Human factors in escalating acute ward care: a qualitative evidence synthesis

Jody Ede, Tatjana Petrinic, Verity Westgate, Julie Darbyshire, Ruth Endacott, Peter J Watkinson

ABSTRACT

Background Identifying how human factors affect clinical staff recognition and management of the deteriorating ward patient may inform process improvements. We systematically reviewed the literature to identify (1) how human factors affect ward care escalation (2) gaps in the current literature and (3) critique literature methodologies.

Methods We undertook a Qualitative Evidence Synthesis of care escalation studies. We searched MEDLINE, EMBASE and CINHAL from inception to September 2019. We used the Critical Appraisal Skills Programme and the Grading of Recommendations Assessment-Development and Evaluation and Confidence in Evidence from Reviews of Qualitative Research tool to assess study quality.

Results Our search identified 24 studies meeting the inclusion criteria. Confidence in findings was moderate (20 studies) to high (4 studies). In 16 studies, the ability to recognise changes in the patient’s condition (soft signals), including skin colour/temperature, respiratory pattern, blood loss, personality change, patient complaint and fatigue, improved the ability to escalate patients. Soft signals were detected through patient assessment (looking/listening/feeling) and not Early Warning Scores (eight studies). In contrast, 13 studies found a high workload and low staffing levels reduced staff’s ability to detect patient deterioration and escalate care. In eight studies quantifiable deterioration evidence (Early Warning Scores) facilitated escalation communication, particularly when referee/referee were unfamiliar. Conversely, escalating concerning non-triggering patients was challenging but achieved by some clinical staff (three studies). Team decision making facilitated the clinical escalation (six studies).

Conclusions Early Warning Scores have clinical benefits but can sometimes impede escalation in patients not meeting the threshold. Staff use other factors (soft signals) not captured in Early Warning Scores to escalate care. The literature supports strategies that improve the escalation process such as good patient assessment skills.

PROSPERO registration number CRD42018104745.

INTRODUCTION

Failure to rescue

‘Failure to rescue’ (FTR), defined as mortality following complications during hospital admission, is common. At least 11 000 hospital patients each year suffer preventable deaths though other sources believe this number to be higher. It is also recognised that patients who die following a cardiac arrest are likely to have preceding warning signs that are not adequately managed.

Though differences between hospital complication rates are small, patients can be three times more likely to die from complications depending on which hospital they are in. Poor surveillance of these patients can be linked to inadequate monitoring of abnormal vital signs, poor fluid balance management or diagnostic errors. Reports to the National Reporting and Learning System demonstrate that 7% were related to a failure to act or recognise patient deterioration.

Escalation of care

Avoiding FTR requires successful escalation of care whereby patients’ deteriorations are detected, communicated and acted on. Escalation interventions focus primarily on specialist clinical teams such as Critical Care Outreach or Rapid Response Teams (RRT). These teams aim to target improvements to the initial detection and ward management of patient deterioration. Other interventions target communication breakdowns.

Human factors (HF) identified to positively or negatively affect care escalation include situational awareness, team working, communication, safety culture, workload, clinical experience, negative emotions and leadership. However, research has historically focused on outcomes. The aims of this qualitative evidence synthesis (QES) are to identify (1) how HF affect ward care escalation (2) gaps in the current literature and (3) critique literature methodologies.

METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was adhered to (see online supplemental file 1). We undertook a QES of the literature exploring escalation of care. The research question was developed by the two authors (JE and VW) using the Population, Intervention and Context framework. A full protocol has been published in a peer-reviewed journal.
The search strategy was assisted by a specialist librarian (TP). Searches were performed on three databases, MEDLINE, EMBASE and CINHAL. Dates searched were from database inception to September 2019. Medical Subject Headings terms were used and searched as free text (full search strategy is included in online supplemental file 2). Reference lists of all eligible studies were also checked, and incidental references included from these.

**Eligibility criteria**

This evidence synthesis includes qualitative studies reporting primary data. No limits on publication date or country were applied. We included studies that explored how HF affect FTR and care escalation from staff, patients or relative’s perspective. Qualitative methods include (but are not limited to) ethnography, interviews, focus groups and HF methods. We defined HF as any human interaction affecting teamwork, tasks, equipment, workspace, culture or organisation. Data analysis included, but has not been not limited to, thematic analysis, grounded theory and discourse analysis.

