![Health Quality & Safety Commission New Zealand — Kupu Taurangi Hauora o Aotearoa]

Patient deterioration programme

Findings of an evaluation of the early implementation of a recognition and response system

June 2017

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1. Introduction

The Health Quality & Safety Commission (the Commission) patient deterioration programme identified significant opportunities to improve the quality and safety of systems for recognising and responding to signs of deterioration among adult patients in New Zealand acute hospitals. It has funded a five-year programme to help New Zealand hospitals implement three workstreams to improve the care of adult patients (excluding obstetrics) who acutely deteriorate while in hospital. The workstreams are:

1. a recognition and response system – including a standardised national vital sign chart and New Zealand early warning score (NZEWS), localised clinical escalation and response system, and structures for ongoing clinical governance and system evaluation
2. a patient, family and whānau escalation system – developed locally using a process of co-design
3. processes for determining and documenting shared goals for patient care.

This paper reports on early implementation activities for workstream 1, the national recognition and response system. Six hospital sites were involved in implementing the system in advance of the national roll-out and gave feedback on the Commission's tools and guidance for it. The Commission will use these findings to inform the way it supports the national roll-out of the system, such as by refining its tools and guidance in response to feedback from the sites.

Overall feedback about the recognition and response system was very positive. Participants highlighted some issues and made suggestions for improvement in relation to specific elements of the vital sign chart and implementation process. Clinical staff mainly raised specific issues about the vital sign chart and escalation processes. Issues project team members identified across the different sites included: problems with clinical engagement, governance and leadership; burdensome audit and data collection processes; resource limitations; and clinical practice issues that the chart's implementation indirectly highlighted.

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2. Early implementation sites

Six hospital sites agreed to participate in early implementation and refinement of the recognition and response system. The purpose of this work was to test usability and usefulness of the Commission's tools and guidance materials in order to refine them before rolling out the system throughout the country. The project team chose sites to represent a range of hospital settings across all district health board (DHB) regional groupings (Table 1). Preparation and implementation activities occurred between November 2016 and May 2017.

Table 1: Early implementation sites		
Organisation	**Hospital type**	**Implementation sites**
Auckland DHB	Tertiary	Three Auckland City Hospital wards – acute medicine, acute surgery, acute mental health
Canterbury DHB	Tertiary and regional (electronic vital signs system)	Christchurch, Burwood, Hillmorton and Ashburton hospitals
Hauora Tairāwhiti DHB	Rural	Gisborne Hospital
Nelson Marlborough DHB	Metropolitan and regional	Nelson and Wairau hospitals
Southern Cross	Private surgical	Southern Cross Christchurch
Whanganui DHB	Metropolitan	Whanganui Hospital, including acute and forensic mental health

Each participating site committed to:

- testing the Commission's tools and guidance
- collecting and reporting data
- training staff to use the recognition and response system
- participating in evaluation activities
- having a clinical and project lead and establishing a project team
- making project staff available for training and to attend learning sessions, webinars and teleconferences during the test period.

The patient deterioration programme team supported the sites by providing:

- regular webinars and teleconferences
- at least two site visits from programme team members
- two face-to-face learning sessions
- ad hoc support by telephone and email
- training on how to use the tools and resources (where needed)
- guidance to support project teams (for example, evidence summary, planning and teaching tools, guidance on quality improvement activities).

The Commission provided sites with the following tools and guidance materials:

- a preparation and implementation guide
- a project charter template
- countdown to launch posters
- an example vital sign and early warning score policy for local adaptation
- a vital sign chart with NZEWS
- an escalation mapping tool to develop local escalation pathway
- escalation and rapid response call activation stickers for documentation in clinical notes
- training presentation on the vital sign chart and NZEWS
- clinical governance recommendations
- measurement guidance
- audit guidance, including a paper-based audit tool for monitoring use of recognition and response processes and an electronic spreadsheet for data entry
- a post-event case review tool to guide clinical staff in exploring issues related to the recognition and response system for individual patients.

Throughout the early implementation period the Commission also developed additional materials such as frequently asked questions and factsheets about specific clinical aspects of using the system.

Two sites, Canterbury DHB and Hauora Tairāwhiti, were unable to implement the recognition and response system within the Commission's timeframe. Section 9 discusses the learning from these sites.

3.   Evaluation approach

Commission staff carried out the evaluation because the main purpose was to understand any clinical issues with using the vital sign chart and NZEWS and implementation issues that project teams experienced, as well as to refine the Commission's tools, guidance and support. The evaluation involved a mixed method approach. Commission staff gathered quantitative data from audit and measurement activities and from one site's electronic vital sign database. For qualitative data, they conducted focus group interviews with project teams and clinical staff at each site, and gathered feedback in learning sessions. Commission staff also interviewed project teams from Canterbury DHB and Hauora Tairāwhiti in order to learn from the issues that had delayed implementation at each of these sites. This evaluation report has also drawn on submissions from a more formal and broader stakeholder feedback exercise (see section 10).

4.   Focus group methods

The specialist advisor for the patient deterioration programme facilitated 18 focus group interviews using a semi-structured question guide. Focus group sizes ranged from 4–15 participants, who included doctors and nurses working clinically; doctors and nurses working in education, management, quality and leadership roles; and project team members. Commission staff transcribed the focus group interviews for analysis. Although they did not conduct formal thematic analysis, they identified clear and repeating themes in the data.

5.   Quantitative analysis methods

Commission staff analysed data from the hospitals using statistical process control (SPC) charts. SPC is a branch of statistics that combines rigorous time series analysis methods with graphical presentation of data, often producing insights into the data more quickly and in a way that is more understandable to lay decision-makers. SPC and its primary tool – the control chart – provide researchers and practitioners with a method of better understanding and communicating data from efforts to improve health care. SPC charts are used in quality improvement initiatives to monitor improvement, stability and predictability of processes over a period of time.

SPC theory uses the phrase 'common cause variation' to refer to the variation that is a natural, regular part of a process. This variation is expected to occur according to the underlying statistical distribution if its parameters remain constant over time. In contrast, 'special cause variation' refers to unnatural variation due to events, changes or circumstances that have not previously been a typical or normal part of the regular process. Interventions in a research study or change ideas in a quality improvement project are deliberate attempts to introduce special causes of variation. Statistical tools are therefore needed to help identify whether patterns in a set of measurements demonstrate common or special cause variation.

