Chapter 3

RECOGNIZING AND MANAGING THE CLINICALLY DETERIORATING PATIENT: THE ROLE OF RAPID RESPONSE SYSTEMS, RAPID RESPONSE TEAMS, AND RAPID RESPONSE NURSES

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LEARNING OUTCOMES

After completing this e-chapter you will be able to:

1. Describe the characteristics of the Rapid Response System (RRS).
2. Understand the evidence underpinning the afferent and efferent limbs of the RRS.
3. Explain the role of track-and-trigger tools for the identification of clinically deteriorating patients outside the Intensive Care Unit.
4. Describe different initiatives that have been implemented to support patients and their family to summon help if they believe they (or their loved one) is deteriorating in the hospital setting.
5. Explain the different service models that have been implemented internationally to uphold the efferent limb of the RRS.
6. Outline the role, activities and operation of Rapid Response Nurses.
7. Understand modifications to the RRS necessary to optimise the detection and response to clinically deteriorating children and pregnant women.
8. Describe the administrative and governance structures necessary for establishing, implementing, monitoring and improving RRS performance.
9. Identify future directions of RRSs.

ABBREVIATIONS

- AI – Artificial Intelligence
- CCON – Critical Care Outreach Nurse
- CCOT - Critical Care Outreach Team
- ECG - Electrocardiogram
- EHR – Electronic health record
- EWS – Early Warning Score
- ICU – Intensive Care Unit
- ICU-LN – Intensive Care Unit – Liaison Nurse
- MET – Medical Emergency Team
- MEOWS - Modified Obstetric Early Warning Score
- NEWS (2) – National Early Warning Score (2)
- NFR - Not For Resuscitation
- PART - Patient At Risk Team
- PEWS - Paediatric Early Warning System
- RRN – Rapid Response Nurse
- RRS – Rapid Response Systems
- RRT – Rapid Response Team
- SAE - Serious Adverse Events
- UK – United Kingdom
- USA - United States of America
- PART – Patient at Risk Team
- PFAES - Patient and Family Activated Escalation System

CHAPTER OVERVIEW

Clinical deterioration is broadly defined as the change in a patient's condition from one clinical state to a worse clinical state that accompanies a greater risk of mortality and morbidity (Jones et al., 2013). Evidence from across the world indicates that patients who clinically deteriorate without appropriate care are at risk of Serious Adverse Events (SAEs) including cardiac arrest, unplanned admission to an Intensive Care Unit (ICU), and death (Padilla & Mayo, 2019; Tirkkonen et al., 2013; Trinkle & Flabouris, 2011). More than half of patients who clinically deteriorate in the acute hospitals develop abnormalities in vital signs (e.g., respiratory rate, blood pressure, heart rate) before a SAE occurs (Andersen et al., 2016). There is also some evidence that a patient's perception of their own condition (i.e., if they feel generally better, worse, or the same) provides an early signal of potential clinical deterioration even before changes in vital signs are detectable (Albutt et al., 2021). Accurate measurement and interpretation of vital signs alongside open and compassionate communication with patients and their families enables clinicians to recognise clinical deterioration in some vulnerable patients and take appropriate action.

To optimise detection and management of clinically deteriorating patients, Rapid Response Systems (RRSs) have been implemented in the United Kingdom (UK), Europe (Haegdorens et al., 2018), North America, Australasia (Jones et al., 2013), and in some low- and middle-income countries (Alberto et al., 2017; Opio et al., 2013). Broadly, these systems include linked *afferent* (detection) and *efferent* (response) limbs (DeVita et al., 2006) with governance, administration and quality improvement overarching these detection and response workflows (Olsen et al., 2019) (Figure 1). Recognising the signs and symptoms associated with clinical deterioration and calling for help (termed escalation of care) are crucial for effective function of the afferent limb.

Once an escalation of care has taken place a clinical response is provided (i.e., the efferent limb of the RRS is activated). This response varies between organisations and countries ranging from responses from ward-based doctors, a single critical care practitioner, through to a team of practitioners with expertise in critical illness management (Sprogis & Smith, 2024). The terms Critical Care Outreach Team (CCOT), Rapid Response Team (RRT) and Medical Emergency Team (MET) are used internationally to describe the different teams who hold responsibility for responding to clinically deteriorating patients (Lyons et al., 2018). These teams may be led by medical professionals or by nurses (Williams et al., 2022). Different titles have been used to describe nurses working in these teams including critical care outreach nurse (Garry et al., 2019), intensive care outreach nurse, intensive care liaison nurse (Alberto et al., 2014) and patient at risk team nurse (Pirret et al., 2015).

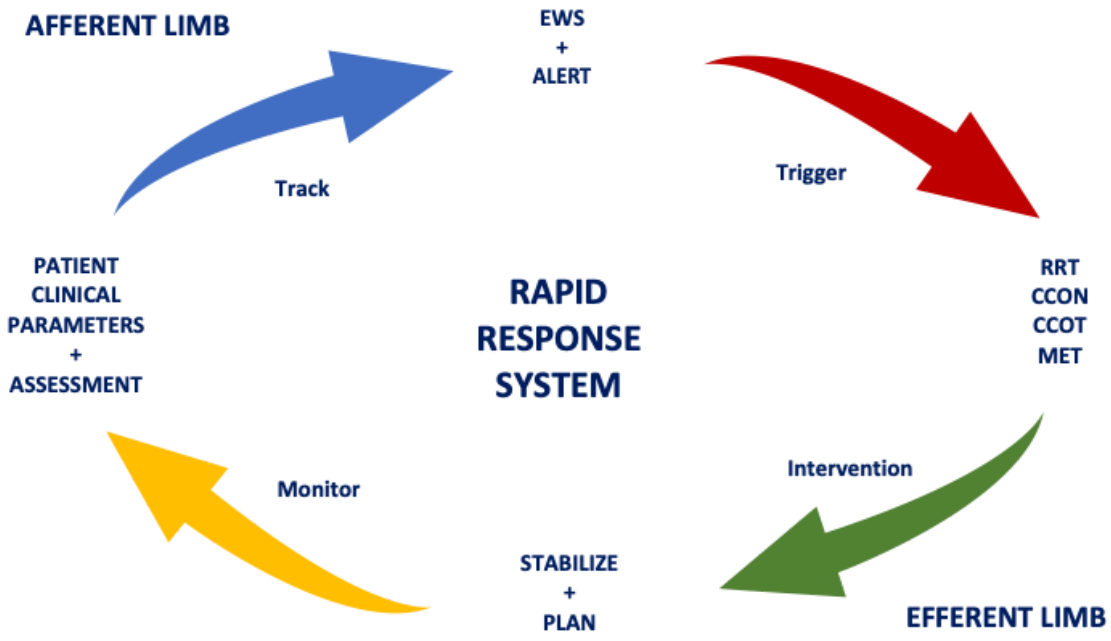

Figure 1 – The closed-loop Rapid Response System (RRS)

