How do nurses use early warning scoring systems to detect and act on patient deterioration to ensure patient safety? A scoping review

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ABSTRACT

Background: Despite widespread adoption of rapid response systems and the use of various early warning scoring systems, the detection of patient deterioration remains suboptimal, leading to the development of potentially avoidable serious adverse events. Why this occurs has been the focus of many investigations, but the complexities around advancing understanding that leads to effective actions are less evident.
Objective: To better understand medical/surgical nurses use of early warning scoring systems.
Design: A five-step process was used in this scoping review including: identify the research question; search and identify the relevant studies; selecting relevant studies; charting the data; and collate, summarize and report the results. The PRISMA extension for scoping reviews was used to guide this scoping review.
Data Sources: In August 2018 a literature search was performed using the following medical subject headings: physiological, clinical deterioration, and the expanders early warning score, system, nurse attitudes, with Boolean operators in Ovid MEDLINE, CINAHL, and EMBASE databases.
Review Methods: Extracted data included study aims, key findings, afferent/efferent focus and rapid response team description. Effective practice and organisation of care taxonomy guided data synthesis, before a thematic analysis was performed.
Results: Of 120 unique articles, 23 were included in the scoping review (11 qualitative, 8 quantitative and 4 mixed methods studies). Fifteen studies focused on the afferent limb of the rapid response system whilst eight focused on both the afferent and efferent limbs. In the effective practice and organisation of care taxonomy twenty-two studies met criteria for quality and safety improvements while nineteen met criteria for referral, outreach and teams. Three themes, Inconsistent activation of the rapid response team; Barriers to following early warning scoring system algorithms; and Overreliance on scores emerged.
Conclusion: Nurses aim to use early warning score systems to detect deterioration and ensure patient safety, however cultures, confidence and past experiences impact on rates of afferent limb failure globally. Simple to follow algorithms used in track and trigger charts are likely difficult for nurses to adhere to due to heavy workloads and challenges in getting medical officers to review within recommended time frames. Nurses rely heavily on the scores generated by early warning score systems but should aim to follow algorithms better and undertake holistic physical assessments to detect deterioration earlier and ensure patient safety is not compromised.

What is already known about the topic?

- Nurses use early warning scoring systems to help detect patient deterioration.
- Despite the widespread introduction of early warning scoring systems, patient deterioration is often detected late.

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- Nurses are often reluctant to activate the rapid response team when patients meet specific criteria.

What this paper adds

- Nurses rely heavily on the scores generated by track and trigger charts to help recognise and respond to patient deterioration.
- Early warning score systems often generate higher scores for patients with chronic illnesses, which require score modifications to be implemented to reduce the incidence of constantly elevated scores.
- There is a gap in the research that investigates why nurses are reluctant to activate the rapid response team when patients meet specific criteria in early warning scoring systems.

1. Introduction

The acuity of patients on general wards has increased significantly over time. Patients who historically resided in critical care areas are increasingly cared for on general wards (Missen et al., 2018). These patients often have numerous co-morbidities, which increases the complexity of their care and when combined with higher acuity, heightens their risk of experiencing deterioration and requiring medical interventions (Martins et al., 2015). Internationally, organisations such as the World Health Organisation, The National Patient Safety Agency in the United Kingdom and the Australian Commission on Safety and Quality in Health Care recognise the need to ensure patients are safe and therefore a priority is the prompt detection of deteriorating patients (Cherry and Jones, 2015).

The rapid response system conceptualised and developed over the last 20 years includes an afferent (recognition) limb and efferent (response) limb (Chua et al., 2017). In 2006 at the first conference on medical emergency teams, the aims of the afferent and efferent limbs of rapid response systems were outlined. Specifically, the afferent limb should facilitate the detection of a patient whose emergent needs are unmet and activate a mechanism through which the immediate care-provider can summon help. The efferent limb should include a timely response by external personnel with appropriate skills to address the imbalance between the patient's needs and the resources available (De Vita et al., 2006). The afferent limb generally incorporates a type of early warning score system to determine when the efferent limb known often as the rapid response team should be activated (De Vita et al., 2006).

Early warning score systems aim to help nurses detect the early signs of deterioration in patients and contain algorithms that suggest interventions to manage and prevent further clinical deterioration (McGaughey et al., 2017). Despite this, afferent limb failures are a factor in about 80% of serious adverse events in patients who have deteriorated (Petersen et al., 2016). Several studies have investigated various aspects of rapid response systems including the design of observation charts and the effects of implementing rapid response systems on patient outcomes (Kolic et al., 2015) with extensive research investigating the efferent limb (Odell, 2015). However, it is only recently that researchers have begun to investigate factors that influence nurse adherence to the afferent limb of rapid response systems and barriers preventing nurses activating the rapid response team (Smith and Aitken, 2016).

Regardless of whether hospitals use early warning score systems, clinical research shows patient deterioration is often detected late or missed completely contributing to the development of serious adverse events (Petersen et al., 2017). Serious adverse events are classified as events that lead to extended hospital stays or unplanned intensive care unit admissions or increases in morbidity and mortality rates (Spagnolli et al., 2017). Contributing factors to delayed recognition of the deteriorating patient include excessive nursing workloads, insufficient medical staffing, poor communication and ineffective interprofessional collaboration (Odell, 2015).

Track and trigger charts form part of the afferent limb of early warning score systems and are designed with a mechanism that should trigger a call for the rapid response team if a patient's score meets a predetermined criterion (McGaughey et al., 2017). Nurses completing a track and trigger chart calculate a score based on the patient's observations and then follow the early warning score systems algorithm which outlines the frequency of observations for different scores and if anyone should be notified (Missen et al., 2018). For example, the Adult Deterioration Detection System track and trigger chart utilises the following criteria to determine the level of response: 1–3 indicate a low-level response; 4–5 indicate a moderate response; 6–7 a more urgent response and scores of 8 or more indicate an emergency response (Missen et al., 2018).

Using the Adult deterioration detecting system chart as an example, low-level responses specify an increased frequency in observations and necessitate the charge nurse to review the patient. Moderate suggests a further increase with a review by resident medical officer. Urgent response advises a further increase in observation frequency and a review by a senior physician such as a registrar. An emergency response indicates a bedside review by the rapid response team (McGaughey et al., 2009). Observations that independently trigger an emergency response vary slightly between the different track and trigger charts used by various early warning score systems, but generally consist of a threatened airway resulting in difficulty breathing; respiratory rates outside the range of 8–30 per minute; oxygen saturations under 90% despite high flow oxygen; acute drop in systolic blood pressure below 90mmhg; heart rates outside the limits of 40–140 beats per minutes; and acute changes in level of consciousness or seizure (Peters van Ton et al., 2014).

Track and trigger charts have evolved to be simple easy to use tools that aim to assist nurses in identifying patients at risk of deterioration (Alam et al., 2014). Unfortunately, it has been widely reported that abnormalities in vital signs are frequently documented for up to 24 hours prior to a serious adverse event occurring (Panday et al., 2017). Furthermore, despite the focus on national health and safety standards by the Australian commission on safety and quality in health care, researchers in Australia have identified that the monitoring of vital signs is increasingly seen as a nursing task to be performed rather than a gathering of clinical information that should be clinically and critically interpreted. Additionally, such clinical responsibilities are often delegated to junior and inexperienced staff members (Cherry and Jones, 2015).

