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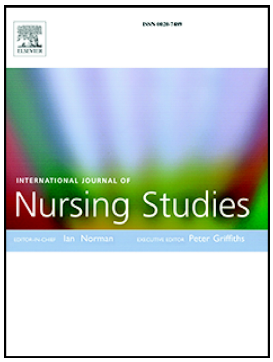

The determinants of nursing staff escalating clinical deterioration out-of-hours: A mixed methods systematic review

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Title

The Determinants of Nursing Staff Escalating Clinical Deterioration Out-of-Hours: A Mixed Methods Systematic Review

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Abstract

Background: 'Failure to rescue' remains as a critical challenge in acute care globally. Despite the implementation of rapid response systems and early warning scoring tools, adverse outcomes persist especially out-of-hours - defined as night and weekends - when patient morbidity and mortality is higher. The underlying causes of this disparity remain poorly understood. Timely recognition and escalation of clinical deterioration are essential to prevent harm, with nursing staff playing a vital role. However, significant gaps persist in understanding the determinants to escalation out-of-hours.

Objective: To synthesise existing literature addressing the question: *What are the determinants of nursing staff escalating care for clinically deteriorating patients out-of-hours?*

Information sources: Embase, Medline, PsycINFO and CINAHL

Methods: A systematic mixed-methods review was conducted, covering studies published up to May 2025. Eligible studies examined nursing staff recognition and response to clinical deterioration out-of-hours in adult inpatient wards. Quality appraisal used Critical Appraisal Skills Programme, Newcastle-Ottawa Scale, and the Mixed Methods Appraisal Tools. Data synthesis followed the Joanna Briggs Institute Convergent Integrated Approach.

Results: Of 3085 records screened, 26 studies met inclusion criteria (n=18 quantitative, n=7 qualitative, n=1 mixed methods). Most were of moderate to high quality, though limitations in recruitment and reporting were noted. No study exclusively examined the determinants of nursing staff behaviour in escalating care out-of-hours, making this the first comprehensive review on the subject. Five key determinants of behaviour were identified: (1) *The unique challenges and workarounds of the 'hospital at night'*, (2) *Workforce composition and team dynamics*

out-of-hours, (3) *Organisational oversight and adaptive strategies, (4) Clinical nursing workflow and supporting resources,* (5) *Individual determinants of behaviour, strengths and limitations.*

Conclusions: This review underscores the complex interplay of determinants influencing nursing staff' escalation out-of-hours, highlighting the urgent need for targeted interventions to enhance patient safety. Increasing psychological safety, integrating automated vital signs monitoring technologies, and redesigning communication pathways may strengthen clinical decision-making and teamwork. Staffing models and skill-mix require reassessment to reflect out-of-hours challenges. Future research should prioritise feasible, context-sensitive interventions informed by behavioural and human factors science. By advancing these strategies, healthcare organisations can mitigate out-of-hours risks and deliver safer, more effective patient care.

Registration: https://www.crd.york.ac.uk/PROSPERO/ CRD42024500837, registered 10/January/2024

Keywords: Adult; After-Hours Care; Clinical Deterioration; Nurses; Nursing Staff; Out-of-Hours; Ward

What is already known

- Out-of-hours is associated to worse patient outcomes with reasons poorly understood.
- Nursing staff play a vital role in timely recognition and escalation of deterioration.

What this paper adds

- 'Hospital at night' presents unique challenges for deteriorating patients, where suboptimal environments and competing priorities of sleep and surveillance complicate nursing recognition of deterioration.

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- Optimising out-of-hours team composition and workforce models, including skill mix and nurse–patient ratios that mirror weekday staffing, could improve rapid response system efficacy.
- Delayed escalation due to perceived consequences such as fear of blame highlight the need for psychologically safe, behaviourally-informed organisational change.

1. Introduction

Despite various initiatives, 'failure to rescue' due to delayed recognition or inadequate response to clinical deterioration remains a persistent global safety challenge (NCEPOD, 2007, NCEPOD, 2017). Clinical deterioration refers to a patient's transition from a stable state to one of physiological instability, increasing the risk of adverse outcomes such as clinical complications or death (Jones et al., 2013).

Silber et al. (1992) first introduced the term 'failure to rescue' as a safety and quality metric, arguing it was more closely linked to hospital characteristics than patient illness severity. The findings of McQuillan et al. (1998) supported this, reporting that over half of intensive care unit (ICU) admissions were potentially avoidable and often resulted from suboptimal care. Further studies on preventable in-hospital cardiac arrests have reinforced these findings, frequently attributing such events to delayed or inadequate responses to early signs of clinical deterioration (Hodgetts et al., 2002, Donaldson et al., 2014). These adverse events may have been avoided if clinical deterioration had been recognised or responded to earlier (Massey et al., 2014).

Previous reviews have explored the determinants that influence recognition and response to clinical deterioration (Jones et al., 2009, