



Nursing Surveillance for Deterioration in Pediatric Patients: An Integrative Review

James R. Stotts, RN, MS, PhD, CNS^{a,b,*}, Audrey Lyndon, PhD, RNC, FAAN^{a,1},
Garrett K. Chan, PhD, APRN, FAEN, FPCN, FAAN^{c,d}, Arpi Bekmezian, MD^{e,f}, Roberta S. Rehm, PhD, RN, FAAN^a

^a Department of Family Health Nursing, University of California, San Francisco, CA, USA

^b Department of Patient Safety and Regulatory Affairs, UCSF Health, San Francisco, CA, USA

^c Department of Physiologic Nursing, University of California, San Francisco, CA, USA

^d Division of Primary Care and Population Health, Stanford School of Medicine, Stanford, CA, USA

^e Department of Pediatrics, University of California, San Francisco, CA, USA

^f San Francisco, CA, USA

ARTICLE INFO

Article history:

Received 17 March 2019

Revised 14 October 2019

Accepted 15 October 2019

Keywords:

Nursing surveillance

Recognition

Detection

Deterioration

Pediatric

ABSTRACT

Problem: Adverse events occur in up to 19% of pediatric hospitalized patients, often associated with delays in recognition or treatment. While early detection is recognized as a primary determinant of recovery from deterioration, most research has focused on profiling patient risk and testing interventions, and less on factors that impact surveillance efficacy. This integrative review explored actions and factors that influence the quality of pediatric nursing surveillance.

Eligibility criteria: Original research on nursing surveillance, escalation of care, or cardiopulmonary deterioration in hospitalized pediatric patients in non-critical environments, published in English in peer reviewed journals.

Sample: Twenty-four studies from a literature search within the databases of CINAHL, PubMed, and Web of Science were evaluated and synthesized using a socio-technical systems theory framework. Study quality was assessed using The Mixed Methods Appraisal Tool.

Results: Assessment, documentation, decision-making, intervening and communicating were identified as activities associated with surveillance of deterioration. Factors that influenced nurses' detection of deterioration were patient acuity, nurse education, experience, expertise and confidence, staffing, standardized assessment and communication tools, availability of emergency services, team composition and opportunities for multidisciplinary care planning.

Conclusions: Research provides insight into some aspects of nursing surveillance but does not adequately explore factors that affect clinical data interpretation and synthesis, and role integration between nurse and parents, and nurse and other clinicians on surveillance of clinical stability.

Implications: Research is needed to enhance understanding of the contextual factors that impact nursing surveillance to inform intervention design to support nurses' timely recognition and mitigation of clinical deterioration.

© 2019 Elsevier Inc. All rights reserved.

Problem

Clinical deterioration is an unexpected, undesired experience for children who are admitted to the hospital. Physiologic deterioration is typically characterized as either an abrupt or gradual outcome of

impaired or worsening vitality (Anderson, 2002; Stedman, 2012). Abrupt clinical deterioration is primarily measured as rates of adverse events such as failure to rescue (death following adverse events or complications of care), cardiopulmonary arrest, or in-hospital mortality (Bonafide et al., 2012). Institution of resuscitative treatments such as fluids or oxygen or transfer to a higher level of care has also been used as surrogate measures (Jones, Mitchell, Hillman, & Story, 2013). For children hospitalized in acute care settings, the rates of clinical deterioration vary from 2 to 19% (Berg, Nadkarni, Zuercher, & Berg, 2008; Tume, 2007). Up to 16% of clinical deterioration events can be attributed to suboptimal care such as delays in recognition or escalation (Hayes et al., 2012).

* Corresponding author at: University of California San Francisco Medical Center, 350 Parnassus Avenue, Suite 706, San Francisco, CA 94122, USA.

E-mail addresses: james.stotts@ucsf.edu (J.R. Stotts), audrey.lyndon@nyu.edu (A. Lyndon), garrett.chan@nursing.ucsf.edu, gchan@stanfordhealthcare.org (G.K. Chan), Arpi.Bekmezian@ucsf.edu (A. Bekmezian), roberta.rehm@ucsf.edu (R.S. Rehm).

¹ Present address: NYU Rory Meyers College of Nursing, 433 First Avenue, Room 606, New York, NY 10010, USA.

Recent studies have shown that surveillance efficacy and rescue outcomes are impacted by several individual and organizational factors: the availability of equipment, staffing, skill and team composition, interactions between people, and with technology (Azzopardi, Kinney, Moulden, & Tibballs, 2011; Brady et al., 2013; Brady & Goldenhar, 2014; Hayes et al., 2012; Joffe, Anton, & Burkholder, 2011). According to Benner (1984), essential aspects of nursing practice are to detect changes in patient condition, anticipate deterioration prior to confirming diagnostic signs, and assess the patient's response to treatment. Nursing surveillance is a continuous process of acquisition, interpretation, and synthesis of physical, behavioral, and cognitive patient data to determine intervention and threats to health and safety during the course of nursing care (Bulechek, Butcher, Dochterman, & Wagner, 2013; Kelly & Vincent, 2011; Meyer, Lavin, & Perry, 2007). Research in the sociotechnical aspects of nursing surveillance in children's hospitals is sparse and has focused mostly on intensive care units (ICU) (Hickey, Gauvreau, Curley, & Connor, 2013; Krapohl, Manojlovich, Redman, & Zhang, 2010). More research is needed to broaden our understanding of the contextual factors that affect nursing surveillance. Such research could inform the design of interventions that will support nurses' timely recognition and mitigation of clinical deterioration.

Aim

The purpose of this integrative review was to synthesize the findings of studies that examined factors that influence in-hospital pediatric nurses in non-ICU environments when confronted by clinical deterioration. Four lines of inquiry were analyzed: (a) What do nurses do when they recognize and respond to patient deterioration?; (b) What social interactions between nurses, other clinicians, patients, and families impact the quality of surveillance?; (c) What factors facilitate or hinder actions associated with nursing surveillance of unstable patients?; and,

(d) What gaps remain in our understanding of nursing surveillance of pediatric patients who experience clinical deterioration?

Theoretical framework

A socio-technical systems framework (Fig. 1) by Karsh, Holden, Alper, and Or (2006) and the socioecological theory of child development and adaptation by Bronfenbrenner (1977) informed the search for factors associated with nursing surveillance and deterioration, guided inclusion and exclusion criteria, and framed the discussion of findings. In the socio-technical systems framework, health care delivery is described as several interacting social and technical processes (throughputs), shaped by family, patient, environment, and clinician characteristics or contributing factors (inputs) which influence clinical outcomes (outputs). In this model clinicians refers to all healthcare workers including nurses. Bronfenbrenner's socioecological theory sensitized the search for studies that explain the effects of interactions and relationships between patients and family and the health care system on surveillance.

Method

Data sources

A search of the CINAHL, PubMed, and Web of Science databases was conducted in January 2019 by JRS for English-language research published up to December 31, 2018 that was filtered for human and child, birth to 18 years. Searches were performed without restriction to year of publication, geography, race, or sex. Combinations of MeSH terms related to the recognition of clinical deterioration and failure to rescue were used but were not specific enough to narrow the search to pertinent studies. Thus, several combinations of keywords were used as search terms (Table 1). A trained librarian and colleagues with

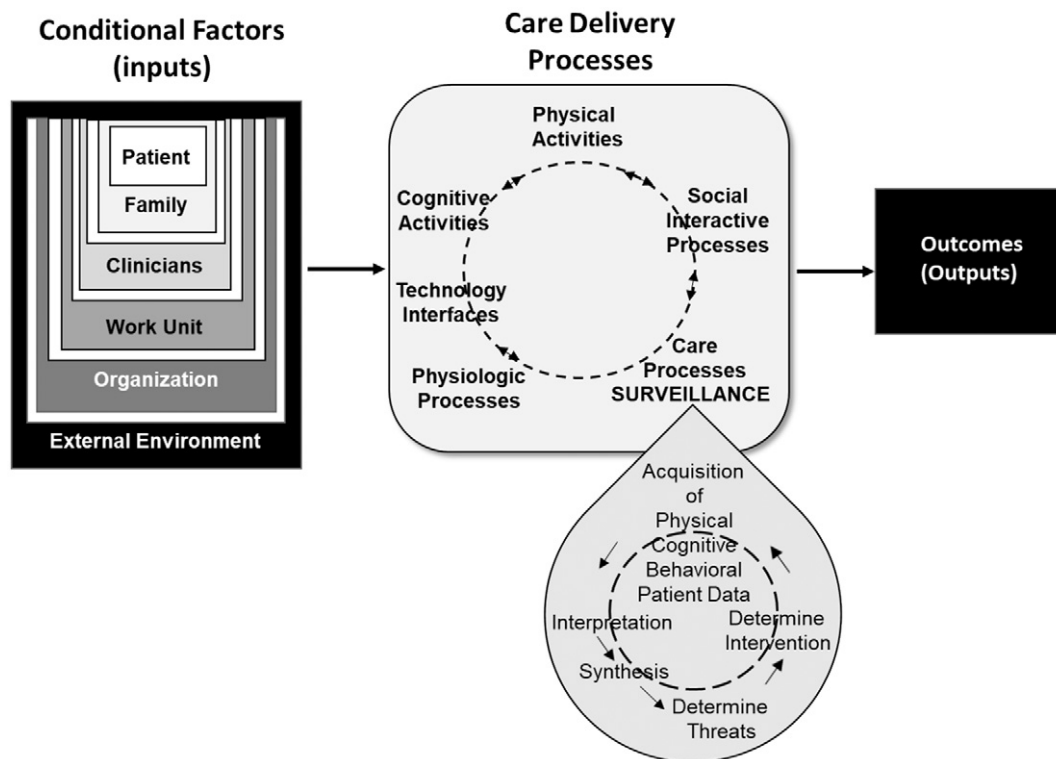


Fig. 1. Socio-technical systems framework. Schematic of socio-technical system framework adapted from Karsh et al. (2006). The family, patient, clinician, work unit, organization and external environment are conditional factors (inputs) which influence how care is delivered. Care delivery is comprised of activities and interactions of and between people, the environment and technology. Surveillance is a mechanism of care processes that involves acquisition, interpretation and synthesis of patient data and determining threats to health and safety and course of action. A course of action begins the cycle of data acquisition, interpretation, synthesis, and decision making about threat and action.

Table 1
Search terms and keyword combinations.