**Inclusion**

- Qualitative studies reporting primary data.
- Qualitative studies exploring how HF affect escalation of care of the in-hospital patient population.
- Studies employing qualitative data collection methods, for example, semistructured interviews, focus groups or observations.
- Observational studies relating to FTR or care escalation.
- Adult population.

**Exclusion**

- Systematic or literature reviews.
- Correspondence and short communications.
- Simulation studies.
- Studies written in any language other than English.
- Studies in the emergency department and maternity.

Eligible studies were entered into Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia. Available at www.covidence.org) and deduplicated. Study screening and selection was undertaken by two reviewers independently. The titles and abstracts were screened against the eligibility criteria. Disagreements between reviewers were resolved by third person mediation. Reasons for excluding studies were noted.

**Quality assessment and confidence in synthesised findings (Critical Appraisal Skills Programme and Grading of Recommendations Assessment, Development and Evaluation-CERQual)**

Two researchers (JE and VW) reached a consensus regarding which study quality assessment tools to use during the review. Two different quality assessments were conducted on all studies by both researchers. The Critical Appraisal Skills Programme (CASP) qualitative checklist was used to assess papers for credibility, confirmability, dependability and transferability. This comprehensive framework tool is commonly used in qualitative study assessment.

We assessed confidence in synthesised findings using the Grading of Recommendations Assessment-Development and Evaluation and Confidence in Evidence from Reviews of Qualitative Research (GRADE-CERQual) Criteria and associated guidance publications. The four-stage assessment (methodological limitations, coherence, adequacy of data and relevance) examines each synthesised finding for confidence by critiquing contributing study rigour. The output of this evaluation is a Summary of Qualitative Findings table detailing themes and papers contributing to this theme. This table promotes transparency in the synthesis methods. Themes from the data analysis are presented in order of highest to lowest confidence according to the GRADE-CERQual assessment.

**Analysis**

We undertook a thematic synthesis using Thomas and Harden’s framework to map how HF affect escalation of care. This is a three-stage process. Initially, study findings are coded, these codes are then categorised into descriptive themes and finally these descriptive themes are categorised into analytical themes. Stage 1 involves line-by-line coding of data, where each sentence is allocated a code. Stage 2 involves categorising each coded sentence into descriptive, broader themes. The final stage involves generating analytical themes, or ‘going beyond’ the findings of the initial study, which relate to the fixed or emerging research question (see table 1 for definitions of analytical themes). This framework supports data extraction from anywhere within the paper and is not confined to the results alone.

Data extraction tools were developed and piloted before the review took place to ensure consistency of data extraction. Study data were entered into an Excel spreadsheet (Windows, 2019. Microsoft Office) and study themes were analysed using NVivo software (NVivo qualitative data analysis Software; QSR International, V.10, 2014).

**Patient and public involvement**

Patient representative (TD) reviewed the original published protocol and aims of the review were discussed and deemed of patient importance.

**RESULTS**

The search identified 2404 papers which met the initial search criteria (refer to online supplemental file 3 for PRISMA diagram). After duplicates were removed, 1651 articles were screened. 1627 were excluded based on methodology, subject of interest or incorrect population. This resulted in 24 papers meeting the inclusion criteria and being reviewed in full. A full description of synthesised study characteristics are presented in table 2.
Quality assessment results

Critical Appraisal Skills Programme

Studies were assessed to be of moderate to high quality and no studies were excluded based on this assessment (table 3). Two studies31 32 used surveys to understand nurses’ perceptions of caring for deteriorating patients and were scored poorly for choice of methodology. These studies were still included as open ended free-text questions were used and it was felt that this could still contribute to answering the research question, while acknowledging data from these studies are unlikely to be rich and is therefore a limitation of the method.

Grading of Recommendations Assessment, Development and Evaluation-CERQual

Following the CASP assessment all studies were evaluated against the GRADE-CERQual criteria. A Summary of Qualitative Findings table (table 4) is presented which promotes transparency in this synthesis’ findings and methods. The table includes documented rationale for grading judgements.

