Factors influencing the activation of the rapid response system for clinically deteriorating patients by frontline ward clinicians: a systematic review

WEI LING CHUA1, MIN TING ALICIA SEE1, HELENA LEGIO-QUIGLEY2,3, DARYL JONES4,5,6, AUGUSTINE TEE7, and SOK YING LIAW1

1Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, 2Saw Swee Hock School of Public Health, National University of Singapore, Singapore, 3London School of Hygiene and Tropical Medicine, London, UK, 4Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, VIC, Australia, 5University of Melbourne, Melbourne, VIC, Australia, 6Department of Intensive Care, Austin Hospital, Melbourne, VIC, Australia, and 7Department of Respiratory and Critical Care Medicine, Changi General Hospital, Singapore

Address reprint requests to: Wei Ling Chua, Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore. Level 1, Clinical Research Centre, Block MD11 10 Medical Drive, Singapore 117597. Tel: +65-6516-7456; Fax: +65-6776-7135; E-mail: chuaweiling@u.nus.edu

Editorial Decision 25 October 2017; Accepted 26 October 2017

Abstract

Purpose: To synthesize factors influencing the activation of the rapid response system (RRS) and reasons for suboptimal RRS activation by ward nurses and junior physicians.

Data sources: Nine electronic databases were searched for articles published between January 1995 and January 2016 in addition to a hand-search of reference lists and relevant journals.

Study selection: Published primary studies conducted in adult general ward settings and involved the experiences and views of ward nurses and/or junior physicians in RRS activation were included.

Data extraction: Data on design, methods and key findings were extracted and collated.

Results of data synthesis: Thirty studies were included for the review. The process to RRS activation was influenced by the perceptions and clinical experiences of ward nurses and physicians, and facilitated by tools and technologies, including the sensitivity and specificity of the activation criteria, and monitoring technology. However, the task of enacting the RRS activations was challenged by seeking further justification, deliberating over reactions from the rapid response team and the impact of workload and staffing. Finally, adherence to the traditional model of escalation of care, support from colleagues and hospital leaders, and staff training were organizational factors that influence RRS activation.

Conclusion: This review suggests that the factors influencing RRS activation originated from a combination of socio-cultural, organizational and technical aspects. Institutions that strive for improvements in the existing RRS or are considering to adopt the RRS should consider the complex interactions between people and the elements of technologies, tasks, environment and organization in healthcare settings.

Key words: patient safety, human factors, rapid response system, clinical deterioration, early warning scoring system, systematic review
Introduction

There has been a growing body of research that focus on recognizing and responding to clinically deteriorating patients in general ward settings in the past decade [1–4]. Much of this interest was prompted by studies that demonstrated patient deterioration not being recognized and responded to in a timely manner [5–10]. This lapse in patient care has led to an increase risk and incidences of serious adverse events such as unplanned admissions to intensive care units, in-hospital cardiopulmonary arrests, and unexpected deaths [11, 12]. Improving timely recognition and prompt interventions is therefore pivotal to the provision of safe and quality care to a deteriorating patient before his condition becomes life-threatening [13].

International concerns over delays or failure to recognize and escalate care for clinically deteriorating ward patients have led to the widespread implementation of a hospital-wide patient safety initiative known as the rapid response system (RRS) in acute hospitals [14, 15]. The RRS is designed with afferent and efferent components, and mechanisms for quality control, audit and administration [16]. The afferent arm involves monitoring and identifying deteriorating patients using a set of activation criteria, commonly known as the Early Warning Scoring System (EWSS), which is based on abnormal vital signs and/or observations such as threatened airway, declined neurological status and staff concerns (‘worried’ criterion) [17–19]. Once a patient meets the activation criteria, the efferent arm, i.e. the rapid response team (RRT) or medical emergency team (MET), comprising personnel with critical care expertise and diagnostic skills, will be activated to swiftly bring critical care expertise to the deteriorating patient [13, 17]. The RRS bypasses the traditional hierarchical escalation of care by sanctioning bedside nurses and junior physicians to promptly access senior medical assistance, outside the primary physician team’s chain of command [13, 16, 20].

Theoretically, the RRS offers significant advantages over the traditional referral model of care and potentially decreases resuscitation events in general wards [21]. However, two decades of research still demonstrate mixed evidence on the effectiveness of the RRS in achieving their stated aims to reduce resuscitation events outside of the ICU, unplanned ICU admissions and hospital mortality [22–28]. Some proponents have questioned the existence of the tangible benefits of the RRS and suggested the need for higher level research and randomized controlled trials while others argued that the benefits are self-evident. Several authors have also attributed the conflicting evidence regarding the effectiveness of the RRS to delay or failure in ward clinicians to activate the RRT despite patients fulfilling the activation criteria [24, 27, 29–32]. An epidemiology review of adult RRT patients in Australia revealed that close to 50% of the activations were delayed [33]. Apart from cognitive failure to recognize the need for RRS activation, socio-cultural factors and professional hierarchies are also strong reasons that impede adherence to the RRS protocol [34–39]. Existing studies found that junior physicians were reluctant to breach the traditional system of patient management while ward nurses feared being reprimanded if they bypassed attending physicians [21, 31, 40]. This highlights the need for a detailed analysis to understand individual and work system issues that may prevent frontline ward clinicians from activating the RRS.

Therefore, this review aims to synthesize and summarize the factors influencing an activation of the RRS by ward nurses and junior physicians in general wards. This review is also anticipated to identify reasons for suboptimal activation of the RRS, and highlight gaps for further research.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used to guide the reporting of this systematic review [41].

Eligibility criteria

The eligibility criteria are outlined in Table 1.

Information sources

A comprehensive search was performed included searching relevant electronic databases (CINHAL, PubMed, Cochrane Library, EMBASE, Scopus, ScienceDirect, Web of Science, PsycINFO and ProQuest Dissertations & Theses database), mining the reference lists of selected articles, and hand-searching Resuscitation and BMJ Quality & Safety, which are known for publishing articles related to the RRS and/or patient deterioration.

Search

Three broad search key concepts were developed: RRS, EWSS and deteriorating ward patients. Thesaurus terms of these concepts were used. Search terms were used singly and/or in combination (Appendix

Table 1 Eligibility criteria for inclusion of articles in the review

| PICOS | Details of eligibility |
|-------|-----------------------|
| Population | Ward nurses and junior physicians (residents, medical officers and house officers). |
| Phenomena of Interest | Articles related to factors influencing the RRS activation for adult patients in general wards by frontline ward clinicians and/or frontline ward clinicians’ attitudes, perceptions and experiences of the RRS were included. Articles related to evaluating the effectiveness or impact of the RRS on patient outcomes and/or involved patients with the ‘Do-Not-Resuscitate’ order were excluded. |
| Context | Conducted in adult general ward settings. Articles conducted in rural, obstetric and gynecological, pediatrics and mental-health settings, as well as outside of the adult general ward settings were excluded. |
| Study design | Original primary studies of any design in the English language published between January 1995 and January 2016 were included. The year 1995 was chosen as the cut-off date as it marked the first study outlining the concept of the RRS. Only full text articles were included. Conference abstracts or proceedings were excluded due to insufficient study details. General editorials, case reports, and gray literature were excluded to provide a level of quality control and to reflect evidence-based practice. |

PICOS, Population, Phenomena of Interest, Context, Study design; RRS, rapid response system.
Literature that was published between January 1995 and January 2016 was searched. The year 1995 was chosen as the cut-off date as it marked the first published literature outlining the concept of the RRS [42].

Study selection
One reviewer (WLC) screened the titles and abstracts of relevant articles before conducting a full-text review while meeting regularly with the two other reviewers (MTAS & SYL) to discuss article eligibility. Reasons for exclusion were recorded.

Data extraction
A data extraction form was developed to catalog the author(s), publication year, study aims, country and setting of study, sample, methods for data collection and data analyses, and relevant key findings. Data were extracted independently by WLC, then reviewed by SYL. Differences were resolved by discussions among the two reviewers.

Quality assessment
All included studies were appraised independently by WLC and MTAS using the Critical Appraisal Skills Programme [43] for qualitative studies, Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument [44] for quantitative studies, and Mixed Methods Appraisal Tools [45] for mixed-method studies. Articles were scored against each item in the appraisal checklist by scores of not met (0'), partially met (0.5'), fully met (1'), or unsure. A total study quality percentage was tabulated. Depending on the total appraisal score, the included articles were classified as low (<50%), medium (50–70%), or high (>70%) quality. The results were compared and disagreements were resolved by consultation with SYL.

Data synthesis
Data synthesis adopted the integrated design for mixed research synthesis [46] and the hybrid process of inductive and deductive thematic analysis [47]. The synthesis began with converting the extracted quantitative findings into qualitative forms, i.e. free codes, and, together with the extracted qualitative findings, was subjected to the inductive portion of a hybrid thematic analysis.

