To identify the factors that influence the recognizing and responding to adult patient deterioration in acute hospitals

MRS MICHELLE TREACY (Orcid ID : 0000-0001-8219-3376)

Article type : Review

- **Short informative title**

To identify the factors that influence the recognizing and responding to adult patient deterioration in acute hospitals.

- **Short running title**
  Recognizing and responding to adult deterioration

- **List of all authors**
  Michelle TREACY, Senior Lecturer, University of West London, UK, MSc, RN
  (Corresponding author Michelle.Treacy@uwl.ac.uk Twitter @MichelleTreacy1)

  Louise Caroline STAYT, Senior Lecturer, Oxford Brookes University, UK, PhD, MSc, RN

- **Author contributions**

[(This will be published with your article. Please provide authors' initials as appropriate)]

Criteria	**Author Initials**
Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data;	MT, LCS
Involved in drafting the manuscript or revising it critically for important intellectual content;	MT, LCS
Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content;	MT, LCS
Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.	MT, LCS

- **Funding Statement**
  This secondary research received no specific grant form any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Aims: To identify factors that influence recognition and response to adult patient deterioration in acute hospitals.

Design: A Mixed-Studies Systematic Review.

Data sources: CINAHL, Medline and Web of Science were searched for relevant literature published between; 2007-2018.

Review Methods: Studies were critically appraised, data extracted and thematically analyzed.

Results: Thirteen papers met the inclusion criteria. Three main themes were identified: (1) Knowledge and understanding of clinical deterioration; (2) Organizational factors; managing deterioration and staffing levels; and (3) Communication; inter-professional relationships and professional-patient communication.

Conclusion: Despite national guidelines, the review findings suggest that the recognition and response to adult patient deterioration in acute hospital settings is sub-optimal. A multitude of factors influencing the recognition and response to adult patient deterioration emerged from the findings.

Impact:

Patients are receiving sub-optimal care due to failure in recognizing and responding to patient deterioration in an appropriate and timely manner. Nurses lack knowledge and understanding of deterioration. Organizational factors contribute to inadequate care and communication

among professionals was highlighted as challenging. The factors that influence the recognizing and responding to patient deterioration in acute hospitals are multi-faceted, however this review highlights immediate recommendations for professionals in the acute care setting.

Keywords: patient deterioration, clinical deterioration, rapid response teams, early warning score, acutely ill patient, vital signs, acute care, nurses, critical care, recognizing and responding to patient deterioration.

INTRODUCTION

Failure to recognize and respond to an acutely unwell and deteriorating patient in a timely manner has been highlighted as a global patient safety concern (National Confidential Enquiry into Patient Outcome and Death, NCEPOD, 2017; Department of Health, 2009; NCEPOD, 2007; National Institute for Health and Care Excellence, NICE, 2007; Buist et al. 2004; Kause et al. 2004). Despite efforts over the last decade to address this problem (Australian Commission on Safety and Quality in Health Care, 2016; Health Information and Quality Authority, 2012; NICE 2007; Berwick, Calkins, McCannon & Hackbarth, 2006; Department of Health, 2000), there is evidence that avoidable adverse events such as admission to critical care or cardiac arrests, are still occurring as a result of a failure to recognize and respond to acute deterioration in an effective and timely manner (Scott, Considine & Botti, 2015; Donaldson, Pansesar, & Darzi, 2014; Churpek, Yuen & Edelson, 2013; NICE, 2007). The purpose of this mixed-studies systematic review is therefore to identify the factors that influence recognizing and responding to adult patient deterioration in acute hospitals.

Background

A large-scale retrospective study by Donaldson, Pansesar & Darzi, (2014) reviewed 2,010 incidents recorded on the UK database, which revealed 23% were due to failure to recognize or respond to deterioration. A report by NCEPOD (2017) identified that vital signs were not consistently assessed or monitored as appropriate, resulting in patient's deterioration not being recognized. This led to 92/328 of the study's participants being admitted to critical care, where later 28% died. In America, Bapoje, Gaudiani, Narayanan & Albert, (2011), concluded almost 80% of the 152 patients with unplanned ICU admissions were avoidable. While in Australia, a retrospective study established that 9% of the in-hospital cardiac arrests were preventable, possibly due to failing to escalate and mismanagement of deterioration (Bingham et al. 2018). The ramifications of this leads to a growing demand for critical care beds (Intensive Care Society (ICS), 2015), with a 4% rise per annum anticipated (Intensive Care National Audit & Research Centre (ICNARC), 2018).

Many efforts have been made to address this growing concern. Early warning scoring systems (EWS)/Track and Trigger Scores (TTS) were developed as a method of addressing patients' needs by alerting appropriately skilled staff to the physiological clues that a patient is deteriorating (Donahue and Endacott, 2010; National Institute for Health and Research, NIHR, 2009). Furthermore, EWS are used in the clinical risk management for acute hospitals (Donahue and Endacott, 2010). NICE (2007) advocates the implementation of EWS in all acute hospitals. The National Early Warning Score 2 (NEWS2) developed by the Royal College of Physicians (RCP), (2017) has been validated as an effective tool in the recognition of deterioration. Other studies have suggested that it is equivocal (Alam et al. 2014; Gao et al. 2007). Gao et al. (2007) concluded their systematic review which included 36 studies, with the recommendation that EWS should only be used as an adjunct to clinical judgement.

Another international initiative to improve the management of deteriorating patients was the development of Rapid Response Teams (RRT), also referred to as medical emergency teams (MET) or Critical Care Outreach Teams (CCOT). RRT comprise of experienced critical care staff who are competent in managing patient deterioration (Sethi & Chalwin, 2018). A large multi-centre study assessed the impact of RRT and identified that the number of in-hospital cardiac arrests since their introduction were significantly less; the service is cost-effective and improves communication between the multi-disciplinary team (NIHI, 2009). Despite this, a systematic review by Chan, Jain, Nallmothu, Berg & Sasson, (2010) found insignificant evidence that RRT reduced hospital mortality. It is evident that despite these initiatives recognizing and responding to patient deterioration remains suboptimal.

THE REVIEW

Aim

The aim of this mixed-studies systematic review is to identify the factors that influence the recognizing and responding to adult patient deterioration in acute hospitals.

Design

This mixed-studies systematic review was conducted using a methodology informed by an integrated methodological approach which combines both qualitative and quantitative data in a convergent qualitative synthesis (Pearson et al. 2014; Pluye & Hong, 2014). The term "mixed-studies review", rather than mixed method review, has been used throughout this report to clarify that this review includes studies of diverse methodologies rather than being a review of studies that adopt mixed methods (Ploye and Hong, 2014; Hong et al. 2017). Pearson et al. (2015) suggest that a review of studies of diverse designs may maximize study

findings and more effectively inform evidence-based nursing practice. As the research question is focused on a complex and multifaceted aspect of patient care, a mixed-studies review allows qualitative and quantitative evidence to be collated to identify the range of factors that influence the recognition and response to the deteriorating adult patient in acute hospitals. The review has been reported according to both Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) (Moher et al. 2009) and the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) guidelines (Tong et al. 2012).

Search methods

Two literature search strategies were utilised. Firstly, the electronic databases, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline and Web of Science were searched in collaboration with the healthcare subject librarian. Key search terms incorporating synonyms and Medical Subject Headings (MeSH) were identified. These included "patient deterioration", "adverse health outcomes", "worsening prognosis", "acutely ill patient", "pre-cardiac arrest", "vital signs", "patient monitoring", "rapid response team(s)", "early warning score", "recognizing and responding to patient deterioration", "patient assessment" and "clinical deterioration", (see supplementary file 1 for the search terms used).