THEME RESULTS

Themes presented are ranked from the highest to lowest confidence in synthesised findings. Data extracted mostly related to organisational and patient assessment factors affecting escalation of care. Organisational factors could be classified into Information Packaging and Communication Credibility, Flattened Hierarchy, Workload, Staffing and Situational Awareness and Team Functioning. We found patient assessment Themes of ‘Soft Signals of Patient Deterioration’ and Early Warning Scores (EWS), Decision Making and Clinical Assessment Skills and Experience.

Information packaging and communication credibility (high GRADE-CERQual evidence)

Eight studies identified that information packaging during escalation of care was a facilitator to success.15 33–39 Packaging involved using quantifiable evidence of patient deterioration such as vital signs15 33 34 40 41 to initiate escalation of care. This removed ambiguity,33 provided numerical evidence of deterioration15 and was a common language34 for clinical staff. This was particularly important when staff were unfamiliar to each other.34 Conversely, staff felt communication credibility was questioned when referrals were made using non-medical language33 or delivered in an unsystematic way.34 This made an escalation referral difficult to understand and prioritise, with medics often having to question further to gain more information to facilitate decision making.33

Flattened hierarchy (high GRADE-CERQual evidence)

A common organisational facilitator to escalation of care was a flattened hierarchy meaning that escalation is accepted from anyone to anyone.15 31 35–45 This created a confidence in staff to raise concerns regarding a patient’s clinical condition, opening channels of communication. Staff also felt that electronic vital signs systems increased the accountability of patient illness32 35 42 46 with acutely unwell patients being everyone’s responsibility. However, it was also acknowledged identifying who is accountable for an unwell patient was sometimes challenging. Synthesised studies demonstrated instances of lack of deteriorating patient ownership32 or passing on of the problem34 by clinical staff to another team or colleague.

Workload, staffing and situational awareness (high GRADE-CERQual evidence)

Several studies described resources as a significant factor affecting care escalation. Three studies identified a lack of skilled staff as limiting the ability to escalate the deteriorating patient.15 35 47 During high workload or low staffing periods staff felt their awareness of patient deterioration reduced due to sensory overload and suboptimal monitoring due to competing demands.13 32 34 36 41 42 43 47–52 Staff believed continuity of care improved situational...
## Table 2 Synthesised studies summary table

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Study design</th>
<th>Name of journal</th>
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RRT, rapid response team.
### Table 3  CASP quality assessment for synthesised studies

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CASP, Critical Appraisal Skills Programme.
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<th>CERQual confidence assessment</th>
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<td>Low concerns about relevance</td>
<td>High Confidence</td>
<td>All studies, demonstrated good methodology, data were considered moderately thick with high numbers of participants and methods, a high no of studies contributed to review finding</td>
</tr>
<tr>
<td>Flattened hierarchy and were organisational components affecting escalation of care</td>
<td>15 31 32 34 35 41–46</td>
<td>Low concerns regarding methodology</td>
<td>Low concerns about coherence</td>
<td>Low concerns about adequacy</td>
<td>Low concerns about relevance</td>
<td>High Confidence</td>
<td>One study with minor concerns regarding methodology (survey), high no of studies contributing to finding, data were considered moderately thick with high numbers of participants and methods</td>
</tr>
<tr>
<td>Workload and staffing were factors considered by clinical staff to affect their Situational awareness of patient deterioration.</td>
<td>15 32 33 34 41 42 46 47–52</td>
<td>Minor concerns regarding methodology</td>
<td>Low concerns about coherence</td>
<td>Low concerns about adequacy</td>
<td>Low concerns about relevance</td>
<td>High confidence</td>
<td>Two studies with minor methodological concerns with one study where using a survey, and another study using participants for a focus group put forward by head nurse, high no of studies contributing to review finding, rich data sources and multiple methods of data collection, data were considered moderately thick with high numbers of participants and methods</td>
</tr>
<tr>
<td>Team functioning caused problems or facilitated care during escalation</td>
<td>15 32 33 35 36 41–45 47–51</td>
<td>Minor concerns regarding methodology</td>
<td>Low concerns about coherence</td>
<td>Low concerns about adequacy</td>
<td>Low concerns about relevance</td>
<td>High confidence</td>
<td>Two studies with methodological concerns, one study where using a survey, and another study using participants for a focus group put forward by head nurse, all other studies demonstrate good methodology, high no of studies contributing to review finding, data were considered moderately thick with high numbers of participants and methods</td>
</tr>
<tr>
<td>Soft signal of patient deterioration used by clinical staff indicating a patient's worsening condition, not adequately represented in Early Warning Score</td>
<td>15 31 33 36 38 41–42 44 46–51 54–56</td>
<td>Moderate concerns regarding methodology</td>
<td>Low concerns about coherence</td>
<td>Moderate concerns about adequacy</td>
<td>Low concerns about relevance</td>
<td>Moderate Confidence</td>
<td>Three studies had methodological concerns. One utilising a survey methodology with open ended-questions, the other was being observed by the implementer of the local Medical Emergency Team (MET), the last one using participants for a focus group put forward by head nurse, large no of studies contributing to synthesis finding,</td>
</tr>
<tr>
<td>Clinician confidence affected decision making during escalation of care</td>
<td>31–33 38 43–46 47 49–52</td>
<td>Moderate concerns regarding methodology</td>
<td>Low concerns about coherence</td>
<td>Moderate concerns about adequacy</td>
<td>Low concerns about relevance</td>
<td>Moderate confidence</td>
<td>Four studies had methodological concerns, two studies utilised a survey methodology with open ended-questions, the other study had a focus group where participants were selected by head nurse, the other had observation completed by the implementer of the local RRT, data were considered moderately thick with high numbers of participants and different methods, large no of studies contributing to synthesis finding</td>
</tr>
</tbody>
</table>
Open access awareness.36 41 42 49 51 Staff felt that a benchmark 'baseline', meant they could identify any significant changes to patient illness. It was not uncommon for staff to employ workarounds during the periods of system pressure such as escalating to the RRT. This was done (rightly or wrongly) to supplement care escalation when medical support was scarce.15 47

