Effective Strategy to Reduce Readmission to Intensive Care Unit:
A Quasi-experimental Study with Historical Control Group

Dr. SO Hang Mui, Nurse Consultant (Intensive Care)
Pamela Youde Nethersole Eastern Hospital
Hong Kong SAR
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Introduction

- High ICU readmission: 6.7% in the study site
- ICU readmitted patients:

- 40% Respiratory failure
- 2-10X Higher mortality
- 2X Hospital LOS

(Tam et al., 2014; Timmers et al., 2012)
Overseas Improvement Programmes

- Establish an outreach team
  - Critical Care Outreach Team
  - ICU Liaison Nurse
  - Patient At Risk Team
  - Medical Emergency Team
  - Rapid Response Team

- Interventions:
  - Bedside support to critically ill patients
  - Skill transfer at bedside to empower ward nurses’ competency to early detect patients at risk of deterioration

Griffiths & Jones, 2002
Summary of Evidences on Measures to Address ICU Readmission (15 studies)

3 RCT

No significant difference in hospital mortality
Hillman et al. 2005

Significant ↓ in mortality
(Adjusted OR=0.52; 95% CI 0.32-.85)
Priestley et al. 2004

No ICU readmission in both group
Tabamekas et al. 2016
Critical Care Transition Programs and the Risk of Readmission or Death After Discharge From an ICU: A Systematic Review and Meta-Analysis*

Daniel J. Niven, MD, MSc, FRCP C\(^1,2,3\); Jaime F. Bastos, MD, PhD\(^1,2,4\); Henry T. Stelfox, MD, PhD, FRCP C\(^1,2,3,5\)

Include 8 before and after intervention studies

9895 Intervention

6538 control

Post-ICU Discharge Follow-up

No

risk of ICU readmission

(RR, 0.87 95% CI 0.76-0.99, \(p=0.03\)).

Niven, Bastons & Stelfox, 2013
Summary of Evidences on Measures to Address ICU Readmission

Before and after study designs with post-ICU discharge patients only

- **↓** in ICU readmission by 1.8% to 6.4%  
  (Ball et al, 2003; Pirret, 2008; Green & Edmonds, 2004; Baxter et al, 2008)

- **↓** hospital mortality significantly  
  (Harrison et al., 2010)

- Critical care outreach team might be one of the ways to reduce ICU readmission  
  Evaluation of outreach services in critical care. NHS Project, Department of Health, UK 2002

- **No** difference in ICU readmission  
  (Garcea et al, 2004; Pittard, 2003; Leary & Ridley, 2003; Williams et al 2010; Stelfox et al., 2016)
Gaps Identified

- No clear typology of outreach services
- Wide variations in
  - **Population**:
  - **Intervention**:
  - **Outcome**:
  - **Composition of outreach team**:
- **Inconsistent evidence**
  - Criticized as “black-box” evaluations
    - (Dodds et al., 2013; Sidani & Braden, 1997, Walshe, 2007)
  - No post ICU discharge FU service in the study site
The Purposes of the Study

To evaluate the effect of an ICU Follow-up (ICU FU) Programme on the ICU readmission rate and the mortality rate among post-ICU discharge patients with respiratory problem during their first ICU admission as compared to the historical comparison group.

Study design: A quasi-experimental study with a historical control group
Maintain continuity of care through
✓ Direct communication
✓ Direct nursing care
✓ Perceived improvement in competency
✓ Perceived increases in support from Outreach Team

Use Program Theory to guide the planning, implementation and evaluation of the ICU FU Program.
The ICU FU Programme: Intervention

1. Proactive post-ICU discharge follow-up visits
2. A revised Modified Early Warning Score with a lower trigger score (MEWS ≥ 3)
3. Standardized vital signs monitoring
4. Clinical bedside teaching
5. Support to the needed upon ward nurses’ call

NICE clinical guideline 50

The historical control group: NO ICU FU Programme
The Study Protocol

The Critical Care Outreach Team

- Consist of
  - one Nurse Consultant
  - one Advanced Practice Nurse
- Supported by ICU doctors
- Cover 7 days/week
- 09:00-17:00

Fit inclusion criteria & Exclusion criteria

Sign the consent form

Receive ICU FU Program

Terminate ICU FU Program
- Complete 3 FU visits, or
- Readmit to ICU within 72h, or
- discharge home, or
- die
Study Participants

