Does this patient need ICU?

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Disclaimer
• Not a comprehensive review
  – Trauma
• Clinical gestalt should always play a role
• There are ALWAYS exceptions

Objectives
• Discuss importance of identifying patients prior to decompensating
• Provide background information on early warning scores and predictions models
• Identify certain abnormalities often associated with decompensation
• Improve your confidence in triaging and differentiating GPU from ICU patients
• Improve communication with ICU

Case 1
• 76 y/o female with 40 pack year history presents with cough, fever, shortness of breath. Found to have right lower lobe pneumonia, started on antibiotics.
  – While in the ED her oxygen requirements continue to decrease, she becomes lethargic and is ultimately intubated for hypoxic respiratory failure.

Case 2
• 65 y/o male with COPD presents with one week cough, cold, runny nose. Found to be febrile, tachycardic and tachypneic. Chest x ray shows bilateral pneumonia, he is given antibiotics and during his ED stay he begins to feel better.
• HR 110 RR 28 T 39.1 BP 120/80 SpO2 90%on 8LNC
Why do I care, as long as they have a Dispo?

- Patients with unplanned transfer to ICU from GPU have worse outcomes
  - Increased cost
  - As much as a 21% (25%) increased mortality
  - Increased length of ICU (~1 day) and GPU (up to six days) stays
  - Septic patients have nearly double risk of mortality if progress to shock on a GPU as opposed to in the ICU
- ER physicians are front lines in identifying these patients

Recognition of Clinical Deterioration

- Mid 1990’s- Are in-hospital arrests preventable
- Vital sign abnormalities are detected in up to 80% of patients
  - Many abnormalities were unreported or mismanaged
  - Medicolegal implications (69% were “preventable”)
- Most studies looked at deterioration on GPUs, significantly fewer look at the ED.
  - Extrapolation?

Clinical Antecedents to In-Hospital Cardiopulmonary Arrest


- 1998 Landmark retrospective chart review
- 4 month observation window at University of Miami
- 16,141 admissions and 64 arrests
- 52% with cardiopulmonary arrest, 8% pure respiratory
- Divided into 5 categories of preceding abnormalities to arrest
  - 36% respiratory
  - 27% mental
  - 11% metabolic
  - 9% cardiovascular
  - 6% Neurologic
- 8% of arrested patients survived to discharge
- 84% of the patients charts “documented acute deterioration of the patients condition” either by patient complaint or nurse report
- Can we prevent or predict deaths?

How Can We Fix This?

- Retrospective Chart Review of unexpected death or ICU transfers from GPU
- Single Center hospital review board
- 477 deaths, 317 on GPU
  - 45% over the weekend (5p Friday to 7a Monday)
- 86 unplanned ICU admissions
  - 36% deemed to receive suboptimal care with 65% mortality (42% normal)
  - Primary reasons cardiovascular and respiratory
- Hypothesized these are due to knowledge gaps and proposes medical emergency teams and standardization of “abnormalities.”
The ACADEMIA Study
Multi-center prospective observational study of several institutions looking at vital sign abnormalities 24 hours prior to cardiac arrest (AUS, NZ, UK)

Antecedents considered:
- RR <5 >36
- HR <40 >140
- sBP < 90 mmHg
- AMS, seizure
- Airway compromise (stridor)

- 60% of patients had antecedent
- Most common antecedents:
  - Hypotension
  - AMS
  - Respiratory abnormality
- Discussed the potential for standardized warning systems

“Early Warning Systems”
- Built off one of the first Early Warning Systems derived in the UK
  - Used 5 physiologic parameters (SBP, HR, LOC, RR and Temp) to identify patients at risk for decompensation
  - NOT intended to predict outcome
  - “Normals”
    - SBP >100, <200
    - HR >50, <100
    - AAO
    - RR >9, <14
    - Temp >36.1, <38
- Modified version (1997) included urine output
- Scores >5 indicate patients at risk for adverse event

Modified Early Warning Score
- For bedside evaluation of GPU patients to trigger rapid response team activation or physician notification
  - Initial models did not include urine output as below
  - Sedation score refers to "AVPU" : Alert, reacting to Voice, Pain and Unconscious
- Some institutional differences but general idea is same: higher scores indicates increasing instability and need for escalation, meant to be a less cumbersome evaluation than APACHEII

Rapid Response Teams
- Hospital response to reports that in-hospital cardiac arrests were often preceded by vital signs abnormalities
- Usually made up of
  - ICU RN
  - Respiratory Therapist
  - +/- Internal medicine senior (or hospitalist)
  - +/- Intensivist
  - +/- Pharmacist
- Did the presence of these teams change outcomes in cardiac arrest?
  - Controversial
- The 100,000 lives campaign (Institute for Healthcare Improvement, 2004)
  - "Deploy Rapid Response Teams"

