Hospital Wide Critical Care Programs are Optimum for Delivery of Critical Care Services

Rolf D Hubmayr
Mayo Clinic College of Medicine
1) Personal financial relationships with commercial interests relevant to medicine, within past 3 years:

• DSMB Member: Novartis
• Consultant: Implicit Biosciences
Rolf D Hubmayr

2) Personal financial support from a non-commercial source relevant to medicine, within past 3 years:

• Grants from NIH
3) Personal relationships with tobacco industry entities within the past 3 years:

No relationship to disclose
Hospital-wide Integrated CC Delivery Services Serve Patients better than ICU Silos

• Background & Rationale
• Hypothesis
• Experiment
• Results
• Interpretation
How are we going to test this?

The World Is Flat
Outline

• Attributes of the Desired State
• Context or Present Realities
• History of Medical Specialization
• Rationale for Integration
• Barriers to achieving the Desired State
• Solutions
Attributes of the Desired State

Core Principles

Practice
Practice medicine as an integrated team of compassionate, multi-disciplinary physicians, scientists and allied health professionals who are focused on the needs of acutely ill patients.

Education
Educate physicians, scientists and allied health professionals and be a dependable source of health information for our patients and the public.

Research
Conduct basic and clinical research programs to improve patient care and to benefit society.
Attributes of the Desired State

Core Principles

**Mutual Respect**
Treat everyone in our diverse community with respect and dignity.

**Commitment to Quality**
Continuously improve all processes that support patient care, education and research.

**Work Atmosphere**
Foster teamwork, personal responsibility, integrity, innovation, trust and communication within the context of a physician-led team.
The Needs of the Patient Comes First

• Providers, who are content experts in Acute Care Medicine, and who operate in a culture committed to excellence and safety, attend to the needs of critically ill patients, whenever and wherever that need arises.
An expert, more generally, is a person with extensive knowledge or ability based on research, experience, or occupation and in a particular area of study.

1: Resuscitation and initial management of the acutely ill patient
2: Diagnosis: assessment, investigation, monitoring and data interpretation
3: Disease management
   - Acute disease
   - Co-morbid disease
   - Organ system failure
4: Therapeutic interventions / organ system support in single or multiple organ failure
5: Practical procedures
   - Respiratory system
   - Cardiovascular system
   - Central nervous system
   - Gastrointestinal system
   - Renal / Genitourinary system
6: Peri-operative care
7: Comfort and recovery
8: End of life care
9: Paediatric care
10: Transport
11: Patient safety and health systems management
12: Professionalism
   - Communication skills
   - Professional relationships with patients and relatives
   - Professional relationships with colleagues
   - Self governance
Association between Critical Care Physician Management and Patient Mortality in the Intensive Care Unit

Mitchell M. Levy, MD; John Rapoport, PhD; Stanley Lemeshow, PhD; Donald B. Chalfin, MD, MS; Gary Phillips, MAS; and Marlon Danis, MD

Figure 1. Critical care management (CCM) and mortality.

SAPS = Simplified Acute Physiology Score.
Association between Critical Care Physician Management and Patient Mortality in the Intensive Care Unit

Mitchell M. Levy, MD; John Rapoport, PhD; Stanley Lemeshow, PhD; Donald B. Chalfin, MD, MS; Gary Phillips, MAS; and Marlon Danis, MD

Table 4. Expected and Actual Hospital Mortality*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Critical Care Management†</th>
<th>No Critical Care Management†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥95%</td>
<td>5%–95%</td>
</tr>
<tr>
<td>Patients, n</td>
<td>18 601</td>
<td>23 324</td>
</tr>
<tr>
<td>Mean SAPS II probability</td>
<td>0.1650</td>
<td>0.1733</td>
</tr>
<tr>
<td>Mean mortality rate</td>
<td>0.1800</td>
<td>0.1884</td>
</tr>
<tr>
<td>SMR (95% CI)</td>
<td>1.09 (1.05–1.13)</td>
<td>1.09 (1.05–1.12)</td>
</tr>
</tbody>
</table>

* SAPS = Simplified Acute Physiology Score; SMR = standardized mortality ratio.
† For the entire stay for patients in the intensive care unit.
Are Intensivists Safe?

