The Application of Telemedicine (tele-ICU) to ED, Stepdown, RRT, and Progressive Care Units – Clinical and Financial Benefits

Michael Ries MD, MBA, FCCM, FCCP, FACM
Medical Director of Advocate Critical Care and Advocate Intensivist Partners and AdvocateAurora eICU

September 20, 2018
No conflicts of interest
Objectives

• Understand that telemedicine can achieve clinical and financial benefits for acute care across a large healthcare system utilizing implementation science

• Recognize that the success of telehealth is determined less by what technologies you have and more by how you use them

• Realize that the tele-ICU is a facilitator of change management as much as an “intervention”
Value is created not by what technology you have but how you use the technology that you have.
Advocate Critical Care

• 10 hospitals / Five Level One Trauma Centers
• 16 ICUs
• AdvocateAurora eICU = 764 beds
• Advocate legacy = 424 beds
  – 312 Critical Care beds (plus three Outreach programs = 104 additional beds)
  – eMobile carts in the ED (N = 7)
  – Critical Access Hospital with eMobile cart
• > 6000 physicians / > 100 Intensivists
• 24,140 ICU Admissions with APACHE Predictions in 2017
  – Ventilator days: 25,986 on 8,199 cases
  – Total direct costs for days while the patients were treated in the ICU (excluding ED and OR costs) were approximately $200M or 17% of direct costs for inpatients
• eIntensivist and eRN coverage 24/7/365 with board certified critical care physicians
Aurora Critical Care

• 15 Hospitals
• 18 ICUs
• 2 Outreach customers = 35
• Aurora legacy eICU = 320 beds
• eIntensivist and eRN coverage 24/7/365 with board certified care physicians
• ED Triage program separate from eICU
• Telestroke program at single hospital
eIntensivist Workstation
Transformation to Integrated Care

- Population Management and Evidence-Based Standardization
- Patient Centric Focus
- Information Technology
- Collaborative and Integrated Workflows
Variance in Practice of Tele-ICU

- Technology
- Types of ICUs
- Bedside intensivist staff model
- Bedside documentation/CPOE availability
- Remote center staffing patterns
- Qualifications of providers
- Hours of Operation
- Buy-in by bedside clinicians
- Adherence to best practices
- Use of quality and safety information
- Intensivist handover of their patients
- Community v. Tertiary Facility
- Teaching v. Non-teaching
What Does Tele-ICU do to Improve Quality?

• Disease Management
  - Acute interventions
  - Patient surveillance for proactive intervention
• “Population Management” – Best Practices
• Support Individual Unit Special Needs – Process flow variability through “gap analysis”
• Education
  - Resident eRounds
  - Nurse Mentoring
• Leveraging the technology in other care settings
Opportunities that can leverage Telemedicine

• “AHA” moments
• Data demonstrating Opportunities for Improvement
• Serious Safety events
• Gap analysis
• Evidence–based practice
• Individual ICU requests leading to successes that can be disseminated
• Lessons learned from other population management successes
Factors that reduce variation in care

- Surveillance
- Every Patient, Every Day
- Consistent Evidence-Based Practice
- Timely Interventions
- Risk Adjusted Data
- Horizontal Integration
- Vertical Integration
Data, data, data,....

• W. Edward Deming
  - “In God we trust; all others bring data.”
  - “Without data, you're just another person with an opinion.”
  - “If you can't describe what you are doing as a process, you don't know what you're doing.”
# Year over Year Improvements

## ICU Detailed Clinical Outcomes Summary

**Advocate**

*Obtained from Quarterly Detailed Clinical Outcomes Reports*

## Annual

<table>
<thead>
<tr>
<th>System</th>
<th>2014Q4 - 2015Q3</th>
<th>2015Q4 - 2016Q3</th>
<th>2016Q4 - 2017Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-A ICU Mortality (Lives Saved)</td>
<td>828</td>
<td>1203</td>
<td>1288</td>
</tr>
<tr>
<td>P-A ICU LOS (ICU Days Saved)</td>
<td>22792</td>
<td>29837</td>
<td>30250</td>
</tr>
<tr>
<td>P-A Vent Days (Fewer Vent Days)</td>
<td>5718</td>
<td>6793</td>
<td>7621</td>
</tr>
</tbody>
</table>
## 2017 Safety & Quality Accomplishments

<table>
<thead>
<tr>
<th>Area of Focus</th>
<th>Initiative</th>
<th>Financial Impact</th>
</tr>
</thead>
</table>
| eICU®         | Improvements in quality of patient care | **68 ICU lives saved** (mortality ratio went from 0.44 to 0.42).  
**Increase of 413 ICU days**, with an additional expenditure of **$181K** (ICU LOS ratio went from 0.62 to 0.63).  
**Decrease of 259 ICU vent days**, with a cost avoidance of **$168K** (vent ratio went from 0.78 to 0.77). |
Who is your Customer: Define Your “Population”