Previous reviews on various aspects of the afferent limb of the rapid response system have been conducted. For example, researchers undertook a systematic review of fourteen studies focused on nursing practice in detecting and managing deteriorating ward patients (Odell et al., 2009). The authors found intuition plays an important part in nurses' detection of deterioration and vital signs are used to validate internal feelings (Odell et al., 2009). Similarly, researchers conducting another systematic review examined nurses' perceptions of barriers to rapid response system activation in eight studies concluding that barriers included rapid response system activator-responder interaction, physician influence, nurse education and nurse experience (Padilla et al., 2018). Finally, researchers have also performed an integrative review of seventeen studies examining factors that influence ward nurse's identification and management of patient deterioration, they found that issues with timely recognition and responses to

deteriorating patients are complex but rely heavily on nurses' assessments and actions (Massey et al., 2017).

We found these reviews helped us understand some of the reasons for delayed activation of the rapid response team, however they do not examine how nurses use the data collected from early warning score systems to facilitate detection of patient deterioration. Therefore, the aim of this scoping review was to better understand medical/surgical nurses use of early warning score systems. Specifically, we aimed to provide a broad overview of the range and variety of published research relating to medical/surgical nurses use of early warning score systems to detect deterioration amongst adult patients in the general ward settings. This review provides a foundation for future research that could be undertaken using a variety of both qualitative and quantitative approaches.

2. Materials and methods

A scoping review was undertaken. In identifying what method should best answer the research question, it is firstly important to review the literature. Whilst several different types of review could be suitable for this project it was deemed that a scoping review would be the most appropriate typology (Grant and Booth, 2009). Scoping reviews are used to assess the extent of a body of literature on a topic and have great utility for synthesising research evidence, often being used to map existing literature in a given field in terms of its nature, features, and volume (Arksey and O'Malley, 2005). Scoping reviews are particularly useful when there is a range of evidence generated from a variety of methods, as was the case for this review, because they can be used to map the nature and features of the evidence in the area (Peterson et al., 2017). Furthermore, they are often undertaken to ensure that further research in that area is a beneficial addition to world knowledge (Khalil et al., 2016). Thus, a scoping review appeared the most appropriate given our aims and the body of literature in the area.

We used the five steps of a scoping review as outlined by Arksey and O'Malley (2005) which included; (1) Identifying the research question; (2) Searching for and identifying the relevant studies; (3) Selecting relevant studies; (4) Charting the data; and (5) Collate, summarize and report the results to guide this review. The search question for the review was initially "Why is patient deterioration not being recognised in a timely manner?" It evolved throughout the research process into "How do medical/surgical nurses use early warning score systems to detect and act on patient deterioration to ensure patient safety?"

The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist was used as a reporting guide for this review (Tricco et al., 2018).

2.1. Patient and public involvement

Including lay volunteers in the research process is seen as beneficial to ensure resources are targeting areas of importance to consumers and encouraged by groups which fund research (Price et al., 2018). Consequently, the consumer advisor group from the local health board were contacted to discuss the project to attain a patient's perspective on the issue. Unfortunately, the particular group was in its relative infancy and whilst providing support for some research, they were unable to use their limited resources to provide insight into this particular review.

2.2. Information sources and search strategy

A search of the MEDLINE, EMBASE, and CINAHL databases was undertaken in consultation with research librarians in August 2018. Boolean operators were used to search the terms monitoring,

physiological, clinical deterioration, vital signs [AND] early warning score, system, chart, track and trigger, rapid response system [OR] Nurse attitudes, beliefs, experiences, culture, nursing staff, care, process [NOT] Paediatric. As an example, the full search strategy for the CINAHL database undertaken on August 9th, 2018 is included in Appendix A as recommended by the preferred reporting for systematic reviews and meta analyses (PRISMA) -scoping review (ScR) checklist (Tricco et al., 2018).

For the purpose of this review, the term early warning score system included: *Adult Deterioration Detection System, National Early Warning System, Modified Early Warning System, Standard Adult General Observation and Physiological Observation Track and Trigger System* (McGaughey et al., 2009). Additionally, while the names given to the teams who respond to emergencies vary and include rapid response team, medical emergency team, hospital outreach team, critical care outreach team, for the purposes of this review rapid response team will be used to indicate all these teams (Alam et al., 2014).

2.3. Eligibility criteria

To be included in the review, published articles had to be research reports available in English with accessible full text printed from 2008 onwards; research describing (or focusing on) nurses use of any early warning score system; research examining nurse activation of any rapid response team; research on early warning score system use in general ward settings; research on nurse knowledge, skills or attitudes towards early warning score systems; research investigating the afferent limb of early warning score system. The 2008 date was chosen because several international organisations including the National Institute for Health and Clinical Excellence released policies and guidelines for recognising and responding to deteriorating patients around this time (National Institute for Health and Clinical Excellence, 2007).

Papers were excluded for the following reasons, if they were research focusing on the rapid response team's composition or its effect; research focusing on paediatric or obstetric early warning score systems; studies examining use of early warning score systems in emergency, intensive care, psychiatric or pre-hospital settings; research reporting on the design of track and trigger charts; review articles. In addition, studies that compared various designs of track and trigger charts were excluded as we identified they focused on the layout and aesthetics of the chart design rather than how nurses utilise them (Preece et al., 2012).

2.4. Selecting sources of evidence

Deciding which articles to include in the scoping review was an iterative process as the scoping question was refined by the authors. Covidence, a software developed for systematic literature review methods was used to allow two authors to screen titles and abstracts before assessing the full-text of 59 studies to determine eligibility for the study (Babineau, 2014). Regular meetings occurred between the two authors selecting studies whereby the studies where interrogated to ensure rigour within the study selection process.

2.5. Data charting and item extraction

The data charting process evolved during the review as the authors considered what particular data should be extracted to help answer the review question. Initially data including setting, study design, aims and key findings were extracted from the articles and entered into Microsoft excel. Then, after discussion and revision of the scoping question, additional data such as whether the study focused on the afferent or efferent limb of the rapid response system, the names of track and trigger charts and rapid

response teams and declarations of funding were extracted. Data that best answered the research question has been transcribed into tables as outlined by the Joanna Briggs Institute Methodology for Scoping Reviews (The Joanna Briggs Institute, 2015). As with the study selection the data extraction process was an iterative three-part process that involved regular meetings between all authors. The data was initially extracted by the lead author before being reviewed and interrogated by another author. To maintain rigour and authenticity a final recheck was performed by all authors.

2.6. Synthesis of results

In order to better understand, compare and synthesise the actual early warning score systems used in the studies, we assessed studies against the Cochrane Effective Practice and Organisation of Care taxonomy of health service interventions (Effective Practice and Organisation of Care (EPOC), 2016). This taxonomy includes four domains, delivery arrangements, financial arrangements, governance arrangements and implementation strategies. The domain delivery arrangements was determined to be the most appropriate for this review as it covers changes in how, when and where healthcare is organised and delivered, and who delivers healthcare (Effective Practice and Organisation of Care (EPOC), 2016). The Delivery domain is divided into five categories containing a total of 39 sub-categories, of which nine where deemed relevant for the focus of this review.

