REVIEW ARTICLE

Clinical cues used by nurses to recognize changes in patients' clinical states: A systematic review

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Funding information
Deakin University, School of Nursing and Midwifery, Acute Nursing Care Research Scholarship

Abstract

The aim of this systematic review was to examine the clinical cues used by acute care nurses to recognize changes in clinical states of adult medical and surgical patients that occurred as usual consequence of acute illness and treatment. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and checklist were followed. Four databases and reference lists of included studies were searched: from 1,049 studies, 38 were included. There were 26 subjective and 147 objective cues identified; only 6% of all cues described improvements in patients' clinical states. The most common clinical cues used were heart rate, blood pressure and temperature. Many studies (n = 31) focused on only one element of assessment, such as physiological stability, pain, or cognition. There was a paucity of studies detailing the complexity of acute care nurses' assessment practices as they would occur in clinical practice and a disproportionate focus on the objective assessment of deterioration. Studies are needed to understand the full breadth of cues acute care nurses use to recognize clinical change that includes both improvement and deterioration.

KEYWORDS
acute care, clinical deterioration, cues, nurses, nursing assessment, vital signs systematic review patient safety

1 | INTRODUCTION

Nurses are primarily responsible for patient assessment and recognition of changes to patients' clinical states (Cardona-Morrell et al., 2016). Patients' clinical states are expected to fluctuate between improvement and deterioration over the course of hospitalization as a consequence of patients' illness or response to treatment. An acute change in clinical state is defined as a state that is different in comparison to the last patient assessment or changes as reported by the patient or significant others (Rhudy & Androwich, 2013). Many patients managed on medical and surgical wards are acutely unwell, have multiple comorbidities, and often require complex nursing care. Effective clinical care relies on a proactive approach to patient assessment, with greater emphasis on early recognition of changes in patients' clinical states (Cardona-Morrell et al., 2016). Early recognition of changes in patients' clinical states enables suitably targeted care that protects patients from adverse events and promotes recovery (Hart, Spiva, Dolly, Lang-Coleman, & Prince-Williams, 2016).

The use of vital sign abnormalities to recognize clinical deterioration is now well established (Australian Commission on Safety and Quality in Health Care, 2017; Institute for Healthcare Improvement, forthcoming). Rapid response systems (RRS) have been introduced in many hospitals worldwide to promote the early recognition and an appropriate response to patients experiencing clinical signs and symptoms of deterioration. Predefined calling criteria are

commonly based on the abnormal vital signs of respiratory rate, blood pressure, heart rate, oxygen saturation, and conscious state and are used to recognize and differentiate the degree of patient deterioration (Australian Commission on Safety and Quality in Health Care, 2017; Institute for Healthcare Improvement, forthcoming). In response to patients assessed with abnormal vital signs that breach calling criteria thresholds, nurses and other clinicians activate the RRS to escalate patient assessment and management to nurses and doctors equipped with qualifications and experience commensurate with the level of patient deterioration. The implementation of rapid response systems has enabled early recognition of clinical deterioration and has decreased in-hospital mortality and cardiac arrests (Jones, Rubulotta, & Welch, 2016). Nurses have the greatest degree of responsibility for vital sign assessment and interpretation and activate the majority of rapid response system calls for deteriorating patients (Hart et al., 2016).

Although the success of RRSs is highly dependent on nurses' recognition of vital sign abnormalities, "clinician concern" is also a common criterion for the activation of a rapid response for a deteriorating patient (Chua et al., 2019). The "clinician concern" criterion enables nurses to identify patient deterioration and call for medical assistance early by using their intuition or concern about a patient's clinical state (Chua et al., 2019). A systematic review by Douw et al. (2015) identified 37 patient signs and symptoms that triggered nurses to feel worried or concerned about a patient's clinical condition. These 37 signs and symptoms were classified into ten general indicators of clinical deterioration: changes in breathing, circulation, temperature, mentation, agitation, pain, unexpected trajectory, patient reports of feeling unwell, subjective nurse observations, and knowing without a rationale (Douw et al., 2015). Nurses may become concerned for a patient's clinical state when observing these signs and symptoms of deterioration, which may or may not be present with abnormal vital sign parameters (Douw et al., 2015).

Despite patients' clinical states being dynamic in nature, point prevalence studies demonstrate up to only 19% of patients have documentation of one abnormal vital sign that fulfils rapid response system activation criteria (Bingham et al, 2015). Little is known about the clinical cues acute care nurses use to recognize changes in patients' clinical states that do not require rapid response system activation. Further, the majority of studies focusing on patient assessment to date have focused on nurses' recognition and response to clinical deterioration (Jones et al., 2016). There is little attention to how nurses recognize improved changes in patients' clinical states that indicate recovery or response to therapy. Early recognition of improvement provides opportunity for nurses to respond by adjusting clinical care that minimizes exposure to unnecessary treatments and promotes patient recovery. Understanding the clinical cues nurses use to recognize changes to patients' clinical states, both deterioration and improvement, will further our understanding of how nurses achieve safe and effective care for hospitalized patients.

2 | AIM

The aim of this systematic review was to examine the clinical cues used by acute care nurses to recognize changes in clinical states of adult medical and surgical patients. For the purpose of this systematic review, "nurses" were defined as registered nurses or second-level nurses who held a nursing qualification and were registered by a nursing regulatory authority such as, but not limited to, enrolled nurses, licenced nurses, and licenced practical nurses. Other personnel, however titled, who did not hold nursing qualifications and were not registered by a nursing regulatory authority were not included in this definition. "Acute care" were clinical settings in hospitals where patients with sudden or emergent injury and illness were treated.

3 | METHODS

3.1 | Protocol and registration

This systematic review was planned, conducted, and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) Statement. The protocol for this systematic review was registered with the International Prospective Register of Systematic Reviews (PROSPERO) (Registration number: CRD42019133548) on June 24, 2019.

3.2 | Eligibility criteria

Papers eligible for inclusion were original research papers that: (i) described acute changes in adult patients' clinical states; (ii) reported objective and/or subjective clinical cues by acute care nurses to recognize changes in patients' clinical states; and (iii) were situated in acute adult medical or surgical wards. Objective clinical cues were defined as patient information that was observable and/or measurable. Subjective clinical cues were defined as patient information that was reported by the patient or the patient's significant other/s.

Studies were excluded if: (i) inadequate information was provided to determine whether participants met the definition of "nurse"; (ii) nurse participants did not meet the definition of "acute care nurse"; (iii) clinical cues used by acute care nurses were reported in combination with other health care professionals such as medical or allied healthcare personnel or in combination with nurses who were not part of medical or surgical ward staffing (e.g., outreach nurses, intensive care unit liaison nurses, visiting clinical nurse consultants); (iv) acute clinical areas included critical care or high dependency units, pediatric or obstetric wards, operating theaters, and emergency departments; (v) tested the reliability of an assessment tool, or (vi) used simulation.

