

Paediatric early warning system  
measurement guidance

This measurement guidance will support hospitals as they make improvements to their paediatric early warning system (PEWS). The measures capture information on the process of recognising and responding to deteriorating tamariki as well as their outcomes at a hospital level.

Collecting, analysing and reporting this information will help to identify how well changes are being embedded into clinical areas and where further improvement activity is needed. Additionally, it can be used to monitor the impact of these improvement efforts and strengthen local governance arrangements.

Share the results with ward staff as soon as possible. The results, with a commentary, should be reported to the local governance group each month. When reporting, it will be important to consider the ward acuity and staffing levels to provide context to the results.

We are considering if there will be a requirement for a subset of these measures to be reported nationally as quality and safety marker measures.

Summary of measures

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| Information | Source | Frequency | |
| **Collection** | **Reporting** |
| 1. Outcome measures for:   * number of patients escalated to rapid response team (or equivalent) * number of patients with cardiopulmonary arrests * number of patients transferred to higher level of care. | Switchboard or local collection | As happens | Monthly |
| 2. Process measures for:   * appropriate frequency of vital sign monitoring * appropriate use of partial sets of vital signs * completed core vital signs set * use of partial (+) symbol * recording of whānau concern * correct calculation of total PEW score (partial and complete sets) * modifications made to PEW score triggers * triggers for escalation * escalation and response occurring according to local pathway * completed documentation as per local policy. | Chart audit | Weekly | Weekly to wards; monthly to clinical governance group |

Data collection

Project teams will need to identify how to collect data for the outcome measures.[[1]](#footnote-2) This may be through switchboard or by local collection through the teams involved. These measures may already be collected, otherwise the method for collecting will need to be established during the preparation period.

Project teams will also need to identify how to collect data for the balance measure(s)[[2]](#footnote-3) they have chosen to use as well as how they will report these measures. A suggested balance measure could be qualitative measurement of the impact of the PEWS on workloads.

An audit form has been developed to aid data collection for the process measures.[[3]](#footnote-4) The audit involves the collection of information from the paediatric vital signs charts (PVSCs) and related clinical records.

When you are gathering data to assess your current state, you can use the audit form to do a snapshot audit of 50 audited cases and start collecting your outcome measures, if these are not already collected.

Before starting an audit, develop a data collection plan that outlines who will be involved, when and how auditing will be done and where the data collection tool will be stored and accessed. We recommend real-time auditing as this can provide a further opportunity for project team members and champions to provide on-the-spot education and feedback to staff in wards on how they are using the PVSCs, PEW scores and local mandatory escalation pathway.

Agreement on the following is needed:

* Sampling: a random sampling strategy is recommended. Project teams can choose the sampling strategy but should ensure that the sample is representative of the ward population. This includes ensuring the sample has patients that were cared for over weekends and at night so that you are looking at the process over a range of time periods. Work with the business analytics team in your hospital to see if a case selection list can be generated based on the ward admissions list. Select the charts for audit of patients who have been on the ward for at least four hours; these need to be current admissions. Please note that the last set of observations recorded prior to the patient being discharged should be excluded from the auditing.
* Sample size and frequency of data collection: from a quality improvement perspective, we recommend that each ward audits 10 patients’ clinical records per week as part of the baseline and initial implementation (the first six months), until the changes are embedded and the audit data shows evidence of sustained improvement. This will give teams sufficient data points, in a short period of time, to observe a change in the processes and identify further improvement areas.
* Auditors: decide which project team members and/or ward staff will be doing the audits. We recommend that the auditing is not reliant on one person to do. The workload needs to be shared so that it is done when planned. Most clinicians have a requirement for their practice certification to be involved in auditing; this is a great opportunity for them to be able to demonstrate this and their involvement in improvement activities. Prior to starting auditing, train the auditors so they are consistent in their approach to the questions.
* Local definitions: you will need to provide direction to auditors on what the following means for your PEWS:
  + ‘appropriate’ frequency of observations
  + ‘appropriate’ use of partial vital signs sets
  + ‘documentation’ on why a partial (or incomplete) vital signs set was recorded
  + ‘documentation’ to reflect that a whānau concern was acted on
  + ‘documentation’ by recogniser and responder when escalating and responding to deteriorating tamariki.
* Time of audits: consider when auditing will be done so that it is not always done on the same day and time.
* Setting baselines for the process measures: consider when you will start your auditing to set your baselines so that you can see whether you are improving. In quality improvement, this is done over a number of data points, rather than one single data point. The more data points you have, the better; however, we recommend starting to collect your baseline data at least eight weeks prior to implementation (eg, from February 2023). This will help you work through any challenges with auditing prior to implementation. You can use the audit form to collect this as baseline process data, acknowledging that not all of the questions may match your current situation.
* Setting baselines for the outcome measures: if these are new measures, work out how these will be collected as part of gathering information about your current system. The more data points you have, the better. Check the operational definitions to ensure that you understand these and if you need to adapt similar measures you may already be collecting.