Nursing and surveillance
Add Pediatric
Nursing surveillance and Deterioration
Add Pediatric
Nursing surveillance and Pediatric and Deterioration
Nursing observations
Add Pediatric
Nursing Observation Critical
Nursing Observation Cardiopulmonary Arrest
Add Pediatric
Detection and Deterioration
Add Pediatric
Detection Deterioration Cardiac
Recognition and Deterioration
Add Pediatric
Nursing Recognition Emergency
Add Pediatric
Early Recognition of deteriorating patients
Add Pediatric
Surveillance and Deterioration
Add Pediatric
Surveillance or monitor
Add adverse events or deterioration or inpatients and/or hospitalization
Critical illness/nursing AND Deterioration AND Pediatric
Nurses AND Decision Making AND Pediatric
Hospital rapid response team AND Pediatric AND Nursing Surveillance
Hospital rapid response AND Pediatric and Nursing Care Hospitals, Pediatric
Add infant or child or adolescent
Pediatric AND Nursing records AND Quality of health care
Communication Barriers
Add rapid response or emergency or deterioration or deterioration
Schema
Rapid response
Add delay
Prevention or recognition or monitoring
Add deterioration or emergency
Serious Safety Event
Add prevention or recognition or monitoring
Situation awareness
Recognition
Add deterioration
Barriers
Add recognition or deterioration or clinical deterioration
Awareness
Add Patient Safety and/or inpatients or hospitalization or Hospitals
Pediatric or Patient Harm/prevention and control
Patient harm/prevention and control

Filters: English, Human, Child: birth–18 years.

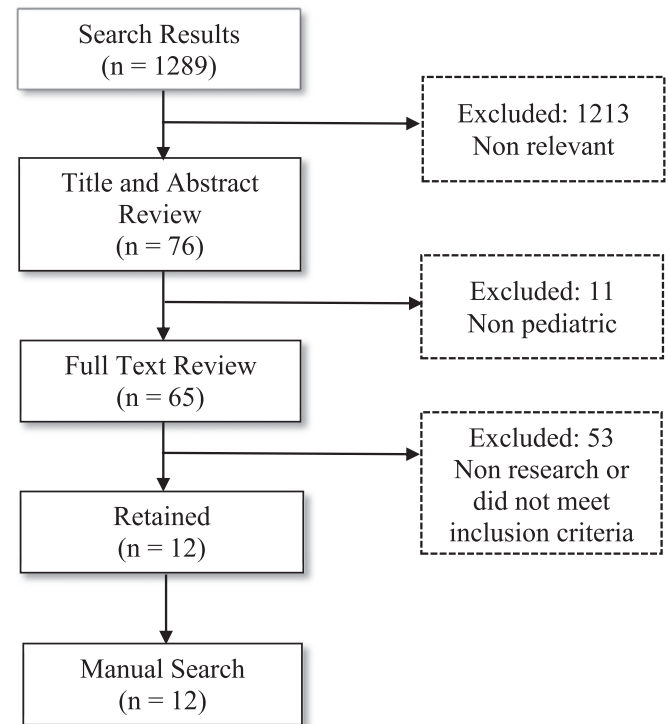


Fig. 2. Search strategy.

Search outcome

The initial literature search yielded 1289 articles. Following a review of their abstracts, 65 articles were read in full for relevancy. Based on the inclusion and exclusion criteria, 12 articles were selected for review. Twelve more articles, the yield of screening reference lists, were added for a total of 24 (Fig. 2). Complete study characteristics can be found in Table 2.

Quality appraisal

The Mixed Methods Appraisal Tool (MMAT; Pluye et al., 2011) was used to evaluate the quality of research methods. This tool's criteria enables one to assess the quality of qualitative, quantitative, and mixed-methods studies with a numerical point score of 0–5, or percentage scores of 0, 25, 50, 75, and 100% based on how many of the tool's assessment criteria are met. Scores for mixed method research reflect an assessment of quality based on the lowest scoring methodology component. The MMAT's criteria have been found to have acceptable inter-rater reliability with interclass correlation of 0.72–0.94 (Pace et al., 2012). No articles were excluded based on quality scores because each study's findings were consistent with general themes.

Results

Twenty-four articles, published from 2004 to 2018, met the selection criteria. Most were published after 2009. Thirteen studies were conducted in the United States (Akre et al., 2010; Bonafide et al., 2013; Brady et al., 2015; Brady & Goldenhar, 2014; Dudley & Carr, 2004; Kaul et al., 2014; Martin, Keller, Long, & Ryan-Wenger, 2016; Reese, Simmons, & Barnard, 2016; Roberts et al., 2014; Thrasher, McNeely, & Adrian, 2017; Voepel-Lewis, Pechlavanidis, Burke, & Talsma, 2013; Watson, Skipper, Steury, Walsh, & Levin, 2014; Zenker et al., 2007), three in Canada (Lobos, Fernandes, Ramsay, & McNally, 2014; Lobos, Fernandes, Williams, Ramsay, & McNally, 2015; McGillis Hall et al.,

extensive experience with qualitative research assisted the author in the derivation process. To complement the online search, the reference lists of relevant studies were also checked. Finally, journals with the greatest publications of relevant papers were searched from January 2005 to December 2018 for citations that may have been missed.

Inclusion and exclusion criteria

To be included in this review, studies had to (a) describe original research that was published in a peer-reviewed journal; (b) address any aspect of surveillance activities performed by nurses or contributing factors to nursing surveillance in noncritical care areas, as defined within the theoretical framework; and, (c) report on at least one of the following outcomes: impact on surveillance, intensity, or escalation of care; transfer to a higher level of care; cardiopulmonary arrest; or death. Experimental and non-experimental studies were included to allow for a full review of nursing surveillance.

Table 2

Summary of studies about factors associated with nursing surveillance of pediatric patients.

Author (year) Country	Purpose	Setting Sample	Design Measurement	Results related to nursing surveillance	Quality
Akre et al., 2010 (USA)	Evaluate outcomes of PEWS and examine staff awareness of deterioration.	Med/surg units of 325 bed freestanding Children's Hospital 186 RRT/code blue events	Retrospective descriptive cohort study using chart review by critical care nurses Staff awareness measured as increased surveillance or intervention.	<ul style="list-style-type: none"> Higher PEWS associated with earlier escalation, increased consultations, added monitoring, increased nursing documentation Subset analysis showed elevated PEWS hours prior to intervention or documentation 	75%
Almblad et al., 2018 (Sweden)	Describe PEWS data entry and examine adherence to PEWS clinical guidelines related to work context.	3 clinical units at a freestanding Children's Hospital, 875 charts reviewed of patients <19 years	Retrospective descriptive cohort study comparing clinical unit results of random sample chart review post early detection and treatment program for RNs and NAs Alberta Context survey tool used to assess differences in work context	<ul style="list-style-type: none"> Adherence to PEWS guidelines (assessments and intervention) varied between units; highest for oxygen saturation with respiratory distress and on admission; lowest for assessments of BP and pain Documentation of recommended actions was incomplete. No differences in work context except for leadership qualities 	75%
Azzopardi et al., 2011 (Australia)	Assess value of and barriers to MET activation.	250 bed freestanding Children's Hospital 280 RNs, 127 MDs	Mixed methods, descriptive cohort study using survey tool and thematic analysis of open ended questions. Participants coded as callers of MET or responders	<ul style="list-style-type: none"> Response rate 24.1% MET valued for support & intervention Clinicians disagreed that MET deskilled MD callers/RN responders felt MET overused Delays in MET calls d/t initial escalation to Attending or PICU, unrecognized deterioration, fear of or actual criticism, instruction not to, patient appearing well 50% participants call for concern PEWS facilitated recognition, surveillance, intervention, and communication of concern except with stable, baseline abnormal, or neurologic instable patients. 	25%
Bonafide et al., 2013 (USA)	To identify mechanisms by which physicians and nurses use PEWS to support decision making.	504 bed freestanding Children's Hospital 27 RNs, 30 MDs caring for child ≤18 yrs. on general medical or surgical ward with false negative/positive PEWS	Grounded theory Semi-structured interviews		75%
Brady & Goldenhar, 2014 (USA)	Learn about factors that influence situational awareness (SA) and identification, mitigation and escalation of patient risk.	523 bed freestanding Children's Hospital 31 participants (10 charge nurses, 8 bedside nurses, 3 respiratory therapists, 10 residents)	Grounded theory Semi-structured interviews with focus groups assigned by role	<p><i>Themes for improved (SA)</i></p> <ul style="list-style-type: none"> Team based care resulting in empowered families and nurses, and culture of teamwork, accountability & safety Standardization of training, risk identification, intervention, communication, and staffing Increased clinical experience, and opportunities for care continuity planning 	75%
Brady et al., 2015 (USA)	To understand why families call MET, burden of family-activated MET calls, and all MET call outcomes.	577 bed freestanding Children's Hospital 40 family-activated MET calls, 1156 clinician MET calls	Retrospective cohort study using nested case-control method using structured chart review as part of a quality improvement project. Data from both sample sets were stratified by nursing unit and month of call.	<ul style="list-style-type: none"> 23% family vs. 60% clinician calls resulted in transfer to ICU; 77% vs 40% remained on floor Reason for activation similar between groups with clinical deterioration most prevalent Unique family triggers were lack of response and dismissive interaction 	50%
Doman et al., 2004 (United Kingdom)	Explore experiences and issues of vigilance providing high dependency care in children's wards.	Multiple sites of children wards and hospitals 12 pediatric nurses	Qualitative study using focus group interviews	<ul style="list-style-type: none"> Over reliance on equipment/-monitors Good assessment/observational skills, adequate skill training/-education, experience, ability to communicate with MD, being assertive, confidence, use of instinct or gut feelings were identified as essential nurse characteristics for recognizing patient deterioration Teamwork, MD trust in RN judgment, leadership/management, and adequate staffing are important cultural characteristics 	75%
Dudley & Carr, 2004 (USA)	To explore the phenomenon of vigilance of parents staying at the bedside with a hospitalized child.	34 bed general pediatric unit in teaching hospital 10 parents of children aged 5–18 hospitalized for at least	Ethnographic study Semi-structured interview Participant observation	5 themes describing vigilance:	100%

Table 2 (continued)

