

The impact of mandated use early warning system tools on the development of nurses' higher-order thinking: A systematic review

Author

Flenady, T, Connor, J, Byrne, AL, Massey, D, Le Lagadec, MD

Published

2024

Journal Title

Journal of Clinical Nursing

Version

Version of Record (VoR)

DOI

[10.1111/jocn.17178](https://doi.org/10.1111/jocn.17178)

Rights statement

© 2024 The Authors. Journal of Clinical Nursing published by John Wiley & Sons Ltd. This is an open access article under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

Downloaded from

<https://hdl.handle.net/10072/431296>

Griffith Research Online

<https://research-repository.griffith.edu.au>

SYSTEMATIC REVIEW

The impact of mandated use early warning system tools on the development of nurses' higher-order thinking: A systematic review

Tracy Flenady RN, BN (Dist), PhD, Associate Professor¹  |

Justine Connor RN, MPhil, Head of Course BN¹  |

Amy-Louise Byrne RN, PhD, Postgraduate Research Coordinator¹  |

Deb Massey RN, PhD, Professor of Nursing² |

Marie Danielle Le Lagadec RN, PhD², Assistant Head of Course BN¹ 

¹Central Queensland University,
Rockhampton, Queensland, Australia

²Edith Cowan University, Joondalup,
Western Australia, Australia

Correspondence

Tracy Flenady, Central Queensland
University, Bruce Highway, Rockhampton,
QLD 4701, Australia.
Email: t.flenady@cqu.edu.au

Funding information

Central Queensland University, Grant/
Award Number: RSH6503

Abstract

Aim: Ascertain the impact of mandated use of early warning systems (EWSs) on the development of registered nurses' higher-order thinking.

Design: A systematic literature review was conducted, following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and checklist (Page et al., 2021).

Data Sources: CINAHL, Medline, Embase, PsycInfo.

Review Methods: Eligible articles were quality appraised using the MMAT tool. Data extraction was conducted independently by four reviewers. Three investigators the-matically analysed the data.

Results: Our review found that EWSs can support or suppress the development of nurses' higher-order thinking. EWS supports the development of higher-order think-ing in two ways; by confirming nurses' subjective clinical assessment of patients and/ or by providing a rationale for the escalation of care. Of note, more experienced nurses expressed their view that junior nurses are inhibited from developing effective higher-order thinking due to reliance on the tool.

Conclusion: EWSs facilitate early identification of clinical deterioration in hospitalised patients. The impact of EWSs on the development of nurses' higher-order thinking is under-explored. We found that EWSs can support and suppress nurses' higher-order thinking. EWS as a supportive factor reinforces the development of nurses' heuristics, the mental shortcuts experienced clinicians call on when interpreting their subjective clinical assessment of patients. Conversely, EWS as a suppressive factor inhibits the development of nurses' higher-order thinking and heuristics, restricting the develop-ment of muscle memory regarding similar presentations they may encounter in the

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2024 The Authors. *Journal of Clinical Nursing* published by John Wiley & Sons Ltd.

future. Clinicians' ability to refine and expand on their catalogue of heuristics is important as it endorses the future provision of safe and effective care for patients who present with similar physiological signs and symptoms.

Impact: This research impacts health services and education providers as EWS and nurses' development of higher-order thinking skills are essential aspects of delivering safe, quality care.

No Patient or Public Contribution: This is a systematic review, and therefore, comprises no contribution from patients or the public.

KEYWORDS

clinical reasoning, early warning systems, higher-order thinking, nurses, systematic review

1 | INTRODUCTION

Early warning systems (EWSs), used to detect and manage clinical deterioration, have been widely implemented to support clinical decision-making and enhance patient safety (Seibert et al., 2021). These EWSs use patients' observed physiological data to detect signs of deterioration. Depending on the level of deterioration detected, clinicians are prompted to take action in line with pre-determined protocols (Le Lagadec & Dwyer, 2017). Patient deterioration detection tools have been mandated in many countries globally, with Australian healthcare facilities implementing EWSs over a decade ago (Australian Commission on Safety and Quality in Health Care, 2021; Rihari-Thomas et al., 2019). As a result, EWS tools have become an embedded component of contemporary nursing practice both nationally and internationally, with the first introduction to such tools often occurring during undergraduate studies (Butler, 2020; Saab et al., 2017). EWSs have become integrally embedded in clinical practice and the efficacy of these tools to detect patients' clinical deterioration has been well investigated (Kyriacos et al., 2019; Le Lagadec et al., 2020; Pimentel et al., 2018). However, the impact of the mandated use of EWSs on developing a nurse's higher-order thinking is under-explored.

1.1 | Background

The increasing complexity of healthcare provision and the requirement to deliver safe, quality patient-centred nursing care necessitates clinical competencies in higher cognitive skills, such as clinical judgement and reasoning (van Graan et al., 2016). While nurses must provide holistic, person-centred care (Delaney, 2018), there is emerging literature questioning the impact of EWS on nurses' critical thinking and the resulting impact on patient safety (Ansell et al., 2015; Gao et al., 2007; Jensen et al., 2019). Some researchers suggest that over-reliance on EWSs may impact the development of higher-order thinking in early career nurses (McGaughey et al., 2017; van Graan et al., 2016). Similarly, it has been suggested that EWS tools may create a dependence on numerical values rather than understanding

What does this paper contribute to the wider global community?

- This paper explores the relationship between the development of registered nurses' higher-order thinking and their use of early warning systems.
- The review uncovered a dichotomy within the literature, whereby some nurses suggest EWSs supports higher-order thinking, and others report the use of EWS suppresses the development of higher-order thinking in junior nurses.
- Further research on the impact of the mandated use of EWS is needed, particularly regarding the development of higher-order thinking skills in less experienced nurses.

the entire clinical picture and the individual patient's needs (Ansell et al., 2015; Jensen et al., 2019). Benner et al. (2008) articulated the requirement for nurses to have multiple thinking strategies to be effective safe clinicians, including critical thinking, clinical judgement, diagnostic reasoning, deliberative rationality, scientific reasoning, dialogue and argument, along with creative thinking. Researchers also argue that clinical judgement is applied as a reflective process, where the nurse's reasoning, drawn from all available data, is reconciled through the nurse's knowledge base, ultimately leading to a clinical conclusion (Connor et al., 2023). While nurses exercise clinical judgement and reasoning, the proficient nurse must practice forethought, understand the entire context within which the patient presents and plan nursing interventions accordingly (Benner et al., 2008). These thinking strategies, including clinical judgement and reasoning, are collectively referred to as higher-order thinking (Benner et al., 2008). Higher-order thinking skills encompass cognitive processes that go beyond basic recall and comprehension. We recognise that the term has roots in various disciplines, including both the humanities and sciences, leading to distinct interpretations based on philosophical and psychological frameworks (Paul &

Elder, 2006). In terms of our study, the emphasis is on the cognitive abilities that nurses employ in clinical decision-making, critical analysis and problem-solving within the healthcare setting. We do not exclusively align with a single disciplinary perspective but rather seek to capture the holistic nature of higher-order thinking as it applies to nursing practice (Benner et al., 2008).

Of concern, emerging literature suggests that reliance on tools, like EWS, may facilitate the bypassing of higher-order thinking techniques, where nurses rely only on the numerical score and associated clinical protocols to recognise deterioration and escalate patient care (Jensen et al., 2019). In fact, much of the research involving EWS tools reports multiple points of tension between standardisation and clinical judgement, rules and compliance and accountability and divisions of labour (Downey et al., 2017; Flenady et al., 2020; Molgaard et al., 2022; Nielsen et al., 2020). This has resulted in a conflicting understanding of the use and benefits of such tools. Indeed, many improvements in patient safety and the reduction of adverse events have been attributed to EWS tools (Credland et al., 2021). However, the impact of EWSs on the development of higher-order thinking skills in nurses is not clear. Hence this study provides an important opportunity to understand how nurses' higher-order thinking is impacted through the mandatory use of tools like EWS.