Out of the 12 process step measures that sites audited, the following seven were selected to reflect the reliability and overall effectiveness of the process:

1. monitoring
2. modifications
3. correct calculation of NZEWS
4. the number of patients reaching any of the triggers for escalation in the 24-hour audit period
5. escalation according to pathway
6. patient review within the specified timeframe
7. documentation for patients whose vital signs triggered escalation of their care.

6.   Findings

General feedback was that the recognition and response system is a useful way of prompting early management of deteriorating patients. Clinicians from all of the sites reported finding benefits from using it. In particular, ward nurses and junior doctors reported feeling empowered to speak up and ask for help, and those in senior roles reported seeing earlier escalation of care and more proactive management of deteriorating patients. Negative feedback was limited to specific design or process issues people found when using the chart (see sections 6.2–6.5 for more detail).

The quotes below illustrate views that clinicians commonly gave about how useful the system as a whole is.

> 'We're actually recognising things sooner and because of the pathway [we're] getting on to it.'

Charge nurse manager, acute surgery

> 'I actually really like the set parameters as to, 'this is what you do'. It is a really good guide, particularly if the nurse is not as confident as some.'

Duty nurse manager

> 'As a house officer it's really helpful … because I think sometimes you feel like patients are too sick to warrant your review, but you feel like it's unfair to just call the reg [registrar] straight off the bat … It gives us more authority to just call.'

House officer, acute medicine

> 'There's lots of good things about it … someone who works in Auckland or Middlemore then shifts down to Taranaki and has got the same forms, I think it's a very good idea.'

Surgical registrar

> 'I think it will work really well for the other people that pick this up. You've got your strategies, you've got your toolbox, you've got your factsheets … The support from the Commission's been really, really good.'

DHB project team member

6.1   Lessons for implementation

Commission staff asked project teams what advice they would give others who are beginning to implement a recognition and response system. The teams and clinical leaders identified a number of key lessons about the preparation period, the development of governance structures, clinical engagement, and methods for providing education and training about using the system.

Project management and preparation

Almost all members of project teams were implementing the recognition and response system on top of their other responsibilities as clinicians, educators and members of quality improvement teams. This was problematic for many, who saw it as potentially compromising the quality of their work.

> 'It's a lot of work to be doing alongside your own job as well … to a certain extent I probably haven't done this as well as I could have if I'd had allocated hours. I think ideally it's better to have somebody with some designated time.'
> Nurse educator coordinating a DHB project team

Project teams reported that the task of implementing the recognition and response system can highlight a wide range of organisational and clinical practice issues that may have existed for a long time. Examples include: resourcing of the hospital after hours and across multiple sites; clinical skills and knowledge for responding to clinical deterioration; and communication, documentation and teamwork practices.

> 'That's a core risk for the project team really, that other things swamp you and distract you.'
> Director of quality, safety and risk

Participants emphasised the need for adequate lead-in time before implementing the system. This was important for identifying clinical leads, identifying or developing clinical governance structures, and developing and agreeing on key policy and guidelines. Logistical tasks also required significant preparation time, such as ordering, printing and distributing charts, and arranging for adequate education and training opportunities for clinical staff .

> 'I think in those early stages it was quite rushed. There was quite a lot that had to be processed in a fairly short time …'
> Nurse educator coordinating a DHB project team

Governance and policy

Although all of the early implementation sites had some form of recognition and response system in place before they implemented the national project, teams from all sites reported that their organisation had no formal clinical governance structures for those systems.

> 'Effectively there wasn't an overarching governance group, even though people here had worked to get one … [We} went about setting up a very representational broad cross-section steering group to get the buy-in.'
> Director of quality, safety and risk

> 'There was virtually nothing that already existed, apart from a previous chart … there was no other support.'
> Nurse educator, DHB project team

Project teams worked to use, and align with, existing clinical governance groups and structures wherever possible. Their approaches differed depending on the size and strategic priorities within each site. For example, some sites re-oriented existing resuscitation committees to focus on the care of deteriorating patients more broadly. Others developed new committees to oversee the work in line with other organisational priorities (such as implementing electronic vital signs systems or redesigning the 24/7 model of care). Figures 1 and 2 give two examples of the clinical governance structures that sites developed.

Figure 1: Clinical governance structure developed in a tertiary DHB
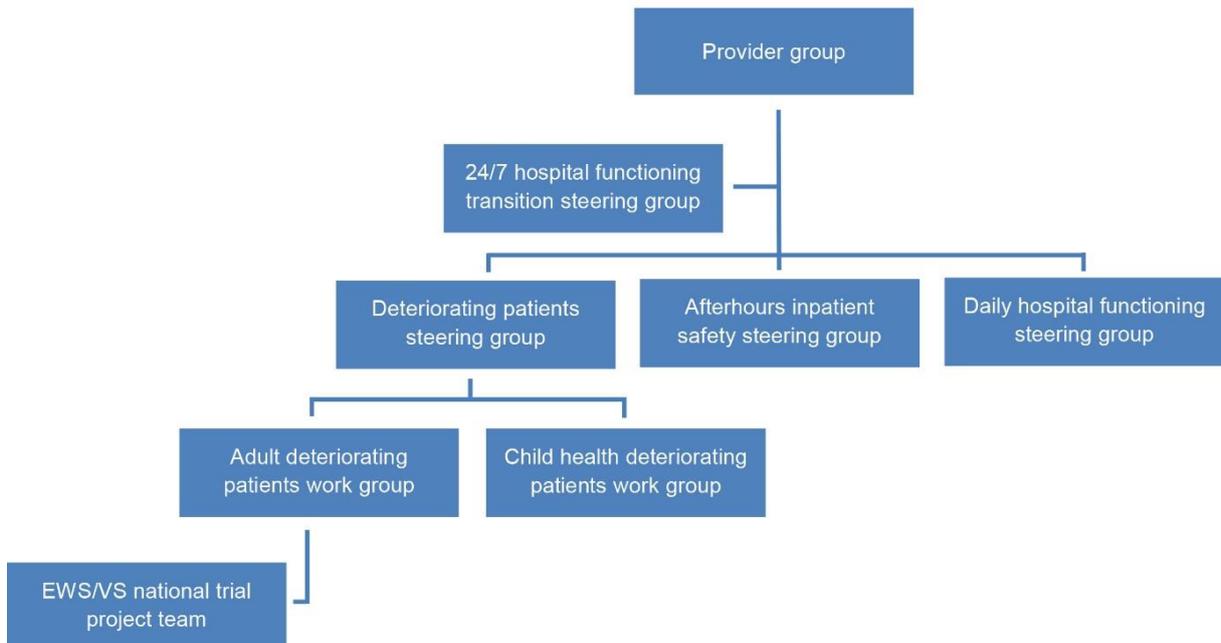
Figure 2: Clinical governance structure developed in a small regional DHB

