Healthcare Improvement Scotland

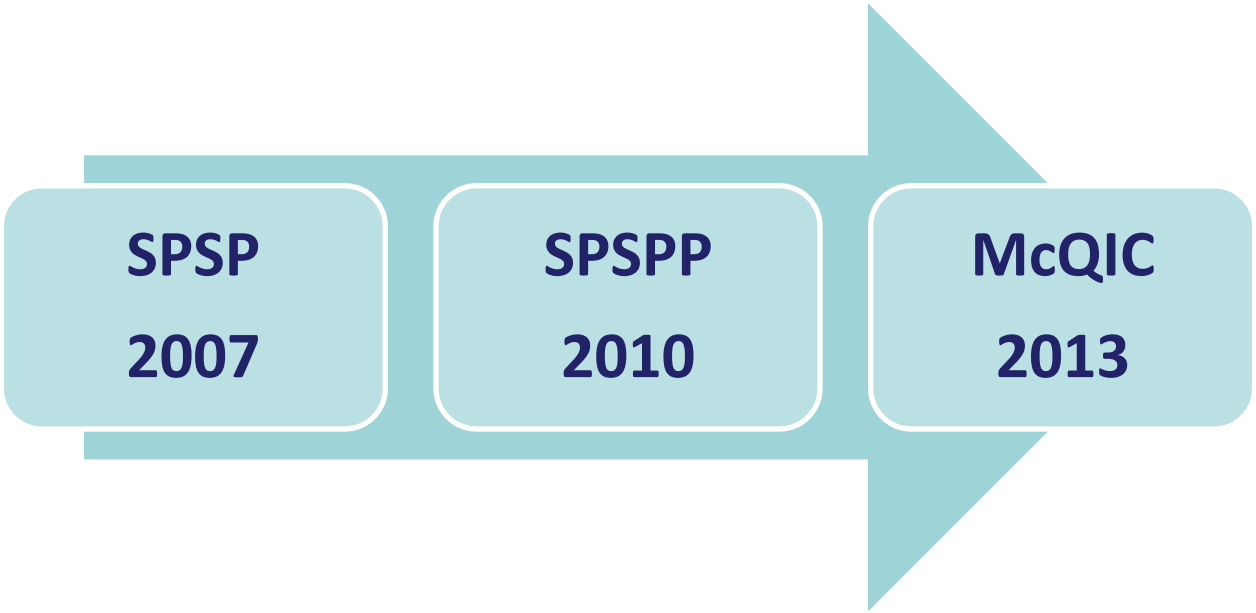
EVERY PERSON EVERY TIME SCOTTISH PATIENT SAFETY PROGRAMME

Paediatrics

PEWS & Deteriorating Patients

Linda Clerihew

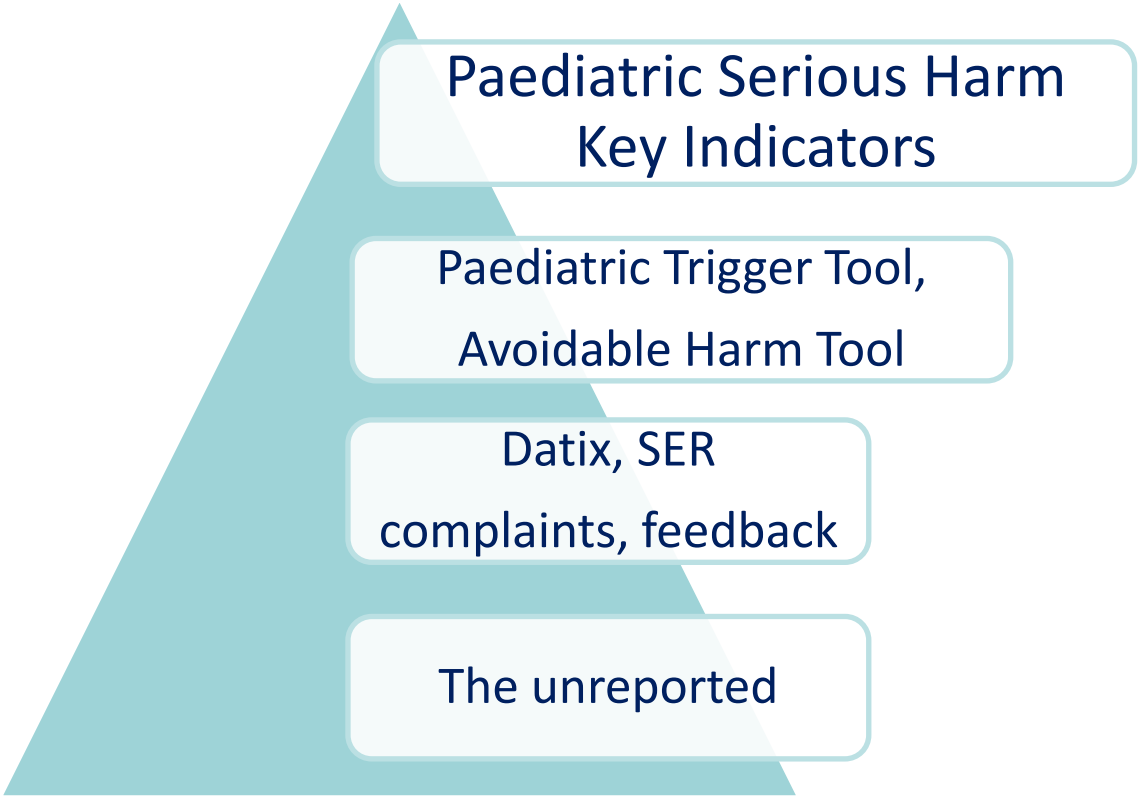
NHS SCOTLAND



Aim

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

Measuring Harm

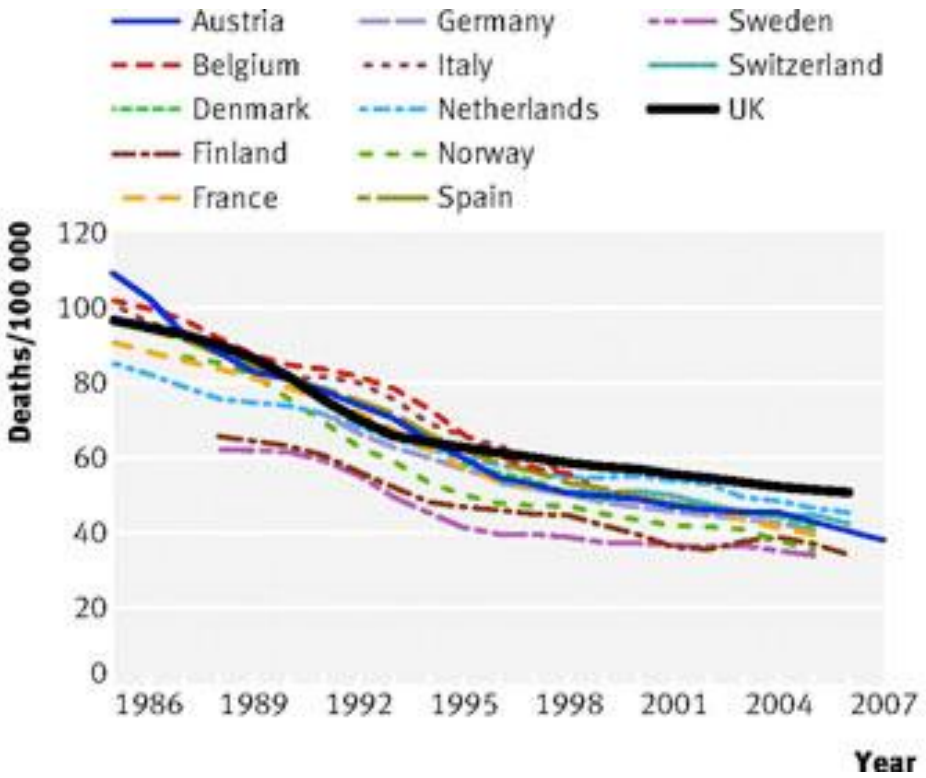


Paediatric Serious Harm Key Indicators

Category	Operational Definition	Outcome measure of
Serious Safety Event	Datix >4	All
Serious Medication Event	Datix >4	Medicines safety
Unplanned Admission to ICU	All in hospital	Deteriorating patient
CLABSI	All healthcare	HAI
VAP	PICU only	HAI
Child protection harm	In development	MDT working

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 deaths[14]. 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 children[23]. 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.

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Why children die: avoidable factors associated with child deaths

G A Pearson,[1] M Ward-Platt,[2] A Harnden,[3] D Kelly[1]

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.

