Paediatrics

PEWS & Deteriorating Patients

Linda Clerihew
Aim
30% reduction in avoidable harm measured by the Paediatric Serious Harm Key Indicators by December 2015
Measuring Harm

Paediatric Serious Harm Key Indicators

Paediatric Trigger Tool, Avoidable Harm Tool

Datix, SER complaints, feedback

The unreported
# Paediatric Serious Harm Key Indicators

<table>
<thead>
<tr>
<th>Category</th>
<th>Operational Definition</th>
<th>Outcome measure of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious Safety Event</td>
<td>Datix &gt;4</td>
<td>All</td>
</tr>
<tr>
<td>Serious Medication Event</td>
<td>Datix &gt;4</td>
<td>Medicines safety</td>
</tr>
<tr>
<td>Unplanned Admission to ICU</td>
<td>All in hospital</td>
<td>Deteriorating patient</td>
</tr>
<tr>
<td>CLABSI</td>
<td>All healthcare</td>
<td>HAI</td>
</tr>
<tr>
<td>VAP</td>
<td>PICU only</td>
<td>HAI</td>
</tr>
<tr>
<td>Child protection harm</td>
<td>In development</td>
<td>MDT working</td>
</tr>
</tbody>
</table>
Deteriorating Patient - Unplanned admission to ICU

• Is **not** the same as **PREVENTABLE** admission to ICU

• ? How many can be prevented
2000 excess deaths <19yo per annum in UK compared with Sweden
Identifiable failures in 26% potentially avoidable in further 43%

The first method has been done to notable effect by the Confidential Enquiry into Maternal and Child Health in England, which conducted a meticulous audit into the deaths of a representative sample of children. They reported identifiable failures in a child’s direct care in just over a quarter of deaths, and potentially avoidable factors in a further 43% of deaths14. An audit of asthma deaths is due to report soon. From an epidemiological perspective, this type of evidence does not demonstrate causality. However, from a clinical perspective it provides useful information, pointing out where to investigate further in our attempts to improve care. From a parental perspective, it is alarming and demands attention and indeed in the past decade, and especially since the Bristol Royal Infirmary Enquiry in 2001, there has been a welcome degree of scrutiny into the quality of care for children23. There is now a systematic multiagency process for gathering data after every childhood death, known as a Child Death Review (CDR), which attempts comprehensively to gather information on potentially avoidable factors in order to make recommendations on changes in practice.
Why children die: avoidable factors associated with child deaths

G A Pearson,1 M Ward-Platt,2 A Harnden,3 D Kelly1

The most significant recurrent avoidable factor between cases was a failure to recognise severe illness in children. This most often occurred at the point of first contact between the sick (and often febrile) child and the healthcare services. In some instances, there was a failure to understand the importance of the history, in others a failure to examine the patient or interpret physical signs correctly. There were also failures in anticipating or recognising complications of illness and failures in clinical supervision. In some cases, the impact was immediate, in others there resulted a critical delay in referral or treatment.
Any PEWS is better than no PEWS
80% of acute admissions to HDU score < 3 – why admit to HDU
SBAR

Safety Briefs & Hospital Huddles
The Huddle

Bed state & prediction

Staff state & prediction

Organisation safety threats

High PEWS/watchers;
child protection,
CAMHS
absconsion

Mitigation plan in place?
Developing and Testing the Paediatric Sepsis 6

Background:
In the UK sepsis accounts for >10% of deaths in children < 1 yr. Outcome is significantly improved by compliance with the ACCP PACS 2007 guideline. Only 62% of children received treatment in accordance with this guideline in the UK in 2006.

Aim: >95% correlation with paediatric sepsis 6 bundle by June 2013

Time to first dose of antibiotics in hours:
- Target: < 24 mins
- Baseline: > 60 mins

Pilot population: Patients under 16 years of age
- Baseline: 49% not related to temperature
- Baseline: 48% not related to temperature

Balancing measures:
- Improved culture and antibiotic stewardship
- Improved antibiotic administration
- Improved culture and antibiotic stewardship
- Improved culture and antibiotic stewardship

Even though it was my first day on the ward I now know that even as a student I have something to contribute. I understand that I need to know my environment. I know that I am part of a team and there are other people to help me. I know how to pull the emergency buzzer.
Unplanned admissions to ICU

- RHSC Edinburgh—more rapid escalation, ↓ LOS in ICU, trend to reduced mortality
- Tayside – significant reduction, multifactorial
13 charts to choose from in Scotland
Where do we start?