The elements of recognition and response systems are linked to many other aspects of clinical practice. In many cases sites had to modify multiple clinical documents, policies and guidelines to reflect the change to the early warning score and associated escalation pathway. For example, some sites had to develop new clinical documents for recording parameters such as the Glasgow Coma Scale, while others identified a variety of policy documents that they needed to amend.

> 'We had over 70 policies and procedures that we knew of, and we do still have a lot of specialty policies and procedures that aren't in our electronic system …'

DHB project team member

A number of project team members commented on the need for clear minimum standards around expectations for physiologically monitoring inpatients. Where policy did not already exist, sites needed to work to achieve consensus on expected minimum frequency for vital sign monitoring. Some wove these expectations into new policy guidance on how to use the standardised vital sign chart and NZEWS, as well as on expectations for clinicians providing care to deteriorating patients.

> 'I think the reason why it's been easy for us is because we already had a pretty strong physical obs[ervations] policy prior to starting it … Yeah, it would be really hard if you were starting from zero.'

Charge nurse manager, mental health unit

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Engagement and clinical leadership

Teams repeatedly highlighted strong clinical leadership as a crucial factor for successful implementation. Where this was lacking, project teams had difficulties with matters such as reaching agreement on the content of escalation pathways or resolving practice issues around how to use particular aspects of the chart (for example, the modifications box).

> 'You need to get those passionate personalities in the room. You can't have somebody in the room who's just going to be along for the ride and just come along to meetings and do nothing in between.'
>
> DHB project team member

> 'We set up a network of clinical leaders for us to put in clinical practice issues …, which weren't the project's business to solve, but we identified them and needed things to be done.'
>
> Director of quality, safety and risk

Several doctor participants acknowledged that senior medical staff can be particularly difficult to engage in the system.

> 'There's a lot of documentation which, I confess, I haven't read because I lack the time. I think we probably, as doctors, have been the laggards in your system. It's hard to weigh your other competing interests.'
>
> Senior medical officer, DHB project team

Another suggestion was that some clinical staff were sceptical about the system after having negative experiences with previous national programmes and this attitude made engagement challenging.

> 'Some people have said, "Well, we nationally adopted another thing, and that was a waste of time".'
>
> DHB project team member

Project teams saw direct communication with individual clinicians as a key part of successful engagement. They emphasised the importance of using both data and stories to engage clinical staff in the project and overcome initial scepticism or lack of engagement.

> 'If you can tell a story, and say, "That's why we're doing it", it's very hard to argue.'
>
> Clinical lead, DHB project team

> 'Auditing it: knowing what your performance was before you start. Then you can objectively tell people … that you've made a difference.'
>
> DHB project team member

One site recommended having regular walk-arounds with senior clinical and executive leaders to make their support and commitment to the project visible to clinical staff.

> 'Any form of visibility is very, very useful. The staff can then identify that this is important. This is something that we can be proud of, we're part of it, and higher up noticed, yeah, and are interested and behind us.'

DHB project lead

Education and training

Project teams reported that education and training focused on using the vital sign chart, NZEWS and local escalation and response processes. None of the teams reported providing any additional education and training for responders.

A clear message was that one-off education sessions were not adequate to get all clinicians consistently and correctly using the recognition and response system. As a consequence, sites had to consider making resources available for teaching time.

> 'It's not a matter of turning up for one [education] session; you need constant sessions, and you need time for that.'

Nurse educator, private hospital

Participants generally agreed that ward-based education for nursing staff was effective, especially when senior nurses on the ward, nominated 'ward champions' or members of the project team followed up with opportunistic, on-the-spot teaching. On-the-spot teaching had added benefits in that it allowed open discussion and feedback about issues that were unclear or that individual staff had misinterpreted.

Accessing doctors to provide education and training was more difficult, as participants described it. In the most successful strategies they reported, clinical leads for the project teams presented at grand rounds, attended departmental meetings and junior doctor teaching time, and talked one-to-one to individual colleagues.

> 'The RMOs [resident medical officers] have teaching most days, and that is one opportunity to hammer home some of the issues … You could definitely target some of those where you bring along a chart or do a patient example, or whatever … Then obviously there are departmental-specific meetings.'

Clinical lead, DHB project team

Suggestions for sustaining education and training over time included: accessing new staff on orientation days; updating clinical handbooks and orientation manuals; using hospital intranet sites for 'marketing' activities and refresher training about particular issues; and booking regular sessions at grand rounds to present data and patient stories and prompt discussion about system performance.

6.2   Overall vital sign chart format

Many participants reported that their initial issues with the vital sign chart resolved over time. They thought that the likely reason for such issues was the process of change rather than actual design or formatting problems.

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> 'I think the hardest thing is change and anything new. I know initially I saw it [the vital sign chart] and thought, "Oh my God, the piece of paper!" But actually, once you get used to it, it is quite user-friendly.'

Clinical nurse consultant

However, a range of issues persisted for some chart users. Some focus group participants suggested that the escalation pathway occupied too much room on the chart and more columns are needed in the graphing area. Among the suggestions for the escalation pathway were to print it separately or only on one side of the chart, or to reduce its size.

A few participants reported various other formatting issues but different sites tended to report different issues. Among these concerns were that: the A3 format of the chart did not fit into the clipboards one ward used; the 'Z' fold slipped open and hung out of folders; the hole punches tore; the white edge of the chart made it difficult to locate when filed with other documents; and too little space was available for writing the date. Another suggestion was to visually distinguish the two sides of the chart because clinicians could chart vital signs on the wrong side.