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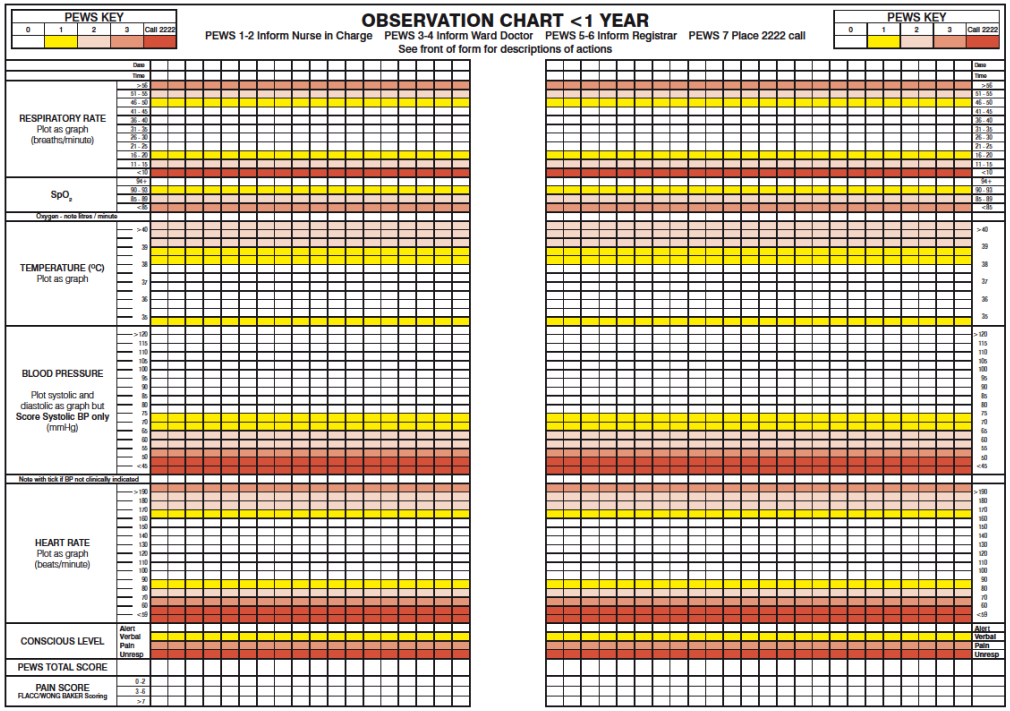
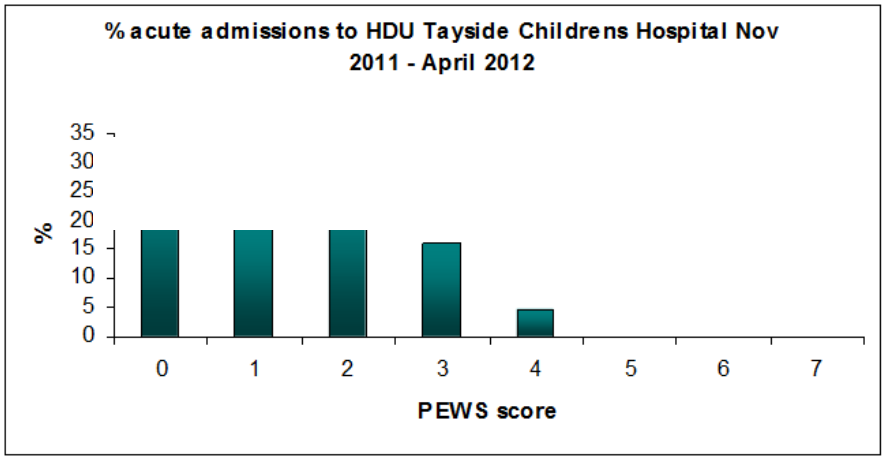


Any PEWS is better than no PEWS

Watchers



Date:				
Time:	0800			
Staff concerns about patient (Y/N)	N			
Staff concerns about airway (Y/N)	Y			
Staff concerns about work of breathing (Y/N)	Y			
Apnoeas (number since last observations)	3			
Carer concerns about clinical change (Y/N)	N			

example

80% of acute admissions to HDU score < 3 – why admit to HDU

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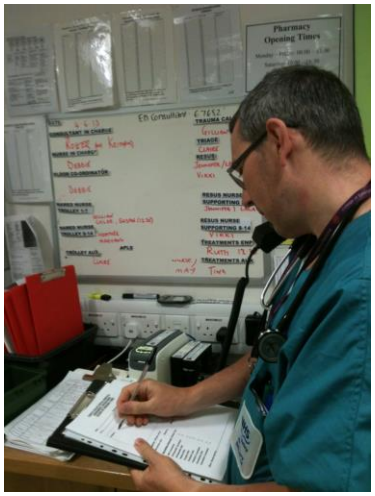
SBAR



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?

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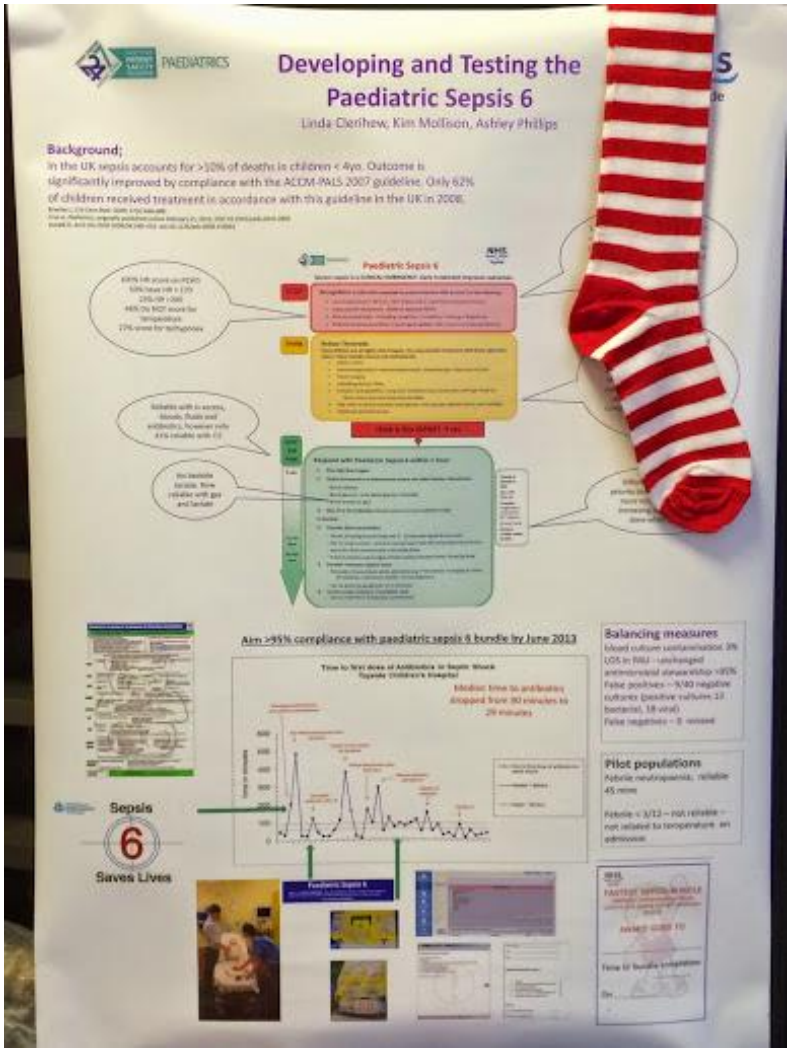

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I understand that I need to know my environment

Even though it was my first day on the ward I now know that even as a student I have something to contribute

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

Resuscitation 84 (2013) 218–222

Contents lists available at SciVerse ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Simulation and education

Regular in situ simulation training of paediatric Medical Emergency Team improves hospital response to deteriorating patients☆

U. Theilen[a,*], P. Leonard[a], P. Jones[b], R. Ardill[a], J. Weitz[a], D. Agrawal[a], D. Simpson[a]

[a] Royal Hospital for Sick Children Edinburgh, United Kingdom
[b] University of Edinburgh, United Kingdom

- RHSC Edinburgh– more rapid escalation, ↓ LOS in ICU, trend to reduced mortality

- Tayside – significant reduction, multifactorial

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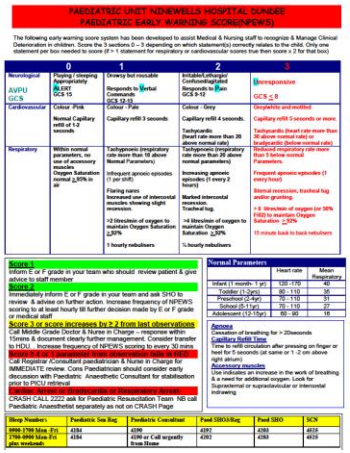

PAEDIATRIC UNIT NINEWELLS HOSPITAL DUNDEE
PAEDIATRIC EARLY WARNING SCORE(PNEWS)

The following early warning score system has been developed to assist Medical & Nursing staff to recognize & Manage Clinical Deterioration in children. Score the 3 sections 0 – 3 depending on which statement(s) correctly relates to the child. Only one statement per box needed to score (if > 1 statement for respiratory or cardiovascular scores true then score x 2 for that box)

	0	1	2	3
Neurological AVPU GCS	Playing / sleeping Appropriately ALERT GCS 15	Drowsy but rousable Responds to Verbal GCS 13-14	Irritable/Lethargic/ Confused/Agitated Responds to Pain GCS 9-12	Unresponsive GCS ≤ 8
Cardiovascular	Colour - Pink Normal Capillary refill of 1-2 seconds	Colour - Pale Capillary refill 3 seconds	Colour - Grey Capillary refill 4 seconds. Tachycardic (Heart rate more than 20 above normal rate)	Grey/white and mottled Capillary refill 5 seconds or more. Tachycardic (heart rate more than 30 above normal rate) Bradycardic (below normal rate)
Respiratory	Within normal parameters, no use of accessory muscles Oxygen Saturation normal ≥ 95% in air	Tachypnoeic (respiratory rate more than 10 above Normal Parameters) Infrequent apnoeic episodes (1 per shift) Flaring nares Increased use of intercostal muscles showing slight recession. >2 litres/min of oxygen to maintain Oxygen Saturation ≥ 90%	Tachypnoeic (respiratory rate more than 20 above normal parameters) Increasing apnoeic episodes (1 every 2 hours) Marked intercostal recession. Tracheal tug. >4 litres/min of oxygen to maintain Oxygen Saturation ≥ 90% ¼ hourly nebulisers	Reduced respiratory rate more than 5 below normal Parameters. Frequent apnoeic episodes (1 every hour) Sternal recession, tracheal tug and/or grunting. > 6 litres/min of oxygen (or 50% FiO2) to maintain Oxygen Saturation ≥ 90% 15-minute back to back nebulisers

Score 1
Inform E or F grade in your team who should review patient & give advice to staff member

Score 2
Immediately inform E or F grade in your team and ask SHO to review & advise on further action. Increase frequency of NPEWS scoring to at least hourly till further decision made by E or F grade or medical staff

Score 3 or score increases by 2 2 from last observations
Call Middle Grade Doctor & Nurse in Charge – response within 15mins & document clearly further management. Consider transfer to HDU. Increase frequency of NPEWS scoring to every 30 mins