3.3 | Information sources and search strategy

The search was conducted on January 20, 2020. The databases searched from dates of inception were MEDLINE Complete, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete

via EBSCO Host, EMBASE, and INFORMIT Health Subset of 11 databases and no date limiters were applied. The search terms were related to acute care nurses, medical and surgical wards, patient assessment, patient cues, recognition of changes in clinical state, and clinical change. Refer to Appendix 1–4 for the complete search strategy. The search was limited to peer-reviewed, full-text papers published in English that reported on adult patients (as defined in the study or database). Abstract-only papers and opinion, discussion, or review papers were excluded. Reference lists of the final included studies were hand searched to ensure no relevant studies were missed.

3.4 | Study selection

One researcher (GB) conducted the search and identified and removed duplicates from the retrieved articles. Two researchers (GB and GL) independently assessed titles and abstracts for eligibility using the inclusion and exclusion criteria. Further information was sought from study investigators when eligibility for inclusion required clarification of nurse participant qualifications. Full-text papers of potentially eligible studies were then independently assessed for inclusion by the same two researchers. The rationale for exclusions were documented and inconsistencies between researchers were resolved through discussion and ratified by the research team.

3.5 | Data collection process and synthesis of results

One researcher extracted the following data from each included study: study aim, study design, study country, study setting, study sample, data collection method, and clinical cues. Included studies were heterogeneous and therefore a meta-analysis was not conducted. One researcher (GB) analyzed all objective and subjective clinical cues extracted from the literature. Identical clinical cues were removed, and synonyms were grouped together and identified by one major term to produce a final list of unique clinical cues. Clinical cues were then categorized according to commonalities identified between clinical cues. Categories were then grouped under the clinical state they most represented. The final clinical cues, categories, and clinical states were presented to the research team for discussion and approval (GL, BR, JC).

3.6 | Risk of bias in individual studies

Two researchers (GB and JC) critically appraised the risk of bias of each study independently. Qualitative studies were appraised using the Critical Appraisal Skills Program (CASP) Qualitative checklist (Critical Appraisal Skills Programme, forthcoming). Survey and questionnaire-based studies were appraised using the Clarity Risk of Bias Tool for the Critical Appraisal of Survey and Questionnaire Studies (Clarity-Group, forthcoming). Mixed-methods studies were appraised using the Mixed Methods Appraisal Tool (Nha Hong

et al., 2018). Discrepancies were resolved through discussion and ratified by the research team.

4 | RESULTS

4.1 | Study selection

After removal of duplicates, the initial search identified 1,049 articles. After title and abstract screening, 137 full-text articles were reviewed, of which 35 were included. Hand searching of the reference lists of included studies identified another three studies that met the inclusion criteria. In total, 38 studies were included in the review; the PRISMA diagram detailing the study selection process is presented in Figure 1.

4.2 | Study characteristics

The characteristics of the 38 included studies are presented in four evidence summary tables grouped according to the main aims of each study; assessment of physiological stability (Table 1), pain (Table 2), or cognition (Table 3). Table 4 includes studies with a range of different aims related to acute care nurses' assessment practices.
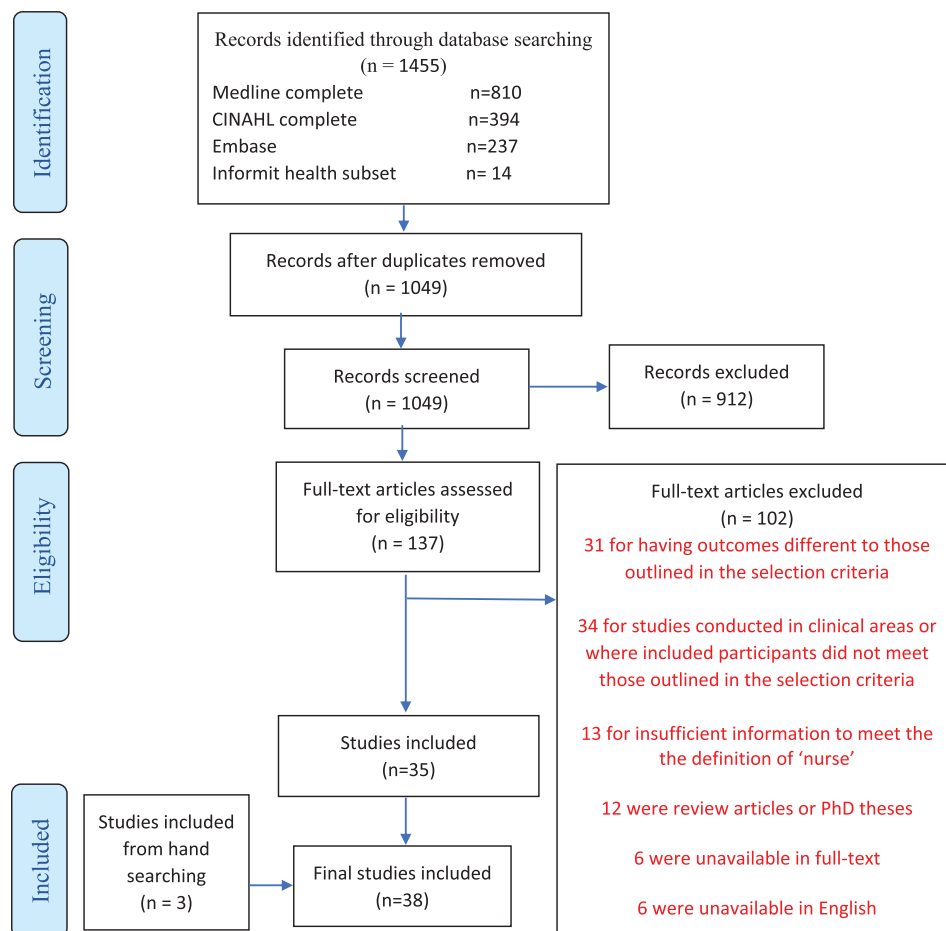
The included studies were published between 1991 and 2019. The majority of studies were conducted in Australia (n = 13), the United States (n = 9), and the United Kingdom (n = 5) (Tables 1–4). Studies were also conducted in Canada (n = 3), Denmark (n = 2), Norway (n = 2), Ireland (n = 2), and Singapore (n = 1) (Tables 1–4). One study was conducted across three countries; the United States, Korea, and Norway (Kim et al., 2008).

Thirty-two studies had qualitative designs that included interview or focus groups (n = 13), participant observation (n = 7), or a combination of observations of clinical practice and interview (n = 8) (Tables 1–4). Two studies combined think-aloud techniques with observation or interview (Rhudy & Androwich, 2013; Tower et al., 2012). Four studies used mixed-methods designs, combining questionnaires or chart audit with interview or focus groups (Cherry & Jones, 2015; Endacott et al., 2007; Schafheutle et al., 2001; Stewart et al., 2014). Two studies used survey and two studies used chart audits (Hare et al., 2008; Steis & Fick, 2012). Of the 38 included studies, only three examined acute care nurses' documentation of clinical cues (Endacott et al., 2007; Hare et al., 2008; Steis & Fick, 2012) with the majority of data collected using observation and self-report.