Morbidity Prediction Models
**APACHE II**

- Determine severity of disease in ICU patients within 24 hours of admission
  - Includes 12 physiologic variables, co-morbidities and age
  - One time score, not (supposed to be) recalculated
  - Subjected to multiple validation studies and determined a reliable and accurate predictor of disease severity
  - Wide disease process application: Pancreatitis, liver disease, GI Bleed, COPD, sepsis, etc.
  - Validated for use in ICU, not ED
- Underestimate ED mortality

**SAPS and SOFA**

- SAPS (Simplified Acute Physiology score) II and III:
  - II: gives a mortality estimate for a particular disease (not patient specific)
  - III: tries to predict mortality for particular patient with disease
- SOFA (Sequential Organ Failure Assessment)
  - Measures patients evolution over duration of ICU stay
  - Score based on documented vitals signs in: Respiratory, Neuro, Cardio, Coagulation, Liver and Renal systems
  - Worsening SOFA score strongly correlates with poor outcome

**qSOFA**

- Developed with Sep-3
- Goal was to identify an easily computable bedside scoring system to predict clinical course of critically ill patients
- Score 0-3
  - HR \( \geq 100 \)
  - RR \( \geq 21 \)
  - SBPs\( \leq 100 \)
  - Scores \( \geq 2 \) associated with 3-14 fold increase in hospital mortality

**Pneumonia Severity Index**

- More sophisticated and reliable than CURB65
- Stratifies patients into Risk Classes I-V based on demographics, co-morbidities and physiologic parameters.
- Risk classes are meant to predict 30 day mortality
Liver Failure: MELD/Childs-Pugh

• MELD
  – Originally developed to predict mortality post TIPS
  – Now UNOS for status
  – \[3.78 \times \ln(\text{serum bilirubin (mg/dL)}) + 11.2 \times \ln(\text{INR}) + 9.57 \times \ln(\text{serum creatinine (mg/dL)}) + 6.43\]
  – INR has highest weight

Application to ED patients?

• Designed to provide mortality risk probabilities in specifically ICU or GPU
• Often not validated in Emergency Department's
• Lead time bias when applied to ED because pre-ICU severity of illness is not accounted for
• So let's focus on the ED…

Identifying Infected Emergency Department Patients Admitted to the Hospital Ward at Risk of Clinical Deterioration and Intensive Care Unit Transfer

- 2000, First of its kind study to highlight the impact of ED care on critically ill patients
- Prospective, observational cohort study
- APACHEII, MODS and SAPSII scores were calculated at ED admission, ED discharge, 24, 48 and 72 hours from ICU admission.
- 81 patients enrolled over 3-month period
  – 30.9% mortality
- Majority of headway in improving severity scores is done in the first 24 hours, with ED being average of 6 of those hours
- Reinforces the need for ED specific assessment modules

- 2009, Prospective cohort studies, included by blood cultures ordered within 3 hours and documented in MDM
- 5,365 patients
  – 1.7% transferred to ICU within 48 hours
  – Median time 20 hours
  – Most common reason was worsening respiratory status
- Independent predictors:
  – Respiratory compromise
  – CHF
- Mortality for patients transferred to the ICU was 24%
- Strongest predictor of deterioration was respiratory compromise (tachypnea or hypoxia)
- Weaknesses: small event rate
Emergency Department Tachypnea Predicts Transfer to a Higher Level of Care in the First 24 Hours After ED Admission

Heather Furlley, MD, Marc T. Zuberbier, MD, Doyna Gan, MD, Paul Kolm, PhD, Susan Mascii, RN, RN, MD, Doyna D. Mahoney, and William S. Weilens, MD

- (Christiana Care, 2010) Retrospective case-control study, over one year period after Rapid Response Team activation
- Aimed to identify patients at risk for clinical deterioration within 24 hours of GPU admission from the ED
- 74 cases total
  - Tachypnea was the most predictive indicator of transfer to higher level of care
  - Odds of transfer increased by factor of 2.79 for every 10 breaths/min
  - Probability of transfer greater than 50% for a patient with final ED RR of 30 breaths/min
  - 1.15 for every 10 beats/min increase in HR
  - Nonwhites were 2.3 times more likely to need an elevation in level of care
  - sBP was not a independent predictor (likely because of ER resus)
- Weakness: small study size

ED Scoring Systems?

Rapid Acute Physiology Score (RAPS)
- 1987
- "Abbreviated APACHE II" - correlated well in mortality prediction
- Meant to predict mortality of transported patients by using the most abnormal documented vitals pre and post transport
  - Pulse, BP, RR, GCS
  - Maximum score of 16, with increasing score associated with higher mortality
- Dependence on vital signs could skew picture (anxiety, pain, etc.)

Rapid Emergency Medicine Score
- 2004
- Modifies RAPS by adding Age, temperature and Pulse Ox
- Intended for predicting inpatient mortality of non surgical GPU patients
- Blood pressure and body temp were not considered independent predictors of mortality, all other parameters were.