The final phase in the data synthesis was a thematic analysis. The findings from each of the papers were reviewed, contrasted and compared until preliminary themes were identified (Vaismoradi et al., 2013). The preliminary themes were then given sub headings and discussed extensively amongst the authors as the data extraction and thematic synthesis evolved, the thematic synthesis was then updated and altered between various drafts of the review.

3. Results

3.1. Selection of sources of evidence

The database search produced 200 articles 69 from EMBASE (Elselvier); 69 from MEDLINE (Ovid) and 62 from CINAHL (Ebsco), which once duplicate articles were removed left 120 articles for further screening. As recommended by PRISMA-ScR a PRISMA flow chart, describes how articles not meeting inclusion criteria have been excluded, see Fig. 1 (Moher et al., 2015). The titles and abstracts of all studies were screened with 61 studies excluded leaving 59 for full text review. After reading all studies deemed eligible for the review, we excluded 12 studies that focused on the composition or the effects of the rapid response team; 10 that did not focus on nurses use of early warning score systems; eight reviews and six quality improvement studies A total of 23 articles were included in the review. Fig. 1 demonstrates the flow of articles that were included and reasons for excluding articles.

3.2. Characteristics of sources of evidence

Table 1 provides a summary of the included studies. Of the 23 studies included in the review, 11 were qualitative (Rihari-Thomas et al., 2017; Petersen et al., 2017; McGaughey et al., 2017; Martland et al., 2016; Liaw et al., 2017; Kitto et al., 2015; Hart et al., 2016; Elliott et al., 2015; Donohue and Endacott, 2010; Currey et al., 2018; Burns et al., 2018), 8 were quantitative research studies (Davies et al., 2014; Douglas et al., 2016: Fox and Elliot, 2015; Heal et al., 2017; Liaw et al., 2016; Ludikhuize et al., 2011; Osborne et al., 2015; Rattray et al., 2011) and 4 were of a mixed methodology (Aitken et al., 2015; Cherry and Jones, 2015; Shearer et al., 2012; Smith and Aitken, 2016).
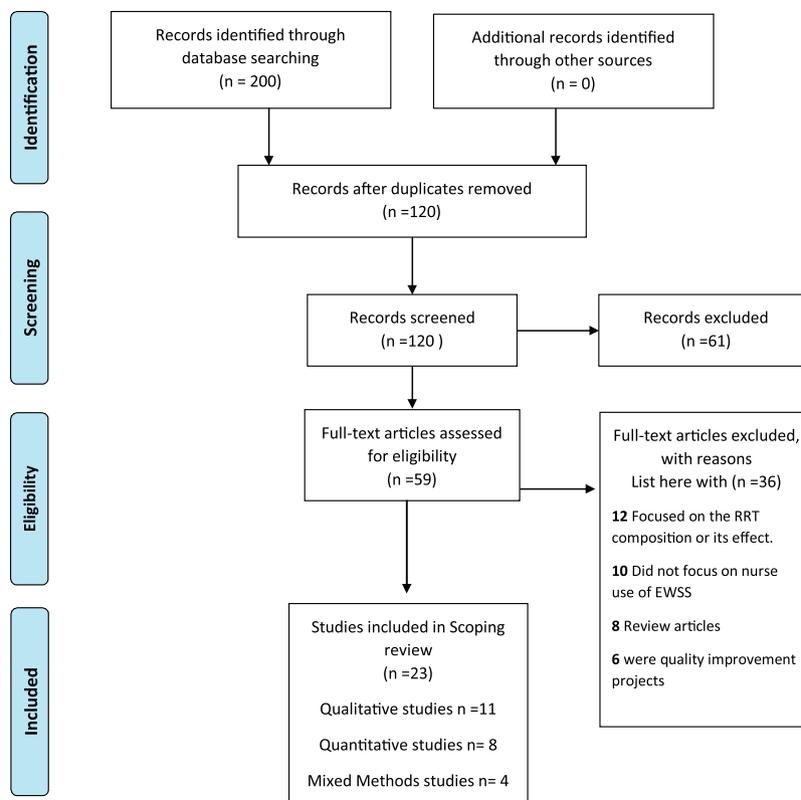

Fig. 1. PRISMA flow chart.

Table 1
General characteristics of selected studies.

Author, Year	Country	Study Aims	Study Design	Population	Sample Size	Funding
Aitken et al., 2015	Australia	1- To describe the structures and processes used to implement a 2-tier Rapid Response System (RRS). 2- To determine the prevalence of deteriorating patients and the incidence of cardiac arrests and unplanned ICU admissions prior to implementation of the RRS. 3- To determine clinician satisfaction with the RRS.	Quasi experimental pre/post-test design	Patient outcomes and clinicians' perceptions	1-n/a. 2- 2030 patients over a 12-month period who were reviewed by the RRT. 3- 192 survey respondents.	Funded by the Princess Alexandra hospital private practice trust fund.
Burns et al., 2018	USA	To determine how an enhanced early warning system (EEWS) impacts nursing practice.	Qualitative descriptive phenomenology	Registered Nurses	25 nurses	No specific funding received.
Cherry and Jones, 2015	UK	Gain an understanding of the attitudes of nursing staff surrounding the use the Modified Early Warning Score (MEWS) to monitor patients on an acute medical unit.	Mixed methods (questionnaire and focus group)	Nurses using EWSS	9 nurses	No statement made on funding.
Currey et al., 2018	Australia	Explore the opinions and perceptions of critical care staff who review deteriorating patients regarding barriers and solutions to recognising and responding to deterioration earlier in processes that culminate in a MET call.	Descriptive exploratory design	Intensive care staff who attend Medical Emergency Team (MET) reviews	294 conference registrants (197 nurses; 61 medical consultants; 11 allied health; 10 medical registrars; 10 industry reps; 2 consumers; 3 health administrators	No specific funding received.
Davies et al., 2014	USA	To identify barriers associated with RRS activation by clinical staff and assess their understanding and familiarity with Rapid Response Team (RRT) calling criteria.	Clinician surveys	Physicians and nurses	84 staff (68 physicians 16 nurses)	No specific funding received.
Donohue and Endacott, 2010	UK	Explore the perceptions of general ward nurses and Critical Care Outreach Team (CCOT) members of the management of deteriorating patients in acute care wards.	A qualitative design with critical incident technique.	Nurses managing a patient that was reviewed by the CCOT.	11 nurses	No statement made on funding.
Douglas et al., 2016	Australia	To compare the Nursing and Medical perceptions of RRS.	A single-site, cross-sectional survey design	Nurses + Doctors	624 staff (434 RNs + 190 medical staff)	No statement made on funding.
Elliott et al., 2015	Australia.	Following implementation of track and trigger charts in adult general medical-surgical wards the aim was to report on the initial clinical user experiences and views of the charts.	44 Semi structured focus groups across 8 sites	Clinical ward staff	218 participants mainly nurse ratio not stated	Australian Commission on Safety and Quality in Health Care.
Fox and Elliott, 2015	Ireland	To evaluate nurses' experiences of using the National Early Warning System (NEWS) in an acute hospital, it aimed to identify its effect on clinical decisions making and highlight problems of system utility in clinical practice.	Survey	Nurses	74 nurses	No statement made on funding.
Hart et al., 2016	USA	To explore and understand the experiences of medical-surgical nurses who are first to respond to clinical deterioration events.	A descriptive, qualitative approach	Nurses who have activated the RRT	28 medical-surgical nurses	No specific funding received.
Heal et al., 2017	USA	To determine if a newly designed RRS would increase the number of RRT activations and facilitate earlier patient deterioration detection.	Quasi experimental design	Nurses activating the RRT	2 medical-surgical units	No statement made on funding.
Kitto et al., 2015	Australia	Advance the understanding into the social, professional and cultural factors that influence RRS use and activation of the RRT.	Exploratory case study- 10 focus groups	Senior and Junior Nurses and Physicians	27 doctors and 62 nurses	This study was funded by the Victorian Managed Insurance Authority (VMIA).
Liaw et al., 2016	Singapore	To evaluate the effects of an educational program on improving the performance of nurses' when recognising and responding to acute patient deterioration events.	Randomised control trial with pre-test post-test design	Registered nurses <5 years' experience working in general wards	67 nurses	This study was supported by NUS research start-up grant funded by Yong Loo Lin School of Medicine and Alice Lee Centre for Nursing Studies
Liaw et al., 2017	Singapore	Explore nurses' outlook of an internet based educational program that aims to improve their skills and management of recognising and responding to deteriorating ward patients.	Exploratory descriptive qualitative study design	Nurses who encountered deteriorating patients	26 nurses	No statement made on funding.

