IDENTIFYING HUMAN FACTORS PROBLEMS IN THE DESIGN OF 25 OBSERVATION CHARTS

ACSQHC/CEC Deteriorating Patient Workshop
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Heuristic Analysis

- This is a method of systematically reviewing design problems in a system.
- Each chart was evaluated by five independent trained evaluators against 10 pre-determined human factors design categories.
- 1189 design problems were identified, an average of 48 per chart (ranging from 35-63).
Recording of vital signs as numerical data

- Raters considered information displayed numerically rather than plotted as a graph to be problematic.
- The majority of charts did not display all vital signs as graphs. This was argued to make it difficult to notice deterioration.
This chart uses graphs to show the same data as in the previous slide.

- Deterioration is easier to see.
Many charts had graphs where 2 or more vital sign plots could be confused.

Here’s an example of how multiple plots on same graph could be confusing.
The same 3 plots were considered clearer when separated.
Other problems

- Track and trigger systems were considered valuable for helping detect deterioration but only 36% of the 25 charts reviewed had some sort of track and trigger system.

- Some charts put a high cognitive load on users (e.g. having to compare information over different areas of the page or having to transcribe information between two pages).

- All the charts assessed contained text regarded as being too small (including one chart that used 4 point font). This could be a particular problem under low light conditions.
Other problems

- Two thirds of charts did not use colour (or used it in a non-meaningful way) – missing the opportunity it provides to improve usability.

- Problems included lack of clarity in labelling and phrasing and lack of standardisation in labelling. For example, we found 18 different terms among the 25 charts for Oxygen Saturation.

<table>
<thead>
<tr>
<th>O² saturation (%)</th>
<th>Oxygen Saturation</th>
<th>SpO Sats%</th>
</tr>
</thead>
<tbody>
<tr>
<td>O2 Saturations</td>
<td>Oxygen Saturation</td>
<td>SpO₂</td>
</tr>
<tr>
<td>O Sat</td>
<td>(SpO₂)</td>
<td>Sp0₂</td>
</tr>
<tr>
<td>O Sat%</td>
<td>SaO</td>
<td>SpO2 Sats</td>
</tr>
<tr>
<td>O Sat.</td>
<td>Sat O</td>
<td>SpO2%</td>
</tr>
<tr>
<td>Oxygen - Saturation %</td>
<td>SATS (SpO2)</td>
<td>SPO²</td>
</tr>
</tbody>
</table>
We used the best features of existing charts to create a draft of a new chart. The new chart ended up being largely based on:

- The **Prince Charles Hospital MEWS chart** which in turn was based on the **COMPASS chart** in use at Canberra Hospital.
- The **Royal Children’s Hospital CEWT chart** (designed by Kevin McCaffery)

We have called it the Adult Deterioration Detection System (ADDS) chart.

Specific aim is to detect deterioration rather than being a general observation chart.
The objective was to present the most important vital signs for detecting deterioration in most patients in a user-friendly manner.

We wanted to avoid the temptation to include additional data because, from a human factors standpoint, every extra item on a chart will compete with the existing information for the user’s attention.
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Respiratory Rate (breathe/min)</th>
<th>O₂ Flow Rate (L/min)</th>
<th>O₂ Saturation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>21 - 30</td>
<td>5 - 10</td>
<td>≥ 92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31 - 35</td>
<td>1 - 5</td>
<td>≥ 93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36</td>
<td>≤ 1</td>
<td>≤ 84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - 20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood Pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
</tr>
<tr>
<td>110</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heart Rate (beats/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
</tr>
<tr>
<td>130</td>
</tr>
<tr>
<td>120</td>
</tr>
<tr>
<td>110</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.5</td>
</tr>
<tr>
<td>36.1 - 36.9</td>
</tr>
<tr>
<td>35.1 - 34.1</td>
</tr>
<tr>
<td>≤ 34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4 Hour Urine Output (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 800</td>
</tr>
<tr>
<td>795 - 790</td>
</tr>
<tr>
<td>791 - 799</td>
</tr>
<tr>
<td>≤ 79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consciousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert</td>
</tr>
<tr>
<td>Voice</td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td>Unresponsive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increased Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
</tr>
</tbody>
</table>

### ADDS Scores

- **Respiratory Rate**
- **O₂ Flow Rate**
- **O₂ Saturation**
- **Systolic BP**
- **Heart Rate**
- **Temperature**
- **4 Hour Urine Output**
- **Consciousness**

### Total ADDS Score

**Score 0**

**Score 1**

**Score 2**

**Score 3**

**Score 4**

**Score 5**

**MET Call**

### Medical Emergency Team (MET) call if:

- Any observation is in a purple area
- Airway threat
- Respiratory or cardiac arrest
- New drop in O₂ Saturation < 90%
- Sudden fall in level of consciousness
- Seizure
- You are seriously worried about the patient but they do not fit the above criteria

### Total ADDS Score ≥ 8

- Consider MET call
- Registrar to review patient within 10 minutes
- Request review, and note on the back of this form
- Registrar to ensure Consultant is notified
- Ward doctor to attend
- If patient must leave ward area, Intern and Nurse must accompany patient
Observations

- You should record appropriate observations:
  - On admission
  - At a frequency appropriate for the patient's clinical state
  - Whenever you are concerned about the patient.

- For each vital sign, place a dot (+) in the box which includes the current observation in its range of values. Then draw a line between this dot and the previous dot to create a graph (unless this is the first observation).

- Whenever an observation falls within a shaded area, you must enter the ADDS Score for that vital sign in the appropriate row of the ADDS Scores table.

- Every time that observations are recorded, you must enter a Total ADDS Score (even if 0).

