Readmissions to Intensive Care: A Prospective Multicenter Study in Australia and New Zealand

CCM February 2017
Introduction

• Readmission to ICU during same hospital admission is uncommon event with benchmark rate 4.0-6.3 per 100 patient discharges

• Patients readmitted to ICU reported to have increased mortality, longer ICU and hospital LOS and increased costs

• ICU readmissions considered a “failure of clinical care” and included by authors and bodies as ICU quality of care indicators

• Identification of risk factors for ICU readmission therefore considered important and subject to previous investigations
Introduction

• Investigations have attempted to identify risk factors on the assumption that readmissions are preventable and independently contribute to worse outcome

• May not be the case

• Costly and complex interventions have been devoted to the prevention of readmission but have met with unclear benefits

• Discharge and Readmission Evaluation study (DARE) undertaken to examine impact of ICU discharge process on hospital mortality and characterise ICU readmissions in a prospective study
Introduction

• Followed 10000 patients discharged from ICU to ward and collected detailed information on clinical condition at time of discharge, final outcome as well as their readmissions to ICU

• In this study, aimed to describe demographics and outcomes of patients readmitted to ICU and to determine whether readmission to ICU is independent predictor of outcome
Material and Methods

• 40 ICUs in Australia (n=33) and New Zealand (n=7)
• Study outcomes
  1. Readmission to ICU during same hospital admission
  2. Hospital mortality
Data Collected

• Demographic details
• Admission and discharges date/time
• Primary admission diagnosis
• Need for advanced therapies during each ICU admission
• Markers of severity of illness at time of ICU discharge
  • Tracheostomy
  • Inotropic drug infusion
  • NIV
  • RRT
  • Parenteral nutrition
  • GCS<15
  • Presence of documented orders that limited future medical Rx
• Discharges determined to be premature or delayed by intensivist on duty
• Presence of written discharge summary, clinical handover and timing of post-ICU nursing and medical review observations also recorded
• At time of readmission to ICU, clinicians were asked:
  1. Was the readmission **planned** (e.g. booked for ICU bed following surgery or procedure) or **unplanned** (clinical deterioration or cardiac arrest on ward etc.)
  2. Was the original ICU discharge (in retrospect) premature?
  3. If optimal care had been provided, was the readmission avoidable?
Readmissions

• Further characterised as:
  • Elective correction of underlying problem
  • Management of original medical or surgical problem
  • Management of new medical or surgical problem

• Characterised as:
  • Early (<72hr)
  • Late (>72hr)
Data Collection

• Oct 2009-Feb 2010 = 10000 patients
• Included all patients 16+ discharged alive from ICU to another ward in same hospital
• Assessed patient status at time of hospital discharge
Results

• 10884 discharges from ICU
• 581 readmissions
  • 2 admissions - n=510
  • 3 admissions – n=56
  • 4 admissions – n=11
  • 5 admissions – n=2
  • 6 admissions – n=1
  • 7 admissions – n=1
• Median age=63
• APACHE 3 risk of death on first admission 9% (IQR 3-25%)
# Primary Diagnosis on Admission

<table>
<thead>
<tr>
<th>Medical</th>
<th>Surgical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>664 (6.52%)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>1101 (10.81%)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>371 (3.64%)</td>
</tr>
<tr>
<td>Neurological</td>
<td>495 (4.86%)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>610 (5.99%)</td>
</tr>
<tr>
<td>Trauma</td>
<td>489 (4.8%)</td>
</tr>
<tr>
<td>Metabolic</td>
<td>578 (5.68%)</td>
</tr>
<tr>
<td>Hematological</td>
<td>35 (0.34%)</td>
</tr>
<tr>
<td>Renal</td>
<td>159 (1.56%)</td>
</tr>
<tr>
<td>Gynecological</td>
<td>89 (0.87%)</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>281 (2.76%)</td>
</tr>
<tr>
<td>Other</td>
<td>69 (0.68%)</td>
</tr>
</tbody>
</table>
## 20 Most Common Primary Admission