We recognise that some teams will struggle to achieve the recommended sample size and frequency for a variety of reasons. Reducing the sample size and time between data collections will reduce the number of data points and lengthen the period of time that teams can observe an improvement in processes. However, any auditing needs to be practical for project teams and ward staff.

Once the process is stable and well embedded, the project team and governance group can decide whether the audit frequency and sample size can be reduced. For example, five patients per week reduces the sample size but retains the audit frequency, or 20 per month reduces the sample size and the audit frequency. You may also choose to reduce the questions being audited based on local learning and national reporting requirements, for example, if a quality and safety marker is established.

Data analysis and reporting

An Excel data collection tool has been created to help hospitals collate and analyse their process and outcomes data. It includes dashboards and graphs that automatically populate once data has been entered. Project teams should review the dashboards and graphs regularly to identify areas where focused attention needs to be placed, for example, reinforcing recording of blood pressure. Guidance on how to enter data and how to use the dashboards is provided on the first tab of the tool.

Regularly give staff on the wards feedback on the audit so that they know how they are doing, can celebrate their achievements and engage in the discussion on how improvements can be made. The graphs in the data collection tool can be copied and pasted into Word to aid giving feedback.

Regularly share the results with the clinical governance group responsible for the PEWS. They will be able to review areas for improvement and assist with championing these improvements. When reporting, it will be important to consider the ward acuity and staffing levels to provide context to the results and suggest improvements.

The Commission’s PEWS programme team can provide additional support to help you use the tools, develop data collection plans and interpret and make sense of what the data is showing. You can also seek assistance from your local IT or business analytics teams.

Definition of measures

This next section defines all the outcome and process measures in detail. The data collection tool calculates and provides graphs for these measures automatically.

*Outcome measures*

These are measures that give you insight into how the PEWS is operating at a system level and the impact it is having on patient outcomes and safety. These are collected when they happen and collated monthly. As a minimum, the data needs to be collected by ethnicity. This will aid with analysing inequities.

The data collection tool can generate charts to assist with sharing the results once monthly data has been entered. These could be collected through a review of switchboard call records and/or directly collected by the cardiopulmonary arrest and rapid response (or equivalent) teams.

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| 1. Number of in-hospital cardiopulmonary arrests in paediatric inpatient wards | |
| Definition | Cardiopulmonary arrests include:   * cardiac arrest: absence of pulse, consciousness and respiratory effort, necessitating the commencement of cardiopulmonary resuscitation * respiratory arrest: absence of respiratory effort and the presence of palpable pulse and measurable blood pressure necessitating the commencement of artificial ventilation (either manual or mechanical).   Exclusions are areas providing high-acuity specialist care, such as intensive care and post-anaesthetic recovery and emergency departments. |
| Numerator | Number of in-hospital cardiopulmonary arrests |
| Denominator | Not applicable |
| Calculation | Total per month and by ethnicity by month |