Team functioning (high GRADE-CERQual evidence)
Seven studies found poor team relationships were a barrier to escalating patient care, resulting in significant delays.15 32 33 35 42 45 50 Poor team working was presented as tasks being done sequentially rather than concurrently, or where there was a lack of understanding of team roles and the care individuals could provide contributed to uncertainty about to whom patients should be escalated.32 35 42 45 49 51 53 Escalation to outside resources, such as the RRT, was sometimes perceived to be negative15 43 45 with staff reporting that they preferred to cope with a patient deterioration.

Soft signals of patient deterioration and EWS (moderate GRADE-CERQual evidence)
Soft signals of patient deterioration and EWS (moderate GRADE-CERQual evidence) at times overruled the EWS derived escalation pathways using other patient related factors in their decision-making process when considering escalation.31–33 35 36 44 50 Staff at times escalated care to outside resources when patients did not meet the trigger threshold but nurses felt they required an increase in care surveillance.33 50 In some instances staff felt they had to wait for clinical deterioration to occur before being able to escalate.33

Decision making (moderate GRADE-CERQual evidence)
Escalation decision making involved clinical reasoning surrounding the detection, communication and management of escalation of care. Seven papers found that clinician confidence is a facilitator to decision making during patient deterioration management.31–33 35 36 44 50 Confidence can be derived from staff providing peer support to one another.15 35 36 38 42 43 46 49–51 54–56

Table 4 Continued

<table>
<thead>
<tr>
<th>Summary of review finding</th>
<th>Methodological limitations</th>
<th>Coherence</th>
<th>Adequacy</th>
<th>Relevance</th>
<th>CERQual confidence assessment</th>
<th>Explanation of the CERQual evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Assessment skills relating to patient assessment and staff experience positively or negatively affected deterioration detection by clinical staff</td>
<td>15 35 36 38 42 43 46 49–51 54–55</td>
<td>Moderate concerns regarding methodology</td>
<td>Low concerns about coherence</td>
<td>Moderate concerns about adequacy</td>
<td>Low concerns about relevance</td>
<td>Moderate Confidence Two studies with methodological concerns. One had observations completed by the implementer of the local RRT, the other study had a focus group where participants were selected by head nurse, data were considered moderately thick</td>
</tr>
</tbody>
</table>

GRADE: Grading of Recommendations Assessment, Development and Evaluation; RRT, rapid response team.
one another, training or education level. Shared team decisions were sometimes an escalation facilitator.\textsuperscript{38 44 45 47 49 51}