Author (year) Country	Purpose	Setting Sample	Design Measurement	Results related to nursing surveillance	Quality
		48 h without a terminal illness		<ul style="list-style-type: none"> ■ <i>Commitment to care</i>: parents feeling responsible to advocate, be involved, and watch over child ■ <i>Resilience</i>: perseverance, hope and self-care ■ <i>Emotional upheaval</i>: constant worry, uncertainty, loss of control, life & death decisions ■ <i>Dynamic relationships</i> between relatives and with staff ■ <i>Transition</i>: change in comfort, space, daily life pattern 	
Gawronski et al., 2018 (Italy)	To identify factors influencing escalation of care in deteriorating children.	607 bed freestanding Children's Hospital 23 clinicians with pediatric clinical experience with deterioration in last 12 months from 9 clinical areas 9 parents from non-ICU	Qualitative study with thematic analysis Focus groups with semi-structured interview guide using scripts of clinical deterioration. Parents asked to recall child's hospital experience and describe response of staff. Focus groups assigned by role (staff nurses, nurse managers, ward physicians, PICU physicians, and parents).	4 facilitator/barrier themes: <ul style="list-style-type: none"> ■ Skill, experience, knowledge impacts confidence, professional credibility, parent comfort, need for consultation ■ Relationships and leadership in care impacts hierarchy, empowerment, partnership, communication, teamwork ■ Recognition & management supported by experience and intuition, monitoring, rounding, standard observation, critical thinking, situation awareness, empowerment ■ Organizational factors: staffing, workload, competing demands, continuity of care, patient pathways 	100%
Kaul et al., 2014 (USA)	Determine impact of PEWS tool on RNs' ability to recognize and manage deterioration, communicate assessments, and MD and RN perception of RN abilities.	2 acute care medical units in a 300 bed freestanding Children's Hospital 35 RNs and 17 MDs	Descriptive, cross-sectional study using study and control group Study unit received training on PEWS and care recommendations while control unit did not. Separate RN and MD survey tools used to evaluate RN outcomes	<ul style="list-style-type: none"> ■ Study unit RNs reported greater ability to recognize deterioration and escalate care ■ Study unit MDs reported RNs on study unit more effective at communicating concerns about deterioration ■ Differences identified between RN and MD groups in assessment parameters used to determine stability and answers to scenario questions 	75%
Lobos et al., 2014 (Canada)	Describe patient characteristics, MET activation, MET interventions, and patient disposition by type of health care staff (HCS) activating MET.	166 bed freestanding Children's Hospital 800 MET activations of patients <18 yrs.	Retrospective descriptive cohort study Chart review & outcome variables (PICU admission, # interventions, type of interventions) abstracted from MET data base	<ul style="list-style-type: none"> ■ <i>MET activators</i>: 53.3% MDs, 47.7% RNs; no difference in call indications ■ RN activations were mostly in medical patients, more likely when being followed by MET, following surgery, resulted in less PICU admits, more sedative use ■ Multiple activators associated with higher PICU admission rates, more respiratory issues, more likely to have had prior activation ■ Similar # and type of interventions between groups (those requiring MD order and those under RN control) 	75%
Lobos et al., 2015 (Canada)	Investigate follow-up activities of MET team and associations between patient variables and intervention or additional MET visits following PICU discharge.	166 bed freestanding Children's Hospital 1805 patients 18 yrs. and younger; 4841 MET follow-up visits	Retrospective, descriptive, cohort study Demographic, process, and outcome data abstracted from chart review and MET database	<ul style="list-style-type: none"> ■ Major MET interventions associated with patients with multiple diseases, surgery within last 7 days, unscheduled visit, intervention at first follow-up visit ■ 11 patients readmitted to PICU at time of MET planned visit ■ 64 patients required unplanned MET to evaluate patient ■ 230 patients received intervention (those requiring MD order and those under RN control) by MET during follow-up visit, with physiotherapy and suctioning most common. 	75%

(continued on next page)

Table 2 (continued)

Author (year) Country	Purpose	Setting Sample	Design Measurement	Results related to nursing surveillance	Quality
Martin et al., 2016 (USA)	To evaluate effect of simulation on RN clinical judgment and performance with deterioration, and patient outcomes. To evaluate relationships between judgment accuracy and RN characteristics.	527 bed, freestanding Children's Hospital 83 RNs on general medicine unit	Pre/post observational, descriptive study following 5 simulation experiences. <ul style="list-style-type: none"> Health Science Reasoning Test Medical Education Technologies Incorporated Simulation Effectiveness Tool Confidence/competence self-evaluation tool Chart audit 	<ul style="list-style-type: none"> # of simulations increased confidence & critical thinking but not PEWS accuracy. PEWS PICU transfer rates PEWS accuracy was not effected by age, self-appraised confidence or competence, degree, yrs. of experience, or FTE hired to work, but increased on day shift and with experiences with code/ACT events. PICU admission not effected by RN demographics or confidence/competence self-appraisal. 	50%
McGillis Hall et al., 2010 (Canada)	To investigate the context of interruptions in work with nurses in pediatric acute care units.	4 units in a 400 bed freestanding Children's Hospital 32 nurses 9 nurses randomly selected to participate in focus group	Descriptive mixed method study with thematic analysis. <i>1st phase</i> cross-sectional observation <i>2nd phase</i> thematic analysis	<ul style="list-style-type: none"> Source of distraction were primarily the environment and people with staff nurses being the greatest percent. Types of distractions were unexpected encounters and managing discrepancies. Primary causes included communication about patient care, equipment, and need for assistance. Distractions impacted completion of work, concentration, having to multitask Some distractions perceived as increasing safety and improving care. 	75%
McKay et al., 2013 (Australia)	To evaluate impact of multifaceted intervention on vital sign documentation, interprofessional communication & medical review in deteriorating pediatric patients.	2 pediatric wards at tertiary hospital Random selection of patients admitted pre (262) and post (221) study periods	Prospective controlled pre/post intervention trial Chart review Pre/post intervention survey to assess knowledge of signs of deterioration, confidence in assessing	<ul style="list-style-type: none"> Significant improvement in documentation of assessment data and communication between RN & MD Reduced time for escalation and for medical reviews Reduction in the unexpected transfers to higher level of care Improved compliance with MET criteria No significant changes in unexpected deaths, hospital length of stay, or # of MET calls Nonsignificant improvement in knowledge or confidence in assessing. 	100%
Oliver et al., 2010 (Wales)	To determine the feasibility of implementation of a PEWS and assess compliance with recording vital assessments during PEWS implementation.	Freestanding Children's Hospital 1000 non ICU or high dependency unit patients aged 0–16 yrs. without cardiac/respiratory arrest 9075 sets of PEW data	Observational study during prospective, observational cohort study Retrospective chart review/audit for frequency of PEW parameter recording.	Compliance with vital assessment recordings: <ul style="list-style-type: none"> T – 88.4% HR – 86.8% RR – 79.7% SpO2 – 76.7% BP – 58% AVPU – 36% Clinician worried – 20.7% Airway threat – 8.1% <p>Variations in compliance attributed to medical consultant preference, reluctance to disturb children with equipment for BP and SpO2, lack of specificity to frequency of routine observations</p> <p><i>Interpersonal factors</i></p>	50%
Reese et al., 2016 (USA)	To understand facilitators and barriers effecting assertion communication of concerns among nurses and physicians on an inpatient pediatric medical unit.	freestanding 373 bed Children's Hospital 11 RNs 16 MDs in pediatric rotation 9 attendings	Qualitative study – thematic analysis Focus groups for each clinician type using semi-structured interviews using tool based on literature.	<p><i>Organizational factors</i></p> <ul style="list-style-type: none"> Fears related to hierarchy: reluctance to assert d/t fear of appearing incompetent, go above someone, not being heard r/t position Prior encounters/relationships Closed personality Communication style <p><i>Standardized communication</i></p> <ul style="list-style-type: none"> Standardized communication Face-to-face communication 	75%

Table 2 (continued)

Author (year) Country	Purpose	Setting Sample	Design Measurement	Results related to nursing surveillance	Quality
				<i>Care complexities</i>	
Roberts et al., 2014 (USA)	Identify and understand barriers to calling for urgent assistance where an RRS had been implemented.	Freestanding 530 bed Children's Hospital 27 nurses 30 physicians caring for patients <18 yrs. on medical or surgical units with either false negative or false positive EWSs following MET	Grounded theory Semi-structured interviews using tool based on literature and expert opinion	<ul style="list-style-type: none"> Opportunities for care coordination and planning <i>Barriers for initiating MET</i> <ul style="list-style-type: none"> Lack of self-efficacy Perception of hierarchy Fear of losing control of patient (MD) Fear of criticism <i>Strategies used to mitigate barriers</i> <ul style="list-style-type: none"> Delegating up or conferring with others Teaming up with others 	75%
Theilen et al., 2013 (Scotland)	To evaluate the impact of team training on hospital response to deteriorating patients.	Freestanding Children's Hospital All unplanned admissions to Pediatric ICU for 1 year	Prospective pre/post intervention observational cohort study Chart audit for process measures related to pre-event recognition, escalation, and management, and patient outcomes	<ul style="list-style-type: none"> Decreased time between warning sign & first response Increase nursing observations Increase consultant reviews Increase patient transfer to higher level of care Decrease time between first response & PICU admission No significant change in outcomes but improved trends 	75%
Thrasher et al., 2017 (USA)	To evaluate nurses' perceptions of barriers to early clinical intervention and escalation to reduce code events on pediatric inpatient medical units.	82 beds of a 486 bed freestanding Children's Hospital 10 nurses working on 2 pediatric medical units.	Qualitative study using thematic analysis Interviews	<i>Facilitators in calling RRT:</i> <ul style="list-style-type: none"> Experienced resources Culture of assertion Recognition skills Supportive leadership <i>Barriers in calling RRT:</i> <ul style="list-style-type: none"> ICU bed capacity Equipment issues Lack of experience Qualities of prior experience with MD Misinterpretation of cues Self-expectation to manage deterioration Delay to escalation up chain of command first Delay d/t having to convince providers 	75%
Voepel-Lewis et al., 2013 (USA)	Describe relationships between patient & perioperative factors, staffing, surveillance, & serious adverse events (SAE). Determine effects of staffing on relationship between patient/perioperative factors and SAE and surveillance on relationship between staffing and SAE.	Children's Hospital Children who had non-cardiac surgery with serious event within 7 days post surgery 98 events 158 controls 2 controls matched on surgical procedure	Retrospective, nested case-control correlational study Chart review for nursing surveillance data and patient outcomes Staffing derived from administrative data	<ul style="list-style-type: none"> Presence of major comorbidity increased surveillance but was dependent on staffing Relationship between staffing and SAE was dependent on surveillance, when adjusted for all factors Staffing levels without added surveillance was insufficient to impact outcomes Physical status, perioperative complication, greater surveillance associated with probability of SAE SAEs detected during informal/-undocumented surveillance 	100%
Watson et al., 2014 (USA)	To evaluate workflow variables surrounding calculation and documentation of PEWS.	7 non-ICU units in a 303 bed freestanding Children's Hospital All patients on unit during data collection times 2583 vital sign instances, 2556 PEWS Random selection of 15 nurses for observation	Mixed-method study Pre/post education program descriptive, observational study Retrospective chart review Behavioral observations PEWS satisfaction question asked at end of observations	<ul style="list-style-type: none"> Documentation delays: vital signs mean 20–37 min, mean PEWS calculation 77–83 min; delays d/t work, communication, information collection, interventions, RNs taking vital signs Barriers to concurrent charting: lack of computer availability/functionality, excessive log-on times, preference to chart away from patients/families 	50%

(continued on next page)

Table 2 (continued)