In this chapter, we will explore the different components of the RRS including the afferent limb, the efferent limb, modifications for specific patient cohorts (including paediatrics and obstetrics), and the administrative and governance elements. To illustrate how these different components of the RRS are operationalised in clinical practice, a clinical case will be presented and woven throughout the chapter.

THE AFFERENT LIMB OF THE RAPID RESPONSE SYSTEM

Track-And-Trigger Tools

The afferent (detection) limb workflow is underpinned by a cluster of behaviours that includes intermittent monitoring of vital signs, recognition of clinical deterioration, increasing frequency of vital signs monitoring, escalating care to an appropriate responder, and initiating a revised plan of care (Smith et al., 2020). These behaviours are frequently enacted by registered nurses (Smith et al., 2020), junior members of the nursing team, including enrolled nurses (Chua et al., 2021) and un-registered nursing assistants (Ede et al., 2020). To support nurses to recognise clinical deterioration, track-and-trigger tools have been developed and implemented across the world. Broadly, a track-and-trigger tool is a chart where vital signs are entered (*the tracking*) that provides a signal when vital signs deviate from acceptable ranges (*the triggering*) and staff are then prompted to act by following an escalation of care protocol. For some track-and-trigger tools, a deviation in a single parameter (i.e., in one vital sign) is enough to trigger. An example of a single parameter track-and-trigger tool is the 'Between the Flags' chart which has been implemented in some Australian hospitals (*Between the Flags*, 2025). To evaluate the impact, a multi-site observational study was conducted across rural and urban hospitals in a single state within Australia (Bhonagiri et al., 2021). From the analysis of 6-years of prospectively collected data, it was found that over 900 cardiac arrests were prevented from the implementation of 'Between the Flags'.

In other track-and-trigger tools, a score is assigned to each of the vital signs with higher scores reflecting greater abnormality. The scores for each vital sign are then aggregated to generate an Early Warning Score (EWS) with higher scores indicating greater risk of SAE. In the UK, the National Early Warning Score (NEWS) was implemented in 2012 to standardise practice (Royal College of Physicians, 2012) and updated in 2017 to NEWS2 (Royal College of Physicians, 2017). Several observational studies have demonstrated that a high NEWS2 score (a total score of ≥7 where the range is 0-20) is independently associated with a greater risk of SAE (Hogan et al., 2020; Klepstad et al., 2019; Skov et al., 2020; Spångfors et al., 2019), with NEWS2 demonstrating greatest reliability in predicting an adverse patient outcome within 24 hours of scoring (Holland & Kellett, 2022). A group of researchers from the United States of America (USA) extracted a large data set of vital signs (>4 million records) from across 5 hospitals to compare the prognostic performance of NEWS with other track-and-trigger tools (including the 'Between the Flags' single parameter tool) (Green et al., 2018). Whilst limited by its retrospective design, they found that NEWS more effectively identified patients at risk of cardiac arrest, unplanned ICU admission, or death within 24 hours of triggering compared to other tools including 'Between the Flags'. These favourable results might explain why NEWS2 has been widely adopted across the UK and in parts of Europe (Haegdorens et al., 2018) with reports that 76% of acute hospitals in England are using it (National Institute for Health &

Care Excellence, 2020). Given this figure is from a document that is 5-years old, it is plausible that this will be even higher now.

In the study by Green et al (2018), the only track-and-trigger tool that out-performed NEWS in predicting SAE was the electronic Cardiac Arrest Triage model that combines vital signs with laboratory values from the patient's electronic health record (EHR). Example laboratory values included in the model were white blood cell count, haemoglobin, sodium, potassium, and bicarbonate (Green et al., 2018). Since this work was published, further literature has emerged reporting the potential of these more sophisticated and intelligent systems that integrate vital signs, patient demographics, and frequently measured laboratory values to generate an EWS. Whilst there is an early signal from the literature that these tools may have an important role in enhancing detection of clinically deteriorating patients in the future (Jo et al., 2023; Pimentel et al., 2021), successful implementation is contingent on healthcare organisations having the money and technological infrastructure to implement EHRs across departments and clinical areas. Whilst this may be feasible in some high-income settings (Honeyford et al., 2023), it may not be possible in all areas or in low-and middle-income countries. Consequently, having validated track-and-trigger tools available in a range of formats (including paper-based charts) remains important to ensure accessibility.

Ward Nurses' Worry, Intuition, And Clinical Reasoning

Despite the favourable evidence underpinning track-and-trigger tools, data acquired from studies with qualitative designs suggest that ward nursing staff hold dissenting views about how useful they are in clinical practice. Whilst some nurses report track-and-trigger tools enhance their decision making and provide a useful 'safety net', others find the escalation of care protocols restrictive and believe what they were instructed to do is often at odds with their clinical reasoning (Massey et al., 2025). These mixed beliefs may explain why there is a lack of adherence with protocols attached to track-and-trigger tools (Credland et al., 2018). To reconcile this, some track-and-trigger tools incorporate a 'nurse concern' component which allows nurses to either adjust the EWS and/or to activate the efferent limb of the RRS even when vital signs are not significantly deranged.