Table 1 (*Continued*)

Author, Year	Country	Study Aims	Study Design	Population	Sample Size	Funding
Ludikhuize et al., 2011	Netherlands	To assess whether training nurses in the use of Modified Early Warning System (MEWS) and SBAR tools made them more likely to recognise a deteriorating patient.	Prospective quasi-experimental trial	Nurses on medical or surgical wards	95 nurses	No statement made on funding.
Martland et al., 2016	Australia	To develop a grounded theory related to the communication process that occurs between clinicians prior to activation of the RRT for the general concern criterion.	Qualitative grounded theory with focus group discussions	Clinicians involved in the activation of the RRT	43 clinicians 28 nurses 15 doctors	No statement made on funding.
McGaughey et al., 2017	Northern Ireland	To identify the contexts and mechanisms which impact on the successful achievement of outcomes in practice by testing the RRS program theory against the practice components of the RRS implemented.	Realist evaluation	Nurses and doctors involved in RRS	42 clinicians interviewed	This was a Sandra Ryan Doctoral PhD Fellowship funded by the School of Nursing and Midwifery at Queen's University Belfast
Osborne et al., 2016	Australia	Determine the minimum core skills used when undertaking nursing assessments of hospitalised patients and identify nurse and workplace predictors of the use of physical assessment to detect patient deterioration.	Single centre survey	registered nurses working on general wards	434 acute care registered nurses/ midwives	No specific funding received.
Petersen et al., 2017	Denmark	To determine the barriers and facilitators of three aspects of the EWSS protocol, adherence to monitoring frequency; call for junior doctors to patients with an elevated EWS and call for the medical emergency team.	Focus groups	Nurses	18 nurses	The research was funded by unrestricted research funds from Trygfonden and the Capital Region of Copenhagen
Rattray et al., 2011	Scotland	To determine which characteristics, predict nurses' judgements of patient acuity and the likelihood of referral for further review.	Factorial survey design	Registered nurses working in acute care areas	99 nurses	No statement made on funding.
Rihari-Thomas et al., 2017	Australia	To understand how acute care clinicians experience and negotiate care for deteriorating patients within the RRS.	Focus group interviews	Physicians and nurses	21 physicians 13 nurses	No statement made on funding.
Shearer et al., 2012	Australia		Multi-method study; point prevalence survey, audit of staff and structure interviews	1) Adult inpatient charts on specified date/time 2) Clinical staff in the health service	91 interviews with clinical staff	This study was supported by a grant of $75,000 from the Victorian Managed Insurance Agency.
Smith and Aitken, 2016	England	To investigate how nurses, use a track and trigger chart to help plan implementation of the National Early Warning Scoring (NEWS) tool. 1- To report on triggers identified, frequency of different triggers and time taken to repeat observations for different triggers. 2- To explore the nurses perceived barriers and facilitators related to patient monitoring.	Mixed methods study	Registered nurses, student nurses and healthcare assistants	1-74 triggering patients over three-week period. 2-31 questionnaires completed by RNs, student nurses and healthcare assistants.	No statement made on funding.

Of the qualitative studies, five used focus groups to gather information (Elliott et al., 2015; Kitto et al., 2015; Martland et al., 2016; Rihari-Thomas et al., 2017; Petersen et al., 2017). The remaining six used a variety of descriptive exploratory and phenomenological designs (McGaughey et al., 2017; Donohue and Endacott, 2010; Currey et al., 2018; Burns et al., 2018; Hart et al., 2016; Liaw et al., 2017). The methods of the Quantitative studies involved surveys in five studies (Davies et al., 2014; Douglas et al., 2016; Fox and Elliot, 2015; Osborne et al., 2015: Rattray et al., 2011) and trials in the three other studies (Ludikhuize et al., 2011; Heal et al., 2017; Liaw et al., 2016). The methods used in the mixed methods studies included pre and post intervention, evaluation and interviews with clinicians (Aitken et al., 2015), data

collected from questionnaires and focus groups (Cherry and Jones, 2015) and point in times audits and interviews with staff (Shearer et al., 2012; Smith and Aitken, 2016).

Included studies originated from various countries, with nine being undertaken in Australia, six in the UK and Ireland, four in the USA, two in Singapore and one each in Denmark and the Netherlands. The name of the track and trigger charts vary throughout the studies with some studies examining more than one chart however the national early warning score and modified early warning score were the most common and were found in seven studies. Eight studies did not state which chart they were using or investigating often describing it as a standard early warning score or track and trigger chart (Aitken et al., 2015; Davies

et al., 2014; Hart et al., 2016; Kitto et al., 2015; Liaw et al., 2016; Rihari-Thomas et al., 2017; Shearer et al., 2012; Smith and Aitken, 2016). Likewise, the names for rapid response team vary throughout the studies and included rapid response system, critical care outreach team and medical emergency team, however rapid response team was the most common and used in ten studies (Aitken et al., 2015; Davies et al., 2014; Douglas et al., 2016; Hart et al., 2016; Heal et al., 2017; Kitto et al., 2015; Ludikhuize et al., 2011; Martland et al., 2016; Rihari-Thomas et al., 2017). A world map outlining track and trigger chart names and rapid response team names along with study locations is included in Fig. 2. Table 2 provides a summary of findings from each study. It also identifies details about the context of the research including the chart, the type of rapid response team and examination of the afferent limb only or both the afferent and efferent limbs (when this data was identified).

3.3. Synthesis of study results

Table 3 displays the data from the selected sub-categories within the Delivery Domain on effective practice and organisation of care taxonomy. Given that how nurses use tools which aim to improve patient safety is the focus of this review, it is not surprising that all but one of the studies met the criteria for quality and safety systems. Only four studies did not meet criteria for outreach services, referral systems and teams, whereas only three studies met criteria for disease management. Individually none of the studies met all criteria from the effective practice and organisation of care taxonomy, however seventeen met over 50% of the criteria, and just three met less than 25% of the criteria.

