Keys steps in recognising and responding to deterioration in children: What do we know?

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Children in hospital require complex care.
Critically ill children are not confined to the PICU
Unplanned PICU admission
(2009) PICaNET

- A&E
- HDU
- ICU
- Intermed care
- Theatre/recovery
- Ward
- X-ray
- Unknown
Why Children Die:
A Pilot Study 2006

Avoidable 19
Potentially avoidable 44
Unavoidable 26

May 2008
England (South West, North East & West Midlands), Wales and Northern Ireland
Suboptimal care in the initial management of children who died from severe bacterial infection: A population-based confidential inquiry*

Elise Launay, MD; Christèle Gras-Le Guen, MD, PhD; Alain Martinot, MD, PhD; Rémy Assathiany, MD; Thomas Blanchais, MD; Nadjette Mourdi, MPH; Albertine Aouba, MD; Marie-Hélène Bouvier-Colle, PhD; Jean-Christophe Rozé, MD, PhD; Martin Chalumeau, MD, PhD

Objectives: To study the frequency and types of suboptimal care and medical errors in children who died of severe bacterial infection as the first-stage procedure intended to improve quality of care.


Setting: Two adjoining administrative districts in France.

Patients: Children older than 3 months dead from severe bacterial infection from 2000 through 2006.

Interventions: The medical files were summarized on standardized forms and then evaluated independently by two experts, who determined whether the initial management before the patients’ arrival in intensive care was or was not optimal, in comparison with current guidelines.

Measurements and Main Results: Of 23 deaths from severe bacterial infection, 21 could be analyzed; management was considered suboptimal in 76%. The coefficient of agreement between the experts was high, with a weighted κ of 0.73. The types of errors identified included parental delay in seeking medical care (33%; 95% confidence interval, [12–54]), physicians’ delay in administering appropriate treatment (antibiotic therapy in the case of purpura; 38%; 95% confidence interval, 16–60), insufficient doses of or failure to repeat fluid resuscitation (24%; 95% confidence interval, [9–35]), and overall underestimation of disease severity (38%; 95% confidence interval, [16–60]).

Conclusion: This study found a high frequency of suboptimal care in the initial management of children who died of severe bacterial infection, with four separate types of errors. Other studies are needed to assess the potential avoidability of this type of death. (Pediatr Crit Care Med 2010; 11:469–474)

Key Words: severe bacterial infection; suboptimal care; medical error; pediatric death
Key issues around deteriorating hospitalised patients

- Failure to monitor
- Failure to recognise
- Failure to communicate
- Failure to respond
Recognising and responding to clinical deterioration

- Measure and document observations
- Recognise deterioration
- Communicate appropriately
- Respond effectively
Measure and document observations

• Which observations?
• Evidence base for best practice
• Taken by who? When? How?
• Observation charts
• Electronic data collection
Recognise deterioration

- Age-appropriate values
- Track and trigger/PEWS charts
- Separate or combined into the observation chart
- Staff training
- Role of ‘non-specific’ staff concern
- Role of parents
Many different titles.....