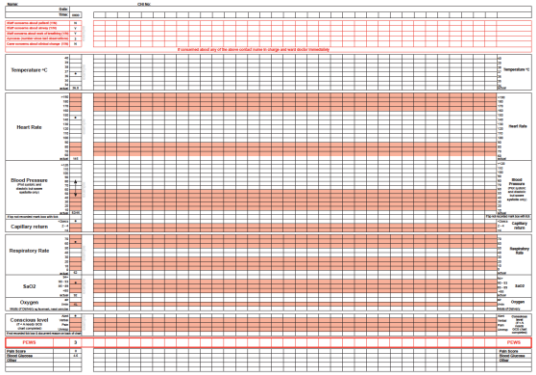
Score 4 or score increases by 2 from last observations
Call Registrar /Consultant paediatrician & Nurse in Charge for IMMEDIATE review. Cons Paediatrician should consider early discussion with Paediatric Anaesthetic Consultant for stabilisation prior to PICU retrieval

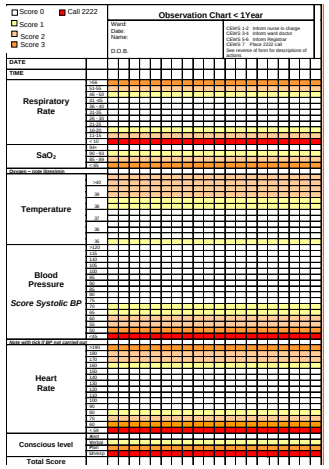
Cardiac Arrest or Bradycardia or Respiratory Arrest
CRASH CALL 2222 ask for Paediatric Resuscitation Team NB call Paediatric Anaesthetist separately as not on CRASH Page

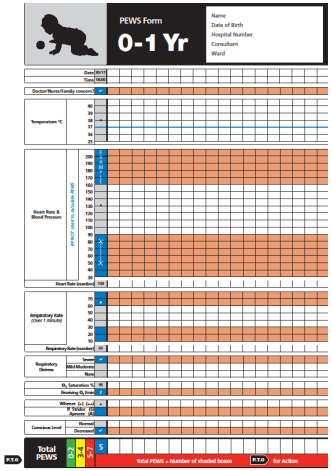
Normal Parameters	Heart rate	Mean Respiratory Rate
Infant (1 month- 1 yr)	120 - 170	40
Toddler (1-2yrs)	80 - 110	35
Preschool (2-4yr)	70 - 110	31
School (5-11yr)	70 - 110	27
Adolescent (12-15yr)	60 - 90	18

Apnoea
Cessation of breathing for >20seconds
Capillary Refill Time
Time to refill circulation after pressing on finger or heel for 5 seconds (at same or 1 -2 cm above right atrium)
Accessory muscles
Use indicates an increase in the work of breathing & a need for additional oxygen. Look for Suprasternal or supraclavicular or intercostal indrawing

Shop Numbers	Paediatric Sen Reg	Paediatric Consultant	Paed SHO/Reg	Paed SHO	SCN
0900-1700 Mon -Fri	4186	4190	4182	4183	4818
1700-0900 Mon-Fri plus weekends	4184	4190 or Call urgently from Home	4182	4183	4818

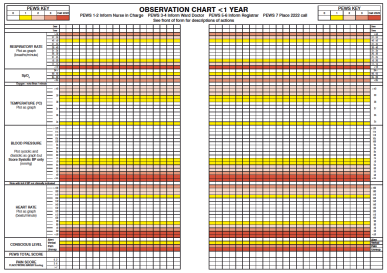

Temperature °C
Heart Rate
Blood Pressure
Capillary return
Respiratory Rate
Sat02
Oxygen
Consciousness level
Pain Score
Blood Glucose
Other

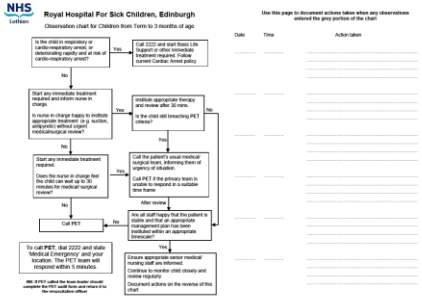

Score 0 Call 2222
Score 1
Score 2
Score 3
Observation Chart < 1Year
Ward:
Date:
Name:
D.O.B.
DATE
TIME
Respiratory Rate
SaO2
Oxygen – note litres/min
Temperature
Blood Pressure
Score Systolic BP
Heart Rate
Conscious level
Total Score


PEWS Form
0-1 Yr
Name
Date of Birth
Hospital Number
Consultant
Ward
Date
Time
Doctor/Nurse/Family concern
Temperature °C
Heart Rate & Blood Pressure
Respiratory Rate (Over 1 minute)
Respiratory Distress
Sats
Wheeze (+) Crackles (++) Stridor (+++) Apnoea
Consciousness Level
Total PEWS
Total PEWS – Number of shaded boxes
RTA for Action

13 charts to choose from in Scotland

14


OBSERVATION CHART <1 YEAR
PEWS KEY
RESPIRATORY RATE
SpO2
TEMPERATURE (°C)
BLOOD PRESSURE
HEART RATE
CONSCIOUS LEVEL
PEWS TOTAL SCORE
PAIN SCORE


NHS Lothian
Royal Hospital For Sick Children, Edinburgh
Observation chart for Children from Term to 3 months of age
Use this page to document actions taken when any observations entered the grey portion of the chart
Date
Time
Action taken
Is the child in respiratory or cardio-respiratory arrest, or deteriorating rapidly and at risk of cardio-respiratory arrest?
Yes
Call 2222 and start Basic Life Support or other immediate treatment required. Follow current Cardiac Arrest policy
No
Start any immediate treatment required and inform nurse in charge.
Is nurse in charge happy to institute appropriate therapy (e.g. suction, antiparetic) without urgent medical/surgical review?
Yes
Institute appropriate therapy and review after 30 mins.
No
Is the child still breaching PET criteria?
Yes
No
Start any immediate treatment required.
Does the nurse in charge feel the child can wait up to 30 minutes for medical/ surgical review?
Yes
Call the patient's usual medical/ surgical team, alerting them of urgency of situation.
Call PET if the primary team is unable to respond in a suitable time frame.
No
Call PET
No
After review
Are all staff happy that the patient is stable and that an appropriate management plan has been implemented, an appropriate timescale?
Yes
To call PET, dial 2222 and state 'Medical Emergency' and your location. The PET team will respond within 5 minutes.
Ensure appropriate senior medical/ nursing staff are informed.
Continue to monitor child closely and review regularly.
Document actions on the reverse of this chart.

Brighton Paediatric Early Warning Score.

How to do it

Use the Obs to work out a value for Behaviour, Cardiovascular & Respiratory and Total them

	0	1	2	3
Behaviour	☐ Playing / Appropriate.	☐ Sleeping.	☐ Irritable.	☐ Lethargic/ Confused ☐ Reduced response to pain.
Cardiovascular	☐ Pink or Capillary refill time (CRT) 1-2 seconds	☐ Pale or CRT 3 seconds	☐ Grey or CRT 4 seconds. ☐ Tachycardia of 20 above normal rate.	☐ Grey and mottled or CRT 5 seconds or above. ☐ Tachycardia of 30 above normal rate or bradycardia.
Respiratory	☐ Within normal parameters, ☐ no recession or tracheal tug.	☐ 10 above Normal Parameters, ☐ Using accessory muscles, ☐ 30+% FiO2 or 4+ litres/min.	☐ >20 above normal parameters ☐ recessing, ☐ tracheal tug. ☐ 40+% FiO2 or 6+ litres/min.	☐ 5 below normal parameters with sternal recession, tracheal tug or grunting. ☐ 50% FiO2 or 8 + litres/min.

Score 2 extra for ½ hourly nebulisers or persistent vomiting following surgery.

The PaedEWS should be part of the routine TPR observations for **all** patients.
- Do the obs as usual
- Use the obs to work out the PaedEWS (remember to add any "extras")
- **Consult the Action Sheet for any score greater than 1**