The predictive validity of a nurse's concern about their patient was first demonstrated by a multi-phase programme of work conducted in the Netherlands. First, researchers conducted a systematic review to identify the tangible factors that underpin nurse worry and used this information to synthesise a worry indicator score (Douw et al., 2015). Second, the team prospectively tested the worry indicator in a cohort of surgical patients. In 85% of patients with an adverse outcome, the nurse caring for the patient reported worry before the event happened (Douw et al., 2016) suggesting that nurse worry has predictive validity. These findings have been corroborated by more recent work from Belgium, where researchers developed and validated a Nurse Intuition Patient Deterioration Scale which includes domains like changes in patient behaviour, increasing pain, altered facial expressions, changes in skin colour, and lethargy (Haegdorens et al., 2023). The researchers found that the scale effectively predicted adverse events or proxies of clinical deterioration in medical and surgical patients, suggesting that nurse intuition can be used to supplement information from track-and-trigger tools (Haegdorens et al., 2023). Building on this evidence, a score was developed that permits nurses to increase or decrease

the aggregate score (by a specified number of points) at their discretion based on their clinical judgement (Nielsen et al., 2020). Whilst the impact on patients from this individualised EWS has not yet been evaluated, the tool was found to be feasible and acceptable to clinical staff (Nielsen et al., 2020).

Collectively this body of work suggests there is promise to track-and-trigger tools that encourage the integration of vital signs with other clinical cues and permit registered nurses to use clinical reasoning. Such tools have the potential to reduce the frequency of false positive alerts (where the patient triggers but comes to no harm) (Haegdorens et al., 2020) and strengthen the afferent limb of the RRS.

Patient And Family Concerns

Whilst the afferent limb of the RRS is typically upheld by ward-based nursing staff, there is increasing recognition internationally of the need to provide patients and their families with mechanisms to raise the alarm if they believe they are deteriorating (or their loved-one is deteriorating in the case of family members). Accounts from across the world of young people who lost their lives due to deficiencies in clinical care underscore the importance of these mechanisms. These people include (but are not limited to): *Lewis Blackman* (USA - 2000), *Josie King* (USA - 2001), *Ryan Saunders* (Australia - 2007) (Haskell, 2024) and *Martha Mills* (UK – 2022) (Siddique, 2022). Broad themes from across these individual stories include failures of clinicians to identify severity of illness due to a lack of prompt referral by junior staff to more senior clinicians, a tendency of senior staff to overrule their juniors when concerns were raised, and/or a lack of engagement from clinicians with family members' concerns. Some of these cases have resulted in changes to state-wide or national policies with the broad intent of creating accessible and inclusive pathways for patients and their families to raise concerns about their care. Examples of this include the implementation of *Ryan's Rule* in Queensland, Australia (*Ryan's Rule*, 2024) and *Martha's Rule* in the UK (*Martha's Rule*, 2024).

Whilst policy drivers are undoubtedly part of the picture, effective implementation of patient and family activated escalation systems (PFAESs) requires organisations to re-design aspects of the RRS. Prominent examples of where the afferent limb has been re-designed to include a PFAES include the implementation of *Condition Help* in the USA (Dean, 2008), *Call-4-Concern* in the UK (Odell et al., 2010), and the integration of a patient or family concern criterion into the *Between the Flags* track-and-trigger tool in Australia (Haskell, 2024). Success of these pathways may also depend on individual clinicians changing aspects of their behaviour (Guinane et al., 2018) to facilitate a more collaborative culture where patients, families, and staff engage in the common goal of enhancing safety (Hrisos & Thomson, 2013).

Findings of systematic reviews focusing on PFAESs are inconclusive in terms of demonstrating the clinical effectiveness of these pathways suggesting the need for further research (Albutt et al., 2017; Gill et al., 2016). Whilst the evidence base underpinning PFAESs is equivocal, integrating these pathways within the afferent limb of the RRS is considered imperative for healthcare organisations across the world for ethical reasons (Haskell, 2024). This is reflected in international standards for rapid response systems where the inclusion of PFAESs is strongly recommended (Subbe et al., 2019).

Clinical Case – Part 1

Mrs Sophia Garcia has been admitted to hospital following an episode of chest pain and feeling faint. Her initial blood tests and 12-lead electrocardiogram (ECG) results in the Emergency Department were inconclusive. She is admitted to the acute medical ward for serial ECGs and for a follow-up Troponin test to confirm whether there has been any damage to her myocardium. On arrival to the ward, her vital signs are taken and are as follows:

Blood Pressure (BP) 130/70mmHg

Pulse rate 60bpm and regular.

She is alert and fully orientated.

Her temperature is 36.2^{o}C.

She has a respiratory rate of 18 breaths/min and $Sp0_2$ of 97% with no supplementary oxygen.

A NEWS2 score is calculated which is 0 (low risk)

Shortly after arriving on the ward, Mrs Garcia's husband approaches the registered nurse (RN) caring for the patient and raises concerns that his wife "does not look quite right". He also reports that Mrs Garcia is saying "I am feeling worse in myself than before". The RN knows that the last vital signs were stable but is mindful that patient and family concern should be taken seriously and agrees to come and re-assess Mrs Garcia.

Strengthening The Afferent Limb Of The Rrs

There is evidence that nurses' adherence with track-and-trigger tools is inconsistent (Credland et al., 2018) despite their use across the world. This means that patients continue to clinically deteriorate without appropriate detection and escalation of care (Jones et al., 2023; O'Connell et al., 2023). Recent research from Australia found that clinicians from different disciplines faced barriers in more than a third of conversations where the intent was to escalate care for a clinically deteriorating patient (Wright et al., 2023). Given these challenges, a relatively large body of research has emerged to increase our understanding of what barriers impact nurses' behaviour around detection and escalation of care. Whilst descriptive qualitative designs were used in earlier studies, more recently, theories from behavioural and human factors science have been used to underpin evidence synthesis (Ede et al., 2021) and empirical research (Smith et al., 2021; Walker et al., 2021). Reported barriers from this theory-based work included a lack of clinical and procedural knowledge, paucity of equipment and resources for monitoring vital signs, fear of reprimand when asking for help, lack of opportunity to escalate concerns to senior colleagues, beliefs that the patient is not as unwell as their vital signs suggest, misconceptions about roles and responsibilities, and lack of continuity of care (Ede et al., 2021; Smith et al., 2021; Walker et al., 2021).