• Patients
• Physicians
• RNs
• Regulatory Reporting Requirements
• Administration
Implementation Alternatives

• **Pilot in one or two units**
  – Pros:
    • Allows testing and modification of the tool (PDSA)
    • Manageable for the eICU staff during learning curve
    • May recruit sites with high need for that particular initiative to volunteer for pilot
  – Cons:
    • Limited population
    • Still requires education and roll out to other sites if successful
    • Variances by type of ICU
    • Delays in achieving the benefits

• **Roll out across the entire system at once**
  – Pros:
    • Big Bang theory – everyone gets it on day one
    • Depending on initiative, may help prevent a safety event
  – Cons:
    • All sites may not perceive initiative as beneficial in the absence of data to demonstrate efficacy
### Multidisciplinary Round Checklist

<table>
<thead>
<tr>
<th>Concept</th>
<th>2/26/2018</th>
<th>2/25/2018</th>
<th>2/24/2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>CentralLineFollowup</td>
<td>212773</td>
<td>212126</td>
<td>211472</td>
</tr>
<tr>
<td>FoleyFollowup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NutritionFollowup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VentadFollowup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CentralLineNA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CentralLineType</td>
<td>Subclavian</td>
<td>Subclavian</td>
<td>Subclavian</td>
</tr>
<tr>
<td>CentralLineInsertionDate</td>
<td>2/13/2018 12:00:00 AM</td>
<td>2/13/2018 12:00:00 AM</td>
<td>2/13/2018 12:00:00 AM</td>
</tr>
<tr>
<td>CentralLineRemarks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CentralLineType2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CentralLineInsertionDate2</td>
<td>2/15/2018 12:00:00 AM</td>
<td>2/24/2018 12:00:00 AM</td>
<td>2/24/2018 12:00:00 AM</td>
</tr>
<tr>
<td>CentralLineIndication</td>
<td>Administration of drugs likely to induce phlebitis</td>
<td>Administration of drugs likely to induce phlebitis</td>
<td>Administration of drugs likely to induce phlebitis</td>
</tr>
<tr>
<td>CentralLineNecessity</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>FoleyNA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FoleyInsertionDate</td>
<td>2/13/2018 12:00:00 AM</td>
<td>2/24/2018 12:00:00 AM</td>
<td>2/24/2018 12:00:00 AM</td>
</tr>
<tr>
<td>FoleyIndication</td>
<td>Need for accurate measurements of urinary output in critically ill patients</td>
<td>Need for accurate measurements of urinary output in critically ill patients</td>
<td>Need for accurate measurements of urinary output in critically ill patients</td>
</tr>
<tr>
<td>FoleyRemarks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeedWithin4H</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EnteralNutrition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NutritionRemarks</td>
<td>TF 80/80</td>
<td>TF 80/80</td>
<td>TF 80/80</td>
</tr>
<tr>
<td>VentadNA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Height</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>IdealBodyWeight</td>
<td>-88.68</td>
<td>-88.68</td>
<td>-88.68</td>
</tr>
</tbody>
</table>

---

**AdvocateAuroraHealth**
Multidisciplinary Round Checklist Report
ICU CLABSI: Attributable Cost Trend

• Sherman Hospital included starting in 2013
• Data represents Adult ICU units only
Leveraging the Technology in Other Care Settings
Patient Safety Story

• An elderly patient was admitted to the ED with shortness of breath and a decision was made to admit to ICU. While boarding in ED due to lack of ICU bed availability, the patient continued to deteriorate, suffered a cardiac event and ultimately expired.

• A Root Cause Analysis (RCA) ensued with at least four areas of opportunity for improvement identified

• Corrective action resulted in the implementation of four eCareMobile carts, definition of new work flows for ICU boarders including the handover process and continuous patient monitoring (unique in the ED for ICU overflow monitoring)

Ongoing PDSA revealed an opportunity to utilize change management of both the IT and clinical processes
Caution Map Opportunities for Improvement

Patient Safety Goal
Impacted

Death
Cardiogenic shock
Significant myocardial injury
Delay in cardiac cath
Delay in diagnosing STEMI

Pt admitted to MICCU and holding in ED
No beds available
Patients awaiting bed availability to transfer from MICCU.

ED physicians cannot write admit orders
No repeat labs/EKGs ordered
No ICU protocols utilized in ED

Patient not seen in ED by attending or MICCU docs/residents
Intensivist/Resident from MICCU not involved in patient care in ED
MICCU residents work under intensivists who do not see patients before admit to MICCU

Too busy with MICCU patients

Limited treatment options for cardiac condition
Patient hemodynamic unstable

Credentials do not allow
Lack of available beds due to census.