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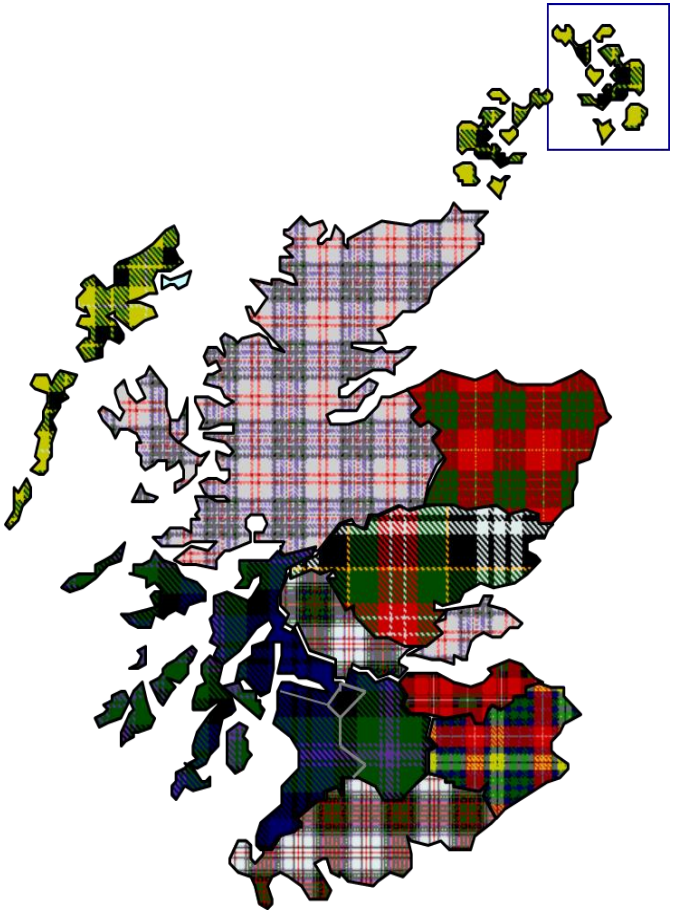
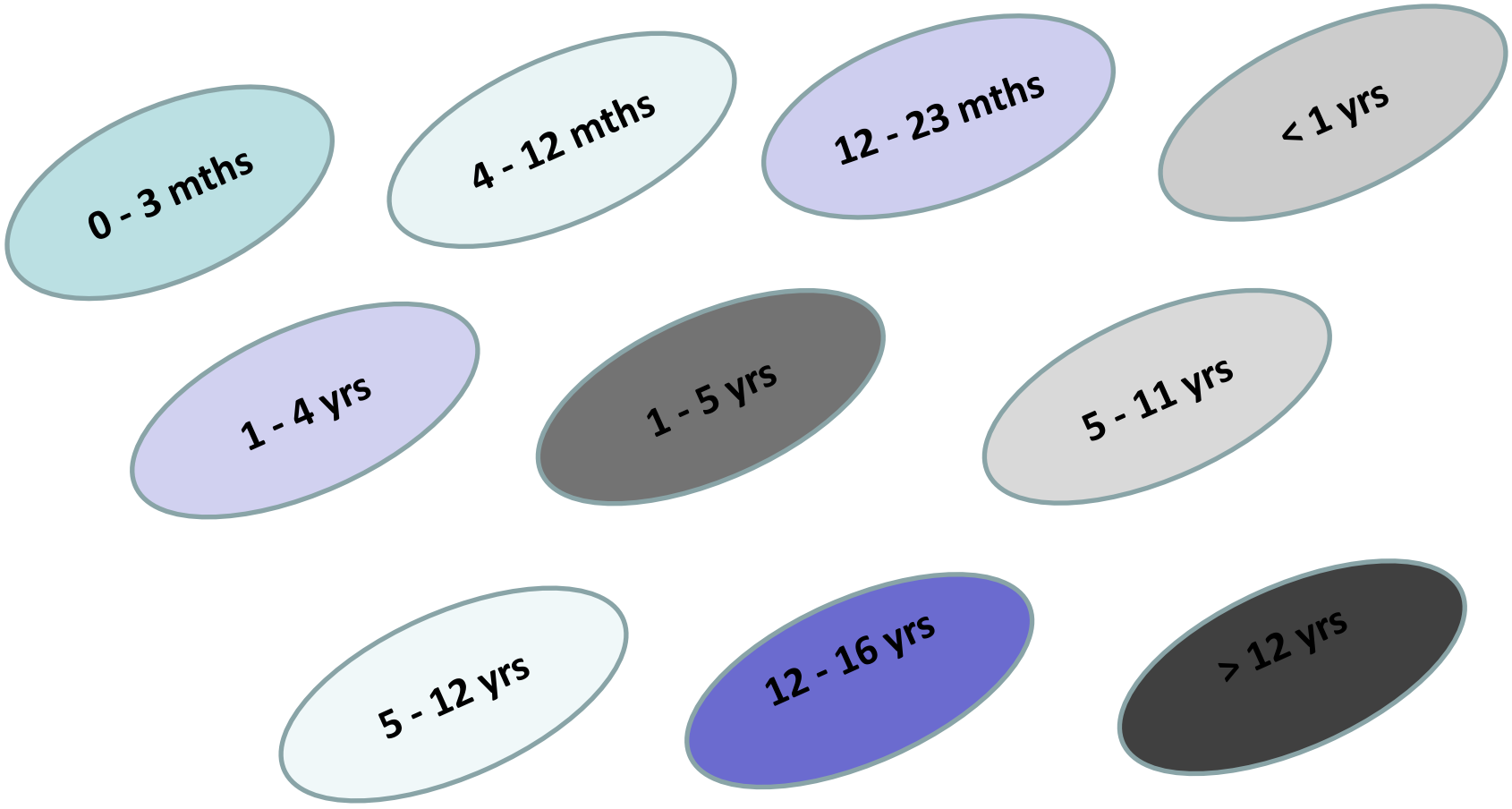


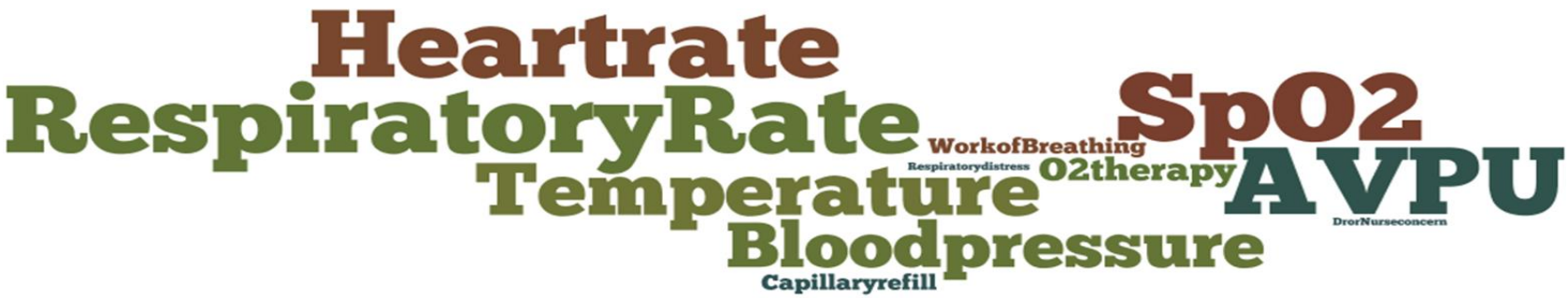
Where do we start?

- What's the evidence
- What age ranges
- What parameters do you score
- What parameters do you not score
- Track and trigger / weighted scores