2 | THE REVIEW

2.1 | Aim

The aim of this systematic review was to ascertain the impact of mandated use of EWSs on the development of registered nurses' higher-order thinking. In this context, registered nurses are defined as nurses who have completed an approved program of nursing education and are currently registered to practice as nurses. This study is important when considering that the development and refinement of nurses' higher-order thinking is integral for the provision of safe and effective patient care. Findings from our study have the potential to be transferable to other industries that rely on clinical pathways, checklists or similar tools to guide decision-making, and may also inform the pedagogy of tools such as EWSs in undergraduate nursing curriculums.

2.2 | Design

A systematic mixed studies review (Pluye & Hong, 2014) was undertaken to describe, critically appraise and synthesise the literature on the impact of EWS on the development of nurses' higher-order thinking skills. The updated Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) was used to report review findings (Figure 1), and the study's reporting guidelines utilised the PRISMA checklist (Data S1) (Page et al., 2021). This review was registered with PROSPERO—CRD42022372671.

2.3 | Search methods

A comprehensive list of search terms (Appendix A), using a combination of keywords and subject headings/MeSH terms to reduce the risks of bias from inconsistent terminology, was used to identify potentially relevant articles in the Ovid Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Elsevier Embase and Ovid APA PsycInfo databases. There were no date or geographical limits set. The search strategy was developed in consultation with a CQUniversity librarian. The search was completed between 17 July and 15 August of 2022 and was updated on 11 August 2023.

2.4 | Eligibility criteria

For studies to be included in this review, they needed to pertain to nurses who are university-trained or similar, excluding enrolled nurses with diplomas or vocational certificates in nursing or unlicensed healthcare workers (nursing assistants). This is because we needed to assess the impact of EWSs on nurses in positions expected to employ higher-order thinking, as opposed to nurses in task-oriented positions, such as enrolled nurses or assistants in nursing positions. When studies included mixed cohorts of healthcare workers, for example, midwives, doctors and allied health workers, only studies that separated the data analysis via population were included because we were only interested in the impact on nurses. Therefore, we only analysed and reported data that were related to registered nurses. The studies needed to consider, and report on, the effect of implementing or utilising EWS on higher-order thinking skills such as clinical reasoning, critical thinking or clinical decision-making. With no limit on publication date, articles were included if the study was peer-reviewed, primary research, written in English and the full text was available. All types of peer-reviewed papers, including papers reporting results from primary research or quality improvement projects, were eligible.

All articles that met eligibility were imported into Covidence software and independently reviewed by two authors (JC and DLL). Where consensus on eligibility was not reached, a third author (TF) reviewed the article and resolved the conflict. Meetings were held with the entire research team to review the records and to ensure consensus on the included articles was reached.

2.5 | Quality appraisal

The quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). The MMAT is explicitly designed for appraising the methodological quality of quantitative, qualitative, and mixed methods studies and has demonstrated established validity and reliability (Pluye & Hong, 2014). None of the studies were found to be low quality, and no studies were excluded at the quality appraisal stage.

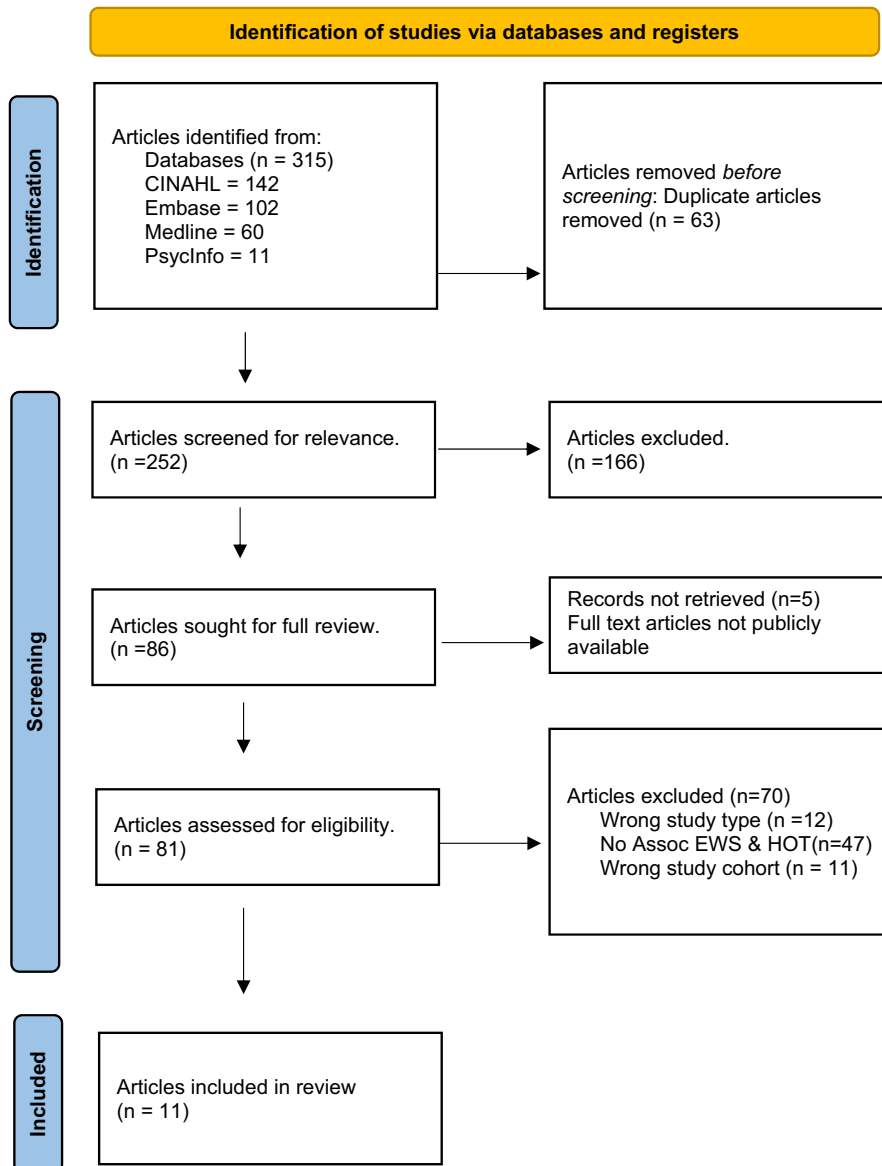


FIGURE 1 PRISMA flow chart for search strategy and outcomes.

2.6 | Search outcome

2.6.1 | Data abstraction and synthesis

A data extraction table was developed to enable the reviewers to apply evidence to address the review aims systematically. Data extraction occurred as an iterative process in which we continually extracted data and updated the data extraction table to best encapsulate the available information. Four reviewers (TF, DLL, JC, DM) undertook independent data extraction, with a random cross-check of 25% of the extracted papers. Finally, TF undertook a further thorough review and revision of all included studies to minimise the risk of bias or oversight.

Synthesis of the literature was conducted via thematic analysis using the work of Clarke and Braun (2017). Thematic analysis is a method used to identify, analyse and report themes within a data set, leading to a complete synthesis of the given topic (Clarke & Braun, 2017). In this case, the impact of EWSs on the development

of higher-order thinking in nurses. The data were collated for analysis and three authors (TF, AB, DLL) became familiar with the data through reading and re-reading, noting ideas and initial codes. Initial codes were generated, based on key features within the data, with these data collated under themes designated by the team. Meetings were held with all members of the team to discuss and expand on the codes before themes were reviewed and collapsed into overarching themes until consensus within the team was reached. Final themes were named and defined, leading to the finalisation and presentation of the thematic analysis against the defined aim of the article. A table providing an overview of the theming is included as Appendix B.

3 | RESULTS

Once all retrieved articles were screened for eligibility, 11 studies were included for analysis, a summary of which is provided in Table 1 (Burns et al., 2018; Cassidy et al., 2019; Dalton et al., 2018;

TABLE 1 Summary of articles included for analysis.