6.3   Clinical utility of the vital sign chart

Project teams audited vital sign charts to collect data about how frequently clinical staff were monitoring vital signs and whether they were calculating early warning scores correctly. Table 2 in section 7.1 provides information from the sites.

Clinical staff did not consistently record the additional parameters of pain and urine output across sites, which were not particularly relevant in some specialty areas.

> 'Little things like urine output … we don't tend to record that down here in mental health.'

Staff nurse, mental health unit

Focus group participants asked for many additional parameters, largely based on existing practice at their own site and/or the specialty needs of a particular ward or unit. Examples of additional parameters that they requested include: weight; bowel function; sedation score; neurovascular observations; heart rhythm and regularity; and blood sugar level. Some also suggested adding a signature box.

At every site, staff reported that the coloured zones on the graphing area of the vital sign chart were difficult to distinguish from each other. Their particular concerns were distinguishing the yellow zone from the orange zone, and the orange zone from the red zone.

> 'I've just done a couple of weeks of nightshift and I actually find it quite hard to see the colours on nights – just the colours aren't bright enough.'

Clinical nurse consultant, medical

One focus group participant suggested reordering the core vital sign parameters to put the earliest indicators of physiological deterioration closest to the top of the chart. This approach is consistent with human factors studies identifying that the most critical information should appear at the top left of the page so that it is read first.

6.4 Modifications

Modifications to the early warning score can be made when abnormal vital signs associated with chronic disease or a short-term acute process are expected and not associated with acute deterioration. Consistent feedback was that clinical staff needed additional guidance around the expectations for modifying early warning scores. Focus group participants highlighted the need for clear local policy specifying which clinicians were allowed to make modifications and the timing for review of those modifications. In a number of the sites that allowed only registrars or senior doctors to make modifications, other staff had to deal with practical issues.

> 'You ring somebody up and they say, "Well, I haven't got time to do that". You leave a note at morning rounds and it just gets ignored. There's only so many times you can chase something…. I do think that some of the house surgeons, who actually know the patients, would be quite capable of doing this … We see more of the house surgeons than the registrars and consultants.'
>
> Charge nurse manager, medical ward

However, other focus group participants expressed concerns about potential issues for patient safety due to inappropriate modifications.

> 'What we're seeing at the intensive care department is inappropriate modifications made by mid-level junior staff… We're seeing the worst of the worst, because they either end up with us or dying, so we have a slightly skewed thing, but [we've] certainly seen inappropriate changes to high respiratory rate to decrease the amount of calls.'
>
> Senior medical officer, intensive care

Participants generally agreed that this was largely an issue to be resolved by developing clear local policy and providing clinical education.

> 'I think it's a real education issue. You've got to look at what are appropriate issues to modify, and why, and what are completely inappropriate … They've got to be patient focused rather than number focused.'
>
> Clinical lead, DHB project team

In many cases, clinical staff needed to modify the parameter of using supplementary oxygen on the vital sign chart. This experience highlighted practice issues around oxygen use.

> 'There are a lot of practice issues around oxygen that have been highlighted in the last few weeks, ranging from the complete failure to recognise what an escalating oxygen requirement might mean …; through to people not knowing how much oxygen to give through what device; through to people routinely giving two litres of oxygen for everybody on a PCA [patient controlled analgesia], regardless of the fact they're saturating at 100 percent.'
>
> DHB project team member

Modifications for oxygen use were particularly common for patients leaving the post-anaesthetic recovery unit for the ward. One site developed a sticker for anaesthetists to use that modified the NZEWS associated with oxygen supplementation for up to four hours after leaving the unit.

6.5   Escalation pathways

Project teams identified that developing escalation pathways was a complex task. They considered the Commission's escalation mapping tool was a useful starting point for discussion, but that it needed further work to identify current practices and examine workload issues and to address those issues to ensure that the pathway operated as expected. Section 7.1 discusses the data on compliance with escalation pathways.

> 'I think some auditing and understanding of how your current escalation plan works, and whether you're actually achieving that, would be a good base point. Because I think a lot of it just came straight across. I think the two-hour obs[ervations] came straight across, and I think if we had done a bit of work auditing, and realising actually we're not meeting that, we might've thought, back then, should we be doing this?'
>
> Nurse consultant, DHB project team

Compliance with the escalation pathway varied within and between sites. Focus group feedback indicated one reason for poor compliance may be that staff see clinical review for single-parameter triggers in the orange zone as having limited value (for example, oxygen supplementation alone triggered an orange zone review). Focus group participants reported that escalation did not occur according to the pathway for some patients with a single-parameter trigger in the orange zone.

Another area in which the data reflects low compliance is in undertaking reviews within the timeframe specified in site escalation pathways (see Table 2 in section 7.1). The reasons for this finding are difficult to identify; exploring the issues locally will improve understanding. If competing clinical priorities are preventing timely review, sites may need to re-examine workflows, workloads and escalation pathways to find ways of optimising the process.

Staff did not complete documentation tasks consistently. These tasks included:

- the recogniser placing an activation sticker (or other documentation indicating that escalation occurred) in the clinical record
- the reviewer completing the bottom half of the activation sticker
- the reviewer documenting a plan for ongoing care in the clinical record.

Focus group participants reported that reviewers rarely completed the second half of the activation sticker because they saw it as duplicating the task of writing up the clinical assessment and plan in the clinical record. Participants also highlighted the need for stickers to be readily available. One site reported that nurses had started carrying stickers in their pockets so they had ready access to them when needed.

A number of focus group participants mentioned difficulties with accessing senior clinical staff in hospitals after hours. Project team reports highlighted the same issue, noting staff met with difficulties reaching agreement on escalation pathways that would effectively cover the 24-hour period. Some sites undertook significant work in order to gather data on existing systems for managing patient deterioration after hours, call volumes for on-call staff, and potential call volumes with the change to the NZEWS. They then used this data to inform discussions and help staff agree on appropriate local escalation pathways. Concern around after-hours resourcing was particularly problematic at Hauora Tairāwhiti in that it prevented the site from implementing the system within the Commission's timeframe. Section 9.2 discusses this issue in more detail.