Figure 1 PRISMA flow diagram of study selection process.
| Author       | Study aim(s)                                                                 | Country & setting | Years of RRS | Methods                                                                 | Relevant key findings                                                                                     | Study quality |
|--------------|------------------------------------------------------------------------------|-------------------|--------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------|
| Astroth et al. [48] | To identify barriers and facilitators to nurses’ decisions regarding activation of RRTs | US, community hospital | NS           | Sample: Convenience sampling; registered nurses (n = 15) | Facilitators: Immediate expert assistance provided by RRT                                           | High          |
|              |                                                                              |                   |              | Data collection: Individual semi-structured interviews                  | Support and encouragement from nursing colleagues and leaders to activate RRT                           |               |
|              |                                                                              |                   |              | Data analysis: Concept thematic analysis                                | Barriers: Condescension in tone of RRT members                                                          |               |
| Bagshaw et al. [49] | To evaluate nurses’ beliefs and behaviors about the MET system. | Canada, teaching hospital | 3           | Sample: Convenience sampling; registered nurses & licensed practical nurses working in general acute units (n = 293) (Response rate: 93.9%) | Barriers: Fear that nurses should call attending physicians first                                     | Medium        |
|              |                                                                              |                   |              | Data collection: Cross-sectional survey with open-ended questions       | Experienced nurses confident of managing deterioration themselves                                      |               |
|              |                                                                              |                   |              | Survey tool adopted from Jones et al. [37]                          | Unstandardized RRT education and no follow-up or reinforcement                                        |               |
|              |                                                                              |                   |              | Data analysis: Descriptive statistics; content analysis for open-ended comments | Unclear about hospital’s RRT policy and their role in the process                                       |               |
|              |                                                                              |                   |              |                                                                         | 75.9% of respondents would call attending physician before activating the MET and 10.1% would not activate the MET if unable to contact & notify the attending physician about a change in patient’s condition |               |
|              |                                                                              |                   |              |                                                                         | 15.4% of respondents indicated reluctance to activate the MET because of fear of criticism            |               |
|              |                                                                              |                   |              |                                                                         | 48% indicated they would activate MET for a patient they were worried about, but has otherwise normal vital signs |               |
|              |                                                                              |                   |              |                                                                         | Comments: Conflicting opinions among healthcare professionals about how to manage patients once the MET had been activated |               |
|              |                                                                              |                   |              |                                                                         | Anecdotes of criticism and concern about how the MET was activated and the role of the unit nurse during MET activation |               |
|              |                                                                              |                   |              |                                                                         | Nurses viewed RRT as a solution to pre-existing problems e.g. not getting a satisfactory outcome/response from house staff | Medium        |
|              |                                                                              |                   |              |                                                                         | RRT activation enables real-time redistribution of workload for nurses and physicians. It also reduces neglect of non-acutely ill patients during emergencies |               |
|              |                                                                              |                   |              |                                                                         | Some primary team physicians discouraged the nurse from calling an RRT regardless of the severity of the situation. They felt that they are better suited in caring the patient |               |
|              |                                                                              |                   |              |                                                                         | Perception by physicians that a call to RRT implied a failure on the part of physician and detriment to education of house officers due to inadequate exposure to decision-making process |               |
|              |                                                                              |                   |              |                                                                         | Some participants feel that RRS activation could result in errors, disjointed care and delay due to lack of continuity as RRT members were unfamiliar with patient’s medical history and condition |               |
|              |                                                                              |                   |              |                                                                         | Need to have clear RRS protocols stating individual role and responsibilities                          | High          |
|              |                                                                              |                   |              |                                                                         | RRT activation requires justification especially for subtle/gradual clinical changes which can lead to delay activation, i.e. increasing monitoring, waiting for bigger change to occur, waiting for higher level consult, or trying available interventions |               |
|              |                                                                              |                   |              |                                                                         | Justification requires increase competencies e.g. deciding the need for increased observation, apply clinical reasoning, reliance on one’s experience, junior nurse consulting experienced nurse while experienced nurse consulting a peer prior to activation and articulate the reasons for RRT call |               |
|              |                                                                              |                   |              |                                                                         | Scarcity of staffing level to closely observe or perform physical assessment for patients with subtle changes |               |
| Benin et al. [50] | To qualitatively describe the experiences of and attitudes held by nurses, physicians, administrators and staff regarding RRT | US, teaching hospital | 3           | Sample: Purposive sampling; registered nurses (n = 18), administrators (n = 8), senior physicians (n = 6), house officers (n = 6), RRT physicians (n = 4), RRT nurses (n = 4), RRT respiratory therapists (n = 3) | Barriers: Activation criteria were seen as nonspecific to diff medical condition | High          |
| Braaten [51] | Using cognitive work analysis to describe factors within a hospital system that shaped medical-surgical nurses’ RRT activation behavior | US, acute care hospital | 7           | Sample: Purposive sampling; nurses (n = 12)                          | Barriers: Activation criteria were seen as nonspecific to different medical conditions                  | Medium        |
|              |                                                                              |                   |              | Data collection: Individual semi-structured interview using cognitive work analysis framework & document review of RRT policy and protocols | RRT activation requires justification especially for subtle/gradual clinical changes which can lead to delay activation, i.e. increasing monitoring, waiting for bigger change to occur, waiting for higher level consult, or trying available interventions |               |
|              |                                                                              |                   |              | Data analysis: Content analysis                                         | Justification requires increase competencies e.g. deciding the need for increased observation, apply clinical reasoning, reliance on one’s experience, junior nurse consulting experienced nurse while experienced nurse consulting a peer prior to activation and articulate the reasons for RRT call |               |
| Study | Purpose | Setting | Sample | Methodology |
|-------|---------|---------|--------|-------------|
| Butcher et al. [32] | To determine whether resident physicians perceive education benefit from collaboration with RRT and the impact of RRT on their clinical autonomy | US, acute tertiary hospitals | Sample: Convenience sampling; physicians (n = 236) (Response rate: 72%) | Data collection: Cross-sectional survey; Data analysis: Descriptive statistics |
| Cioffi [53] | To explore the experiences of nurses calling the MET to ward patients who require early medical interventions | Australia, acute tertiary hospital | Sample: Purposive sampling; registered nurses (n = 32) with ≥5 years of nursing experience | Data collection: Individual unstructured interviews; Data analysis: Thematic analysis |
| Cioffi [54] | To investigate nurses’ use of past experiences in the decision-making process to call the MET | Australia, acute tertiary hospital | Sample: Purposive sampling; registered nurses (n = 32) with ≥5 years of nursing experience | Data collection: Individual unstructured interviews; Data analysis: Thematic analysis |
| Cretikos et al. [55] | To measure the process of the implementation of the MET system and to identify factors associated with the level of MET utilization | Australia, acute tertiary hospitals (n = 12) | Sample: Convenience sampling; nurses at initial point (n = 708) (Response rate: 41%), nurses at follow-up point (n = 781) (Response rate: 47%), Data collection: Longitudinal survey with open-ended questions; Initial survey: 4 month post implementation; Follow-up survey: 6 month post implementation; Survey tool developed and piloted | Data analysis: Descriptive statistics, correlational analysis; content analysis for open-ended comments |
| Davies et al. [56] | To identify and assess the types and prevalence of barriers associated to the activation of the RRS by clinical staff | US, community hospital | Sample: Convenience sampling; physicians (n = 68), registered nurses (n = 16) from medical & surgical wards (Respond rate: 59% for physicians and 33% for nurses) | Data collection: Cross-sectional survey |

- RRT as last resort when there is no response from physician or no patient improvement
- Expectation that nurses should first try to ‘handle’ the situation
- Limitations of electronic monitoring equipment
- 78% of the residents agreed that working with the RRT is a valuable educational experience
- 76% of the residents disagreed that RRT decreased their clinical autonomy
- The majority of resident physicians perceive educational benefit from interaction with the RRT, though this benefit is greater for less experienced residents
- A gut feeling, knowing the patient and past experiences with similar patients were involved in the recognition of deterioration
- Nurses’ decision to call the MET was made in conditions of uncertainty: mainly being unsure if the patient met the MET criteria, questioned themselves whether they were doing the ‘right thing’ calling the MET, do not know what will be expected of them when the MET arrives
- Less experienced nurses sought the opinions of more experienced nurses while experience nurses conferred with their peers
- Decision to call the MET was also influenced by the ability of staff to support the patient or primary team physicians to support the deteriorating patient and effectiveness of team’s management
- RRS activation were made more frequently during night shift and on weekends as they were fewer physicians on duty to offer medical help to deteriorating ward patients and to reduce neglect of other non-acute ill patients during emergencies
- 63% of the nurses described using their past experiences in the decision-making process to call the MET. However, 37% of them did not overtly refer to past experiences in their accounts of calling the MET
- Nurses most commonly described recognizing a similarity between the present patient’s condition/situation and a group of patients they had cared for with this presenting condition/situation. The use of experience in this manner was often related to a group of patients who were exhibiting a nonspecific state of unwell or ‘just not being right’
- Nurses who had attended MET education session had a significantly greater intention to call the MET (87.0% vs. 72.9%, P < 0.001), significantly more positive attitude to the MET than those who had not attended (91.5% vs. 78.5%, P < 0.001) and correctly identified more of the MET activation criteria than those who had not attended a session (5 versus 4 out of 6, P < 0.001)
- Nurses who were more senior indicated a significantly greater intention to call the MET than more junior nurses (P < 0.001)
- This measure of MET system utilization varied significantly across the 12 hospitals (P = 0.002), and was significantly associated with knowledge of the activation criteria (P = 0.048), understanding the purpose of the MET system (P = 0.01), perceptions of the hospital’s readiness for a change in the way care was provided (P = 0.004), and an overall positive attitude to the MET system (P = 0.003)
- Negative comments typically expressed concern about the appropriateness of activating the MET system in certain specialist areas of hospital; rude and condescending behavior/ attitude of MET team towards staff who had called the team
- Self-reported adherence rate was ≤25% for the 6 activation criteria
- Respondents were most familiar with mental status change criteria (76.2%) and least familiar with ‘Not looking right’ (63.5%)
| Author                  | Study aim(s)                                                                 | Country & setting                  | Years of RRS | Methods                                                                 | Relevant key findings                                                                                                                                                                                                 | Study quality |
|------------------------|------------------------------------------------------------------------------|-----------------------------------|--------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Donohue and Endacott   | To examine ward nurses and critical care outreach team perceptions of the management of patients who deteriorate in acute wards | UK, acute tertiary hospital NS     |              | Survey tool adapted from 2 previously validated surveys                 | • 65% of respondents felt that they had not been trained to an adequate level on RRS despite the existence of education and in-service training (lectures, posters & orientation sessions) to reinforce on the RRS system<br>• As familiarity with, agreement with, and perceived benefit of activating the RRS increases, the self-reported adherence to the activation criteria also increases significantly ($0.001 < P < 0.05$)<br>• The outreach team was perceived by ward staff as calming and reassuring to the team and patient, and providing support, knowledge and skills<br>• When assessing the patient visually, nurses compared the patient’s condition across time<br>• MEWS was unreliable especially when used on chronically ill patients<br>• Some nurses indicated the need to ensure they have convincing evidence of patient’s condition prior to contacting the outreach team<br>• Medical help is sought through a clear hierarchy where the call went from the RN to the junior physician, who then contacted the outreach team or after notifying more senior medical help. In some instances, junior physicians were often reluctant to seek more senior advice which frustrates nurses<br>• RNs held a stronger belief than medical staff in disagreeing that MERT reduced their skills in managing sick patients ($P = 0.04$)<br>• >70% of staff would contact the patient’s treating physician before activating the MERT, but found more prevalent among medical staff ($P < 0.01$)<br>• 55.7% of RNs and 55.8% medical staff were uncertain or disagreed that they perceived that they were often criticized for invoking a MERT call based on criteria set down by medical staff<br>• Some ward medical and nursing staff had reservations with the clinical markers because they feared criticism for unnecessary activations<br>• RNs perceived greater support from ward nurses ($P < 0.01$) and senior nurses ($P < 0.01$) to activate MERT than medical staffs' perception<br>• The system was dependent on the clinical judgment of physicians. Nurses perceived that they were often criticized for invoking a MERT call based on criteria set down by medical staff<br>• Respondents were generally positive to the clinical marker project/tool, offering clear guidelines for staff to respond to patient’s clinical condition, and contact the medical staff and the ICU liaison team as appropriate.<br>• Only 49.2% of ward medical staff agreed that the clinical markers identified patients at risk of further deterioration, whereas 28.8% indicated that they were unsure<br>• Some ward medical and nursing staff had reservations with the clinical markers chosen (some of the criteria could be normal parameters in some cases)<br>• 74% of nurses and 85.6% of ward medical staff requested further education about the clinical marker project<br>• Bivariate correlation analysis showed that older ($r = 0.330, P = 0.02$) and more experienced nurses ($r = 0.330, P = 0.014$) were more likely to call RRTs.<br>• 92% indicated receiving strong support from nursing leaders and colleagues in activating the RRT and 95% indicated they could rely on their peers to help them with other duties during the call. | Medium         |
| Douglas et al.         | To explore and compare nursing and medical staff’s perceptions of Medical Emergency Response Team (MERT) use | Australia, tertiary hospital NS     |              | Sample; Purposive sampling; nurses ($n = 11$) & outreach team members ($n = 3$) Data collection: Individual semi-structured interviews using critical incident techniques Data analysis: Thematic analysis | • When assessing the patient visually, nurses compared the patient’s condition across time<br>• MEWS was unreliable especially when used on chronically ill patients<br>• Some nurses indicated the need to ensure they have convincing evidence of patient’s condition prior to contacting the outreach team<br>• Medical help is sought through a clear hierarchy where the call went from the RN to the junior physician, who then contacted the outreach team or after notifying more senior medical help. In some instances, junior physicians were often reluctant to seek more senior advice which frustrates nurses<br>• RNs held a stronger belief than medical staff in disagreeing that MERT reduced their skills in managing sick patients ($P = 0.04$)<br>• >70% of staff would contact the patient’s treating physician before activating the MERT, but found more prevalent among medical staff ($P < 0.01$)<br>• 55.7% of RNs and 55.8% medical staff were uncertain or disagreed that they perceived that they were often criticized for invoking a MERT call based on criteria set down by medical staff<br>• Some ward medical and nursing staff had reservations with the clinical markers because they feared criticism for unnecessary activations<br>• RNs perceived greater support from ward nurses ($P < 0.01$) and senior nurses ($P < 0.01$) to activate MERT than medical staffs' perception<br>• The system was dependent on the clinical judgment of physicians. Nurses perceived that they were often criticized for invoking a MERT call based on criteria set down by medical staff<br>• Respondents were generally positive to the clinical marker project/tool, offering clear guidelines for staff to respond to patient’s clinical condition, and contact the medical staff and the ICU liaison team as appropriate.<br>• Only 49.2% of ward medical staff agreed that the clinical markers identified patients at risk of further deterioration, whereas 28.8% indicated that they were unsure<br>• Some ward medical and nursing staff had reservations with the clinical markers chosen (some of the criteria could be normal parameters in some cases)<br>• 74% of nurses and 85.6% of ward medical staff requested further education about the clinical marker project<br>• Bivariate correlation analysis showed that older ($r = 0.330, P = 0.02$) and more experienced nurses ($r = 0.330, P = 0.014$) were more likely to call RRTs.<br>• 92% indicated receiving strong support from nursing leaders and colleagues in activating the RRT and 95% indicated they could rely on their peers to help them with other duties during the call. | Medium         |
| Green and Allison      | To explore nursing and medical staff’s perceptions, attitudes, perceived understanding of a clinical marker referral tool implemented to assist in early identification and referral of unstable patients in the general wards | Australia, tertiary hospital <½ |              | Sample: Convenience sampling; registered nurses ($n = 434$), medical staff ($n = 190$) (Response rate: 29.8%) Data collection: Cross-sectional survey with open-ended questions Survey tool adopted from Australian Commission on Safety and Quality in Health care Data analysis: Descriptive statistics, Fisher exact tests, using analysis of covariance, adjusting for years of clinical experience Constructivist methodology for analysis of open-ended text | • 74% of nurses and 85.6% of ward medical staff requested further education about the clinical marker project<br>• Bivariate correlation analysis showed that older ($r = 0.330, P = 0.02$) and more experienced nurses ($r = 0.330, P = 0.014$) were more likely to call RRTs.<br>• 92% indicated receiving strong support from nursing leaders and colleagues in activating the RRT and 95% indicated they could rely on their peers to help them with other duties during the call. | Medium         |
| Jenkins et al.         | To explore the non-ICU nurses’ perceptions of facilitators and barriers to RRT activation | US, community hospital 9 |              | Sample: Convenience sampling; non-ICU nurses ($n = 50$) Data collection: Cross-sectional survey Survey tool developed and content validated Data analysis: Descriptive statistics, bivariate correlations | • 74% of nurses and 85.6% of ward medical staff requested further education about the clinical marker project<br>• Bivariate correlation analysis showed that older ($r = 0.330, P = 0.02$) and more experienced nurses ($r = 0.330, P = 0.014$) were more likely to call RRTs.<br>• 92% indicated receiving strong support from nursing leaders and colleagues in activating the RRT and 95% indicated they could rely on their peers to help them with other duties during the call. | Medium         |
14% were unfamiliar with RRT protocols and 12% were unfamiliar with their 50% believed inadequate continuing RRT education: 40% noted that they had not participated in RRT education for >12 months, and 42% indicated that they had never received any education on RRT.