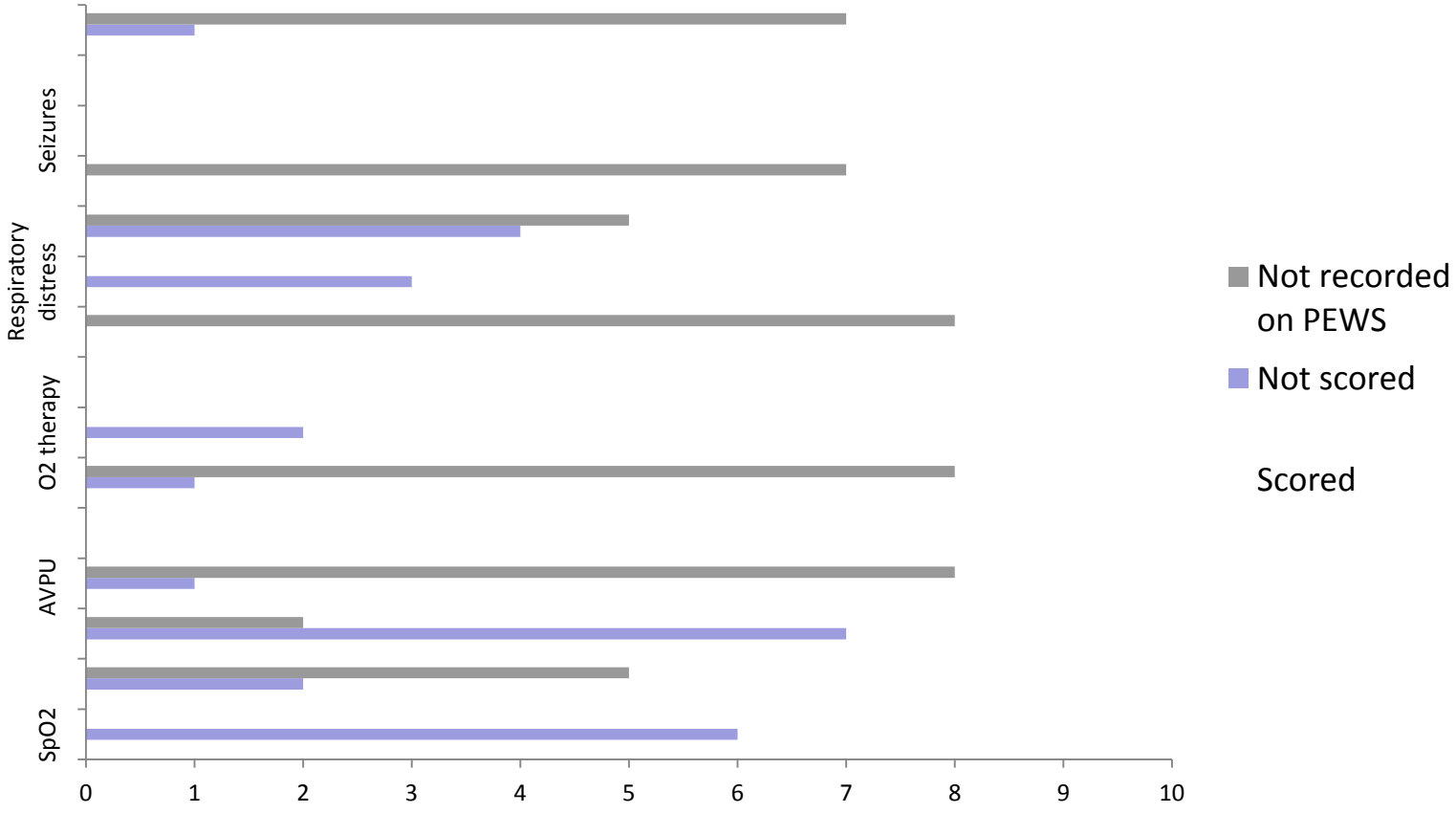
Age ranges used across Scotland

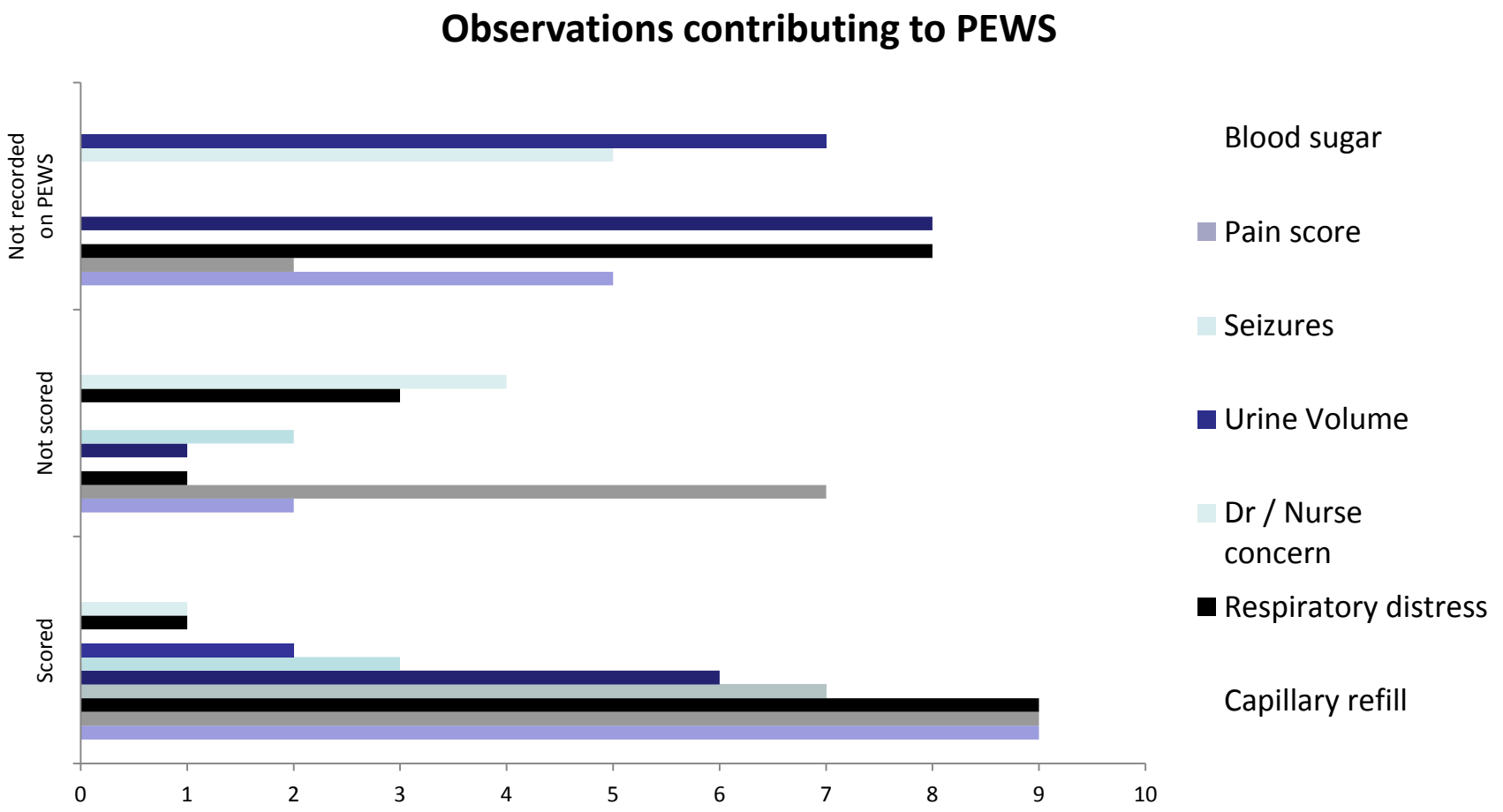


Observations which contribute to the Paediatric Early warning Score (PEWS)

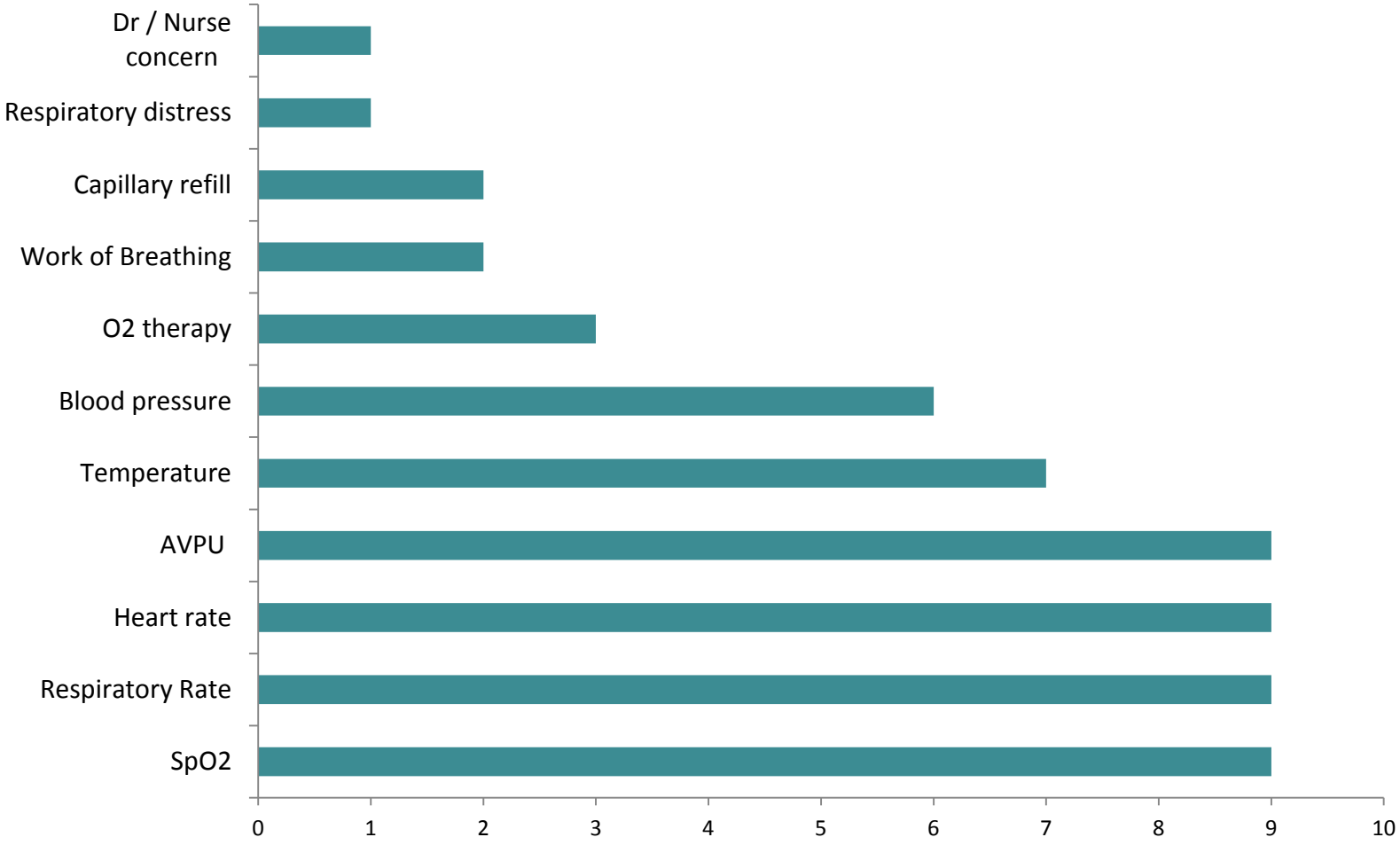


Observations contributing to PEWS




Observations contributing to PEWS
Not recorded on PEWS
Not scored
Scored
0
1
2
3
4
5
6
7
8
9
10
Blood sugar
Pain score
Seizures
Urine Volume
Dr / Nurse concern
Respiratory distress
Capillary refill

Observations contributing to PEWS



Evidence

Articles

Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies

Susannah Fleming, Matthew Thompson, Richard Stevens, Carl Heneghan, Annette Plüddemann, Ian Maconochie, Lionel Tarassenko, David Mant

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 centile charts for these vital signs and to compare these centiles with existing international ranges.

Methods We searched Medline, Embase, CINAHL, and reference lists for studies that reported heart rate or respiratory rate of healthy children between birth and 18 years of age. We used non-parametric kernel regression to create centile charts for heart rate and respiratory rate in relation to age. We compared existing reference ranges with those derived from our centile charts.

Findings We identified 69 studies with heart rate data for 143 346 children and respiratory rate data for 3881 children. Our centile charts show decline in respiratory rate from birth to early adolescence, with the steepest fall apparent in infants under 2 years of age; decreasing from a median of 44 breaths per min at birth to 26 breaths per min at 2 years. Heart rate shows a small peak at age 1 month. Median heart rate increases from 127 beats per min at birth to a maximum of 145 beats per min at about 1 month, before decreasing to 113 beats per min by 2 years of age. Comparison of our centile charts with existing published reference ranges for heart rate and respiratory rate show striking disagreement, with limits from published ranges frequently exceeding the 99th and 1st centiles, or crossing the median.

Interpretation Our evidence-based centile charts for children from birth to 18 years should help clinicians to update clinical and resuscitation guidelines.

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

Introduction

Heart rate and respiratory rate are key vital signs used to assess the physiological status of children in many clinical settings. They are used as initial measurements in acutely ill children, and in those undergoing intensive monitoring in high-dependency or intensive-care settings. During cardiopulmonary resuscitation, these indices are critical values used to determine responses to life-saving interventions. Heart rate and respiratory rate remain an integral part of standard clinical assessment of children with acute illnesses,[1] and are used in paediatric early warning scores[2,3] and triage screening.[4,5] Early warning scores are used widely in routine clinical care, and there is good evidence that they can provide early warning of clinical deterioration of children in hospital and in emergency situations.[6–8]

Reference ranges for heart rate and respiratory rate in children are published by various international organisations (webappendix p 1). Of these publications, only two guidelines cite sources for their reference ranges: the pediatric advanced life support guidelines[10] cite two textbooks,[11,12] neither of which cite sources for their ranges, and WHO limits for respiratory rate, which are based on measurements made in developing countries.[13] Evidence underpinning guidelines is therefore scarce, and many ranges are probably based on clinical consensus.

Scoring systems underpinning triage and resuscitation protocols for children invariably require measurement of heart rate and respiratory rate. Rates are converted to a numerical score by applying age-specific thresholds. Accurate reference ranges are key to assessing whether vital signs are abnormal. Thresholds that are incorrectly set too low risk overdiagnosing tachycardia or tachypnoea, whereas those set too high risk missing children with these signs. Additionally, a reference range that is applied to an age range that is too broad is likely to lead to incorrect assessment of children in some parts of these age groups.

We aimed to develop new age-specific centiles for heart rate and respiratory rate in children, derived from a systematic review of all studies of these vital signs in healthy children. We use these centiles to define new evidence-based reference ranges for healthy children, which we compare with existing reference ranges.