> 'The nights are vastly different. That's probably the most vulnerable time in the hospital just because of how few people are around and how relatively junior they are.'
> Senior medical officer

> 'What this has highlighted for us is there is a definite hole in terms of our hospital at night, night safety, and support for junior staff. Those are the things that this has actually put into stark focus.'
> Clinical lead, DHB project team

> 'We're very restricted because of our rapid response resources. We're having to use in-house and no additional resources.'
> Nurse educator coordinating a DHB project team

Focus group participants identified the need for clear policy to underpin the actions required as part of the escalation pathway. Some sites experienced issues because the escalation pathway required a specific increase in the frequency of vital signs that staff did not see as clinically necessary or practically achievable in the context of the nursing workload more generally. Participants described this issue as problematic for patients who triggered the yellow zone in particular, as the majority of patients on some acute wards had vital signs that triggered the yellow zone. Discussion centred on the need to allow nurses to use clinical judgement about the frequency of vital signs for such patients. Some suggested using policy to identify minimum standards and documentation requirements. Another suggestion was for escalation actions in the yellow zone to prompt staff to consider increasing the frequency of vital sign monitoring, as an approach that would be preferable to making it mandatory to increase frequency.

> 'The EWS of one [yellow zone] … increasing your [vital sign monitoring] frequency, for example, is creating a lot of work and of course we fail the audit, because we don't do that …'
> Charge nurse manager, rehabilitation ward

It was clear that specialist clinical settings and small satellite hospitals are likely to need to vary their escalation pathways based on their local context.

> 'Consider carefully how you go about introducing the system into geriatrics and mental health, or any other unit without constant resident medical staff. A separate escalation system involving nursing staff and transfer to ED [emergency department] for assessment needs to be set up.'
>
> Clinical director of surgical services, project clinical lead

Although the vital sign chart and NZEWS were designed for use in general adult wards, one site implemented it in the post-anaesthetic recovery unit and the emergency department. Clinicians working in these areas gave clear feedback that they expected abnormal vital signs to be common in these contexts and that medical staff were generally present in the department and available to attend as required.

> 'If something happens we've got our anaesthetists and we've got our surgeons. We haven't just got the RMO [resident medical officer] standing there – everybody is already involved.'
>
> Charge nurse manager, post-anaesthetic recovery unit

Participants from small hospitals reported that it was easy to access responders during the day time as they were usually already present on the ward. They saw this situation as a barrier to using the escalation pathway correctly in the strictest sense – staff would not make rapid response team calls if responders were already present in the ward. They also identified having responders on the ward as potentially making it difficult to achieve the culture change necessary to embed principles of calling for help routinely, particularly for junior staff or in the after-hours period.

> 'We have to become almost robotic, for want of a better word, in how we follow the algorithm for the first six months or more, so that then that becomes embedded and it becomes a natural part of what we do.'
>
> Clinical nurse consultant

7. Audit and measurement

Audit and measurement activities focused on collecting data about compliance with recognition and response processes by auditing clinical records; retrospectively reviewing individual cases; and measuring outcomes such as in-hospital cardiac arrest rates per 1,000 admissions.

7.1 Audit

Project teams were asked to audit the monitoring, escalation, response and documentation processes involved in the recognition and response system throughout the early implementation period. This involved auditing 10 vital sign charts and clinical records per ward each week using a standard paper audit tool with 15 questions. The Commission's quality improvement advisor developed a dashboard presenting collated audit data.

The Commission created graphs for 12 process steps. It also further analysed three of the process steps (modifications, breakdown of triggered category and completion of documentation tasks).

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Data collection template and definitions

Project teams found the audit data collection template easy to use. However, they indicated that the current data collection method results in double-handling of the data. A suggestion was to develop an app to automate the data collection, analysis and reporting with real-time graphs. Teams showed an inconsistent understanding of some audit questions, indicating a need to clarify definitions.

Ongoing data collection

Project teams consistently raised concerns about the resource implications of the ongoing burden of collecting data that they needed to do as part of the audit process.

> 'I think the weekly audits are not sustainable long term.'

Nurse educator coordinating a DHB project team

> 'If people see huge audit burden they just won't do it on top of their current FTE [full-time equivalent] roles.'

Acting chief medical officer, DHB site

Sample size

Each testing site collected its data on the agreed pilot testing areas. The target was to complete audit for 10 patients per clinical area each week. Sites met this target in most areas, except in some elective surgical areas where the patient volume was low. Teams highlighted the time required to complete the survey each week.

> 'Each audit of 10 charts took approximately 40–60 minutes to complete.'

Nurse consultant coordinating a DHB project team

Using the data

The Commission provided two Microsoft Excel spreadsheets where project teams were to enter the data collected using the paper audit tool. One spreadsheet was for reporting data at the ward or unit level, and the other was for aggregating data at the hospital level. At first, teams were not clear about how to use the two templates. They experienced design and data entry issues with the individual ward or unit spreadsheet, with the result that the data graphs were incorrect.

Teams shared the data with the national team regularly and promptly. Commission staff collated the data and created a dashboard for each hospital every month. Two hospitals shared the data with management and one hospital used the data to drive improvement in its area.

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Feedback from sites indicated that:

- the dashboard was a bit busy and teams did not understand the graphs at first
- once the dashboard was explained, it was easy for teams to follow
- project teams really valued having the operational definition and summary along with dashboard graphs
- aggregated data at the hospital level was not useful for ward staff.

Sites did not routinely feed back local data to clinical areas.

> 'Yeah, what you do with them [the audits] I don't know – they go to audit land.'
>
> Charge nurse manager, rehabilitation ward

Many participants suggested that real-time local ward or unit-level data would be useful.

> 'If there're particular areas that are failing or have been flagged – if we're not aware of them, then we can't help mediate that.'
>
> Duty nurse manager

What is the data showing us?

For a process to function effectively, all the critical process steps need to operate at peak efficiency. Inefficiencies in any process step will make it more difficult to achieve the desired outcome. For example, 80 percent compliance indicates that 20 out 100 patients are vulnerable to completely or partially missing out on the process step. Audit data demonstrated that many of the critical process steps of the recognition and response system are operating at a low level on average and vary significantly (Table 2). It is important to note that baseline information about vital sign monitoring and documentation practices is unknown, so it is possible that these results could represent an improvement.

