Improving ICU outcomes and cost-effectiveness

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Targets for improvement

• Staffing & structure
  • High vs. low intensity; “open” vs. “closed”
  • Nighttime in-house intensivist staffing
  • Multidisciplinary rounds
• Clinical interventions
  • Bundles and protocols

Disclosures

• CHQI grant, UC Health
• Travel support, Moore Foundation

A brief overview:
ICU care in the United States

• ~ 6000 ICUs
• 55,000 patients/day (~ 75% occupancy)
• ICU costs = approximately 1% of GDP
• Only 26.4% of ICUs were “high-intensity”

Angus et al. CCM 2006; Gutsche & Kohl CCM 2007
Staffing

Probable truths

- High intensity produces better outcomes than low intensity
- Multi-disciplinary rounds and care approaches lead to better outcomes
- Nighttime in-house intensivist staffing isn’t usually beneficial
- Non-MD providers are safe in critical care

Possible truths

- Optimal number of patients/attending is at least < 15/1
- Non-intensivists (e.g. hospitalists) provide safe care in ICUs, depending on:
  - Presence in ICU
  - Access to intensivist consults
  - ICU telemedicine may improve outcomes

What’s the evidence for high-intensity staffing?

- Multiple studies since mid-1990s demonstrate that high-intensity ICU staffing is associated with:
  - Decrease ICU and hospital mortality
  - Reduced ICU and hospital length of stay (LOS)
  - Positive outcomes seen in variety of ICU settings (MICU, SICU, Neuro ICU)
Physician Staffing Patterns and Clinical Outcomes in Critically Ill Patients

A Systematic Review

Pronovost et al. JAMA 2002

- Meta-analysis of 27 studies, grouped into low- vs. high-intensity staffing
- Majority of studies cohort studies with “before-after” design
- 16/17 studies showed reduced hospital mortality; pooled unadjusted RR 0.61 (95% CI 0.50-0.75)
- Reduced ICU mortality, LOS with high-intensity staffing

52 studies

High intensity staffing =

- Decreased hospital and ICU mortality
- Decreased hospital and ICU LOS
- Variable results by type of unit
- No benefit from 24 hour in-house coverage

One negative study

Ann Intern Med 2008

- Patients receiving critical care management had higher mortality rates, even after adjusting for severity of illness and propensity score
- Possible explanation: most of the patients in the cohort received care in ICUs with elective intensivists consult
Limitations to the staffing data

- Observational studies, often retrospective
- Concerns:
  - Selection bias
  - Publication bias
  - Temporal trends
  - Studies generally performed by intensivists

Pronovost et al. JAMA 2002
Gutsche & Kohl CCM 2007

Nighttime Intensivist Staffing and Mortality among Critically Ill Patients

- Nighttime staffing associated with improved in-hospital mortality only in low-intensity units

Pronovost et al. JAMA 2002
Gutsche & Kohl CCM 2007

How to explain the benefits seen in high-intensity units?

- Expertise
- Availability
- Enhanced communication and coordination with key providers
  - RNs
  - Pharmacists
  - RTs
  - PTs
  - Nutritionists
- Awareness of and belief in evidence-based guidelines

Gajic & Alissa Chest 2009
What else can we do to improve the organizational structure in the ICU?

Multidisciplinary rounds

**Health Care Reform**

The Effect of Multidisciplinary Care Teams on Intensive Care Unit Mortality

Michelle M. Ron, MSC; André A. Barnato, MD, MPH; Drello C. Angos, MD, MPH;
Lee F. Fletcher, MD, Jonny N. Kaha, MD, MSC

*Arch Intern Med* 2010

- Retrospective cohort study: 112 hospitals, > 100,000 pts
- Daily rounds associated with 16% reduction in the odds of death among MICU patients
- Lowest odds of death in ICUs with daily multidisciplinary rounds and high-intensity physician staffing

**International Approach**

- ICU physician staffing is one of key Safety Standards
- ICU Staffing Guidelines
  - Board certified MDs with additional certification in critical care*
  - ICU is managed or co-managed by intensivists
  - Intensivists present/dedicated during daytime; other times, return pages < 5 min & arrange for FCCS-certified assistant present < 5 min

- Closed or high-intensity organizational structures much more common in Europe and Australia
- 1999 UK survey revealed that intensivists initiate care in 80% of all ICUs
- In regions of Australia, all ICUs have been closed for 15 years
- ESICM recommendations for high-intensity staffing date back to late 1990s

Prandoni et al. JAMA 2002
CLINICAL INTERVENTIONS:
Bundles and protocols

So many options

What works?

• Lung protective ventilation decreases mortality and increases ventilator free days
Central Line Bundles

- Pronovost et al. *NEJM* 2006
  - 66% reduction in rate of catheter-associated blood stream infections at 16-18 months
- Schulman et al. *Pediatrics* 2011
  - 40% statewide reduction in CLABSI in NICU population

VAP Bundles

- Popularized by IHI in 2005
  - Bundle elements now somewhat controversial
- SHEA/IDSA VAP prevention recs (2014)
  - Use NIV when possible
  - Limit and interrupt (daily) sedation
  - SBT with SAT trials daily
  - Early mobility
  - Subglottic tubes
  - HOB 30 – 45 degrees
  - Limit circuit changes

What might work?

**EGDT for Septic Shock**

- Pro
- Con
- ProMISc
- ProCESS
- ARISE

Rivers
But what about basic sepsis protocols?

- Surviving Sepsis Campaign:
  - Hugely important guidance about many aspects of care regarding:
    - Early resuscitation goals
    - Antibiotic timing and approach to cultures
    - Approach to fluid resuscitation and vasopressor use
    - Lung protective ventilation
    - And much more!!

- UCSF Sepsis Bundle (2012-present)
  - Basic elements
    - Lactate, cx before abx, early abx, treat hypotension or elevated lactate with crystalloid, vasopressors to maintain MAP > 65
  - Improved mortality

What doesn't work?

Intensive Insulin Therapy: early hope…

Reality
Cost effectiveness in the ICU

- Important
  - ICU costs ~ 1/3 of all hospital costs
  - Challenging to study using standard CEA methods (quality of life and utility assessment)
    - ICU interventions are usually supportive
    - ICU outcomes measures often not appropriate for CEA
    - EOL care hard to measure and value

Talmor et al., CMM 2006; ATS workgroup AJRCCM 2002

Cost-effective interventions …a few examples

- Intensivist Staffing
  - Pronovost et al. CCM 2006
  - Antiseptic-impregnated catheters
    - Veenstra et al., JAMA 1999
  - HAI prevention protocols

Choosing Wisely® Top 5 Critical Care Medicine (paraphrasing)

1. No regular diagnostic tests
2. No transfusions if hgb > 7 and patient stable
3. No TPN or PPN in first 7 days for adequately nourished patients
4. No deep sedation for mechanically ventilated patients without good reasons
5. No ongoing, aggressive life-supporting therapy without offering comfort care alternatives

Halpern et al., AJRCCM 2014

A path forward to improved outcomes

- Understand metrics and standards relevant to ICU care
- Collect and analyze data
- Disseminate data to staff and senior leadership
- Implement evidence-based best practices and target institution-specific interventions based on local data