Study settings included medical wards (n = 8), surgical wards (n = 10), and combined medical and surgical wards (n = 13). Seven studies undertook hospital-wide recruitment of medical and surgical nurses (Tables 1–4).

4.3 | Risk of bias within studies

Supporting information shows the results of critical appraisal of all included studies in three risk of bias charts. Thirty studies were

Identification

Records identified through database searching
(n = 1455)

Medline complete	n=810
CINAHL complete	n=394
Embase	n=237
Informit health subset	n= 14

Screening

Records after duplicates removed
(n = 1049)

Records screened
(n = 1049)

Records excluded
(n = 912)

Eligibility

Full-text articles assessed
for eligibility
(n = 137)

Full-text articles excluded
(n = 102)
31 for having outcomes different to those
outlined in the selection criteria

34 for studies conducted in clinical areas or
where included participants did not meet
those outlined in the selection criteria

13 for insufficient information to meet the
the definition of 'nurse'

12 were review articles or PhD theses

6 were unavailable in full-text

6 were unavailable in English

Studies included
(n=35)

Included

Studies included
from hand
searching
(n = 3)

Final studies included
(n=38)

evaluated for risk of bias using the CASP qualitative tool (Chart 1). The strengths of these studies included clear statements of the study aims, appropriate design and methodology, clear statement of findings, and valuable research. The most common limitations related to poor reporting of the researcher–participant relationship, inadequate description of recruitment strategies, or a high risk of bias in some recruitment strategies such as participant selection by nurse managers.

Four studies were evaluated using the Clarity Risk of Bias Tool for the Critical Appraisal of Survey and Questionnaire studies (Chart 2). The strengths of these studies included high response rates to questionnaires, and studies used reliable and valid instruments. The major limitations were that three studies did not provide adequate information to assess the representativeness of the population (Flagg et al., 2010; Fox & Elliott, 2015; Hare et al., 2008), and one study was at high risk of bias from missing data within a questionnaire (Flagg et al., 2010).

Four studies were evaluated using the Mixed Methods Assessment Tool (Chart 3). The strengths of these studies were appropriate qualitative approaches, adequate qualitative data collection strategies, interpretation of results, and coherence within the research methods. Limitations included poor reporting of nonresponse information to ascertain bias and inadequate statistical analysis. Evidence of a rationale for mixed methods, the integration of qualitative and

quantitative results, and consideration of divergences or inconsistencies between the different components of the mixed methods were limited.

Omissions of methodological detail were evident across many included studies with only two studies free from some form of limitation. Poor assessment of quality across studies meant that it was difficult to exclude studies on the basis of poor quality. Therefore, no study was excluded due to poor quality. Studies were checked to ensure none had been retracted.

4.4 | Results

The 38 included studies reported 173 unique clinical cues used by acute care nurses to recognize changes in clinical states. Table 5 shows the 147 unique objective clinical cues used to recognize patient change. These objective clinical cues were grouped into 32 different categories that represent nine objective clinical states; physiological, neurological, respiratory, gastrointestinal, urinary/elimination, skin, function/activity, observed pain,and cognition. Table 6 shows the 26 subjective clinical cues as expressed by the patient or reported by patients' significant others. These subjective clinical cues were grouped into four categories that described patients' self-report of the presence or absence of pain, clinical tools patients used to report

TABLE 1 Evidence summary table: Cues to indicate change in physiological stability (n = 14 studies)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
Bunkenborg, Samuelson, Akeson, & Poulsen, 2012 Qualitative descriptive Denmark	To explore nursing practice of monitoring in-hospital patients	750-bed university hospital • 1 medical ward • 2 surgical wards • 1 medical-surgical ward Data collection (n = 13 nurses[a]) • Structured individual observations (70 hours of data) • Semi-structured interviews	Physiological Self-report -change	Heart rate Blood pressure - hypotension Body temperature – Hyperthermia Feels warmer
Cardona-Morrell et al., 2016 Qualitative observational Australia	To establish a profile of nurses' vital signs monitoring practices	A large urban teaching hospital • 1 respiratory ward • 1 neurosurgical ward Data collection • Observation (n = 62 registered nurses) (68 hours & 41 minutes of data; 441 nurse–patient interactions)	Physiological Respiratory Neurological Self-report -change Gastrointestinal Urinary/ elimination Skin	Clinical cues were assessed during 229 of the 441 nurse–patient interactions. The 229 clinical cues assessed included: • Full set of vital signs 21.0% • Blood pressure 97.0% • Body temperature 98.0% • Heart rate 95.0% • Oxygen saturation 94.0% • Respiratory rate 22.0% • Breathing related cues 2.2% • Limb strengths 40.0% • Pins & needles 5.0% • Numbness, feeling & movement 1.5% • Dizziness 0.7% • Nausea 0.7% • Food/fluid intake 2.2% • Urinary output 1.5% • Bowel movements 40.0% • Clammy hands, tongue 1.4%
Cherry & Jones, 2015 Mixed methods United Kingdom	To understand the attitudes of nurses concerning the modified early warning system (MEWS) score chart	An acute trust hospital • 1 medical ward Data collection • Questionnaires (n = 9 registered nurses) • Focus group (n = 6 registered nurses)	Physiological Urinary/ elimination	Respiratory rate - tachypnea Oxygen saturations - hypoxemia Heart rate - tachycardia Blood pressure - hypotension MEWS, high score indicates deterioration Urinary output
Chua et al., 2019 Qualitative descriptive Singapore	To explore the experiences of enrolled and registered nurses in recognising clinically deteriorating patients in general wards	1,000-bed acute general public hospital Registered nurses (n = 14) and enrolled nurses (n = 8) working in 6 medical & surgical wards Data collection • Semi-structured interviews (n = 22)	Physiological Respiratory Neurological Cognition Urinary/ elimination Skin	Heart rate - tachycardia Blood pressure Oxygen saturations Respiratory distress Changes in breathing patterns Patient becomes drowsy Overarching statement: No specific cues stated New oliguria Color changes
Cox, James, & Hunt, 2006 Exploratory descriptive	To explore factors that influence nurses caring for	A district general hospital • 1 medical ward	Physiological Respiratory	Overarching statement: No specific cues stated

(Continues)