To overcome these barriers and improve care, recommendations for education and training are common in the RRS literature (Connell et al., 2016; Ede et al., 2021; Wright et al., 2023). Systematic reviews focusing on the efficacy of educational interventions in improving care of clinically deteriorating patients show mixed findings in terms of the quality of the evidence and the benefits to staff and patients (Connell et al., 2016). Several studies included in these reviews used self-reporting of confidence and competency to assess the outcome of the educational intervention, with fewer measuring actual improvements in knowledge and skills, and fewer still attempting to measure patient outcomes (Connell et al., 2016; Saab et al., 2017). Whilst there is evidence that educational interventions may increase clinicians' confidence, knowledge, and skills in caring for clinically deteriorating patients, their propensity to change staff behaviour and improve patient outcomes remains unclear (Connell et al., 2016; Saab et al., 2017).

Education remains a common approach for strengthening the afferent limb of the RRS despite the lack of convincing evidence. This may be explained by the relatively quick and inexpensive nature of developing staff training packages compared to more complex and resource intensive approaches to intervention design (Smith & Aitken, 2023). Given the deficits in knowledge and skills reported in the literature (Smith et al., 2021), it is appropriate that education remains part of the broad strategy to improve care with inter-disciplinary and simulation-based approaches showing promise (Connell et al., 2016; King et al., 2021).

As previously identified, barriers to the effective use of track-and-trigger tools extend beyond knowledge and skills domains and include a range of individual and situational determinants including barriers related to the physical environment and the social context (Flenady et al., 2020; Smith & Aitken, 2023). To address these barriers more comprehensively, reports were found of two multi-faceted interventions designed using theory in Australia and the UK respectively (Bucknall et al., 2022; Smith et al., 2022). The UK-based behaviour change intervention has yet to be evaluated. In the Australian context, an implementation framework was used to develop a tailored facilitation intervention and its impact evaluated using a pragmatic cluster trial (Bucknall et al., 2022). Whilst there was evidence of increased adherence with track-and-trigger protocols in the intervention group at 6 months this was not sustained at 12 months (Bucknall et al., 2022). Further, escalation of care did not occur more promptly after abnormal vital signs were detected in intervention areas compared to control areas leading the researchers to conclude that the impact of the intervention was mixed.

The decisions nurses make surrounding escalation of care are complex and cognitively demanding (Ede et al., 2024). There is also evidence that nurses take a more active role beyond simply escalating care when a patient is identified as clinically deteriorating. In these circumstances, ward nurses perform initial interventions to stabilise the patient including delivering supplemental oxygen, administering prescribed medications or intravenous fluids, and obtaining blood gas samples for analysis (Smith et al., 2021; Sprogis et al., 2021a). One explanation for the gap between vital signs monitoring and escalation of care noted by Bucknall et al (2022) could be that nurses recognised clinical deterioration, delivered interventions, noted an improvement in the patient's condition, and decided that an escalation of care was not warranted. This evidence emphasises the role of the ward-nurse within the RRS suggesting it is more complex than policies and protocols suggest (Smith & Aitken, 2023; Sprogis et al., 2021b). Moving forward, creating policies that more

accurately reflect the contribution of nurses and permit them to use clinical judgement alongside track-and-trigger tool recommendations may strengthen the afferent limb (Ede et al., 2024; Smith & Aitken, 2023).

Clinical Case – Part 2

The RN re-assesses Mrs Garcia which includes taking some history and re-measuring her vital signs. Mrs Garcia tells the RN that she has a "thumping sensation in her chest" and is feeling "lightheaded again". When re-measured the vital signs are:

BP 105/60mmHg.

Pulse rate 120bpm and now feels very irregular.

Respiratory rate 22 breaths/min with a $Sp0_2$ of 96% on no supplementary oxygen.

Temperature remains unchanged at 36.2°C.

Remains alert but she looks slightly pale.

A NEWS2 score is calculated which is 5

(medium risk).

The RN decides to perform a further 12-lead ECG and follows the escalation of care protocol which prompts referral to the resident ward doctor.

THE EFFERENT LIMB OF THE RAPID RESPONSE SYSTEM

The efferent limb includes the response elements of the RRS activated when a patient is recognised to be clinically deteriorating and an escalation of care takes place (DeVita et al., 2006). Activation of the efferent limb typically occurs when a patient's vital signs breach specified criteria on the track-and-trigger tool (Chua et al., 2023). This is usually carried out by the bedside nurse following an assessment where the signs of deterioration are identified (Gerry et al., 2020). This activation initiates a sequence of prescribed responses along the efferent limb of the RRS closed-loop system (Figure 1). The nature of the response depends on the composition of the response team, the skills of the team members, and their capability to meet the patient's unmet needs.

Composition Of The Efferent Limb Of The Rrs

The name and composition of the response team who uphold the efferent limb of the RRS varies between countries and organisations (Maharaj et al., 2015). Common names which are often used interchangeably in the literature include Rapid Response Team (RRT), Medical Emergency Team (MET), Critical Care Outreach Team (CCOT), ICU Liaison Nurse (ICU-LN) service, and Patient-at-Risk Team (PART) (Williams et al., 2022). Despite variations, the efferent limb commonly involves professionals from multiple disciplines. It usually operates with two or more individuals from the multidisciplinary team with complementary advanced clinical skills. For example, the RRT can consist of ICU nurses or advanced practice nurses, respiratory therapists and/or an ICU physician and it can be led by any RRT member (Niven et al., 2014). The MET generally consists of ICU physicians/anaesthetists, ICU nurses and other allied health clinicians, and it is usually led

by a physician (Honarmand et al., 2024; Maharaj et al., 2015). Whereas CCOTs are often nurse-led. Advanced practice or ICU nurses usually operate and lead ICU-LN services (Williams et al., 2022). Whilst the evidence is inconclusive about which practitioner is best suited to lead the clinical response (Honarmand et al., 2024), critical care nurses clearly play a pivotal role in responding to clinically deteriorating patients. For ease of discussion, regardless of the composition, response teams of the RRS will be referred to as the RRT in this chapter.