Methods

Search strategy and selection criteria

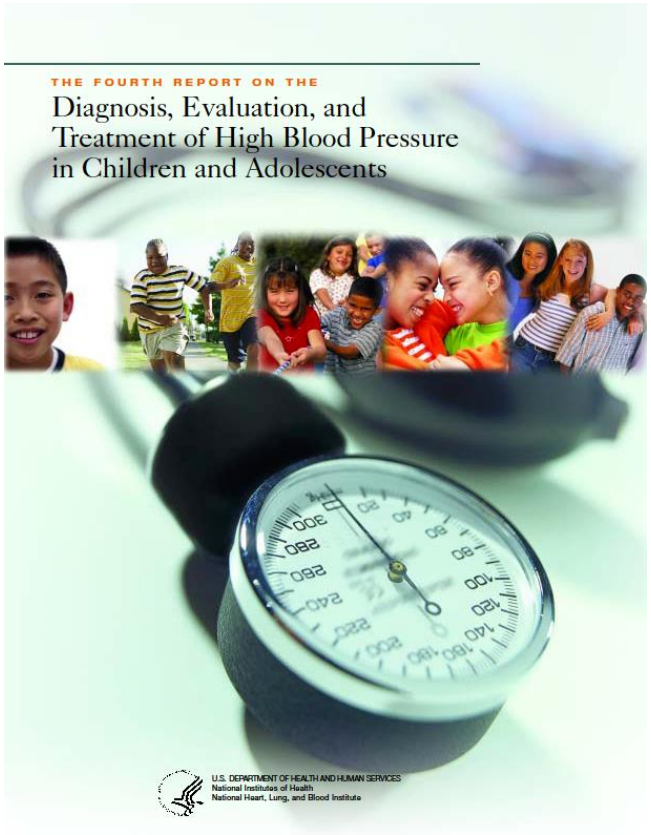
We searched Medline, Embase, CINAHL and reference lists to identify studies that measured heart rate or respiratory rate in healthy children between birth and

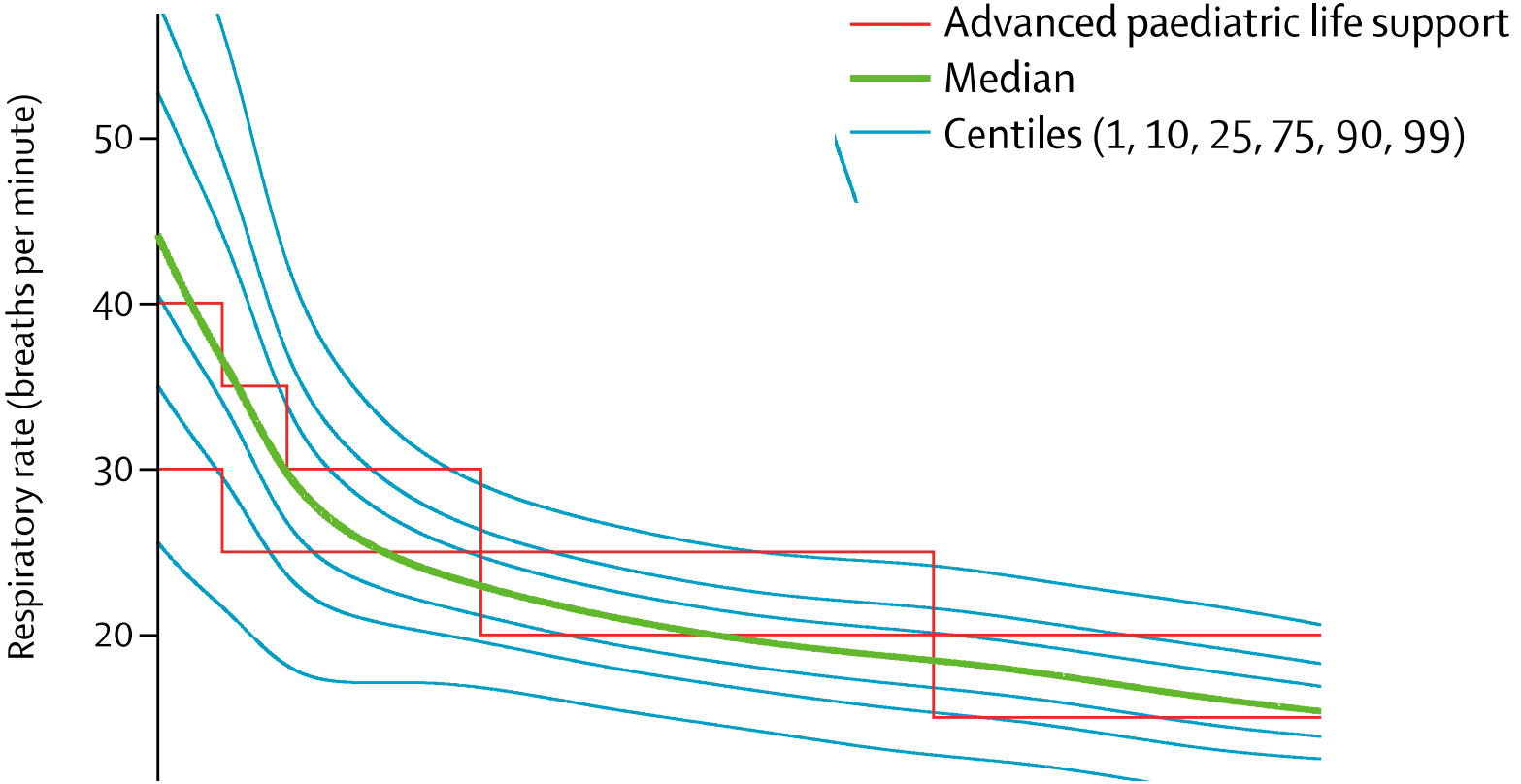
Lancet 2011; 377: 1011–18
Published Online March 15, 2011
DOI:10.1016/S0140-6736(10)62226-X
See Comment page 974

Oxford University, Department of Primary Health Care, Rosemary Rue Building, Old Road Campus, Headington, Oxford, UK (S Fleming DPhil, M Thompson DPhil, R Stevens PhD, C Heneghan DPhil, A Plüddemann PhD, D Mant FMedSci); Department of Family Medicine, Oregon Health and Science University, Portland, OR, USA (M Thompson); Accident and Emergency, St Mary's Hospital, Praed St, London, UK (I Maconochie PhD); and Oxford University Institute of Biomedical Engineering, Department of Engineering Science, Old Road Campus, Headington, Oxford, UK (L Tarassenko DPhil, S Fleming)

Correspondence to: Dr Matthew Thompson, Oxford University, Department of Primary Health Care, Rosemary Rue Building, Old Road Campus, Headington, Oxford OX3 7LF, UK matthew.thompson@dphpc.ox.ac.uk