POPS

PEWS

CEWS

C-CHEWS

CHEWS

M-PEWS

NEWS

PAWS

ManCHEWS

CPOTTS

PEWT
Overview

- 18 UK
- 6 international
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
<th>Parameter</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Respiratory rate</td>
<td>18</td>
<td>Diabetic ketoacidosis</td>
<td>5</td>
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<tr>
<td>Heart rate</td>
<td>17</td>
<td>Meningococcaemia</td>
<td>5</td>
</tr>
<tr>
<td>Nurse concern</td>
<td>16</td>
<td>Acidosis</td>
<td>5</td>
</tr>
<tr>
<td>Doctor concern</td>
<td>14</td>
<td>Abnormal serum potassium</td>
<td>5</td>
</tr>
<tr>
<td>Respiratory effort</td>
<td>13</td>
<td>Fluid bolus &gt;10 ml/kg</td>
<td>5</td>
</tr>
<tr>
<td>Shock</td>
<td>12</td>
<td>Artificial airway</td>
<td>4</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>11</td>
<td>Abnormal serum sodium</td>
<td>4</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td>11</td>
<td>Abnormal coagulation</td>
<td>4</td>
</tr>
<tr>
<td>Abnormal consciousness</td>
<td>11</td>
<td>Inotrope infusion</td>
<td>4</td>
</tr>
<tr>
<td>Oxygen therapy</td>
<td>10</td>
<td>Apnoea</td>
<td>3</td>
</tr>
<tr>
<td>Stridor/wheeze</td>
<td>8</td>
<td>Arrhythmia</td>
<td>3</td>
</tr>
<tr>
<td>Post ICU discharge</td>
<td>8</td>
<td>Mean blood pressure</td>
<td>3</td>
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<tr>
<td>Nebulised medication</td>
<td>8</td>
<td>Neutropaenia</td>
<td>2</td>
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<td>Urine output</td>
<td>7</td>
<td>Central line (temporary)</td>
<td>1</td>
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<tr>
<td>Temperature</td>
<td>7</td>
<td>Cardiac pacing (temporary)</td>
<td>1</td>
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<tr>
<td>Exhaustion</td>
<td>6</td>
<td>Major trauma</td>
<td>1</td>
</tr>
<tr>
<td>Prolonged seizure</td>
<td>6</td>
<td>Burns &gt;10%</td>
<td>1</td>
</tr>
<tr>
<td>Respiratory arrest</td>
<td>5</td>
<td>Need for ventilation</td>
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Single parameter or aggregate weighted?
Variable thresholds

### Respiratory Rate

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<tr>
<th>Age (yrs)</th>
<th>&lt;1</th>
<th>1 - 2</th>
<th>2 - 5</th>
<th>5 - 12</th>
<th>&gt;12</th>
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<tr>
<td>Cameron P</td>
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<table>
<thead>
<tr>
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<th>2</th>
<th>5</th>
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<th>15</th>
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<tbody>
<tr>
<td>Macnab A</td>
<td>25</td>
<td>25</td>
<td>22</td>
<td>19</td>
<td>18</td>
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</table>

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
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<tbody>
<tr>
<td>Wong</td>
<td>25</td>
<td>23</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>19</td>
<td>18</td>
<td>17</td>
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</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Infant</th>
<th>Toddler</th>
<th>Pre-school</th>
<th>School</th>
<th>Adolescent</th>
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<tbody>
<tr>
<td>Hazinski</td>
<td>30-60</td>
<td>24-40</td>
<td>22-34</td>
<td>18-30</td>
<td>12-16</td>
</tr>
</tbody>
</table>
Systematic review of paediatric alert criteria for identifying hospitalised children at risk of critical deterioration

Abstract  
Introduction: Unrecognised or untreated clinical deterioration can lead to serious adverse events, including cardiopulmonary arrest and unexpected death. Paediatric alert criteria aim to identify children with early signs of physiological instability that precede clinical deterioration so that experienced clinicians can intervene with the aim of reducing serious adverse events and improving outcome.  

Purpose: To identify the number and nature of published paediatric alert criteria and evaluate their validity, reliability, clinical effectiveness and clinical utility.  

Method: Systematic review of studies identified from electronic and citation searching and expert informants.  

Results: Eleven studies fulfilled the inclusion criteria and described ten paediatric alert criteria. Six studies described the introduction and use of the paediatric alert criteria in practice, four examined the development and testing of the paediatric alert criteria, and one described both. There was marked variability across all aspects of the paediatric alert criteria, including the method of development, and the number and type of component parameters. Five studies explored the predictive validity of the paediatric alert criteria, but only three reported appropriate methodology. Only one study evaluated reliability, and none evaluated clinical utility of paediatric alert criteria.  

Conclusions: Evidence supporting the validity, reliability and utility of paediatric alert criteria is weak. Studies are needed to determine which physiological parameters or combinations of parameters, best predict serious adverse events. Prospective evaluation of validity, reliability and utility is then needed before widespread adoption into clinical practice can be recommended.