TABLE 1 (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
United Kingdom	critically ill patients within a general ward setting	Data collection • Semi structured interviews (n = 7 registered nurses)		Labored breathing Rapid breathing
Donohue & Endacott, 2010 Qualitative United Kingdom	To examine nurses' perceptions of the management of patients who deteriorate in acute care wards	One district general hospital • Medical and surgical wards Data collection • Semi-structured interviews (n = 11 registered nurses)	Physiological Respiratory Neurological Gastrointestinal Skin Function/activity	Respiratory rate - tachypnea Oxygen saturations - "poor" Heart rate - tachycardia Medical emergency warning score (MEWS) Breathing pattern No response from pt Changes in blood sugar level Cyanosis Pt appears exhausted from sitting in the chair
Endacott, Kidd, Chaboyer, & Edington, 2007 Mixed methods Australia	To identify cues ward nurses and doctors use to identify patient deterioration	Rural acute care hospital • Medical and surgical wards Data collection • Chart audit • Semi-structured interviews (n = 11 registered nurses)	Physiological Neurological Function/activity	Respiratory rate documented 17.6% Heart rate documented 52.9% Systolic blood pressure 29.4% Oxygen saturation 11.8% Temperature 29.4% Overarching statement: No specific cues stated Ability to get out of bed and to ambulate
Foley & Dowling, 2019 Descriptive Case study Ireland	To describe how nurses use the early warning score (EWS)	Large regional hospital • 1 acute medical ward Data collection • Non-participant observation (n = 9 nurses[a]) • Semi structured interviews (n = 8 nurses[a])	Physiological Respiratory Neurological Function/activity	Oxygen saturations - hypoxemia Blood pressure - hypotension Body temperature changes Higher EWS indicates deterioration Changing need for supplemental oxygen New confusion Changing patients' capability to perform activities of daily living
Fox & Elliott, 2015 Post implementation survey Ireland	To evaluate nurses' experiences of using the National Early Warning Score (NEWS)	285-bed acute regional hospital • Surgical and medical wards Data collection • Survey (74/140 registered nurses)	Physiological	Blood pressure - hypertension NEWS prompts nurses to recognize clinical change and refer deteriorating pts for medical review (70% agree) NEWS supports nurses' concern about unstable pts (50% agree)
Hart et al., 2016 Descriptive qualitative United States	To explore nurses' experiences as first responders during clinical deterioration	Five hospitals within a healthcare system • Medical-surgical nurses Data collection • Semi-structured interviews (n = 28 nurses[a])	Physiological Respiratory Neurological Skin Urinary/ elimination	Respiratory rate – Tachypnea, increasing rate Oxygen saturations - hypoxemia Poor peripheral perfusion leads to an inability to

TABLE 1 (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
			Significant others' report of pt change	obtain an oximeter reading Heart rate Blood pressure - hypotension Gasping for air Shallow breathing Shortness of breath Pt appears to have a decreasing awareness of their surroundings Becoming more difficult to rouse the pt Pt has become unresponsive Pt is showing signs of acute agitation Pt has slurred speech, is now drooling and has become nonverbal Pale Diaphoretic Blood loss from drain tube New stress incontinence Change in pts' cognitive state
Jensen, Skar, & Tveit, 2019 Qualitative Norway	To explore general hospital ward nurses' experiences with the National Early Warning Score (NEWS) and to determine its impacts on their professionalism	One state funded hospital • Medical, surgical and rheumatology nurses Data collection • Semi-structured interviews (*n* = 12 registered nurses)	Physiological Respiratory Neurological	Respiratory rate - tachypnea Heart rate - elevated Temperature - high Blood pressure - hypotension Elevated NEWS indicates changes in pts' clinical state NEWS prompts nurses to refer pts for medical review NEWS supports nurses' concern about deteriorating pts Wheezing and other adventitious sounds Changes in level of consciousness
Minick & Harvey, 2003 Qualitative cross-over United States	To describe the phenomena of early recognition of pt problems	One urban hospital • Medical-surgical nurses Data collection • In-depth group interviews (*n* = 14 registered nurses)	Physiological Respiratory Self-report -change Self-report -pain Neurological Cognition Urinary/ elimination Skin Significant others' report of pt change	Blood pressure - hypotension Body temperature – Hyperthermia Slow breathing Difficult breathing Shallow breathing Dyspnea Intractable pain Inability to speak Pt is nonverbal Confusion Slurred speech Unable to follow commands Change in mood Oliguria

(Continues)

TABLE 1 (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
				Temperature - cool Color of skin becomes mottled Change in level of function or behaviors
Mohammmed Iddrisu, Hutchinson, Sungkar, & Considine, 2018 Exploratory descriptive qualitative Australia	To explore nurses' role in recognizing and responding to deteriorating post-operative pts	A metropolitan hospital • 1 general surgical ward • 1 orthopaedic ward Data collection • Four focus groups (2/ward; *n* = 14 registered nurses)	Physiological Neurological Gastrointestinal Urinary/ elimination	Blood pressure – Hypotension Heart rate – Tachycardia Elevated modified early warning score (MEWS) indicates changes in pts' clinical state Pt appears drowsy Vomiting Pt now unable to drink due to nausea Urinary output "borderline low"
Stewart, Carman, Spegman, & Sabol, 2014 Mixed methods United States	To evaluate the effect of the implementation of the modified early warning system (MEWS)	242-bed acute care hospital • 3 medical-surgical units Data collection • Medical records review • Focus groups (*n* = 11 registered nurses)	Physiological	An elevated MEWS score is used as a cue by nurses to recognize clinical change and prompts nurses to trigger the rapid response system.

[a]No distinction made between the level of licenced nurse.
Abbreviation: pt, patient.

change, self-report of pain, and significant others' report of patient changes.

Acute care nurses were shown to most commonly assess for changes in patients' physiological stability, as evidenced by 25 of the 38 included studies that reported the measure of at least one vital sign parameter. Specifically, heart rate, blood pressure, and temperature were the most common vital signs measured across studies to detect abnormalities such as tachycardia, hypertension, hypotension, and hyperthermia.

The 173 unique clinical cues described changes in patients' clinical states in three forms—(i) deterioration, (ii) improvement, or (iii) could be applied to describe either deterioration or improvement dependent upon further assessment and description of the cue. Deterioration was recognized when a usually normal cue became abnormal or an abnormal cue worsened. Respiratory distress and tachypnoea were examples of deterioration. Improvement was recognized when clinical cues described a clinical state that became better or had returned to normal. For example, postoperative patients were observed with relaxed behaviors and increased independence in activities of daily living. Acute care nurses used these clinical cues to recognize improvement in patients' pain and level of function. Other clinical cues required additional information and clinical context to define the direction of change. For example, wound discharge was described as an important clinical cue for the recognition of change in wound healing. To further differentiate an improvement or deterioration in

patients' wound state required further description. Only 11 clinical cues described an improved clinical state; the majority of all other clinical cues described deterioration.

4.5 | Results of individual studies

Table 1 shows the clinical cues reported in 13 included studies where the focus of clinical change was physiological stability. Five studies examined the use of aggregated physiological scoring systems such as Modified Early Warning Systems (MEWSs), Early Warning Systems (EWS), and National Early Warning Scores (NEWSs) to recognize changes requiring rapid response system activation. Two studies examined acute care nurses' decision making in clinical assessment, six studies examined acute care nurses' experiences of recognizing clinical deterioration, and one study examined the experience of managing a critically unwell patient on the ward. Cardona-Morrell et al. (2016) was the only study to define a full set of six vital signs. Changes in respiratory rate or breathing pattern were specifically described in seven studies. The assessment of level of consciousness, such as drowsiness or lack of response, were reported cues in three studies.