Nurses value and appreciate the potential benefit of MET.

Major barrier to calling MET appears to be allegiance to the traditional approach of initially calling parent medical unit doctors.

72% of nurses indicated that they would call the covering doctor before the MET for a sick ward patient.

56% suggested that they would make a MET call for a patient they were worried about even if patient’s vital signs were normal.

RRS seen as nursing ‘work-around’ strategy.

Junior nurses seek the guidance & experiential knowledge of senior nurses when deciding whether or not to activate RRS.

Doctors have the authority to modify RRS criteria.

Instances where missed RRS calls: ward staff accessed local support without activating the system; intimidated by the potential negative repercussion by the RRT for incorrect ‘call’.

Reasons for not activating RRS: RRS activation was potentially a show of incompetence by junior physicians and from a senior physicians’ point of view as deskilling of junior physicians, potentially taking out their decision-making opportunities and taking away essential learning opportunities to make difficult decisions.

Bedside RNs use their knowledge of the RRT trigger protocol, knowledge of subjective cues, interpretation of data and clinical experience to make a thought decision to call the RRT.

After which, some RNs would sought consultation with other RNs to get support.

In some cases, traditional hierarchies and relationships with physicians and supervisors impede some components of RN decision-making during rescuing.

RRT RNs and bedside RNs support one another in a synergistic way to prevent adverse patient events during the rescuing process, whereby RRT RNs enables immediate access to resources and applied their expertise with critically ill patients, while bedside RNs brought patient information to the situation.

Nurses appear to prefer to access help or support from among their team (consult their peers or more senior nurses) and ‘use the home team’.

Fear of reprisals for incorrect activation was related to clinical inexperience and uncertainty whether a RRT was warranted.

Participants who had graduated from a four-year educational program could identify more accurately clinical situations that necessitated MET activation.

Jones et al. [37]

To assess whether nurses value the MET service and to determine whether barriers to calling MET exist.

Australia, acute tertiary hospital

Sample: Convenience sampling; ward nurses (n = 351) (response rate 100%)

Data collection: Cross-sectional survey using personal interview approach

Survey tool developed and piloted

Data analysis: Descriptive statistics

Nurses value and appreciate the potential benefit of MET.

Major barrier to calling MET appears to be allegiance to the traditional approach of initially calling parent medical unit doctors.

72% of nurses indicated that they would call the covering doctor before the MET for a sick ward patient.

56% suggested that they would make a MET call for a patient they were worried about even if patient’s vital signs were normal.

RRS seen as nursing ‘work-around’ strategy.

Junior nurses seek the guidance & experiential knowledge of senior nurses when deciding whether or not to activate RRS.

Doctors have the authority to modify RRS criteria.

Instances where missed RRS calls: ward staff accessed local support without activating the system; intimidated by the potential negative repercussion by the RRT for ‘incorrect’ call.

Reasons for not activating RRS: RRS activation was potentially a show of incompetence by junior physicians and from a senior physicians’ point of view as deskilling of junior physicians, potentially taking out their decision-making opportunities and taking away essential learning opportunities to make difficult decisions.

Bedside RNs use their knowledge of the RRT trigger protocol, knowledge of subjective cues, interpretation of data and clinical experience to make a thought decision to call the RRT.

After which, some RNs would sought consultation with other RNs to get support.

In some cases, traditional hierarchies and relationships with physicians and supervisors impede some components of RN decision-making during rescuing.

RRT RNs and bedside RNs support one another in a synergistic way to prevent adverse patient events during the rescuing process, whereby RRT RNs enables immediate access to resources and applied their expertise with critically ill patients, while bedside RNs brought patient information to the situation.

Nurses appear to prefer to access help or support from among their team (consult their peers or more senior nurses) and ‘use the home team’.

Fear of reprisals for incorrect activation was related to clinical inexperience and uncertainty whether a RRT was warranted.

Participants who had graduated from a four-year educational program could identify more accurately clinical situations that necessitated MET activation.

Kitto et al. [38]

To examine medical and nursing staff members’ experiences of the RRS and to explore social, professional and cultural factors that mediate RRS usage.

Australia, mixed settings (n = 4)

Sample: Criterion & maximum variation sampling; nurses (n = 62), doctors (n = 27)

Data collection: Exploratory case study approach using multiple case analysis using Focus group discussions (n = 10)

Data analysis: Conventional content analysis & complementary directed content analysis

Nurses appear to prefer to access help or support from among their team (consult their peers or more senior nurses) and ‘use the home team’.

Fear of reprisals for incorrect activation was related to clinical inexperience and uncertainty whether a RRT was warranted.

Participants who had graduated from a four-year educational program could identify more accurately clinical situations that necessitated MET activation.

Leach et al. [60]

To investigate how RNs rescue patients in hospitals where RRTs are in place and to understand the processes involved in making the decision to call the RRT.

US, acute hospitals (n = 6)

Sample: Purposive sampling; bedside RNs (n = 14), RRT RNs (n = 16), RRT respiratory therapists (n = 2), nurses supervisors (n = 18)

Data collection: Individual semi-structured interviews

Data analysis: Thematic & constant comparative analysis following grounded theory approach

Nurses appear to prefer to access help or support from among their team (consult their peers or more senior nurses) and ‘use the home team’.

Fear of reprisals for incorrect activation was related to clinical inexperience and uncertainty whether a RRT was warranted.

Participants who had graduated from a four-year educational program could identify more accurately clinical situations that necessitated MET activation.

Massey et al. [61]

To explore nurses’ experiences of using and activating a MET, and to understand facilitators and barriers to nurses’ use of the MET.

Australia, teaching hospital

Sample: Consecutive sampling; registered nurses (n = 15) from 5 medical wards

Data collection: Individual semi-structured interviews

Data analysis: Inductive thematic analysis

Nurses appear to prefer to access help or support from among their team (consult their peers or more senior nurses) and ‘use the home team’.