Modification to ADDS

If abnormal observations are to be tolerated for the patient's clinical condition, write the acceptable ranges (where the ADDS Score will be 0) below.

Respiratory Rate
- O2 Flow Rate
- O2 Saturation
- Systolic BP
- Heart Rate
- Temperature
- 4 Hour Urine Output
- Consciousness

Interventions

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Clinical Reviews

Review Requested
- Reason
- Review Undertaken
- Management
  - Management changed
    - Specify:

ADDs Chart
### Adult Deterioration Detection System (ADDS)

If any observation is in a shaded area, add up the Total ADDS Score and take action.

#### Score 0
- Record observations at least once every 4 hours
- Carry out appropriate interventions as prescribed
- Manage fever, pain or distress
- Review O2 delivery
- Consider informing Team Leader

#### Score 1
- Ward doctor to review patient within 30 minutes
- Request review, and note on the back of this form
- Notify Team Leader
- Record observations at least once every 30 minutes
- If patient must leave ward area, Nurse must accompany patient

#### Score 2
- Registrar to review patient within 30 minutes
- Request review, and note on the back of this form
- Registrar to ensure Consultant is notified
- Ward doctor to attend
- If patient must leave ward area, Intern and Nurse must accompany patient

#### Score 3
- Consider MET call
- Registrar to review patient within 10 minutes
- Request review, and note on the back of this form
- Registrar to ensure Consultant is notified
- If patient must leave ward area, Registrar and Nurse must accompany patient

- Medical Emergency Team (MET) call if:
  - Any observation is in a purple area
  - Airway threat
  - Respiratory or cardiac arrest
  - New drop in O2 Saturation < 90%
  - Sudden fall in level of consciousness
  - Seizure
  - You are seriously worried about the patient but they do not fit the above criteria
Vital signs plots

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Respiratory Rate (breaths / min)</th>
<th>O₂ Flow Rate (L / min)</th>
<th>O₂ Saturation (%)</th>
<th>Write ≥ 200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>≥ 37</td>
<td>&gt; 5</td>
<td>≥ 93</td>
<td>≥ 200 Write</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36</td>
<td>1 - 5</td>
<td>90 - 92</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31 - 35</td>
<td>&lt; 1</td>
<td>85 - 89</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21 - 30</td>
<td></td>
<td>≤ 84</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 - 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 - 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 4</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- Vital signs all plotted as graphs (arranged into ranges).
- More critical vital signs towards the top of the page.
- Scales labelled on both left and right.
- Bold vertical lines every 3 columns.
- Progression in colours increasing in severity/importance from yellow → orange → red → purple.
- Colour key is positioned close to the data area.
**Track and trigger systems**

- Can be used as a single parameter system (MET) or multiple parameter system (ADDS).

**Medical Emergency Team (MET) call if:**
- Any observation is in a purple area
- Airway threat
- Respiratory or cardiac arrest
- New drop in O₂ Saturation < 90%
- Sudden fall in level of consciousness
- Seizure
- You are seriously worried about the patient but they do not fit the above criteria

**Adult Deterioration Detection System (ADDS)**

If any observation is in a shaded area, add up the Total ADDS Score and take action.

<table>
<thead>
<tr>
<th>Score 0</th>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
<th>Score 4</th>
<th>Score 5</th>
<th>MET call</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**ADDS Scores**

- Respiratory Rate
- O₂ Flow Rate
- O₂ Saturation
- Systolic BP
- Heart Rate
- Temperature
- 4 Hour Urine Output
- Consciousness
- TOTAL ADDS

**Action guide can be referred to without page turning.**

- Used checkboxes so users can even as they complete actions

**Actions Required**

**Total ADDS Score 1 – 3**
- Record observations at least once every 4 hours
- Carry out appropriate interventions as prescribed
- Manage fever, pain or distress
- Review O₂ delivery
- Consider informing Team Leader

**Total ADDS Score 4 – 5**
- Ward doctor to review patient within 30 minutes
- Request review, and note on the back of this form
- Notify Team Leader
- Record observations at least once every 30 minutes
- If patient must leave ward area, Nurse must accompany patient

**Total ADDS Score 6 – 7**
- Registrar to review patient within 30 minutes
- Request review, and note on the back of this form
- Registrar to ensure consultant is notified
- Ward doctor to attend
- If patient must leave ward area, Intern and Nurse must accompany patient

**Total ADDS Score ≥ 8**
- Consider MET call
- Registrar to review patient within 10 minutes
- Request review, and note on the back of this form
- Registrar to ensure Consultant is notified
- If patient must leave ward area, Registrar and Nurse must accompany patient
The upper option gives thresholds tailored to patient’s usual SBP but is less user friendly as a result.
If abnormal observations are to be tolerated for the patient’s clinical condition, write the acceptable ranges (where the ADDS Score will be 0) below.

<table>
<thead>
<tr>
<th>Modification to ADDS</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Rate</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O₂ Flow Rate</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O₂ Saturation</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic BP</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart Rate</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Hour Urine Output</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consciousness</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Doctor’s name | Designation
Doctor’s signature

Date | Time

System allows modification of the threshold scores for a particular patient (on the first page the user would see)
Further studies to be completed

- Online survey – evaluating the preferences of chart users with respect to a number of different charts.
- Experimental studies evaluating the performance (in terms of response times and errors generated) of a sample of observation charts in a simulated hospital environment.
Any feedback about the new chart is welcomed

- Please email me (Mark Horswill) with any comments or suggestions: m.horswill@psy.uq.edu.au
- Also, please log on to our online survey, which is canvassing views on charts: https://experiment.psy.uq.edu.au/obschart/