Optimal use of ICU resources

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ICU resources

- How much do we spend on ICU services?
  - Are our expenses growing?
  - Are the resources becoming more expensive?

- Are we spending evenly?
  - Within countries
  - Across countries

- Is it enough? Or is it too much?

- Are we spending wisely?
  - How might we spend better?
Current ICU resource use
How much do we spend?

- **70,000 ICU beds in the United States**
  - 6,000 ICUs in 4,000 hospitals

- **~ $2,600 per bed per day**
  - ~ $66 billion per year
    - 5% of healthcare costs
    - 0.75% of US GDP
  - Spent on ~ 6 million people
How is this money spent?

ICU Cost Breakdown by ICU Day

Daily mean ICU cost ($)

OR Services
Other
Imaging
General Supplies
Laboratory
Pharmacy
Respiratory Therapy
Room

ICU Day

### Are costs and resources rising?

<table>
<thead>
<tr>
<th>Medicare (&gt;65y)</th>
<th>1994</th>
<th>2004</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total admissions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>10.7M</td>
<td>11.9M</td>
<td>11.4</td>
</tr>
<tr>
<td>Cost</td>
<td>$98B</td>
<td>$116B</td>
<td>17.6</td>
</tr>
<tr>
<td><strong>ICU admission</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>2.2M</td>
<td>2.9M</td>
<td>31</td>
</tr>
<tr>
<td>Cost</td>
<td>$24B</td>
<td>$32B</td>
<td>35.7</td>
</tr>
<tr>
<td>Daily cost</td>
<td>$2.6k</td>
<td>$2.6k</td>
<td>-1.6</td>
</tr>
</tbody>
</table>

Across country variation
## ICU resources

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>France</th>
<th>UK</th>
<th>Belgium</th>
<th>Germany</th>
<th>NL</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td># adult ICUs (excluding CCUs)</td>
<td>5960</td>
<td>550</td>
<td>274</td>
<td>135</td>
<td>NA</td>
<td>115</td>
<td>258</td>
</tr>
<tr>
<td># adult ICU beds</td>
<td>71 979</td>
<td>5 707</td>
<td>1 993</td>
<td>NA</td>
<td>20 259</td>
<td>1 367</td>
<td>3 628</td>
</tr>
<tr>
<td>ICU beds/100,000</td>
<td>24,3</td>
<td>9,3</td>
<td>3,3</td>
<td>NA</td>
<td>24,6</td>
<td>8,4</td>
<td>8,2</td>
</tr>
<tr>
<td>ICU beds as % of all hospital beds</td>
<td>11,0%</td>
<td>2,5%</td>
<td>1,4%</td>
<td>3,8%</td>
<td>4,1%</td>
<td>2,8%</td>
<td>2,5%</td>
</tr>
<tr>
<td># of beds per ICU</td>
<td>12,0</td>
<td>10,4</td>
<td>7,3</td>
<td>17,2*</td>
<td>NA</td>
<td>11,9</td>
<td>14</td>
</tr>
</tbody>
</table>

*National health department data*

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Wunsch et al. Critical Care Med 2008
Healthcare Spending Per Capita

Wunsch H, et al. CCM 2008
Resources Available Per Capita

- 3x vs. 7x variation in hospital vs. ICU beds/pop
- 3.5 ICU: 100 hosp beds/pop

Wunsch H, et al. CCM 2008
Within country variation
ICU Cases by Hospital Size

- 6000 ICUs
- 70,000 ICU beds
- 55,000 ICU patients each day

% of Total

- > 100
- 100-300
- 300-500
- > 500

Hospital Size (Beds)

Angus et al. JAMA 2000; CCM 2006
Critical Care Physician Supply

Number of physicians / 100,000 population

Includes All Physicians in AMA Master File
Sources: American Medical Association, U.S. Census Bureau

CRISMA • Critical Care Medicine • the University of Pittsburgh
ICU Care Patterns by Hospital Size

Angus et al. JAMA 2000
ICU Care Patterns by Unit Type

General ICU
- Full-time Intensivist: 46
- Consultant Intensivist: 19
- Consultant Specialist: 13
- Single Physician: 4
- Other: 17

MICU
- Full-time Intensivist: 47
- Consultant Intensivist: 17
- Consultant Specialist: 33
- Single Physician: 14
- Other: 3

SICU
- Full-time Intensivist: 45
- Consultant Intensivist: 21
- Consultant Specialist: 18
- Single Physician: 14
- Other: 14

Specialty
- Full-time Intensivist: 52
- Consultant Intensivist: 13
- Consultant Specialist: 21
- Single Physician: 14
- Other: 14