Keywords  
Paediatrics  
Cardiovascular monitoring  
Critical care organisation  
Severity-of-disease scoring systems
# Diagnostic accuracy

<table>
<thead>
<tr>
<th>Lead author</th>
<th>Patients</th>
<th>Outcome measures</th>
<th>Diagnostic accuracy</th>
<th>Quality</th>
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<tbody>
<tr>
<td>Brilli</td>
<td>44 cases</td>
<td>Cardiac arrest, respiratory arrest</td>
<td>90% CI reported on paired parameters. Sensitivity, specificity, PPV, NPV and ROC not reported.</td>
<td>Inadequate</td>
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<tr>
<td>Duncan</td>
<td>87 cases 128 controls</td>
<td>Code Blue</td>
<td>Sensitivity 78%, Specificity 95% PPV 4.2% for score of 5. Area under ROC curve 0.9. NPV not reported.</td>
<td>Adequate</td>
</tr>
<tr>
<td>Edwards</td>
<td>1000 cases</td>
<td>Adverse outcome (respiratory arrest cardiac arrest HDU admission PICU admission death)</td>
<td>Sensitivity 89%, Specificity 64% PPV 2.2%, NPV 99.8% for score of 1. Area under ROC curve 0.86.</td>
<td>Adequate</td>
</tr>
<tr>
<td>Haines</td>
<td>360 cases 180 controls</td>
<td>Level of care, Admission to PICU, Mode of death</td>
<td>Sensitivity and specificity incorrectly calculated PPV, NPV and ROC not reported.</td>
<td>Inadequate</td>
</tr>
<tr>
<td>Tucker</td>
<td>2979 cases</td>
<td>Transfer to PICU</td>
<td>Sensitivity 90%, Specificity 74% PPV 5.8%, NPV 100% for score of 3 Area under ROC curve 0.89</td>
<td>Adequate</td>
</tr>
</tbody>
</table>
Communicate appropriately

• All front line staff know
  – who to call
  – how to call
  – when to call

• Documentation

• Handover

• Role of parents

• Standardised communication
  – SBAR
Communicate appropriately

S - Situation
B - Background
A - Assessment
R - Recommendation

The SBAR tool originated from the US Navy and was adapted for use in healthcare by Dr M Leonard and colleagues from Kaiser Permanente, Colorado, USA

Institute for Innovation and Improvement
Respond effectively

- Right person, right time, right skills, right equipment
- Standardised response
- Escalate and refer
- Multi-professional training
- Role of simulation
Organisational factors

- Leadership
- Effective implementation
- Training
- Ongoing evaluation and feedback
Leadership

Local

• Executive support
• Clinical champions
• Deteriorating patient steering group?
• Motivation,
• Protected time
• Resources
Effective implementation

• Model for improvement
  – How much
  – By when
  – By whom

• Small scale tests of change

• Spread and sustainability

• Engaging and motivating staff

• Policies and procedures
Training

- Staff training
  - Initial
  - Ongoing
  - Updates
- Who? When? Where?
- Reliability
- Role of simulation
- e-learning
Ongoing evaluation

- Evaluation and feedback strategy
- Ongoing responsibility
- Continuous monitoring – process, outcome and balancing measures
- Benchmarking
- Safety and incident reports
- Failure to rescue, M & M and case reports
Human factors

- Safety culture
- Designing for safety?
- Human performance
  - Fatigue
  - Situational awareness
- Human error
  - Slips
  - Lapses
  - Migrations
  - Violations
  - Mitigation
Areas for development

• Taking observations
• Paediatric Early Warning Score/Tool
• Paediatric observation chart
• Communication tool
• Staff training and competencies
• Measures for R&R to deterioration
Possible strategies

• National tools
• National guidance
• National standards
• How to guide….
• Best practice examples
• National paediatric deteriorating patient forum
Conclusion

- Wide variation in practice
- Poor consensus on trigger thresholds
- Poor evidence base for published PEWS
- Role of vital sign monitoring poorly understood
- Improvement versus research