainstorm ways to resolve unintended problems

**Results of Johns Hopkins MICU Rehab QI Project:**

- **Staffing:** ↑ PT consults: 59% vs. 93% of pts (p=0.04)
- **Staffing:** ↓ ICU days with no PT/OT: 41% vs. 7% (p=0.004)
- **Sedation:** Significant ↓ in sedative drug use & deep sedation
  - Median Narc: 71 vs. 24 mg/day (p=0.01), Benz: 47 vs. 15 mg/day (p=0.00)
  - MICU days alert: 30 vs. 67% (p=0.001)
  - No difference in pain scale (0-10): 0.6 vs. 0.6 (p=0.79)
- **Benefits:** More ICU days without delirium
  - No delirium: 21% vs 53% (p=0.003)
- **Benefits:** ↓ MICU & hosp LOS by 30% and 18%, respectively (p<0.03)

**Timeline of the MICU QI Project**

1. Summarize evidence
2. Identify barriers
3. Measure performance
4. Ensure all patients receive the interventions

<table>
<thead>
<tr>
<th>Year</th>
<th>Engage</th>
<th>Educate</th>
<th>Execute</th>
<th>Evaluate</th>
</tr>
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<tbody>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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**Arch Phys Med Rehabil. 2010;91:536-42.**

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