Author (year) Country	Purpose	Setting Sample	Design Measurement	Results related to nursing surveillance	Quality
Ygge & Arnetz, 2004 (Sweden)	Gain an understanding of factors that influence parents' views of their own involvement in pediatric care. Develop a theory about interactions between hospital staff and parents of chronically ill children.	200 bed Children's Hospital 14 parents	Grounded theory Semi-structured interviews	<ul style="list-style-type: none"> Median time to assessment 18 min, documentation 47 min, communication 30 min Prevalent use monitors instead of assessment, transfer of assessment from paper to EMR RN preference to own assessment vs. PEWS for risk determination <p>Themes of parents perceptions/experiences:</p> <ul style="list-style-type: none"> Need for support: information, guidance, routine for communication or interaction with staff Professionalism: communication deficiencies about information, participating and individualizing care, concerns about competence Work environment: staff busy, stressed, time pressured, disorganized, parent expected to stay 24/7 Responsibility: for care coordination and updated on new research/treatment methods 	50%
Zenker et al., 2007 (USA)	To evaluate effectiveness & impact of implementing RRT.	381 bed, Children's Hospitals and Clinics All code and RRT events in non ICU or emergency department	Pre/post intervention, observational, descriptive study Retrospective chart review for patient outcomes pre RRT Prospective chart review and RRT consultation record and log post RRT Satisfaction questionnaire	<ul style="list-style-type: none"> Most RRT activations by RNs 2 activations at the request of parents More calls on off shifts; winter and spring d/t respiratory illness 39% of RRT calls within 24 h of admission Objective criteria for call often not documented Rx's: suctioning, increased oxygenation/ventilation therapy, vasopressors, fluids, intubation, transfer to higher level of care, cardioversion, increased monitoring 	50%

2010), three in the United Kingdom (Doman, Prowse, & Webb, 2004; Oliver, Powell, Edwards, & Mason, 2010; Theilen et al., 2013), two in Australia (Azzopardi et al., 2011; McKay et al., 2013), two in Sweden (Almblad, Siltberg, Engvall, & Malqvist, 2018; Ygge & Arnetz, 2004), and one in Italy (Gawronski et al., 2018). Twenty-one studies were conducted in children's hospitals (Akre et al., 2010; Almblad et al., 2018; Azzopardi et al., 2011; Bonafide et al., 2013; Brady et al., 2015; Brady & Goldenhar, 2014; Gawronski et al., 2018; Kaul et al., 2014; Lobos et al., 2014; Lobos et al., 2015; Martin et al., 2016; McGillis Hall et al., 2010; Oliver et al., 2010; Reese et al., 2016; Roberts et al., 2014; Theilen et al., 2013; Thrasher et al., 2017; Voepel-Lewis et al., 2013; Watson et al., 2014; Ygge & Arnetz, 2004; Zenker et al., 2007), two in pediatric units in a medical health system for adults and children (Dudley & Carr, 2004; McKay et al., 2013), and one in multiple centers (Doman et al., 2004). Two studies were performed within a larger study conducted at the same hospital (Bonafide et al., 2013; Roberts et al., 2014).

All of the studies reviewed used non-experimental designs. Twelve observational descriptive studies used cohort (Akre et al., 2010; Almblad et al., 2018; Lobos et al., 2014; Lobos et al., 2015; Martin et al., 2016; Oliver et al., 2010; Theilen et al., 2013), case-control (Brady et al., 2015; McKay et al., 2013; Voepel-Lewis et al., 2013; Zenker et al., 2007), or cross-sectional designs (Kaul et al., 2014). Nine studies reported the use of qualitative research methodologies including five grounded theory (Bonafide et al., 2013; Brady & Goldenhar, 2014; Doman et al., 2004; Roberts et al., 2014; Ygge & Arnetz, 2004), three thematic analysis studies (Gawronski et al., 2018; Reese et al., 2016; Thrasher et al., 2017), and one ethnographic study (Dudley &

Carr, 2004). Three studies used mixed methods with cohort or cross-sectional designs combined with thematic analysis of observations or open-ended responses to questionnaires (Azzopardi et al., 2011; McGillis Hall et al., 2010; Watson et al., 2014).

Four studies addressed factors associated with pediatric nurse surveillance or facilitators and barriers to recognizing or managing clinical deterioration (Brady & Goldenhar, 2014; Gawronski et al., 2018; Thrasher et al., 2017; Voepel-Lewis et al., 2013). The remaining 20 studies, although not focused on nursing surveillance, reported findings that elucidate our understanding of the conditions or context of nursing surveillance of clinical deterioration. Six articles described outcomes associated with rapid response systems that are designed to assist non-ICU clinicians in identifying and managing clinically unstable patients (Azzopardi et al., 2011; Lobos et al., 2014; Lobos et al., 2015; Roberts et al., 2014; Zenker et al., 2007). Five articles described the effects of implementing a pediatric early warning scoring system (PEWS) on documentation, recognition, communication, and management of clinical deterioration (Akre et al., 2010; Almblad et al., 2018; Bonafide et al., 2013; Kaul et al., 2014; Oliver et al., 2010). Three studies described the experiences of parents in caring for their hospitalized child (Brady et al., 2015; Dudley & Carr, 2004; Ygge & Arnetz, 2004). Five papers described the effect of socio-technical variables such as distractions within the clinical environment, equipment, teamwork, and staffing levels on facilitating or interfering with the ability of nurses to recognize clinical deterioration or make decisions about the clinical status of patients (Doman et al., 2004; McGillis Hall et al., 2010; McKay et al., 2013; Reese et al., 2016; Watson et al., 2014). Finally, two studies described

the impact of training on documentation, communication, or clinical response associated with managing instability (Martin et al., 2016; Theilen et al., 2013).

As outlined by Whittemore and Knafl (2005), the synthesis approach is used to critically analyze data. Concepts are categorized in a matrix format, as described by Webster and Watson (2002). Six themes associated with the aims of this research were derived through iterative and constant comparison.

Nursing surveillance and management of clinical deterioration

Assessing and documenting

Performing and documenting assessments were identified as important activities in recognizing patient deterioration and marshalling support for intervention. Knowledge of patients' baseline assessment, professional experience, and recognizing the early signs of clinical deterioration were acknowledged to be essential in deciding how and when to intervene (Azzopardi et al., 2011; Brady & Goldenhar, 2014; Gawronski et al., 2018; Kaul et al., 2014; McKay et al., 2013; Thrasher et al., 2017). Education about the indicators of deterioration, clinical experience, situation awareness, and use of a standard assessment tool such as the PEWS enhanced nurses' ability to evaluate instability (Azzopardi et al., 2011; Bonafide et al., 2013; Brady & Goldenhar, 2014; Kaul et al., 2014; Martin et al., 2016; McKay et al., 2013; Theilen et al., 2013). Trusting one's intuition about abnormal assessments also aided identification of deterioration (Brady & Goldenhar, 2014; Doman et al., 2004; Gawronski et al., 2018).

Assessment documentation, in particular vital signs, followed by documentation of interventions was identified as indicators of instability awareness (Oliver et al., 2010; Theilen et al., 2013). Inadequate documentation or gaps in documentation were common (Akre et al., 2010; Almblad et al., 2018; Oliver et al., 2010; Watson et al., 2014; Zenker et al., 2007). However, evidence suggests that nurses used objective and subjective assessment findings to evaluate instability (Zenker et al., 2007) and did not consistently document objective evidence of clinical deterioration or increased surveillance activities (Akre et al., 2010; Voepel-Lewis et al., 2013). Education about the importance of documentation and simulation training increased documentation (McKay et al., 2013; Theilen et al., 2013). Barriers to concurrent documentation of assessments and interventions included lack of computer availability and functionality, excessive log-on times, and a preference not to enter information into medical records in front of patients and families (Watson et al., 2014).

Decision making

Under specific conditions, nurses made decisions about monitoring intensity, how to intervene, and whether to call for help (Lobos et al., 2014; Lobos et al., 2015; Voepel-Lewis et al., 2013; Zenker et al., 2007). Surveillance intensity and escalating care increased when acuity of conditions was higher and staffing lower (Lobos et al., 2015; Voepel-Lewis et al., 2013). Standardized assessment tools with action algorithms facilitated data trending and decision making about monitoring and intervention (Akre et al., 2010; Almblad et al., 2018; Bonafide et al., 2013; Brady & Goldenhar, 2014; Gawronski et al., 2018; Kaul et al., 2014). Interruptions interfered with concentration and introduced competing priorities, which resulted in fragmented or delayed care (McGillis Hall et al., 2010). Simulation training increased critical thinking skills, confidence, and competence in decision making and response times to recognition and intervention (Martin et al., 2016; Theilen et al., 2013).

Readily accessible resources such as a rapid response team (RRT) or medical emergency team (MET) and diverse and clinically competent staff provided assistance to the bedside clinician in determining course of treatment or the need to escalate care (Brady & Goldenhar, 2014; Gawronski et al., 2018; Lobos et al., 2014; McKay et al., 2013; Zenker

et al., 2007). Deciding whether to call for help and who to call were influenced by hierarchical or cultural norms, nurses' self-confidence, fear of reprisal or criticism, physician bias not to escalate, clinician preference, and failure to recognize physiologic decline in patients who appeared to be asymptomatic (Azzopardi et al., 2011; Gawronski et al., 2018; Reese et al., 2016; Roberts et al., 2014; Thrasher et al., 2017). Nurses were more prone to activate the RRT or MET for surgical patients because they perceived that surgeons were less available and less likely to address medical issues (Lobos et al., 2014).

Communicating changes in patient conditions

Doman et al. (2004) concluded that communicating changes in patients' conditions is an essential skill in caring for unstable patients. Nurses were more likely to report early changes in the status of patients following implementation of a RRT or MET, implementation of a PEWS, or an educational program on skills for managing deteriorating patients (Akre et al., 2010; Bonafide et al., 2013; Kaul et al., 2014; McKay et al., 2013; Theilen et al., 2013; Zenker et al., 2007). The PEWS provided a common language and objective criteria for communicating changes in the condition of patients (Brady & Goldenhar, 2014; Kaul et al., 2014; Oliver et al., 2010). Being assertive and having self-confidence and strong beliefs of self-efficacy empowered nurses to overcome perceived hierarchical barriers to communication (Azzopardi et al., 2011; Brady & Goldenhar, 2014; Doman et al., 2004; Roberts et al., 2014; Thrasher et al., 2017). Abrupt or discourteous communication and lack of face-to-face interaction resulted in curtailed communication (Reese et al., 2016). A sense of trust and safety between team members, a culture of accountability, access to expert resources, and structured opportunities for care planning supported collaboration, contingency planning, and seeking second opinions (Brady & Goldenhar, 2014; Doman et al., 2004; Reese et al., 2016; Roberts et al., 2014).