Rapid Response Teams

Members of the RRT work collaboratively and cooperatively to assess, stabilise and plan the care of a patient at risk of further deterioration in the general ward setting outside the ICU (National Institute for Health & Care Excellence, 2020). The RRT interventions include, but are not limited to, intubation, non-invasive and invasive ventilation, venous access device insertion, administration of critical medications, staff support and education, and proactive assessment of patients at risk of clinical deterioration (Maharaj et al., 2015). The potential remit of different members of the RRT is summarised in Table 1. There is unclear evidence on the appropriate composition of the RRT (Honarmand et al., 2024) and the type of RRT response. However, there is consistent evidence highlighting the association between RRT activation and reduction of in-hospital mortality and cardiac arrest (Maharaj et al., 2015). Broadly, the RRT response may be organised into a 'two-tiered' or 'single tiered' approach.

Healthcare Practitioner	Remit within the RRT
Medical officer / anaesthetist / critical care advanced practitioner / respiratory therapist	Management of airway/breathing Advanced airway management skills (e.g., endotracheal intubation)
Medical officer / intensivist	Management of physiological deterioration Broad critical care knowledge and skills
Rapid response nurse / critical care outreach nurse	Advanced assessment of clinical deterioration Leadership and management support to ward medical and nursing staff

Table 1 – Remit of different members of the Rapid Response Team

In the two-tiered response, the first tier involves a small team with either a nurse and/or a physician who respond to an initial escalation of care and provide support, guidance, and/or clinical interventions. The EWS threshold or other calling criteria used to engage the first-tier response are typically set at a lower level than the second-tier activation criteria (Williams et al., 2022). For example, a NEWS2 score of 5 triggers a first-tier response whilst a score of ≥7 prompts activation of the second tier (Royal College of Physicians, 2017). The second tier typically involves a larger multidisciplinary team as described previously (Table 1) who can respond to all calls, including complex clinical emergencies, life-threatening situations, and cardio-respiratory arrests.

Clinical Case – Part 3

The resident ward doctor arrives to assess Mrs Garcia. They review the 12-lead ECG and confirm that the patient has atrial fibrillation (AF) with a rapid ventricular response (fast AF). The doctor checks the latest blood test results. The patient is found to be slightly hypokalaemic. The doctor prescribes potassium replacement, an anti-dysrhythmic medication, and speaks to their senior colleague about transferring the patient to the cardiac unit so they can have continuous ECG monitoring. The RN discusses the case with the bed manager to arrange the transfer to the cardiac unit and instigates hourly vital signs monitoring. Shortly after the doctor leaves the ward, Mrs Garcia appears to deteriorate further. When re-measured her vital signs are now:

BP 110/60 mmHg.

Pulse rate 120bpm and very irregular.

Respiratory rate 35 breaths/min with a $Sp0_2$ of 85% on no supplementary oxygen. She has increased work of breathing with clear use of accessory muscles.

Temperature remains unchanged at 36.2°C.

Remains alert but she looks pale and is now cool and clammy to touch.

A NEWS2 score is calculated which is 9 (high-risk)

The RN initiates 15L/min of supplementary oxygen by facemask and follows the escalation of care protocol which prompts re-referral to the resident ward doctor and to the rapid response nurse (RRN).

Single-tier RRTs require that all resources be made available at the patient's bedside following any escalation of care. Some facilities consider that any call for assistance should have the same level of urgency and composition of RRT as the second-tier team described above, even when the patient's needs are less (Williams et al., 2022). Proponents of the single-tier model argue that the first tier in a two-tier system may be understaffed or personnel under-skilled to respond to a rapidly deteriorating patient. However, if staff only have the option to activate the most intensive response for every patient, available resources could become exhausted. This concern led to the development of a pre-MET response which involves an initial review of the patient by a member of the admitting medical team following detection of less severe vital sign abnormalities or clinical concern from nursing staff or parent/family (Sprogis et al., 2017; Sprogis & Smith, 2024). The aim of the pre-MET tier is to enhance the care of ward patients showing early signs of deterioration, avoid severe clinical decline that necessitates RRT intervention, and ensure the long-term viability of the RRS (Sprogis et al., 2021b). Whilst the pre-MET tier is potentially beneficial for both the system and clinically deteriorating patients, its implementation may present some challenges. Suggestions for optimal use of the pre-MET tier includes development of policy that aligns with patient needs and practical application, enabling nurses to address pre-MET events within their scope of practice as well as escalating care when required, simplifying escalation procedures, and enhancing both the availability of staffing and equipment to support its effective use (Sprogis et al., 2023).

The differing tiers may be related to the prescribing capabilities of the responding team. If the RRT has a prescribing clinician arriving first at the patient's bedside, there may be diagnostic and therapeutic interventions easily accessible without the need to summon further assistance (Honarmand et al., 2024). In contrast, if the first responder is a non-prescribing clinician there may be a need to ramp-up to the second tier (Honarmand et al., 2024). Proponents of the two-tier system suggest that many situations picked up early will only require consultation, advice and guidance. Therefore, the RRN and/or physician alone is accessible and sufficient in most instances. A small response team is less intimidating to the ward staff (and especially ward nurses) to call for advice and it is less costly and disruptive to the system.

The evidence is inconclusive about appropriate team composition and whether one or two-tier deployment of RRT is more appropriate (Honarmand et al., 2024). Each organisation will need to assess and determine which system it will adopt and provide clear evidence and guidance to staff to inform the rationale for each choice. Critical to the effectiveness of the RRT, is clear written protocols and algorithms that all members of the team are familiar with and competent in enacting; where each member knows their role and can implement their contribution competently, efficiently and effectively (Williams et al., 2022). Another key element to sustain the efferent limb of the RRS is the provision of patient-centred leadership. This accompanies a clear vision of expected performance, and the capacity to tailor actions to the setting's needs and resources.