Table 2 shows the results of nine included studies that examined acute care nurses' recognition of changes in pain states. Eight studies examined nurses' assessment and management of pain, and one study

TABLE 2 Evidence summary table: Cues to indicate change in pain (n = 9 studies)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
Clabo, 2007 Descriptive comparative qualitative United States	To examine nursing pain assessment practices	700-bed teaching hospital • 2 surgical wards Data collection (n = 20 registered nurses) • Observations • Semi-structured interviews • One focus group per ward	Physiological Self-report -pain Observed pain	Heart rate Blood pressure Sore, scratchy, irritable throat Pt reports pain and rates level of pain using the numerical pain scale Changes in facial expression suggest pain Restrictions in pts' usual ability to move in bed
Dihle, Bjolseth, & Helseth, 2006 Qualitative descriptive Norway	To understand how nurses contribute to postoperative pain management in a surgical setting	Two hospitals • 1 surgical ward hospital A • 2 surgical wards hospital B Data collection (n = 9 nurses[a]) • Semi-structured observations (350 hours of data) • In-depth interviews	Physiological Self-report -pain Observed pain	Blood pressure Pt reports experiencing pain Pain improved after analgesia administration Inability to sleep because of pain Rubbing body sites Sweaty, paleness Observed body language; reluctance to move and appears tense
Gregory & Waterman, 2012 Qualitative Cross-over United Kingdom	To describe pain assessment practices within a medical unit	District general hospital • 1 medical ward Data collection • Observation (n = 18 registered nurses) 38.5 hours in data	Self-report -pain	Pain rated using pain scores Pt requests analgesia because of pain Pt reports improvement of pain after the administration of analgesia
Manias, Bucknall, & Botti, 2002 Qualitative observational Australia	To explore nurse–pt interactions for pain assessment and management in hospitalised pts	Metropolitan teaching hospital • 1 surgical ward Data collection • Observation (n = 12 registered nurses) Data from 41 pain activities	Physiological Self-report -pain Observed pain Skin	Blood pressure Heart rate Body temperature Pt reports pain or discomfort Wincing, restlessness, yelling, moaning Wound appearance
Manias, 2003 Qualitative observational Australia	To examine how nurses manage pts' pain and anxiety	Public teaching hospital • 2 gastro-surgical wards Data collection • Observation (n = 6 registered nurses)	Physiological Self-report -pain Self-report -change Observed pain Skin	Blood pressure, heart rate, respiratory rate Body temperature Pain on palpation, pt requests analgesia Pt points to painful site Difficulty sleeping from pain The level of pain is rated using the visual analogue pain scale or the numerical pain scale "I am anxious";"I cannot rest or relax" Pt is teary and appears distressed from pain Altered facial expression from pain Wounds and drain sites assessed for inflammation

(Continues)

TABLE 2 (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
Manias, Bucknall, & Botti, 2004 Qualitative observational Australia	To determine how nurses make decisions in their assessment of pts' pain In the postoperative setting	Metropolitan teaching hospital • 2 surgical units Data collection • Observation (n = 52 registered nurses) 74 observations	Physiological Self-report -pain Observed pain Neurological Skin	Overarching statement: No specific cues stated Improved pain since cessation of morphine drip Pt reports pain and describes pain "It (the pain) feels tighter and more than before" "No pain" on palpation Pain rated using the numerical pain scale Changes in pts' facial expression Pt unable to get out of bed because of pain Pt heard moaning Movement appears stiff and contracted Sensation present on touch Level of sensation of ice on skin Changes described; heat, pain, swelling, redness
Manias, Bucknall, & Botti, 2005 Qualitative observational Australia	To determine the strategies nurses used to manage pts' pain in the postoperative setting	Metropolitan teaching hospital • 2 surgical units Data collection • Observation (n = 52 registered nurses) 74 observations	Self-report -pain Observed pain Self-report -change Skin	Pt requests pain relief, reports pain, reports improved pain Pain rated using the numerical rating scale Pt requests a sleeping tablet due to pain Pt observed gritting their teeth when moving Deep breaths during a procedure indicate pain Nausea Dressing Bruising observed
Nielsen, Svantesson-Martinseon, & Bergbom Engberg, 1994 Qualitative exploratory Denmark	To examine how nurses perceive their assessment of pts' postoperative pain	• 3 surgical wards Data collection • Semi-structured interviews (n = 8 nurses[a])	Observed pain	Pain observed on changing position, on breathing, and when coughing
Schafheutle, Cantrill, & Noyce, 2001 Mixed methods United Kingdom	To explore nurses' views about barriers to effective pain management within the ward setting	7 teaching hospitals, 5 nonteaching And 2 private hospitals • Vascular and urology surgical wards Data collection • Questionnaire (180/335 registered nurses) • Interviews • (6 registered nurses)	Observed pain	Pts assessed as having no pain related to nurses' observation of: • Relaxed behaviors • Chatting • Laughing • Comfortable appearance • Mobilzing freely • Sleeping well • Independent to all needs

[a]No distinction made between the level of licenced nurse.
Abbreviation: pt, patient.

examined barriers to pain management (Table 2). Nurses showed preference for observing behavioral pain cues and questioned the credibility of patient reported pain scores (Clabo, 2007; Manias, 2003; Manias et al., 2005; Schafheutle et al., 2001). Patient behaviors such as alterations in facial expression, patients rubbing body sites, and restrictions in movement were cues used to recognize pain changes

TABLE 3 Evidence summary table: cues to indicate change in cognition (*n* = 8 studies)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
Flagg, Cox, McDowell, Mwose, & Buelow, 2010 Descriptive cross-sectional study United States	To describe nurses' ability to recognize delirium on medical-surgical units	280-bed and 350-bed nonteaching hospitals • Medical and surgical units Data collection • Survey (*n* = 34 registered nurses)	Neurological Cognition	Assessment of pupils Assessment of level of alertness Glascow coma scale (GCS) The percentage of nurses surveyed who positively identified each of the following sign or symptom of delirium: • Verbal/physical aggression 96.7% • Wandering 96.7% • Anger 96.7% • Euphoria 93.5% • Inattention 90.3% • Confusion 100.0% • Psychomotor hyperactivity 93.5% • Hyper-alert 83.8% • Lethargy 77.4% • Psychomotor hypoactivity 74.1% • Decreased responsiveness 74.1% • Somnolence 74.1% • Apathy 70.9%
Hare, McGowan, Wynaden, Speed, & Landsborough, 2008 Chart audit Australia	To describe nurses' documentation of cognition and behavioral changes in pts in acute care settings	Tertiary hospital • Medical ward and surgical wards Data collection • Nurses[a] chart audit (*n* = 183 charts)	Cognition	A breakdown of the 364 descriptors of changes in pt cognition and behavior: • Plucking/pulling 4.7% • Physical aggression 4.1% • Wandering 3.9% • Verbally abusive 2.8% • Noisy 2.5% • Non-compliant 1.9% • Angry 1.1% • Threatening 0.6% • Vague 3.6% • Confused 27.2% • Disorientated 14.8% • Hallucinating 6.0% • Agitated 12.6% • Fearful 1.4% • Anxious 0.6% Delirium rating scale (DRS) was documented in 1/132 pts audited.
Hussein & Hirst, 2016a Qualitative Canada	To construct a grounded theory to explain the clinical reasoning processes registered nurses use to recognize delirium	Acute care hospitals • Medical and surgical units Data collection • Semi-structured interviews (*n* = 17 registered nurses)	Cognition Function/activity Significant others' report of pt change	Changes in behavior and cognition described as; • Aggressive and agitated • Pt not engaged with nurses or surroundings • Acute confusion or disorientation • Pt unusually quiet Changes in the level of assistance required to

