



# Guide to recording blood pressure in acutely unwell tamariki | He aratohu hei tuhi i te taukapa o te toto i te tamariki e māuiui ana

## *Introduction | He kupu whakataki*

This guide covers the common questions raised by paediatric teams during the national rollout of the Aotearoa New Zealand paediatric early warning system (PEWS) about the routine measurement of blood pressure in acutely unwell tamariki (children).

It highlights the significance of blood pressure in the PEWS and its role in recognising deterioration in unwell tamariki.

It discusses documented cases where failing to measure blood pressure resulted in missed opportunities for timely intervention.

It also includes accurate blood pressure measurement methods and further guidance to support education so tamariki of all ages have better clinical outcomes.

## *Key points about blood pressure | Mō te taukapa o te toto*

- Systolic blood pressure is a core vital sign in the Bedside PEWS.<sup>1</sup>
- PEWS is most sensitive when all seven core vital signs are completed.
- Recording of blood pressure in acutely unwell tamariki is clinically important.
- All staff should know how to measure blood pressure accurately in tamariki.

## *Common questions raised by paediatric teams | Ngā pātai noa ka pātaihia e ngā tīma kaimātai mātātahi*

### **Why is blood pressure part of the PEWS?**

Systolic blood pressure is one of seven core vital signs that contribute to the paediatric early warning score. This score is a key part of the recognition phase in the PEWS. Systolic and diastolic blood pressure are measured and recorded on the paediatric vital sign charts. Only the systolic reading contributes to the paediatric early warning score.

The National PEWS is based on the Bedside PEWS model developed by Parshuram et al.<sup>1</sup> During validation of the model, each vital sign was reviewed to see how well it could contribute to the recognition of deterioration in unwell tamariki. The review showed that, even though blood pressure was the most common parameter not measured, it made a clinically relevant contribution to recognising deterioration.

Another study compared the predictive performance of 18 PEWS in recognising deterioration. Systolic blood pressure was used in the three highest-performing systems.<sup>2</sup>

## Why is it important to have a complete set of core vital signs?

The PEWS is designed to be most effective at recognising deterioration when a complete set of vital signs is recorded. However, it was evident in testing<sup>3</sup> and rollout of the national PEWS that incomplete sets were common, and blood pressure was the most frequently missed observation.

The phenomenon of blood pressure not being taken regularly as part of the PEWS can be seen in international research.<sup>4, 5, 6</sup> What is not clear from the research is why blood pressure is omitted. Frequent omission of blood pressure measurement is not universal, with some studies showing it measured in 89 percent of all sets of observations.<sup>6</sup>

In a study conducted at Great Ormond Street Hospital in London<sup>6</sup> authors examined 297 case events in which tamariki suffered a critical deterioration event. It was found that systolic blood pressure was one of two vital signs recorded the least. The authors described incomplete sets of observations in the paediatric early warning score as 'missed opportunities'. They found that, in 9.1 percent of cases, a different escalation pathway would have been followed if a complete set of vital signs had been taken.

## Is recording blood pressure that important?

Recording blood pressure is clinically important, as highlighted by documented paediatric cases in Aotearoa New Zealand where blood pressure was not measured, with detrimental results. Two recent examples are provided in the following Health and Disability Commissioner decisions.

### 18HDC00063 Sep 2022

The first case is that of a six-year-old tamaiti (child) who died while being cared for in hospital.<sup>7</sup> The nursing advisor providing opinion in the case highlighted missing core vital signs and total scores on the paediatric vital sign charts. These were described as errors in the nursing assessment of the tamaiti. Note: the escalation pathway was not mandatory at that time.

The PEWS scores within the documentation are not consistently correct. From admission, there are errors and a lack of PEWS scores when blood pressures are not measured. Whilst mandatory reporting is not a requirement and clinical judgement is to be respected, the history surrounding the introduction of the PEWS was in response to missed subtle changes and missed early intervention opportunities.<sup>7</sup>

### 18HDC02160 Feb 2021

The second case involved a three-year-old tamaiti who also died while being cared for in hospital.<sup>8</sup> The recording of blood pressure is discussed frequently in the report as it was not recorded in any of the sets of observations prior to the collapse of the tamaiti.