- What’s the evidence
- What age ranges
- What parameters do you score
- What parameters do you not score
- Track and trigger / weighted scores
Age ranges used across Scotland

- 0 - 3 mths
- 4 - 12 mths
- 12 - 23 mths
- < 1 yrs
- 1 - 4 yrs
- 1 - 5 yrs
- 5 - 11 yrs
- 5 - 12 yrs
- 12 - 16 yrs
- > 12 yrs
Observations which contribute to the Paediatric Early warning Score (PEWS)
Observations contributing to PEWS

- Seizures
- Respiratory distress
- O2 therapy
- AVPU
- SpO2

Scores:
- Not recorded on PEWS
- Not scored
- Scored
Observations contributing to PEWS

- **Blood sugar**
- **Pain score**
- **Seizures**
- **Urine Volume**
- **Dr / Nurse concern**
- **Respiratory distress**
- **Capillary refill**
Observations contributing to PEWS

- SpO2
- Respiratory Rate
- Heart rate
- AVPU
- Temperature
- Blood pressure
- O2 therapy
- Work of Breathing
- Capillary refill
- Respiratory distress
- Dr / Nurse concern

The bars represent the observed values for each parameter, with higher bars indicating more severe observations.
Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies


Summary

Background: Although heart rate and respiratory rate in children are measured routinely in acute settings, current reference ranges are not based on evidence. We aimed to derive new cardiac norms for these vital signs and to compare these cardiac values with existing international ranges.

Methods: We searched Medline, Embase, Cochrane, and reference lists for studies that measured heart rate in children from birth to 18 years of age. We used consensus-based criteria to determine the eligibility of studies. We used a random-effects model to estimate heart rate and respiratory rate. We compared the resulting ranges with those derived from our cardiac norms.

Results: We identified 15 studies with 16,436 children and respiratory rate data for 10,634 children. Our cardiac norms showed respiratory rate and heart rate to be slightly lower than the reference range established in this study. With respect to the reference range established in this study, we compared heart rate and respiratory rate in children from birth to 18 years of age.

Conclusion: Our cardiac norms for children from birth to 18 years should help clinicians to update clinical and consensus guidelines.

Funding

National Institute for Health Research, Engineering and Physical Sciences Research Council.

Introduction

Heart rate and respiratory rate are two vital signs that are important for physiological assessment of children in many clinical settings. They are used in neonatal assessment in neonatal intensive care units, in high-dependency or intensive-care settings. During cardiorespiratory assessment, these signs are used to determine respiratory effort and cardiac output. They are important in the evaluation of clinical assessment of children in the emergency department. In the intensive care unit, these signs are an integral part of standard clinical assessment of children, and they are used to determine the severity of illness and risk assessment. In the intensive care unit, these signs are an integral part of standard clinical assessment of children, and they are used to determine the severity of illness and risk assessment.

Reference ranges for heart rate and respiratory rate in children are published by various international organizations (Table 8.1). However, there are gaps in published ranges for these reference ranges. The pediatric subcommittee of the Cardiac and Pulmonary by the American Academy of Pediatrics, published their own reference ranges for heart rate and respiratory rate in children. However, these reference ranges are not based on evidence and may not be appropriate for all children. Therefore, there is a need for new reference ranges for heart rate and respiratory rate in children that are based on evidence-based studies.

Methods

Search strategy and selection criteria

We searched Medline, Embase, Cochrane, and reference lists for studies that measured heart rate and respiratory rate in children from birth to 18 years of age. We included all studies that reported heart rate and respiratory rate in children from birth to 18 years of age. We excluded studies that did not report heart rate and respiratory rate in children from birth to 18 years of age. We also excluded studies that did not report heart rate and respiratory rate in children from birth to 18 years of age.
Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies

*Lancet* 2011; 377: 1011–18

Susannah Fleming, Matthew Thompson, Richard Stevens, Carl Heneghan, Annette Plüddemann, Ian Maconochie, Lionel Tarassenko, David Mant
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Susannah Fleming, Matthew Thompson, Richard Stevens, Carl Heneghan, Annette Pluddemann, Ian Maconochie, Lionel Tarassenko, David Mant
Development of Heart and Respiratory Rate Percentile Curves for Hospitalized Children
Christopher P. Bonafide, Patrick W. Brady, Ron Keren, Patrick H. Conway, Keith Marsolo and Carrie Daymont