See Online for webappendix

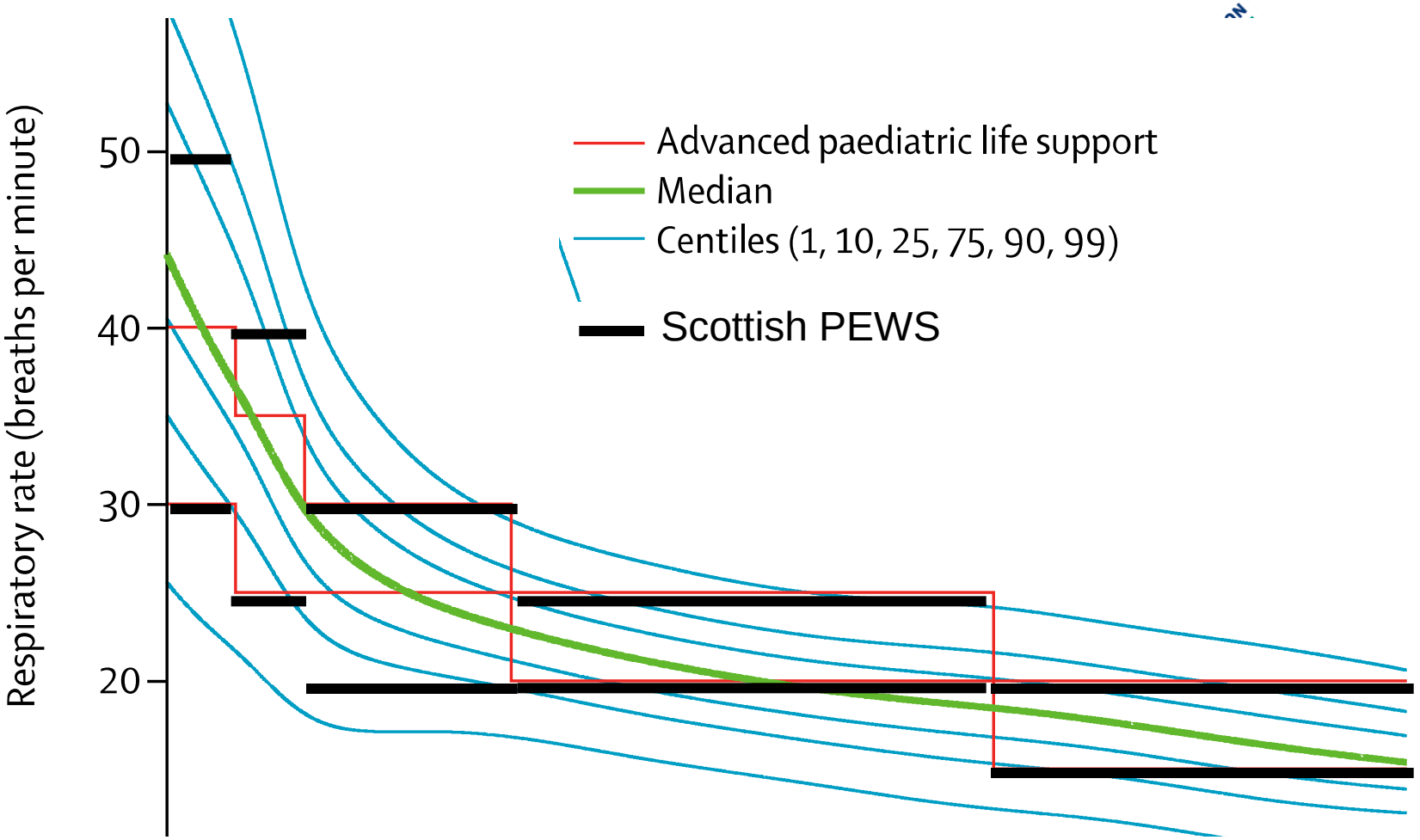




Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies

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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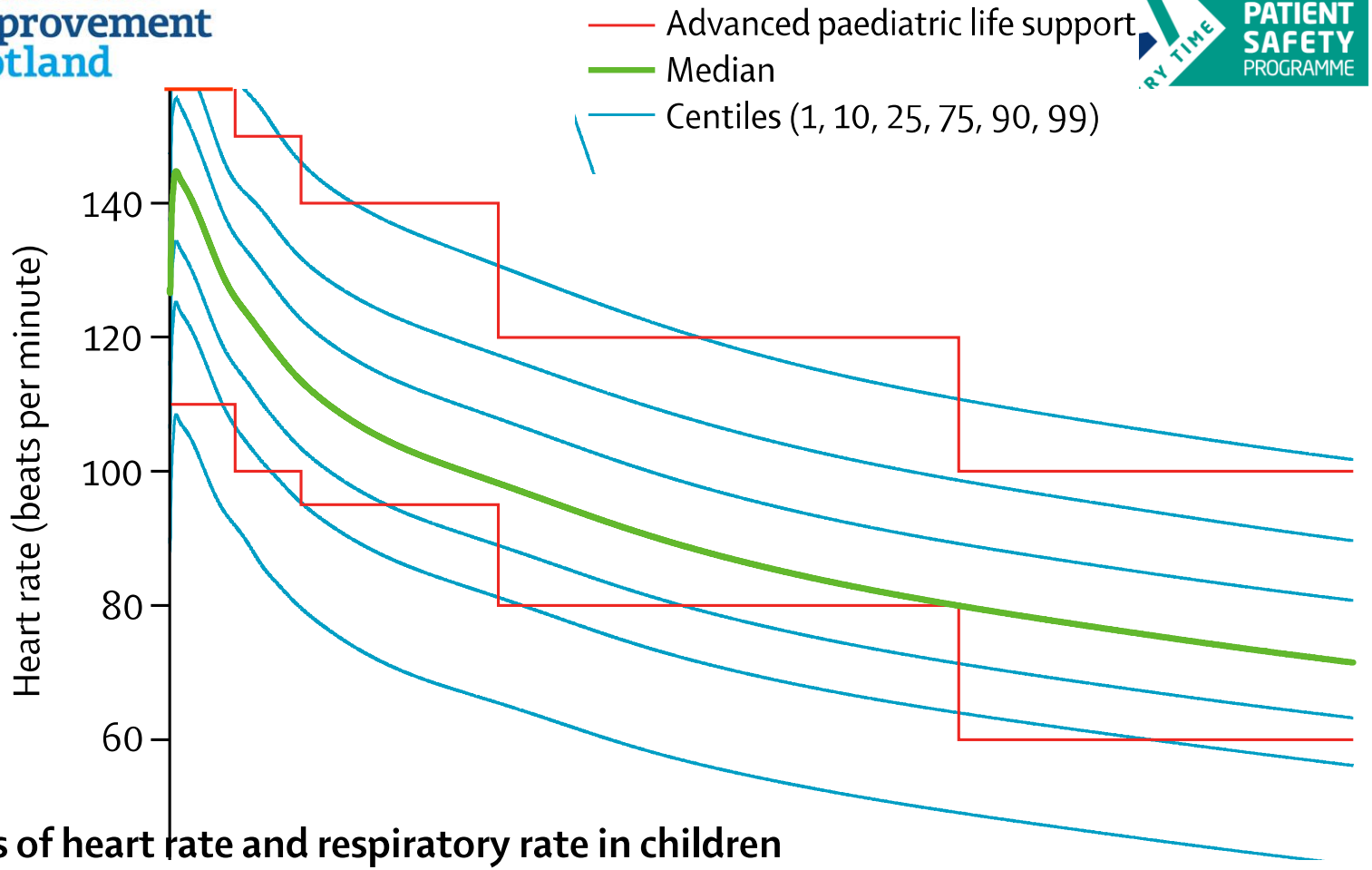

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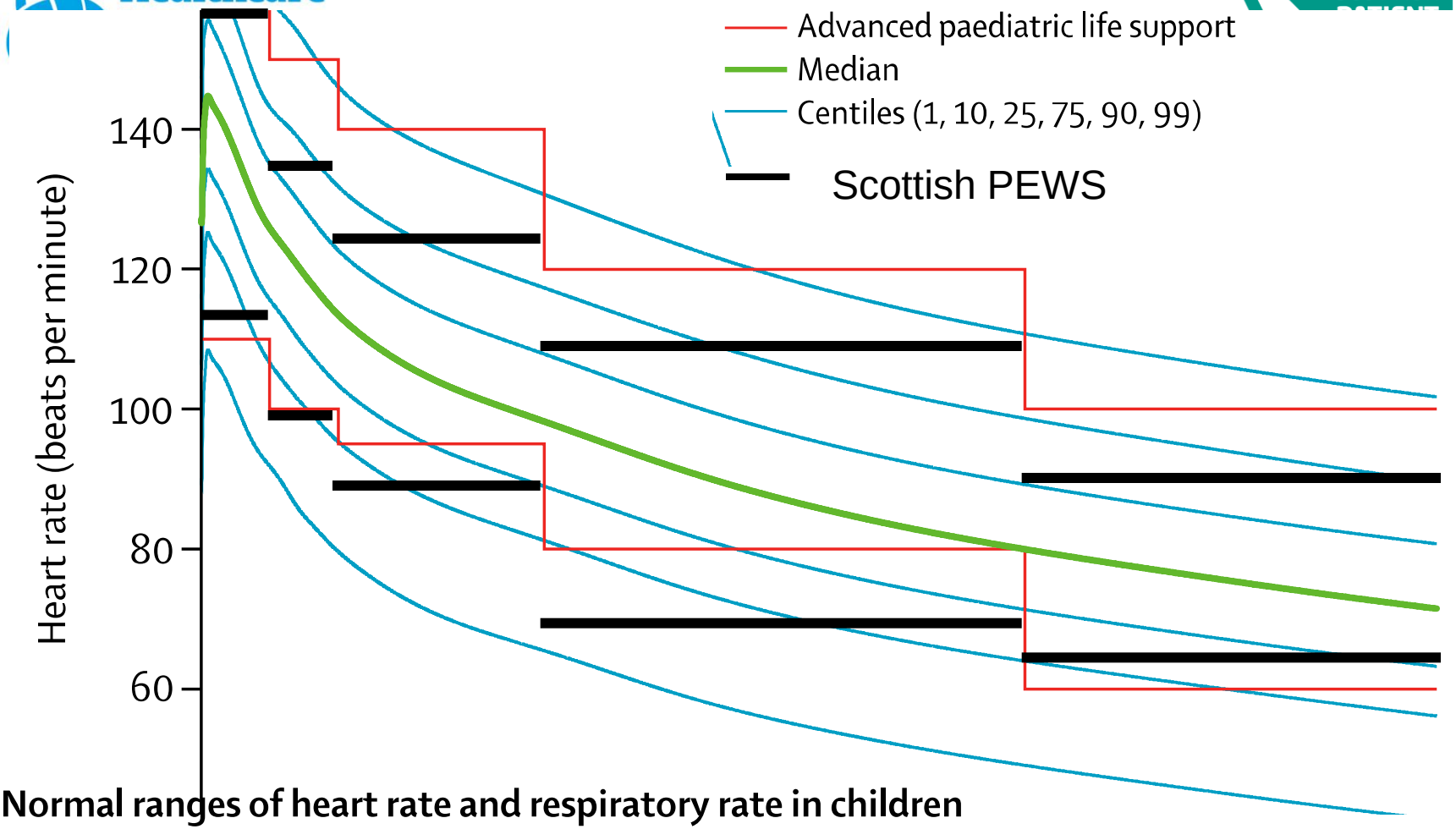

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Susannah Fleming, Matthew Thompson, Richard Stevens, Carl Heneghan, Annette Plüddemann, Ian Maconochie, Lionel Tarassenko, David Mant

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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

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PEWS scale

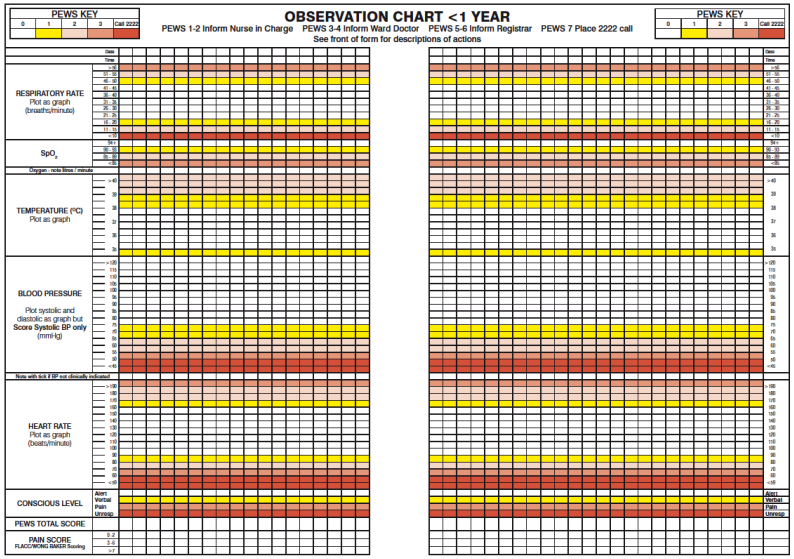
1 red or 2 orange or 3 yellow
2 red or 3 orange or 5 yellow