Advocate Aurora Health
MICU Admission Boarding in ED Workflow

MICU patient in ED, MICU bed needed

Physician places ICU bed request after “Dr. Done”

Bed request to Bed Board

ED notified by bed board that ICU bed not available
(MICU bed not available if less than 2 open beds)

Desk clerk places patient into “ICU Virtual Hold Bed” ECC5, ECC6, ECC8, ECC9

Patient is admitted as Inpatient status

ED RN notifies ED Attending Physician and/or ED Resident that patient is placed on Cart

ED RN staff notifies eICU RN of admission and provides report:
1. Name
2. Patient ID (MRN)
3. Diagnosis
4. Attending Intensivist
5. ED room number
6. Virtual Unit Admit Date/Time

eICU HCA admits patient into eCareManager
Verifies lab and trended vital signs, enters height, weight and other data per eICU process. Notifies eRN and ePhysician of admission.

eICU RN
Intensivist
Attending
Resident
RN

ED staff enters MRN, Pt Name (Last, First) on monitor

Hand-over (Follow Communication Workflow)

After report is received the eRN will call the MICU to inform them of the boarding eMobile cart patient
MICU charge RN 41-8558

eICU Intensivist writes summary note on chart every shift to provide better handover

ED notifies eICU of transfer to MICU bed by eAlert button or phone call

Physician places ICU bed request after “Dr. Done”

Bed request to Bed Board

ED notifies MICU RN to handover the patient only if update needs to be provided. Note: ED RN will provide full report.

eICU RN
Intensivist
Attending
Resident
RN

Physician

eICU intensivist writes brief summary note upon transfer to MSDU and provides handover to Attending Physician.
eMobile Cart Percent by Unit Discharge Location

Cumulative February 2015 through May 2017

- Death, 1%
- Floor, 20%
- Home, 0%
- Other Hospital, 0%
- Step-Down Unit (SDU), 9%
- ICU, 69%
ED Collaboration Results

- **ICU LOS** similar excluding outliers 
  (95% CI -0.8-0.5, p=0.65)
  - eICU 3.2 days
  - Non-eICU 3.0 days

- **Hospital LOS** less in eICU excluding outliers 
  (95% CI 0.6-2.8, p=0.0023)
  - eICU 5.2 days
  - Non-eICU 6.9 days

- **Mortality** less in the eICU group
  Odds ratio [OR], 0.18 [95% CI 0.07-0.52],
  p=0.0012
  - eICU 4.4%
  - Non-eICU 19.8%

Downgrades resulted in
$436K in avoided expense
ICU vs. MED/Surg Saved Expenditures (Day One of Hospitalization) – February 2015 – May 2017

- ICU: $662,286
- Med/Surg Floor: $226,008
- Avoided Expense: $436,278

Other Benefits:
• No additional Patient Safety events for ICU/ED boarders
• Shorter LOS indicates improved throughput
• Now covering Step Down boarders as of 7/24/17
MSDU Admission Boarding in ED Workflow

1. **MSDU patient in ED, MSDU bed needed**
2. **ED Physician calls Admitting PMD and obtains Critical Care Pulmonologist Consult**
3. **ED RN calls bedside Critical Care Pulmonologist for admission orders**
4. **Desk clerk places patient into “ICU Virtual Hold Bed” ECC5, ECC6, ECC8, ECC9**
5. **Patient is admitted as Inpatient status**
6. **ED RN notifies ED Attending Physician and/or ED Resident that patient is placed on Cart**
7. **ED RN notifies ED RN of admission and provides report:**
   1. Name
   2. Patient ID (MRN)
   3. Diagnosis
   4. Attending Intensivist
   5. ED room number
   6. Virtual Unit Admit Date/Time
8. **ED RN staff notifies eICU RN of admission and provides report:**
   1. Name
   2. Patient ID (MRN)
   3. Diagnosis
   4. Attending
   5. ED room number
   6. Virtual Unit Admit Date/Time
9. **ED staff enters MRN, Pt Name (Last, First) on monitor**
10. **Hand-over (Follow Communication Workflow)**
11. **eICU Clinician camera assesses patient upon notification**
12. **eICU Clinician writes brief summary note upon transfer to MSDU and provides hand-over to Attending Physician.**
13. **eICU HCA admits patient into eCareManager**
   - Verifies lab and trended vital signs, enters height, weight and other data per eICU process.
   - Notifies eRN and ePhysician of admission.
14. **eICU Attending to contact Critical Care Pulmonologist on case to review management:**
   - As needed for questions
   - Change in patient’s status requiring either an upgrade to the MICU or a downgrade to the floor/telemetry.
   - AND at the time of hand-off when MSDU bed assigned to Patient
15. **ED RN calls MSDU RN to handover the patient only if update needs to be provided. Note: ED RN will provide full report.**
16. **eRN calls MSDU RN to handover the patient only if update needs to be provided. Note: ED RN will provide full report.**
17. **eICU intensivist writes brief summary note upon transfer to MSDU and provides hand-over to Attending Physician.**
18. **eICU Intensivist writes summary note on chart every shift to provide better handover. (Update and summary note to be written as an addendum to the original note)**