Fear of reprisals for incorrect activation was related to clinical inexperience and uncertainty whether a RRT was warranted.

Participants who had graduated from a four-year educational program could identify more accurately clinical situations that necessitated MET activation.

Pantazopoulos et al. [62]

To evaluate the relationship between nurse demographics and correct identification of

Greece, tertiary hospital

Sample: Random sampling; medical-surgical nurses (n = 94)

Data collection: Cross-sectional survey

Nurses appear to prefer to access help or support from among their team (consult their peers or more senior nurses) and ‘use the home team’.

Fear of reprisals for incorrect activation was related to clinical inexperience and uncertainty whether a RRT was warranted.

Participants who had graduated from a four-year educational program could identify more accurately clinical situations that necessitated MET activation.
| Author | Study aim(s)                                                                 | Country & setting | Years of RRS | Methods                                                                 | Relevant key findings                                                                                          | Study quality |
|--------|-----------------------------------------------------------------------------|-------------------|--------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------|
| Pattison and Eastham [63] | To explore referrals to CCOT, the associate factors around patient management and survival to discharge, and the qualitative exploration of CCOT referral characteristics | UK, specialist hospital NS | Sample: 407 episodes of CCOT referrals from 20 ward areas; Theoretical sampling of nurses (n = 7) & doctors (n = 2) | Data analysis: Descriptive statistics, Mann-Whitney test, Pearson’s chi-square test and fisher’s exact test | Junior nurses made fewer referrals (18/407 = 4.4%) in comparison with senior nurses (202/407 = 49.6%). | Medium |
| Radeschi et al. [64] | To identify the attitudes and barriers to MET utilization among both ward nurses and physicians and to investigate whether these attitudes and barriers are influenced by participation in a specific educational program of MET | Italy, mixed settings (n = 10) NS | Sample: Convenience sampling; nurses (1278), physicians (n = 534) (Response rate: 79.6%) | Survey tool modified from Jones et al. Data analysis: Descriptive statistics, chi-square test, logistic regression adjusting for profession | Only 54% respondents agreed that the MET course significantly improved their skills in managing unstable patients in the ward | High |
| Robert [65] | To explore the experiences of staff nurses using intuition in the process of activating RRT for patients being cared for in medical-surgical and telemetry units. | US, acute hospital 5 | Sample: Theoretical and zig zag sampling; registered nurses (n = 32) | Data collection: Individual semi-structured interviews using grounded theory Data analysis: Thematic & constant comparative analysis following grounded theory approach | The decision to call the RRT is rooted in a combination of nurse’s personal knowledge of a patient, patient assessment and intuitive knowledge. | High |
| Study                      | Objective                                                                 | Setting(s)                          | Sample Size | Data Collection Method                                                                 | Analysis Method                                                                 |
|----------------------------|---------------------------------------------------------------------------|-------------------------------------|-------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Salamonson et al. [66]     | To explore nurses’ satisfaction with the MET, perceived benefits and suggestions for improvement, and to examine the characteristics of nurses who were more likely to activate the MET | Australia, acute hospital NS         | Sample: Convenience sampling; medical-surgical nurses (n = 73) | Data collection: Cross-sectional survey with open-ended questions | A positive significant relationship was found between years of nursing experience and MET activation (P = 0.018). Nurses who were less experienced (0–5 years) were less likely to have activated the MET than nurses who were more experienced (≥11 years) |
| Sarani et al. [67]         | To assess the perceptions of physicians and registered nurses about the effects of a MET on patient safety and their own educational experiences | US, acute tertiary hospital I       | Sample: Convenience sampling; medical-surgical nurses (n = 414) | Data collection: Medical record reviews | Suggestions for improvement: more education on medical emergencies for both ward and MET staff, a more positive attitude of the MET staff when summoned for ‘borderline’ cases (11% of participants) |
| Schiid-Mazzocco-li et al. [68] | To compare differences in nurse, patient and organizational characteristics in medical and surgical patients requiring a MET activation | US, tertiary hospital 15-17         | Sample: Convenience sampling; 108 MET activations (51 medical patients & 57 surgical patients) | Data analysis: Descriptive statistics, logistic regression model | Both residents and RNs agreed that the MET improved patient safety, although RNs held this belief more strongly than the residents (residents = 4.0, RNs = 4.4, P < 0.01) |
| Shapiro et al. [40]        | To described the impact of RRTs on staff nurses’ practice, perspectives, experiences and challenges when RRTs are used. | US, mixed settings (n = 18) NS      | Sample: Nominated sampling; nurses (n = 56) | Data analysis: Modified thematic & constant comparison analysis | Residents neither agreed nor disagreed that the MET decreased their skills and educational opportunities in critical care and resuscitation, whereas, RNs disagreed with this assertion (skills: residents = 2.7, RNs = 2.1, P < 0.01; education: residents = 2.9, RNs = 2.4, P < 0.01) |
| Shearet et al. [39]        | To determine the incidence of clinical staff failing to call the RRS and the socio-cultural barriers to failure to activate the RRS | Australia, mixed settings (n = 4) 3-13 | Sample: 570 observation charts; 363,760 patient cases; purposive sampling of 91 junior physicians, nursing staff, MET members & ICU teams | Data analysis: Phase 1: Two part medical record reviews to determine the incidence of abnormal simple bedside observations & activation of RRS Phase 2: individual structured interviews | Of 108 event, 44% were delayed and delayed events occurred more often during the night shift (P = 0.012) |
|                           |                                                                           |                                     |             |                                                                                        | Shift and patient-unit-match were significant predictors of delays |
|                           |                                                                           |                                     |             |                                                                                        | There was a 3.23 greater likelihood of delayed RRS activation occurring on night shifts (95% CI: 1.34–7.9, P = 0.009) |
|                           |                                                                           |                                     |             |                                                                                        | Although not statistically significant, there was a trend for more delays when more patients were assigned (4:1 vs. 6:1 = 43%, P = 0.609) |
|                           |                                                                           |                                     |             |                                                                                        | Three reasons for activation: (1) patient exhibited signs and symptoms significantly different from baseline; (2) gut feeling; (3) nurses convinced that the patient needed immediate evaluation but was unable to get the treating physician to respond |
|                           |                                                                           |                                     |             |                                                                                        | Presence of RRT allowed primary nurse to care for other patients and families when the team was responding to the crisis |
|                           |                                                                           |                                     |             |                                                                                        | Nurses from robust-adopter hospitals expressed receiving clear communication regarding RRS activation and had numerous reinforcements on RRS. They had no hesitation to call the RRT and had no fear of repercussions if the call was ultimately deemed unnecessary |
|                           |                                                                           |                                     |             |                                                                                        | Nurses in reluctant-adopter hospitals (nurses hesitated to activate RRT) expressed receiving mixed messages regarding RRS activation protocol and difficulty in differentiating between situations that warrants a call to the RRT versus code blue team |
|                           |                                                                           |                                     |             |                                                                                        | Some physicians insisted that nurses follow the usual chain of command no matter what. They also expressed unclear individual roles and responsibilities during a rapid response |
|                           |                                                                           |                                     |             |                                                                                        | 42% did not receive an appropriate clinical response from staff (missed RRS call) despite 69.2% recognizing their patient met physiological criteria for activating RRS, and being ‘quite’, or ‘very’ concerned about their patient |
|                           |                                                                           |                                     |             |                                                                                        | Actions performed prior to activating RRS: awaiting further review by medical staff (51.8%); specific treatment or investigation delay activation (50.6%); involved ICU outreach (33.7%); involved senior nursing staff (12%) |
|                           |                                                                           |                                     |             |                                                                                        | Main barriers: feel that they should be able to manage patients by themselves (34.2%) |
| Author          | Study aim(s)                                                                 | Country & setting           | Years of RRS | Methods                                                                 | Relevant key findings                                                                                                                                                                                                                       | Study quality |
|-----------------|-------------------------------------------------------------------------------|-----------------------------|--------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Stewart et al.  | To evaluate the impact of the implementation of the MEWS on the early identification of patients at risk for clinical deterioration and factors that influence how nurses use MEWS as a framework in the decision-making process for RRS activation | US, acute care hospital     | 1 year       | Phase 1: Descriptive statistics Phase 2: Thematic analysis              | - Insufficient 'face validity' in the sensitivity and specificity of RRS activation criteria: primary team was experienced and felt RRS activation was not required (16.9%); poor communication/ prioritization of medical team (15.7%)  
- While the MEWS was considered a valuable tool to enhance interdisciplinary communication about a patient's condition, participants do not rely exclusively on the MEWS score to prescribe an intervention  
- The MEWS score prompts them to gather additional clinical data from a prioritized physical and behavioral assessment of the patient  
- Participants cited that the MEWS does not assign a numeric value to nurse worry so the nursing assessments are not factored into the aggregated score  
- Participants expressed confidence in activating the RRS if they believed it was necessary without fear of being ridiculed or reprimanded by physicians or RRT members  
- Nursing administrators were regarded by participants as supporters of nurses' decisions to activate the RRS  
- Perceived barriers to utilization of MEWS system: the inability of nurses to tailor the MEWS alarm settings and limits to accommodate patients whose vital signs measurements normally fell outside predetermined threshold  
- Documentation of vital signs before MET activation was suboptimal. Particularly, documentation of respiratory rate was alarming low (75% monitored bed vs. 17% non-monitored beds)  
- When adjusted to the documentation frequency of vitals, failure and delayed activations occurred more among monitored ward patients (monitored bed 91% vs. non-monitored bed 53%, P < 0.0001)  
- Delayed and failure of ward staff to call MET immediately when patient meets the calling criteria is associated with increased hospital mortality (OR 95% CI 1.02–2.72, P < 0.041)  
- Individual nurse use intuition/gut feeling to activate the RRT  
- However, at times they are hesitant to call RRT as RRT members could not assemble nurses' concerns of a patient's condition  
- RRS as working around people and processes (system barriers): RRT as a relief for nurses and safeguard for patients when support was needed; work around time of delays in care of having to page physicians and getting call back for orders  
- Presence of resistance from some physicians for nurses to call the RRT for their patients  
- Negative reactions from RRT made nurses reluctant to call an RRT  
- Top 3 reasons for calling RRT: (1) sudden change in patient's condition (78%), (2) steady decline in patient condition (56%), (3) inadequate response from the physician (35%).  
- Education and experience are the most important predictors of independent calling  
- Independent callers were 4.95 times more likely to have a bachelor degree in nursing (95% CI: 1.43–17.16, P = 0.01), and 3.72 times more likely to have more than 3 years of nursing experience (95% CI: 1.07–12.92, P = 0.04), than nurses who called at the request of another nurse or physician, after adjusting for the effects of other independent variables | High  
| Tirkkonen et al. | Using the Ustein template to study documentation of vital signs before a MET call, with special reference to patients having automated patient monitoring in general ward and to identify factors associated with delayed MET activation | Finland, tertiary hospital | <1 year      | Sample: 569 MET reviews to 458 general ward patients  
Data collection: Medical record reviews  
Data analysis: Descriptive statistics, multivariate logistic regression | - High correlation between the frequency of vital signs monitoring and the time to MET activation  
- Late documentation of vital signs was associated with increased hospital mortality  
- High documentation of vital signs before MET activation was suboptimal. Particularly, documentation of respiratory rate was alarming low (75% monitored bed vs. 17% non-monitored beds)  
- When adjusted to the documentation frequency of vitals, failure and delayed activations occurred more among monitored ward patients (monitored bed 91% vs. non-monitored bed 53%, P < 0.0001)  
- Delayed and failure of ward staff to call MET immediately when patient meets the calling criteria is associated with increased hospital mortality (OR 95% CI 1.02–2.72, P < 0.041)  
- Individual nurse use intuition/gut feeling to activate the RRT  
- However, at times they are hesitant to call RRT as RRT members could not assemble nurses' concerns of a patient's condition  
- RRS as working around people and processes (system barriers): RRT as a relief for nurses and safeguard for patients when support was needed; work around time of delays in care of having to page physicians and getting call back for orders  
- Presence of resistance from some physicians for nurses to call the RRT for their patients  
- Negative reactions from RRT made nurses reluctant to call an RRT  
- Top 3 reasons for calling RRT: (1) sudden change in patient's condition (78%), (2) steady decline in patient condition (56%), (3) inadequate response from the physician (35%).  
- Education and experience are the most important predictors of independent calling  
- Independent callers were 4.95 times more likely to have a bachelor degree in nursing (95% CI: 1.43–17.16, P = 0.01), and 3.72 times more likely to have more than 3 years of nursing experience (95% CI: 1.07–12.92, P = 0.04), than nurses who called at the request of another nurse or physician, after adjusting for the effects of other independent variables | High  
| Williams et al. | To describe nurses’ experiences and perceptions of RRT                        | US, community hospital      | 4 years      | Sample: Convenience sampling; registered nurses (n = 14) from 3 medical and cardiac care units  
Data collection: Focus group discussions using semi-structured guide (n = 6)  
Data analysis: content analysis | - High correlation between the frequency of vital signs monitoring and the time to MET activation  
- Late documentation of vital signs was associated with increased hospital mortality  
- High documentation of vital signs before MET activation was suboptimal. Particularly, documentation of respiratory rate was alarming low (75% monitored bed vs. 17% non-monitored beds)  
- When adjusted to the documentation frequency of vitals, failure and delayed activations occurred more among monitored ward patients (monitored bed 91% vs. non-monitored bed 53%, P < 0.0001)  
- Delayed and failure of ward staff to call MET immediately when patient meets the calling criteria is associated with increased hospital mortality (OR 95% CI 1.02–2.72, P < 0.041)  
- Individual nurse use intuition/gut feeling to activate the RRT  
- However, at times they are hesitant to call RRT as RRT members could not assemble nurses' concerns of a patient's condition  
- RRS as working around people and processes (system barriers): RRT as a relief for nurses and safeguard for patients when support was needed; work around time of delays in care of having to page physicians and getting call back for orders  
- Presence of resistance from some physicians for nurses to call the RRT for their patients  
- Negative reactions from RRT made nurses reluctant to call an RRT  
- Top 3 reasons for calling RRT: (1) sudden change in patient's condition (78%), (2) steady decline in patient condition (56%), (3) inadequate response from the physician (35%).  
- Education and experience are the most important predictors of independent calling  
- Independent callers were 4.95 times more likely to have a bachelor degree in nursing (95% CI: 1.43–17.16, P = 0.01), and 3.72 times more likely to have more than 3 years of nursing experience (95% CI: 1.07–12.92, P = 0.04), than nurses who called at the request of another nurse or physician, after adjusting for the effects of other independent variables | High  
| Wynn et al.     | To examine nurse characteristics and nursing action related to RRT calls      | US, acute tertiary hospital | 1 year       | Sample: Convenience sampling; registered nurses (n = 97) (Response rate: 70%)  
Data collection: Cross-sectional survey  
Survey tool developed  
Data analysis: Descriptive statistics, chi-square test, independent samples t test, Pearson correlation and logistic regression | - High correlation between the frequency of vital signs monitoring and the time to MET activation  
- Late documentation of vital signs was associated with increased hospital mortality  
- High documentation of vital signs before MET activation was suboptimal. Particularly, documentation of respiratory rate was alarming low (75% monitored bed vs. 17% non-monitored beds)  
- When adjusted to the documentation frequency of vitals, failure and delayed activations occurred more among monitored ward patients (monitored bed 91% vs. non-monitored bed 53%, P < 0.0001)  
- Delayed and failure of ward staff to call MET immediately when patient meets the calling criteria is associated with increased hospital mortality (OR 95% CI 1.02–2.72, P < 0.041)  
- Individual nurse use intuition/gut feeling to activate the RRT  
- However, at times they are hesitant to call RRT as RRT members could not assemble nurses' concerns of a patient's condition  
- RRS as working around people and processes (system barriers): RRT as a relief for nurses and safeguard for patients when support was needed; work around time of delays in care of having to page physicians and getting call back for orders  
- Presence of resistance from some physicians for nurses to call the RRT for their patients  
- Negative reactions from RRT made nurses reluctant to call an RRT  
- Top 3 reasons for calling RRT: (1) sudden change in patient's condition (78%), (2) steady decline in patient condition (56%), (3) inadequate response from the physician (35%).  
- Education and experience are the most important predictors of independent calling  
- Independent callers were 4.95 times more likely to have a bachelor degree in nursing (95% CI: 1.43–17.16, P = 0.01), and 3.72 times more likely to have more than 3 years of nursing experience (95% CI: 1.07–12.92, P = 0.04), than nurses who called at the request of another nurse or physician, after adjusting for the effects of other independent variables | Medium  