- ICU patients ready for transfer out to wards

Inclusion criteria
- 1st ICU admission
- ICU stay for ≥ least 24 hours, and
- Had respiratory problem in form of the following risk factors:
  - Pulmonary problems
  - Use of non-invasive mechanical ventilation
  - Patient with tracheostomy

(Timmers et al., 2012; Tam et al., 2014)

Exclusion Criteria
- Pediatric patients aged < 18 years old
- Patients were transferred to other hospitals or transferred to Cardiac Care Unit of the same hospital directly from ICU
ICU Follow-up Programme

ICU Outreach Team

Provide follow-up to intervention group at ward daily for 3 times

Perform patient assessment and provide care

Patient's GC = serious

No

Monitor patient's vital signs*

Yes

Call ICU doctor for review

Patient's GC improved

Yes

No

Patient's GC fit ICU admission criteria

Yes

For ICU readmission

No

GC = general condition

*Nurse at ward performs MEWS:
Day 0 Q4H
Day 1 QID + nocte
Day 2 QID
# Data Collection Period & Outcome Measures

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of patients</strong></td>
<td>185</td>
<td>184</td>
</tr>
<tr>
<td><strong>Data collection method</strong></td>
<td>Prospective with a structured data collection form, CIS &amp; CMS</td>
<td>Retrospective via CIS &amp; CMS</td>
</tr>
</tbody>
</table>

## Outcomes

<table>
<thead>
<tr>
<th>Outcome Type</th>
<th>Measures</th>
<th>Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>ICU readmission within 72 hours</td>
<td>Chi square test/ t-test</td>
</tr>
<tr>
<td>Secondary</td>
<td>All ICU readmission Hospital morality and 90-day morality</td>
<td>(IBM SPSS Statistics Version 24)</td>
</tr>
<tr>
<td>Process</td>
<td>Patient’s satisfaction using an Visual Analog Scale</td>
<td>Descriptive</td>
</tr>
</tbody>
</table>
Results and Discussion
## Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Patients</th>
<th>Intervention group (n= 185)</th>
<th>Control group (n=184)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>119 (64.3)</td>
<td>125(67.9)</td>
<td>0.464</td>
</tr>
<tr>
<td>Mean age (±SD)</td>
<td>64.4 ± 15.5</td>
<td>68.5 ± 16.3</td>
<td>0.014</td>
</tr>
<tr>
<td>APACHE IV score: Mean (±SD)</td>
<td>78.85 (31.75)</td>
<td>86.76 (29.73)</td>
<td>0.014</td>
</tr>
<tr>
<td>GCS: Median (IQR)</td>
<td>14 (7-15)</td>
<td>11 (6–15)</td>
<td>0.027</td>
</tr>
<tr>
<td>ICU LOS: Mean (±SD)</td>
<td>11.72 (10.05)</td>
<td>10.44 (14.86)</td>
<td>0.331</td>
</tr>
<tr>
<td>Parent Specialties (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>119 (64.3)</td>
<td>117 (63.6)</td>
<td>0.883</td>
</tr>
<tr>
<td>Non-medical wards</td>
<td>66 (35.7)</td>
<td>67 (36.4)</td>
<td></td>
</tr>
<tr>
<td>Admission type (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-operation</td>
<td>135 (73)</td>
<td>140 (76.1)</td>
<td>0.492</td>
</tr>
</tbody>
</table>

Control group: older, higher mean APACHE IV score and lower GCS
## Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Patients</th>
<th>Intervention group (n= 185)</th>
<th>Control group (n=184)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease category (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>79 (42.7)</td>
<td>68 (37)</td>
<td>0.003</td>
</tr>
<tr>
<td>Neurosurgical/ neurological</td>
<td>37 (20)</td>
<td>28 (15.2)</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>36 (19.5)</td>
<td>24 (13)</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>11 (5.9)</td>
<td>33 (17.9)</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>8 (4.3)</td>
<td>16 (8.7)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>14 (7.6)</td>
<td>15 (8.2)</td>
<td></td>
</tr>
<tr>
<td>No. of Co-morbidities (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>159 (85.9)</td>
<td>141 (76.6)</td>
<td>0.005</td>
</tr>
<tr>
<td>1</td>
<td>21 (11.4)</td>
<td>42 (22.8)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5 ( 2.7)</td>
<td>1 ( 0.6)</td>
<td></td>
</tr>
</tbody>
</table>