Original Date: 2016.12.20     Modified: 2018.2.27
eICU Handoff to MSDU

1. MSDU bed available
2. eICU calls Intensivist to handover patient
3. ED RN calls report to MSDU RN
4. Patient transfers to MSDU
5. MSDU RN calls Intensivist if orders are required
# MSDU Unit Discharge – Rolling 12 months

## eMobile Cart System Report  Rolling 12 Mos

*CMC-ECC-MSDU started on 7/24/17

### MSDU Boarder (Multiple Items)  2017 & 2018

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosp-Unit</td>
<td>CMC-ECC-MSDU</td>
<td>26</td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>38</td>
<td>45</td>
<td>29</td>
<td>33</td>
<td>58</td>
<td>29</td>
<td>37</td>
<td>17</td>
<td>371</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>26</td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>38</td>
<td>45</td>
<td>29</td>
<td>33</td>
<td>58</td>
<td>29</td>
<td>37</td>
<td>17</td>
<td>371</td>
</tr>
</tbody>
</table>

### MSDU Boarder (Multiple Items)  2017 & 2018

<table>
<thead>
<tr>
<th>Unit Name</th>
<th>CMC-ECC-MSDU</th>
</tr>
</thead>
</table>

### Post-ED Cart Status

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Downgrade</td>
<td>26.9%</td>
<td>15.8%</td>
<td>10.0%</td>
<td>50.0%</td>
<td>36.8%</td>
<td>33.3%</td>
<td>34.5%</td>
<td>33.3%</td>
<td>31.0%</td>
<td>31.0%</td>
<td>31.0%</td>
<td>8.1%</td>
<td>17.6%</td>
<td>28.3%</td>
</tr>
<tr>
<td>ICU</td>
<td>0.0%</td>
<td>10.5%</td>
<td>30.0%</td>
<td>10.0%</td>
<td>18.4%</td>
<td>11.1%</td>
<td>6.0%</td>
<td>3.0%</td>
<td>8.6%</td>
<td>17.2%</td>
<td>5.4%</td>
<td>11.8%</td>
<td>10.5%</td>
<td></td>
</tr>
<tr>
<td>SDU</td>
<td>73.1%</td>
<td>73.7%</td>
<td>60.0%</td>
<td>40.0%</td>
<td>46.7%</td>
<td>55.8%</td>
<td>58.6%</td>
<td>63.6%</td>
<td>60.3%</td>
<td>51.7%</td>
<td>85.3%</td>
<td>70.8%</td>
<td>61.2%</td>
<td></td>
</tr>
</tbody>
</table>

### MSDU Boarder (Multiple Items)  2017 & 2018

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosp-Unit</td>
<td>CMC-ECC-MSDU</td>
<td>8.96</td>
<td>5.66</td>
<td>5.65</td>
<td>8.83</td>
<td>9.24</td>
<td>8.68</td>
<td>8.73</td>
<td>7.71</td>
<td>11.73</td>
<td>7.35</td>
<td>5.70</td>
<td>7.73</td>
<td>8.36</td>
</tr>
</tbody>
</table>

* Downgrade = less acute level of care
* ICU = patient deteriorated and became ICU status
* SDU = patient continued as SDU status

---

AdvocateAuroraHealth
eSepsis
90th percentile target is 77%

83% increase over 3Q2016
(30 point increase in percentage points)
SIRS ALERTS

• Almost half of patients hospitalized on the wards developed SIRS at least once during their ward stay.

• SIRS does not equate with Sepsis

• SIRS Alerts are not specific and clinicians often do not even know what they are supposed to do with a SIRS Alert
SIRS ALERTS

• One of these alerts, created by the Cerner Corporation, is described in a recent publication in the *American Journal of Medical Quality*. Its cloud-based system analyzes patient data in real-time as it enters the EMR and matches the data against the SIRS criteria. Based on 6,200 hospitalizations retrospectively reviewed, the alert fired for 817 patients (13 percent) meeting two or more SIRS criteria. Of these, 622 (76 percent) were either superfluous or erroneous, with the alert occurring either after the clinician had ordered antibiotics or in patients for whom no infection was suspected or treated. Of the remaining alerts occurring prior to action to treat or diagnose infection, most (89 percent) occurred in the emergency department, and a substantial number (34 percent) were erroneous.