The Role of the Rapid Response Nurse

Nursing roles in RRTs have different titles and scopes of practice depending on the context and the intended aims of the role. Some titles used in the literature include, but are not limited to, Rapid Response Nurse (RRN), ICU Liaison Nurse, Nurse-at-Night, Clinical Team Coordinator, MET nurse, and Critical Care Outreach Nurse (CCON) (Williams et al., 2012; Williams et al., 2022). In this chapter, nurses who participate as members of any type of RRT regardless of their level of qualification (either critical care specialty or advanced practice) will be termed Rapid Response Nurses (RRNs).

The scope of the RRNs role includes tasks and activities of different levels of complexity, they were described by Williams et al (2012) and are outlined in Table 2. Critical to success is that the RRN demonstrates excellence in the following attributes: clinical assessment, technical intervention, communication, and clinical teaching (Williams et al., 2012; Williams et al., 2022). RRNs perform in complex clinical environments and potentially face competing clinical and administrative priorities. In a recent systematic review, researchers found that RRNs respond to escalations of care, prevent adverse events, collaborate and lead the initial and final part of rapid response events, perform rounds to identify high-risk patients, make decisions to determine the right level of care, support end-of-life care planning, and communicate plans for patient centred care (Holtsmark et al., 2024). Also, the RRN needs to be familiar with the clinical and practice policies, procedures and protocols across many areas of the facility and have a reputation for being approachable, compassionate and responsive to the needs of both medical and nursing staff (Williams et al., 2012).

Parameters	Measures	
Core scope of the RRN role	Actively coordinates rapid response or EWS trigger events as first responder	
Extended potential scope of the RRN role	Clinical assessment and surveillance	- Continuously monitors patients at risk - Aids with patient flow activity - Informs prioritization of clinical workloads of teams
	Technical intervention	- Aids with other hospital codes (violence, evacuation, etc.) - Assists staff to manage difficult tasks e.g. intravenous cannulation - Engages in problem solving and troubleshooting of clinical issues - Delivers guidance on resource needs and management, e.g. borrowing scarce or specialist resources and equipment from other departments
	Communication/ interpersonal	- Facilitates dispute resolution - Provides multidisciplinary leadership - Formally reports patients reviewed at the end of a shift
	Clinical Teaching	- Engages different members of the multidisciplinary team - Delivers impromptu bedside teaching and support - Assesses staff competency - Uses every opportunity as a *teachable moment*

Table 2 - Core and extended potential scope of the rapid response nurse role

The proactive rounding to find patients at risk is an important safety mechanism that enables RRNs to identify derangements before deterioration and potentially avoid unnecessary RRT activations throughout the hospital (Alberto et al., 2017; Elliott et al., 2016; Williams et al., 2022). This approach could be particularly important in settings where there is no pre-MET tier to the RRS or where the pre-MET criteria are underutilised by ward staff (Sprogis et al., 2023). This proactive surveillance also provides RRNs with an opportunity to deliver education and support to medical and nursing staff from the wards and potentially transfer clinical skills (Alberto et al., 2014; Holtsmark et al., 2024; Williams et al., 2022).

Clinical Case – Part 4

The RRN from the rapid response team (RRT) and the resident ward doctor both arrive on the ward at the same time. Along with the ward RN they assess the patient who is now also complaining of chest pain. The resident doctor auscultates Mrs Garcia's chest and reports they can hear bilateral inspiratory crackles. The RRN takes an arterial blood gas which shows hypoxaemia and confirms type 1 respiratory failure. The patient's lactate is also elevated on the blood gas. The working diagnosis is acute pulmonary oedema secondary to fast AF with associated myocardial ischaemia. The RRN and resident doctor confer and agree that the patient has decompensated and is at risk of cardio-respiratory arrest. On that basis, they decide that an emergency electrical cardioversion may be warranted, and they ask the RN to activate an emergency call to bring additional expertise (including an ICU doctor/anaesthetist) to the bedside. The patient receives an emergency cardioversion on the ward under conscious sedation administered by the ICU doctor. The patient is successfully cardioverted and transferred to the ICU for their ongoing care and further cardiac investigations. The RRN stays with the patient until they are safely admitted to ICU supporting the handover process.

SPECIFIC VARIATIONS TO THE STANDARD RAPID RESPONSE SYSTEMS

Paediatrics

There is a relatively low incidence of sudden onset events such as cardiac arrest in the pediatric population (Wong et al., 2019). Physiological deterioration is more likely to be associated with respiratory system compromise, while haemodynamic instability associated with cardiac, neurologic and infectious diseases are also common (Gawronski et al., 2022). However, early detection and intervention in pediatric patients is of equal importance as it is in adults. Many Paediatric EWS (PEWS) tools provide age-specific parameters for children accounting for nuanced age-related variance in physiologic development of children (*National paediatric early warning system (PEWS)*). As with adult systems, the key measures include threatened airway, hypoxemia, tachypnoea, tachy/bradycardia, hypotension, acute changes in neurological condition, respiratory or cardio-respiratory arrest and/or concern from the clinical team caring for the child (Gill et al., 2024).

A relatively new trend in paediatric medicine, which is also being adopted in some countries, is the ability for the parents/family to be able to activate the response team directly or via a central call number (Cresham Fox et al., 2023). Paediatric RRS show similar benefits to those published regarding adult RRS (Bonafide et al., 2014). However, despite the wide use of PEWS in many developed countries, a large multinational study of bedside PEWS was unable to support the use of the Bedside PEWS to reduce hospital mortality (Parshuram et al., 2018). Nevertheless, the use of PEWS remains in place as a guide to support junior staff to recognise the warning signs and prompt required actions when a patient's condition starts deteriorating.

Whilst the principles informing pediatric and adult RRS are relatively alike, the major and obvious difference between adult and paediatric RRS are the physiological variables of EWS and the knowledge and skills of the paediatric RRT members, who must be experts in paediatric assessment and treatment.