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed ICU</td>
<td>All patients are cared for by 1 team of intensivists in collaboration with a primary service. Only intensivists have admitting privileges to the ICU. Also called <em>mandatory transfer</em>.</td>
</tr>
<tr>
<td>Open ICU</td>
<td>Any physician can admit patients to the ICU.</td>
</tr>
<tr>
<td>Elective consultation</td>
<td>Intensivists are available for consultation at the discretion of the responsible physician.</td>
</tr>
<tr>
<td>Choice ICUs</td>
<td>An ICU in which an intensivist is the responsible physician for some patients but not others; presumably an open ICU with elective consultation.</td>
</tr>
<tr>
<td>No-choice ICU</td>
<td>An ICU in which there is no choice about intensivist care—either all patients or no patients have an intensivist as their responsible physician.</td>
</tr>
<tr>
<td>Intensivist</td>
<td>A physician with subspecialty training in critical care medicine</td>
</tr>
<tr>
<td>High-intensity staffing</td>
<td>Includes both closed and mandatory consult models</td>
</tr>
<tr>
<td>Low-intensity staffing</td>
<td>Any model other than closed or mandatory consult model</td>
</tr>
</tbody>
</table>
The Needs of the Patient Comes First

• Providers, who are content experts in Acute Care Medicine, and who operate in a culture committed to excellence and safety, attend to the needs of critically ill patients, whenever and wherever that need arises.
Table 3. Prospective comparison of intensive care unit (ICU) complications 6 months before and after the staffing model intervention

<table>
<thead>
<tr>
<th>Complication</th>
<th>Before, 356 Days (n = 97)</th>
<th>After, 963 Days (n = 191)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVT</td>
<td>5 (1.4)</td>
<td>14 (1.5)</td>
<td>.980</td>
</tr>
<tr>
<td>PE</td>
<td>3 (0.8)</td>
<td>3 (0.3)</td>
<td>.213</td>
</tr>
<tr>
<td>Bleeding</td>
<td>8 (2.2)</td>
<td>8 (0.8)</td>
<td>.047</td>
</tr>
<tr>
<td>VAP</td>
<td>9 (2.5)</td>
<td>18 (1.9)</td>
<td>.449</td>
</tr>
<tr>
<td>Reintubation</td>
<td>13 (3.6)</td>
<td>21 (2.2)</td>
<td>.147</td>
</tr>
<tr>
<td>Cumulative ICU complication rate</td>
<td>38 (11)</td>
<td>64 (7)</td>
<td>.023</td>
</tr>
</tbody>
</table>

DVT, deep venous thrombosis; PE, pulmonary embolism; VAP, ventilator-associated pneumonia. All values are n (%) per patient-day.
# Association Between ICU Admission During Morning Rounds and Mortality

Bekele Afessa, MD, FCCP; Ognjen Gajic, MD, FCCP; Ian J. Morales, MD; Mark T. Keegan, MB; Steve G. Peters, MD, FCCP; and Rolf D. Hubmayr, MD, FCCP

## Table 6—Comparison of Mortality Rates in the Medical ICU Before and After Initiation of Two-Physician Teams, Nighttime Intensivist Coverage, and Rapid Response Team

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Round-Time Mortality (%)</th>
<th>Non-Round-Time Mortality (%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-physician team</td>
<td>145/702 (20.7)</td>
<td>930/6,373 (14.6)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Two-physician team</td>
<td>175/990 (17.7)</td>
<td>1,139/7,934 (14.4)</td>
<td>0.005</td>
</tr>
<tr>
<td>No in-house intensivist at night</td>
<td>267/1,308 (20.4)</td>
<td>1,621/10,995 (14.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>In-house intensivist at night</td>
<td>53/384 (13.8)</td>
<td>448/3,312 (13.5)</td>
<td>0.881</td>
</tr>
<tr>
<td>Before rapid response team</td>
<td>272/1,331 (20.4)</td>
<td>1,638/11,125 (14.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>After rapid response team</td>
<td>48/361 (13.3)</td>
<td>431/3,182 (13.5)</td>
<td>0.896</td>
</tr>
</tbody>
</table>
The Needs of the Patient Comes First

• Providers, who are content experts in Acute Care Medicine, and who operate in a culture committed to excellence and safety, attend to the needs of critically ill patients, whenever and wherever that need arises.
What is the definition of critical illness?

GEOGRAPHY IS NOT PART OF THE DEFINITION...
A disease or state in which death is possible or imminent.
One or more organ dysfunction that creates physiological instability, or the significant risk of instability, that threatens life.

Every doorway, every intersection has a story.
--Katherine Dunn
Providing critical care...

*Where are the boundaries?*
Which of these patients are critically ill?

The most efficacious critical care is the critical care that is actually never needed...
RECYCLING of a different sort...

History is a race between education and catastrophe
--H.G. Wells
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• Barriers to achieving the Desired State
• Solutions
Estimated cost of critical care medicine in the U.S.

In 2005, US CCM costs were:

Estimated to be $81.7 billion

Accounted for 13.4% of hospital costs

4.1% of national health expenditures

0.66% of the gross domestic product.