• Therefore, based on the presented data, 126 of 817 SIRS alerts (15 percent) provided accurate, potentially valuable information. Unfortunately, another 80 patients in the hospitalized cohort received discharge diagnoses of sepsis despite never triggering the tool. Finally, these data only describe patients requiring hospitalization and not those discharged from the emergency department. We can only speculate regarding the number of alerts triggered on the diverse ED population not requiring hospitalization, as prior work has estimated infection constitutes no more than a quarter of patients with SIRS in the emergency department. If such estimates hold true, the potential utility of such a SIRS-based tool drops below 5 percent.
## Sepsis Alert Summary Report

**Report Time Frame:** 11/1/2017 - 11/30/2017  
**Encounter Type:** DAY SURGERY/24 HR OBSERVATION, EMERGENCY ROOM, INPATIENT, NEWBORN, OUTPATIENT, RECURRING OUTPATIENT  
**Patient Age Category:** 18 - 64, 65 - 79, 80+  
**OB Indicator:** All

### Site and Unit Summary

<table>
<thead>
<tr>
<th>Site</th>
<th>Unit</th>
<th>Highest Sepsis Level</th>
<th># Patients</th>
<th># SIRS Alerts</th>
<th># Sepsis Alerts</th>
<th>Total # Alerts</th>
<th>Average # Alerts</th>
<th># First SIRS Alerts</th>
<th>Average Time from Criteria Met to First SIRS Alert</th>
<th># First Sepsis Alerts</th>
<th>Average Time from Criteria Met to First Sepsis Alert</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSH</td>
<td></td>
<td></td>
<td>536</td>
<td>1,929</td>
<td>2,250</td>
<td>3,642</td>
<td>7</td>
<td>329</td>
<td>5.7</td>
<td>150</td>
<td>2.4</td>
</tr>
<tr>
<td>SSH 2EST</td>
<td></td>
<td></td>
<td>14</td>
<td>69</td>
<td>187</td>
<td>246</td>
<td>18</td>
<td>5</td>
<td>8.3</td>
<td>2</td>
<td>5.5</td>
</tr>
<tr>
<td>SSH 2NOR</td>
<td></td>
<td></td>
<td>6</td>
<td>24</td>
<td>44</td>
<td>54</td>
<td>9</td>
<td>2</td>
<td>12.5</td>
<td>2</td>
<td>20.5</td>
</tr>
<tr>
<td>SSH 2WPP</td>
<td></td>
<td></td>
<td>10</td>
<td>52</td>
<td>158</td>
<td>157</td>
<td>16</td>
<td>2</td>
<td>25.5</td>
<td>3</td>
<td>2.0</td>
</tr>
<tr>
<td>SSH 3NOR</td>
<td></td>
<td></td>
<td>14</td>
<td>143</td>
<td>273</td>
<td>376</td>
<td>27</td>
<td>4</td>
<td>282.4</td>
<td>6</td>
<td>3.1</td>
</tr>
<tr>
<td>SSH 3SOU</td>
<td></td>
<td></td>
<td>11</td>
<td>49</td>
<td>41</td>
<td>76</td>
<td>7</td>
<td>5</td>
<td>90.0</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>SSH 4EST</td>
<td></td>
<td></td>
<td>11</td>
<td>49</td>
<td>41</td>
<td>76</td>
<td>7</td>
<td>5</td>
<td>90.0</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>SSH 4NOR</td>
<td></td>
<td></td>
<td>11</td>
<td>49</td>
<td>41</td>
<td>76</td>
<td>7</td>
<td>5</td>
<td>90.0</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>SSH 4SNF</td>
<td></td>
<td></td>
<td>11</td>
<td>49</td>
<td>41</td>
<td>76</td>
<td>7</td>
<td>5</td>
<td>90.0</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>SSH 4WST</td>
<td></td>
<td></td>
<td>2</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>9.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSH EEM</td>
<td></td>
<td></td>
<td>98</td>
<td>158</td>
<td>19</td>
<td>174</td>
<td>2</td>
<td>89</td>
<td>0.5</td>
<td>11</td>
<td>2.3</td>
</tr>
<tr>
<td>SSH EMER</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSH EMR</td>
<td></td>
<td></td>
<td>309</td>
<td>1,421</td>
<td>215</td>
<td>1,627</td>
<td>5</td>
<td>220</td>
<td>0.6</td>
<td>93</td>
<td>1.3</td>
</tr>
<tr>
<td>SSH ICU</td>
<td></td>
<td></td>
<td>41</td>
<td>0</td>
<td>1,309</td>
<td>915</td>
<td>22</td>
<td></td>
<td>29</td>
<td></td>
<td>4.1</td>
</tr>
<tr>
<td>SSH PACU</td>
<td></td>
<td></td>
<td>11</td>
<td>49</td>
<td>41</td>
<td>76</td>
<td>7</td>
<td>5</td>
<td>90.0</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>SSH Peds</td>
<td></td>
<td></td>
<td>536</td>
<td>1,929</td>
<td>2,250</td>
<td>3,642</td>
<td>7</td>
<td>329</td>
<td>5.7</td>
<td>150</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Total ED Patients & ICU Patients = 479  
Remaining - rest of SSUB = 58 - alert St John’s alerts for Nov 2017
**Adult sepsis inpatient**