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| 2. Number of rapid response escalations | |
| Definition | This measures how many patients had an escalation to the rapid response team (or equivalent). A ‘rapid response team’ can be a medical emergency team or a 777 call. This team is often external to the ward.  An escalation of care to the rapid response team (or equivalent) that has been triggered by any vital sign in the blue zone or clinical and whānau concern (the ‘worried criterion’). |
| Numerator | Number of rapid response escalations |
| Denominator | Not applicable |
| Calculation | Total per month and by ethnicity by month |

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| 3. Number of unplanned admissions to a higher level of care | |
| Definition | This measures how many patients had unplanned admissions to a higher level of care. Unplanned is when the admission is not anticipated as part of the provision of care. Higher level of care means admission to intensive care and high-dependency units and transfers to a higher acuity hospital. |
| Numerator | Number of unplanned admissions to a higher level of care |
| Denominator | Not applicable |
| Calculation | Total per month and by ethnicity by month |

*Process measures*

These are measures that give you insight into the frequency of observations and how tamariki who deteriorate are being recognised and responded to. These process measures relate to the audit form. The data collection tool generates these measures as weekly percentages and displays the data in graphs to assist with sharing the results. Further analysis is possible by ward, ethnicity, age and type of chart when using the data collection tool.

There may be other measures that you want to collect data for. Include these in the measurement section of the project charter and your data collection plan.

Observation frequency measures related to the whole PVSC and the 72 hours of vital signs monitoring

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| 1. Percentage of patients receiving appropriate frequency of vital signs monitoring | |
| Definition | This measure relates to the whole PVSC and requires the auditor to review the last 72 hours of vital signs monitoring. Appropriate frequency is determined by the organisational minimum standard, local policy/guidelines, the escalation pathway, procedural requirements or as documented in the plan of care. |
| Numerator | Number of audited charts with appropriate frequency of vital signs monitoring (*yes* responses for question 1.1 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 2. Percentage of patients where the use of incomplete and partial sets of vital signs was appropriate | |
| Definition | This measure relates to the whole PVSC and requires the auditor to review the last 72 hours of vital signs monitoring. Appropriate use is determined by reviewing the number of incomplete and partial sets on the PVSC and assessing if this is in line with local guidelines/policy, escalation pathway or plan of care. |
| Numerator | Number of audited charts with appropriate use of incomplete and partial sets of vital signs (*yes* responses for question 1.2 of the audit form) |
| Denominator | Total number of audited charts with appropriate and inappropriate use of incomplete and partial sets of vital signs (*yes* + *no* responses for question 1.2 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

Recognition measures related to the most recent set of vital signs

Important note: if the patient has been discharged from the ward, exclude the final set of vital signs. Use the set of vital signs prior to this as the most recent set of vital signs.

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| 3. Percentage of patients with complete core vital signs set for the most recent set of vital signs | |
| Definition | This measures whether **all** the core vital signs were recorded in the most recent vital signs set.  This measure relates to the most recent set of vital signs. The core vital signs set is complete when all the vital signs required to calculate the PEW score are recorded: respiratory rate, respiratory distress, oxygen, oxygen saturation, heart rate, central capillary refill, systolic blood pressure. |
| Numerator | Number of audited charts with completed core vital signs set (*yes* response for question 2.1 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 4. Percentage of recording of each core vital sign (presented with each vital sign displayed as part of a radar diagram) | |
| Definition | This measures which core vital signs were recorded. This allows opportunity for focused education on frequently absent vital signs.  The core vital signs are respiratory rate, respiratory distress, oxygen, oxygen saturation, heart rate, central capillary refill, systolic blood pressure. |
| Numerator | Number of audited charts with recorded specific vital sign (recorded vital signs that were absent for questions 2.1a−g of the audit form; these are marked as *no* in the data collection tool) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 for each vital sign |