Authors, year, location	Population/setting	Design methods	Findings/comments	Relationship to higher-order thinking	MMAT score study limitations
<i>Quantitative studies</i>					
Fox and Elliott (2015) Ireland	Regional acute hospital. Staff nurses with experience in using EWS (NEWS) in medical and surgical wards (n = 74)	This quantitative study utilised a validated survey and then analysed using SPSS. A content analysis was conducted on open ended question responses	Nurses in this study found the use of NEWS helpful in escalating care by calling a doctor to review a patient's condition. Nurses placed high value on the tools to help them prioritise care, therefore the tool enhances the nursing care. Nurses were aware of the limitation of the NEWS but viewed the tool as a supplement to their own clinical judgement rather than replacing their clinical judgement	Around 70% of nurses in this study agreed that NEWS support their clinical decision making. Nurses specifically highlighted that in patients with hypertension and Acute Myocardial Infarction nurses needed to use clinical judgement to activate a medical review as the NEWS could not solely be relied on for this	4/5 Only information from medical-surgical nurses was collected and other members of the multidisciplinary team were not included. The focus was nurses' experiences of using NEWS and no attempt was made to audit patient records or measure actual response to patient times. Therefore, the findings must be interpreted as participants' perspectives, and it must be acknowledged that other healthcare team members may have different views
<i>Qualitative studies</i>					
Burns et al. (2018) USA	Community hospital—medical, surgical or telemetry unit; nurses and nursing supervisors (n = 25)	Qualitative study, descriptive phenomenological methodology, used semi-structured interviews, purposive sampling	Nurses in this study reported that investigating and prioritising escalation was clearer using the EWS. The EWS also had an impact upon organisational culture, with nurses in this study suggesting EWS had improved communication, increased collaboration, increased accountability, and proactive responses to deterioration	Participants in this study reported that EWS enhanced their clinical judgement and critical thinking, with the added bonus of improving communication and supporting a culture of escalation	5/5 Interview bias to report positively. Enhanced EWS is unique to this one hospital and results cannot be generalised

(Continues)

TABLE 1 (Continued)

Authors, year, location	Population/setting	Design methods	Findings/comments	Relationship to higher-order thinking	MMAT score study limitations
Cassidy et al. (2019) Canada	Nurses in children's hospital ($n = 15$ pre and $n = 8$ post-implementation)	Pre- and Post-Implementation, qualitative descriptive study	The study identified barriers in the implementation of CHEWS, a paediatric EWS, related to clinical decision making. Barriers included interprofessional relationships, unit context, and negative emotions toward the tool. Enablers included nurses associating CHEWS with quality of care and patient safety. The article concludes that tailored strategies are needed to implement such tools, including strategies which address nurses' perceptions of the tool	The post-implementation results of this study found that these tools can be used to support nurses' decision making, but that nurses may regard them as taking away judgement and critical thinking	2/5 Study only single study site, different nurses used in pre and post-implementation survey. No indication of education provided pre implementation
Dalton et al. (2018) United Kingdom	Nurses working in an acute NHS trust facilities ($n = 10$)	Qualitative approach, semi-structured interviews and thematic analysis	This study investigated the factors that influence how nurses assess acuity and their response to deterioration. The research identified some key themes including collegial relationships, intuition and interpretations of EWS	Nurses found that when the EWS did not indicate deterioration, but nurses were concerned, they felt challenged justifying their concerns. Nurse had no issues escalating care when the EWS indicated deterioration that aligned with their concern for the patient	5/5 Newly qualified nurses were excluded from the population, therefore the collected data only reported data from nurses with experience

TABLE 1 (Continued)

Authors, year, location	Population/setting	Design methods	Findings/comments	Relationship to higher-order thinking	MMAT score study limitations
Elliott et al. (2015) Australia	Nurses who had received training on EWS tools (n = 218)	Focus groups studies, thematic analysis of findings	Key themes arising from this research included: vital sign ranges versus precision to support decision making, using generalist EWS chart in various clinical specialist practice areas, issues with clinical credibility, professional autonomy of nurse; positive, negative and mixed views were evident regarding EWS use. Work based cultures, boundaries between disciplines and communication were raised as barriers to optimal use of the EWS charts	Nurses in this study expressed that the tool was not always in sync with their clinical judgement. More experienced nurses used judgement to escalate care in conjunction with the tools	3/5 Authors stated that the study had limited understanding of chart design/ characteristics, which has the potential to impact findings
Foley and Dowling (2019) Ireland	Nurses using EWS tools	Phenomenological approach. Data triangulation between non-participant observations (n = 9), semi-structured interviews (n = 8) and document analysis	Key findings are summarised as protocol adherence versus clinical judgement, parameter adjustment and escalation, culture—a task driven approach and poor communication processes. The study highlighted the need for more training with EWS tools and the need for behaviour change and cultural shifts	Nurse reported that the protocol for EWS were too rigid, not allowing for clinical judgement. Nurses often used the tools to validate their own judgements. More junior nurses could not interpret data due to insufficient clinical judgement	4/5 Case study approach examined only one setting, limiting generalisability. Potential for Hawthorne effect as nurses knew they were being observed

(Continues)

TABLE 1 (Continued)

Authors, year, location	Population/setting	Design methods	Findings/comments	Relationship to higher-order thinking	MMAT score study limitations
Jensen et al. (2019) Norway	Hospital nurses in a Norwegian hospital (n = 14)	Qualitative hermeneutic design, semi-structured in-depth interviews	The study looked at the implementation of the National Early Warning Score (NEWS) and the perceived impacts on professionalism. Findings included four tension areas: using NEWS versus clinical judgement in patient assessment, tension in community of practice, tension relating to NEWS rules and compliance, NEWS resulting in more work for nurses	Professional competence in this context was considered clinical judgement and discretion, accountability. The NEWS study found a positive association between NEWS and professionalism, however when it comes to accountability, a wide understanding outside of NEWS was needed	5/5 A hermeneutic approach guided this study, and this approach relies on the researcher's self-awareness to interpret the data. Some information about the researcher is included to allow readers to judge the credibility of the research
Langkjaer et al. (2021) Denmark	Six Danish hospitals with registered nurses from medical, surgical, and emergency departments (n = 45)	Qualitative exploratory design. Focus groups and content analysis	This study explored how registered nurses' experiences and perceptions with NEWS impact upon identifying patient deterioration	Overall, it found that NEWS was meaningful to identifying deterioration, but frustrating due to lack of flexibility. The study cautioned that an over-reliance on the NEWS systems could impact clinical judgement	5/5 Interviewer bias and the issue of giving the most socially acceptable response is potential study limitations when using focus groups. However, interviewer bias was controlled using co-moderators, who compared to the facilitator were experienced researchers

TABLE 1 (Continued)

Authors, year, location	Population/setting	Design methods	Findings/comments	Relationship to higher-order thinking	MMAT score study limitations
Langkjaer et al. (2023) Denmark	Ward nurses from six regional and university hospitals in Denmark (n = 32)	Ethnographic analysis	The aim of this study was to explore how nurses use the NEWS and I-EWS and how these systems support their patient risk assessment practice. Three categories emerged during analysis: (1) Effects on nursing practices, (2) NEWS requires local adaptations and (3) I-EWS affects nurses' professionalism	I-EWS seemed to trigger critical thinking among nurses, as they were enabled to adjust the score. This critical thinking meant that the nurses paid attention to the single parameters and not only the aggregated score. Hence, the opportunity to adjust gave the nurses an easy and safe way to signal their concerns to both nursing colleagues and to the physician	5/5 Nurses' use of NEWS and I-EWS during night shifts do not form part of this study. To overcome this limitation, if nurses talked about an experience the EWS during a night shift, this was included in the field notes
Molgaard et al. (2022) Denmark	Registered nurses on two wards in a Danish hospital (n = 10)	Focused ethnographic qualitative study, including interviews	This study found that nurses were ambivalent regarding the use of EWS, prioritising their own clinical judgement over the EWS. When EWS supported their judgement, the tool was used to optimise patient care	EWS were used in a way to support the nurses' clinical judgement or given a lower priority when EWS did not support the nurses' judgement	5/5 Nurse Unit Managers as gate keepers may have influenced the sample. Limited discussion about sampling strategy, one setting. EWS used not described
Stafseth et al. (2016) Norway	Nurses implementing a modified EWS (n = 7)	Exploratory qualitative investigation—focus groups	Themes include experiences with the early recognition of deterioration using the MEWS, supportive collaboration and knowledge transfer between nurses, a 'new' precise language using the score for communication with physicians	In this study nurses reported a new confidence in the recognition and management of deterioration. The EWS allowed for more open and 'non-critical' communication and interactive learning, and supported the nurses' clinical decision-making	3/5 Nurse Unit Managers as recruiters. Limited discussion about sampling strategy, one setting

Elliott et al., 2015; Foley & Dowling, 2019; Fox & Elliott, 2015; Jensen et al., 2019; Langkjaer et al., 2021, 2023; Molgaard et al., 2022; Stafseth et al., 2016). The aim of this systematic review is to ascertain the impact of mandated use of EWSs on the development of registered nurses' higher-order thinking. Along with one study conducted in the UK, there were three from Denmark, two from Norway and Ireland and one from Australia, Canada and the United States of America. While all 11 studies involved registered nurses, the number of participants per study varied between 7 and 218. Our analysis of the 11 included studies revealed that the use of EWSs can support or suppress the development of nurses' higher-order thinking. We identified two overarching themes that explain how nurses' use of EWSs can inform, rather than override their decision-making and is helpful when escalating care, and in contrast, is sometimes thought to suppress the development of higher-order thinking.