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary artery bypass graft</td>
<td>1202</td>
<td>11.81%</td>
</tr>
<tr>
<td>Valvular heart surgery</td>
<td>542</td>
<td>5.32%</td>
</tr>
<tr>
<td>GI surgery for tumour</td>
<td>418</td>
<td>4.11%</td>
</tr>
<tr>
<td>Overdose</td>
<td>370</td>
<td>3.63%</td>
</tr>
<tr>
<td>Bacterial pneumonia</td>
<td>304</td>
<td>2.99%</td>
</tr>
<tr>
<td>Coronary bypass surgery with valve</td>
<td>277</td>
<td>2.72%</td>
</tr>
<tr>
<td>Sepsis with shock other than urinary</td>
<td>240</td>
<td>2.36%</td>
</tr>
<tr>
<td>Sepsis other than urinary</td>
<td>232</td>
<td>2.28%</td>
</tr>
<tr>
<td>Post cardiac arrest</td>
<td>218</td>
<td>2.14%</td>
</tr>
<tr>
<td>Head trauma ± multi-trauma (non-surgical)</td>
<td>210</td>
<td>2.06%</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>200</td>
<td>1.96%</td>
</tr>
<tr>
<td>COPD</td>
<td>197</td>
<td>1.93%</td>
</tr>
<tr>
<td>Other cardiovascular surgery</td>
<td>197</td>
<td>1.93%</td>
</tr>
<tr>
<td>Other gastrointestinal surgery</td>
<td>192</td>
<td>1.89%</td>
</tr>
<tr>
<td>Multi-trauma excluding head</td>
<td>190</td>
<td>1.87%</td>
</tr>
<tr>
<td>Seizure</td>
<td>170</td>
<td>1.67%</td>
</tr>
<tr>
<td>Other medical respiratory disease</td>
<td>169</td>
<td>1.66%</td>
</tr>
<tr>
<td>Post surgery for GI rupture or perforation</td>
<td>150</td>
<td>1.47%</td>
</tr>
<tr>
<td>Renal diseases</td>
<td>146</td>
<td>1.43%</td>
</tr>
<tr>
<td>Post resection of respiratory neoplasm</td>
<td>143</td>
<td>1.40%</td>
</tr>
</tbody>
</table>
Results

• **Source of readmission**
  • Theatre/recovery – 52%
  • ED – 25%
  • General ward – 14%
  • Interhospital transfer – 8%
  • Cardiac surgery – 20%
Results

• At first admission:
  • Ventilated – 56%
  • Inotropes – 42%
  • RRT – 5%

• At time of discharge:
  • 16% had altered conscious state
  • 5.3% limits of medical treatment

• 5.2% died before hospital discharge
### Nature of readmission

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Readmissions (674)</th>
<th>First Readmission (581)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned 107 (15.9%)</td>
<td>Unplanned 567 (84.1%)</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>New problem</td>
<td>22 (20.6%)</td>
<td>219 (38.6%)</td>
</tr>
<tr>
<td>Origin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating room</td>
<td>89 (83.2%)</td>
<td>98 (17.3%)</td>
</tr>
<tr>
<td>General ward</td>
<td>16 (15.0%)</td>
<td>463 (81.7%)</td>
</tr>
<tr>
<td>Premature first discharge&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1 (1.0%)</td>
<td>61 (10.8%)</td>
</tr>
<tr>
<td>Preventable readmission</td>
<td>2 (1.9%)</td>
<td>58 (10.2%)</td>
</tr>
<tr>
<td>Interval to readmission, days&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15.6 (7.3–68.9)</td>
<td>3.2 (1.3–7.2)</td>
</tr>
</tbody>
</table>

<sup>a</sup>As assessed at the time of first readmission.

<sup>b</sup>Results are median and interquartile range.