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| 5. Percentage of patients with a partial PEW score for the most recent vital signs set | |
| Definition | This measures partial PEW scores. A plus symbol (+) is used to mark that the vital sign set is a recognised partial PEW score. If the PEW score total has the calculated number with a ‘+’ symbol, eg, 6+. |
| Numerator | Number of audited charts with the PEWS total marked with a plus sign (+) (*yes* response to question 2.2 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 6. Percentage of patients with the reason documented for a partial or incomplete recording for the most recent vital signs set | |
| Definition | This measures whether the reason was documented for why an incomplete or partial recording of vital signs was done for the most recent vital signs set. The reason is documented in the clinical record and corresponds to the date and time of the most recent vital signs set. |
| Numerator | Number of audited charts with the reason documented in the clinical record for incomplete or partial recording of vital signs (*yes* response to question 2.3 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 7. Percentage of patients with whānau concern recorded for the most recent vital signs set | |
| Definition | This measures whether the patient had whānau concern recorded. There is a whānau concern box that is completed using Y (yes), N (no) or A (whānau away/asleep). This vital sign does not contribute to the PEW score but is an important part of assessment. |
| Numerator | Number of audited charts with the whānau concern marked with a Y, N or A. (*yes* response to question 2.4 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 8. Percentage of patients with correctly calculated PEW score for the most recent vital signs set | |
| Definition | This measures the correct calculation of the total PEW score. It incorporates both complete and partial recording of the core vital signs set.  A correct calculation can only occur when all of the following apply:   * question 2.1 **or** question 2.2 is a ‘yes’   **and**   * any valid modification is correctly applied to the calculation,   **and**   * the PEW score total is calculated correctly. |
| Numerator | Number of audited charts with the total PEW score calculated correctly (*yes* response to question 3 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 9. Percentage of patients with the complete vital signs set calculated correctly for the most recent vital signs set | |
| Definition | This measures the correct calculation of the total PEW score for those with a complete vital signs set.  A correctly calculated complete vital signs set can only occur when all the following apply:   * a complete core vital signs set (*yes* response to question 2.1) * any valid modification has been correctly applied to the calculation * the score has been calculated correctly. |
| Numerator | Number of audited charts with the complete vital signs set (*yes* response to question 2.1) **and** the total PEW score calculated correctly (*yes* response to question 3 of the audit form) |
| Denominator | Total number of complete vital signs set (*yes* response to question 2.1 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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| 10. Percentage of patients with the partial vital signs set calculated correctly for the most recent vital signs set | |
| Definition | This measures the correct calculation of the total PEW score. It incorporates both complete and partial recording of the core vital sign set.  A correctly calculated partial vital signs set can only occur when all the following apply:   * the total PEW score has a ‘+’ beside the number (*yes* response to question 2.2) * any valid modification has been correctly applied to the calculation * the score has been calculated correctly. |
| Numerator | Number of audited charts with the total PEW score has a ‘+’ beside the number (*yes* response to question 2.2) **and** the total PEW score calculated correctly (*yes* response to question 3 of the audit form) |
| Denominator | Total number of audited charts with the total PEW score has a ‘+’ beside the number (*yes* response to question 2.2 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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| 11. Percentage of patients with modification made to PEW score triggers | |
| Definition | This measures the percentage of modifications made to the PEW score triggers. Modifications must be documented in the modifications box on the PVSC (or electronic equivalent).  The PVSC allows for modifications to vital sign triggers using the modifications box. There are three spaces for modifications to be made. |
| Numerator | Number of audited charts with modification made (*yes* response to question 4 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 12. Percentage of patients with clinical requirements recorded for modifications | |
| Definition | This measures the percentage of modifications that had clinical requirements recorded. The modification entry must have the clinical requirements recorded: vital sign, rationale and duration for modification. |
| Numerator | Number of audited charts with modifications that met clinical requirements (*yes* response to question 4a of the audit form) |
| Denominator | Number of audited charts with modification made (*yes* response to question 4 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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| 13. Percentage of patients with documentation requirements recorded for modifications | |
| Definition | This measures the percentage of modifications that had documentation requirements recorded. The modification entry must have the documentation requirements recorded: legible date, signature and contact details. |
| Numerator | Number of audited charts with modifications that met documentation requirements (*yes* response to question 4b of the audit form) |
| Denominator | Total number of audited charts with modification made (*yes* response to question 4 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