(Continues)

TABLE 3 (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
				complete activities of daily living; specifically in feeding Changes in usual level of cognition
Hussein & Hirst, 2016b Qualitative Canada	To construct a grounded theory to explain the clinical reasoning processes registered nurses use to recognize delirium	Acute care hospitals • Medical and surgical units Data collection • Semi-structured interviews (*n* = 17 registered nurses)	Cognition Function/activity	Fluctuation in behavior Confusion Pt requires cuing-in to complete tasks Using the confusion assessment method (CAM) to identify changes in cognition Changes in the level of assistance required to complete activities of daily living; specifically in feeding and dressing
Rasmussen & Creason, 1991 Descriptive United States	To identify nurses' perception of signs, symptoms, assessment and reversibility of confusion in elderly	225-bed acute care setting Medical, surgical and rehabilitation units Data collection • In-depth interviews (*n* = 10 registered nurses)	Physiological Cognition Function/activity	Body temperature Cognition and behavior fluctuation "Sundowners" become confused at night and "clear" during the day Inappropriate behaviors such as calling out, drinking out of urinals, pulling at tubes, unaware of own safety needs Aggressive and angry behavior, agitated Combative, uncooperative Decreased attention, impaired short term memory, distracted Unable to interact Confusion, disorientation to time, place and/or person, unable to follow commands Senseless speech, inconsistent answers Hallucinations Quiet, withdrawn, lethargic Changes in the level of assistance required to complete activities of daily living; specifically dressing, feeding, washing, toileting
Rogers & Gibson, 2002 Qualitative exploratory Canada	To investigate nurses' experiences of caring for acutely confused Older pts	450-bed tertiary care hospital •1 orthopaedic unit Data collection • Semi-structured interviews (*n* = 10 registered nurses)	Physiological Cognition Function/activity Significant others' report of pt change	Oxygen saturation Changes in pts' cognition described using the following terms; • Aggression, violent • Argumentative, negative attitude • Constantly trying to get out of bed • Tearing off dressings • Pulling out catheters • Unexpected strength

TABLE 3   (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
				• Oblivious to pain • Disturbances in the sleep–wake cycle • Poor concentration • Acute memory problems • Awareness of surroundings • Inability to recognize family • Hallucinations - auditory or visual • Confusion, disorientation Agitation, hyperactivity, paranoia Withdrawn Changes in the level of assistance required to complete activities of daily living; specifically unable to drink through a straw Acute changes in ability to move and patient's usual level of function
Steis & Fick, 2012 Retrospective descriptive United States	To determine the accuracy of nurses' description of clinical features of acute delirium in dementia pts	200-bed community hospital • 1 medical-surgical unit Data collection • Chart audit (*n* = 138 charts of registered nurses and licensed practical nurses documentation)	Cognition	More cooperative, improved disposition Fluctuating mental state, lack of cooperation Disorganized thinking, inattention, poor memory Restlessness, agitated, confusion Disorientation to person, place and/or time Delusions, hallucinations Affect – Negative, positive Appears anxious Less alert, harder to rouse, lethargic, sleeping more, more awake
Yeaw & Abbate, 1993 Exploratory descriptive United States	To determine the significance of nurses' descriptions of confusion when diagnosing pt confusion	A large, acute care, teaching hospital. • 5 general medical-surgical units Data collection • Semi-structured interviews (*n* = 25 registered nurses)	Cognition	Pt has become incontinent Wandering about Verbally inappropriate Disorientation Inappropriate response Pt asking for things not there

[a]No distinction made between the level of licenced nurse.
Abbreviation: pt, patient.

(Table 2). Five studies reported nurses used changes in vital signs to recognize patient pain: three studies showed that nurses used blood pressure, pulse rate, or respiratory rate as clinical cues to correlate with patients' self-report of pain (Clabo, 2007; Manias, 2003; Manias, Bucknall, & Botti, 2004). Infrequently, acute care nurses working on

surgical wards were observed to conduct a physical examination of a painful site to investigate possible wound or device complications (Manias, 2003; Manias et al., 2002; Manias, Bucknall, & Botti, 2004).

Table 3 presents the clinical cues nurses used in eight studies to recognize changes in patients' cognition. Four studies focused on

TABLE 4 Evidence summary table: Cues to indicate change in clinical states when using a general approach to patient assessment (n = 7 studies)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
Kim, Ellefsen, Han, & Alves, 2008 Qualitative fieldwork Norway, Korea, and the United States	To describe how nurses construct meanings of clinical situations	Major acute university affiliated hospitals • Medical-surgical wards Data collection (registered nurses; n = 6 Norway; n = 5 United States; n = 4 Korea) • Participant observation 126–144 hours of observation • In-depth interviews	Physiological Respiratory Cognition Gastrointestinal Urinary/ elimination Skin Function/ activity Self-report -change	Overarching statement: No specific cues stated Respiratory distress Reduced ability to cough Increasing or decreasing amount of secretions Screaming, Confusion and agitation Hypoglycemia Poor eating New urinary incontinence Appearance of bedsores, scratches, rash, excoriation Changes in the level of assistance required to complete activities of daily living; specifically Pt not up and about as expected, not moving, only able to sit in chair for a limited time Sleep difficulties Loss of appetite Heartburn
Manias, Aitken, & Dunning, 2004 Qualitative observational Australia	To examine the barriers to graduate nurses' clinical judgment in medication management activities and the reasoning patterns used In decision making	Metropolitan university teaching hospital • Medical and surgical wards Data collection • Direct observation (n = 12 registered nurses)	Physiological Cognition Self-report -change Gastrointestinal Urinary/ elimination	Heart rate Blood pressure Newly confused Pt appears anxious Nausea Changes in blood glucose levels Vomiting New bowel symptoms
Peet, Theobald, & Douglas, 2019 Qualitative Australia	To explore the context and culture of nursing surveillance on an acute care ward	Large acute hospital • Neuroscience ward Data collection • Observation of ward activities (ward =42 registered nurses) • Semi-structured interviews (n = 12 registered nurses)	Physiological Neurological Self-report -pain Cognitive	Blood pressure - hypertension Assessment of limb power for changes Increasing pain Pt is impulsive
Penney, Poulter, Cole, & Wellard, 2016 Qualitative descriptive Australia	To explore registered nurses' views of their assessment of older adults	Regional hospital • 2 acute medical units • 1 inpt rehabilitation unit Data collection (n = 13 registered nurses) • Participant observation Semi-structured interviews	Physiological Respiratory Cognitive Function/ activity	Blood pressure – Hypotension Assessment of breathing Starting to make sense Confusion Level of pt responsiveness Pt's movement in bed, and ability to stand and ambulate
Popescu, Currey, & Botti, 2011 Qualitative exploratory Australia	To explore the multifactorial influences on medication quality and safety in the context of a single checking policy for medication administration in acute care	Major metropolitan tertiary referral hospital •1 medical ward (n = 4 registered nurses) •1 surgical ward	Respiratory	Pt assessed for changes in respiratory function