Intervening

Nursing intervention for instability included more frequent assessments or adding some method of electronic surveillance (Akre et al., 2010). The PEWS and parental concern prompted increased surveillance and consultation with other clinicians or activating the RRT (Bonafide et al., 2013; Gawronski et al., 2018; Kaul et al., 2014; McKay et al., 2013). Increased assessments and consultations occurred following intense simulated practice (Theilen et al., 2013). Nurses identified lack of knowledge or skills, loss of situation awareness, misinterpretation of cues, lack of confidence, lack of functioning equipment, interruptions, staffing shortages, and competing priorities as obstacles to mitigate clinical deterioration and precursors of suboptimal care (Brady & Goldenhar, 2014; McGillis Hall et al., 2010; Thrasher et al., 2017).

Social interactions affecting surveillance

Relationships between team members

A culture and environment that fosters teamwork, communication, accountability and safety were noted to improve situation awareness of clinical deterioration and recognition of patient risk (Brady & Goldenhar, 2014). Researchers identified support from leadership such as availability of strong clinical resources, established escalation protocols, and processes for multidisciplinary communication as a conditional factor for optimizing team communication, developing trust among clinicians, and empowering nurses to call emergency response teams (Gawronski et al., 2018; Thrasher et al., 2017). Standardized assessment and intervention tools provided a common reference for describing and evaluating clinical deterioration. Opportunities for interprofessional care planning facilitated team cohesiveness on shared goals and contingency plans (Almblad et al., 2018; Bonafide et al., 2013; Brady & Goldenhar, 2014; Doman et al., 2004; Kaul et al., 2014; McKay et al., 2013).

Table 3
Factors Associated with Nursing Surveillance.

Factors			Akre et al. (2010)	Almblad et al. (2018)	Azzopardi et al. (2011)	Bonafide et al. (2013)	Brady and Goldenhar (2014)	Brady et al. (2015)	Doman et al. (2004)	Dudley and Carr (2004)	Gawronski et al. (2018)	Kaul et al. (2014)
Conditions	Facilitators	Parents available for consultation/care					X	X		X	X	
		Adequate staffing					X				X	
		Low staffing ratio										
		Experience with recognition/management			X		X		X		X	
		Intuition/gut feeling					X		X			
		Education/knowledge/training			X		X		X		X	X
		Confidence/self-efficacy/being assertive					X		X		X	
		Management leadership/skills/support		X					X		X	
		Availability of electronic monitoring							X			
		Shared language of risk and indicators				X	X					X
	Standardized assessment method/treatment guidelines	X			X	X		X			X	
	Patient co-morbidities/surgical patient											
	Electronic medical record for data trending					X						
	Relationships								X	X		
	Culture of reporting											
	Support structures for handoff/continuity					X				X		
	Barriers	Increased patient acuity					X		X			
		Not being listened to by providers							X			
		Perceived hierarchy			X							
		Inexperienced providers in pediatric care					X		X		X	
Lack of experienced clinical resources for consultation						X						
Lack of resources if patient deteriorates						X		X		X		
Shift work/duration and change in assignments impacting continuity of care						X				X		
Lack of continuity of care providers											X	
Lower resources available on off shifts												
Previous negative encounters with MD												
Staff mix										X		

Physician perceptions of the risks and benefits of calling the MET or transferring patients to the pediatric intensive care unit (PICU) mitigated escalation of care by nurses (Azzopardi et al., 2011; Roberts et al., 2014). Nurses and physicians reported that they were told not to call the MET (Azzopardi et al., 2011) because of a perception that they might lose control over clinical decision making (Roberts et al., 2014).

Hierarchical differences and norms influenced nurses' responses to clinical deterioration. In two studies, nurses said that they would call the attending physician before calling a MET (Azzopardi et al., 2011; Thrasher et al., 2017). Deferring to the attending physician was seen as a strategy for maintaining relationships among team members (Roberts et al., 2014).

Nurses attributed delays in escalating care to a lack of ICU beds, having to convince physicians that treatment was urgent, or feeling pressure from physicians to manage patients before calling for emergency assistance (Doman et al., 2004; Roberts et al., 2014; Thrasher et al., 2017). Researchers noted that nurses and physicians feared reprisal and criticism by colleagues for escalating care (Azzopardi et al., 2011; Brady & Goldenhar, 2014; Reese et al., 2016; Roberts et al., 2014). Nurses solicited opinions from others or teamed up with more senior nurses to advocate for intervention; this strategy helped them to overcome hierarchical barriers and avoid criticism about escalating care (Azzopardi et al., 2011; Roberts et al., 2014).

Parents as partners in surveillance

Physicians, nurses, and parents reported that parent involvement helped identify concerning changes in a child's condition during

hospitalization (Brady & Goldenhar, 2014; Gawronski et al., 2018). Nurses relied on parents to provide baseline characteristics of their child, identify when changes occurred, and summon emergency medical assistance when concerned about their child's condition or communication breakdowns (Brady et al., 2015; Gawronski et al., 2018; Zenker et al., 2007). Listening to and engaging parents in their child's care were perceived as a beneficial strategy to enable situation awareness of patient risk and parent empowerment (Brady & Goldenhar, 2014; Gawronski et al., 2018). Parents expressed the need to be at the bedside to assure continuity of care, individualize attention, and monitor omissions in care (Dudley & Carr, 2004; Ygge & Arnetz, 2004). Parents reported that being provided opportunities (a) to be updated; (b) to partner in their child's care routines and treatment decisions; and, (c) to listen to concerns as supportive strategies that foster parental engagement and improve care delivery (Brady & Goldenhar, 2014; Dudley & Carr, 2004; Gawronski et al., 2018; Ygge & Arnetz, 2004). Parents believed that clinician work pressure, competing priorities, staffing shortages, and discontinuous care providers were obstacles to safety and quality of care (Dudley & Carr, 2004; Gawronski et al., 2018; Ygge & Arnetz, 2004).

Facilitators and barriers to surveillance of unstable patients

Several factors facilitate or interfere with nurses' ability to recognize or intervene when clinical deterioration occurs (Table 3). Conditions and processes that support nursing surveillance are environments rich with adequate staffing, tools for identifying and treating unstable patients, confident nurses and physicians with pediatric experience and

Lobos et al. (2014)	Martin et al. (2016)	McKay et al. (2013)	Oliver et al. (2010)	Reese et al. (2016)	Roberts et al. (2014)	TTheilen et al. (2013)	Thrasher et al. (2017)	Voepel-Lewis et al. (2013)	Watson et al. (2014)	Ygge and Arnetz (2004)	Zenker et al. (2007)
										X	X
								X		X	
							X				
X	X	X			X	X			X		X
	X						X				
			X	X					X		
X								X	X		
							X				
								X			
				X							
				X	X		X				
	X										
				X			X				

training, protocols for communication and escalation, opportunities for collaborative decision making, and a culture that fosters collegial respect, teamwork, and family involvement.

Discussion

We set out to synthesize research that described nursing actions and influencing factors of nursing surveillance of pediatric patient instability in a non-ICU environment. Our search yielded limited studies specifically focused on pediatric nursing surveillance in acute care units in the setting of clinical instability (Brady & Goldenhar, 2014; Gawronski et al., 2018; Thrasher et al., 2017; Voepel-Lewis et al., 2013). The rest were found after using iterative combinations of relevant MeSH terms, reviewing reference citations, and canvassing journals with related publications. Sources for relevant terms included general definitions of nursing surveillance (Benner et al., 2006; Bulechek et al., 2013; Kelly & Vincent, 2011; Meyer et al., 2007) conceptual analyses of deterioration (Jones et al., 2013; Smith, 1988) and nursing surveillance (Aiken, Clarke, & Sloane, 2002; Henneman, Gawlinski, & Giuliano, 2012; Kelly & Vincent, 2011; Kutney-Lee, Lake, & Aiken, 2009) and constructs from socio-technical and ecological systems theories. Articles that described processes or factors that impacted nursing surveillance, though perhaps not the primary aim of the study, were included. Brady and Goldenhar (2014) propose a model for explaining system factors that impact situation awareness of pediatric patients who are at risk for deterioration, however; there were no models that specifically describe attributes or mitigating factors of nursing surveillance within the specialty of pediatrics. This indicates that the evidence characterizing nursing surveillance of unstable pediatric patients in acute care is limited and merits additional exploration.

The literature coalesced around descriptions of selected surveillance processes: nursing assessment and documentation, decision making and intervention, communication, and social interactions with physicians and parents.

Assessment and documentation

Education, simulation training, intuition, and implementation of the PEWS increased assessment frequency, enhanced awareness of clinical deterioration, and improved nurses' ability to recognize and evaluate instability (Kaul et al., 2014; Martin et al., 2016; Theilen et al., 2013). Situation awareness, clinical knowledge, and experience enhanced their ability to interpret assessment findings (Brady & Goldenhar, 2014; Doman et al., 2004; Gawronski et al., 2018; Thrasher et al., 2017). Nurses in other practice venues identify changes through sensory data; objective findings; intuitive feelings based on knowledge of their patients; patients' physical, cognitive, and behavioral changes from baseline; nurses' knowledge of usual condition patterns and illness trajectory; and input from medical records, handoff reports, and parents (Andrews & Waterman, 2005; Cioffi, 2000; Minick & Harvey, 2003). How these indices are used in pediatric nursing surveillance are topics for future study.

Lapses in documentation of nurse and physician activities in the hours before physiological deterioration is a common finding in other retrospective reviews (Endacott, Kidd, Chaboyer, & Edington, 2007; Goldhill, White, & Sumner, 1999; Hayes et al., 2012; McQuillan et al., 1998; National Patient Safety Agency, 2007; Oliver et al., 2010; Tume, 2007). A number of context variables were found to contribute to absence or delayed documentation of assessment findings. Zenker et al. (2007) found that nurses used objective and subjective assessments to evaluate instability, which was not documented in patients' medical records. Other reasons included user/interface limitations of electronic health record systems and preferences to not enter information into medical records concurrently or in front of patients (Watson et al., 2014; Zenker et al., 2007). A more thorough understanding of the impact of the electronic medical record on maintaining situation awareness of clinical deterioration is another opportunity for future research.