Obstetrics

The principle of obstetric RRS overlaps with those described for adults and pediatrics. However, like pediatrics, the physiological response in obstetric patients can be different particularly in the context of acute illness. As part of the normal adaptive physiology of pregnancy, the obstetric patient has increased circulating volume, cardiac output, respiratory minute volume, tidal volume and reduced partial pressure of carbon dioxide to name a few (Vinturache & Khalil, 2021). Variations in vital signs are also common (Green et al., 2021). Early postpartum women can deteriorate rapidly with little warning due to their increased capacity for initial compensation (from the physiological changes described earlier) before profound decompensation occurs (Vinturache & Khalil, 2021). The types of condition that can cause rapid deterioration in obstetric patients are major obstetric haemorrhage, sepsis, pre-eclampsia/eclampsia, as well as a multitude of respiratory, cardiac, renal, liver, metabolic and haematological disorders (Banerjee & Cantellow, 2021).

Recognition of clinical deterioration in pregnancy may be delayed due to cognitive bias from healthcare practitioners based on the following assumptions:

- A perception that pregnancy is a healthy, life event - most women are 'low risk' - so presume that all is well
- Serious complications in pregnancy are rare
- Recognition of non-obstetric diagnoses e.g. appendicitis, splenic artery rupture, cardiovascular pathology, can be delayed if symptoms overlap with normal obstetric conditions
- Clinically relevant signs and symptoms are dismissed and ascribed to the pregnancy (the so called 'minor discomforts' of pregnancy e.g. headache, breathlessness, oedema, heartburn and indigestion, back pain, constipation etc.)

Due to the many variances already noted, Modified Obstetric Early Warning Score (MEOWS) charts are valuable to guide bedside clinician orientation and awareness to the nuanced deterioration of the obstetric patient and prompt immediate action and escalation (Cole, 2014; Singhal et al., 2022). Umar et al. (2020) have provided validated MEOWS for low resourced settings also.

Staff training in Advanced Life Support- Obstetrics is essential in maternity settings as Advanced Life Support is in general adult settings (Dauphin-McKenzie et al., 2007). Finally, and importantly, the RRT that attends obstetric patients requires a slightly biased composition towards obstetric expertise in addition to the general advanced critical care skills. An obstetrician, midwife and neonatologist should be considered as integral or immediately available on request for all RRS involving obstetric patients.

THE "ADMINISTRATIVE LIMB" – RAPID RESPONSE GOVERNANCE

An often forgotten yet vital component to the introduction and maintenance of RRSs is the governance and management of such an intervention. The RRS is a hospital-wide, multi-disciplinary clinical and system improvement policy direction, designed to impact the overall capacity to save and rescue patients in most clinical settings. Contemporary hospitals are measured on their performance against important patient safety and outcome measures such as standardised mortality ratios, unplanned admission or readmission to ICU, cardiac arrest rates, and unexpected deaths. Whilst RRSs may help to improve such outcomes they are an expensive commodity and require senior oversight and attention to ensure the benefits outweigh the costs.

Our experience suggests that the RRS steering committee ought to be a high-level clinical quality and safety committee that reports directly to the executive or through the clinical governance committee or resuscitation committee of the hospital (Williams et al., 2022).

At least in the initial years of establishing the RRS program the following key members ought to be on this committee.

- Chief Medical Officer,
- Chief Nursing officer,
- ICU medical lead,
- ICU nursing lead,
- CCON representative,
- General medicine lead,
- Charge Nurse representative,
- Data analyst.

The role of the committee is to enable successful change and improvement in clinical systems by ensuring the four key elements of empowerment are provided: Direction, Knowledge, Resources and Support (Byham & Cox, 1988). The need for high-level executive representation and commitment cannot be overstated. Our experience suggests that one of the key differences between those hospitals who can successfully implement RRS and those that cannot, is that the unsuccessful teams have not been able to engage with, or achieve investment from, senior executives.

Output and Outcome Measures

The ideal measures to have in place to monitor the efficiency and effectiveness of the RRS encompass demographic, process, output and outcome measures. All are necessary to ensure the system is functioning to achieve best possible results and to ensure continuous improvement over time. Figure 2 provides a summary of the measures that can be used

to inform the performance and effectiveness of a RRS in contemporary hospital settings and uses the work of Williams et al. (2022) to build on our original list.

Demographics (Referrals):

- Patient age, sex, admission diagnosis
- Event: day of week, time of day, specialty, and ward
- Number of ward patients/admissions to help create denominator and ratio descriptors per 1000 admissions
  - Referrals
  - Reviews
  - RRT calls
  - Cardiac and/or respiratory Arrest Calls
- Number of patient or family activations (where applicable)
- Number of patients discharged from critical care to the ward and/or followed up within 24 h

Process Measures:

- Rescue response time -Time of trigger to time of call
- Rapid response time - Time of call to time of RRT arrival
- RRT time on ward
- RRT composition

Output Measures:

- Reason for call
- Types of interventions rendered
- Frequency of calls
- Staff education/training provided at event or immediately after
- Ward staff evaluation of response team actions
- Response team evaluation of ward staff response

Outcome Measures:

- Failure to rescue: Review of ward cardiac arrest patients to identify potential delays in escalation
- Number of serious incidents related to sub-optimal care of a deteriorating patient
- Admission or re-admission to ICU or other higher acuity area
- Not For Resuscitation (NFR) or change in treatment order
- Death

Figure 2 - Minimum data set used to evaluate RRS

FUTURE DIRECTIONS

Advances in technology and artificial intelligence (AI) will continue to have a major influence and impact on how RRSs evolve over the next decade. The EHR, sophisticated personalised wearable devices to monitor patient vital signs, and centralised monitoring of patients via wireless devices are allowing mobility and ease of patient surveillance. AI promises to provide sophisticated filtering of large volumes of real time data to differentiate artifact from true deterioration allowing clinicians to focus on those patients most in need of their attention (Cho et al., 2020).

On the human side, RRS responders are now becoming “super-specialist”. Designated senior clinical advanced practice nurses are recruited into seemingly prestigious and recognised RRN roles. With greater specialisation, it is foreseeable that these nurses will lead further research and refinement of practices leading to an even greater skills-set and scope of practice. This will mean RRNs will require further education and potential clinical privileging requirements (i.e., formal authorisation to practice with an advanced scope) to ensure optimal practice and safety.