However, a lack of consensus in decision making particularly for end of life care,\textsuperscript{39} was seen as problematic.\textsuperscript{34 44 49 55} Often leading to deviation from guidelines or escalation protocols. Lack of consistency in decisions meant escalation of care demonstrated response variability,\textsuperscript{34} leading to differing and unpredictable priorities.\textsuperscript{47} There was also evidence of clinicians assuming physiology changes were not significant and waiting for confirmation of deterioration before responding meaningfully.\textsuperscript{43}

**Clinical assessment skills and clinical experience (moderate GRADE-CERQual evidence)**

Clinical assessment involved looking, listening and touching the patient to identify respiratory, skin, neurological or physiological abnormalities.\textsuperscript{15 49 51 55 57} The ability to clinically assess patients well enabled staff to make better escalation of care decisions,\textsuperscript{35 36 38 43 49–51 55} particularly as the ability to detect ‘soft signs’ was seen as key. Conversely, undertaking a poor patient clinical assessment posed barriers to illness detection.\textsuperscript{15} Many studies found that as staff gained experience of deteriorating patients they were better able to detect and predict impending illness.\textsuperscript{15 36 38 42 43 46 49 50 54 55}

**DISCUSSION**

We identified 24 qualitative studies of moderate to high methodological quality that identify how HF affect escalation of care. Our evidence synthesis has contributed to escalation of care literature and themes derived from analysis are pertinent to clinical practice.

The studies within this synthesis demonstrated that EWS provide staff with a tool that facilitates communication of concerns and assists workload prioritisation.\textsuperscript{35} Studies reported successful escalation of care was best facilitated when a patient’s deterioration aged neatly with quantifiable evidence. However, some staff in the synthesised studies felt able to escalate non-triggering patients requiring medical attention, although this process was acknowledged to be challenging. It was also suggested that some staff can anticipate clinical deterioration before a triggering EWS\textsuperscript{58} and that there are soft signals (fatigue, skin temp/colour, patient complaint, personality change, blood loss, respiratory pattern), of deterioration recognised by nurses but are not adequately captured by EWS in their current format. Many studies also found that as staff gained experience of deteriorating patients, they were better able to predict deterioration patterns and anticipate problems. It seems that the EWS alone may not maximise improvements to patient outcomes.\textsuperscript{59 60} Evidence suggests that organisations should facilitate good patient assessment, as this was key to detecting soft signals that would otherwise go undetected through an alerting system. Research should also aim to identify how clinical staff anticipate problems in certain patient groups and how they recognise and respond to these to ultimately create safety.\textsuperscript{61} It is evident that the literature does not fully report good escalation catches\textsuperscript{62} such as rescued non-triggering sick patients. This event is in effect invisible and not measured in current healthcare evaluation systems or metrics. Incorporating this tacit knowledge into education programmes or simulation training and scenarios, may be a feasible strategy to improve care escalation.

A flattened hierarchy\textsuperscript{63} was implemented in the aviation industry when it was discovered that a number of flight incidents may have been avoided had the copilot been empowered to challenge the pilot.\textsuperscript{64} Synthesised studies identified that a Flattened Hierarchy was felt by healthcare staff to be a positive strategy for escalating care of deteriorating patients (escalation can be initiated from anyone). However, the effectiveness of a flattened hierarchy may be influenced by poor team functioning. Poor team working was a common barrier to escalation of care identified in this evidence synthesis. This finding is corroborated by a retrospective case review of preventable hospital deaths\textsuperscript{5} and a literature review on FTR following surgery.\textsuperscript{65} In both publications, the authors isolated several contributory factors such as poor team communication, leadership and decision making. Without adequate team communication, the benefits of a flattened hierarchy and team decision making may be lost. If organisations wish to implement a flattened hierarchy escalation system this must also be complemented with an emphasis on non-technical skills and training\textsuperscript{66} before evidence of full patient benefit.