Control group: older and having more patients with CVS problems, accounting for comorbidities and higher APACHE IV score.
## Baseline Patient Characteristics

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<thead>
<tr>
<th>Patients</th>
<th>Intervention group (n= 185)</th>
<th>Control group (n=184)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers of risk factors (%)</td>
<td></td>
<td></td>
<td>0.097</td>
</tr>
<tr>
<td>1</td>
<td>62 (33.5)</td>
<td>74 (40.2)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>104 (56.2)</td>
<td>101 (54.9)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>19 (10.3)</td>
<td>9 (4.9)</td>
<td></td>
</tr>
<tr>
<td>Risk factors (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory rate ≥ 26/min</td>
<td>88 (47.6)</td>
<td>138 (75)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Non-invasive mechanical ventilation</td>
<td>49 (26.5)</td>
<td>80 (43.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor coughing effort /moderate amount of</td>
<td>76 (41.1)</td>
<td>41 (22.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>114 (61.6)</td>
<td>44 (23.9)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Different types of risk factors
Outcomes: Early ICU & Total ICU Readmission Rate

ICU readmission <72 h

- Intervention group: 3/185 (1.6%)
- Control group: 17/184 (9.2%)

ICU readmission <72 h

- Intervention group: 18/185 (9.7%)
- Control group: 44/184 (23.9%)

p=0.001

p<0.001
Independent Factors to Predict Reduction of Early ICU Readmission by Logistic Regression

<table>
<thead>
<tr>
<th>Factors</th>
<th>$\beta$</th>
<th>Adjusted Odds ratio</th>
<th>95% CI</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>-1.847</td>
<td>0.158</td>
<td>0.041-0.602</td>
<td>0.007</td>
</tr>
<tr>
<td>Medical wards</td>
<td>-1.327</td>
<td>0.265</td>
<td>0.095-0.741</td>
<td>0.011</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>-1.622</td>
<td>0.198</td>
<td>0.042-0.927</td>
<td>0.04</td>
</tr>
</tbody>
</table>

ICU FU Programme contributes significantly to early ICU readmission
Reduction of All ICU Readmission

- From 23.9% to 9.7% ($p<0.001$)

Determinants for successful outcomes

1. Direct communication
2. Direct patient care
3. Perceived improved competency in respiratory care
4. Perceived increased support from ICU Outreach Team
## Outcomes: Hospital Mortality

<table>
<thead>
<tr>
<th></th>
<th>Intervention group (n= 185)</th>
<th>Control group (n=184)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital mortality (%)</td>
<td>33 (17.8)</td>
<td>49 (26.6)</td>
<td>0.042</td>
</tr>
<tr>
<td>90-day mortality (%)</td>
<td>29 (15.7)</td>
<td>42 (22.8)</td>
<td>0.081</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors</th>
<th>β</th>
<th>Adjusted Odds ratio</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>-0.474</td>
<td>0.622</td>
<td>0.362-1.069</td>
<td>0.086</td>
</tr>
</tbody>
</table>
### Types and Frequency of Suggested Treatment / Nursing Actions Performed during FU visits

<table>
<thead>
<tr>
<th>Suggested treatment /nursing actions</th>
<th>Total FU= 531</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; FU visit (n=183)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; FU visit (n=174)</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; FU visit (n=170)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suggested treatment/nursing actions (%)</td>
<td>Yes</td>
<td>110 (60.1)</td>
<td>81 (44.3)</td>
<td>63 (34.3)</td>
</tr>
<tr>
<td>Types (frequency)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid management</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Medication</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Microbiology workup</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Management of MV</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Blood test</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Refer to chest physiotherapy</td>
<td>19</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Refer to other allied health services</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Perform tracheal suction</td>
<td>32</td>
<td>24</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>guide tracheostomy management</td>
<td>31</td>
<td>23</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Optimize patient’s position</td>
<td>19</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Others:</td>
<td>68</td>
<td>50</td>
<td>39</td>
<td></td>
</tr>
</tbody>
</table>
# Time and Staff Required for FU Visit