3.1 | EWS supports the development of higher-order thinking

Ten of the eleven included studies (Burns et al., 2018; Cassidy et al., 2019; Dalton et al., 2018; Elliott et al., 2015; Foley & Dowling, 2019; Fox & Elliott, 2015; Jensen et al., 2019; Langkjaer et al., 2023; Molgaard et al., 2022; Stafseth et al., 2016) indicated that the EWS was seen as a resource that supports the development of nurses' higher-order thinking. Our data analysis revealed that EWS' objective data has two main functions when supporting nurses' development and actualisation of their higher-order thinking, (1) the EWS objective data confirm nurses' subjective clinical assessment of patients, and (2) the EWS provides a rationale for the escalation of care.

3.2 | Informs, rather than overrides, decision-making

All but one study (Langkjaer et al., 2021) indicated that when used as a supporting mechanism, the EWS was used to inform, rather than override, nurses' clinical assessment of the patient. For example, a study that sought to investigate the impact of EWSs on nursing practice found that nurses placed a high value on the tool and believe the EWS helps them prioritise care, enhancing the care they deliver (Burns et al., 2018). Burns et al. (2018) said that rather than hinder critical thinking, as many EWS critics claim, nurses from their study reported that the EWS increased their awareness of changes in a patient's condition, resulting in earlier response and reassessment times.

Importantly, participants from eight studies (Burns et al., 2018; Elliott et al., 2015; Foley & Dowling, 2019; Fox & Elliott, 2015; Jensen et al., 2019; Langkjaer et al., 2023; Molgaard et al., 2022; Stafseth et al., 2016), noted that EWSs did not override nurses' decision-making on the delivery of treatment or escalation of

care actioned. To illustrate how the use of EWSs did not inhibit nurses' decision to escalate care, participants from the Fox and Elliott (2015) and Stafseth et al. (2016) studies, indicated that when patients with specific medical conditions required assistance and their EWS score did not indicate the need for escalation, the nurses employed their clinical judgement to activate a review regardless of the EWS score. This was also the case with nurses in the Elliott et al. (2015) study, who indicated the tool's calculation of physiological derangement was not always in sync with nurses' clinical assessment of the patient.

More experienced nurses used their clinical judgement to escalate care in conjunction with the tool's data, rather than in isolation (Elliott et al., 2015). Participants from the Langkjaer et al. (2023) study went so far as to say that they do not always follow the escalation protocol because sometimes it just does not make sense to do so. Conversely, when the tool suggested escalation was required, and nurses did not agree with the tool's escalation guidelines, nurses employed their clinical judgement to manage the patient without escalating care (Foley & Dowling, 2019). Nurses stressed the importance of incorporating objective data to inform their clinical assessment of patients and felt reassured when the objective data from the EWS supported their clinical judgement (Jensen et al., 2019). An overall finding from a study involving Danish nurses (Molgaard et al., 2022) sums up many of our included studies when they reported that nurses used EWSs to support their clinical judgement when the tool's score aligned with their assessment, but when the score was lower than their assessment, they gave more priority to their clinical judgement than to the EWS.

3.3 | EWS helpful when escalating care

Participants in various studies (Burns et al., 2018; Dalton et al., 2018; Fox & Elliott, 2015; Langkjaer et al., 2023) found EWSs especially helpful when rationalising nurses' requests for support when they were concerned about the declining health of patients. Nurses in a regional hospital in Ireland found EWSs useful when calling for a doctor to review a patient's condition because the tool provided objective data supporting their clinical assessment (Fox & Elliott, 2015). Furthermore, a study assessing the impact of EWSs on nurses' practice (Burns et al., 2018) found that nurses used EWS's visual prompts (colour codes and numerical values) as communication points when summoning a physician to review the patient. These nurses felt that the EWS was useful when involving doctors in the early stages of care and that the tool provided the impetus they needed to support their subjective clinical assessment of the patient. Nurses in the UK study (Dalton et al., 2018) said that while the EWS was useful in authenticating their decision to escalate care when the score was high, when the patient's physiological response did not score high enough to warrant a doctor review, they felt frustrated. When this occurred, the nurses were still likely to escalate care, but said the EWS score undoubtedly aided the process. It is noteworthy to report studies

that claim the EWS objective data provides less experienced nurses with the gravitas required to summon a doctor (Jensen et al., 2019). Examples of this phenomenon were accompanied by statements that using the EWS in this way supported the development of nurses' confidence in their clinical assessment and decision-making (Burns et al., 2018; Langkjaer et al., 2021; Stafseth et al., 2016).

3.4 | EWS suppresses the development of higher-order thinking

While 10 of the included studies presented evidence that an EWS supports the development of higher-order thinking in nurses, some of these studies also reported findings that contradicted this. Eight studies report that nurses believe EWSs suppress higher-order thinking (Cassidy et al., 2019; Dalton et al., 2018; Elliott et al., 2015; Foley & Dowling, 2019; Fox & Elliott, 2015; Jensen et al., 2019; Langkjaer et al., 2021; Langkjaer et al., 2023). It is worth noting that of these eight, all except Langkjaer et al. (2021) also reported positive outcomes.

3.5 | Relying on objective data

An interesting observation is that whenever studies included findings that the EWS inhibits the development of nurses' higher-order thinking, the data presented were framed as 'third party' evidence. For example, nurses did not claim that using the EWS inhibited their own higher-order thinking, but stated their belief that the EWS was breeding a culture whereby junior nurses were encouraged to respond to objective EWS scores, rather than trust their subjective clinical assessment of the patient. Participants from an Australian study involving over 200 nurses felt the use of EWSs caused less experienced nurses to second guess their assessment of patients (Elliott et al., 2015). They believed that EWSs inhibited the development of nurses' higher-order thinking by creating a dependency on objective data. The Elliott et al. (2015) study explained that more experienced nurses combined their clinical judgement and the EWS protocols when escalating care but stated that less experienced nurses were becoming reliant on the scoring system. Thus, EWSs are responsible for deskilling the next generation of nurses.

Reinforcing this evaluation, nurses from the Elliott et al. (2015) study advocated for junior staff to be supported in developing their subjective clinical assessment skills rather than encouraging them to rely solely on EWS objective data. This sentiment was shared by participants from the Foley and Dowling (2019) study, who expressed concerns that junior nurses could not interpret data due to their underdeveloped clinical judgement and that their reliance on tools such as EWSs inhibited their ability to develop their higher-order thinking. Dalton et al. (2018)'s study, involving nurses from the UK, investigated the factors influencing nurses' assessment of patients' clinical acuity. The research identified that when the EWS was not showing deterioration, but nurses were concerned, nurses had difficulty

justifying their concerns when escalating care. This study also highlighted that nurses relied on the EWS numerical summation to identify clinical deterioration, rather than employ their own subjective clinical assessment of the patient. Similarly, authors of a Danish study (Langkjaer et al., 2021) involving 45 nurses cautioned that less experienced nurses' over-reliance on EWSs has the potential to impact the development of their clinical judgement. The authors of the Langkjaer et al. (2021) study surmise junior nurses' over-reliance on EWS was partly due to their fear of making mistakes as well as their motivation to avoid potential legal consequences resulting from inaccurate documentation and subsequent treatment.