To limit the search and ensure only relevant data were included in the review, eligibility criteria were adopted;

Inclusion criteria

- Published, peer reviewed papers
- Focused on adult patients only

- Population of healthcare professionals working in the acute care environment only.
- English language
- Published between 2007 - 2018
- Primary research studies only

Exclusion criteria

- Studies conducted in the pediatric environment
- Studies conducted in the intensive care environment
- Research where recognizing and responding to adult deterioration was not a primary research aim or objective.

The second literature search strategy involved checking the backward and forward citations of selected studies.

Search outcomes

The results of the electronic database and reference list search are presented in Figure 1. The database search identified 354 studies. The evaluation of the forward and backward citations resulted in a further 25 studies being included in this review. Duplicates were removed which resulted in 322 papers. Both researchers evaluated the papers against the eligibility criteria based on the title and abstract, 289 papers were excluded as not relevant. 33 studies were assessed for eligibility, this led to 20 articles being excluded as they did not meet the inclusion criteria. This resulted in 13 papers being identified which met the inclusion criteria.

Quality appraisal

The Critical Appraisal Skills Programme (CASP) tool was used for the qualitative studies and sections of the mixed method papers (CASP, 2018), (Supplementary file 2). The Effective Public Health Practice Project (EPHPP) quality appraisal tool was used for the quantitative studies and sections (EPHPP, 2009), (Supplementary file 3). Each researcher evaluated the quality of each of the included studies independently and then together until a consensus was reached. No studies were excluded on the basis of their quality, as each study was of a similar methodological quality, of weak to moderate. Given the relative paucity of research in this area, inclusion of all studies was further justified (Dixon-Woods et al. 2006). (See supporting information 2 and 3 for the quality appraisal).

Data abstraction

Data from each study were extracted into a summary table (Table 1) and agreed by both researchers. The direct participant quotes from both the qualitative and the mixed methods studies can be viewed in supplementary file 4. The quantitative data has been extracted onto a table, please see supplementary file 5.

Data Synthesis

It is acknowledged in the literature that methods to synthesize mixed-studies data is emergent, varies greatly and is often poorly described (Pearson et al. 2014; Pearson et al. 2015; Hong et al. 2017). Hong et al. (2017) highlight the importance of providing a clear description of the synthesis design used. Qualitative and quantitative data were first organized into method specific tables and data were presented in original format (numbers and narratives), see supplementary files 4 and 5. This study then adopted an adapted

convergent qualitative synthesis approach where study data were transformed into qualitative themes using an inductive thematic synthesis (Pearson et al. 2014; Hong et al. 2017). In this process however data were largely preserved in original format and numerical findings from quantitative studies were presented under themes and in supplemental files in line with PRISMA reporting guidelines. The subsequent procedure followed for synthesizing the data is aligned with the steps for thematic analysis outlined by Nowell et al. (2017). Firstly, both researchers familiarized themselves with the data. This process involved reading and re-reading the included studies and extracting the relevant data and compiling onto a matrix which allowed for quantitative and qualitative data to be constantly compared and analyzed in parallel. Secondly, initial codes were generated and findings with similar codes were grouped together. The researchers kept the original included studies at hand to ensure the emerging codes were faithful to the original findings. This is recognized as a means of instilling rigor in a review of this type (Parahoo, 2014; Pluye and Hong, 2014). The initial analysis of each research study also allowed the researcher to draw inferences about why results were similar or different. In the third step, both researchers independently searched for themes by sorting and collating relevant coded data into tentative themes. Tentative themes were generated inductively with constant reference to the raw study data. Themes were then reviewed and refined in the fourth step. Coded data extracts for each theme were discussed between researchers and themes refined and re-organized until a consensus was reached. The final step was to define and name the themes. At this stage, themes were checked against the whole data set to ensure that the themes adequately reflected the original data. The scope and content of the final themes was then discussed and confirmed between both researchers.

RESULTS

Thirteen studies were included in the review, the PRISMA guidelines for quantitative studies has been used (Moher et al. 2009), (please see supplementary file 6) and the Enhancing Transparency in Reporting the Synthesis of Qualitative Research guide has been used for the qualitative studies (Tong et al. 2012), (please see supplementary file 7). The 2 qualitative studies were considered as moderate quality. Of the quantitative studies, 4 were considered of moderate quality and 4 of weak quality. The 3 mixed method studies were rated as weak. The included studies had relatively small sample sizes and outcome measures varied, however the findings are of importance to the aim of the review. Three main themes emerged from the included studies: (1) Knowledge and understanding of clinical deterioration; (2) Organizational factors; this included managing deterioration and staffing levels; (3) Communication; which included interdisciplinary relationships and communication between professionals and patients.

Knowledge and understanding of clinical deterioration

Eight studies, rated as weak to moderate quality, reported deficits in the knowledge and understanding of nurses in relation to clinical deterioration. The theme describes how there is a lack of knowledge and skill in relation to assessing deterioration (Endacott et al. 2007; Cioffi et al. 2009; Donohue and Endacott. 2010; Leuvan & Mitchell, 2008; Cioffi et al. 2010; Odell, 2015; Fasolino & Verdon, 2015; Mok et al. 2015). Three studies noted that nurses relied on vital signs for recognizing deterioration however, frequently lacked the appropriate skills (Osborne et al. 2015; Endacott et al. 2007; Leuvan & Mitchell, 2008). Both Endacott et al. (2007) and Cioffi et al. (2010) identified that basic assessment skills were lacking, with nurses using subjective methods to highlight concerns, such as nurses using a patient's level

of activity or if a patient was unusually quiet or withdrawn, as a marker for deterioration. In the same study, doctors expressed a preference for objective assessments, including information gained from basic assessment skills and observed that nurses did not consistently provide this information. Donohue and Endacott, (2010) identified that ward nurses were not consistent in detecting the subtle signs of deterioration and often only raised alarm when the patient had deteriorated to a catastrophic end.

Five studies identified variations in the frequency and quality in assessment of vital signs (Cioffi et al. 2009; Leuvan & Mitchell, 2008; Odell, 2015; Fasolino & Verdin, 2015; Mok et al. 2015). It was found that the assessment of respiratory rate (RR) was often omitted (Leuvan & Mitchell, *2*008; Odell, 2015; Mok et al. 2015). Mok et al.'s (2015) study, surveyed 234 registered and enrolled nurses in acute care settings and reported a limited understanding of the key indicators of deterioration. In particular, they highlighted that registered nurses and enrolled nurses lacked awareness of the significance of assessing a patient's RR; with nurses estimating RR 20% of the time. In addition, Mok et al. (2015) highlighted that enrolled nurses are often designated to assess vital signs, however their study found enrolled nurses less able to interpret vital signs. Furthermore, the moderate-rated study by Fasolio & Verdin (2015), identified that the assessment of patients' mental state and urine output was frequently missed, with patients less likely to have their vital signs assessed during night-time hours. Odell (2015), rated as moderate methodological quality, identified that more cardiorespiratory arrests occurred during unsociable hours, suggesting that the less frequent monitoring of vital signs during unsociable is having a direct impact on patient care.

Organizational factors – Managing deterioration

Eight papers, rated as weak to moderate, reported a variety of organizational factors that influence the management of deterioration. This theme discusses how factors such as work load and staffing levels influence the management of deterioration. Several studies suggest that using Early Warning Scores (EWS) in the recognition of deterioration may be beneficial, as when the patient triggers, it highlights the need for escalation (Rattray et al. 2011; Odell, 2015; Preece et al. 2012). The data from the studies demonstrated that EWS were often inaccurately completed, with either errors or omissions of vital signs (Odell, 2015; Preece et al. 2012). Odell (2015) identified that inaccuracies resulted in patients not being referred to escalation teams. When deterioration was detected, only 23% of cases followed the correct procedure for escalating care. Donohue and Endacott (2010) highlighted that nurse competence played a significant role in the recognition of patient deterioration.