RRT, rapid response team; US, United States; NS, not specify; MET, medical emergency team; RRS, rapid response system; RN, registered nurse; UK, United Kingdom; ICU, intensive care unit; CCOT, critical care outreach team; MEWS, modified early warning system; METTaL, medical emergency team alert.
The application of SEIPS model to ward clinicians’ work system in the activation of the rapid response system. Dotted arrows and box: No identified interacting relationship between physical environment and the rest of the work system components (person, tools and technologies, tasks and organization). Descriptions of work system components (adapted from SEIPS model by Carayon et al. [73]). PE: Physical, cognitive, or psychosocial characteristics or conditions of an individual at the center of the work system. TT: Objects or instruments that the person(s) uses to do work or assist people in doing work (RRS activation). TA: Characteristics of the task such as difficulty, variety and sequence of work performed by the person(s) to accomplish the objectives. OR: Organizational conditions governing or influencing the way the person(s) performs tasks using tools and technologies in a specific environment. EN: Physical characteristics of the environment where work is performed.

Themes that explored the relevance of the categories of codes in the context of the research question were developed. The deductive portion involved categorizing the inductively developed themes into a conceptual framework [47]. While the process was initially undertaken by WLC, the groupings were further refined by discussions with the co-authors and rechecking of the included studies.

Results

Search results
The search strategy yielded 9524 records after removing duplicated articles. Following the review of titles and abstracts, 83 articles were selected for full-text review, from which 53 articles were excluded, leaving 30 studies for this review [21, 37–40, 48–72] (Fig. 1).

Study characteristics
Studies originated from the United States (US) (n = 14), Australia (n = 10), the United Kingdom (n = 2), along with one study each from Canada, Finland, Greece, and Italy. The study setting included acute and tertiary care (n = 19), community hospitals (n = 4), and mixed-settings (n = 7). Eight studies were multi-site studies. The median sample sizes were 32 participants for qualitative studies, 246 participants for quantitative studies and 407 medical record reviews and 10 participants for mixed-method studies. The population studied included ward nurses (n = 16), physicians (n = 1), both nurses and physicians (n = 7), a mixture of healthcare professionals (n = 4), and general ward patients (n = 2).

There were 15 quantitative, 12 qualitative and 3 mixed-methods studies. Most quantitative studies were self-administered survey-based studies (n = 12), except for one study, which employed face-to-face surveys. Reviews of medical records and RRT activations were used in five studies, with three of these studies using record review in conjunction with a qualitative approach (mixed-method studies). Qualitative data were collected through interviews (n = 9) and focus groups (n = 3). Table 2 summarizes the included studies.

Quality assessment
The overall quality assessment of the study was medium (n = 18) to high (n = 12) (Appendix 2), with a substantial overall agreement of 83.3% between WLC and MTAS (Kappa = 0.658, P < 0.001).

The studies were generally good at providing clear research aims, congruity between the research aims and research design, providing details on the sample, and outlining the data collection and data analysis methods. More than half of the qualitative studies had inadequate clarifications for ethical issues and failed to consider the effect of the researcher–participant relationship.

The main weaknesses of the quantitative studies were the lack of considerations for confounders and insufficient psychometric evaluation of the different questionnaires administered. Only five studies addressed confounders using a statistical approach [21, 64, 67, 68, 72]. More than half of the studies have limited generalizability, given the small sample size and non-response bias due to poor response rates.

All the mixed-method studies had inadequate justifications for the need of a mixed-method design to address their research questions and did not consider the limitations associated with integration of qualitative and quantitative data.