Angus et al. JAMA 2000
‘Leapfrog’ compliance

Intensivist management standard

<table>
<thead>
<tr>
<th>Coverage standard</th>
<th>Intensivist management standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>4.3%</td>
</tr>
<tr>
<td></td>
<td>Partial</td>
</tr>
<tr>
<td></td>
<td>2.2%</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>3.3%</td>
</tr>
<tr>
<td>No</td>
<td>22.1%</td>
</tr>
<tr>
<td></td>
<td>18.1%</td>
</tr>
<tr>
<td></td>
<td>49.9%</td>
</tr>
</tbody>
</table>

Angus et al. Critical Care Medicine 2006
Spending and outcome
Availability Drives Case Mix

• % ICU pts with sepsis increases if fewer beds available…

Wunsch H, et al. CCM 2008
Availiability and Outcomes

- Sepsis mortality higher if fewer beds available… “sicker” patients admitted

Wunsch H, et al. CCM 2008
Availability and Outcomes

- Overall ICU mortality... fewer beds, “sicker” patients admitted

Wunsch H, et al. CCM 2008
Do patients fare better with critical care?

- **Empiric value of a dedicated location**
  - Clustering of expertise
  - "self-learning" units
  - Fewer trade-offs when modifying structure
  - Volume – quality relationship

- **Formal evaluation is scant**
  - Acute myocardial infarction
    - Defibrillation
      - Beck JAMA 1956
  - Monitoring/treatment of arrhythmias
    - Gotsman S Aft Med J 1968
  - Burns
  - Trauma
ICU Utilization

Alberta and Western Massachusetts
- 50,030 hospital admissions
- 2-3 fold higher ICU days per population in MA than Alberta
- Higher ICU admission rate
- No difference in mortality

Are we improving outcomes?

Milberg et al. JAMA 1995
ICU discharges at night

Discharges at night
- 2.7% in 1988-90
- 6.0% in 1995-98

Ultimate hospital mortality: night vs. daytime discharges
- crude OR 1.46
- case-mix adjusted OR 1.33

Increased bed pressure over time
- more “premature” discharges at night
- higher hospital mortality

Goldfrad & Rowan Lancet 2000
What about the future
Cases by Age Group

Wunsch H, et al. AJRCCM 2011
Age-Specific Population Rates

Wunsch H, et al. AJRCCM 2011
Demand and supply of intensivists

Number of FTEs

Demand
Supply

Angus, et al. JAMA 2000
10% reduction in all ICU diseases
10% increase in ICU hours
Retire from ICU care at 77
What will we do?
What will (can) we do?

- Do nothing - eventually run out of money!
  - ‘Price-elasticity of demand’

- Expand training slots
  - Pressure to reduce slots
  - Pressure from other specialties and subspecialties

- Share care with non-intensivists, e.g., hospitalists
  - Training and education
  - Parameters of relationship

- Provide ‘remote’ intensivist care
  - Physician extenders
  - Telemedicine
    - Rosenfeld et al. CCM 2001

- Stratify ICUs and implement regionalization
  - Limit intensivists to ‘high level’ ICUs
Organized trauma centers decrease mortality

Nathens et al. JAMA 2000
Regionalization

- Improves patient outcome

- Doesn’t happen because
  - Existing referral patterns strongly engrafted
  - Financial and political disincentives to entire system
  - No centralized mandate or legislative muscle

- In other words, less than compelling argument to all stakeholders

- Solution
  - Demonstration projects
    - Physician-led and government-sponsored?
  - UK ECMO collaborative trial (Lancet)
    - Randomized sick newborns
      - Local NICU
      - Transfer to regional ECMO center
    - Odds of death reduced to 0.6

Angus and Black. Lancet 2004
Regionalizing adult ICU care?

Mechanically ventilated non-surgical ICU population

- N=20,241 pts at 37 hospitals
- OR: 0.66 for hospital death
  - High volume to low volume

Kahn et al. NEJM 2006
Potential consequences

- **Eight large US states**
  - 1170 hospitals
  - 126 million covered lives

- **Lower 2 ‘Kahn’ quartiles**
  - <275 cases per year
  - 76% of all hospitals
  - 42% (or 96,614) of all patients

- **Solution?**
  - For 50%, high volume center <5 miles
  - For all low volume, mean travel to high volume = 8 miles
  - Potential impact: 20,000 saved lives per year

Kahn et al. AJRCCM 2008
Conclusion

- **Current ICU resource use**
  - Large and expensive in many countries
  - Growing everywhere

- **Variation in provision of ICU services**
  - Between countries
  - Within countries

- **More ICU resources may or may not improve outcomes**

- **Future pressures**
  - More patients, sicker patients, and higher costs
  - (Relatively) less money, less resources, fewer people (?)
  - Staffing likely to worsen

- **Consider more strategic, population-based planning**
  - Stratified ‘levels’ of care
  - Regionalization of services