Endacott et al. (2007) identified that despite nurses having concerns regarding a deteriorating patient being managed by a junior doctor, they did not consistently escalate care to a more senior physician. Donohue and Endacott (2010) identified that nurses expressed frustration at the delays in response from doctors, however they perceived RRT as being more responsive to their requests. A mixed method study by Lydon et al. (2015) highlighted nurses are using the EWS to escalate their concerns, however, felt that once the EWS had been reported by the nurses' they did not take any further responsibility. Furthermore, use of EWS was criticized by Lydon et al. (2015), as they posited that the use of EWS limits nurses' clinical judgement and subsequent role in recognizing deterioration. The qualitative data in this study indicated that Doctors mostly viewed EWS as positive, as EWS provides a clear process for referral to a more senior clinician. Doctors also revealed that when an elevated EWS was reported, they felt under pressure to perform interventions on the patient some of which were not always essential.

Endacott et al. (2007) reported that the admission category and the patient's level of co-morbidities were considered when escalating care, with staff admitting the frequency of vital sign assessment was often guided by the usual practice on the ward rather than the condition of the individual patient. A lack of clinical guidelines regarding vital sign assessment and escalation of patient deterioration was identified in two studies, (Endacott et al. 2007; Leuvan & Mitchell, 2008); however, it is acknowledged that these studies are now dated.

The observation chart design was highlighted as problematic by Preece et al. (2012), as depending on the order in which vital signs were placed on the chart, it influenced how likely they were to be assessed. This study highlighted that a population of healthcare professionals (nurses and doctors) made a similar number of errors in their documentation of vital signs on the EWS chart as a group of non-healthcare professionals (Preece et al. 2012). Chart designs were trialed in the study by Elliot et al. (2016) where modifications could be made based on the presentation and trend of the patient's vital signs, however the nurses identified that while it is a theoretically a good suggestion, they pre-empted that the chart would not be completed by doctors. The inability to see a patient's trend of vital signs was highlighted by Elliot et al. (2016) as a cause of concern when using the EWS charts. Charts frequently only require a dot aligned on a scale or a range of values. Nurses expressed concern that no exact values were required when plotting vital signs (Elliott et al. 2016).

Organizational Factors – Staffing levels

Six studies, rated as weak to moderate quality, identified that staffing levels and lack of time had an impact on recognizing and responding to patient deterioration. Mok et al. (2015) identified that a large proportion of nurses and enrolled nurses found vital sign assessment to be time consuming, which contributed to omissions. Nurses admitted that routinely they do

not check blood results; this task is allocated to the night staff, due to time constraints (Endacott et al. 2007). Odell (2015) identified that EWS were only completed in 83.7% of cases, possibly due to time constraints. Agency staff are often placed on wards due to staffing shortages, however, one study highlighted that agency staff may be unfamiliar with the environment and the local escalation policy on managing deterioration thus contributing to the level of error (Endacott et al. 2007). Donohue and Endacott (2010), identified that sometimes doctors are not available to come and review a patient, as they may be in clinic or off site. Osborne et al. (2015) established that lack of time was a perceived barrier in patient assessment. Qualitative data identified that junior doctors expressed concerning data that it was often down to luck if an ICU consultant was on site or not (Endacott et al. 2007). Reduced staffing levels during the night was highlighted as problematic (Lydon et al. 2015; Endacott et al. 2007). Reduced medical cover during night-time hours was highlighted as a barrier to escalation as doctors had many patients to review making appropriate prioritization challenging (Lydon et al. 2015; Endacott et al. 2007). Notably, Odell (2015) rated as moderate, established that more cardiac-respiratory arrests occurred during unsociable hours, where typically, fewer senior staff are on duty.

Communication - Inter professional relationships

This theme is informed by 4 studies, with methodological quality rated as weak to moderate. It describes how communication between professionals and between patients and professionals, influence the effective recognition and response to patient deterioration. Lydon et al. (2015) suggested that nurses often lacked an understanding of doctor's workload. Conversely, in a previous study by Endacott et al. (2007), nurses recognized the pressures faced by doctors, which resulted in the nursing staff providing support to doctors.

Lydon et al (2015) further reported that doctors expressed frustration that nurses often only reported the EWS but were unable to provide additional, pertinent, clinical information. A cross sectional survey of nurses (86.1%) and midwives (13.1%) by Osborne et al. (2015) identified that patient assessment mostly comprised of only vital sign assessment. In addition, the nurse participant in Lydon et al.'s (2015) study indicated that they felt that their key responsibility was to report the EWS, with one participant stating, 'once you call, you are protected', (Lydon et al. 2015 p.691). Furthermore, Endacott et al. (2007), highlighted that often doctors did not trust nurse's reports; doctors revealed that nurses often failed to provide objective information regarding the patient's condition, which resulted as a barrier to escalation. In Endacott et al.'s (2007) study, RRT members expressed concern that ward nurses often failed to recognize subtle signs of deterioration even when they have previously been asked to observe for them. RRT also identified that often a referral is made by a nurse who does not know the patient, merely the EWS which reflects Lydon et al.'s (2015) findings. The quality of these two studies were rated as weak, however their findings strongly resonate with each other strengthening their assertions.

Findings from both Endacott et al. (2007) and Donahue and Endacott (2010), identified a lack of communication, between junior and senior doctors with regards to patient deterioration, which often resulted in treatment delays. Endacott et al. (2007), established that despite nurses having concerns, they would not contact a more senior doctor; no rationale for this was given.

Professional-patient Communication

Two studies, one qualitative and one quantitative study using a survey for data collection highlighted the importance of effective communication between HCPs and patients. Both studies (Cioffi et al 2009; Cioffi et al. 2010) were rated methodologically weak to moderate. Language barriers emerged as a significant finding in the exploratory descriptive study carried out by Cioffi et al. (2009). Nurses expressed concern that a high proportion of the patients on their wards spoke no English; the primary language of the study site. Cioffi et al. (2009) concluded that if patients were unable to communicate with staff; it is a potential cause for deterioration going undetected. It was highlighted that particular patients may be cognitively impaired and unable to express their concerns. In the quantitative follow-up study by Cioffi et al. (2010) it emerged that 100% of the experienced nurse participants were aware that impaired mentation is a significant indication of deterioration, therefore nurses need to be able to assess cognition. While Cioffi et al. (2009) identified that due to some patient's cultural and religious views they may not be forthcoming with expressing their symptoms to HCPs.

DISCUSSION

This mixed-studies review offers a unique synthesis and analysis of qualitative and quantitative data relating to factors influencing the recognition and response to adult patient deterioration in acute care hospitals. The complexity of the factors reported reflect the complex nature of clinical care in an acute care setting and may offer insight into possible areas of practice amenable to improvement in an area of practice that we know to be sub-optimal.