<table>
<thead>
<tr>
<th>Resources allocation</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; FU (n=183)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; FU (n=174)</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; FU (n=170)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total FU=531 (81hrs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total time spent, min (hr)</td>
<td>1836 (30.6)</td>
<td>1576 (26.3)</td>
<td>1403 (23.4)</td>
</tr>
<tr>
<td>Time / visit, (min) Mean ± SD</td>
<td>10.03 ± 5.54</td>
<td>9.06 ± 5.30</td>
<td>8.25 ± 5.00</td>
</tr>
<tr>
<td>Conduct FU visit by (%)</td>
<td>Nurse Consultant (NC)</td>
<td>91 (49.7)</td>
<td>78 (42.6)</td>
</tr>
<tr>
<td></td>
<td>Advanced Practice Nurse (APN)</td>
<td>32 (17.5)</td>
<td>29 (15.8)</td>
</tr>
<tr>
<td></td>
<td>ICU doctor</td>
<td>58 (31.7)</td>
<td>66 (36.1)</td>
</tr>
</tbody>
</table>

**Estimated net saving of HK$ 1,135,792**

(Reduction of 14 early ICU-readmission)
High Patient Satisfaction Survey

91 returns

Mean satisfaction score: 92
### Measures to Tackle Challenges

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Measures</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Busy ward environment</td>
<td>A4-size poster on top of patient’s file for reminder</td>
<td>Ward staff knew what was expected for the programme</td>
</tr>
<tr>
<td>2. ICU doctors verbalized embarrassment to FU patient in special care units as there were specialists</td>
<td>Nurse team members were responsible to FU these patients. ICU doctors as back-up</td>
<td>ICU Outreach Team satisfied</td>
</tr>
<tr>
<td>3. Lack of equipment/accessories to support continuity of care</td>
<td>ICU was the last resort to support if there was no other alternatives</td>
<td>Some unit considered to buy e.g. heated humidifier for tracheostomy care</td>
</tr>
</tbody>
</table>
Strengths and Limitations

Strengths
- Theory-driven evaluation
- History threats were addressed

Limitations
- Non-randomized sample allocation
- Social response to questionnaire
- Hawthorn effect
Implication and Recommendations for Nursing Practice

- **ICU FU Program**
  - A platform for continuity
  - Enable NC for knowledge transfer
  - Build trusting relationship
  - Promote ICU service without wall
  - Collaborate with Physio partners to review chest physiotherapy provision
  - Hospital wide system approach
Conclusions: ICU FU Programme

- Highly recommend the development of ICU FU Programme as an integral part of ICU service in future.
- Early ICU readmission and total ICU readmission.
- Patient satisfaction score.
Acknowledgement

1. Study participants
2. ICU Outreach Team
   • Ms. Li Siu Chun, APN
   • Dr Natalie Leung
   • Dr Lau Chun Wing
   • Dr Grace Lam
   • Dr Shum Hoi Ping
   • Dr Lili Chang
   • Dr Tang Kin Bond
   • Dr Yan Wing Wa
3. ICU nurse managers
4. Nurses of ICU & from collaborative departments
5. Partners from Physiotherapy Department
Co-authors:

Dr YAN Wing-wa,
Chief of Service,
Department of Intensive Care,
Pamela Youde Nethersole Eastern Hospital, Hong Kong SAR, China.

Prof. CHAIR Sek-Ying,
Director and Professor,
The Nethersole School of Nursing,
The Chinese University of Hong Kong, Hong Kong SAR, China.

The End
Reference


• Timmers TK. (2012). Patients’ characteristics associated with readmission to a surgical intensive care unit. American Journal of Critical Care, 21(6), e120. doi:10.4037/ajcc2012773


**PY ICU**

(Attachment: This information sheet to patient’s file upon patient’s transfer out of ICU)

<table>
<thead>
<tr>
<th>Recommended frequency of vital signs observation</th>
<th>Day 0</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>On the day of transfer out ICU to general ward</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>Q4H+prn</td>
<td>QID+ Nocte</td>
<td>QID</td>
<td>Once /shift, or decided by parent team doctor</td>
</tr>
<tr>
<td><strong>ICU FU visit</strong></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Consultation service**

- **Weekdays** 9am-5pm: If patient’s MEWS ≥ 3 or patient’s condition causes concern, call 64600482 (SO Hang Mui, NC, ICU), ICU Outreach Team Coordinator or Li Siu Chun, APN, ICU at 64600619.

- **Other times**: Support by ICU team doctors

**Expected date of implementation**

In September 2015