3.4. Thematic synthesis

We identified three themes from the qualitative synthesis of the articles namely, inconsistent activation of the rapid response team; barriers to following early warning score system algorithms; and overreliance on scores, we describe each in detail below.

3.4.1. Inconsistent rapid response team activation

Studies frequently showed nurses activation of the rapid response team was inconsistent finding some nurses called the rapid response team when they were unhappy with the treating team plan, whilst others didn't call the rapid response team when patients met criteria but didn't look unwell (Douglas et al., 2016). It was identified that some decisions to activate the rapid response team are influenced by the confidence of their inter-professional collegiality (Kitto et al., 2015). Some nurses prefer to call treating teams before activating the rapid response team whilst others called the rapid response team if the treating team are not responding appropriately (Aitken et al., 2015). Aitken et al. (2015) found that patients fulfilled a medical emergency call criterion on the early warning score system chart more often than the rapid response team were called to assess patients. It identified that nurses didn't often feel confident enough to activate the rapid response team but felt more confident in calling the intensive care outreach nurse.

Similarly, Davies et al. (2014) found that as familiarity and agreement with rapid response team activation criteria increased, clinicians were more likely to activate the rapid response team than those who were unfamiliar or believed the criteria to be incorrect. Douglas et al. (2016) found that nurses and junior doctors feared calling the rapid response team in case the patient was not found to be critically unwell. A significant amount of those surveyed in the study stated they would not call the rapid response team if a patient met criteria but did not look unwell. Shearer et al. (2012) found 42% of patients in the study did not have the rapid response system activated when they met criteria despite almost 70% of the staff recognising their patient met the criteria for activation and they were worried or concerned about their patient.

In contrast, an exploratory case study by Kitto et al. (2015) found that the rapid response team was activated when criteria were met or when communication between professionals broke down such as when nurses could not reach doctors through normal lines of communication or when there were interprofessional disagreements surrounding decisions that affect patient care.
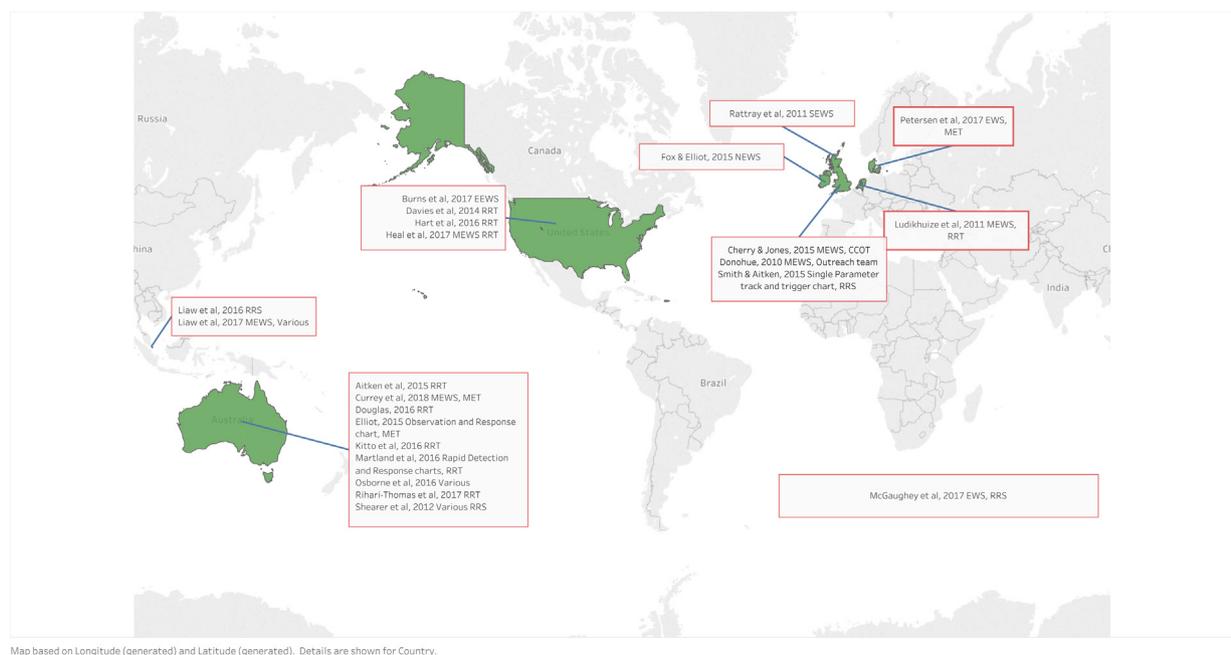

Map based on Longitude (generated) and Latitude (generated). Details are shown for Country.

Fig. 2. World map highlighting study locations, track and trigger chart and RRT names.

Table 2
Context and key findings of each study.