A clinically significant theme to emerge from the synthesised findings was that the greater the workload, the less staff felt they were able to keep track of patient illness or monitor their patients. This sometimes resulted in staff undermonitoring their patients causing some triggering patient deterioration to go unnoticed.\textsuperscript{59} This finding is supported by a recent study demonstrating that lower numbers of registered nurses led to a higher rate of missed vital signs observation.\textsuperscript{67} Organisations could focus on reducing workload, (an unlikely solution), or improving vital signs monitoring processes. A recent option is utilising wearable continuous monitoring that may reduce the nursing workload spent performing regular vital signs observation rounds.\textsuperscript{68}

Other significant clinical effects of high workloads may be a reduction in staff ability to detect deterioration in patients who are not triggering, losing the human safety net for false negative (non-triggering) patients. When mental capacity is limited with reduced team resources, this will directly affect an individual’s situational awareness of the environment as mental resources reduce as cognitive demands increase.\textsuperscript{69} A recent study found the risk of death increased by 3% for every day a patient experienced nurse staffing levels below ward mean.\textsuperscript{70} Poor situational awareness, reduced ability to detect soft signals of deterioration and undermonitoring may explain these results. Conversely, staff described improved situational awareness when there was continuity to their patient care.

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This was felt to facilitate staff in detecting often nuanced clinical changes or soft signals and also bridged the care elements through a patient’s illness. A strong local emphasis on nursing continuity should be encouraged as time impede escalation in patients not meeting the escalation threshold. Staff use other factors (soft signals) not captured in EWS to escalate care. The literature supports strategies that improve the escalation process such as good patient assessment skills. An organisational emphasis on non-technical skills and team cohesion should be synonymous with a flattened hierarchy to enable effective care escalation.

Conclusion
This evidence synthesis has identified HF that affect escalation of care. EWS have clinical benefits but can sometimes impede escalation in patients not meeting the escalation threshold. Staff use other factors (soft signals) not captured in EWS to escalate care. The literature supports strategies that improve the escalation process such as good patient assessment skills. An organisational emphasis on non-technical skills and team cohesion should be synonymous with a flattened hierarchy to enable effective care escalation.

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2 Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and failure to rescue with high-risk surgery. Med Care 2011;49:1076–81.
5 NCEPOD. Themes and recommendations common to all Hospital Specialities. 2018.
7 NRLS national patient safety incident reports: commentary 2018.
10 NHS Improvement. The adult patient who is deteriorating: sharing learning from literature, incident reports and root cause analysis investigations. 2016: 23.
17 Stern C, Jordan Z, Mahrour A. Systematic reviews, step by step developing the review question and inclusion criteria, 2014: 114.
21 Greenhalgh T. How to read the basics of evidence based medicine, 2001: 315.

Disclaimer
The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR, University of Plymouth, NHS or the UK Department of Health and Social Care.

Competing interests
PJW report modest grants and personal fees from Health Education England (HEE) / National Institute for Health Research (NIHR) for the conduct of the study. JD and VW are funded by Health Innovation Challenge Fund (HICF–Health Education England (HEE) / National Institute for Health Research (NIHR) for agreed the final manuscript. PJW have substantially contributed to this work, provided expertise and have agreed the final manuscript.

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Data availability statement
Data are available upon request.

Supplemental material
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Contributors
All authors have substantially contributed to this work and have agreed the final manuscript. JE designed and led the project. TP provided specialist librarian knowledge and assisted in conducting literature searches. JD, VW, RE and PJW have substantially contributed to this work, provided expertise and have agreed the final manuscript.

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Not required.

Provenance and peer review
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Data accessibility statement
Data are available upon request.

Conflict of interest statement
None declared.

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HSE. *High reliability organisations high reliability organisations a review of the literature*, 2011.


# PRISMA 2009 Checklist for Human factors in escalating acute ward care: a qualitative evidence synthesis

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
<td>Title, Abstract Pg 1, Pg 4, Line 115</td>
</tr>
<tr>
<td><strong>ABSTRACT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
<td>Abstract</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
<td>Pg 4 line 107-111</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
<td>Pg 4 line 108</td>
</tr>
<tr>
<td><strong>METHODS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
<td>Abstract line 74, Pg4 Line118-120</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
<td>Pg 5-6</td>
</tr>
</tbody>
</table>
### PRISMA 2009 Checklist for Human factors in escalating acute ward care: a qualitative evidence synthesis

<table>
<thead>
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<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
<td>Pg 4 Line 122-126</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
<td>Sup File</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
<td>Pg 6 Line 152</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>Pg 7 Line 177-191</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
<td>Protocol, Pg 5 Line 128-150</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td>Pg 6 Line 159-174, table 3 and table 4</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
<td>n/a</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>14</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis.</td>
<td>Pg 7 Line 188-191</td>
</tr>
</tbody>
</table>

Risk of bias across studies:

Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).