Escalation and response measures related to 72-hour audit period

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| 14. Percentage of patients that triggered an escalation | |
| Definition | This measures those patients who triggered an escalation with a PEW score 4–5, PEW score 6–7, PEW score 8+ or a single vital sign in the blue zone. |
| Numerator | Number of audited charts that triggered an escalation (*yes* response to question 5 of the audit form) |
| Denominator | Total number of audited charts |
| Calculation | (Numerator/denominator) × 100 |

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| 15. Percentage of patients that triggered an escalation for whom the escalations occurred as per pathway | |
| Definition | This measures how many of those patients that triggered an escalation had their care escalated according to the agreed pathway. If more than one escalation was triggered in the current admission, the most recent trigger is to be included in the audit.  Note any deviation from the agreed escalation pathway or inadequate documentation means that the escalation did **not** occur as per pathway. |
| Numerator | Number of audited charts that had an escalation occur according to the pathway (*yes* response to question 5a of the audit form) |
| Denominator | Number of audited charts that triggered an escalation (*yes* response to question 5 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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| 16. Percentage of patients that triggered an escalation for whom the response occurred as per pathway | |
| Definition | This measures how many of those patients that triggered an escalation received the appropriate response to that escalation according to the agreed pathway.  If more than one escalation was triggered in the current admission, the most recent trigger is to be included in the audit.  The responder has to attend in the time frame specified on the escalation pathway. |
| Numerator | Number of audited charts that had a response occur according to the pathway (*yes* response to question 5b of the audit form) |
| Denominator | Number of audited charts that triggered an escalation (*yes* response to question 5 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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| 17. Percentage of patients that triggered an escalation for whom the responder completed documentation as per local policy | |
| Definition | This measures how many of those patients that triggered had documentation completed as per local policy by the responder. If more than one escalation was triggered in the current admission, the most recent trigger is to be included in the audit.  The responder has to meet all documentation requirements according to local policy (eg, this may include documenting an assessment and plan for ongoing care in the clinical record or completing a rapid response call sticker). |
| Numerator | Number of audited charts where the responder completed documentation requirements (*yes* response to question 5c of the audit form) |
| Denominator | Number of audited charts that triggered an escalation (*yes* response to question 5 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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| 18. Percentage of patients that triggered an escalation for whom the recogniser completed documentation as per local policy | |
| Definition | This measures how many of those patients that triggered had documentation completed as per local policy by the recogniser. If more than one escalation was triggered in the current admission, the most recent trigger is to be included in the audit.  The recogniser has to meet all documentation requirements according to local policy (eg, this may include documenting the escalation in the clinical record or completing an escalation call sticker). |
| Numerator | Number of audited charts where the responder completed documentation requirements (*yes* response to question 5d of the audit form) |
| Denominator | Number of audited charts that triggered an escalation (*yes* response to question 5 of the audit form) |
| Calculation | (Numerator/denominator) × 100 |

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Graphical user interface

Description automatically generated with medium confidence

1. Outcome measures are used to measure the performance of the system; they relate directly to the aim of the project and provide evidence that changes made are having an impact at the system level. [↑](#footnote-ref-2)
2. Balance measures monitor whether the project has any unintended consequences [↑](#footnote-ref-3)
3. Process measures are used to measure whether an activity has been accomplished and can be leading indications of whether the project is likely to impact the outcome measure. [↑](#footnote-ref-4)