Author, year	Track and trigger chart	RRT type	Afferent or efferent	Key findings
Aitken et al., 2015	Not stated	Rapid Response Team (RRT)- multidiscipline team with ICU outreach nurse	Dual	Patients met Medical Emergency criteria, however treatment was often not initiated. Ward staff described not feeling confident enough to activate the RRT but were happy to call ICU outreach nurse. The statistical process control chart showed the dual RRT was associated with a non-significant trend towards an increase in the number of RRT calls, a non-significant decreased in cardiac arrest calls ($p = 0.22$) and a non-significant increase in the incidence of unplanned ICU admissions ($p = 0.45$).
Burns et al., 2018	Enhanced Early Warning Score (EEWS)	Not stated	Afferent	Nurses use the EEWS to identify early signs of deterioration and to review and evaluate clinical data to determine significance of changes in vital signs. The EEWS supported nurses in investigating, assessing and notifying physicians of deteriorating patients.
Cherry and Jones, 2015	Modified Early Warning score (MEWS)	Critical care outreach team (CCOT)	Dual	Scores are often miscalculated. Nurses don't obtain subjective data from patients, or consider their medical history decreasing the amount of information they gather. Nurses state it's difficult to get medical reviews when scores are high. The attitude of doctors varies dependant on the colour of the nurses' uniform.
Currey et al., 2018	MEWS	Physician led Medical Emergency Team (MET)	Dual	Clinicians are deficient in the knowledge and skills required to recognise and respond to deterioration. Clinicians lacked sufficient experience and didn't apply theoretical knowledge during practice. Nurses frequently documented fears of criticism or retribution for inappropriate referrals to the MET team. Increasing the number and skill level of nurses managing patients has been shown to decrease the rates of afferent limb failure.
Davies et al., 2014	Not stated	RRT Composition not stated	Afferent	As familiarity, perceived agreement with and benefit of activating the RRS increased the adherence rate increased, with statistical significance for familiarity with heart rate ($p = 0.01$), respiratory rate ($p = 0.017$) and change in mental status ($p=0.011$)).
Donohue and Endacott, 2010	MEWS	Outreach team composition not stated	Dual	The MEWS was used intermittently or too late and was not utilised to communicate with the outreach team. Nurses understand they need to give detailed information to the outreach team but continue to call them with little relevant information. To improve patient outcomes, teamwork and communication between ward and outreach staff needs to be improved.
Douglas et al., 2016	Standardized observation and response chart- Name not stated)	RRT Composition not stated	Afferent	Some RNs and Medical staff were reluctant to call RRT as they feared criticism if the patient was found not to be critically unwell. Over 50% of the sample said they were unlikely to activate the RRS based on the 'worried' criteria if the patients' vital signs were normal. 34.2% of medical respondents and 20% of RNs stated they would not activate the RRS of the patient met activation criteria when the patient did not look unwell ($p=<0.01$).
Elliott et al., 2015	Observation and Response chart	MET- Composition not stated	Afferent	Design features of the chart facilitated detection of patient deterioration. Respondents described experiencing difficulty in communicating actions recommended by the chart such as obtaining a response from medical officers. The attitudes of medical staff significantly impacted on the chart's acceptance as a tool in clinical practice.
Fox and Elliott, 2015	NEWS	Not stated	Afferent	Nurses from the sample reported that the NEWS was easy to use, helped improve their ability to identify patients who are unwell and did not increase their workload. 85% of those surveyed believed doctors didn't review patients within the recommended timeframe whilst 95% said it gave clear guidelines on what to do and 70% said it supported their decision on what to do. Nurses identified barriers to successful use of the chart included lack of training for doctors in the tool and doctors frequently failing to chart modifications to parameters for patients with chronic diseases.
Hart et al., 2016	Not stated	RRT Composition not stated	Afferent	Medical-surgical nurses have a key role to play in the identification and implementing responses to deteriorating patients, they are an essential link that helps escalate the level of care a patient requires. Medical-surgical nurses can identify and respond to early signs of deterioration beyond those identified by early warning score charts. Their knowledge level, experience and training all influence the cognitive, behavioural and technical skills used to manage deteriorating patients.
Heal et al., 2017	MEWS	RRT Composition not stated	Afferent	Computerised automatic RRT activation led to an increase in RRT calls in the intervention unit compared to the control unit ($p = 0.05$). The intervention demonstrated increased sensitivity to earlier patient deterioration ($p = 0.01$).
Kitto et al., 2015	Not stated	RRT- medical and nursing staff	Afferent	The RRS is activated when patients meet criteria and when collaboration between professionals breaks down, this use of the RRT occurs mostly when nurses cannot reach doctors via other pathways of communication or when there are interprofessional disagreements on decisions affecting patient care.
Liaw et al., 2016	Not stated	Rapid Response System (RRS) Composition not stated	Afferent	Nurses in the experimental group were more likely to monitor heart rate ($p = 0.01$) and respiratory rate ($p=0.05$). The performance of nurses in managing clinical deterioration ($p = 0.001$) and reporting of deterioration ($p = 0.001$) where both better in the experimental group than the control group.
Liaw et al., 2017	MEWS	Various	Dual	

Table 2 (Continued)

Author, year	Track and trigger chart	RRT type	Afferent or efferent	Key findings
Ludikhuize et al., 2011	MEWS	RRT composition not stated	Afferent	The education program enables nurses to develop, improve and refresh their ability to perform holistic physical assessments on deteriorating patients. Nurses trained in SBAR and using the MEWS were more likely to undertake action and notify a physician of an abnormality in patient observations than non-trained nurses. More trained than non-trained nurses assessed the patient immediately and on subsequent assessments more trained nurses measured respiratory rates of patients (p=-0.025)
Martland et al., 2016	Rapid Detection and response Charts	RRT Composition not stated	Afferent	30% of RRT clinicians work involves issues with end of life care making it clear the RRT is no longer solely focused on responding to patient deterioration. The RRT has become an outreach service that provides critical care services to the bedside a significant proportion of which includes end of life care.
McGaughey et al., 2017	Early Warning Score (EWS)	RRS composition not stated	Dual	Experienced nurses using clinical judgement and early warning score protocols that empowered nurses and influenced organisational change were key factors that enabled effective functioning of the RRS. Conversely low staffing, inappropriate staff skill mix and, poor communication processes and rigid implementation of protocols were major barriers to its effective use.
Osborne et al., 2016	Specific chart not stated	Various	Afferent	Patients on general wards need nurses to develop physical assessment skills beyond that of vital signs. The focus on vital signs can be partially attributed to the rise in early warning and rapid response systems diverting attention from comprehensive nursing assessment that could detect signs of deterioration earlier in a patient admission. Registered nurses utilise more skills than Clinical nurses whilst work area ($p = 0.002$) and clinical role ($p<0.001$) are significant predictors of the numbers and types of skills used.
Petersen et al., 2017	EWS	MET composition not stated	Afferent	During busy periods adherence to the recommended vital signs monitoring frequency would be neglected during busy periods for other tasks. It was deemed unrealistic to communicate with doctors about every patient with an elevated score due to the high number of patients with these. The MET were described as having negative attitudes making discussion and collaboration with them about patients problematic.
Rattray et al., 2011	Scottish early warning score (SEWS)	Not stated	Afferent	Scores generated by the SEWS was the most important predictor for referral behaviour amongst nurses. The study found nurses process complex information appropriately when deciding on assessments and whether to refer acutely unwell patients.
Rihari-Thomas et al., 2017	Not stated	RRT Composition not stated	Dual	Clinicians operate differently within the RRS dependant upon how they perceive its value as a tool for patient safety, how they communicate between disciplines also influences how they operate. Failure to activate the RRS can risk patient safety leading the develoment of serious adverse events. Ongoing training is required to evaulaate physicians roles within the RRS to ensure patient safety remains high.
Shearer et al., 2012	Various	RRS composition not stated	Afferent	42% of the patients deemed to be unstable didn't receive an appropriate clinical response. 69.2% of staff recognised their patient met the criterai for RRS activation and 75.8% were concerned about their patient. Sociocultural reasons were identified by staff in structured interviews as barriers that prevented them activating the RRS.
Smith and Aitken, 2016	Single parameter track and trigger chart	RRS composition not stated	Dual	Triggers were often identified in older patients and there was often a long-time interval between triggers being identified and a repeat set of observations being undertaken. Nurses identified workload, equipment availability, interactions between staff and interactions with patients as barriers that prevented correct adherence to patient monitoring.

3.4.2. Barriers to following early warning score system algorithms and rapid response team activation

Barriers to following early warning score system algorithms and activating the rapid response team appear to correlate with previous experiences with the rapid response team. Workloads also influence how stringently early warning score system algorithms are adhered too. Aitken et al. (2015) found confidence was a barrier that prevents nurses from activating the rapid response team, as do Burns et al. (2018) who explore this finding further. Worryingly, nurses had a fear of criticism and retribution for inappropriate referrals which directly contributed to afferent limb failure. Collaboration with the rapid response team appears to be arduous in some settings as the study by Petersen et al. (2017) identified who found the rapid response team to be problematic when called if the patient wasn't critically unwell.

Workload was a common theme that prevents nurses and doctors from following the algorithms laid out by the early warning score systems. Smith and Aitken (2016) identified there was often a delay between a trigger being identified and a repeat set of observations or a review being undertaken. Petersen et al. (2017) found that adherence to monitoring frequency would be neglected during busy periods. Additionally, collaboration and communication with doctors about patients with elevated early warning scores was deemed to be unrealistic due to the high number of patients with elevated scores. Nurses who participated in the surveys by Fox and Elliot (2015) identified that doctors need more training in the tool as they had a lack of understanding and therefore poor response times when called to review patients with elevated scores.