The findings highlight that knowledge and understanding of clinical deterioration requires improvement. It was identified that nurses rely on the measurement of vital signs to detect deterioration, however the accuracy and frequency with which these are carried out is variable. Physiological deterioration is often challenging to detect (Andrews and Waterman, 2005). Vital sign assessment is a fundamental nursing skill and yet it was identified that appropriate RR assessment is frequently inadequate, which reflects the findings from other studies (McGain et al. 2008; NCEPOD 2005; Hillman et al. 2005). A report by Cretikos et al. (2008) highlighted RR as the neglected vital sign and in spite of improvements in care such as EWS, failure to assess RR is still commonplace. Conversely, more recent studies have established that nurses are aware of the significance of RR (Douglas et al. 2016; McDonnell et al. 2012). Measurement of RR is classed as a simple, cost effective and probably the most important vital sign (Kellett and Sebat, 2017), yet also often called the vexatious vital sign, as time, skill and patience are required (Kellett and Sebat, 2017; Lovett et al. 2005). It has been acknowledged that the reasons why nurses do not monitor RR are complex and multifaceted (Kellett and Sebat, 2017). Flenady, Dwyer & Applegarth (2016) propose that nurses are rationalizing transgression. This is a theory that explains how nurses are aware of the importance in assessing RR, but the fact that it takes time and they have numerous other priorities, eliminating RR is justified, this behavior may contribute to reduced job satisfaction and burnout (Nonnis, Massidda, Cuccu & Cortese, 2018; Flenady, Dwyer & Applegarth).

Results from this review suggest that it is often only when a patient displays significant alteration in their vital signs that escalation occurs. A previous study by Andrews and Waterman (2005) suggested that nurses may consciously wait until the deterioration is significant as they will not get a response from doctors in the early stages of deterioration. Whereas, Douglas et al. (2016) argue that assessment approaches have not evolved to meet

the current demands of clinical practice. It is evident that nurses sometimes estimate vital signs or omitted assessment of vital signs due to lack of time and staffing shortages. The Mid Staffordshire NHS Foundation Trust Public Inquiry (2013) investigated failings which resulted in high mortality rates, unsafe patient care and the provision of poor care. Lack of nursing staff was attributed to these failings as well as high usage of agency staff who were deemed unfamiliar with the environment. The World Health Organization (2018) acknowledge the continued global shortage of nurses, therefore there is no immediate solution to this problem.

The benefits of assessment tools such as EWS were reported however some health care professionals suggested that such tools removed the need for clinical judgment (Lydon et al. 2015). The Royal College of Physicians (2017) however emphasize that NEWS2 is not a substitute for competent clinical competence (RCP, 2017). The NCEPOD (2012) report into cardiopulmonary arrests in the UK, where the use of EWS were already in practice, established that signs of deterioration were often poorly recognized, infrequently acted on and infrequently escalated to more senior clinicians. The effectiveness of EWS has therefore yet to be established. The emphasis must therefore be shifted from the tool itself to the skill and competence of the clinical practitioner performing the clinical assessment (Grant, 2018).

The observation chart design was highlighted as a potential barrier in the recognition of deterioration for a multitude of factors. NEWS2 provides a standardized observation chart, in an attempt to provide patients with the same level of high-quality care (RCP, 2017), when correctly documented and implemented. The NEWS2 observation chart follows the ABCDE order (RCP, 2017). The clinician must map the patient's vital signs onto the chart and then

add up the total score, this has been shown to reduce the number of documentation errors and increased assessment of RR (Christofidis, Hill, Horswill & Watson, 2015). The findings from this review suggest further educational support regarding the assessment and documentation of vital signs and use of EWS is necessary.

Poor communication among healthcare professionals was identified in this review. The Joint Commission (2014) established that poor communication is a contributing factor in more than 60% of all hospital adverse events, including those linked in failure to recognize deterioration. The use of the situation, background, assessment and recommendations (SBAR) tool offers a solution to eliminating this (Muller et al. 2018). The SBAR tool, was developed to increase handover quality and a recent systematic review established that there is moderate evidence for improved safety through use of the tool, when communicating via telephony (Muller et al. 2018).

Professional relationships between nurses and doctors have long been seen as problematic (Chua et al. 2019; Chalwin et al. 2016; Douglas et al. 2016; Kitto et al. 2015; Massey, Chaboyer & Aiken 2014). A qualitative study identified that the perceived hierarchy between the medicine and nursing professional may halter escalation of care (Chua et al. 2019). A qualitative study, based in New Zealand with both nurses and doctors identified that mutual respect and trust is necessary for an effective working relationship (Pullon, 2008). This review reported that doctors admitted that they sometimes considered the location of the patient, along with what was usual practice in that ward area, rather than the concerns raised by the ward staff (Endacott et al. 2007). This lack of trust may be attributed to the fact that in some health care systems, nurses can be seen as subservient to clinicians and this creates a

potentially steep hierarchical gradient between them (Green et al. 2017a). Notably the increased use of agency staff allows little time for trust to be gained in the acute health care setting.

There is evidence of hierarchy existing in healthcare which is having a negative impact on patient care (Green et al. 2017b). The case of Elaine Bromiley, a previously healthy woman, undergoing elective surgery, died in 2013 due to a hypoxic brain injury after several failed attempts to intubate. Two of the nurses present in the anesthetic room subsequently reported that they had known what should have been done but had not asserted themselves because of the perceived hierarchy of the consultant anesthetists (Green et al. 2016). Results of this review suggests there remains a hierarchy in today's society, with the reluctance of nurses to escalate to more senior members. There is a strong body of evidence emerging which highlights the effectiveness of simulation as a teaching method among nurses and doctors to improve practice and working relationships (Aggarwal et al. 2010; Stayt et al. 2015; Goolsarran, Hamo, Lane, Frawley & Lu, 2018; O'Rourke, Horsley, Doolen, Mariani & Pariseault, 2018).

Communication between staff and patients was highlighted as a potential barrier to recognition of deterioration. This is specifically prevalent for patients with cognitive impairment as they may not be able to express their new symptoms which would alert the nurse to recognize deterioration. In 2017, it was predicted that there are globally 50 million individuals living with dementia, with this figure estimated to trend upwards (Alzheimer's Disease International, 2018).

Limitations

There are several limitations in this review, there was a relatively small number of studies included. While the heterogeneity of the studies included, in particular the methodology, sample size and location of these studies makes it more difficult to generalize the settings. The overall quality of the included studies is weak to moderate, no studies with a strong methodological quality were found. This review highlights several factors that influence the recognizing and responding to adult patient deterioration in acute hospitals, the focus is broad and further research is required to provide more information into what makes a positive impact on the recognition of deteriorating patients. The search strategy was limited to computerized databases and reference list searching, ideally a broader search strategy could have been used to include every unpublished primary research article which met the inclusion criteria, which could have been used to eliminate risk of publication bias.

CONCLUSION

This mixed-studies systematic review highlights that the factors that influence the recognition and response to adult patient deterioration in acute hospitals are complex and multifaceted. Failure to recognize and respond to a deteriorating patient undoubtedly has negative consequences on patient safety, therefore there is an impetus to effectively address these factors. Providing improved education and training in patient assessment to the nurses and increasing the numbers of skilled nurses in acute areas would certainly pave the way to addressing the problem, however, in a healthcare landscape where resources are increasingly limited, these high-cost strategies may not be immediately feasible. Equally challenging is improving communication and teamwork where a hierarchical culture is often embedded in clinical practice. Despite these challenges, health care providers must actively enhance the ability of nurses to recognize and respond to patient deterioration as the patient safety agenda

remains high in priority, with patient acuity and complexity of care is only set to increase in the future.

The lack of significance placed on vital sign assessment, the evidence of missed assessments and inaccurate documentation of vital signs highlighted in this review may be, in part, mitigated by the use of a standard vital signs' assessment protocol such as NEWS2. A tool such as this, where observations and assessments are listed in order of priority may highlight the important indicators of deterioration. The use of a standardized tool may also facilitate communication amongst professionals and provide objective assessment data to inform appropriate escalation of care and subsequent clinical decision making. However, the emphasis needs to be on developing clinically competent nurses, who have a clear professional identify.