*Values are comparisons between planned and unplanned readmissions.
Timing of Readmissions

Figure 1. Interval in hours to first readmission stratified by elective/unplanned readmission.
Early Readmissions (<72hr)

• More likely to:
  • Have unplanned readmission
  • To come from general ward
  • To have been discharged (in retrospect) prematurely
  • To have had opportunity to prevent readmission (?evidence)
Readmitted v Non-Readmitted Patients

- Readmitted patients:
  - Older
  - Greater severity of illness at admission
  - Had more organ support at initial admission
  - More likely to be discharged from ICU prematurely
  - More ongoing organ dysfunction
  - Primary medical reason for admission
  - Less likely to have treatment limits
  - Seen earlier by doctor after first ICU discharge
  - Required more assessments by MET team
  - Had more cardiac arrests
  - **Hospital mortality significantly higher (23.3% v 4.3%)**
Characteristic of First and Second Admission

• First readmission:
  • More often come from ward
  • Greater illness severity
  • Longer stay in ICU
  • Less likely to be prematurely discharged
  • More likely to have their discharge delayed
  • Medical diagnoses more common (even in those with an initial surgical diagnosis): respiratory, cardiovascular, neurological
Statistical Modelling of Unplanned First Readmission

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>1.01</td>
<td>1.01–1.02</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Cardiac surgery</td>
<td>0.53</td>
<td>0.38–0.73</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Original admission from general ward</td>
<td>1.84</td>
<td>1.49–2.36</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Days in ICU during primary admission</td>
<td>1.02</td>
<td>1.01–1.03</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Discharge prematurely from original admission</td>
<td>3.73</td>
<td>2.28–6.12</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Treatment limitation at time of transfer from ICU</td>
<td>0.36</td>
<td>0.22–0.60</td>
<td>0.011</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>1.64</td>
<td>1.12–2.43</td>
<td>0.11</td>
</tr>
<tr>
<td>Altered conscious state (Glasgow Coma Scale, &lt; 15)</td>
<td>1.59</td>
<td>1.26–2.01</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Ongoing dialysis</td>
<td>2.09</td>
<td>1.27–3.41</td>
<td>0.003</td>
</tr>
<tr>
<td>Parenteral nutrition</td>
<td>2.32</td>
<td>1.55–3.46</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mechanical ventilation during admission</td>
<td>1.27</td>
<td>1.02–1.60</td>
<td>0.036</td>
</tr>
</tbody>
</table>

OR = odds ratio. The full statistical model is included in the supplemental digital content.
Impact of Multiple Readmissions

• Recurrent event analysis
• Age, illness, illness severity during and on discharge from ICU and limitations of care associated with mortality
• Need for readmission was not a predictor of outcome after adjustment for these factors
Discussion

• Prospective multicentre observational study
• Describe demographics and outcomes of patients readmitted
• Determine whether readmission is an independent predictor of outcome
• Majority of readmissions to ICU were unplanned
• Often due to a new problem (cardioresp)
• Readmission occurred earlier if unplanned but still >3 days after primary discharge
Discussion

• Readmission was not associated with subsequent mortality
• Patient factors were far more significant
• After adjusting for patient related factors and for multiple ICU admissions, no independent statistical association between readmission to ICU and subsequent mortality
• Vast majority of ICU readmissions are unexpected and not preventable
Implication of Study Findings

• Readmission per se is not a risk factor for subsequent mortality and readmissions are commonly unplanned or unexpected and not preventable

• There is no statistical or clinical rationale for using ICU readmission as quality indicator of ICU care

• Subsequently, Australian Council on Healthcare Standards removed readmission as a quality indicator (2015)
Strengths and Limitations (Author)

➕ Large multicentre prospective investigation
➕ No exclusions
➕ Data collected prospectively to examine readmissions
➖ Observational
➖ Descriptive
➖ Cannot attribute causation
➖ Antipodes based
➖ May be organisational issues that influence readmissions
➖ Didn’t follow after hospital discharge
My Thoughts

- Observational studies are difficult to read – the statistics are open to wide interpretation
- The main premise of the study (financial) is (currently) not relevant to UK
- Clinicians not blinded and hindsight questions peculiar
- Impossible cause-effect questions re. medical attention/outreach
- Readmissions are impossible to predict and “the threat” should not influence discharge decisions: particularly as there is no “mortality penalty” according to this study.