Factors		Akre et al. (2010)	Almblad et al. (2018)	Azzopardi et al. (2011)	Bonafide et al. (2013)	Brady and Goldenhar (2014)	Brady et al. (2015)	Doman et al. (2004)	Dudley and Carr (2004)	Gawronski et al. (2018)	Kaul et al. (2014)
Context processes	Facilitators					X				X	
	RN/MD episodes of communication										
	Parents available for baseline									X	
	Parents available for surveillance					X	X		X	X	
	Processes for contingency planning					X					
	Trust in gut/intuition for decision making					X		X			
	Spirit of/processes that foster teamwork					X		X		X	
	Resources for collaboration/escalation			X		X					
	Documentation of clinical indicators	X	X			X					
	Having a MET/RRT	X		X							X
	Situational awareness					X				X	
	Communication skills							X		X	
	Surveillance using electronic monitoring	X						X			
	Standardized treatment decision process	X			X	X				X	X
	Standardized guidelines for management	X			X	X				X	X
Barriers	Lack of team work between physicians							X			
	Fear of criticism when escalating care			X		X					
	Documentation in different places in EHR					X					
	Rushed encounters/work pressure									X	
	Lack of trust between practitioners				X	X				X	
	Distractions										
	Documentation demands/time									X	
	Expectation/desire to treat patient on floor									X	
	Lack of beds in ICU									X	
	Lack of RN empowerment									X	
	Indirect interface r/t geography/phone/text										
	Previous negative encounters with MD										
	Equipment not working or available										
	Having to convince providers										
	Loss of control with RRT									X	

Decision making and intervention

Decision-making was contextual and centered primarily on choosing how and when to increase surveillance, initiate an intervention, or escalate care by calling for help or activating emergency services (Akre et al., 2010; Bonafide et al., 2013; Gawronski et al., 2018; Kaul et al., 2014; Lobos et al., 2014; Lobos et al., 2015; McKay et al., 2013; Theilen et al., 2013; Voepel-Lewis et al., 2013; Zenker et al., 2007). Situation awareness, standardized assessment tools and action algorithms, and the availability of clinical resources assisted in data trending and making treatment decisions (Brady & Goldenhar, 2014; Gawronski et al., 2018; Lobos et al., 2014; McKay et al., 2013; Zenker et al., 2007). Failures in communication, knowledge deficits, interruptions, cultural norms, and a lack of self-confidence contributed to failures in recognition and treatment delays (Azzopardi et al., 2011; Gawronski et al., 2018; Reese et al., 2016; Roberts et al., 2014; Thrasher et al., 2017).

Though not identified in this review, uncertainty and time pressure influenced clinical decision making in other practice settings (Cranley et al., 2009; Thompson et al., 2008). Areas for additional study include how heuristics, decision making tendencies, team skills, familiarity with patients, interpersonal dynamics, and communication patterns influence decision making about surveillance activities and interventions in the pediatric setting.

The studies in our review showed that pediatric nurses relied on the RRT or MET to initiate interventions that are typically within the purview of acute care nurses either by protocol, scope of practice, or physician order such as administer oxygen or physiotherapy, obtain venous access, suction, apply electronic monitoring, and obtain laboratory specimens (Akre et al., 2010; Lobos et al., 2014; Lobos et al., 2015). No study described specific actions, facilitators, or barriers to interventions by pediatric nurses when interacting with deteriorating patients. More research is warranted to identify what interventions acute care pediatric

The presence of parents or a caregiver during hospitalization to assist in the initial and on-going assessment of a child's response to illness has been well-established (Balling & McCubbin, 2001; Eckle & MacLean, 2001; Kristensson-Hallström & Elander, 1997; Paciotti et al., 2014; Thompson, 1986) and was reiterated in the studies within this review (Brady et al., 2015; Brady & Goldenhar, 2014; Gawronski et al., 2018). Parents provided baseline information, participated in care, and reported condition changes (Dudley & Carr, 2004; Ygge & Arnetz, 2004).

The experiences of, and interactions with, parents during the hospitalization of children has been studied from many perspectives (Power & Franck, 2008). However, the efficacy of family involvement in recognizing clinical deterioration, and the process of integrating nursing and parent roles in surveillance have not been fully studied. Anecdotal and quality improvement evidence supports the value of family members as surveillance agents in pediatric and adult patients (Baird & Turbin, 2011; Bogert, Ferrell, & Rutledge, 2010; Hueckel, Mericle, Frush, Martin, & Champagne, 2012; King, 2006). Although parents do recognize clinically significant changes, reports suggest their concerns are dismissed, overlooked, or inadequately evaluated in some situations (Bogert et al., 2010; Brady et al., 2015; Dunning et al., 2010; Greenhouse, Kuzminsky, Martin, & Merryman, 2006; Zenker et al., 2007). Other researchers have described how parents and nurses interact within the context of care for pediatric patients with acute and chronic conditions (Balling & McCubbin, 2001; Coyne & Cowley, 2007; Diehl, Moffitt, & Wade, 1991), but none have explored the factors that influence collaboration between families and nurses in detecting and acting on clinical deterioration.

Limitations

The objective of this integrative review was to describe what is known about nursing surveillance of clinical deterioration in pediatric patients. However, few studies were found that share this specific aim. Accordingly, the review was broadened to include studies whose secondary aims or incidental outcomes were related to the aim of this review. Thus, the analysis was based on direct and indirect evidence.

Only studies published in English were reviewed. The literature search was based on word combinations from the quality and safety literature because the yield using standard MeSH terms was nonspecific and limited. As such, relevant studies may have been missed because of inexact word sequencing or grouping or subjective citation bias.

Despite these limitations, this is the first review to our knowledge that addresses the factors that influence how well non-ICU pediatric nurses surveil clinical deterioration in hospitalized children. The methodology to locate relevant research was comprehensive and yielded findings that more fully developed existing surveillance theoretical models.

Research and clinical implications

This review proposes a new model that combines aspects of socio-technical and socioecological theories with current definitions of nursing surveillance. Also presented, is a novel accounting of conditional or input factors as well as care delivery or throughput processes that facilitate or impede nursing surveillance. These two additions propose advances to current theoretical models of nursing surveillance, as well as provide a basis for future research and program development to improve nursing surveillance. Clearly, there is more to learn about the facilitators and barriers to interpretation, synthesis, analysis, and decision making when it comes to surveillance intensity and when or how to intervene. Education and standardized tools facilitate assessment and documentation. Not known is how other data sources such as handoff reports, medical records, family, sensory cues, or intuition influence surveillance or prompt intervention. The studies in this review elucidate the actions nurses have taken when patients experience

changes in their condition, although the full range of interventions have not been described.

Some research has endorsed the benefits of parent engagement in surveillance, but the evidence is insufficient to inform its effective implementation (Berger, Flickinger, Pfoh, Martinez, & Dy, 2014). Studies have focused on how nurses and parents define and negotiate their 'partnership' in providing care (Coyne & Cowley, 2007; Espezel & Canam, 2003), but not specifically on the collaboration between parents and nurses in the surveillance of hospitalized children. Research that provided a greater understanding of how to integrate the roles of parents and nurses in surveillance would assist to enhance hospital based patient safety and patient experience programs.

How pediatric nurses decide what interventions should be initiated for unstable patients has yet to be explored. The high-stakes, time-dependent, and uncertain conditions of clinical deterioration seem to favor an intuitive-humanistic, information-processing strategy. What environmental or cultural factors support this decision-making process for pediatric nurses with varying characteristics are unknown.

Initiatives to improve resuscitation efforts may well use the findings of this review to improve socio-technical aspects in clinical environments, including the accessibility of equipment for monitoring and treatment and using staffing models that emphasize patient continuity, assignment flexibility, and availability of clinical expertise to increase staff resilience in handling clinical instability. Incorporating standardized assessment methods such as the PEWS and treatment guidelines, parent engagement in surveillance, simulation training, and opportunities for contingency planning are strategies that may increase recognition, situation awareness, shared mental models, decision making, and escalation. Finally, cultivating teamwork through structured communication, communication training, and opportunities for interprofessional care planning may increase confidence and assertion of concerns and escalation and reduce hierarchal barriers and missed opportunities to mitigate harm.

Conclusions

There is limited research to understand the full spectrum of factors and processes that influence all aspects of nursing surveillance of clinical stability of pediatric patients on acute care units. Evidence for factors that impact data collection and decision making about intervention is the most robust, while insights into facilitators and barriers for data interpretation and synthesis require additional study. More research is needed to understand how to effectively integrate the roles of nurses and parents, and nurses and other clinicians, in surveillance. A new model of nursing surveillance nested in a socio-technical system framework has been proposed along with an account of influencing conditions and context processes. This model can be used as a basis for testing relationships among surveillance variables and evaluating efficacy of surveillance process improvements.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

James R. Stotts: Conceptualization, Methodology, Investigation, Data curation, Writing - original draft, Visualization. **Audrey Lyndon:** Validation, Writing - review & editing, Supervision. **Garrett Chan:** Writing - review & editing. **Arpi Bekmezian:** Writing - review & editing. **Roberta S. Rehm:** Validation, Writing - review & editing, Supervision.

Declaration of competing interest

None.

Acknowledgements

The authors wish to thank Kirsten Wisner, Jennifer Malana, Loretta Reagan for their review of manuscript iterations and for offering insightful and constructive feedback.