Research investigating the human factors influencing the recognition of deterioration and escalation of care may offer further insight into the often insufficient communication and mistrust between different professional groups. There is a need for more large-scale robust research to be carried out in this area. While innovate methods of allowing health care providers access to post-qualifying education are required. The role of lecturer-practitioners may help reduce costs, with education delivery being provided on the hospital site. Global initiatives are required to attract individuals into the nursing profession, such as, highlighting the significance and value of nurses in improving patient outcomes.

In summary, this mixed-studies systematic review contributes to the current national and international research base into effective recognition and response to patient deterioration and

highlights some key factors that influence effective practice and critically, highlights areas that are amenable to improvement. Despite national guidelines addressing the need for changes to be implemented in 2007, it is evident from this review that the same failings remain evident in healthcare today. There are a multitude of factors which emerged from the findings. The recommendations offer small immediate solutions to help improve the practice of HCPs at local and national level.

Conflict of Interest statement

No conflict of interest has been declared by the authors.

References

About dementia | alzheimer's disease international. (2018). Retrieved October 3, 2018, from https://www.alz.co.uk/about-dementia

Aggarwal, R., Mytton, O. T., Derbrew, M., Hananel, D., Heydenburg, M., Issenberg, B., Reznick, R. (2010). Training and simulation for patient safety. Quality and Safety in Health Care, 19 (Suppl 2), i34–i43. https://doi.org/10.1136/qshc.2009.038562

Alam, N., Hobbelink, E. L., van Tienhoven, A. J., van de Ven, P. M., Jansma, E. P., & Nanayakkara, P. W. B. (2014). The impact of the use of the Early Warning Score (EWS) on patient outcomes: A systematic review. Resuscitation, 85(5), 587–594. https://doi.org/10.1016/j.resuscitation.2014.01.013

Andrews, T., & Waterman, H. (2005). Packaging: a grounded theory of how to report physiological deterioration effectively. *Journal of Advanced Nursing*, *52*(5), 473–481. https://doi.org/10.1111/j.1365-2648.2005.03615.x

Australian Commission on Safety and Quality in Health Care (2016). Vital signs, The State of Safety and Quality in Australian Health Care. Retrieved from https://www.safetyandquality.gov.au/wp-content/uploads/2016/11/Vital-Signs-2016-PDF.pdf

Bapoje, S. R., Gaudiani, J. L., Narayanan, V., & Albert, R. K. (2011). Unplanned transfers to a medical intensive care unit: Causes and relationship to preventable errors in care. Journal of Hospital Medicine, 6(2), 68–72. https://doi.org/10.1002/jhm.812

Berwick, D. M., Calkins, D. R., McCannon, C. J., & Hackbarth, A. D. (2006). The 100 000 lives campaign: setting a goal and a deadline for improving health care quality. JAMA, 295(3), 324. https://doi.org/10.1001/jama.295.3.324

Bingham, G., Bilgrami, I., Sandford, M., Larwill, S., Orosz, J., Luckhoff, C., & Kambourakis, T. (2018). Avoiding adult in-hospital cardiac arrest: A retrospective cohort study to determine preventability. Australian Critical Care, 31(4), 219–225. https://doi.org/10.1016/j.aucc.2017.05.002

Buist, M., Bernard, S., Nguyen, T. V., Moore, G., & Anderson, J. (2004). Association between clinically abnormal observations and subsequent in-hospital mortality: a prospective study. *Resuscitation*, 62(2), 137–141. https://doi.org/10.1016/j.resuscitation.2004.03.005

Chalwin, R., Flabouris, A., Kapitola, K. and Dewick, L. (2016) 'Perceptions of interactions between staff members calling and those responding to, rapid response team activations for patient deterioration', *Australian Health Review*, 40(4), p. 364. doi: 10.1071/AH15138.

Chan, P. S., Jain, R., Nallmothu, B.K., Berg, R.A. and Sasson, C. (2010). Rapid response teams: a systematic review and meta-analysis. Archives of Internal Medicine, 170(1), 18. https://doi.org/10.1001/archinternmed.2009.424

Christofidis, M. J., Hill, A., Horswill, M. S., & Watson, M. O. (2015). Less is more: the design of early-warning scoring systems affects the speed and accuracy of scoring. Journal of Advanced Nursing, 71(7), 1573–1586. https://doi.org/10.1111/jan.12618

Chua, W. L., Legido-Quiglet, H., Jones, D., Hassan, N. B., Tee, A. and Liaw, S. Y. (2019) 'A call for better doctor–nurse collaboration: A qualitative study of the experiences of junior doctors and nurses in escalating care for deteriorating ward patients', *Australian Critical Care*. doi: 10.1016/j.aucc.2019.01.006.

Churpek, M. M., Yuen, T. C., & Edelson, D. P. (2013). Predicting clinical deterioration in the hospital: The impact of outcome selection. Resuscitation, 84(5), 564–568. https://doi.org/10.1016/j.resuscitation.2012.09.024

Cioffi, J., Conway, R., Everist, L., Scott, J., & Senior, J. (2010). 'Changes of concern' for detecting potential early clinical deterioration: A validation study. Australian Critical Care, 23(4), 188–196. https://doi.org/10.1016/j.aucc.2010.04.002

Cioffi, J., Conwayt, R., Everist, L., Scott, J., & Senior, J. (2009). 'Patients of concern' to nurses in acute care settings: A descriptive study. Australian Critical Care, 22(4), 178–186. https://doi.org/10.1016/j.aucc.2009.07.001

Combining the power of stories and the power of numbers: Mixed methods research and mixed studies reviews. Annual Review of Public Health, 35, 29–45. https://doi.org/10.1146/annurev-publhealth-032013-182440

Cretikos, M. A., Bellomo, R., Hillman, K., Chen, J., Finfer, S., & Flabouris, A. (2008). Respiratory rate: The neglected vital sign. *Medical Journal of Australia, 188*(11), 657-9.

Critical Appraisal Skills Programme. (2018). CASP qualitative checklist. Retrieved from www.casp-uk.net

Department of Health (2000). Comprehensive critical care: a review of adult critical care services [Publication]. Retrieved October 3, 2018, from http://webarchive.nationalarchives.gov.uk/+/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4006585

Department of Health (2009). *Competencies for Recognising and responding to Acutely Ill Patients in Hospital.* Available at: http://webarchive.nationalarchives.gov.uk/20130123195821/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_096989 (Accessed: 15 January 2019).

Dixon-Woods, M., Cavers, D., Agarwal, S., Annandale, E., Arthur, A., Harvey, J., Sutton, A. J. (2006). Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups. *BMC Medical Research Methodology*, *6*(1). https://doi.org/10.1186/1471-2288-6-35

Donaldson, L. J., Panesar, S. S., & Darzi, A. (2014). Patient-safety-related hospital deaths in england: thematic analysis of incidents reported to a national database, 2010–2012. PLoS Medicine, 11(6), e1001667. https://doi.org/10.1371/journal.pmed.1001667

Donohue, L. A., & Endacott, R. (2010). Track, trigger and teamwork: Communication of deterioration in acute medical and surgical wards. *Intensive and Critical Care Nursing*, *26*(1), 10–17. https://doi.org/10.1016/j.iccn.2009.10.006

Douglas, C., Booker, C., Fox, R., Windsor, C., Osborne, S., & Gardner, G. (2016). Nursing physical assessment for patient safety in general wards: reaching consensus on core

skills. *Journal of Clinical Nursing*, *25*(13–14), 1890–1900. https://doi.org/10.1111/jocn.13201

Douglas, C., Osborne, S., Windsor, C., Fox, R., Booker, C., Jones, L. and Gardner, G. (2016) 'Nursing and Medical Perceptions of a Hospital Rapid Response System: New Process But Same Old Game?', *Journal of Nursing Care Quality*, 31(2), pp. E1–E10. doi: 10.1097/NCQ.0000000000000139.