The scores themselves were often a bone of contention for nurses in one study who identified that patients often have elevated scores due to treating teams neglecting to chart modifications on the track and trigger charts for chronic diseases such as chronic obstructive pulmonary disease (Fox and Elliot,

Table 3
Selected Effective Practice and Organisation of Care criteria Delivery Arrangements.

Author, Year	1	2	3	4	5	6	7	8	9	Total /9
Aitken et al., 2015	✓	✓	✓				✓	✓	✓	6
Burns et al., 2018	✓	✓	✓		✓		✓		✓	6
Cherry and Jones, 2015	✓	✓	✓	✓		✓	✓		✓	7
Currey et al., 2018		✓		✓	✓		✓	✓	✓	6
Davies et al., 2014	✓	✓	✓	✓			✓	✓	✓	7
Donohue and Endacott, 2010		✓	✓				✓	✓	✓	5
Douglas et al., 2016	✓	✓	✓				✓	✓	✓	6
Elliott et al., 2015	✓	✓	✓	✓	✓	✓	✓		✓	8
Fox and Elliott, 2015		✓	✓				✓		✓	4
Hart et al., 2016			✓	✓			✓	✓	✓	5
Heal et al., 2017		✓	✓				✓		✓	4
Kitto et al., 2015		✓	✓	✓		✓	✓		✓	6
Liaw et al., 2016		✓								1
Liaw et al., 2017		✓		✓						2
Ludikhuize et al., 2011		✓	✓				✓	✓	✓	5
Martland et al., 2016	✓	✓	✓	✓	✓		✓	✓	✓	8
McGaughey et al., 2017	✓	✓	✓	✓	✓		✓		✓	7
Osborne et al., 2016		✓			✓					2
Petersen et al., 2017	✓	✓	✓	✓	✓		✓	✓	✓	8
Rattray et al., 2011		✓	✓				✓		✓	4
Rihari-Thomas et al., 2017	✓	✓	✓		✓		✓	✓	✓	7
Shearer et al., 2012		✓	✓	✓	✓		✓		✓	6
Smith and Aitken, 2016		✓	✓	✓	✓		✓	✓		6
Total /23	10	22	19	12	12	3	19	15	19	

✓ = criteria met.
Key
1. Co-ordination of care amongst different provider (Organizing different providers and services to ensure timely and efficient delivery of healthcare.).
2. Quality and Safety Systems (Essential standards for quality of healthcare, and reduction of poor outcomes related to unsafe healthcare).
3. Outreach Services (Visits by health workers to different locations, for example involving specialists, generalists, mobile units).
4. Care pathways (Aim to link evidence to practice for specific health conditions and local arrangements for delivering care).
5. Communication between providers (Systems or strategies for improving the communication between health care providers, for example systems to improve immunization coverage in LMIC).
6. Disease management (Programs designed to manage or prevent a chronic condition using a systematic approach to care and potentially employing multiple ways of influencing patients, providers or the process of care).
7. Referral systems (Systems for managing the referrals of patients between health care providers).
8. Shared care (Continuing collaborative clinical care between primary and specialist care physicians).
9. Teams (Creating and delivering care through a multidisciplinary team of healthcare workers).
(Effective practice and organisation of care, 2015).

2015). The incidence of falsely elevated scores was further compounded by nurses who miscalculated scores when undertaking observations, leading to both over and under reporting of vital sign changes, further increasing the workloads of both nurses and doctors (Cherry and Jones, 2015).

3.4.3. Overreliance on scores

Nurses appeared to rely heavily on the early warning score, seemingly privileging it over their own assessments. This is reflected in the survey by Rattray et al. (2011) who found the score generated by the Scottish early warning system was the most important indicator of referral to the rapid response team. Other researchers found that nurses often lack the knowledge and skills to recognise and respond to deterioration in patients (Currey et al., 2018). This is compounded by questionnaire results from Cherry and Jones (2015) whereby nurses identified track and trigger scores were often miscalculated leading to delays in recognising deterioration and therefore, afferent limb failure.

Furthermore, when assessing patients' nurses often neglected to consider their medical history which led them to call the rapid response team with little information, despite having an awareness that the rapid response team need background history when called to review deteriorating patients (Donohue and Endacott, 2010). However, researchers found that education programmes could improve nurses' knowledge and skills when performing a holistic assessment and handover of a deteriorating patient (Liaw et al., 2017). It is also important to note that a study on the experiences of nurses as first responders in clinical deterioration events found that they identified and responded to earlier signs of deterioration including abnormal physical assessment findings as well as changes in vital signs (Hart et al., 2016).

In respect of contemporary healthcare informatics, a quasi-experimental trial undertaken by Heal et al. (2017) in the USA whereby computer aided technology was used to activate the rapid response team, an increased incidence of activation was noted in the intervention unit in comparison to the control unit. Increased sensitivity of the computational equipment is believed to detect patient deterioration earlier.

4. Discussion

This scoping review of 23 studies identified that at times there was a reluctance amongst clinicians to activate the rapid response team when they were concerned about a patient or if they meet emergency criteria on the track and trigger chart (Douglas et al., 2016). It appears there may be several factors at play that influence whether or not clinicians activate the rapid response team. Common reasons for this include nurses' self-confidence, past experience with the rapid response team and fear of retribution or criticism from the rapid response team if the call was made and the patient wasn't critically unwell (Aitken et al., 2015; Douglas et al., 2016; Fox and Elliot, 2015).

Nurses on medical and surgical wards are often the first to identify the signs of deterioration in patients and are key players in escalating care appropriately to prevent the development of serious adverse events (Hart et al., 2016). The likelihood of nurses activating the rapid response team when patients meet criteria is acutely intertwined with their confidence and previous experiences with the rapid response team (Petersen et al., 2017). Experienced nurses are more likely to use clinical judgement and enable the effective use of early warning score systems including activation of the rapid response team whilst poor skill mix levels constrained the optimal use of early warning score systems (McGaughey et al., 2017).

Nurses have described early warning score systems as giving them clear instructions and directions to follow when patients begin to deteriorate however low levels of confidence and fear surrounding activation of the rapid response team preventing them from following the directions (Fox and Elliot, 2015). Lower levels of self-confidence amongst nurses can be attributed to feelings of inadequacy and believing they are unable to give senior clinicians quantifiable information about patients (Fox and Elliot, 2015). Conversely, over-confident nurses can also be detrimental to patients as they don't consistently activate the rapid response team when indicated to do so as they believe they could handle the situation without assistance (Petersen et al., 2017).

Experience is an important factor to consider when contemplating inactivation of the rapid response team due to fear or perceived criticism with false calls. It appears the rate of afferent limb failure of rapid response systems decreases as the experience and number of nurses' available increases (Currey et al., 2018). Perhaps this changes as experienced nurses' have interacted more frequently with the rapid response team and fear retribution or criticism from them less than inexperienced nurses. As experience increases, knowledge and familiarity with track and trigger charts should also increase including the triggers for activating the rapid

response team, which has been linked to increased rapid response team activation (Davies et al., 2014). Furthermore, educational interventions aimed at nurses and focusing on the use of early warning score systems and the management of deteriorating patients, have been shown to increase awareness, knowledge and management of deteriorating patients increasing the reporting of physiological abnormalities and decreasing afferent limb failure (Liaw et al., 2016).