Synthesis of results
The Systems Engineering Initiative for Patient Safety (SEIPS) model of work system and patient safety developed by Carayon et al. is used as a conceptual framework to understand the barriers and facilitators to activation of the RRS by ward nurses and junior physicians [73]. The SEIPS model provides a framework for understanding the impact of work system factors on healthcare processes and patient outcomes [73]. The factors identified were grouped into 10
### Table 3a Person-related factors influencing an activation of the rapid response system by ward nurses and junior physicians

| Themes                              | Explanation                                                                                                               | Evidence                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Perceptions of the RRS             | Ward clinicians’ perceived benefits and drawbacks of the RRS. Both ward nurses and junior physicians valued the RRS but had concerns that hampered RRS activation | Twenty-one studies described the perceived of benefits of the RRS, which included expedited medical expertise to deteriorating patients [21, 37, 38, 40, 48–50, 52, 53, 55, 57–60, 63, 64, 66, 67, 69, 71], resolving system-related issues such as delays in getting hold of the attending physicians and limited availability of nurses [38, 40, 50, 66, 71, 72], and additional manpower from the RRT to assist in the rescue of deteriorating patients [40, 50, 53, 64]. Junior physicians were concerned about deskilling in the management of clinical deterioration [21, 38, 50] while ward nurses were afraid of criticism for unnecessary activations [21, 37, 38, 49, 53, 61, 64, 65]. |
| Clinical expertise                  | Most nurses found the importance of clinical expertise in calling the RRT; however, clinical expertise can also result in over-confidence to manage deterioration within their capacity. This perceived confidence is more prominent among the medical profession | Twenty-three studies identified clinical expertise as a strong factor that influences RRS activations by nurses, but less so by physicians [37, 39, 40, 48–51, 53–55, 57, 59–66, 68, 69, 71, 72]. Experienced nurses not only have greater confidence and intention to activate the RRT compared to junior nurses [53–55, 59, 61, 65, 66, 72], they also made use of their intuitive judgment gained through past experiences to recognize subtle and early signs of clinical deterioration that warrant a RRS activation [37, 39, 40, 49, 51, 53, 54, 60, 65, 69, 71]. Nurses’ knowledge of patients’ conditions [51, 53, 57, 60, 63, 65] and their ability to interpret clinical data gathered from patient assessment [51, 60, 65, 69] were also crucial elements to their clinical judgment in RRS activation. Clinical expertise can also lead to over-confidence in one’s capability to manage patient deterioration without seeking assistance from the RRT [39, 48, 50, 63]. This was more prominently displayed by attending physicians, with the belief of being more experienced and capable in managing deteriorating patients of their own specialty compared to that of the RRT [39, 50]. |
| Support from colleagues and hospital leaders | Ward nurses received support from their fellow nursing peers and hospital leaders in an activation of the RRS despite facing resistance from the attending physicians | Fourteen studies concurred that ward nurses generally received positive and supportive behaviors from their fellow nurses and hospital leaders in activating the RRS [21, 38, 40, 48, 50, 51, 53, 59–61, 63, 65, 69, 71]. Supportive behaviors from nursing peers consisted of giving affirmation for the need to activate the RRT [51, 53, 60, 61, 65] or assisting peers with other duties during RRT call [59]. Supportive hospital administration includes clear communication and numerous reinforcements regarding RRS activation [40]. However, nurses encountered resistance from attending physicians in calling the RRT at times [40, 50, 71]. Some physicians perceived RRT activation as an implied incompetence of the attending physicians to manage patient deterioration and was detrimental to the education of junior physicians [50]. |
Table 3b: Tools and technology-related factors influencing an activation of the rapid response system by ward nurses and junior physicians

| Themes                                      | Explanation                                                                                           | Evidence                                                                                       |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Sensitivity and specificity of activation criteria | The sensitivity and specificity of the activation criteria have been criticized despite its ability to facilitate ward clinicians in the recognition of patient deterioration | Eleven studies questioned the sensitivity and specificity of the activation criteria [21, 37–39, 49, 51, 53, 36–38, 61, 64, 69, 71]. The activation criteria has been described as being oversensitive to chronically diseased patients and lacking in specificity to different medical conditions [21, 37, 49, 48, 69]. While ward nurses reported facing delays and reluctance from physicians to modify the activation limits specific to each patient’s condition [21, 38, 69], suggesting inflexibility of the calling criteria [69]. There were also evidences of underutilization of the ‘worried criterion’ whereby ward clinicians would not or were uncertain to activate the RRT for patients whom they were worried about but otherwise had normal vital signs [21, 37, 49, 53, 56, 61, 71]. While the fear of making unnecessary activations could be one reason for this underutilization, other attributing reasons included difficulty in articulating their worried feeling or subtle clinical changes [53, 61], and the inability of RRT members to assimilate nurses’ concerns of a patient’s condition [71]. Only two studies discussed the influence of electronic monitoring equipment on RRS activations, but both did not demonstrate positive effects [51, 70]. One study reported that electronic monitoring without real-time capture of vital signs may delay entry and errors in transcribing, thus delaying the recognition of clinical deterioration [51]. The other study observed that failure and delayed RRS activations was almost twice in automated monitored patients (81%) compared to non-automated monitored patients (53%) (P < 0.001) [70]. One possible offered explanation was alarm fatigue from an oversensitive activation criteria, which resulted in ward staff being desensitized to deranged vital signs [70].
| Electronic monitoring equipment            | The idea of electronic monitoring equipment is to facilitate the observation and identification of deteriorating patients. However, its limitations may outsmart itself and in turn compromise patient safety | The application of the SEIPS model enabled a clearer connection of various tools of the SEIPS model to the processes of the RRT [21]. The review of the SEIPS model enabled a clearer connection of various tools of the SEIPS model to the processes of the RRT [21]. The interaction of different factors in the work systems factors and supporting evidence for each of the factors identified in Table 3b. Additionally, the review and expanding RRS activations included the way ward-limiting tools and technologies, and performed their tasks at automated RRT members (task-related) which often leads to ward nurses (person-related), and decision-making (environment-related), which often leads to ward nurses (person-related) and decision-making (environment-related). The formal review of the SEIPS model enabled a clearer connection of various tools of the SEIPS model to the processes of the RRT [21]. The interaction of different factors in the work systems factors and supporting evidence for each of the factors identified in Table 3b. Additionally, the review and expanding RRS activations included the way ward-limiting tools and technologies, and performed their tasks at automated RRT members (task-related) which often leads to ward nurses (person-related), and decision-making (environment-related), which often leads to ward nurses (person-related) and decision-making (environment-related).
**Table 3c** Task-related factors influencing an activation of the rapid response system by ward nurses and junior physicians

| Themes                  | Explanation                                                                                   | Evidence                                                                                                                                                                                                                                                                                                                                 |
|-------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Justifying RRS activation | The task of justifying RRS activations by nurses was common for patients who experience subjective, subtle, and/or gradual clinical changes | Ten studies described that nurses’ decision to activate the RRS was often moderated by the task of justifying the need for a RRT through seeking affirmation from peers or more experienced nurses and/or gathering clinical data to avoid unnecessary activation [38, 39, 48, 51, 53, 60, 61, 65, 69, 71]. At times, justification included beyond seeking affirmation to ‘dig deeper’ (p.26) into gathering further objective data, identify an objective finding that served as a 'trigger' (p.27) for RRS activation, or even ‘to wait for a bigger change’ (p.28) to occur [51]. Common reasons for the need in justification included the fear of making ‘incorrect’ calls, lack of confidence in patient assessment, misunderstanding of the activation criteria, and inadequacy of the activation criteria [38, 39, 48, 51, 60, 61, 65] |
| Deliberating over the reactions from RRT members | Ward clinicians’ decision in an activation of the RRS was confronted with the task of deliberating over the attitudes and responses from the RRT members. The collaboration between attending physicians and the RRT members also affects RRS activation | Fourteen studies suggested the task of deliberating over reactions from the RRT members when deciding whether or not to activate the RRS [37, 38, 40, 48–50, 55, 59–61, 63, 64, 66, 69, 71]. Dismissive responses and behaviors from the RRT members such as condescension in tone, arrogant communication styles and negative repercussions by the RRT for unnecessary activations discouraged RRS activations [38, 48, 49, 55, 59, 61, 63, 64, 66, 69, 71] while collegial working relationship between ward clinicians and RRT members achieved through effective communication and mutual respect encouraged RRS activation [60]. Conflicting medical opinions regarding patient management between attending physicians and members of the RRT also hampered RRS activation [49, 50, 63] |
| Workload and staffing | Workload and staffing have bidirectional influences on RRS activation. While heavy workload and inadequate staffing can cause ward clinicians to feel handicapped in supporting deteriorating patients, it can also hinder their ability to provide vigilance to patients | Eight studies demonstrated mixed evidence on the impact of workload and staffing on RRS activation [40, 50, 51, 53, 59, 63, 64, 68]. Heavy workload and inadequate staffing caused ward clinicians to be under resourced in supporting deteriorating patients, which in turn encouraged RRS activation [40, 50, 53, 59, 64]. However, this can also be a barrier to close monitoring and the recognition of patients at-risk of deterioration [51, 63, 68]. A retrospective review of 108 RRS activations in a hospital from the US found a 3.25 greater likelihood of delayed RRS activation occurring on night shifts when vigilance to patients was threatened by fewer staffing (95% CI:1.34–7.9, P < 0.01) [68]. There were also concerns of increased workload following RRS activations [63, 64]; however, this was found to be more apparent among physicians compared to nurses (OR = 1.72 (95% CI:1.2–2.49), 0.01 > P > 0.001) [64] |
### Table 3d Organization-related factors influencing an activation of the rapid response system by ward nurses and junior physicians

| Themes | Explanation | Evidence |
|--------|-------------|----------|
| Traditional model of escalation of care | The RRS ‘breaks’ away from the traditional model of escalation of care, which is inherently rigid to change, especially among the medical profession | Eighteen studies highlighted an allegiance to the traditional model of hierarchical escalation of care in which nurses will escalate for help from junior physicians who will then activate the RRT and/or after notifying their seniors [21, 37–40, 48–51, 53, 57, 59–61, 63, 69, 71, 72]. This inclination to the traditional model was found to be more prevalent among the medical profession, with significantly more medical staff (28%) than nurses (14.7%) indicating that they would not activate the RRT if the attending physician was unavailable (P < 0.01) [21]. There were evidences of nurses being caught between the RRS guidelines and resistance from attending physicians in calling the RRT [40, 50, 71]. Yet, junior physicians were indecisive in their management and had to consult their seniors for a second opinion before activating the RRT [40, 50]. Delays in activation were made worse with expectations from the upper hierarchy that ward nurses and junior physicians should attempt stabilizing measures before seeking medical assistance [39, 51]. Eighteen studies identified that staff training and education on the purpose of the RRS, understanding and familiarity with the activation criteria and RRS activation protocols, and ability to identify deteriorating patient situations who require a RRT review were vital facilitators to RRS activation [21, 37, 38, 40, 48–50, 51, 55, 56, 59–64, 66, 72]. Conversely, unclear RRS protocols and guidelines to define individual roles and responsibilities impeded RRS activations [40, 48–50, 59]. In addition, cursory initial training on the RRS and sporadic follow-ups on RRS education were key reasons to unfamiliarity with the RRS protocols and confusion in individual roles during a joint rescue with the RRT [59]. Conventional education and training methods such as orientation sessions, lectures, and posters may not be adequately effective [56]. |
| Staff training and education (n = 18) | Staff training and education about the RRS is not only crucial in the implementation of the RRS but also imperative in the maintenance phase in order to enhance the acceptance and uptake of the RRS | Our findings demonstrate that frontline clinicians were convinced about the value of the RRS. However, timely RRS activations should be encouraged with appropriate support. Given that junior nurses are often on the front line of action when uncertain about the need for a nurse’s first course of action, they could benefit from support and education about the RRS activation criteria. This could cause nurses to be more vigilant to patients in need of RRS activation, with their understanding of the system’s criteria to detect early and prevent further deterioration. The inadequate skill mix of experienced nurses on shift thus becomes apparent. The considerable amount of experienced nurses on shift then becomes a hindrance, with less experienced nurses being less likely to recognize the signs of deteriorating patients. The introduction of RRS protocols and guidelines to define individual roles and responsibilities is essential to enhance acceptance and implementation of the RRS. Furthermore, the integration of RRS protocols into routine practice is crucial to ensure consistent and timely activation. The adoption of electronic RRS protocols and guidelines into clinical workflows can improve compliance and efficiency in RRS activation. This initiative may be difficult to implement without adequate training and education on RRS protocols and guidelines. In addition, the development of an RRS training program that includes practical scenarios and case studies can enhance clinician knowledge and confidence in RRS activation. The provision of ongoing education and training on RRS protocols and guidelines can reinforce clinician understanding of the system’s criteria to detect early and prevent further deterioration.