Elliott, D., Allen, E., McKinley, S., Perry, L., Duffield, C., Fry, M., Roche, M. (2016). User acceptance of observation and response charts with a track and trigger system: a multisite staff survey. *Journal of Clinical Nursing*, *25*(15–16), 2211–2222. https://doi.org/10.1111/jocn.13303

Endacott, R., Kidd, T., Chaboyer, W., & Edington, J. (2007). Recognition and communication of patient deterioration in a regional hospital: A multi-methods study. Australian Critical Care, 20(3), 100–105. https://doi.org/10.1016/j.aucc.2007.05.002

Fasolino, T., & Verdin, T. (2015). Nursing surveillance and physiological signs of deterioration. Medsurg Nursing: Official Journal of the Academy of Medical-Surgical Nurses, 24(6), 397–402.

Flenady, T., Dwyer, T. and Applegarth, J. (2016) rationalising transgression: A grounded theory explaining how emergency department nurses rationalise erroneous behavior. Grounded Theory Review, 2(15).

Francis, R. (2013). The mid staffordshire nhs foundation trust public inquiry: executive summary. Presented to parliament pursuant to section 26 of the inquiries act 2005. London: Stationery Office. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/279124/0947.pdf (Accessed: 16 January 2019).

Gao, H., McDonnell, A., Harrison, D. A., Moore, T., Adam, S., Daly, K., Harvey, S. (2007). Systematic review and evaluation of physiological track and trigger warning systems for identifying at-risk patients on the ward. Intensive Care Medicine, 33(4), 667–679. https://doi.org/10.1007/s00134-007-0532-3

Goolsarran, N., Hamo, C. E., Lane, S., Frawley, S., & Lu, W.-H. (2018). Effectiveness of an interprofessional patient safety team-based learning simulation experience on healthcare professional trainees. BMC Medical Education, 18(1). https://doi.org/10.1186/s12909-018-1301-4

Grant, S. (2018). Limitations of track and trigger systems and the National Early Warning Score. Part 1: areas of contention. *British Journal of Nursing*, *27*(11), 624–631. https://doi.org/10.12968/bjon.2018.27.11.624

Green, B., Oeppen, R. S., Smith, D. W., & Brennan, P. A. (2017a). Challenging hierarchy in healthcare teams – ways to flatten gradients to improve teamwork and patient care. British Journal of Oral and Maxillofacial Surgery, 55(5), 449–453. https://doi.org/10.1016/j.bjoms.2017.02.010

Green, B., Parry, D., Oeppen, R., Plint, S., Dale, T., & Brennan, P. (2017b). Situational awareness - what it means for clinicians, its recognition and importance in patient safety. Oral Diseases, 23(6), 721–725. https://doi.org/10.1111/odi.12547

Health Information and Quality Authority (2012) General Guidance on the National Standards for Safer Better Healthcare. Retrieved from https://www.hiqa.ie/system/files/Safer-Better-Healthcare-General-Guidance_0.pdf

Hillman, K., Chen, J., Cretikos, M., Bellomo, R., Brown, D., Doig, G., Finfer, S., & Flabouris, A. (2005) Introduction of the medical emergency team (Met) system: a cluster-

randomised controlled trial. *The Lancet*, *365*(9477), 2091–2097. https://doi.org/10.1016/S0140-6736(05)66733-5

Hong, Q. N., Pluye, P., Bujold, M., & Wassef, M. (2017). Convergent and sequential synthesis designs: implications for conducting and reporting systematic reviews of qualitative and quantitative evidence. *Systematic Reviews*, *6*(1). https://doi.org/10.1186/s13643-017-0454-2

Intensive Care National Audit and Research Centre (ICNARC) – reports. (2018). Retrieved October 3, 2018, from https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports

Intensive Care Society (2015) Guidelines for the Provision of Intensive Care Services. Retrieved from https://www.ics.ac.uk/ICS/guidelines-and-standards.aspx

Kause, J., Smith, G., Prytherch, D., Parr, M., Flabouris, A., & Hillman, K. (2004). A comparison of antecedents to cardiac arrests, deaths and emergency intensive care admissions in Australia and New Zealand and the United Kingdom—the academia study. Resuscitation, 62(3), 275–282. https://doi.org/10.1016/j.resuscitation.2004.05.016

Kellett, J., & Sebat, F. (2017). Make vital signs great again – A call for action. *European Journal of Internal Medicine*, *45*, 13–19. https://doi.org/10.1016/j.ejim.2017.09.018

Kitto, S., Marshall, S. D., McMillian, S. E., Shearer, B., Buist, M., Grant, R., Finnigan, M. and Wilson, S. (2015) 'Rapid response systems and collective (in) competence: An exploratory analysis of intraprofessional and interprofessional activation factors', *Journal of Interprofessional Care*, 29(4), pp. 340–346. doi: 10.3109/13561820.2014.984021.

Leuvan, C. H. V., & Mitchell, I. (2008). Missed opportunities? An observational study of vital sign measurements. Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine, 10(2), 111–115.

Lovett, P. B., Buchwald, J. M., Stürmann, K., & Bijur, P. (2005). The vexatious vital: Neither clinical measurements by nurses nor an electronic monitor provides accurate measurements of respiratory rate in triage. *Annals of Emergency Medicine*, *45*(1), 68–76. https://doi.org/10.1016/j.annemergmed.2004.06.016

Lydon, S., Byrne, D., Offiah, G., Gleeson, L., & O'Connor, P. (2016). A mixed-methods investigation of health professionals' perceptions of a physiological track and trigger system. *BMJ Quality & Safety*, *25*(9), 688–695. https://doi.org/10.1136/bmjqs-2015-004261

Massey, D., Chaboyer, W. and Aitken, L. (2014) 'Nurses' perceptions of accessing a Medical Emergency Team: A qualitative study', *Australian Critical Care*, 27(3), pp. 133–138. doi: 10.1016/j.aucc.2013.11.001.

McDonnell, A., Tod, A., Bray, K., Bainbridge, D., Adsetts, D., & Walters, S. (2012). A before and after study assessing the impact of a new model for recognizing and responding to early signs of deterioration in an acute hospital: *Before-and-after study patient deterioration*. *Journal of Advanced Nursing*, *69*(1), 41–52. https://doi.org/10.1111/j.1365-2648.2012.05986.x

McGain, F., Cretikos, M.A., Jones, D., Van Dyk, S., Buist, M.D., Opdam, H., Pellegrino, V., Robertson, M.S. & Bellomo, R. (2008). Documentation of clinical review and vital signs after major surgery. *Medical Journal of Australia*, *189*(7), 380-383.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G., The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta- analyses: The PRISMA statement. PLoS Medicine, 6(7): e1000097. https://doi.org/10.1371/journal.pmed.1000097

Mok, W., Wang, W., Cooper, S., Ang, E. N. K., & Liaw, S. Y. (2015). Attitudes towards vital signs monitoring in the detection of clinical deterioration: scale development and survey of

ward nurses. International Journal for Quality in Health Care, 27(3), 207–213. https://doi.org/10.1093/intqhc/mzv019

Müller, M., Jürgens, J., Redaèlli, M., Klingberg, K., Hautz, W. E., & Stock, S. (2018). Impact of the communication and patient hand-off tool SBAR on patient safety: a systematic review. *BMJ Open*, *8*(8), e022202. https://doi.org/10.1136/bmjopen-2018-022202

National Confidential Enquiry into Patient Outcome and Death (2007). *Emergency Admissions: A journey in the right direction?* Available at: http://www.ncepod.org.uk/2007report1/Downloads/EA_report.pdf (Accessed: 9 January 2019).