A Danish qualitative review found nurses frequently raised concerns about their ability to adhere to the algorithms incorporated into track and trigger charts that aim to guide them when patients deteriorate (Petersen et al., 2017). Specifically, nurses experienced difficulty in ensuring actions recommended by the charts which include reviews by medical officers within a recommended timeframe due to elevated early warning scores were adhered too. The high numbers of patients with elevated scores were often thought to contribute to this issue, making it difficult for doctors to physically review the number of patients within the recommended timeframes (Petersen et al., 2017). This finding was reiterated in another study where the nurses expressed difficulty in getting medical officers to review patients with high scores due to their lack of familiarity and understanding of the charts and algorithms (Cherry and Jones, 2015).

Researchers have investigated how well the early warning score system escalation process is followed when patients deteriorate and whether observation frequency is increased, and reviews attended too (Odell, 2015). In another study there was often a delay between a trigger being reached and repeat observations undertaken, which the nurses reported was due to high workloads, scarcity of equipment and interactions between staff (Smith and Aitken, 2016). It is particularly worrying that nurses are indicating they cannot follow the algorithms due to high workloads or lack of equipment and could indicate health services do not have adequate resources or systems in place that ensure early warning score system algorithms can be followed.

The success of the algorithms used in early warning score systems relies on the mathematical skills of the clinician undertaking the observations and calculating scores. Unfortunately, miscalculations are frequent, often preventing correct escalation of deterioration (Cherry and Jones, 2015). Miscalculations can increase sensitivity and increase workload for the rapid response team and clinicians reviewing patients with falsely elevated scores. They can also allow deterioration to go on undetected putting patients at risk, therefore it is a challenge for nurses to delegate enough time to undertaking observations and calculating scores to ensure patient safety is not compromised.

Early warning scoring systems may result in an over-reliance on the scores generated by track and trigger charts which may have resulted in nurses moving away from performing physical assessment on patients and primarily focusing on vital signs and the early warning score (Osborne et al., 2015). It may be counter-intuitive for nurses' not to undertake holistic physical assessments and instead rely on the early warning score, as they may fail to detect earlier signs of deterioration that are apparent prior to vital sign derangement and elevated early warning scores (Osborne et al., 2015). A study in Scotland found that nurses focus more on early warning scores and individual observations rather than physical presentation when referring to the rapid response team (Rattray et al., 2011).

An additional component of track and trigger charts has been rapid response team activation criteria for nurses who are concerned about a patient. This element was introduced to try and empower nurses to refer patients earlier and prevent further deterioration in patients who are known to be unwell but not meeting specific criteria (Padilla et al., 2018). Unfortunately, if nurses are primarily concerned with the early warning score rather than a patient's physical presentation, they may be unlikely to refer

based on a worry criterion. This was confirmed in an Australian study that found both doctors and nurses were reluctant to call the rapid response team based on the worried criteria alone (Douglas et al., 2016). Whilst the worry criterion could be applied more, research has found that if communication breaks down or there are disagreements between clinicians then rapid response team activation based on the worried criterion is unlikely due to increased anxiety and fear of referring patients who are not unwell (Martland et al., 2016).

Communication appears to be a common thread throughout most of the studies with some highlighting rapid response team referral increased when normal lines of communication breaks down (Kitto et al., 2015). Others have found communication prevents rapid response team activation as nurses feel they do not have the skills or knowledge to provide quantifiable information to the rapid response team about the patient when they arrive (Donohue and Endacott, 2010). Furthermore, as was discussed earlier nurses delay rapid response team activation over fears of criticism and retribution from the rapid response team for false calls (Currey et al., 2018). The study by McGaughey et al. (2017) on rapid response systems found culturally embedded sub-optimal communication processes where a key barrier that prevented correct rapid response team activation.

Alerting other disciplines of changes in a patients' condition is a sequence of vulnerable steps where barriers to effective communication may exist at any point (Smith and Aitken, 2016). It is imperative that effective communication between nurses and teams takes place to ensure patient safety and effective functioning of the rapid response system (Rihari-Thomas et al., 2017). Early warning score systems have been described in some studies as helping build nurses confidence when communicating with medical officers. In particular, improved communication for rapid response team activation for a deteriorating patient results in information that is direct and to the point regarding patient conditions (Burns et al., 2018). However, for communication to improve further and to ensure the successful use of early warning score systems to keep patients safe in hospitals perhaps it is time to place principles before personalities. To achieve this, it may be necessary to increase the confidence and knowledge of junior clinicians through interactive simulated education sessions that involve members of the rapid response team (Bailey and Mixer, 2018).

4.1. Limitations

This scoping review is a broad overview of published research involving nurses use of the early warning score system and afferent limb failure. It used a systematised search strategy that is transparent and easily reproducible like the systematic review (Colquhoun et al., 2014). It is not an exhaustive review of all data sources on the subject and the search was run in only the MEDLINE, CINAHL and EMBASE databases, a limitation of the study. To expand the search and increase results yield the search could be repeated in other databases such as the Joanna Briggs Institute and Google Scholar. It could have also included non-research publications. Furthermore, retrospective searching of studies and examination of the reference lists was not undertaken, potentially further decreasing search results. However, the aim of this review was to provide a broad overview of published works related to the subject to inform the reader and help determine the necessity for further research on the subject, which has been achieved.

5. Conclusion

Overwhelmingly research investigation on this topic thus far has focused on the activation of the rapid response team by nurses

with several studies investigating barriers that prevent correct use and activation. It appears that there are several factors at play that prevent nurses from using the early warning score system appropriately. Barriers include confidence and experience amongst nurses along with previous interactions with the rapid response team. Nurses state track and trigger charts are easy to use and help guide them on intervening when patients deteriorate, however they also state that the algorithms are difficult to follow due to workload and resource availability. There is also evidence indicating that nurses rely heavily on scores generated by track and trigger charts rather than patient assessment and despite the introduction of the worry criteria for rapid response team activation many clinicians are reluctant to use it. Nurses use early warning score systems to maintain safety for hospitalised patients however education sessions focusing on building nurse confidence and increased resources and staffing in busy times can help to improve the function of early warning score systems and patient safety further (Cherry and Jones, 2015). As our findings indicated nurses pay greater attention to the scores generated by early warning score systems than other indicators of deterioration. As a result, recommended education programmes implemented on general medical/surgical wards could encourage nurses to incorporate a patient's visual presentation into their assessment when undertaking vital signs. Future studies are warranted to determine the efficacy of this approach. Finally, despite numerous systematic reviews examining barriers to rapid response team activation to the authors knowledge there is limited research focused on whether improving teamwork or increasing nurses' confidence actually facilitates earlier detection of patient deterioration and improve patient safety. It is clear that knowledge deficit alone cannot account for delayed activation. Good quality qualitative research and meta-summaries may provide important insights and may be beneficial prior to testing various interventions to improve nurses' confidence.

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Conflict of interest

There are no Conflicts of interest to declare

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ijnurstu.2019.03.012.

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