3.6 | One-size-fits-all too rigid

Participants from a study that described how nurses use the EWS in an acute medical ward (Foley & Dowling, 2019) felt that EWS protocols were too rigid and did not facilitate the development of higher-order thinking in junior nurses. The study accentuated the need for more training with EWS tools accompanied by a behaviour change and cultural shift concerning less experienced nurses' unwavering reliance on EWS protocols. Regarding EWS rigidity, some nurses expressed concern that the tool tries to provide a one-size-fits-all solution. A Canadian study involving pre and post focus groups, examined the effect of implementing an EWS (Cassidy et al., 2019). When the nurses were asked pre-implementation what they thought of the EWS, they surmised that the EWS would enhance their critical thinking and lead to more confident decision-making. However, when the same nurses participated in a post-implementation focus group, they reported negative feelings, claiming that the one-size-fits-all approach of EWS protocols hampered nurses' ability to employ their higher-order thinking and led to them second guessing their decisions.

4 | DISCUSSION

Early warning systems are important quality and safety tools that have been embraced by healthcare providers to improve recognition and response to patient deterioration (ACSQHC, 2017; Downey et al., 2017). There is no doubt that EWS have made a significant and important contribution to patient safety and are effective in promoting recognition of patient deterioration (Credland et al., 2021; Gao et al., 2007). However, concerns have been raised about their impact on nurses' skills, knowledge, scope of practice and the 'one-size-fits-all' EWS (Jensen et al., 2019; Langkjaer et al., 2021, 2023).

The role and importance of nurses and how they use EWSs has been recognised (Langkjaer et al., 2023; Massey et al., 2016; Wood et al., 2019). The EWS provide the means to support recognition and response to patient deterioration. However, without the addition of nurses higher-order thinking to support the EWS, nurses' full potential may never be realised. Importantly, EWSs may also dilute or suppress nurses higher-order thinking (Langkjaer et al., 2021) which may

negatively impact patient safety. The impact EWSs have on nurses' higher-order thinking is under-explored. Our study addresses this gap in knowledge.

Our analysis of the 11 included studies revealed that using EWSs can support or suppress the development of nurses' higher-order thinking. In terms of supporting, the EWS has two main functions (1) EWS objective data confirms nurses' subjective clinical assessment of patients (Burns et al., 2018; Dalton et al., 2018; Fox & Elliott, 2015), and (2) the EWS provides a rationale for the escalation of care (Fox & Elliott, 2015; Jensen et al., 2019). Nurses have described the EWS as an important adjunct to their clinical practice because it provides clear instructions and directions when patients begin to deteriorate (Langkjaer et al., 2023; Wood et al., 2019). These prompts are important in clinical practice, particularly with novice practitioners (Benner et al., 2008; Levett-Jones et al., 2010). We argue that the use of the EWS supports and reinforces the development of nurses' heuristics. That is, they facilitate the development of a mental shortcut for interpreting their subjective clinical assessment of a particular patient's clinical status, promoting the effective use of EWSs (McGaughey et al., 2017).

We identified that although the EWS supports the development of nurses' higher-order thinking, in some cases, it also has the potential to dilute and suppress these important skills. Our analysis of the literature identified that more experienced nurses feel junior nurses may lack experience when interpreting EWS objective data in the context of effective higher-order thinking (Cassidy et al., 2019; Elliott et al., 2015; Langkjaer et al., 2023). Senior nurses believe junior nurses are inhibited from developing effective higher-order thinking because of their reliance on EWS (Elliott et al., 2015). Importantly, it was perceived that junior nurses often hesitate in making decisions that contradict the EWS score, and we believe that this practice inhibits the development of their heuristics, restricting the enhancement of muscle memory regarding similar presentations they may encounter in the future. This suppression of higher-order thinking impacts on patient safety because nurses are not able to apply clinical judgement to complex clinical situations (Connor et al., 2023; Coulter Smith et al., 2014). Importantly, confidence and efficacy in recognising and responding to patient deterioration may be reduced in the presence of an EWS. Confidence is one of the most significant influences supporting nurses to make accurate clinical judgements (Schuster et al., 2016).

Other researchers also found that the EWS undermines professional competence, confidence and hamper nurses clinical reasoning because they become conditioned to follow a standardised system. This system uses guidelines that promote objective and rigid clinical decisions (Langkjaer et al., 2023; Salt, 2013) rather than critical thinking and judgement. This may lead to deskilling of nurses' higher-order thinking (Downey et al., 2017; Jensen et al., 2019). Salt (2013) identified that participants in her study reported feeling patronised by being mandated to use an EWS to identify clinical deterioration and preferred to use their clinical judgement. Despite this, many nurses continue to justify their actions based on their use of an EWS, not on their clinical judgements. However, it is also important to

reiterate that EWS were developed as an adjunct to nurses' clinical decision-making and should not replace clinical judgement (Connor et al., 2023). Although EWSs have been modified to suit different clinical settings, for example, NEWS2-L developed for dyspnoeic patients (Villanueva-Rábano et al., 2021), NEWS2-3 for prehospital emergency settings (Martín-Rodríguez et al., 2023) and MEWS used in obstetric patients (Kern-Goldberger et al., 2022), they remain rigid tools which do not accommodate interpatient variations (Grant, 2018). The one-size-fits-all belief about EWS (Langkjaer et al., 2023) directly contradicts the patient-centred model of care (Grover et al., 2022), and there remains an important opportunity to develop an EWS that recognise the heterogeneity of patients who deteriorate (Langkjaer et al., 2021; Nielsen et al., 2020, 2022).

We argue that using EWSs requires nurses to collect, interpret and analyse a wealth of patient data and this complex process requires pattern recognition (Benner et al., 2008; Langkjaer et al., 2023; Tanner, 2006). This pattern recognition requires the collection, understanding and interpreting of vital signs (Douglas et al., 2016; Langkjaer et al., 2021, 2023) and an understanding of the role and importance of other clinical indicators (technical and non-technical) of clinical deterioration (Currey et al., 2018; Douw et al., 2015). Nurses use their higher-order thinking to effectively interpret these complex data sets, identifying subtle changes in a patient's condition that may indicate early signs of deterioration and then use advance communication skills to disseminate their findings (Douw et al., 2015; Romero-Brufau et al., 2019). The nurses' development, consolidation and use of higher-order thinking skills is imperative in promoting patient safety (Connor et al., 2023; Levett-Jones et al., 2010; Williams et al., 2022). Our findings also indicate the benefit of standardised responses to patient deterioration as well as the need for higher-order thinking. By using their higher-order thinking skills nurses also develop their professional identity. Clearly, there is an important opportunity for researchers, educators and healthcare providers to explore how EWS can be used in conjunction with supporting the development of nurses higher-order thinking.

4.1 | Limitations

This review was limited to studies involving registered nurses, early warning tools and the development of higher-order thinking, and as such, more nuanced articles pertaining to the development of higher-order thinking may have been inadvertently excluded.

The search was limited to published academic literature; hence practice protocols, procedures or policies were excluded for analysis. However, an analysis of higher-order thinking was unlikely to occur with such grey literature.

From the 11 included studies, only one uses quantitative methodology. We acknowledge the observed skew and recognise the potential influence of the philosophical orientation of nursing research. The complex and context-dependent nature of nursing practice often lends itself to qualitative methodologies, allowing for a deeper

exploration of experiences, perceptions and contextual factors that contribute to higher-order thinking.

4.2 | Implications for practice

EWSs are useful tools which enhance patient safety by helping nurses recognise and manage clinical deterioration. Their on-going implementation in healthcare should be encouraged. However, EWSs should not be viewed as an alternative to critical thinking but as an adjunct to good nursing assessment. Given junior nurses' lack of experience in recognising patient deterioration, they may have difficulty making decisions that contradict the EWS protocol. Blindly following the EWS escalation protocol inhibits the development of their heuristics, restricting the enhancement of muscle memory regarding similar presentations they may encounter in the future. Junior nurses should be given additional support to encourage the development of their higher-order thinking.