Table 2: Average percentage for achieving each process step, by hospital				
Process step	**Hospital 1**	**Hospital 2**	**Hospital 3**	**Hospital 4**
Comply with frequency of vital signs monitoring	58%	81%	70%	96%
Complete all modification fields	64%	81%	53%	54%
Correctly calculate early warning score	86%	87%	76%	72%
Complete documentation tasks	51%	53%	40%	26%
Escalate in line with the escalation pathway	30%	36%	37%	60%
Review within the specified timeframe	25%	19%	8%	36%

This data highlights areas for improvement in the processes. The Commission can support this improvement by refining the vital sign chart, activation stickers and other documentation, as well as by providing more detailed guidance about modifications. Sites may also need to consider optimising their escalation pathways and processes to support improvement. International experience indicates that it can take several years to develop a mature recognition and response system. It is therefore important to continue to improve audit and quality to refine the processes and learn from the data.

7.2   Case review

The Commission provided sites with a template for case review. It recommended undertaking a retrospective case review after incidents such as cardiac arrests, patient deaths, unplanned transfers to higher acuity care, and other reported events (SAC 1, 2 and 3) related to failures to recognise or respond to clinical deterioration. It also recommended conducting routine case reviews for a random sample of patients who received a rapid response call (for example, every fifth or tenth call). The reviewer needed sufficient clinical expertise and seniority to make a judgement on the appropriateness of the clinical care provided to the patient.

The Commission recommended that sites report data and themes from case reviews for discussion and action. Groups involved in this work might include local quality improvement teams, the recognition and response system clinical governance committee, specialty morbidity and mortality meetings, or grand rounds. In practice, sites largely used individual cases as stories for education and training to highlight particular aspects of using the recognition and response system or caring for acutely deteriorating patients.

> 'Case histories are just brilliant, you know, "Hey, let's have a look at this, guys, this is what happened. You could see this going down the gurgler. If we had one of these systems, we would have picked it up here, we would have picked it up here, we would have picked it up here."'

Clinical lead, DHB project team

7.3   Outcome data

The Commission also asked sites to report cardiopulmonary arrest rates per 1,000 admissions and rapid response call rates per 1,000 admissions. Although the measurement guidance provided some detail about these measures, finding opportunities for sites to progress their local collection systems during the pilot timeframes proved difficult. No site had in place reliable local systems for collecting and/or reporting cardiopulmonary arrest and rapid response call numbers. The need to get data about admission numbers as the numerator for these measures was another barrier to reporting.

Existing cardiopulmonary arrest and rapid response call data mostly came via telephone switchboard logs of emergency calls. Accurately identifying call type was frequently impossible because sites did not clearly document the different call types. In addition, because the hospital switchboards did not collect National Health Index (NHI) numbers, it was likewise impossible to retrospectively identify call type. One site is working to establish a

system for rapid response providers to collect this data prospectively and is building a database to support ongoing data collection. Other sites are working to fine-tune their processes for collecting data at the switchboard so that they can identify call types more accurately.

> 'That's one thing that'd be nice for all the centres to know: the exact minimum data set that the Commission think is a good thing and then I guess, the DHBs can add additional things, but fix down exactly the minimum data set that is a good thing to capture.'
>
> DHB project team member

8. Project support from the Commission

> 'I pretty much read everything you sent out.'
>
> Nurse educator coordinating a DHB project team

The Commission's programme team supported sites by hosting two all-day learning sessions, one in November 2016 and the other in May 2017. From January to June it held teleconferences with the project leads every three weeks. The programme specialist and at least one other Commission team member visited each site in October 2016 to understand current recognition and response systems, measurement systems and levels of engagement. The clinical lead, specialist and quality improvement advisor visited each site in March 2017 to support it in implementing the recognition and response system, discuss issues arising and encourage learning from collected data. Participants gave positive feedback about the Commission's site visits and guidance materials.

> 'The support has been really good … The rationale that you provide is great, because you know it hasn't just come from out of the sky – you've got good reasons for having things in their place.'
>
> Service manager, private hospital

The programme team used the information from its initial site visits to develop the first learning session. That session focused on four areas: clinical engagement, clinical governance, measurement, and quality improvement methodology. The aims of the learning session were to provide guidance and support and develop quality improvement capability. Five of 35 attendees responded to an invitation to provide feedback on the learning sessions through Survey Monkey. All or most of these respondents found this learning session was 'extremely' or 'very' useful for: learning what others were doing (100 percent); networking with others (100 percent); sharing their own recognition and response systems with others (80 percent); and discussing preparation for implementing the new system (80 percent). The three most highly rated areas covered were clinical engagement, quality improvement methods, and measurement.

After the second learning session in May 2017, seven of the 22 attendees gave feedback through Survey Monkey. Most or all of these respondents found this learning session was 'extremely' or 'very' useful for: gaining an understanding of what has been learnt (100 percent); sharing and learning from each other, and discussing improvements to spread to other organisations (86 percent); and strengthening networks (71 percent). The three most

highly rated areas covered were: changes the Commission has made as a result of the testing; hospital teams sharing their recognition and response system journey; and feeding back what worked well and suggestions for improvement. The aspects of the session that respondents most often found useful were sharing learnings across sites and learning about relevant topics. The aspect respondents most commonly found less useful was the time spent on team break-outs during the day. Suggestions for improving the learning session included: poster displays; recognising different needs; holding mid-point learning sessions; allowing more space in the agenda; more clinically focused items; improving screen placement; and better coffee.

During the second learning session attendees were asked to identify tools, guidance and support that worked well, and what could be improved, as well as to suggest ideas for additional guidance, tools and resources that could be developed. Table 3 summarises their responses.