References

- Aiken, L. H., Clarke, S. P., & Sloane, D. M. (2002). Hospital staffing, organization, and quality of care: Cross-national findings. *Nursing Outlook*, 50(5), 187–194. <https://doi.org/10.1067/mno.2002.126696>.
- Akre, M., Finkelstein, M., Erickson, M., Liu, M., Vanderbilt, L., & Billman, G. (2010). Sensitivity of the pediatric early warning score to identify patient deterioration. *Pediatrics*, 125(4), e763–e769. <https://doi.org/10.1542/peds.2009-0338>.
- Almblad, A. C., Siltberg, P., Engvall, G., & Malqvist, M. (2018). Implementation of pediatric early warning score: Adherence to guidelines and influence of context. *Journal of Pediatric Nursing*, 38, 33–39. <https://doi.org/10.1016/j.pedn.2017.09.002>.
- Anderson, D. M. (2002). *Mosby's medical, nursing, & allied health dictionary* (6th ed.). St. Louis, MO: Mosby.
- Andrews, T., & Waterman, H. (2005). Packaging: A grounded theory of how to report physiological deterioration effectively. *Journal of Advanced Nursing*, 52(5), 473–481. <https://doi.org/10.1111/j.1365-2648.2005.03615.x>.
- Azzopardi, P., Kinney, S., Moulden, A., & Tibballs, J. (2011). Attitudes and barriers to a medical emergency team system at a tertiary paediatric hospital. *Resuscitation*, 82(2), 167–174. <https://doi.org/10.1016/j.resuscitation.2010.10.013>.
- Baird, S. K., & Turbin, L. B. (2011). Condition concern: An innovative response system for enhancing hospitalized patient care and safety. *Journal of Nursing Care Quality*, 26(3), 199–207. <https://doi.org/10.1097/NCQ.0b013e31820b1f91>.
- Balling, K., & McCubbin, M. (2001). Hospitalized children with chronic illness: Parental caregiving needs and valuing parental expertise. *Journal of Pediatric Nursing*, 16(2), 110–119. <https://doi.org/10.1053/j.pdn.2001.23157>.
- Benin, A. L., Borgstrom, C. P., Jenq, G. Y., Roumanis, S. A., & Horwitz, L. I. (2012). Defining impact of a rapid response team: Qualitative study with nurses, physicians and hospital administrators. *BMJ Quality and Safety*, 21(5), 391–398. <https://doi.org/10.1136/bmjqs-2011-000390>.
- Benner, P. (1984). *From novice to expert: Excellence and power in clinical nursing practice*. Menlo Park, CA: Addison Wesley.
- Benner, P., Malloch, K., Sheets, V., Bitz, K., Emrich, L., Thomas, M. B., ... Farrell, M. (2006). *TERCAP: Creating a national database on nursing errors*. *Harvard Health Policy Review*, 7(1), 48–63.
- Berg, M. D., Nadkarni, V. M., Zuercher, M., & Berg, R. A. (2008). In-hospital pediatric arrest. *Pediatric Clinics in North America*, 55, 589–604. <https://doi.org/10.1016/j.pcl.2008.02.005>.
- Berger, Z., Flickinger, T. E., Pfoh, E., Martinez, K. A., & Dy, S. M. (2014). Promoting engagement by patients and families to reduce adverse events in acute care settings: A systematic review. *BMJ Quality and Safety*, 23(7), 548–555. <https://doi.org/10.1136/bmjqs-2012-001769>.
- Bogert, S., Ferrell, C., & Rutledge, D. N. (2010). Experience with family activation of rapid response teams. *Medsurg Nursing*, 19(4), 215–222.
- Bonafide, C. P., Roberts, K. E., Priestly, M. A., Tibbetts, K. M., Huang, E., Nadkarni, V. M., & Keren, R. (2012). Development of a pragmatic measure for evaluating and optimizing rapid response systems. *Pediatrics*, 129(4), e874–e881. <https://doi.org/10.1542/peds.2011-2784>.
- Bonafide, C. P., Roberts, K. E., Weirich, C. M., Paciotti, B., Tibbetts, K. M., Keren, R., ... Homes, J. H. (2013). Beyond statistical prediction: Qualitative evaluation of the mechanisms by which pediatric early warning scores impact patient safety. *Journal of Hospital Medicine*, 8(5), 248–253. <https://doi.org/10.1002/jhm.2026>.
- Brady, P. W., & Goldenhar, L. M. (2014). A qualitative study examining the influences on situation awareness and the identification, mitigation and escalation of recognised patient risk. *BMJ Quality and Safety*, 23(2), 153–161. <https://doi.org/10.1136/bmjqs-2012-001747>.
- Brady, P. W., Muething, S., Kotagal, U., Ashby, M., Gallagher, R., Hall, D., ... Wheeler, D. S. (2013). Improving situation awareness to reduce unrecognized clinical deterioration and serious safety events. *Pediatrics*, 131(1), e298–e308. <https://doi.org/10.1542/peds.2012-1364>.
- Brady, P. W., Zix, J., Brilli, R., Wheeler, D. S., Griffith, K., Giaccone, M. J., ... Tegtmeyer, K. (2015). Developing and evaluating the success of a family activated medical emergency team: A quality improvement report. *BMJ Quality and Safety*, 24(3), 203–211. <https://doi.org/10.1136/bmjqs-2014-003001>.
- Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, 32(7), 513–531. <https://doi.org/10.1037/0003-066X.32.7.513>.
- Bulechek, G. M., Butcher, H., Dochterman, J. M., & Wagner, C. M. (2013). *Nursing interventions classification (NIC; 6th Ed.)*. St. Louis, MO: Elsevier.
- Bultas, M. W., Hassler, M., Ercole, P. M., & Rea, G. (2014). Effectiveness of high-fidelity simulation for pediatric staff nurse education. *Pediatric Nursing*, 40(1), 27–32 (42).
- Cioffi, J. (2000). Recognition of patients who require emergency assistance: A descriptive study. *Heart & Lung*, 29(4), 262–268.
- Coyne, I., & Cowley, S. (2007). Challenging the philosophy of partnership with parents: A grounded theory study. *International Journal of Nursing Studies*, 44(6), 893–904. <https://doi.org/10.1016/j.ijnurstu.2006.03.002>.
- Cranley, L., Doran, D. M., Tourangeau, A. E., Kushniruk, A., & Nagel, L. (2009). Nurse's uncertainty in decision making: A literature review. *Worldviews of Evidence-Based Nursing*, 6(1), 3–15. <https://doi.org/10.1111/j.1741-6787.2008.00138.x>.
- Diehl, S. F., Moffitt, K. A., & Wade, S. M. (1991). Focus group interview with parents of children with medically complex needs: An intimate look at their perceptions and feelings. *Children's Health Care*, 20(3), 170–178. https://doi.org/10.1207/s15326888chc2003_6.
- Doman, M., Prowse, M., & Webb, C. (2004). Exploring nurses' experiences of providing high dependency care in children's wards. *Journal of Child Health Care*, 8(3), 180–197. <https://doi.org/10.1177/1367493504045819>.
- Dudley, S. K., & Carr, J. M. (2004). Vigilance: The experience of parents staying at the bedside of hospitalized children. *Journal of Pediatric Nursing*, 19(4), 267–275. <https://doi.org/10.1016/j.pedn.2004.05.008>.
- Dunning, E., Brzozowicz, K., Noel, E., O'Keefe, S., Ponischil, R., Sherman, S., ... Westley, M. (2010). FAST track beyond RRTs. *Nursing Management*, 41(5), 36–41. <https://doi.org/10.1097/01.NUMA.0000372032.52605.ef>.
- Eckle, N., & MacLean, S. L. (2001). Assessment of family-centered care policies and practices for pediatric patients in nine US emergency departments. *Journal of Emergency Nursing*, 27(3), 238–245. <https://doi.org/10.1067/j.1067.115285>.
- Endacott, R., Kidd, T., Chaboyer, W., & Edington, J. (2007). Recognition and communication of patient deterioration in a regional hospital: A multi-methods study. *Australian Critical Care*, 20(3), 100–105. <https://doi.org/10.1016/j.aucc.2007.05.002>.
- Endacott, R., & Westley, M. (2006). Managing patients at risk for deterioration in rural hospitals: A qualitative study. *Australian Journal of Rural Health*, 14(6), 275–279. <https://doi.org/10.1111/j.1440-1584.2006.00829.x>.
- Espezel, H. J. E., & Canam, C. J. (2003). Parent-nurse interactions: Care of hospitalized children. *Journal of Advanced Nursing*, 44(1), 34–41. <https://doi.org/10.1046/j.1365-2648.2003.02765.x>.
- Gawronski, O., Parshuram, C., Cecchetti, C., Tiozzo, E., Coife Degli Atti, M. L., Dall'Oglio, I., ... Latour, J. M. (2018). Qualitative study exploring factors influencing escalation of care of deteriorating children in a children's hospital. *BMJ Paediatrics Open*, 2(1), e000241. <https://doi.org/10.1136/bmjpo-2017-000241>.
- Gazarian, P. K., Henneman, E. A., & Chandler, G. E. (2010). Nurse decision making in the prearrest period. *Clinical Nursing Research*, 19(1), 21–37. <https://doi.org/10.1177/1054773809353161>.
- Gilfoyle, E., Koot, D. A., Annear, J. C., Bhanji, F., Cheng, A., Duff, J. P., ... Gottesman, R. D. (2017). Improved clinical performance and teamwork of pediatric interprofessional resuscitation teams with a simulation-based educational intervention. *Pediatric Critical Care Medicine*, 18(2), e62–e69. <https://doi.org/10.1097/PCC.0000000000001025>.
- Goldhill, D. R., White, S. A., & Sumner, A. (1999). Physiological values and procedures in the 24 h before ICU admission from the ward. *Anaesthesia*, 54(6), 529–534. <https://doi.org/10.1046/j.1365-2044.1999.00837.x>.
- Greenhouse, P. K., Kuzminsky, B., Martin, S. C., & Merryman, T. (2006). Calling a condition (H)elp. *American Journal of Nursing*, 106(11), 63–66.
- Hayes, L. W., Dobyns, E. L., DiGiovine, B., Brown, A. M., Jacobson, S., Randall, K. H., ... Markovitz, B. (2012). A multicenter collaborative approach to reducing pediatric codes outside the ICU. *Pediatrics*, 129(3), e785–e791. <https://doi.org/10.1542/peds.2011-0227>.
- Henneman, E. A., Gawlinski, A., & Giuliano, K. K. (2012). Surveillance: A strategy for improving patient safety in acute and critical care units. *Critical Care Nurse*, 32(2), e9–e18. <https://doi.org/10.4037/ccn2012166>.
- Hickey, P. A., Gauvreau, K., Curley, M. A., & Connor, J. A. (2013). The effect of critical care nursing and organizational characteristics on pediatric cardiac surgery mortality in the United States. *Journal of Nursing Administration*, 43(12), 637–644. <https://doi.org/10.1097/NA.0000000000000005>.
- Hueckel, R. M., Mericle, J. M., Frush, K., Martin, P. L., & Champagne, M. T. (2012). Implementation of condition help: Family teaching and evaluation of family understanding. *Journal of Nursing Care Quality*, 27(2), 176–181. <https://doi.org/10.1097/NCQ.0b013e318235bdec>.
- Joffe, A. R., Anton, N. R., & Burkholder, S. C. (2011). Reduction in hospital mortality over time in a hospital without a pediatric medical emergency team: Limitations of before-and-after study designs. *Archives of Pediatrics and Adolescent Medicine*, 165(5), 419–423. <https://doi.org/10.1001/archpediatrics.2011.47>.
- Jones, D., Mitchell, I., Hillman, K., & Story, D. (2013). Defining clinical deterioration. *Resuscitation*, 84(8), 1029–1034. <https://doi.org/10.1016/j.resuscitation.2013.01.013>.
- Karsh, B. T., Holden, R. J., Alper, S. J., & Or, C. K. (2006). A human factors engineering paradigm for patient safety: Designing to support the performance of the healthcare professional. *Quality & Safety in Health Care*, 15(Suppl. 1), i59–i65. <https://doi.org/10.1136/qshc.2005.015974>.
- Kaul, M., Snethen, J., Kelber, S. T., Zimmanck, K., Maletta, K., & Meyer, M. (2014). Implementation of the bedside paediatric early warning system (BedsidePEWS) for nurse identification of deteriorating patients. *Journal of Specialists in Pediatric Nursing*, 19(4), 339–349. <https://doi.org/10.1111/jspn.12092>.
- Kelly, L., & Vincent, D. (2011). The dimensions of nursing surveillance: A conceptual analysis. *Journal of Advanced Nursing*, 67(3), 652–661. <https://doi.org/10.1111/j.1365-2648.2010.05525.x>.
- King, S. (2006). Our story. *Pediatric Radiology*, 36(4), 284–286. <https://doi.org/10.1007/s00247-005-0077-y>.
- Krapohl, G., Manojlovich, M., Redman, R., & Zhang, L. (2010). Nursing specialty certification and nursing-sensitive patient outcomes in the intensive care unit. *American Journal of Critical Care*, 19(6), 490–498. <https://doi.org/10.4037/ajcc2010406>.
- Kristensson-Hallström, I., & Elander, G. (1997). Parents' experience of hospitalization: Different strategies for feeling secure. *Pediatric Nursing*, 23(4), 361–367.
- Kutney-Lee, A., Lake, E. T., & Aiken, L. H. (2009). Development of the hospital nurse surveillance capacity profile. *Research in Nursing & Health*, 32(2), 217–228. <https://doi.org/10.1002/nur.20316>.
- Lobos, A. T., Fernandes, R., Ramsay, T., & McNally, J. D. (2014). Patient characteristics and disposition after pediatric medical emergency team (MET) activation: Disposition