---

**Implications for clinicians and policymakers, and future research:**

Our findings demonstrate that frontline clinicians were convinced about the value of the RRS. However, timely RRS activations should be encouraged with appropriate support. Given that junior nurses are often on the front line of action when uncertain about the need for a nurse’s first course of action, they could benefit from support and education about the RRS activation criteria. This could cause nurses to be more vigilant to patients in need of RRS activation, with their understanding of the system’s criteria to detect early and prevent further deterioration. The inadequate skill mix of experienced nurses on shift thus becomes apparent. The considerable amount of experienced nurses on shift then becomes a hindrance, with less experienced nurses being less likely to recognize the signs of deteriorating patients. The introduction of RRS protocols and guidelines to define individual roles and responsibilities is essential to enhance acceptance and implementation of the RRS. Furthermore, the integration of RRS protocols into routine practice is crucial to ensure consistent and timely activation. The adoption of electronic RRS protocols and guidelines into clinical workflows can improve compliance and efficiency in RRS activation. This initiative may be difficult to implement without adequate training and education on RRS protocols and guidelines. In addition, the development of an RRS training program that includes practical scenarios and case studies can enhance clinician knowledge and confidence in RRS activation. The provision of ongoing education and training on RRS protocols and guidelines can reinforce clinician understanding of the system’s criteria to detect early and prevent further deterioration.

---

**Patient safety:**

Overconfidence on visual signs and sensations also risks escalating the treatment of apparent conditions, which is superimposed by low degree of suspicion of error [82]. It is thus essential that clinicians are equipped with the ability to conduct and interpret appropriate patient monitoring technologies [79–81]. This could cause nurses to be less vigilant to patients deteriorating, with the knowledge of the system’s criteria to detect early and prevent further deterioration. The inadequacy of the activation criteria to detect early deterioration [82]. It is thus essential that clinicians are equipped with the ability to conduct and interpret appropriate patient monitoring technologies [79–81]. This could cause nurses to be less vigilant to patients deteriorating, with the knowledge of the system’s criteria to detect early and prevent further deterioration. The inadequacy of the activation criteria to detect early deterioration.
examine the impact of clinicians’ decision-making process on timely RRS activations and patient outcome. The lack of substantial evidence on the influence of monitoring technology also recommends research to assess the impact of monitoring technology on timely activations and patient outcome.

Socio-cultural barriers such as adherence to the traditional hierarchical escalation of care, fear of criticism and negative behaviors of the RRT responders could be mediated by hospital leaders. This can be achieved through continuous training coupled with appropriate education and training methods to encourage teamwork and clinicians to respond responsibly, clear RRS protocols, and continuously support advocating RRS activations. An exploration of other viable modes of education and training methods is warranted. Literature has highlighted that certain cultures tend to adopt vertical hierarchies in their working relationships [90], which could potentially be an obstacle to RRS activation. Future studies should be conducted beyond a non-Western context, which was not included in this review.

It is also paramount that hospital leaders periodically evaluate their hospital RRS. An important aspect not to be overlooked is the perspectives of ward nurses and junior physicians, who are key users of the RRS. Understanding the impact of the RRS on junior physicians’ medical education holds strong promise to enhance the implementation process of the RRS in institutions and improve physicians’ acceptance of the RRS. Researchers may seek to develop a tool to help hospital leaders identify core factors to improve each hospital’s RRS. Lastly, this review recommends the adoption of human factors ergonomics perspectives to understand the interactions between the end-users of the RRS and other elements of the work system to further optimize and mitigate obstacles associated with the RRS.

Limitations
Despite an exhaustive literature search, the exclusion of studies that evaluated the effectiveness or impact of the RRS on patient outcomes, which may contain additional insights, may have been missed. Secondly, most of the quantitative studies were cross-sectional surveys that provided information about attributes at a single time-point. It is likely that the perceptions of responders will change overtime. Thirdly, there are variations in the RRS implemented across the included studies i.e. the maturity of the RRS and different composition of the RRT (physician-led RRT versus nurse-led RRT). This may have an influence on ward clinicians’ decisions to activate the RRT. Fourthly, as most of the studies did not report the RRS activation rates, we could not analyze the identified factors in relation to the activation frequency. Lastly, the use of a different conceptual model might have resulted in different themes identified.

Conclusion
This systematic review has demonstrated that RRS activation is a complex intervention that involves navigating through the way clinicians interact with the interplay of socio-cultural, political and organizational considerations. Activations of the RRS were found to be influenced by key factors that include frontline clinicians’ perceptions of the RRS and their clinical judgment, support from colleagues and hospital leaders, adequacy of the activation criteria, attitudes and responses of the RRT members, adherence to the traditional model of escalation of care, and staff training and education. Institutions should consider these factors in the implementation of their RRS and develop strategies to improve the utilization of the RRS. More research efforts, along with clinical practice implications, should be central to improving suboptimal activations of the RRS.

Supplementary material
Supplementary material is available at International Journal for Quality in Health Care online.

Acknowledgments
We thank the NUHS Medical Publications Support Unit, Singapore, for providing editing services to this manuscript.

References
1. Australian Commission on Safety and Quality in Health Care. National Consensus Statement: Essential Elements for Recognising and Responding to Clinical Deterioration. Sydney: ACSQHC, 2010.
2. Institute for Healthcare Improvement. 5 Million Lives Campaign. Getting Started Kit: Rapid Response Teams. Cambridge, MA: Institute for Healthcare Improvement, 2008.
3. National Institute for Health and Clinical Excellence. Acutely Ill Patients in Hospital: Recognition of and Response to Acute Illness in Adults in Hospital. London, England: National Institute for Health and Clinical Excellence, 2007.
4. Scottish Intercollegiate Guidelines Network (SIGN). Care of Deteriorating Patients. Edinburgh: Scottish Intercollegiate Guidelines Network, 2014.
5. DeVita MA, Bellomo R, Hillman K et al. Findings of the first consensus conference on medical emergency teams. Crit Care Med 2006;34:2463–78.
6. Franklin C, Mathew J. Developing strategies to prevent in-hospital cardiac arrest: analyzing responses of physicians and nurses in the hours before the event. Crit Care Med 1994;22:244–7.
7. Goldhill DR, McNarry AF. Physiological abnormalities in early warning scores are related to mortality in adult inpatients. Br J Anaesth 2004;92:882–4.
8. Harrison GA, Jacques T, McLaws ML et al. Combinations of early signs of critical illness predict in-hospital death—the SOCCER study (signs of critical conditions and emergency responses). Resuscitation 2006;71:327–34.
9. Hodgetts TJ, Kenward G, Vlackonikolis I et al. Incidence, location and reasons for avoidable in-hospital cardiac arrest in a district general hospital. Resuscitation 2002;54:115–23.
10. Jacques T, Harrison GA, McLaws ML et al. Signs of critical conditions and emergency responses (SOCCER): a model for predicting adverse events in the inpatient setting. Resuscitation 2006;69:175–83.
11. Burst M, Bernard S, Nguyen TV et al. Association between clinically abnormal observations and subsequent in-hospital mortality: a prospective study. Resuscitation 2004;62:137–41.
12. Taenzer AH, Pyke JR, McGrath SP. A review of current and emerging approaches to address failure-to-rescue. Anesthesiology 2011;115:421–31.
13. Jones DA, DeVita MA, Bellomo R. Rapid-response teams. N Engl J Med 2011;365:139–46.
14. DeVita MA, Hillman K, Bellomo R. Textbook of Rapid Response Systems: Concept and Implementation. New York: Springer Science & Business Media, 2010.
15. DeVita MA, Hillman K, Smith GB. Resuscitation and rapid response systems. Resuscitation 2014;85:1.
16. DeVita MA, Smith GB, Adam SK et al. ‘Identifying the hospitalised patient in crisis’—a consensus conference on the afferent limb of Rapid Response Systems. Resuscitation 2010;81:375–82.
17. Hillman KM, Chen J, Jones D. Rapid response systems. Med J Aust 2014;201:519–21.
18. Silhó AL, Lominadze G, Gong MN et al. Early warning/track-and-triger systems to detect deterioration and improve outcomes in hospitalized patients. Semin Respir Crit Care Med 2016;37:88–95.
Rapid response system activation • Patient safety