Table 3: Feedback from learning session two	
What worked well	• All resources provided were very helpful: 　○ preparation and implementation guide clearly laid out with good questions to consider 　○ escalation mapping tool 　○ national vital sign chart with early warning score 　○ good audit and case review forms 　○ standard project charter template helped to clearly establish our work 　○ training presentation 　○ weekly posters and stickers worked well. • Alex Psirides, who presented at grand rounds, had strong clinical expertise. • Commission staff were accessible and supportive, and responded to issues raised such as triggers and oxygen. They helped with audit spreadsheet issues. • Teleconferences were well structured and timely, and were an opportunity to get feedback from rest of group. Key points from these were sent to the distribution list. • Learning sessions in Wellington and the slides from these worked well. The initial learning session set the scene and established clear guidance and expectations. • Site visits were helpful during the implementation stage.
Suggestions for improvement	• Improve the resources by making the: 　○ project charter template more succinct, with clear identification of the main points governance need to know 　○ audit spreadsheet easier to use 　○ infographic poster available at the beginning of the preparation period as that would have been really beneficial 　○ examples in the training presentation more complex 　○ escalation stickers smaller and possibly without the doctors' response part 　○ questions in the audit tool tighter

	o posters a larger format (A3).
	• Provide timely data dashboards to present to teams earlier.
	• Provide guidance on using the modification box on the vital sign chart.
	• Have a preparation site visit to introduce the whole clinical team to the project.
	• Review the 1-3 pm timing of the teleconferences. If people join late, don't restart as that can be frustrating.
	• Learning sessions are more useful than webinar or telephone sessions because they are in person.
	• Simplify the engagement webinar for clinical staff.
	• Have a longer lead time to prepare for implementation and avoid public holidays.
	• Understand the 'elephants' from other projects.
	• Money for resources and staff.
	• Reinforce support of high-level leaders and help project teams to get this support.
	• Provide food – cake works wonders.
	• Provide more guidance around electronic systems rather than just guidance focused on the paper-based vital sign chart.
	• Have more than one person at each DHB as a key point of contact for distributing information.
	• Have a visible location on the Commission website for tools and guidance.
	• Roll out the system nationally.
Suggestions for additional support, tools and guidance	Suggestions were to have: • Commission resources for chief executives, chief medical officers and directors of nursing and additional support to influence them • an electronic chat room where project teams can meet and share • multidisciplinary frequently asked questions • SBAR stickers for use • a poster template for sites that shows the big differences between the old chart and the new one • additional tools and support on auditing, data results and dashboards • guidance on processes to follow after hours or out of hours • a resource on oxygen in relation to the vital sign chart • pre-recorded 'you are about to go live' webinar for individuals on the ground that covers what is expected, challenges and how to modify • resources that differentiate between big and small hospitals • links to references and research on website.

9. Delayed implementation

Two of the six sites, Canterbury DHB and Hauora Tairāwhiti, did not implement the system in the Commission's timeframe. Their reasons differed significantly, as discussed below.

9.1 Canterbury DHB

Canterbury DHB has been working toward fully implementing an electronic vital sign recording system, known as the eVitals project. While it has done so at Christchurch Hospital, satellite sites at Ashburton and Burwood have yet to change to the eVitals system due to competing priorities with implementing other electronic clinical tools. The DHB decided to delay the switch-over to NZEWS until it had fully implemented eVitals to avoid any chance of creating confusion by using two different early warning scores across the different sites. As a result of this decision, the DHB has been able to do a significant amount of work to prepare for the change to NZEWS, which commenced in September 2017.

As part of this work, the DHB established a project team of clinicians from a range of professions and specialties, quality and risk staff, and data analysts. The project team provides governance for the patient deterioration programme and strongly links to the work of the eVitals project team.

The eVitals system prevents many of the compliance and error issues that are associated with using paper charts to document vital signs, calculating NZEWS and escalating care. The system includes prompts to record a complete set of vital signs; automatically calculates the NZEWS; and will enable automatic alerting of the appropriate responder when escalation is required. This potentially has significant workload implications.

Over six months of using eVitals at Christchurch Hospital, the DHB collected a large database of approximately half a million vital sign sets. With this data, the Canterbury DHB project team could undertake detailed virtual modelling of issues associated with the change to NZEWS. The data from Canterbury DHB has provided key information for decision-making about removing single-parameter scoring in the orange zone from the draft NZEWS chart. From a total of 434,964 vital sign sets collected from 30 Christchurch Hospital wards over six months, 119,259 were orange zone alerts. Removing single-parameter triggers for the orange zone reduces potential call numbers by 113,596 alerts (95 percent) over the period. Table 4 gives details of the trigger for each alert and the number of vital sign sets associated with each trigger.

Table 4: Orange zone triggers over a six-month period at Christchurch Hospital			
Parameter	Orange zone trigger value	Number of vital sign sets reaching trigger value	(%)
NZEWS aggregate score	6–7	5,663	(4.7)
Heart rate	110–129 or 40-49 beats/minute	8,724	(7.3)
Oxygen saturation	92–93%	21,054	(17.7)
Respiratory rate	21–24 breaths/minute	11,110	(9.3)
Supplementary oxygen	Any	53,907	(45.2)
Systolic blood pressure	90–99 mmHG	18,009	(15.1)
Temperature	≥ 39°C or ≤ 34°C	792	(0.7)
Total		**119,259**	**(100)**

The eVitals data has also been useful to the Canterbury DHB project team in prompting it to investigate a number of specific practice issues that virtual modelling of the impact of implementing NZEWS has highlighted. For example, the finding that supplementary oxygen triggers an NZEWS of 2 has drawn attention to issues around routine oxygen use in the hospital. The team used the eVitals data to explore the number of patients receiving supplementary oxygen who had high-normal oxygen saturations. This data suggests there is significant potential for cost savings and reducing inappropriately high NZEWS through a practice improvement initiative focusing on prescribing and using oxygen therapy in the hospital. The project team has established a separate working group to address this issue.

9.2 Hauora Tairāwhiti

Gisborne Hospital initially planned to implement the vital sign chart and NZEWS in February 2017, in line with the project aims. However, it met with delays because of initial difficulties engaging senior medical officers in the project, and, later, significant concern from the senior medical group about the proposed escalation pathway and its potential for requiring more resources. The proposal was to require review from the senior medical officers with responsibility for the patient – or, after hours, the senior medical officers on call – in cases of escalation of care for patients triggering in the red zone. Larger hospitals commonly escalate such reviews to registrars but Gisborne Hospital does not employ registrar-level medical staff.

The concerns of the senior medical group largely centred on the potential impact on their workload, particularly at night, if escalation of patients triggering the red zone was mandatory. The project team took the issue to the chief executive, and after a number of months of discussion, the hospital reached agreement on an escalation pathway. It now plans to Implement the system commenced in July 2017.