National Confidential Enquiry into Patient Outcome and Death (2017). Inspiring Change A review of the quality of care provided to patients receiving acute non-invasive ventilation. Retrieved from https://www.ncepod.org.uk/2017niv.html

National Confidential Enquiry into Patient Outcome and Death (2012). Time to intervene? Retrieved from https://www.ncepod.org.uk/2012cap.html

National Confidential Enquiry into Patient Outcome and Death. (2005). *An acute problem?: a report of the national confidential enquiry into patient outcome and death(2005)* . London: NCEPOD. https://www.ncepod.org.uk/2005report/NCEPOD_Report_2005.pdf

National Institute for Health and Care Excellence (2007). *Acutely ill adults in hospital: recognising and responding to deterioration*. Available at: https://www.nice.org.uk/guidance/cg50/resources/acutely-ill-adults-in-hospital-recognising-and-responding-to-deterioration-pdf-975500772037 (Accessed: 9 January 2019).

National Institute for Health Research (2009). Critical care outreach services in the NHS. Retrieved from http://www.netscc.ac.uk/hsdr/files/adhoc/74-research-summary.pdf

Nonnis, M., Massidda, D., Cuccu, S. and Cortese, C. G. (2018) The impact of workaholism on nurses' burnout and disillusion, The Open Psychology Journal, 11, pp.77-88. doi: 10.2174/1874350101811010077

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*(1), 160940691773384. https://doi.org/10.1177/1609406917733847

O'Rourke, J., Horsley, T. L., Doolen, J., Mariani, B., & Pariseault, C. (2018). Integrative review of interprofessional simulation in nursing practice. The Journal of Continuing Education in Nursing, 49(2), 91–96. https://doi.org/10.3928/00220124-20180116-09

Odell, M. (2015). Detection and management of the deteriorating ward patient: an evaluation of nursing practice. Journal of Clinical Nursing, 24(1–2), 173–182. https://doi.org/10.1111/jocn.12655

Osborne, S., Douglas, C., Reid, C., Jones, L., & Gardner, G. (2015). The primacy of vital signs – Acute care nurses' and midwives' use of physical assessment skills: A cross sectional study. *International Journal of Nursing Studies*, *52*(5), 951–962. https://doi.org/10.1016/j.ijnurstu.2015.01.014

Parahoo, K. (2014). Nursing research: principles, process and issues. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=1453950

Pearson, A., White, H., Bath-Hextall, F., Apostolo, J., Salmond, S. & Kirkpatrick, P. (2014) Joanna Briggs Institute. *Joanna Briggs Institute reviewers' manual: 2014 edition.* Adelaide, South Australia: Joanna Briggs Institute.

Pearson, A., White, H., Bath-Hextall, F., Salmond, S., Apostolo, J., & Kirkpatrick, P. (2015). A mixed-methods approach to systematic reviews: *International Journal of Evidence-Based Healthcare*, *13*(3), 121–131. https://doi.org/10.1097/XEB.0000000000000052

Preece, M. H. W., Hill, A., Horswill, M. S., & Watson, M. O. (2012). Supporting the detection of patient deterioration: Observation chart design affects the recognition of abnormal vital signs. Resuscitation, 83(9), 1111–1118. https://doi.org/10.1016/j.resuscitation.2012.02.009

Pullon, S. (2008). Competence, respect and trust: Key features of successful interprofessional nurse-doctor relationships. Journal of Interprofessional Care, 22(2), 133–147. https://doi.org/10.1080/13561820701795069

Rattray, J. E., Lauder, W., Ludwick, R., Johnstone, C., Zeller, R., Winchell, J., Smith, A. (2011). Indicators of acute deterioration in adult patients nursed in acute wards: a factorial survey: Indicators of acute deterioration in adults. Journal of Clinical Nursing, 20(5–6), 723–732. https://doi.org/10.1111/j.1365-2702.2010.03567.x

Royal College of Nursing (2017). Patient Care 'at risk' as RCN research reveals 12,000 vacant nursing posts in London. Available at: https://www.rcn.org.uk/news-and-events/news/safe-staffing-report (Accessed: 15 January 2019).

Scott, B. M., Considine, J., & Botti, M. (2015). Unreported clinical deterioration in emergency department patients: A point prevalence study. Australasian Emergency Nursing Journal, 18(1), 33–41. https://doi.org/10.1016/j.aenj.2014.09.002

Sethi, S. S., & Chalwin, R. (2018). Governance of rapid response teams in Australia and New Zealand. Anaesthesia & Intensive Care, 46(3), 304–312. Retrieved from http://search.ebscohost.com.ezproxy.uwl.ac.uk/login.aspx?direct=true&AuthType=ip,shib&db=afh&AN=129401214&site=ehost-live

Stayt, L.C., Merriman, C., Ricketts, B., Morton, S., & Simpson, T., (2015). 'Recognizing and managing a deteriorating patient: a randomised controlled trial investigating the effectiveness of clinical simulation in improving clinical performance in undergraduate nursing students' *Journal of Advanced Nursing* 71 (11) (2015) pp.2563-2574. ISSN: 0309-2402 eISSN: 1365-2648

The Joint Commission (2014). Sentinel event data: root causes by event type 2004-2014. http://www.tsigconsulting.com/tolcam/wp-content/uploads/2015/04/TJC-Sentinel-Event-Root_Causes_by_Event_Type_2004-2014.pdf

Tong, A., Flemming, K., McInnes, E., Oliver, S., & Craig, J. (2012). Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ. BMC Medical Research Methodology, 12, 181. https://doi.org/10.1186/1471-2288-12-181

WHO | Nursing and midwifery. (2018). Retrieved February 12, 2019, from http://www.who.int/mediacentre/factsheets/nursing-midwifery/en/

Reference	Country	Study aim	Sample	Methods	Significant findings
Elliot et al. (2016)	Australia	To examine user acceptance with a new format of charts for recording observations and as a prompt for responding to episodes of clinical deterioration in adult medical-surgical patients.	477 healthcare staff	Survey with pen-ended comments	• Respondents were largely supportive of the chart format and content for monitoring patients, and as a prompt for escalating care. Some concerns were noted on chart style and size, the use of ranges to graph vital signs and with specific human factors design features. Information and training issues were identified to improve usability and adherence to chart guidelines and to support improved detection and response for patients with clinical deterioration.
Mok et al. (2015)	Singapore	To explore nurses' attitudes towards vital sign monitoring.	234 nurses (both registered and enrolled nurses [EN]) EN are identified as having basic nursing education with emphasis on technical skills.	Questionnaire	• 56.9% of nurses, mistakenly perceived blood pressure changes as the first indicator of deterioration. • 46% agreed that an altered respiratory rate was the least important indicator. • 59.8% of nurses reported relying on oxygen saturation to evaluate respiratory dysfunction. • 27.4% specified that they make rapid estimates of the respiratory rate. • Current practices for vital signs monitoring were considered to be time consuming (21.0%) and overwhelming (35.3%). • Nurses' attitudes were significantly influenced by whether they had a degree qualification followed by whether they worked in a general ward with a specialty and had >5 years of experience.
Fasolino & Verdin (2015)	USA	Investigate trends and documentation of vital signs.	79 patient case notes reviewed	Retrospective care review	• The frequency of vital signs taken within each time period ranged from just once to more than 10 times. • The average number of vital signs recorded during each time period varied. Midnight to 17:00 was 3.67; 16:00-09:00 was 5.13 and 08:00-00:00 was 6.39. • 22.8% of the sample had physiological measurements taken fewer than twice during the 24 hour period prior to referral to the RRT. • There was a lack of consistency of all vital signs being assessed and recorded. A statistical significance was found in heart rate ($p=0.034$) and Sp02 ($p=0.003$) which suggest changes in these values indicate pending deterioration. • Urinary output and Glasgow Coma Scale variables were part of the original data collection plan but since few entries were recorded data analysis could not be carried out on these variables.
Osborne et al. (2015)	Australia	To determine a minimum data set of core skills used during nursing assessment of hospitalised patients and identify nurse and workplace predictors of the use of physical	434 registered nurses and midwives	Survey	• Core skills used by most nurses every time they were on shift included assessment of temperature, oxygen saturation, blood pressure, breathing effort, skin, wound and mental status. Reliance on others and technology ($p < 0.001$), lack of confidence ($p = .020$, work area ($p = 0.002$) and clinical role ($p < .001$) were significant predictors of the extent of physical assessment skill use, lack of time and interruptions ($p < 0.05$).