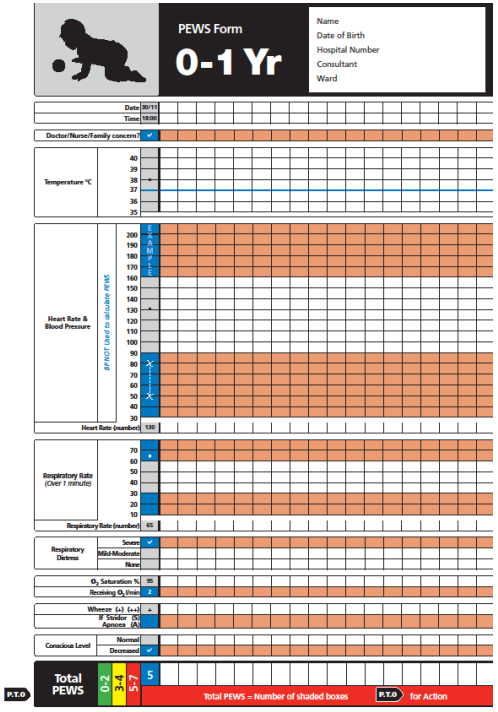
< 3
< 3+ clinical concern
> 3

1 – 2
3 – 5
6 – 7
>7

- Increased frequency of observation recording
- Escalation of help required
  - Nurse to doctor
  - Doctor to consultant

Traffic lights vs binary





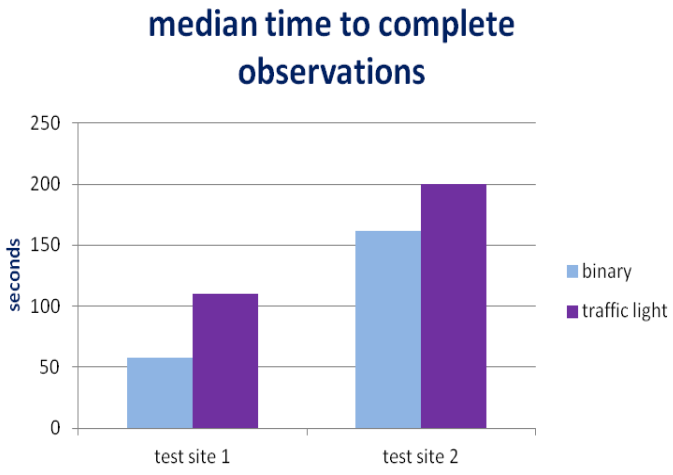
Which chart do you prefer and why?

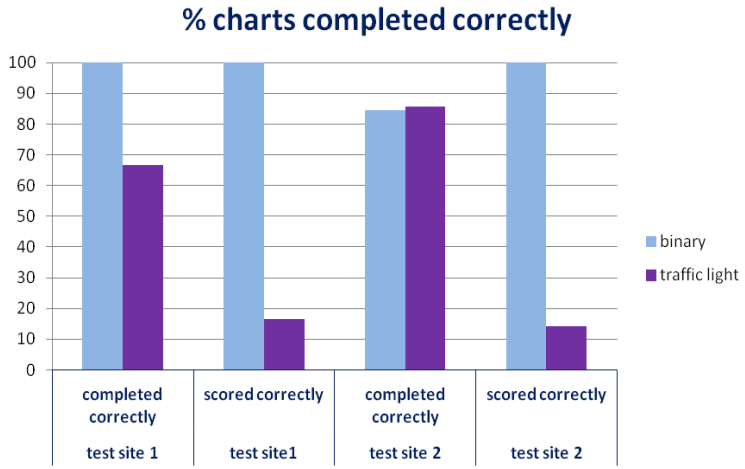
Test site 1: usually use binary chart – 19 prefer binary

- 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





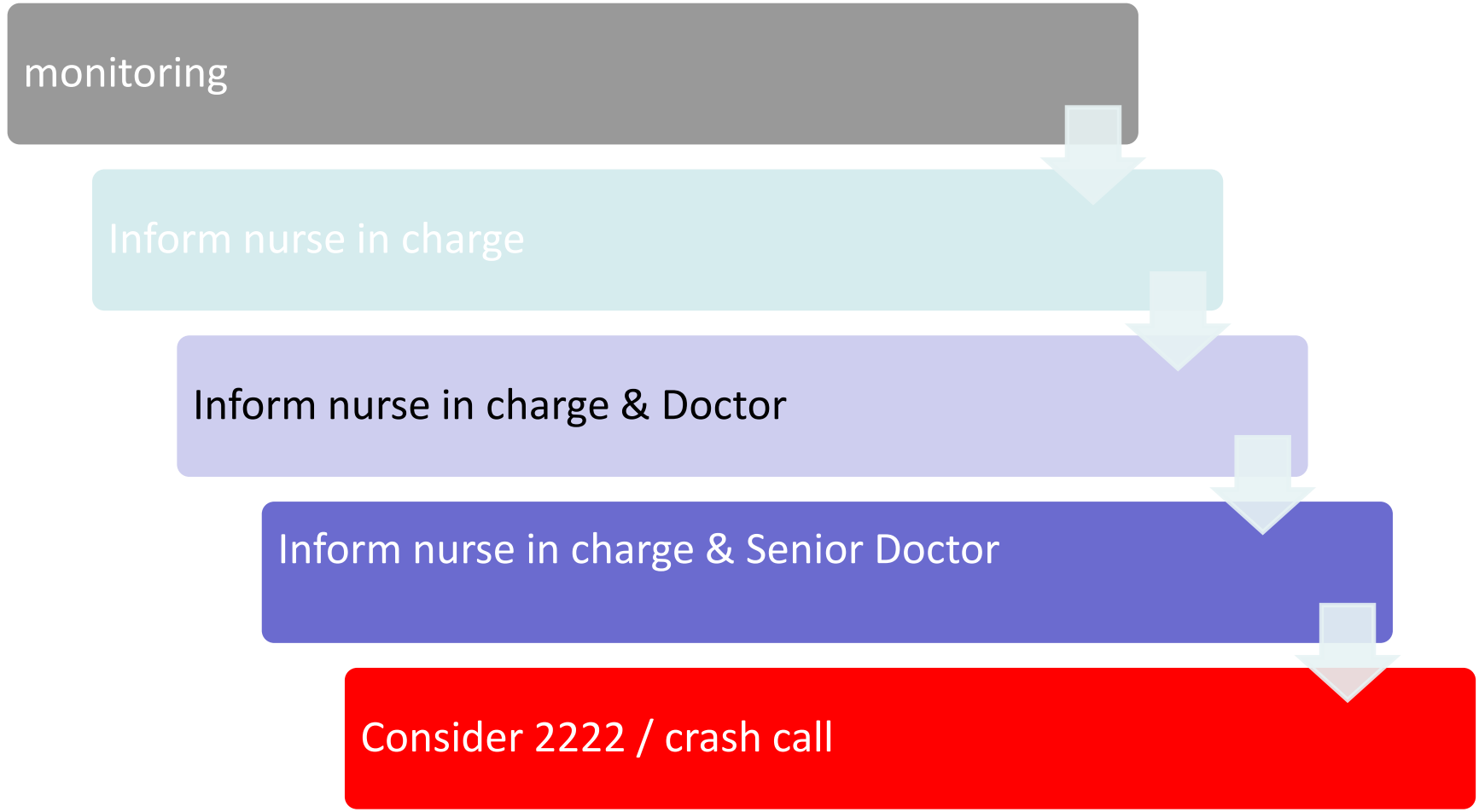
Test site 1 - usually use binary test site 2 usually use traffic light

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

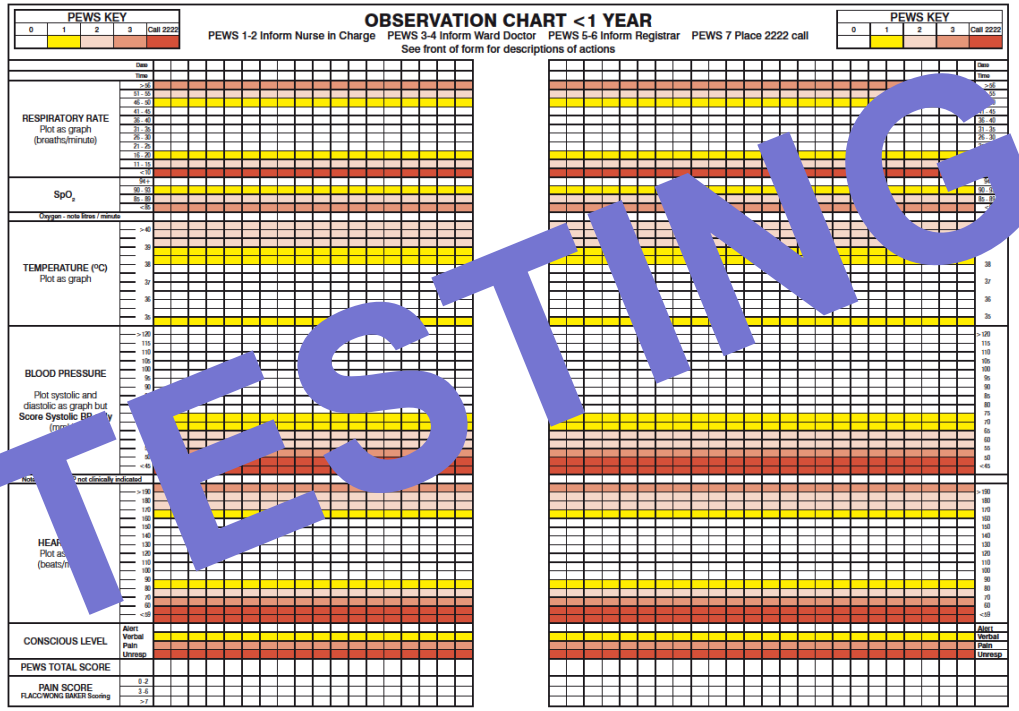
- What is the aim? –
  - can validate electronically for prehospital for admission/ICU/death
  - Can validate in ICU deterioration
  - Big piece of work to do in ward deterioration but some centres have electronic data able to run comparisons of charts

- Further research needed for human factors elements
-

Healthcare Improvement Scotland

EVERY PERSON EVERY TIME SCOTTISH PATIENT SAFETY PROGRAMME

National Paediatric Early Warning Score



Thank-you