Observations were entered into the chart on nine occasions. However, specific observations were not taken regularly or entered on the chart accurately and, as a result, the corresponding Paediatric Early Warning Scores (PEWS) were inaccurate...<sup>8</sup>

The report suggests that recognition of deterioration may have happened sooner, had the correct scores been recorded and the PEWS escalation pathways been followed. The

absence of blood pressure recordings is also discussed in the report in relation to reducing the chance of recognising sepsis earlier.

Reasons given by staff for not taking blood pressures were that it was 'practice' not to wake sleeping tamariki to take blood pressure as it was unnecessary. A medical expert reviewing the case suggested there is a culture in paediatric wards of not taking blood pressure.

A frequent criticism of the PEWS is that to measure a blood pressure involves waking up an already tired and exhausted, unwell, child. On the other hand, had the blood pressure been low, elevating the PEWS it might have alerted staff to impending collapse.<sup>8</sup>

### **Is there a culture of not taking blood pressure in acutely unwell tamariki?**

Clinicians involved in national PEWS testing and rollout gave the following reasons for missed recordings of systolic blood pressure. These explanations were repeated across the country.

Staff did not believe it necessary as abnormal blood pressure was a late sign of deterioration in tamariki

What happens to blood pressure as tamariki become more unwell will depend on the cause of their illness and any underlying conditions they might have. Blood pressure can appear to fall very quickly just before resuscitation, but usually this is because there has been limited monitoring of blood pressure in the time leading up to that point. In many cases, there will have been a more gradual decline in the blood pressure of the tamariki, and therefore an opportunity to intervene earlier.

Blood pressure recording is only necessary on some tamariki with certain illnesses

The idea that blood pressure measurement is only necessary in certain illnesses is problematic as it relies on an accurate diagnosis being made every time, and staff knowing which conditions need blood pressure monitoring and which do not. Neither of these conditions may be present, especially early in an admission.

It is difficult to obtain a reliable reading in distressed or moving tamariki

This is true but is less likely to occur when staff have had the opportunity to practise and improve the clinical skill of measuring blood pressure. Part of this can include the confidence to defer blood pressure measurement for a short time until the tamaiti is more settled.

Taking blood pressure on tamariki wakes them from sleep and staff are reluctant to do this

This is understandable as no one wants to disturb an unwell child. However, the measuring of blood pressure is an important part of assessing circulatory system status. Tamariki are often asleep in hospital, and so avoiding measuring blood pressure when they are would result in blood pressures being taken infrequently or not at all. What we see from the cases above is that this can have a detrimental effect.

Parents and whānau often also dislike their tamariki being woken. To help whānau understand why disruptions are necessary, staff can educate them about the paediatric vital sign charts and how the PEWS works.

Having oscillometric machines set to appropriate paediatric settings can help limit disturbance. Staff can also return when the child is awake and obtain the reading.

## Accurate measurement of blood pressure / Te tika o te ine o te taukapa o te toto

Obtaining accurate blood pressure measurements in neonates, infants and tamariki can be challenging. This is often due to movement and distress in younger tamariki.<sup>9, 10</sup> Staff may not feel confident in taking blood pressure in tamariki and may avoid it. Therefore, education and support from skilled, experienced staff is important.

It is common practice in paediatric wards for non-invasive oscillometric devices to be used. These are suitable and practical, noting that readings can be inaccurate with movement, excitability, and wrong-sized cuffs.<sup>11</sup> Readings can also be checked with a manual sphygmomanometer if necessary.

One-off blood pressure recording can be misleading. Recording multiple blood pressure measurements is important because it allows clinicians to see trends.