---

**Nursing/PCA**
- Vitals entered into EMR
  - *Two SIRS criteria?*
    - Y: On antibiotics or SIRS criteria persist over two shifts?
      - Y: (EMR-generated) CBC with diff, Creatinine, bilirubin, INR, PTT, lactic acid (two tests at least four hours apart)
      - N: (a separate team) End organ damage??
    - N: (a separate team) marks a flag within the patient’s record to reset time 24 hours
  - N: (a separate team) notifies the floor charge nurse

---

**In-house rapid response team**
- Document focused exam, order pressors, call ICU team for transfer
- ICU team: Accept patient for evaluation and treatment
- Is MAP still < 65 mm Hg?
  - Y: 30 mL/kg of normal saline, consider IV access if not already present
  - N: MAP < 65 mm Hg or initial lactate ≥ 4 mmol/L?
- Look for infectious source (e.g., urinalysis, chest x-ray, blood culture)
- Start (or continue) broad spectrum antibiotic
- High suspicion for infection?
- Await additional information
- Is patient clinically septic?
  - Y: Page RRT
  - N: Suspend sepsis alerts for 24 hours

---

*SIRS criteria:*
1. Temperature >38 OR < 36 degrees Celsius
2. Heart rate > 90 beats per minute
3. Respiratory rate >20 OR PaCO₂ < 32 mm Hg, and
4. WBC > 12,000 OR < 4000/mm³ OR > 10% bands

---

*MAP < 65 mm Hg, SBP < 90 mm Hg, Cr > 2.0 (if not ESRD), bilirubin > 2 mg/dL, platelet < 100, INR > 1.5 (not on warfarin), PTT > 60 (not on intravenous heparin) or lactate > 2 mmol/L*

---

Created May 2, 2017; Updated December 11, 2017
Three Possible Scenarios

SEPSIS
- Concern for Severe Sepsis or Septic Shock
- EICU recommends huddle patient at bedside
- Medical Alert: Sepsis Alert paged
- Sepsis Alert Response Team, Charge RN, and Bedside RN huddle patient at bedside

No SEPSIS
- No Concern for new onset Severe Sepsis or Septic Shock OR patient is already being treated appropriately
- No Huddle recommended by eICU
- Alert Suppressed by SSUB Clinician for 12 hours

Something Else
- No Concern for new onset Severe Sepsis or Septic Shock
- Concern noted for patient deterioration for another cause
- EICU recommends RRT response

Sepsis Alert
Fires in EMR: EICU views

Advocate Aurora Health
Future State – Scenario #1

**eICU sees the Alert First**

Scenario #1 – eICU aware first of Care Connection alert

- **Care Connection Alert Fires**
- **Populates Sepsis Alert Screen In eICU**
- **eICU Surveillance team member notifies eICU physician**
- **eICU physician calls S Sub unit – “we have a sepsis alert” and participates in a team sepsis huddle with bedside RN and CN**

- **Sepsis?**
  - Yes? Notify Hospitalist
  - No?

- **Patient Deteriorating?**
  - Yes? Triage/Escalate
  - No? Stop

**The Huddle Team or Wingman Concept is an evidence-based way to improve sepsis recognition**
Future State – Scenario #2

- Scenario #2: South Sub RN suspects or has manually screened the patient for sepsis – no CareConnection alert and calls the eICU for a huddle

The Concerned Nurse

- RN concern for sepsis
- Calls eICU for bedside huddle
- Sepsis?  
  Yes? Notify Hospitalist  
  No?  
  Patient Deteriorating?  
  Yes? Triage/escalate to Hospitalist  
  No? Stop

The Huddle Team or Wingman Concept is an evidence-based way to improve sepsis recognition
Medical Alert: Sepsis Alert

• New Sepsis Alert Response Team to evaluate and “huddle” patients at bedside to determine new onset Severe Sepsis or Septic Shock requiring Sepsis Bundle initiation
  • House Doctor
  • ICU RN
  • Lab

A Sepsis Response team will be paged by: Calling 46-6100 and requesting Sepsis Alert to be paged. Identify patient room number. Operator will overhead page “Medical Alert: Sepsis Alert” followed with patient room number.
Standard Work
(Or You Get Entropy)

1st Pass Improvement

2nd Pass Improvement

The Way We've Always Done It

Advocate Aurora Health
Debriefing Form

Completed by Team members participating in the Sepsis huddle to determine what went well and opportunities for improvement
Attach to Green huddle Sheet for collection by Unit Educators/Sepsis Coordinator
Impact of Telemedicine on Mortality, Length of Stay, and Cost Among Patients in Progressive Care Units: Experience From a Large Healthcare System*