4.3 | Implications for undergraduate nursing education

Findings from this systematic review provide an important opportunity for higher education providers to ensure their curricula promotes strategies to develop nurses' higher-order thinking. Prioritising the integration of training, development and practice of higher-order thinking skills, including clinical judgement and reasoning as essential components of the curriculum, cannot be understated. Educators should carefully consider the role of EWS tools in the education of nursing students. While these tools can support higher-order thinking, educators should be mindful of potential drawbacks and work to strike a balance that encourages critical thinking development.

4.4 | Implications for future research

Future quantitative research on this topic is crucial to complement the existing predominantly qualitative evidence. While qualitative methodologies provide valuable insights into the nuanced aspects of nursing practice, a balanced research approach incorporating quantitative methods is essential for establishing broader generalisations and statistically significant associations. Quantitative studies can contribute to a more comprehensive understanding of the relationships between variables, providing a foundation for evidence-based interventions and policy decisions in the context of nursing education and practice.

5 | CONCLUSION

The training, development, and practice of higher-order thinking, including clinical judgement and reasoning, is essential to

delivering safe, quality nursing care. This review has found that EWS tools can be viewed dichotomously—at times supporting nurses' higher-order thinking and at other times, suppressing the development of critical thinking skills. The EWS as a supportive factor reinforces the development of nurses' heuristics, the mental shortcuts experienced clinicians call on when interpreting their subjective clinical assessment of patients' clinical status. Conversely, EWSs as a suppressive factor inhibits the development of nurses' heuristics, restricting the development of muscle memory to inform similar presentations they may encounter in the future. Clinicians' ability to refine and build on their catalogue of heuristics is important as it expands on their ability to provide safe and effective treatment to patients who present with the same, or similar, physiological signs and symptoms in subsequent episodes of care. This in turn contributes to the on-going development of their higher-order thinking. Our study has found that while standardised approaches to the detection, management and escalation of deterioration are important for patient care, careful consideration of the development of higher-order thinking in the context of EWS tools should be a priority to health services, education providers and policy makers alike.

AUTHOR CONTRIBUTIONS

TF, JC, A-LB, DM, MDLL made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data, made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data, and 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. TF 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.

ACKNOWLEDGEMENTS

We would like to acknowledge Ms Kathryn Ritchie, CQUniversity Senior Librarian, for her invaluable assistance in developing a database search strategy for this systematic review. Open access publishing facilitated by Central Queensland University, as part of the Wiley - Central Queensland University agreement via the Council of Australian University Librarians.

FUNDING INFORMATION

This work was supported by a CQUniversity Internal Grant, RHS6503. The funding body was not involved in the planning or execution of this study and did not contribute to this manuscript.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

As this is a systematic review, all data supporting this study are listed in the reference list.

TRIAL REGISTRATION

This study has been registered with the International Prospective Register of Systematic Reviews database (PROSPERO), registration number CRD42022372671.

ORCID

Tracy Flenady  <https://orcid.org/0000-0002-5286-4789>

Justine Connor  <https://orcid.org/0000-0003-0684-3597>

Amy-Louise Byrne  <https://orcid.org/0000-0002-8679-8310>

Marie Danielle Le Lagadec  <https://orcid.org/0000-0003-0114-8552>

REFERENCES

- ACSQHC. (2017). *National safety and quality health service standards*. Australian Commission on Safety and Quality in Health Care.
- Ansell, H., Meyer, A., & Thompson, S. (2015). Technology and the issues facing nursing assessment. *British Journal of Nursing*, 24(17), 886–889. <https://doi.org/10.12968/bjon.2015.24.17.886>
- Australian Commission on Safety and Quality in Health Care. (2021). *National safety and quality health service standards*. ACSQHC.
- Benner, P., Hughes, R., & Sutphen, M. (2008). Clinical reasoning, decisionmaking, and action: Thinking critically and clinically. In R. Hughes (Ed.), *Patient safety and quality: An evidence-based handbook for nurses*. Agency for Healthcare Research and Quality. <https://www.ncbi.nlm.nih.gov/books/NBK2643/>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 93.
- Burns, K. A., Reber, T., Theodore, K., Welch, B., Roy, D., & Siedlecki, S. L. (2018). Enhanced early warning system impact on nursing practice: A phenomenological study. *Journal of Advanced Nursing*, 74(5), 1150–1156. <https://doi.org/10.1111/jan.13517>
- Butler, Z. A. (2020). Implementing the National Early Warning Score 2 into pre-registration nurse education. *Nursing Standard*, 35(3), 70–75. <https://doi.org/10.7748/ns.2020.e11470>
- Cassidy, C. E., MacEachern, L., Best, S., Foley, L., Rowe, M. E., Dugas, K., & Mills, J. L. A. (2019). Barriers and enablers to implementing the children's hospital early warning score: A pre- and post-implementation qualitative descriptive study. *Journal of Pediatric Nursing*, 46, 39–47. <https://doi.org/10.1016/j.pedn.2019.02.008>
- Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, 12(3), 297–298. <https://doi.org/10.1080/17439760.2016.1262613>
- Connor, J., Flenady, T., Massey, D., & Dwyer, T. (2023). Clinical judgement in nursing—An evolutionary concept analysis. *Journal of Clinical Nursing*, 32(13–14), 3328–3340. <https://doi.org/10.1111/jocn.16469>
- Coulter Smith, M. A., Smith, P., & Crow, R. (2014). A critical review: A combined conceptual framework of severity of illness and clinical judgement for analysing diagnostic judgements in critical illness. *Journal of Clinical Nursing*, 23(5–6), 784–798. <https://doi.org/10.1111/jocn.12463>
- Credland, N., Dyson, J., & Johnson, M. J. (2021). Do early warning track and trigger tools improve patient outcomes? A systematic synthesis without meta-analysis. *Journal of Advanced Nursing*, 77(2), 622–634. <https://doi.org/10.1111/jan.14619>
- Currey, J., Massey, D., Allen, J., & Jones, D. (2018). What nurses involved in a medical emergency teams consider the most vital areas of knowledge and skill when delivering care to the deteriorating ward patient. A nurse-oriented curriculum development project. *Nurse Education Today*, 67, 77–82. <https://doi.org/10.1016/j.nedt.2018.05.009>
- Dalton, M., Harrison, J., Malin, A., & Leavey, C. (2018). Factors that influence nurses' assessment of patient acuity and response to acute deterioration. *British Journal of Nursing*, 27(4), 212–218.
- Delaney, J. L. (2018). Patient-centred care as an approach to improving health care in Australia. *Collegian (Royal College of Nursing, Australia)*, 25(1), 119–123. <https://doi.org/10.1016/j.colegn.2017.02.005>
- 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.
- Douw, G., Schoonhoven, L., Holwerda, T., Huisman-de Waal, G., van Zanten, A. R. H., van Achterberg, T., & van der Hoeven, J. G. (2015). Nurses' worry or concern and early recognition of deteriorating patients on general wards in acute care hospitals: A systematic review. *Critical Care*, 19(1), Article 230. <https://doi.org/10.1186/s13054-015-0950-5>
- Downey, C., Tahir, W., Randell, R., Brown, J., & Jayne, D. (2017). Strengths and limitations of early warning scores: A systematic review and narrative synthesis. *International Journal of Nursing Studies*, 76, 106–119. <https://doi.org/10.1016/j.ijnurstu.2017.09.003>
- Elliott, D., Allen, E., Perry, L., Fry, M., Duffield, C., Gallagher, R., Iedema, R., McKinley, S., & Roche, M. (2015). Clinical user experiences of observation and response charts: Focus group findings of using a new format chart incorporating a track and trigger system. *BMJ Quality and Safety*, 24(1), 65–75. <https://doi.org/10.1136/bmjqs-2013-002777>
- Flenady, T., Dwyer, T., Sobolewska, A., Lagadec, D. L., Connor, J., Kahl, J., Signal, T., & Browne, M. (2020). Developing a sociocultural framework of compliance: An exploration of factors related to the use of early warning systems among acute care clinicians. *BMC Health Services Research*, 20(1), 1–9. <https://doi.org/10.1186/s12913-020-05615-6>
- Foley, C., & Dowling, M. (2019). How do nurses use the early warning score in their practice? A case study from an acute medical unit. *Journal of Clinical Nursing (John Wiley & Sons, Inc.)*, 28(7/8), 1183–1192. <https://doi.org/10.1111/jocn.14713>
- Fox, A., & Elliott, N. (2015). Early warning scores: A sign of deterioration in patients and systems. *Nursing Management—UK*, 22(1), 26–31. <https://doi.org/10.7748/nm.22.1.26.e1337>
- Gao, H., McDonnell, A., Harrison, D., Moore, T., Adam, S., Daly, K., Esmonde, L., Goldhill, D., Parry, G., Rashidian, A., Subbe, C., & 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, 667–679. <https://doi.org/10.1007/s00134-007-0532-3>
- 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>
- Grover, S., Fitzpatrick, A., Azim, F. T., Ariza-Vega, P., Bellwood, P., Burns, J., Burton, E., Fleig, L., Clemson, L., & Hoppmann, C. A. (2022). Defining and implementing patient-centered care: An umbrella review. *Patient Education and Counseling*, 105(7), 1679–1688.
- Hong, Q. N., & Pluye (2018). Systematic reviews: A brief historical overview. *Education for information*, 34(4), 261–276.
- Jensen, J. K., Skår, R., & Tveit, B. (2019). Hospital nurses' professional accountability while using the National Early Warning Score: A qualitative study with a hermeneutic design. *Journal of Clinical Nursing (John Wiley & Sons, Inc.)*, 28(23/24), 4389–4399. <https://doi.org/10.1111/jocn.15021>
- Kern-Goldberger, A. R., Ewing, J., Polin, M., D'Alton, M., Friedman, A. M., & Goffman, D. (2022). The predictive value of vital signs for morbidity in pregnancy: Evaluating and optimizing maternal early