TABLE 4 (Continued)

Author study design country	Study aim	Setting & sample data collection method	Clinical states	Clinical cues that describe changes in patients' clinical states
		(n = 7 registered nurses) Data collection •semi-structured observation • Semi-structured interviews (n = 30 medication episodes)		
Rhudy & Androwich, 2013 Qualitative descriptive United States	To explore the nursing intervention of surveillance in the care of stroke pts	Large academic medical Centre • 1 medical neurology ward Data collection • Think aloud recordings (n = 10 registered nurses)	Physiological Cognition Neurological Gastrointestinal Urinary/ elimination Skin Function/ activity Self-report -change Self-report -pain	Blood pressure -hypertension Oxygen saturation Starting to pulling at things Newly confused Changes to pt's swallow ability – Pocketing Dysphagia, word finding difficulties Neglect – Unilateral Limb weakness, degree of movement and incordination Level of communication Direction of gaze Amount of oral intake Distended abdomen Bowel sounds Palpated bladder Measurement of residual urinary volume Changes in bowel movements Assessment of bruises Changes in pts' ability to ambulate Nausea Abdominal cramps
Tower, Chaboyer, Green, Dyer, & Wallis, 2012 Qualitative descriptive Australia	To examine nurses' decision-making when documenting in pts' charts	Two public hospitals • 6 medical wards Data collection • Think aloud recordings (n = 17 registered nurses; 153 episodes of care) • Semi-structured interviews (details not provided)	Physiological Self-report -change Pt report of pain Neurological Gastrointestinal Urinary/ elimination Function/ activity	Blood pressure - hypertension Body temperature- hyperthermia Oxygen saturation- hypoxemia Pt reports dyspnea Improvement in chest pain Overarching statement: No specific signs stated Blood sugar level - hyperglycemia Changes to oral intake Changes in urinary output New incontinence Changes in the level of assistance required to complete activities of daily living; specifically deterioration in pt's level of mobility

Abbreviation: pt, patient.

delirium; three studies examined recognition of patient confusion; and one study detailed how acute care nurses assessed for cognitive and behavioral changes. Three studies reported limited use of validated clinical tools to recognize delirium such as the Confusion Assessment Method (CAM) or the Delirium Rating Scale (DRC). Hussein and Hirst (2016b) reported that while acute care nurses were aware of delirium recognition tools such as the CAM, they reported poor understanding of this tool, preferring to focus on patients' level of orientation. Finally, Flagg et al. (2010) described acute care nurses' use of the Glasgow Coma Scale (GCS) and pupil checks to assess for delirium.

Seven studies presented a broad range of aims related to nurses' assessment practices; the results of these studies are shown in Table 4. Specifically, studies described how acute care nurses

TABLE 5 Objective clinical cues

Clinical states	Categories of clinical cues	Clinical cues
Physiological	Respiratory rate	Tachypnea, bradypnea
	Heart rate	Tachycardia
	Blood pressure	Hypertension, hypotension
	Oxygen saturation	Hypoxemia
	Body temperature	Hyperthermia
	Clinical tools	Track and trigger tools - calculated high scores indicate deterioration
Neurological	Eyes	Pupils, direction of gaze
	Motor function and sensation	Pins and needles, numbness
		Limb movement and strength- unilateral neglect, limb weakness, limb incoordination
	Level of consciousness	Drowsy, alert, unresponsive, difficult to rouse
		Agitation, confusion, unable to follow commands
	Communication and speech	Nonverbal, slurred speech, aphasic
	Swallow	Dysphagia, drooling, pocketing
	Clinical tools	Glasgow coma scale (GCS)
Respiratory	Alteration in breathing pattern	Distressed, labored, difficult, patient appears short of breath, gasping
		Shallow, wheezing, other adventitious sounds
	Amount of secretions	Increasing, *decreasing*
	Effectiveness of coughing	Reduced ability to cough
	Supplemental oxygen	Increasing, *decreasing* oxygen requirements
Gastrointestinal	Oral intake of food and fluid	Reduced amount of eating and drinking, vomiting
	Blood sugar levels	Hypoglycemia; hyperglycemia
	Abdomen	Distended, bowel sounds, palpated bladder
Urinary/elimination	Urinary output	Oliguria, residual urinary volume
	Continence	Stress incontinence, urinary incontinence
	Bowels	Bowel movements
Skin	Skin characteristics	Clammy, diaphoretic, cool to touch, dry
		Color- pale, cyanosis, mottled
		Appearance of tongue, bedsores, scratches, rashes, excoriation, bruise
		Unable to obtain an oximeter reading
	Wound/dressing appearance	Inflammation, swelling, discharge, amount of blood loss from drain tube exiting the skin
Function/activity	Activities of daily living	Feeding, dressing, washing, toileting, standing, ambulating, moving in bed, getting out of bed, sitting out of bed
		Level of strength and endurance
Assessment for pain	Behaviors	Restrictions in breathing, coughing, moving and activity levels, movement appears stiff and contracted, pain causes teariness, distress, restlessness, wincing, yelling, rubbing body sites, gritting teeth, deep breaths, moaning
		Relaxed behaviors, mobilizing freely, sleeping well, independent to all needs
	Appearance of pain	Sweaty, pale
Cognition	Fluctuation in behaviour	Agitation, anxious, aggressive, *improved disposition*
		Nonsensical behaviors
		Psychomotor hyper/hypo activity
		Non-compliant behaviours, *more cooperative*
		Unexpected strength
	Inattention	Impaired short-term memory, poor concentration
		Patient not engaged with nurses or surroundings

Clinical states	Categories of clinical cues	Clinical cues
		Alterations in function such as continence and in performing activities of daily living
	Disorganised thought processes	Confused, disorientated, distracted
		Incomprehensible speech, *making more sense*
		Hallucinations - auditory or visual
		"Sundowners" become confused at night and "clear" during the day
		Lack of insight into own situation
		Oblivious to pain
	Altered level of consciousness	*Increased* or decreased level of responsiveness, alertness, drowiness
		Easy or difficult to rouse
		Lethargic, sleeping more, somnolence, apathy, disturbances in the sleep–wake cycle
	Clinical tools	Confusion assessment method (CAM); delirium rating scale (DRS)

Note: Clinical cues in italics represent improvement.

TABLE 6   Subjective clinical cues

Clinical states	Categories of clinical cues	Clinical cues
Self-report	Self-report of the presence or absence of pain	Patient requests analgesia, patient locates and reports pain, cramps or discomfort
		No pain, *improving* or increasing pain
		Pain on palpation, intractable pain, pain interrupting sleep, pain becoming tighter
	Clinical tools	Level of pain rated using a visual analogue pain scale or the numerical pain scale
	Self-report of change	Body temperature, dizziness, nausea, sleeping difficulties, anorexia, heart burn, anxiety, dyspnea
	Significant others' report of patient change	Change in level of function, behaviors, cognition, mood

Note: Clinical cues in italics represent improvement.

recognize and construct clinical situations; medication administration quality and safety; acute care nurses' perceptions of their assessment of older adults; surveillance activities when caring for stroke patients; assessment decisions made by graduate nurses when administering medication; the influence of context and culture on nursing surveillance; and how acute care nurses' made decisions when documenting patient information in progress notes.