Donna Lee Armaignac, PhD, APRN CNS-BC, CCNS, CCRN; Anshul Saxena, PhD; Muni Rubens, PhD; Carlos A. Valle, MSIT; Lisa-Mae S. Williams, MSN; Emir Veledar, PhD; Louis T. Gidel MD, PhD

TPCU intervention significantly decreased mortality in progressive care unit and hospital and progressive care unit length of stay despite the fact patients in TPCU were older and had higher disease severity, and risk of mortality. Increased postprogressive care unit hospital length of stay and total mean direct costs inclusive of telemedicine costs coincided with improved survival rates. Telemedicine intervention decreased overall mortality and length of stay within progressive care units without substantial cost incurrences.
Survival curves for Cox proportional hazards model with telemedicine at progressive care unit (PCU) (TPCU) admission (solid line) and without telemedicine at PCU (NTPCU) admission (dotted line). LOS = length of stay.
Incorporating eICU Infrastructure into Rapid Response
## 1.1.1 Cluster RCT, CBA and ITS Studies

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Rapid Response Systems</th>
<th>Control</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Weight</td>
</tr>
<tr>
<td>Bristow</td>
<td>243</td>
<td>18338</td>
<td>535</td>
</tr>
<tr>
<td>Hillman</td>
<td>1</td>
<td>622</td>
<td>1</td>
</tr>
<tr>
<td>Howell</td>
<td>1755</td>
<td>90045</td>
<td>1383</td>
</tr>
<tr>
<td>Priestley</td>
<td>27</td>
<td>530</td>
<td>28</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>109535</strong></td>
<td><strong>100104</strong></td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>2026</td>
<td>1947</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 3.11, df = 3 (P = 0.38); I² = 3%
Test for overall effect: Z = 2.70 (P = 0.007)

## 1.1.2 Observational and Before After Studies

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Rapid Response Systems</th>
<th>Control</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Weight</td>
</tr>
<tr>
<td>Al–Qahtani</td>
<td>3191</td>
<td>157804</td>
<td>2214</td>
</tr>
<tr>
<td>Baxter</td>
<td>400</td>
<td>11271</td>
<td>279</td>
</tr>
<tr>
<td>Beiler</td>
<td>1086</td>
<td>79013</td>
<td>1194</td>
</tr>
<tr>
<td>Bellomo</td>
<td>222</td>
<td>20921</td>
<td>302</td>
</tr>
<tr>
<td>Buist</td>
<td>393</td>
<td>22847</td>
<td>380</td>
</tr>
<tr>
<td>Campello</td>
<td>357</td>
<td>70850</td>
<td>94</td>
</tr>
<tr>
<td>Chan</td>
<td>773</td>
<td>24978</td>
<td>780</td>
</tr>
<tr>
<td>Dacey</td>
<td>402</td>
<td>17090</td>
<td>160</td>
</tr>
<tr>
<td>Hayani</td>
<td>26</td>
<td>294</td>
<td>53</td>
</tr>
<tr>
<td>Jones</td>
<td>4070</td>
<td>104001</td>
<td>873</td>
</tr>
<tr>
<td>Kenward</td>
<td>1054</td>
<td>53500</td>
<td>1070</td>
</tr>
<tr>
<td>Konrad</td>
<td>1211</td>
<td>73825</td>
<td>3854</td>
</tr>
<tr>
<td>Lim</td>
<td>583</td>
<td>3499</td>
<td>569</td>
</tr>
<tr>
<td>Santamaria</td>
<td>551</td>
<td>74616</td>
<td>1174</td>
</tr>
<tr>
<td>Shah</td>
<td>970</td>
<td>45125</td>
<td>390</td>
</tr>
<tr>
<td>Simmes</td>
<td>89</td>
<td>2410</td>
<td>25</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>793244</strong></td>
<td><strong>687871</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total events: 15378 13411
Heterogeneity: Tau² = 0.02; Chi² = 129.79, df = 15 (P < 0.00001); I² = 88%
Test for overall effect: Z = 3.20 (P = 0.001)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Rapid Response Systems</th>
<th>Control</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Weight</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>902779</strong></td>
<td><strong>787975</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total events: 17404 15358
Heterogeneity: Tau² = 0.02; Chi² = 135.66, df = 19 (P < 0.00001); I² = 86%
Test for overall effect: Z = 3.69 (P = 0.0002)
Test for subgroup differences: Chi² = 0.41, df = 1 (P = 0.52), I² = 0%
Of the 20 studies that reported hospital mortality, 9 favored RRT/METs, found no difference with RRT/METs, and 1 favored RRT/METs for surgical patients while favoring usual care (no RRT/MET) for medical patients. The pooled analysis demonstrated that implementation of RRT/METs was associated with a significant reduction in hospital mortality (RR 5 0.88, 95% confidence interval [CI]: 0.83-0.93).