19. Santiano N, Young L, Hillman K et al. Analysis of Medical Emergency Team calls comparing subjective to ‘objective’ call criteria. Resuscitation 2009;80:44–9.
20. Hillman KM, Liford R, Brathwaite J. Patient safety and rapid response systems. Med J Aust 2014;201:64–6.
21. Douglas C, Osborne S, Windsor C et al. Nursing and medical perceptions of a hospital rapid response system: new process but same old game? J Nurs Care Qual 2016;31:E1–10.
22. Chan PS, Jain R, Nallmothu BK et al. Rapid response teams: a systematic review and meta-analysis. Arch Intern Med 2010;170:18–26.
23. Chen J, Ou L, Fabouris A et al. Impact of a standardized rapid response system on outcomes in a large healthcare jurisdiction. Resuscitation 2016;107:47–56.
24. Hillman K, Chen J, Cretikos M et al. Introduction of the medical emergency team (MET) system: a cluster-randomised controlled trial. Lancet 2005;365:2091–7.
25. Ludikhuize J, Bruinsveld-Reinders AH, Dijkgraaf MGW et al. Outcomes associated with the nationwide introduction of rapid response systems in The Netherlands. Crit Care Med 2015;43:2544–51.
26. Mahajar R, Raffaele I, Wendon J. Rapid response systems: a systematic review and meta-analysis. Crit Care 2015;19:254.
27. Wendon J, Hodgson C, Bellomo R. Rapid response teams improve outcomes: we are not sure. Intensive Care Med 2016;42:599–601.
28. Winters BD, Weaver SJ, Pfoh ER et al. Rapid-response systems as a patient safety strategy: a systematic review. Ann Intern Med 2013;158:417–25.
29. Mahajar R, Stelfox HT. Rapid response teams improve outcomes: no. Intensive Care Med 2016;42:596–8.
30. Marshall SD, Kitto S, Shearer W et al. Why don’t hospital staff activate the rapid response system (RRS)? How frequently is it needed and can the process be improved? Implement Sci 2011;6:39.
31. Bonatti MM, Azzolini N, Viana MV et al. Delayed medical emergency team calls and associated outcomes. Crit Care Med 2014;42:26–30.
32. Sandroni C, Cavallaro F. Failure of the afferent limb: a persistent problem in rapid response systems. Resuscitation 2011;82:797–8.
33. Jones D. The epidemiology of adult Rapid Response Team patients in Australia. Anaesth Intensive Care 2014;42:213.
34. Buist MD, Jarmolowski E, Burton PR et al. Recognising clinical instability in hospital patients before cardiac arrest or unplanned admission to intensive care. A pilot study in a tertiary-care hospital. Med J Aust 1999;171:22–5.
35. Dafourn K, Lee A, Hillman KM et al. Do nurses know when to summon emergency assistance? Intensive Care Nurs 1994;10:113–20.
36. DeVita MA, Brathwaite RS, Mahidhara R et al. Use of medical emergency response teams to reduce hospital cardiopulmonary arrests. Qual Saf Health Care 2004;13:251–4.
37. Jones E, Baldwin I, McIntyre T et al. Nurses’ attitudes to a medical emergency team service in a teaching hospital. Qual Saf Health Care 2006;15:427–32.
38. Kitto S, Marshall SD, McMillan SE et al. Rapid response systems and collective (in)competence: An exploratory analysis of intra-professional and inter-professional activation factors. J Interprof Care 2015;29:340–6.
39. Shearer B, Marshall S, Buist MD et al. What stops hospital clinical staff from following protocols? An analysis of the incidence and factors behind the failure of bedside clinical staff to activate the rapid response system in a multi-campus Australian metropolitan healthcare service. BMJ Qual Saf 2012;21:569–75.
40. Shapiro SE, Donaldson NE, Scott MB. Rapid response teams seen through the eyes of the nurse. Am J Nurs 2010;110:28–36.
41. Moher D, Liberati A, Tetzlaff J et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann Intern Med 2009;151:264–9.
42. Lee A, Bishop G, Hillman K et al. The medical emergency team. Anaesth Intensive Care 1995;23:183–6.
43. Critical Appraisal Skills Programme. Qualitative Research Checklist 2013 http://media.wix.com/ugd/dded87_29c5b002d99432788c6ac670e49f274.pdf (18 December 2013, date last accessed).
44. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers’ Manual: 2014 edition. Australia: The Joanna Briggs Institute, 2014.
45. Pace R, Playe P, Bartlett G et al. Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. Int J Nurs Stud 2012;49:47–53.
46. Sandelowski M, Voils CI, Barroso J. Defining and designing mixed research synthesis studies. Res Sch 2006;13:29.
47. Fereday J, Muir-Cochrane E. Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development. Int J Qual Methods 2006;5:80–92.
48. Astroth KS, Woth WM, Stapleton SJ et al. Qualitative exploration of nurses’ decisions to activate rapid response teams. J Clin Nurs 2013;22:2876–82.
49. Bagshaw SM, Mondor EE, Scourten C et al. A survey of nurses’ beliefs about the medical emergency team system in a Canadian tertiary hospital. Am J Crit Care 2010;19:74–83.
50. Benn AL, Borgstrom CP, Jenq GY et al. Defining impact of a rapid response team: qualitative study with nurses, physicians and hospital administrators. BMJ Qual Saf 2012;21:391–8.
51. Braaten JS. Hospital system barriers to rapid response team activation: a cognitive work analysis. Am J Nurs 2015;115:22–33.
52. Butcher BW, Quist CE, Harrison JD et al. The effect of a rapid response team on resident perceptions of education and autonomy. J Hosp Med 2015;10:8–12.
53. Ciofini J. Nurses’ experiences of making decisions to call emergency assistance to their patients. J Adv Nurs 2000;32:108–14.
54. Ciofini J. A study of the use of past experiences in clinical decision making in emergency situations. Int J Nurs Stud 2001;38:591–9.
55. Cretikos MA, Chen J, Hillman KM et al. The effectiveness of implementation of the medical emergency team (MET) system and factors associated with use during the MERIT study. Crit Care Resusc 2007;9:205–12.
56. Davies O, DeVita MA, Ayinla R et al. Barriers to activation of the rapid response system. Resuscitation 2014;85:1557–61.
57. Donohue LA, Endacott R, Tract, trigger and teamwork: communication of deterioration in acute medical and surgical wards. Intensive Crit Care Nurs 2010;26:10–7.
58. Green A, Allison W. Staff experiences of an early warning indicator for unstable patients in Australia. Nurs Crit Care 2006;11:118–27.
59. Jenkins SH, Astroth KS, Woth WM. Non-critical-care nurses’ perceptions of facilitators and barriers to rapid response team activation. J Nurses Prof Dev 2015;31:264–70.
60. Leach LS, Mayo A, O’Rourke M. How RNs rescue patients: a qualitative study of RNs’ perceived involvement in rapid response teams. Qual Saf Health Care 2010;19:e13.
61. Massey B, Chaboyer W, Atken L. Nurses’ perceptions of accessing a Medical Emergency Team: a qualitative study. Aus Crit Care 2014;27:133–8.
62. Pantzopoulos I, Tsoni A, Kouskouni E et al. Factors influencing nurses’ decisions to activate medical emergency teams. J Clin Nurs 2012;21:2668–78.
63. Pattison N, Eastham E. Critical care outreach referrals: a mixed-method investigation of outcomes and experiences. Int J Nurs Stud 2012;49:138–43.
64. Radeschi G, Urso F, Campagna S et al. Factors affecting attitudes and barriers to a medical emergency team among nurses and medical doctors: a multi-centre survey. Resuscitation 2015;88:92–8.
65. Robert RR. The Role of Intuition in Nurses Who Activate the Rapid Response Team (RRT) in Medical-Surgical and Telemetry Units. ProQuest Dissertations & Theses, Texas Woman’s University 2013.
66. Salamonson Y, van Heere B, Everett B et al. Voices from the floor: nurses’ perceptions of the medical emergency team. Intensive Crit Care Nurs 2006;22:138–43.
67. Sarani B, Sonnad S, Bergey MR et al. Resident and RN perceptions of the impact of a medical emergency team on education and patient safety in an academic medical center. Crit Care Med 2009;37:3091–6.
68. Schum-Mazzocco A, Hoffman LA, Wolf GA et al. The use of medical emergency teams in surgical and medical patients: impact of patient, nurse and organisational characteristics. Qual Saf Health Care 2008;17:77–81.
69. Stewart J, Carman M, Spegman A et al. Evaluation of the effect of the modified early warning system on the nurse-led activation of the rapid response system. J Nurs Care Qual 2014;29:223–9.
70. Tirkkonen J, Yla-Mattila J, Olkkola KT et al. Factors associated with delayed activation of medical emergency team and excess mortality: an Utstein-style analysis. Resuscitation 2013;84:173–8.
71. Williams DJ, Newman A, Jones C et al. Nurses’ perceptions of how rapid response teams affect the nurse, team, and system. J Nurs Care Qual 2011;26:265–72.
72. Wynn JD, Engelke MK, Swanson M. The front line of patient safety: staff nurses and rapid response team calls. Qual Manag Health Care 2009;18:40–7.
73. Carayon P, Hundt AS, Karsh BT et al. Work system design for patient safety: the SEIPS model. Qual Saf Health Care 2006;15:i50–8.
74. Carayon P, Wetterneck TB, Rivera-Rodriguez AJ et al. Human factors systems approach to healthcare quality and patient safety. Appl Ergon 2014;45:14–25.
75. Jones L, King L, Wilson C. A literature review: factors that impact on nurses’ effective use of the Medical Emergency Team (MET). J Clin Nurs 2009;18:3379–90.
76. Osborne S, Douglas C, Reid C et al. The primacy of vital signs – acute care nurses’ and midwives’ use of physical assessment skills: a cross-sectional study. Int J Nurs Stud 2015;52:951–62.
77. Chua WL, Liaw SY. Assessing beyond vital signs to detect early patient deterioration. Evid Based Nurs 2016;19:53.
78. Mackintosh N, Sandall J. Overcoming gendered and professional hierarchies in order to facilitate escalation of care in emergency situations: the role of standardised communication protocols. Soc Sci Med 2010; 71:1163–6.
79. Cooper S, Cant R, Sparkes L. Respiratory rate records: the repeated rate? J Clin Nurs 2014;23:1236–8.
80. Mok W, Wang W, Cooper S et al. Attitudes towards vital signs monitoring in the detection of clinical deterioration: scale development and survey of ward nurses. Int J Qual Health Care 2015;27:207–13.
81. Prgomet M, Cardona-Morrell M, Nicholson M et al. Vital signs monitoring on general wards: clinical staff perceptions of current practices and the planned introduction of continuous monitoring technology. Int J Qual Health Care 2016;28:515–21.
82. ISMP Canada. Understanding human over-reliance on technology. ISMP Canada Saf Bull 2016;16:1–4.
83. Buist M, Mahoney A. In search of the ‘Holy Grail’: will we ever prove the efficacy of Rapid Response Systems (RRS)? Resuscitation 2014;85:1129–30.
84. Parmelli E, Flodgren G, Beyer F et al. The effectiveness of strategies to change organisational culture to improve healthcare performance: a systematic review. Implement Sci 2011;6:33.
85. Haas J, Shaffir W. The professionalization of medical students: developing competence and a cloak of competence. Symb Interact 1977;1:71–88.
86. Hall P. Interprofessional teamwork: professional cultures as barriers. J Interprof Care 2005;19:188–96.
87. Bowie P. Leadership and implementing a safety culture. Pract Nurse 2010;40:32.
88. Cioffi J, Conway R, Everist L et al. ‘Patients of concern’ to nurses in acute care settings: a descriptive study. Ana Crit Care 2009;22:178–86.
89. Dowse G, Huisman-de Waal G, van Zanten ARH et al. Nurses’ ‘worry’ as predictor of deteriorating surgical ward patients: a prospective cohort study of the Dutch-Early-Nurse-Worry-Indicator-Score. Int J Nurs Stud 2016;59:134–40.
90. Liew S-L, Ma Y, Han S et al. Who’s afraid of the boss: cultural differences in social hierarchies modulate self-face recognition in Chinese and Americans. PLoS One 2011;6:e16901.