Pediatrics 2013;131;e1150; originally published online March 11, 2013;
DOI: 10.1542/peds.2012-2443
PEWS scale

- < 3
  - < 3+ clinical concern
  - > 3
- 1 – 2
- 3 – 5
- 6 – 7
- >7

1 red or 2 orange or 3 yellow
2 red or 3 orange or 5 yellow

- Increased frequency of observation recording
- Escalation of help required
  - Nurse to doctor
  - Doctor to consultant
Traffic lights vs binary

### Observation Chart <1 Year

<table>
<thead>
<tr>
<th>Observation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>37.5°C</td>
</tr>
<tr>
<td>Pulse Rate</td>
<td>120 bpm</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>28 breaths/min</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>100/60 mmHg</td>
</tr>
<tr>
<td>Conscious Level</td>
<td>Alert</td>
</tr>
<tr>
<td>Pain Total Score</td>
<td>2</td>
</tr>
</tbody>
</table>

### PEWS Form 0-1 Yr

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score</th>
</tr>
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<tbody>
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Which chart do you prefer and why?

Test site 1: usually use binary chart – 19 prefer binary

- 19 prefer binary comments include;
  - “clear”
  - “simple”
  - “know when to escalate, not criticised by medical staff for calling (I have used traffic light previously and got shouted at for calling in the yellow zone.)”

- 7 prefer traffic light (all very junior), comments include;
  - “I know I don’t have to worry until I am in the red”,
  - “I know I can monitor for a while before I respond whereas the binary means I have to escalate,”
  - “traffic light means too many calls to doctor”,
  - “it must be better because it is graded”

Test site 2: usually use traffic light

- Usually use traffic light – interest in binary for simplicity
Test site 1 - usually use binary  test site 2 usually use traffic light

Test site 3 & 4 – unable to complete test – resistance to moving to different chart – not laid out the way we want it
Which chart is best?

• All boards showing >95% reliability for completion of charts correctly
  – Have a chart
  – Correct age chart
  – Correct score

• Variable reliability for appropriate escalation but in the main >90% in all boards
monitoring

Inform nurse in charge

Inform nurse in charge & Doctor

Inform nurse in charge & Senior Doctor

Consider 2222 / crash call
The agreed way forward

- Score for: temp, HR, BP, CRT, RR, sats, O2 delivery, AVPU
- Traffic light scoring system
- Record other things but don’t score eg resp effort, BM
- Automatic triggers – watchers/staff or parental concern, <V of AVPU
- Disputes agreed with reference to NEWS
- 5 age groups - <1, 1-2, 2-5, 5-12, >12
Making it work – ensuring we don’t introduce new risk

- All boards look at last 10 deteriorating patients (150-200 cases)
  - Does NPEWS recognise earlier or later – would management change compared with your current system

- Testing in board 1 followed by 11 others one at a time
- 2 boards continuing on their current charts (both more binary type charts) but aware of national work and are moving to scoring same parameters and ranges

- SAS running in background switch on board by board
Validating

• Electronic validation not the same as paper chart with human factors

• What is the aim? –
  – can validate electronically for prehospital for admission/ICU/death
  – Can validate in ICU deterioration
  – Big piece of work to do in ward deterioration but some centres have electronic data able to run comparisons of charts

• Further research needed for human factors elements
National Paediatric Early Warning Score

[Image of the National Paediatric Early Warning Score chart]

**OBSERVATION CHART < 1 YEAR**

<table>
<thead>
<tr>
<th>PEWS KEY</th>
<th>RESPIRATORY RATE (Breathe/minute)</th>
<th>Svo2</th>
<th>TEMPERATURE (°C)</th>
<th>BLOOD PRESSURE</th>
<th>HEAT</th>
<th>CONSCIOUS LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>2</td>
<td>5</td>
<td>60</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Normal</td>
<td>3</td>
<td>8</td>
<td>70</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td>4</td>
<td>10</td>
<td>80</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Severe</td>
<td>5</td>
<td>12</td>
<td>90</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**PEWS TOTAL SCORE**

- **FAIN SCORE**
  - 1
  - 2
  - 3

See front of form for descriptions of actions.
Thank-you