Education and training of health professionals has progressively moved towards clinical laboratories to simulate real-world clinical environments (Goodell & Lighthall, 2024). However, such models are expensive and hard to access. The use of Virtual /Mixed reality teaching affords individuals the opportunity to wear a head set and immediately become immersed into a simulated clinical world where they can practice decision-making and the delivery of clinical care in a safe space and with other healthcare practitioners. These approaches have the potential for powerful learning in a more dynamic and engaging environment (Walls et al., 2024; Zhang et al., 2021). As the virtual classroom is not constrained by geographic boundaries, these educational approaches have the potential to provide healthcare practitioners from a range of settings across the world (including low- and middle-income countries) with opportunities to learn together.

The movement towards patient and family advocacy and empowerment in health care will ensure stronger representation of patients, carers and family members on to health care safety and quality governing committees and groups. They are likely to demand greater immediate access to RRTs and the ability to initiate such responses directly.

The formation of the International Society of Rapid Response Systems in May 2014 heralded the arrival of RRSs as a significant and important part of the healthcare system globally and recognised it as an essential component of what we do. This multidisciplinary network of members across the world is likely to drive the specialisation and sophistication of this important subspeciality of clinical practice which will undoubtedly lead to bigger and better research programs to inform the evolving art and science of RRSs globally.

CONCLUSION

The future of the role of RRNs looks promising. RRNs play a significant role in responding to and managing clinical deterioration, and as RRS evolves and expands, so will the RRN practice. Recent evidence indicates the RRS implementation is going beyond the settings - USA, Australia and the UK – where they formerly emerged. From a systematic review of 121 studies examining the ability of early warning scores to predict patient mortality, only 3 studies were from low and middle-income countries (LMIC) (1 unpublished, 1 published study from Uganda, and 1 published study from China) (Holland & Kellett, 2022). Similarly, in a Cochrane systematic review that examined the effect of the use of EWS and RRSs on hospital mortality and other patient outcomes, 1 of the 11 included studies was conducted in a LMIC (McGaughey et al., 2021). In addition, a recent study on sepsis practices in low-income settings identified 28% of responders from 28 low-income settings reported they had implemented a critical care outreach service in their hospitals (Williams et al., 2025). This emerging evidence indicates not only the interest in the RRSs in LMICs but also raises the question about the role of RRNs in these settings. It highlights the need for future research to examine how they acquire

advanced critical care skills, what the prevalent patient conditions are, and the clinical characteristics of patients who deteriorate. There is an opportunity for critical care nurses to help develop the RRN practice and RRS science in LMICs.

QUESTIONS

1. Which of the following **are** components of the Rapid Response System:
   a) The afferent (detection) limb
   b) The administrative limb (including monitoring, governance, and quality improvement)
   c) The efferent (response) limb
   d) All the above

2. Which of the following statements about track-and-trigger tools is **not true:**
   a) Whilst track-and-trigger tools may be useful in clinical practice there is absolutely no research that supports their use
   b) Between the Flags is an example of a single parameter track-and-trigger tool
   c) NEWS2 is an example of an early warning scoring tool
   d) Track-and-trigger tools capitalise on the frequency of deranged vital signs in clinically deteriorating patients

3. Which of the following statements about patient and family activated escalation systems (PFAEs) **are true (select two points):**
   a) The current evidence supporting PFAEs is clear and conclusive and therefore no further research is required
   b) Call-4-Concern is an example of a PFAE that has been implemented in some hospitals in the United Kingdom
   c) PFAE implementation is not recommended in international guidelines
   d) Implementation of PFAEs is important from an ethical perspective

4. Which of the following **is not** a reported barrier to nursing staff detecting and/or escalating care for a clinically deteriorating patient:
   a) A strongly held belief that escalating care is the right thing to do no matter how challenging
   b) A lack of opportunity to escalate concerns to senior colleagues
   c) Lack of necessary equipment to monitor vital signs
   d) Beliefs from staff that if they escalate care then they will be dismissed or reprimanded by a more senior colleague

5. Which of the following statements about the efferent limb of the RRS **is true:**
   a) Its primary function is to facilitate detection of clinically deteriorating patients outside the ICU
   b) Activation of the efferent limb is in no way linked to a patient breaching specified criteria on a track-and-trigger tool

c) The responder must always be a doctor
d) Rapid Response Team, Medical Emergency Team, and Critical Care Outreach Team are three examples of teams that respond to clinically deteriorating patients as part of the efferent limb of the RRS

6. Complete the following sentence using the correct phrase from below.
Nursing roles in Rapid Response Teams (RRTs) have _____ depending on the context and the intended aims of the role.
a) Limited autonomy
b) Overlapping titles and scopes of practice
c) Different titles and scopes of practice
d) Limited contribution
7. Which professionals from the following list **should be** involved in an RRS steering committee:
a) ICU medical lead
b) ICU nursing lead
c) Data analyst
d) Ideally all the above

8. Which of the following statements about the pre-MET is **not true:**
a) The evidence suggests that pre-MET is very unsafe and that it should be implemented with caution.
b) It places greater emphasis on using local resources (e.g., ward nurses and medical staff) to provide initial care for clinically deteriorating patients before a Rapid Response Team is activated.
c) Part of the objective for implementing pre-MET is to reduce the burden on the Rapid Response Team and increase its sustainability and viability.
d) Proactive rounding by a Rapid Response Nurse may be particularly useful in areas where the pre-MET tier has not been implemented or is under-utilised.

9. Which of the following statements about modified RRS for paediatric and obstetric patients **is not true:**
a) Physiology in children is no different to adults
b) The concept of the 'normal state of pregnancy' could result in cognitive bias and under-recognition of clinical deterioration in pregnant women
c) In pregnancy, women have reduced circulating volume, cardiac output, tidal volume, and respiratory minute volume
d) In children, vital signs do not alter with age

10. Which of the following **is not** a pregnancy-specific cause for clinical deterioration:
a) Major obstetric haemorrhage
b) Sepsis
c) Pre-eclampsia

d) Eclampsia

ANSWERS

1. D
2. A
3. B, D
4. A
5. D
6. C
7. D
8. A
9. C
10. B

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