Of the 20 studies that reported rates of IHCA, 12 favored RRT/METs and 8 found no difference with RRT/METs (Figure 2b). In the pooled analysis, RRT/METs were associated with a significant reduction in IHCA (RR 5 0.62, 95% CI: 0.55-0.69).

Most studies were performed in teaching hospitals; thus, the results may not be as applicable to community hospitals.
Projecting Critical Care Beyond the ICU: An Analysis of Tele-ICU Support for Rapid Response Teams

Peter A. Pappas, MD, Luann Tirelli, James Shaffer, and Scott Gettings

In this study we sought to evaluate the ability of eMobile to support care administered by RRTs. Materials and Methods: A retrospective review evaluating mobile cart activations for RRT calls was performed. Data on mobile cart deployments were recorded over a 33-month period from January 2012 through September 2014. Results: .... The most common patient conditions were respiratory distress (n = 190, 33%), altered mental status (n = 137, 24%) and hypotension (n = 59, 10%). The most common interventions were medication orders (n = 231, 40%) and laboratory studies (n = 92, 29%). For 566 eMobile calls with documented dispositions, 189 patients (33%) were managed without ICU upgrade. No adverse patient outcomes were recorded involving eMobile. Compared with the RRT program in 2009, the last year before testing of eMobile began (2010–2011), addition of tele–critical care support for calendar years 2012 and 2013 increased projected cost avoidance from unnecessary ICU transfers by a mean of 66% above the 2009 baseline. For Fiscal Year 2014, a projected cost avoidance analysis for unnecessary ICU transfers including costs of information technology (IT) support demonstrated a return on investment up to $1.66 for every $1 invested in IT support. Conclusions: Mobile critical care coupled with RRT is clinically effective and can generate meaningful cost avoidance.
The rapid response system should include team members with:

- Ability to diagnosis the clinical problem
- Ability to initiate therapy
- Appropriately triage patients to appropriate level of care
- Authority to transfer the patient to higher level of care
- A leader to coordinate team actions
Tele-RRT can provide

• An intensivist without pulling a physician away from elsewhere (esp ICU)
• An eIntensivist to fill the role of RRT team leader
• Real time access of an ICU attending to housestaff or nurses during the RRT
• Every RRT to be a teaching opportunity
• An intensivist to establish a differential diagnosis and direct the work up
• Triaging of patients – not all RRTs should be transferred to the ICU
• End of life discussion
Tele-RRT can provide cont’d

• Earlier initiation of critical care while waiting for transfer to ICU
• A longer period of observation to ensure stability for patients not transferred to ICU
• Support for simultaneously occurring RRTs
• Initiation of sepsis EGDT sooner (e.g. antibiotics within 1 hour)
• Appropriate documentation for CMS SEP-1 sepsis compliance
• A forum for “Huddles” during shifts to review the status of RRT patients that were not transferred to the ICU
• Avoid “deskilling” of ward staff
• Assess system safety deficiencies
Delayed transfer to the ICU has been shown to be associated with increased mortality.

Different studies have used different criteria for activating RRT. Simple clinical judgement of nurses on the basis of subjective worry or general concern is a common trigger for RRT activation. The generic ‘worry’ significantly increased the RRT activation 35-fold when compared with activation based on vital signs. The number of RRT activations as a result of false positive calls has not been investigated.

Genardi, Revitalizing an established rapid response team. Dimens Crit Care Nurs 2008; 27: 104–9
Advocate eICU Mentorship Program

Need:

- Our sites identified that new RNs often feel under supported at the bedside and this program was developed to bridge the gap from novice to advanced beginner ICU RN

Results:

- To date (from 2012), >200 RNs have completed the program; 31 currently enrolled and 17 in pipeline
- Will be expanded to outreach partners and to two additional Advocate sites
- This program is utilized as part of the recruitment/retention strategy by our ICUs

Lessons Learned:

- Adapt the program based on feedback from each participant
- eRN staff requested additional education on mentor/precepting principles
- Adjust eRN schedule, for consistency in mentor, based on number of participants
- Instituted support pods in CORE to provide support to mentor/coach
Re-evaluate the process regularly

• Unanticipated discoveries
• Unforeseen outcomes
• Evolving medical literature
• Changes in EMR, technology, staffing,...
Objectives

• Understand that telemedicine can achieve clinical and financial benefits for acute care across a large healthcare system utilizing implementation science

• Recognize that the success of telehealth is determined less by what technologies you have and more by how you use them

• Realize that the tele-ICU is a facilitator of change management as much as an “intervention”
Thank You!
Questions

Contact:
Michael.Ries@Advocatehealth.com