- warning systems. *American Journal of Perinatology*. <https://doi.org/10.1055/s-0041-1739432>
- Kyriacos, U., Burger, D., & Jordan, S. (2019). Testing effectiveness of the revised Cape Town modified early warning and SBAR systems: A pilot pragmatic parallel group randomised controlled trial. *Trials*, 20(1), 809. <https://doi.org/10.1186/s13063-019-3916-0>
- Langkjaer, C. S., Bove, D. G., Nielsen, P. B., Iversen, K. K., Bestle, M. H., & Bunkenborg, G. (2021). Nurses' experiences and perceptions of two early warning score systems to identify patient deterioration—a focus group study [research support, non-U.S. Gov't]. *Nursing Open*, 8(4), 1788–1796.
- Langkjaer, C. S., Bundgaard, K., Bunkenborg, G., Nielsen, P. B., Iversen, K. K., Bestle, M. H., & Bove, D. G. (2023). How nurses use national early warning score and individual early warning score to support their patient risk assessment practice: A fieldwork study. *Journal of Advanced Nursing*, 79(2), 789–797.
- Le Lagadec, M., & Dwyer, T. (2017). Scoping review: The use of early warning systems for the identification of in-hospital patients at risk of deterioration. *Australian Critical Care: Official Journal of the Confederation of Australian Critical Care Nurses*, 30(4), 211–218. <https://doi.org/10.1016/j.aucc.2016.10.003>
- Le Lagadec, M., Dwyer, T., & Browne, M. (2020). The efficacy of twelve early warning systems for potential use in regional medical facilities in Queensland, Australia. *Australian Critical Care*, 33, 47–53. <https://doi.org/10.1016/j.aucc.2019.03.00110.1016/j.aucc.2019.03.001>
- Levett-Jones, T., Hoffman, K., Dempsey, J., Jeong, S. Y.-S., Noble, D., Norton, C. A., Roche, J., & Hickey, N. (2010). The 'five rights' of clinical reasoning: An educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients. *Nurse Education Today*, 30(6), 515–520.
- Martín-Rodríguez, F., Sanz-García, A., Ortega, G. J., Delgado Benito, J. F., Aparicio Obregon, S., Martínez Fernandez, F. T., Gonzalez Crespo, P., Otero de la Torre, S., Castro Villamor, M. A., & López-Izquierdo, R. (2023). Tracking the national early warning score 2 from prehospital care to the emergency department: A prospective, ambulance-based, observational study. *Prehospital Emergency Care*, 27(1), 75–83.
- Massey, D., Chaboyer, W., & Anderson, V. (2016). *What factors influence ward nurses' recognition of and response to patient deterioration? An integrative review of the literature*. *Nursing Open*. <https://doi.org/10.1002/nop2.53>
- McGaughey, J., O'Halloran, P., Porter, S., Trinder, J., & Blackwood, B. (2017). Early warning systems and rapid response to the deteriorating patient in hospital: A realist evaluation. *Journal of Advanced Nursing (John Wiley & Sons, Inc.)*, 73(12), 3119–3132. <https://doi.org/10.1111/jan.13367>
- Molgaard, R. R., Jorgensen, L., Christensen, E. F., Gronkjaer, M., & Voldbjerg, S. L. (2022). Ambivalence in nurses' use of the early warning score: A focussed ethnography in a hospital setting. *Journal of Advanced Nursing*, 78(5), 1461–1472. <https://ezproxy.cqu.edu.au/login?url=https://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med20&AN=34841561https://libkey.io/libraries/2177/openurl?genre=article&aulast=Molgaard&issn=0309-2402&title=Journal+of+Advanced+Nursing&atitle=Ambi>
- Nielsen, P., Schultz, M., Langkjaer, C., Kodal, A., Pedersen, N., Petersen, J., Lange, T., Arvig, M., Meyhoff, C., Bestle, M., Hølge-Hazelton, B., Bunkenborg, G., Lippert, A., Andersen, O., Rasmussen, L., & Iversen, K. (2020). Adjusting early warning score by clinical assessment: A study protocol for a Danish cluster-randomised, multicentre study of an individual early warning score (I-EWS). *BMJ Open*, 10, e033676. <https://doi.org/10.1136/bmjopen-2019-033676>
- Nielsen, P. B., Langkjær, C. S., Schultz, M., Kodal, A. M., Pedersen, N. E., Petersen, J. A., Lange, T., Arvig, M. D., Meyhoff, C. S., & Bestle, M. H. (2022). Clinical assessment as a part of an early warning score—A Danish cluster-randomised, multicentre study of an individual early warning score. *The Lancet Digital Health*, 4(7), e497–e506.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71.
- Paul, R., & Elder, L. (2006). Critical thinking: The nature of critical and creative thought. *Journal of Developmental Education*, 30(2), 34.
- Pimentel, M., Redfern, O., Gerry, S., Collins, G., Malycha, J., Prytherch, D., Schmidt, P., Smith, G., & Watkinson, P. (2018). A comparison of the ability of the National Early Warning Score and the National Early Warning Score 2 to identify patients at risk of in-hospital mortality: A multi-centre database study. *Resuscitation*, 134, 147–156. <https://doi.org/10.1016/j.resuscitation.2018.09.026>
- Pluye, P., & Hong, Q. N. (2014). 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.
- Rihari-Thomas, J., Digiacomio, M., Newton, P., Sibbritt, D., & Davidson, P. M. (2019). The rapid response system: An integrative review. *Contemporary Nurse*, 55, 1–17. <https://doi.org/10.1080/10376178.2019.1633940>
- Romero-Brufau, S., Gaines, K., Nicolas, C. T., Johnson, M. G., Hickman, J., & Huddleston, J. M. (2019). The fifth vital sign? Nurse worry predicts inpatient deterioration within 24 hours. *JAMIA Open*, 2(4), 465–470.
- Saab, M. M., McCarthy, B., Andrews, T., Savage, E., Drummond, F. J., Walshe, N., Forde, M., Breen, D., Henn, P., Drennan, J., & Hegarty, J. (2017). The effect of adult early warning systems education on nurses' knowledge, confidence and clinical performance: A systematic review. *Journal of Advanced Nursing (John Wiley & Sons, Inc.)*, 73(11), 2506–2521. <https://doi.org/10.1111/jan.13322>
- Salt, L. (2013). Evaluating critical care outreach and the early warning score tool—the ward nurse's viewpoint. *Kaitiaki Nursing Research*, 4(1), 17–23.
- Schuster, C., Stahl, B., Murray, C., & Glover, K. (2016). Development and testing of an instrument to measure short peripheral catheter insertion confidence. *Journal of Infusion Nursing*, 39(3), 159–165.
- Seibert, K., Domhoff, D., Bruch, D., Schulte-Althoff, M., Fürstenau, D., Biessmann, F., & Wolf-Ostermann, K. (2021). Application scenarios for artificial intelligence in nursing care: Rapid review. *Journal of Medical Internet Research*, 23(11), e26522. <https://doi.org/10.2196/26522>
- Stafseth, S. K., Grønbeck, S., Lien, T., Randen, I., Lerdal, A. J. I., & Nursing, C. C. (2016). The experiences of nurses implementing the Modified Early Warning Score and a 24-hour on-call Mobile Intensive Care Nurse: An exploratory study. *Intensive & Critical Care Nursing*, 34, 33–41.
- Tanner, C. A. (2006). Thinking like a nurse: A research-based model of clinical judgment in nursing. *Journal of Nursing Education*, 45(6), 204–211.
- van Graan, A. C., Williams, M. J. S., & Koen, M. P. (2016). Professional nurses' understanding of clinical judgement: A contextual inquiry. *Health SA Gesondheid (Online)*, 21(1), 280–293. <https://doi.org/10.1016/j.hsag.2016.04.001>
- Villanueva-Rábano, R., Martín-Rodríguez, F., & López-Izquierdo, R. (2021). National Early Warning Score 2 Lactate (NEWS2-L) in predicting early clinical deterioration in patients with Dyspnoea in prehospital care. *Investigación y Educación en Enfermería*, 39(3), e05.
- Williams, G., Pirret, A., Credland, N., Odell, M., Raftery, C., Smith, D., Winterbottom, F., & Massey, D. (2022). A practical approach to establishing a critical care outreach service: An expert panel research design. *Australian Critical Care*, 36, 151–158. <https://doi.org/10.1016/j.aucc.2022.01.008>