CLINICAL INVESTIGATIONS

Comparison of the Rapid Emergency Medicine Score and APACHE II in Nonsurgical Emergency Department Patients

- Prospective single-center cohort study looking at all non surgical ED patients admitted to ICU
- Attempt to "provide a more potent scoring system" by adding age, O2 sats and temperature
- Calculated RAPS, REMS and APACHE in all admitted patients
- Found that REMS was more accurate than RAPS and that APACHEII was not statistically proven to be superior to REMS

Table 1 (by the scoring system for the parameters in the Rapid Acute Physiology Score (RAPS) peripheral oxygen saturation, heart rate, temperature and age)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>High abnormal range</th>
<th>Low abnormal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>&gt;71</td>
<td>61-70</td>
</tr>
<tr>
<td>Temperature</td>
<td>&lt;95</td>
<td>96-99</td>
</tr>
<tr>
<td>Pulse ox</td>
<td>&lt;91</td>
<td>92-94</td>
</tr>
<tr>
<td>Peripheral oxygen saturation</td>
<td>&lt;25</td>
<td>25-34</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>&gt;24</td>
<td>22-24</td>
</tr>
<tr>
<td>Age</td>
<td>&gt;65</td>
<td>60-64</td>
</tr>
</tbody>
</table>

Rapid Emergency Medicine Score

- 2003, Sought to identify high risk infected/septic patients in the ED
- Based on 5 physiologic variables
  - No lactate
  - Categorized into risk categories: very low, low, moderate, high, very high
  - Increased mortality in:
    - Age > 65 y/o
    - Nursing home resident
    - Presenting with respiratory difficulty
    - Change in mental status

Cons: Low sepsis mortality in the study, blood cultures not always reported
2016 Observational cohort study at Mayo Clinic over 4 years
- Non-ICU patients triggering RRT activation <12 hours from admission
  - 474 patients
  - ~2% of all admissions
  - Most common diagnosis: infectious or respiratory
  - Used parameter estimates from this group to develop a scoring system
- NOT EXTERNALLY VALIDATED

Issues
- Not rapidly accessible (No MDCalc)
- Mortality percentages are not easily accessed
- Not well known or widely incorporated into practice

The Major Takeaways
- Tachypnea is most commonly associated with deterioration
- Hypotension, even transient, is likely to recur
- Altered mental status matters.

Official Guidelines?
- ATS: Disease specific guidelines
- American Association for the Surgery of Trauma
- SCCM: 1999 updated 2016
  - Vague, provider interpretation
  - In order “To optimize resource use while improving resource utilization, we suggest guiding ICU admission on the basis of a combination of specific patient needs, available expertise, prioritization, diagnosis, bed availability, objective parameters at transport, potential for benefit, prognosis”

SCCM Guidelines


<table>
<thead>
<tr>
<th>Level</th>
<th>High Priority</th>
<th>Intermediate Priority</th>
<th>Low Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachypnea ≥ 20 breaths/min</td>
<td>4/14</td>
<td>2/14</td>
<td>1/14</td>
</tr>
<tr>
<td>Hypotension systolic BP &lt; 90 mmHg</td>
<td>4/14</td>
<td>2/14</td>
<td>1/14</td>
</tr>
<tr>
<td>Hypothermia (temperature &lt; 35°C)</td>
<td>4/14</td>
<td>2/14</td>
<td>1/14</td>
</tr>
<tr>
<td>Acidosis (pH &lt; 7.3 or bicarbonate &lt; 22 mEq/L)</td>
<td>4/14</td>
<td>2/14</td>
<td>1/14</td>
</tr>
<tr>
<td>Other conditions not listed, but need care</td>
<td>1/14</td>
<td>1/14</td>
<td>1/14</td>
</tr>
</tbody>
</table>

Note: The algorithm does not take into account the patient's functional status or the patient's needs.
Case 2

- 65 y/o male with COPD presents with one week cough, cold, runny nose. Found to be febrile, tachycardic and tachypneic. Chest x ray shows bilateral pneumonia, he is given antibiotics and during his ED stay he begins to feel better.
- HR 110 RR 29 T 39.1 BP 120/80 SpO2 90%on 9LNC

Specific Scenarios

High Flow Nasal Cannula

- Non hypercapnic respiratory failure
- Most HFNC need ICU
- Increasing/unstable oxygen requirements

Electrolyte Disturbances

- Hyponatremia: there is no “minimal” number, with caveats
- Hypo/Hyperkalemia: with EKG changes should be on monitored floor.
- Hypo/Hypercalcemia: as above
- Acidosis: cause specific

Altered Mental Status

- GCS- Originally described in 1974 as a way to communicate LOC in acute brain injury
- Gained popularity in the mid to late 80’s
- Reliability variable for non traumatic head injuries
- Not a lot of data

Sell The Admission?

- Remember that you are the one who has eyes on the patient
- State the facts
- Advocate for your patient
Take home points:

• Most of the ER scoring systems are not used in daily practice
  – Difficult to access
  – Mortality percentages not readily available

• Tachypnea, AMS, and hypotension (even transient) have been proven to be independent predictors of mortality

• Keep the parameters, and the idea behind them, in your back pocket to support your endeavor for an ICU bed