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# Paediatric early warning system and paediatric vital signs chart

# frequently asked questions

Purpose

These frequently asked questions (FAQs) are for paediatric teams responsible for implementing and improving paediatric early warning systems and using the paediatric vital signs chart (PVSC) within Aotearoa New Zealand hospitals.

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Paediatric early warning system FAQs

Why do we need a national paediatric early warning system?

Early warning systems help paediatric services to recognise and respond to deterioration in tamariki and thus reduce morbidity and mortality.

We know that paediatric early warning systems are in use across Aotearoa New Zealand, albeit in several different forms. An environmental scan performed in 2017 by the Health Quality & Safety Commission (the Commission) found more similarities than differences between systems.

Tamariki in Aotearoa New Zealand are transferred between services within health districts and around the country between hospitals. When transferring these tamariki, the variation in paediatric vital sign charts (PVSCs) used and paediatric early warning scores assigned can make it harder for clinicians to accurately recognise and respond to a deteriorating tamariki.

A national set of four age-based PVSCs would provide a ‘common language’ that would help to reduce risk[[1]](#endnote-2) and also benefit staff when moving from one place to another to work.

In addition, national charts make a much larger data set available to anyone wanting to research ways to improve the recognition of and response to unwell tamariki in Aotearoa New Zealand.

All respondents to a survey conducted by the Paediatric Society of New Zealand survey in 2017 (unpublished) supported the idea of a national system and acknowledged the benefits of standardisation.

What do we need to set up an effective paediatric early warning system?

To be effective and sustainable, a paediatric early warning system must have components that help staff to recognise and respond to deterioration. They also need underpinning structures for clinical leadership and governance, clinical and administrative resource, education and training, teamwork and communication and measurement for continuous improvement.

Who is leading the implementation of the paediatric early warning system?

The Commission, in collaboration with the Paediatric Society of New Zealand, has developed four draft age-based PVSCs and will lead the implementation of these as part of a national paediatric early warning system.

What does the paediatric early warning system mean for clinical judgement?

The system recognises the importance of critical thinking and autonomy. If you are concerned about the tamariki, you are caring for, then you can escalate care immediately, just as you should if the tamariki or whānau are concerned about the tamariki’s health.

The national paediatric early warning system should complement, rather than hinder, the autonomy and critical thinking of clinicians. A national system does not replace or undermine professional care or clinical judgement. Rather, it provides a safety net to reduce failures to identify patient deterioration and prompts health care providers to take action.

What educational guidance will the Commission give health districts?

An educational slide-based package will be given to district project teams, along with a set of factsheets and a user guide. Teams will need to agree within their organisation who will provide education on the system to clinical staff and how it will be provided.

Paediatric vital signs chart FAQs

What evidence supports the development of the four draft age-based PVSCs?

Starship Hospital started with the BedsidePEWS,[[2]](#endnote-3),[[3]](#endnote-4) which was understood to have the strongest evidence base at the time. The BedsidePEWS was further validated by a two-and-a-half-year study (2012‒15 unpublished) performed by Kidz First Children’s Hospital and Counties Manukau health district, in conjunction with the original BedsidePEWS team from Toronto. Results showed a reduction in urgent intensive care unit admissions from the ward following BedsidePEWS implementation (8.1 vs 5.7/1,000 patient-days, p=0.029).

In addition, of 2,345 sets of analysed vital signs data, there were 2,332 (97.1 percent) sets of entries where all seven vital signs were documented. There were also 2,204 (91.7 percent) occasions where the BedsidePEWS documentation frequency recommendation was followed, suggesting compliance can be maintained following good implementation.

Starship was also part of the international randomised clinical trial, the EPOCH[[4]](#endnote-5) study.

In addition, Starship reviewed research on modified vital signs parameters to inform appropriate upper and lower individual vital signs limits based on physiological change. The work by Bonafide and colleagues[[5]](#endnote-6) found a wider range of normal parameters for heart rate and respiratory rate, and Starship adjusted its charts to incorporate these.

Starship then undertook a post-implementation audit to ensure it didn’t alter the performance of the scoring system. This showed no difference in triggers of escalation between Starship’s altered paediatric early warning system and the old BedsidePEWS. The Starship team acknowledges this was a local audit versus a multi-centre validation, but it was also a pragmatic and reasonable approach.

How were the layout and colours decided for the PVSC?

When the Commission developed the adult vital signs chart, it used human factors evidence to guide the design then tested the chart before national implementation. The deteriorating adult patient evidence summary published by the Commission in 2016[[6]](#endnote-7) explains the importance of considering human factor research when designing early warning score charts. We recommend you read the evidence summary, in particular pages 9, 10 and 16, which describe specific human factor principles and chart design elements.