The national PEWS is used for a wide age range of tamariki. Neonates (less than 3 months old)<sup>11</sup> are often cared for on paediatric wards, as are older rangatahi. All staff need education on measuring blood pressure accurately in all age groups. Further guidance to support education is in Table 1.

**Table 1: How to accurately measure blood pressure in tamariki**

Key action	Steps
Use an oscillometric device appropriate for all ages	Check the device is set to the appropriate neonatal, paediatric or adult setting. This ensures the cuff does not cause unnecessary discomfort by being overinflated. Ensure machines are calibrated and in good working order. Have an appropriate range of blood pressure cuffs available, from neonate through to a large, long adult cuffs.
Use the right upper arm for most measurements	Try to avoid using the calf because it gives higher readings in infants and tamariki. <sup>9, 11</sup> There will be times, however, due to injury, lines and surgery when the calf needs to be used, or where more than one limb is used to check for a blood pressure difference between them. Always document where on the body the measurement has been taken.
Ensure the <b>cuff width</b> is at least 40 percent of the circumference of the limb. Ensure the <b>cuff bladder length</b> covers 80–100 percent of the circumference of the limb.	Measure the limb with a measuring tape. A cuff that is too large gives a false low reading. A cuff that is too small gives a false high reading.
Place the centre of the bladder over the brachial artery	
If possible, the tamaiti should be relaxed, not talking or moving	Encourage staff and whānau to help with distraction techniques. If necessary, come back to the tamaiti when they are settled.
Support the arm at the level of the heart	Make use of pillows and whānau holding their tamaiti.

## Endnotes / Kupu āpiti

- <sup>1</sup> Parshuram CS, Hutchison J, Middaugh K. 2009. Development and initial validation of the Bedside Paediatric Early Warning System score. *Critical Care* 13: R135. DOI: [10.1186/cc7998](https://doi.org/10.1186/cc7998).
- <sup>2</sup> Chapman SM, Wray J, Oulton K, et al. 2017. "The Score Matters": wide variations in predictive performance of 18 paediatric track and trigger systems. *Arch Dis Child* 102: 487–95.
- <sup>3</sup> Health Quality & Safety Commission. 2022. *Evaluation report: Test of the national paediatric early warning system implementation*. Wellington: Health Quality & Safety Commission. URL: [www.hqsc.govt.nz/resources/resource-library/evaluation-report-test-of-the-national-paediatric-early-warning-system-implementation](http://www.hqsc.govt.nz/resources/resource-library/evaluation-report-test-of-the-national-paediatric-early-warning-system-implementation).
- <sup>4</sup> Parshuram CS, Dryden-Palmer K, Farrell C, et al. 2018. Effect of a Pediatric Early Warning System on All-Cause Mortality in Hospitalized Pediatric Patients: The EPOCH Randomized Clinical Trial. *JAMA* 319(10): 1002–12. DOI: 10.1001/jama.2018.0948. PMID: 29486493; PMCID: PMC5885881.
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- <sup>7</sup> Health and Disability Commissioner. 2022. Decision 18HDC00063: Missed opportunities to manage care of a girl adequately and in a timely manner. Wellington: Health and Disability Commissioner. URL: <https://www.hdc.org.nz/decisions/search-decisions/2022/18hdc00063/>.
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- <sup>9</sup> Briening E, Lebet R. 2012. Measuring Blood Pressure in Infants and Tamariki: Points to Ponder. *New Hampshire Nursing News* 15.
- <sup>10</sup> Royal College of Nursing. 2021. Standards for Assessing, Measuring and Monitoring Vital Signs in Infants, Tamariki and Young People. London: Royal College of Nursing. URL: <https://www.rcn.org.uk/Professional-Development/publications/pub-005942>.
- <sup>11</sup> Dionne J, Bremner S, Baygani S, et al. 2020. Method of blood pressure measurement in neonates and infants: A systematic review and analysis. *Journal of Paediatrics* 221: 23–31.

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