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10. Written submissions

A stakeholder feedback exercise asked for written submissions on the proposed elements of the national recognition and response system over a period of six weeks. The Commission sent individual letters asking for feedback to relevant professional colleges and societies, to the regional patient safety groups in which each DHB participates, and to other key stakeholders such as the Private Surgical Hospital Association and the Rural Hospital Network. It also advertised the exercise on its website and asked members of the programme's expert advisory group to relay information to their contacts. Table 5 gives details of those making the 21 written submissions the Commission received.

All of the submissions broadly supported the development of the proposed national approach and the draft nationally standardised elements of the recognition and response system that the Commission asked for comment on. The majority of submissions from hospitals, DHBs and private hospital groups identified that the national programme offers useful opportunities to improve on existing systems for the care of deteriorating patients. Submissions from academic institutions and professional colleges similarly supported taking a national approach to this work. No submissions identified any major gaps or errors in the materials the Commission provided. Feedback on design details and clinical use of the vital sign chart corresponded closely to that from the early implementation sites and so we do not discuss it further here.

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Table 5: Organisations and individuals that made submissions on the national recognition and response system
Organisations
Australian and New Zealand College of Anaesthetists
Bay of Plenty DHB
College of Emergency Nurses New Zealand
College of Intensive Care Medicine
Grace Hospital
Lakes DHB
Mercy Hospital
National Critical Care Outreach Group
New Zealand College of Critical Care Nurses
New Zealand Rural Hospital Network
Nurse Executives New Zealand
Royal Australasian College of Surgeons
Southern Cross Hospitals
Southern DHB
University of Auckland School of Nursing
Waikato DHB
Waitemata DHB intensive care unit and outreach team
West Coast DHB early warning score working group
Individuals
Three additional submissions were made by individuals

Written submissions did identify two major issues. The first was the question of adequate resourcing of recognition and response systems within hospitals, including the need to consider opportunity costs when resources are diverted from other services. The second was the need for education and training designed to improve the management of acute physiological deterioration and to support clinicians to exercise sound clinical judgement when providing care. Both hospital resourcing and education and training are outside of the direct influence of the Commission, whose mandate is quality improvement. Addressing these issues will require collaboration among multiple organisations and agencies, such as district health boards, professional colleges, government agencies such as Health Workforce New Zealand, universities and other training providers.

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11. Conclusions and next steps

The six organisations that participated in this early implementation work provided useful and revealing insights into the opportunities and challenges of implementing a recognition and response system. This work has highlighted the need to establish effective clinical governance structures to ensure a site has the capacity to have an ongoing oversight of the system across the organisation, and to escalate organisational, resourcing and clinical issues that project teams cannot resolve in the implementation phase. Strong clinical leadership from both nursing and medicine is clearly a requirement for encouraging clinicians to truly engage with the system and for reaching agreement about the clinical elements of the recognition and response system.

The Commission will recommend that initial and ongoing resourcing is carefully considered when planning implementation of recognition and response systems. The Commission will also highlight that training and education about using the recognition and response system, and in the clinical and non-technical skills responders need, are key requirements for improving the care of deteriorating patients. An online learning module will be available to support clinical staff in using the national vital sign chart and early warning score. A fact sheet about the capabilities responders need is already available, as are some freely accessible simulation-based training courses focused on the care of the deteriorating patient. The Commission will continue to engage with key organisations and agencies to promote the work of the programme, make content consistent where necessary and develop opportunities for collaboration.

In response to the evaluation findings, the Commission recommends a number of revisions to the vital sign chart, as Appendix 1 details. It will not change the formatting in some of the ways focus group participants suggested because human factors design principles have informed these features. For example, the escalation pathway will remain on both sides of the chart and at its current size. Human factors work indicates people need to easily and directly access instructions for action without having to refer to another document, while readability requirements dictate a minimum font size.

The evaluation also highlighted the importance of using data to identify areas for quality improvement. It is vital to continue to collect data and report it to the relevant governance and clinical groups to ensure local systems are continually improved, which in turn makes the system more reliable.

The Commission will use the lessons learned from this early implementation work to refine its tools and guidance and to support the implementation of the standardised vital sign chart and NZEWS in the remaining DHBs and private hospitals across New Zealand. It will work directly with project teams and through the regional safety and quality groups to provide opportunities for collaboration and support among organisations implementing their recognition and response systems.

The Commission gratefully acknowledges the significant work of and valuable feedback from the project teams and other staff in the six early implementation sites.

Appendix 1: Changes made to the vital sign chart

Changes made to the vital sign chart in response to feedback
Additional parameters section
Deleted pain and urine output to allow local decision-making about additional parameters appropriate for patient population. Suggestions and guidelines for content outlined in vital sign chart user guide
Escalation pathway
Changed all lines to 1-point grey
Expanded escalation pathway box to allow for more actions within each category
Removed placeholder text from escalation pathway
Removed single-parameter triggers from yellow and orange zones
Wording changed from '**Call RRT** for any patient you, they or their family are worried about …' to '**Escalate care** for any patient you, they or their family are worried about …'
Graphing area
Changed capitalisation on 'Level of Consciousness' to fit with 'LOC' recommended abbreviation
Changed lowest respiratory rate criterion from < 5 to ≤ 4
Changed uppermost respiratory rate criterion from > 35 to ≥ 36
Extended 100 percent tint to reference columns on left and right of vital sign graphing area
Increased tint on all coloured boxes within vital sign graphing area from 30 percent to 60 percent
Level of consciousness split to allow voice and pain to be recorded in separate rows. Both still attract same score (3).
Reduced 2-point line around vital sign chart area to 1-point
Vital signs reordered in line with relative clinical importance for the early detection of physiological deterioration. From top to bottom, now reads RR, supplementary O_2, SpO_2, HR, BP, Temp, LOC
Margins and labels
Patient labels changed to match national medication chart font, text and formatting
Inverted title of chart from white-on-grey to black-on-white
Page number added
Modifications box
Duration in hours added
Removed EWS colour key from bottom right of chart to expand modifications box
Thick lines below 'Reason' added to clarify divisions
Wording changed from 'should' to 'must' for consistency in modifications and frequency indications

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