		assessment to detect patient deterioration.			
Lydon et al. (2015)	Ireland	The study aimed to examine perceptions of a national physiological track and trigger system (PTTS) amongst nurses and doctors and to identify variables that impact upon intention to comply with protocol.	30 nurses and doctors participated in a series of semi-structured interviews. 215 nurses and doctors responded to a questionnaire.	Semi-structure interviews and questionnaire.	• Interview date revealed largely positive attitude towards the PTTS but not all, a number of barriers were highlighted as to its implementation and with evidence of tension between doctors and nurses. Doctor's views were slightly more negative on the use of PTTS compared to nurses.
Odell (2014)	UK	To audit nursing practice in the adherence to an early warning scoring protocol in the detection and initial management of the deteriorating patient and investigate factors that may impact on practice.	123 patient case notes, who had all experienced a cardio-respiratory arrest	Audit of practice, a predesigned data collection pro-forma was used	• The 123 CRA events included for analysis occurred on a mix of 8 surgical wards, 13 medical wards and 5 elderly care wards. • 23% of cases scored maximum for adherence to the protocol, with 50.4% failing to reach the minimum standard of practice. • Early warning scores were completed in 83.7% of cases but 24.3% were inaccurate. • Sixteen of the inaccuracies were scored below the trigger of 3 so did not get a referral but 15 of these have an actual score of 3 or more therefore should have had a referral for review. • Overall, 36.5% had an ineffective recording of EWS. • The content elements analysed only identified the day of the week as being statistically significant as more CRA occurred during unsociable hours. • Several potentially influential factors on nursing practice were tested, however only deterioration occurring outside normal weekdays was related with a reduced quality of nursing adherence to protocol.
Preece et al. (2012)	Australia	Evaluate the effect of observation chart design.	45 health professional and 46 novices (non-medical)	Questionnaire	• Chart type had a significant effect on error rates ($p < 0.001$), but health professionals made the same number of errors as novices ($p = 0.43$). • Chart type also had a significant effect on response times ($p < 0.001$). Health professionals replied faster overall than novices ($p = 0.006$); but, a significant interaction between chart type and participant group ($p = 0.02$) indicated that the health professionals' advantage was confined to the two most rudimentary charts. • No significant differences were found between doctors and nurses on either measure.
Rattray et al. (2011)	UK	Determine which professional, situational and patient characteristics predict nurse's judgements of patient acuity.	99 registered nurses	Individual vignettes	• An early warning score was the single most significant predictor of referral behaviour accounting for 9.6% of the variance. • When an early warning score was not included in the vignette, nurses used physiological characteristics e.g. respiratory rate, urine output, neurological status. • These explained 12% of the variance in the model predicting assessment of patient acuity and 9.4% or the variance predicting likelihood of referral.

Cioffi et al. (2010)	Australia	Determine the content validity of 'changes of concern' nurses used when calling the emergency response team to patients who were considered to meet the criterion 'patient of concern'.	10 registered nurses	Questionnaire	• The main findings indicate that the 10 'changes of concern' are agreed to be necessary to possibly identify early deterioration in adult patients that may require a call using the criterion 'patient of concern'. • The associated factors that relate to these 'changes of concern' are also confirmed to be necessary to assess when these changes are present in patients. • The 10 'changes of concern', utilised in the study were; noisy breathing, inability to talk in sentences, increasing supplementary oxygen to maintain oxygen saturation levels, agitation, impaired mentation, impaired cutaneous perfusion, 'not following expected trajectory', new or escalating pain, new symptom or new observation.
Donohue and Endacott (2010)	UK	To examine ward nurse and critical care outreach staff perceptions of the management of patients who deteriorate in acute wards.	11 nurses and 3 outreach staff	Semi-structured interviews	• Registered nurses looked at trends when assessing patients visually. Early warning scoring was not a key component of patient assessment and was used more commonly to quantify deterioration once the patient's changing condition had been recognised. Findings demonstrated tensions in team communication.
Cioffi et al. (2009)	Australia	The aim of the study was to identify the cues of potential early deterioration used to recognise 'patients of concern' who are not meeting the current objective physiological emergency response team calling criteria.	17 registered nurses	Exploratory descriptive approach, via focused interviews	• Main findings are ten identified changes of concern (cues): noisy breathing, inability to talk in sentences, increasing supplemental O2 requirements to maintain SaO2, agitation, impaired mentation, impaired cutaneous perfusion, not expected trajectory, new or increasing pain, new symptom, and new observation that nurses used to recognise potential early clinical deterioration. • Two mediating factors, such as cultural and linguistic diversity and cognitive impairment were also identified that negatively influenced the decision-making process.
Leuvan and Mitchell (2008)	Australia	Identify the frequency of vital sign assessment.	62 patient case notes reviewed	Retrospective observational study	• Blood pressure, heart rate and temperature were the most diligently recorded vital signs, but documentation of respiratory rate was poor. • Failure to perform vital sign measurements may underpin the failure to recognise patients in general wards whose condition is deteriorating.
Endacott et al. (2007)	Australia	Identify which cues nurses and doctors use to identify patient deterioration.	17 patient case notes; 17 doctors and 11 registered nurses	Case study design on the patient charts; semi-structured interviews with Health Care Professionals	• Inadequate communication was highlighted between clinicians and lack of process for ensuring timely management when patients deteriorate in a regional hospital. A lack of timely referral to a more senior clinician was identified. • The use of casual or locum staff who are less familiar with the clinical culture of regional hospitals may influence the recognition of, and response to, deteriorating ward patients. • All participants relied heavily on vital signs when it came to assessing deterioration. • While the patient's level of activity; if this was decreased it was perceived by the nurses as deterioration, along with the visual inspection of patients. • While doctors acknowledged the limited value of visual assessment which is brief for doctors due to limited time and work

					pressures. Doctors preferred the use of additional clinical investigations. • Admission category and level of co-morbidities increased clinicians' identification of deterioration but the detail of assessment was dictated by 'usual practice' for the regional hospital, the ward or the patient category. • From the 17 patient charts which were reviewed, 13 of them had clinical markers prior to ICU admission and 10 of these patients had these markers for >2 hours in the previous 24 hour period.

***Figure 1**: Process of paper selection - Transparent reporting of systematic reviews and meta-analyses (PRISMA)* (Moher et al. 2009).