Wood, C., Chaboyer, W., & Carr, P. (2019). How do nurses use early warning scoring systems to detect and act on patient deterioration to ensure patient safety? A scoping review. *International Journal of Nursing Studies*, 94, 166–178.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Flenady, T., Connor, J., Byrne, A.-L., Massey, D., & Le Lagadec, M. D. (2024). The impact of mandated use early warning system tools on the development of nurses' higher-order thinking: A systematic review. *Journal of Clinical Nursing*, 00, 1–18. <https://doi.org/10.1111/jocn.17178>

APPENDIX A

SEARCH TERMS AND DATABASES TERMS

	Domain 1	Domain 2	Domain 3
Search terms	staff nurse Registered nurses licensed practical nurse nurse practitioner registered general nurse Nursing Staff	early warning system early warning early warning score Track and trigger Clinical Assessment Tools early warning tool national early warning score EWS Rapid Response Team Hospital Rapid Response Team	higher-order thinking mental Processes critical thinking clinical decision making Decision Making clinical reasoning clinical judgement diagnostic reasoning Scientific reasoning creative thinking nurse performance nursing intuition Clinical Competence Thinking Cognition

Database	Population	Intervention	Context
Ovid Medline (MESH headings)	Nurses/ Nursing Staff, Hospital/ Exp Licensed Practical Nurses/ Nurse Practitioners/	exp Early Warning Score/ *Hospital Rapid Response Team/	exp Clinical Reasoning/ exp Clinical Decision-Making/ exp Decision Making/ exp Clinical Competence/ Mental Processes/ *Thinking/ or exp Cognition
EbscoHost CINAHL Ultimate (Subject headings)	(MM "Registered Nurses") (MH "Nurse Practitioners+") (MM "Nursing Staff, Hospital") (MM "Staff Nurses")	(MM "Early Warning Score") (MH "Clinical Assessment Tools+") (MM "Rapid Response Team")	(MM "Diagnostic Reasoning") (MM "Clinical Reasoning") (MH "Decision Making, Clinical+") (MH "Decision Making+") (MM "Critical Thinking") (MH "Mental Processes+") (MH "Clinical Competence+") (MM "Thinking") (MH "Cognition+")

Database	Population	Intervention	Context
Elsevier Embase (Emtree subject headings)	'staff nurse'/exp OR 'staff nurse' 'registered nurses' 'licensed practical nurse' 'nurse practitioner'/de registered AND general AND 'nurse'/de nursing AND staff	'early warning system' 'early warning' 'early warning score' 'clinical'/de AND 'assessment'/de AND tools 'Clinical assessment tools' 'early warning tool' 'national early warning score' 'Rapid Response team' 'Hospital Rapid Response team'	higher-order thinking mental Processes critical thinking clinical decision making Decision Making clinical reasoning clinical judgement diagnostic reasoning Scientific reasoning creative thinking nurse performance nursing intuition Clinical Competence Thinking Cognition
Ovid APA PsycInfo (Subject headings)	Staff Nurse.mp Registered Nurse.mp licensed practical nurse.mp nurse practitioner.mp registered general nurse.mp Staff nurse.mp	early warning system.mp early warning.mp early warning score.mp early warning tool.mp Clinical Assessment Tools.mp national early warning score.mp EWS.mp Rapid Response.mp	Higher-order thinking.mp mental Processes.mp clinical decision making.mp clinical reasoning.mp diagnostic reasoning.mp Scientific reasoning.mp creative thinking.mp nurse performance.mp nursing intuition.mp Clinical Competence.mp

APPENDIX B

EWS HOT THEMING OVERVIEW

Phase	Description of the process	Supporting evidence from the data	Outcome
Familiarisation with the data	Three members of the team read and re-read included studies to become familiar with what the data entailed, paying specific attention to occurring patterns	Researcher notes from this phase: <i>The author using the term, EWS supports a proactive, investigative approach—those are very supportive terms</i> <i>One of the themes from this study was nurse intuitions, they found it difficult to defend but they tended towards their intuition</i>	Detailed notes about emerging patterns were generated
Generation of initial codes	One team member then consolidated the notes that had been written thus far, generating initial codes. This involved data reduction where the researcher collapsed data into labels to create categories for more efficient analysis. This phase also involved data compilation, where the researcher made inferences about what the codes mean and how they answer the research question	These are examples of data that informed early codes: <i>Around 70% of nurses in this study agreed that NEWS support their clinical decision making (Fox & Elliott, 2015).</i> <i>Nurses often used the tools to validate their own judgements. More junior nurses could not interpret data due to insufficient clinical judgement (Foley & Dowling, 2019)</i>	Some example codes generated at this stage include: Nurses use of EWS <ul style="list-style-type: none"> • Supports clinical decision making • Validates clinical judgement
Searching for themes	The research team collated all codes into themes that accounted for ALL data	Some early themes included: EWS as a supportive measure EWS builds confidence when escalating care EWS validates subjective assessment	

Phase	Description of the process	Supporting evidence from the data	Outcome
Reviewing themes	Team members then re-read the included study's results, confirming that the resulting themes accounted for ALL the coded extracts and data corpus	<i>NEWS were used in a way to support the nurses clinical judgement, or given a lower priority when they did not support the judgement of the nurse. (Molgaard et al., 2022)</i> <i>Nurses said that when less experienced nurses had concerns for a patient but the EWS did not warrant escalation, the junior nurse had challenges justifying their concerns due to their reliance on the numerical escalation system and the lack of developed clinical judgement (Dalton)</i>	Two main themes: EWS Supports higher-order thinking EWS Suppresses higher-order thinking
Defining and naming categories	Across several team meetings, we generated clear definitions for both themes	1. <i>EWS Supports higher-order thinking</i> EWS scaffold nurses' higher-order thinking—nurses' clinical assessment/judgement is the primary influencer on the care/treatment/escalation delivered or actioned 2. <i>EWS Suppresses higher order thinking</i> EWS Restricts (discourage/suppresses) nurses' higher-order thinking – the tool is the primary influencer of the care/treatment delivered or actioned. Inhibiting the development of higher-order thinking in junior nurses and deskilling experienced nurses	Two clearly defined themes
Producing final report	One team member then wrote up the first draft of the results section and all researchers contributed to refinement of same		The results section of this manuscript

Note: Adapted from Braun and Clarke (2006).