Retrospective review of the Modified Early Warning Score in critically ill surgical inpatients at a Canadian Hospital

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Disclosures

- I have no financial/personal relationships to disclose
Thunder Bay Regional Health Sciences Centre has a well established Medical Emergency Team (MET).

MET activated by single parameter “track and trigger” systems

Team consists of RN and MD, acts as “Code Prevention Team”
MET Calling Criteria
Pt shows signs of acute change in:

- **Airway:**
  - Threatened airway or Stridor or Excessive Secretions

- **Breathing:**
  - RR <8 or >30 or Distressed breathing or Sats <90% on 50% oxygen or 6LNC

- **Circulation:**
  - SBP <90 or >200 or decreased >40mmHg or HR <40 or >130 or Urine output <100mL in 4 hrs except dialysis pts

- **Neurological:**
  - Decreased LOC or GCS decreased greater than 2

- **Worried:**
  - Serious concern about the pt
Background
Background

- Is there a way to help multidisciplinary teams identify patients at risk of catastrophic deterioration?
- Would a scoring system help decrease Code Blue events and catastrophic deterioration in surgical patients?
Modified Early Warning Score (MEWS)

- Quick bedside tool
- Uses already recorded parameters
- Highlights patients at risk of deterioration
- Allows for more vigorous monitoring or transfer to higher level of care before critical decline
<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
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<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td></td>
<td>&lt;41</td>
<td>41-50</td>
<td>51-100</td>
<td>101-110</td>
<td>111-129</td>
<td>&gt;129</td>
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<tr>
<td>Temp</td>
<td>&lt;35.1</td>
<td>35.1-36.0</td>
<td>36.1-38.4</td>
<td>&gt;38.4</td>
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<tr>
<td>SBP</td>
<td>&lt;71</td>
<td>71-80</td>
<td>81-100</td>
<td>100-199</td>
<td>&gt;199</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>&lt;9</td>
<td>9-14</td>
<td>15-20</td>
<td>21-29</td>
<td>&gt;29</td>
<td></td>
<td></td>
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<tr>
<td>LOC</td>
<td>Alert</td>
<td>Voice</td>
<td>Pain</td>
<td>Unresponsive</td>
<td></td>
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</tbody>
</table>
Potential Impact of MEWS

- Gardner-Thorpe et al.,
  - Assessed in 334 surgical patients and colorectal patients
  - 75% of patients transferred to ICU or stepdown had MEWS >4
  - NNT 5

- Maupin et al.,
  - Hospital-wide implementation of MEWS in a hospital in Cincinnati
  - 50% decrease in Code Blues
  - 200% increase in RRT calls

Our Question

- In surgical inpatients who were seen by the Medical Emergency Team (MET) and/or had Code Blue events:
  - What was their MEWS at the time of the event and in the preceding 48hrs?
  - Can this information be used to identify those patients who would have benefited from earlier intervention by MET?
Methods

- Feasibility study, retrospective review of Medical Emergency Team calls from July 1, 2010 to July 1, 2011 to inpatients on surgical floors (3A, 3B)
- Retrospective review of Code Blue calls from July 1, 2010 to July 1, 2011 for inpatients on surgical floors (3A, 3B, 3C, 3CN)
- Assessment of MEWS at time of MET call and in 48hrs prior to MET call
- Assessed 179 patients with 218 MET or Code Blue calls
Primary Outcome

- MEWS at time of MET call and/or Code Blue event
Secondary Outcomes

- Time between MEWS ≥5 and MET call
- 30-day in-hospital mortality rate
- Number of ICU admissions resulting from MET calls
Demographic Information

Admitting Service

- Ortho
- General Surgery
- Hospitalist
- Family Med
- Gyne
- Urology
- Other
Indications for MET Call

% MET Calls

- Airway
- Breathing
- Circulation
- Neurological
- Cardiac Arrest
- Concerned
- Not...

% MET Calls
# Results

<table>
<thead>
<tr>
<th></th>
<th>≥2</th>
<th>≥3</th>
<th>≥4</th>
<th>≥5</th>
<th>≥6</th>
<th>≥7</th>
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</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>98.18</td>
<td>90.91</td>
<td>76.36</td>
<td>69.09</td>
<td>41.82</td>
<td>25.45</td>
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<tr>
<td>Specificity</td>
<td>9.15</td>
<td>20.92</td>
<td>41.18</td>
<td>60.13</td>
<td>77.12</td>
<td>83.66</td>
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<tr>
<td>PPV</td>
<td>27.98</td>
<td>29.24</td>
<td>31.82</td>
<td>38.38</td>
<td>39.66</td>
<td>35.90</td>
</tr>
<tr>
<td>NPV</td>
<td>93.33</td>
<td>86.49</td>
<td>82.89</td>
<td>84.40</td>
<td>78.67</td>
<td>75.74</td>
</tr>
</tbody>
</table>
MEWS Results