5 | DISCUSSION

This systematic review had three major findings. First, of the 173 clinical cues identified, most were objective clinical cues used to recognize a deteriorating clinical state. Second, the most common clinical cues used to recognize clinical change were heart rate, blood pressure and temperature. Third, the majority of studies in this systematic review focused on one discrete element of patient assessment highlighting a gap in the published literature that examines the complexity of acute

care nurses' broad approach to patient assessment as it would occur in clinical practice.

The first major finding of a clear emphasis on recognition of clinical deterioration may reflect national and international agendas related to rapid response systems and the central role acute care nurses have in the recognition of deteriorating patients (Australian Commission on Safety and Quality in Health Care, 2017; Institute for Healthcare Improvement, forthcoming). The focus on clinical deterioration in the literature to date has resulted in the identification of many clinical cues that describe abnormal or deteriorating clinical states. There is a gap in the research that differentiates between clinical cues that indicate deterioration requiring rapid response system activation and clinical cues that indicate clinical change as a result of typical illness trajectory that can be safely managed within nursing scope of practice.

Cues to indicate an improved clinical state are underreported in the literature: only 11 unique clinical cues used to recognize improvement were identified in this systematic review. When patient

improvement is recognized, there is opportunity for nurses to respond by minimizing exposure to unnecessary treatment and promoting patient recovery. Patient outcomes improve when patients are clinically stable enough for interventions such as physical activity and increased mobility (Kappel et al., 2018). Most of the clinical cues used to identify improvement were related to decreasing pain. More research is needed to examine how nurses assess for other improvements in clinical states in hospitalized patients.

Patients' subjective report of changes in clinical states during illness and recovery is not well represented in the literature. Only 26 of 173 clinical cues identified in this systematic review were subjective clinical cues reported by patients or significant others about changes in their clinical state. This finding may suggest that acute care nurses prefer using objective clinical cues to recognize clinical change, rather than the subjective reports from patients or significant others. The most commonly reported subjective cues to recognize changes in clinical states were pain and nausea. It is unclear whether nurses intentionally elicited subjective cues from patients or whether subjective cues were spontaneous reports from patients. Despite many patients preferring to participate in their care, current evidence suggests that most medical inpatients are not actively involved in the patient assessment process (Wiltjer, Seers, & Tutton, 2019). Failure to promote patient participation in care does not align with the current ethos of person-centered care which is important to patient safety and the patient experience of care (Australian Commission on Safety and Quality in Health Care, 2017). Further research about how acute care nurses can involve patients in the patient assessment process and subjective cues used in their assessment of clinical change is warranted.

The second major finding was that heart rate, blood pressure, and temperature were the most common clinical cues reported across all included studies. The use of other vital signs such as respiratory rate, oxygen saturation, and GCS score to recognize changes in clinical states were not as consistently reported, despite tachypnea, hypoxemia, and decreased GCS score being the most accurate signs of critical illness and the most sensitive precursors to in-hospital adverse events (Jacques, Harrison, McLaws, & Kilborn, 2006). In addition, many studies included in this systematic review reported documentation of incomplete sets of vital signs. A complete set of vital signs is commonly defined as assessment of respiratory rate, oxygen saturation, heart rate, blood pressure, temperature, and level of consciousness (Australian Commission on Safety and Quality in Health Care, 2017). Omitting the assessment of specific vital sign parameters may place patients at risk of unrecognized clinical change (Padilla & Mayo, 2018) or, conversely, it may indicate that nurses are tailoring their assessments to patient needs and clinical states. The focus of future research should be on nurses' decision making regarding their approach to vital sign assessment and how they use specific parameters to recognize changes in patients' clinical states.

The third major finding of this systematic review was that the majority of studies were focused on nurses' assessment of changes in one of three specific clinical states; physiological stability, pain, or cognition. This focus on discrete elements of patient assessment, rather than understanding the complexity of patient assessment in its entirety, has narrowed and fragmented the body of knowledge regarding acute care nurses' assessment practices. The clinical cues reported in studies on one element of patient assessment may not accurately represent the reality of nursing practice nor the multifarious nature of patients' clinical states. Currently, there is very little understanding of the breadth and depth of clinical cues acute care nurses use in clinical practice to recognize changes in clinical states of patients in their care.

There are several methodological limitations to consider when interpreting the findings of this systematic review. First, the methodology in most included studies used interviews and, or observation for data collection. Interview data may be biased by social desirability, recall, and self-report biases. Observations carry the risk of the Hawthorne effect, whereby participants change their behavior when being watched. Second, gaps in the reporting of methodological detail and limitations in most studies suggests that a risk of bias should be considered when evaluating the results of this systematic review. Third, publication bias needs to be considered given only studies published in the English language were included. However, only six studies were excluded based on the full-text article not being available in English, and therefore excluded articles are unlikely to have had a significant influence on the systematic review findings. Finally, there was significant heterogeneity across studies in terms of patient selection, patient characteristics, site selection, and outcomes examined, potentially influencing the generalizability of the study findings and precluding meta-analysis.

6 | CONCLUSION

There is a disproportionate focus in the literature on acute care nurses' objective assessment of deteriorating states and a paucity of studies that detail the complexity of acute care nurses' patient assessment as it would occur in day to day clinical practice for the recognition of clinical change. This systematic review highlights a number of gaps that should inform future research. Specifically, a clear description of how nurses working in clinical practice approach patient assessment and use clinical cues to recognize improvement. Second, an understanding of clinical cues nurses use to recognize clinical deterioration that occurs as a usual consequence of acute illness and treatment is needed. Third, understanding why acute care nurses preference some clinical cues over others to recognize changes in patients' clinical states requires further examination. Fourth, it is recommended that research be conducted to explore and describe a complete view of the clinical cues acute care nurses use to recognize changes in patients' clinical states.

RELEVANCE TO CLINICAL PRACTICE

Acute care nurses are primarily responsible for patient assessment and recognition of clinical change. To protect patients from further deterioration and promote patient recovery, it is imperative that nurses use appropriately targeted clinical cues to detect changes in clinical states. The results of this systematic review make important recommendations for further research to broaden our

understanding of how nurses approach patient assessment and use clinical cues to recognize clinical change. The results of further research will provide important opportunities for nursing education and improvements in the recognition of patient changes in clinical practice.

CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

Study design: G.B., G.L., B.R. and J.C.

Data collection: G.B.

Data analysis: G.B., G.L., and J.C.

Manuscript writing: G.B., G.L., B.R., and J.C.

AN AUTHORSHIP STATEMENT

All authors listed with the submitted manuscript meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all authors are in agreement with the content of this manuscript.

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SUPPORTING INFORMATION