Healing is a matter of time, but it is sometimes also a matter of opportunity.
-- Hippocrates

Prioritizing the organization and management of intensive care services in the United States: The PrOMIS Conference*
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Drivers and Governors

• Academia
• Government
• Professional Strategies to monopolize specific domains
• Public Trust in “expertise and science”
• The information age
Outline

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• **Rationale for Integration**
• Barriers to achieving the Desired State
• Solutions
Why not teamwork?

What a rush

The job in the pits is one of the most pressured in Formula 1. A pit stop is studied choreography and only the best are good enough to ensure comprehensive service for the driver in the race against the clock. Every individual role is practiced thousands of times and must be carried out perfectly.

- **0.0s** Car is stationary, time is running
- **0.2s** High-powered airgun set to central wheel nuts
- **1.0s** Hydraulic jack lifts the front end, manual jack at rear
- **1.5s** Fueling hose onto tank nozzle; red light in refueller’s helmet visor indicates fuel flow of 12 litres per second
- **2.5s** Wheels removed
- **3.0s** New wheels mounted and central nut is off jacks
- **3.8s** Car lowered off jacks
- **4.3s** Lollipop man signals to driver to engage 1st gear
- **7.0s** Green light in refueller’s visor; fuel hose is disconnected
- **7.3s** Lollipop man signals to driver to go
Why not learn from each other?
Why not learn from each other?

Stage 1
Initial Ventilator Settings:
- Synchronized Intermittent Mandatory Ventilation (SIMV) 12 breaths per minute (BPM).
- Fraction of Inspired Oxygen (FiO₂) to keep oxygen saturations (SpO₂) greater than 92%.
- Tidal volume (VT) at 10 mL/kg Predicted Body Weight (PBW).
- Positive End Expiratory Pressure (PEEP) at 5 cm H₂O.
- Pressure support ventilation (PSV) at 5 cm H₂O.
- Inspiratory time greater than or equal to 1 second.
- Elevate head of the bed 30 degrees unless contraindicated.
- Obtain Arterial Blood Gas (ABG) in 30 minutes.

Adjust Ventilation to Maintain:
- pH: 7.35 - 7.45
- PaCO₂: 35 - 45 mmHg
- PaO₂: 90 - 120 mmHg
- SpO₂ greater than or equal to 92%
- ETCO₂ less than or equal to 35 mmHg.

Adjustment Ranges:
- FiO₂: 0.4 to 1
- SIMV: 8 - 16 BPM
- PEEP: 4 - 8 cm H₂O
- PSV: 5 - 10 cm H₂O
- Inspiratory time: adjust flow to match patient demand.
- VT: 8 - 15 mL/kg PBW (refer to back of protocol).

If the end-tidal CO₂ is greater than 35 mmHg, RT will increase the tidal volume by 10% and increase the respiratory rate by 2 breaths/minute until achieved.
Note: Notify responsible service if unable to achieve above parameters.

Proceed to patient weaning criteria section.
Why not learn from each other?

Never in Doubt

Take an ASA & call me in the AM
New Developments in Fluid Resuscitation

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Comparison of conventional and high-frequency ventilation: oxygenation and lung pathology

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Barriers to Integration

• Lack of mutual respect
• Fear of losing autonomy
• Fear of loss of income
• Variable understanding of Acute Care Medicine and Hospital Practice amongst the various division and department leaders
• Misaligned financial incentives
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Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study

James H Fowler, associate professor, Nicholas A Christakis, professor

WHAT IS ALREADY KNOWN ON THIS TOPIC

Previous work on happiness and wellbeing has focused on socioeconomic and genetic factors
Research on emotional contagion has shown that one person's mood might fleetingly determine the mood of others
Whether happiness spreads broadly and more permanently across social networks is unknown

WHAT THIS STUDY ADDS

Happiness is a network phenomenon, clustering in groups of people that extend up to three degrees of separation (for example, to one's friends' friends' friends)
Happiness spreads across a diverse array of social ties
Network characteristics independently predict which individuals will be happy years into the future

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Calling people a team does not make it so!
One Step at a time

Hospital level
May already be unified critical care services
Driven as a service line
Certainly, common across multiple surgical services
But MICU and CCU may be separate

University ‘department’ level
Very little precedent in the US
Critical care
Pulmonary/CCM within IM
Trauma/CCM within surgery
CCM within anesthesiology
Cardiac/CCM within cardiology, possibly within IM

And what about?
Emergency medicine
Hospitalist medicine
Four Concrete Advantages of Hospital-wide Integration of Critical Care Delivery

- Access to the loci of power
- Manpower needed to improve clinical care
- Multidisciplinary milieu for trainees
- Structured development of the research agenda

Derek Angus: ATS 2007
Thank You

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