**MET MEWS**

- < 5: 60.00%
- ≥ 5: 50.00%
- Missing Vitals: 10.00%

**Disposition**

- < 5: Ward 50.00%, ICU 10.00%, Deceased 0.00%
- ≥ 5: Ward 20.00%, ICU 30.00%, Deceased 0.00%
Time between MEWS $\geq 5$ and MET

- Time: 4-12 hrs
- Time: 24-48 hrs
## Results at MET call

<table>
<thead>
<tr>
<th>Variable</th>
<th>MEWS &lt;5</th>
<th>MEWS ≥5</th>
<th>Test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (median and range)</td>
<td>72 (20-97)</td>
<td>76 (31-95)</td>
<td>Mann-Whitney U test</td>
<td>0.025</td>
</tr>
<tr>
<td>Gender (male:female)</td>
<td>50:57</td>
<td>50:49</td>
<td>Chi-square</td>
<td>0.588</td>
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<tr>
<td>30-day mortality</td>
<td>14.15%</td>
<td>30.43%</td>
<td>Chi-square</td>
<td>0.006</td>
</tr>
<tr>
<td>Disposition to ICU</td>
<td>15.60%</td>
<td>38.38%</td>
<td>Chi-square</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS (median and range)</td>
<td>9 (1-103)</td>
<td>15 (2-178)</td>
<td>Mann-Whitney U test</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Effect of MEWS in 4-12 hrs preceding MET call

<table>
<thead>
<tr>
<th>Variable</th>
<th>MEWS &lt;5</th>
<th>MEWS ≥5</th>
<th>Test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (median and range)</td>
<td>76 (20-97)</td>
<td>74 (31-93)</td>
<td>Mann-Whitney U test</td>
<td>0.701</td>
</tr>
<tr>
<td>Gender (male:female)</td>
<td>66:85</td>
<td>4:3</td>
<td>Chi-square</td>
<td>0.102</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>16.78%</td>
<td>41.86%</td>
<td>Chi-square</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Disposition to ICU</td>
<td>21.57%</td>
<td>42.86%</td>
<td>Chi-square</td>
<td>0.003</td>
</tr>
<tr>
<td>LOS (median and range)</td>
<td>11 (1-157)</td>
<td>17 (2-73)</td>
<td>Mann-Whitney U test</td>
<td>0.456</td>
</tr>
</tbody>
</table>
The image shows an ROC (Receiver Operating Characteristic) curve for various MET MEWS (Medical Emergency Team Medical Evaluation System) levels. The ROC curve is plotted against sensitivity on the y-axis and 1-specificity on the x-axis. Different lines represent different MET MEWS thresholds, with the area under the curve (AUC) indicated for each.

- ROC Curve (Area)
  - MET MEWS of at least 2 (0.5367)
  - MET MEWS of at least 3 (0.5591)
  - MET MEWS of at least 4 (0.5877)
  - MET MEWS of at least 5 (0.6461)
  - MET MEWS of at least 6 (0.5947)
  - MET MEWS of at least 7 (0.5456)
Results

- Less than half of MET calls reached MEWS calling criteria

- Many patients exhibit signs of clinical deterioration before being seen by MET in the 4-48 hours prior to call

- Statistically significant increase in disposition to ICU, 30-day in-hospital mortality and length of hospital stay with MEWS ≥5
Conclusions

- Despite a well-developed MET team, many patients exhibit vital sign abnormalities suggestive of critical deterioration prior to their assessment by MET.
- MEWS identifies patients at risk of clinical deterioration prior to assessment by MET.
- Implementation of MEWS into pre-existing EMR could be used to identify patients at risk of deterioration.
Limitations

- Retrospective chart review
- Depended on electronically charted vital signs
- Level of consciousness not consistently charted
- Mostly surgical inpatients
Future Directions of Research

- Prospective hospital-wide implementation trial at Thunder Bay Regional Health Sciences Centre
- MEWS will be implemented into EMR, will be automatically calculated
- Algorithm for increasing MEWS will include alerting MRP and increased monitoring
Many Thanks To:

- Dr. S. Zaki Ahmed
- Dr. Alison Fox-Robichaud
- Dr. Heather MacLeod
- The Method Centre, Ottawa
Questions?
References

- Campello G et al., Immediate and long-term impact of medical emergency teams on cardiac arrest prevalence and mortality: a plea for periodic basic life-support training programs. Crit Care Medicine Dec 2009, 37(12): 3054-61

- Ludikhuize J et al., Identification of deteriorating patients on general wards; measurement of vital parameters and potential effectiveness of the Modified Early Warning Score. J Crit Care 2012 ePub 10.1016/jcrc.2012.01.003