- depends on who activates the team. *Hospital Pediatrics*, 4(2), 99–105. <https://doi.org/10.1542/hpeds.2013-0032>.
- Lobos, A. T., Fernandes, R., Williams, K., Ramsay, C., & McNally, J. D. (2015). Routine medical emergency team assessments of patients discharged from the PICU: Description of a medical emergency team follow-up program. *Pediatric Critical Care Medicine*, 16(4), 359–365. <https://doi.org/10.1097/PCC.0000000000000354>.
- Lyndon, A. (2008). Social and environmental conditions creating fluctuating agency for safety in two urban academic birth centers. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 37(1), 13–33. <https://doi.org/10.1111/j.1552-6909.2007.00204.x>.
- Martin, M. G., Keller, L. A., Long, T. L., & Ryan-Wenger, N. A. (2016). High-fidelity simulation effect on nurses' identification of deteriorating pediatric patients. *Clinical Simulation in Nursing*, 12(6), 228–239. <https://doi.org/10.1016/j.ecns.2016.01.013>.
- McGillis Hall, L., Pedersen, C., Hubley, P., Ptack, E., Hemingway, A., Watson, C., & Keatings, M. (2010). Interruptions and pediatric patient safety. *Journal of Pediatric Nursing*, 25(3), 167–175. <https://doi.org/10.1016/j.pedn.2008.09.005>.
- McKay, H., Mitchell, I. A., Sinn, K., Mugridge, H., Lafferty, T., Van Leuvan, C., ... Abdel-Latif, M. E. (2013). Effect of a multifaceted intervention on documentation of vital signs and staff communication regarding deteriorating paediatric patients. *Journal of Paediatrics and Child Health*, 49(1), 48–56. <https://doi.org/10.1111/jpc.12019>.
- McQuillan, P., Pilkington, S., Allan, A., Taylor, B., Short, A., Morgan, G., ... Collins, C. H. (1998). Confidential inquiry into quality of care before admission to intensive care. *British Medical Journal*, 316(7148), 1853–1858. <https://doi.org/10.1136/bmj.316.7148.1853>.
- Messmer, P. R. (2008). Enhancing nurse-physician collaboration using pediatric simulation. *Journal of Continuing Education in Nursing*, 39(7), 319–327. <https://doi.org/10.3928/00220124-20080701-07>.
- Meyer, G. A., Lavin, M. A., & Perry, A. G. (2007). Is it time for a new category of nursing diagnosis? *International Journal of Nursing Terminologies and Classifications*, 18(2), 45–50. <https://doi.org/10.1111/j.1744-618X.2007.00049.x>.
- Minick, P., & Harvey, S. (2003). The early recognition of patient problems among medical surgical nurses. *Medsurg Nursing*, 12(5), 291–297.
- National Patient Safety Agency (2007). Recognising and responding appropriately to early signs of deterioration in hospitalised patients (NHS publication ISBN: 978-0-9556340-8-6). Retrieved from <https://lsbu.r.talis.com/items/790E7253-11BB-BF21-5AAC-80E4A4D56054.html>. Accessed date: 10 March 2019.
- Oliver, A., Powell, C., Edwards, D., & Mason, B. (2010). Observations and monitoring: Routine practices on the ward. *Pediatric Nursing*, 22(4), 28–32. <https://doi.org/10.7748/paed2010.05.22.4.28.c7738>.
- Pace, R., Pluye, P., Bartlett, G., Macaulay, A. C., Salsberg, J., Jagosh, J., & Sellers, R. (2012). Testing the reliability and efficiency of the pilot mixed methods appraisal tool (MMAT) for systematic mixed studies review. *International Journal of Nursing Studies*, 49(1), 47–53. <https://doi.org/10.1016/j.ijnurstu.2001.07.002>.
- Paciotti, B., Roberts, K. E., Tibbetts, K. M., Paine, C. W., Keren, R., Barg, F. K., ... Bonafide, C. P. (2014). Physician attitudes toward family-activated medical emergency teams for hospitalized children. *Joint Commission Journal on Quality and Patient Safety*, 40(4), 187–192. [https://doi.org/10.1016/S1553-7250\(14\)40024-2](https://doi.org/10.1016/S1553-7250(14)40024-2).
- Patterson, M. D., Geis, G. L., LeMaster, T., & Wears, R. L. (2013). Impact of multidisciplinary simulation-based training on patient safety in a paediatric emergency department. *BMJ Quality and Safety*, 22(5), 383–393. <https://doi.org/10.1136/bmjqs-2012-000951>.
- Pluye, P., Robert, E., Cargo, M., Bartlett, G., O'Cathain, A., Griffiths, F., ... Rousseau, M. C. (2011). Proposal: A mixed methods appraisal tool for systematic mixed studies reviews. Retrieved from <http://mixedmethodsappraisaltoolpublic.pbworks.com>. Accessed date: 11 March 2019.
- Power, N., & Franck, L. (2008). Parent participation in the care of hospitalized children: A systematic review. *Journal of Advanced Nursing*, 62(6), 622–641. <https://doi.org/10.1111/j.1365-2648.2008.04643.x>.
- Reese, J., Simmons, R., & Barnard, J. (2016). Assertion practices and beliefs among nurses and physicians on an inpatient pediatric medical unit. *Hospital Pediatrics*, 6(5), 275–281. <https://doi.org/10.1542/hpeds.2015-0123>.
- Reynolds, A., Ayres-de-Campos, D., & Lobo, M. (2011). Self-perceived impact of simulation-based training on the management of real-life obstetrical emergencies. *European Journal of Obstetrics, Gynecology, and Reproduction Biology*, 159(1), 72–76. <https://doi.org/10.1016/j.ejogrb.2011.07.022>.
- Roberts, K. E., Bonafide, C., Paine, C. W., Paciotti, B., Tibbetts, K. M., Keren, R., ... Holmes, J. H. (2014). Barriers to calling for urgent assistance despite a comprehensive pediatric rapid response system. *American Journal of Critical Care*, 23(3), 223–229. <https://doi.org/10.4037/ajcc2014594>.
- Smith, S. K. (1988). An analysis of the phenomenon of deterioration in the critically ill. *Image - The Journal of Nursing Scholarship*, 20(1), 12–15. <https://doi.org/10.1111/j.1547-5069.1988.tb00021.x>.
- Stedman, T. L. (2012). *Stedman's medical dictionary for the health professions and nursing* (7th ed.). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.
- Sutcliffe, K. M., Lewton, E., & Rosenthal, M. M. (2004). Communication failures: An insidious contributor to medical mishaps. *Academic Medicine*, 79(2), 186–194.
- Theilen, U., Leonard, P., Jones, P., Ardill, R., Weitz, J., Agrawal, D., & Simpson, D. (2013). Regular in situ simulation training of paediatric medical emergency team improves hospital response to deteriorating patients. *Resuscitation*, 84(2), 218–222. <https://doi.org/10.1016/j.resuscitation.2012.06.027>.
- Thomas, E. J., Taggart, B., Crandell, S., Lasky, R. E., Williams, A. L., Love, L. J., ... Helmreich, R. L. (2007). Teaching teamwork during the neonatal resuscitation program: A randomized trial. *Journal of Perinatology*, 27(7), 409–414. <https://doi.org/10.1038/sj.jp.7211771>.
- Thompson, C., Dalgleish, L., Bucknall, T., Estabrooks, C., Hutchinson, A. M., Fraser, K., ... Saunders, J. (2008). The effects of time pressure and experience on nurses' risk assessment decisions: A signal detection analysis. *Nursing Research*, 57(5), 302–311. <https://doi.org/10.1097/01.NNR.0000313504.37970.f9>.
- Thompson, R. H. (1986). Where we stand: Twenty years of research on pediatric hospitalization and health care. *Children's Health Care*, 14(4), 200–210. https://doi.org/10.1207/s15326888chc1404_3.
- Thrasher, J., McNeely, H., & Adrian, B. (2017). When nursing assertion stops: A qualitative study to examine the cultural barriers involved in escalation of care in a pediatric hospital. *Critical Care Nursing Clinics of North America*, 29(2), 167–176. <https://doi.org/10.1016/j.cnc.2017.01.004>.
- Tume, L. (2007). The deterioration of children in ward areas in a specialist children's hospital. *Nursing in Critical Care*, 12(1), 12–19. <https://doi.org/10.1177/1478-5153.2006.00195.x>.
- Voepel-Lewis, T., Pechlavanidis, E., Burke, C., & Talsma, A. N. (2013). Nursing surveillance moderates the relationship between staffing levels and pediatric postoperative serious adverse events: A nested case-control study. *International Journal of Nursing Studies*, 50(7), 905–913. <https://doi.org/10.1016/j.ijnurstu.2012.11.014>.
- Watson, A., Skipper, C., Steury, R., Walsh, H., & Levin, A. (2014). Inpatient nursing care and early warning scores: A workflow mismatch. *Journal of Nursing Care Quality*, 29(3), 215–222. <https://doi.org/10.1097/NCQ.0000000000000058>.
- Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, 26(2). <https://doi.org/10.2307/4132319> xiii–xxiii.
- Weinstock, P. H., Kappus, L. J., Kleinman, M. E., Grenier, B., Hickey, P., & Burns, J. P. (2005). Toward a new paradigm in hospital-based pediatric education: The development of an onsite simulator program. *Pediatric Critical Care Medicine*, 6(6), 635–641.
- Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, 52(5), 546–553. <https://doi.org/10.1111/j.1365-2648.2005.03621.x>.
- Ygge, B. M., & Arnetz, J. E. (2004). A study of parental involvement in pediatric hospital care: Implications for clinical practice. *Journal of Pediatric Nursing*, 19(3), 217–223. <https://doi.org/10.1016/j.pedn.2004.02.005>.
- Zenker, P., Schlesinger, A., Hauck, M., Spencer, S., Hellmich, T., Finkelstein, M., ... Billman, G. (2007). Implementation and impact of a rapid response team in a children's hospital. *The Joint Commission Journal on Quality and Patient Safety*, 33(7), 418–425. [https://doi.org/10.1016/S1553-7250\(07\)33048-1](https://doi.org/10.1016/S1553-7250(07)33048-1).