Reported on page 6 Line 159-174, table 3
PRISMA 2009 Checklist for Human factors in escalating acute ward care: a qualitative evidence synthesis

**RESULTS**

<table>
<thead>
<tr>
<th>Additional analyses</th>
<th>16</th>
<th>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study selection</strong></td>
<td>17</td>
<td>Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.</td>
<td>Appendix 1</td>
</tr>
<tr>
<td><strong>Study characteristics</strong></td>
<td>18</td>
<td>For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.</td>
<td>Table 2</td>
</tr>
<tr>
<td><strong>Risk of bias within studies</strong></td>
<td>19</td>
<td>Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).</td>
<td>Table 3 and table 4</td>
</tr>
<tr>
<td><strong>Results of individual studies</strong></td>
<td>20</td>
<td>For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Synthesis of results</strong></td>
<td>21</td>
<td>Present results of each meta-analysis done, including confidence intervals and measures of consistency.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Risk of bias across studies</strong></td>
<td>22</td>
<td>Present results of any assessment of risk of bias across studies (see Item 15).</td>
<td>Table 3 and table 4</td>
</tr>
<tr>
<td><strong>Additional analysis</strong></td>
<td>23</td>
<td>Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).</td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | Table 4, Pg 18-22 |
| Limitations         | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | Pg 25 Line 166-173 |
### PRISMA 2009 Checklist for Human factors in escalating acute ward care: a qualitative evidence synthesis

<table>
<thead>
<tr>
<th>Conclusions</th>
<th>26</th>
<th>Provide a general interpretation of the results in the context of other evidence, and implications for future research.</th>
<th>Pg 25 Line 159-164</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FUNDING</strong></td>
<td></td>
<td></td>
<td>Pg 26 Line 191-195</td>
</tr>
<tr>
<td>Funding</td>
<td>27</td>
<td>Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.</td>
<td></td>
</tr>
</tbody>
</table>


For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org).
1. HOSPITALIZATION/
2. TERTIARY CARE CENTERS/
3. (ward or wards).ab,ti.
4. (inhospital or inpatient* or "in hospital").ab,ti.
5. (hospitalised or hospitalized).ab,ti.
6. "general hospital".ab,ti.
7. "nurs* staff* ".ab,ti.
8. "in patient".ab,ti.
9. bedside.ab,ti.
10. outreach.ab,ti.
11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12. FAILURE TO RESCUE,HEALTH CARE/
13. "fail* to rescue ".ab,ti.
14. VITAL SIGNS/
15. MONITORING,PHYSIOLOGIC/
16. "vital sign* ".ab,ti.
17. (track and trigger).ab,ti.
18."early warning".ab,ti.
19. "warning score* ".ab,ti.
20. "early sign* ".ab,ti.
21. "warning system* ".ab,ti.
22. (deteriorat* or escalat*).ab,ti.
23. triggering.ab,ti.
24. HOSPITAL RAPID RESPONSE TEAM/
25. "rapid response".ab,ti.
27. 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26
28. MEDICAL ERROR/
29. DELAYED DIAGNOSIS/
30. COMMUNICATION/
31. PATIENT CARE TEAMS/
32. PATIENT SAFETY/
33. ORGANIZATIONAL CULTURE/
34. LEADERSHIP/
35. "human factor* ".af.
37. "clinical error* ".af.
38. "medical error* ".af.
40. "protocol compliance".af.
41. "teamwork*".af.
42. communication.af.
43. ("socio cultural" or sociocultural).af.
44. "situation awareness".af.
45. "organisational culture".af.
46. "organizational culture".af.
47. "safety culture".af.
49. leadership.af.
50. "root cause analysis".af.
51. 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50
52. 11 and 27 and 51
Supplementary File 3
PRISMA 2009 Flow Diagram

Records identified through database searching (n = 2404) → Additional records identified through other sources (n = 0)

Number of duplicates records removed (n = 753) → Records screened (n = 1651) → Records excluded (n = 1554)

Full-text articles excluded, with reasons (n = 73)
- Incorrect methodology
- Incorrect subject of interest
- Correspondence
- Incorrect population or setting

Studies included in qualitative synthesis (n = 24)