Why do the paediatric, adult and maternity vital signs charts all look similar?

The same human factor design elements have gone into all three charts, which helps clinicians become familiar with how to use all the tools.[[7]](#endnote-8) Paediatric vital signs parameters obviously vary from adult ones. The PVSC also contains paediatric-specific elements such as ‘central capillary refill’ to ensure tamariki are assessed correctly.

Each chart type has distinct colours to distinguish between the three kinds. In addition, the four age-based PVSCs have a coloured strip down the side and contain symbols to differentiate between age groups and ensure the correct chart is selected for the patient.

Who developed the four PVSCs?

A working group was established by the Paediatric Society of New Zealand with support from the patient deterioration team at the Commission, which has experience in developing other national early warning systems and vital signs charts.

The working group received valuable input from focus group participants, 26 secondary care staff representing the MidCentral and Southern health districts. At the focus groups, held in February 2021, the multi-disciplinary group was able to use the draft PVSC with case studies. This group could then assess whether the draft chart was fit for purpose and reflected the needs of the end user.

The focus groups also provided valuable insights into how the PVSC would work in smaller hospitals across Aotearoa.

The draft PVSC was distributed for national paediatric sector feedback in May 2021.

All feedback was incorporated into the draft PVSCs, which were tested in three districts in 2022. Evaluation of this testing allowed further improvements to be made to the charts and supporting materials.

Why are there four PVSCs?

The working group noted that, in different parts of the world, as well as in Aotearoa New Zealand, four or five age-based PVSCs are used as parts of paediatric early warning systems.

Four age-based PVSCs were chosen to reduce the potential for human error by using the wrong chart for the patient. The age bands are:

* 0–11 months
* 1–4 years
* 5–11 years
* 12+ years.

In choosing the 0–11-month age band, the working group learned from the findings of Starship Hospital, which combined its 0‒3 months chart with its 3‒11 months charts and found in audits that the latter still captured the unwell infant under three months of age.

During testing, historical data from Canterbury district was analysed to determine the effect of moving from five to four charts, and this analysis was reassuring that there would not be a significant amount of unnecessary escalation of care for the 0–3-month-old infants.

What age-based PVSC do I use for a tamariki who was born preterm?

Use the tamariki’s chronological age to select the correct chart. While acknowledging that physiological variables change with age, we expect the effect of corrected gestational age on transition from the 0–11 month to the 1–4 year charts would be minimal. The disadvantage of including the step of having to correct for prematurity is that it is extra work for the user and introduces the possibility for error.  We note that, internationally, countries that use 0–3-month charts use prematurity correction, and those that use 0–11-month charts do not.

Why don’t I use the NOC NEWS for a tamariki admitted under 28 days of age?

The Newborn Observation Chart (NOC), incorporating the Newborn Early Warning Score (NEWS), was developed for use in the immediate post-birth setting. It standardises the initial assessment and care of all newborns in Aotearoa New Zealand; however, it is for the maternity ward setting only and not the paediatric ward. When a tamariki is admitted to the paediatric ward under 28 days of age, they go on the PVSC for tamariki aged 0‒11 months.

Why does the PVSC not have single parameter escalation like the adult chart?

The feedback received from both the focus groups and the working group was that single parameter escalation would be unhelpful, except for in the blue emergency response zone. Consistent clinical opinion was that single parameter triggers were likely to generate unnecessary escalation.

For example, on the 0–11-months PVSC, a heart rate of 180 beats per minute is in the red zone and scores a 4. Other vital signs may not be generating a score. If this was a single trigger mandatory escalation, then care would be escalated frequently to senior clinicians. However, an infant may have an increased heart rate with crying, pain or fever, and this needs to be interpreted in conjunction with other vital signs. Therefore, a total paediatric early warning score (PEWscore) is more useful.

This approach is supported by Chapman and colleagues in a systematic review,[[8]](#endnote-9) which suggested that a single trigger system can present an ‘all or nothing’ approach. The review found that a total score system allowed for a more graded system and demonstrated better sensitivity in trials.

Why is pain not included in scoring?

Some clinicians, particularly specialist pain teams, have proposed pain as a vital sign for several years.[[9]](#endnote-10),[[10]](#endnote-11) To date, no research has shown that pain scores are a necessary component of early warning scores in terms of detecting the potential for deterioration. However, it is important to record pain on the PVSC to help interpret abnormal vital signs and ensure the tamariki’s pain is managed effectively. Accurate pain assessment is supported using objective tools such as the Faces pain scale – revised[[11]](#endnote-12) and the revised FLACC (Face Legs Activity Cry and consolability) observational pain tool,[[12]](#endnote-13) available on the back of the PVSC.

Why have a national respiratory distress score definition?

The focus group noted there were a variety of interpretations of degree of respiratory distress. Also ‘work of breathing’ was terminology often used when discussing respiratory distress. Standardisation was required to support consistency and inter-rater reliability.

The Royal Children’s Hospital Melbourne’s assessment of respiratory distress tool[[13]](#endnote-14) provided the basis for the guide included on the back of the PVSC. Alterations were made when information was already included in scoring on the front of the chart, that is oxygen and respiratory rate.

How do I assess level of consciousness when the tamariki is asleep?

This was discussed thoroughly within the focus groups in the development of the PVSC. Clinicians felt it was important that tamariki were assessed closely and not assumed to be sleeping from a distance.

Once you have assessed the tamariki and determined them to be sleeping normally, annotate ‘Asleep’ on the PVSC within the alert section of ‘Level of Consciousness’.

Why are the escalation pathway boxes blank on the draft PVSC supplied by the Commission?

The mandatory escalation pathways need to be developed locally to reflect the staff and resources that are available there; these won’t be the same in every location. For example, a hospital may have on-site paediatric rapid response teams that will form part of its response plan, and for another this may be a general emergency team with an off-site paediatrician. Emergency codes such as ‘Code blue’, ‘Code pink’ and ‘777’ all need to reflect the local environment. The term ‘RRT’ is the default wording on the PVSC and can be amended with a three-letter acronym.

We encourage project teams to use the mapping tool to review and update their escalation pathway. Ensure the review includes a multi-disciplinary team so different perspectives and experiences are incorporated.

There is limited space available, so wording needs to be brief and actionable. Once succinct wording for the escalation pathway has been agreed, it must be entered into the corresponding section on the PVSC.

What do I do when a full set of observations is not required?

While the true value of a total PEWscore is realised when there is a full set of observations, we appreciate there will be some clinical situations where this isn’t necessarily in the best interest of the tamariki. An example could be after the administration of certain medicines when only a blood pressure is required. In these situations, it is possible to record a PEWscore and use a plus symbol (+) to indicate it is not based on a complete set of observations. See the user guide for more detail.

How do I score when a parameter lands on the line at a change of colour?

Each row of the graphing area for heart rate corresponds to a numerical range of 10 (eg, a heart rate in the 70s, 80s, 90s). In this way, you can clearly identify the relevant coloured zone if the heart rate value falls exactly on the line between zones (for example, in the case of an infant, a heart rate of 170 beats per minute is within the 170s range so scores within the orange zone).



X

**X**

(170 bpm, scores a 2) (80 bpm scores a 2)

What does the box ‘Whānau concern’ mean?

This section requires staff to check in with whānau as to whether they have any concerns about their tamariki’s condition. Asking regularly gives whānau the opportunity to speak up and voice concern. Sharing the PVSC with whānau as part of the admission and orientation process and when completing observations supports communication, helps understanding and encourages partnership.

Listen carefully to whānau because they know their tamariki and can detect subtle changes in their condition before others. Remember that escalation does not always require a specific total PEWscore and can be done solely based on whānau concern.

Why is the central capillary refill specified?

The focus groups and the working group agreed it was important to specify the use of central capillary refill because it is more accurate than peripheral capillary refill time in detecting abnormal perfusion. The Royal College of Nursing also advocates for the use of central capillary refill.[[14]](#endnote-15)

How do I record in the oxygen therapy section?

This section generated a lot of discussion during chart development. We know that tamariki receive a variety of oxygen therapies. The challenge is to provide a format that captures information correctly and accurately reflects the oxygen therapy in use. This information is used within the PVSC to help with the early recognition of and response to physiological deterioration. That is why the total PEWscore is based mainly on the FiO2, ie, an increasing oxygen requirement indicating a deterioration.

The high flow row is used when a tamariki is receiving high-flow therapy only. By including the flow as well as the FiO2, clinicians can check flows are set at appropriate levels for weight. This enables the FiO2 to generate the PEWscore and the flow to give a complete picture of the therapy the tamariki is on.

When a tamariki is receiving oxygen via another method (for example, mask or nasal prongs) this flow is recorded in either the orange or red section depending on the rate.

Please see the example below and the oxygen section in the user guide.

An infant requiring 0.5 L/min of humidified oxygen

Scores 2

Who do I contact if I have questions on this mahi?

The members of the national paediatric early warning system team are available to answer your questions. Please email pews@hqsc.govt.nz, and the most appropriate team member will respond.

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1. **Endnotes**

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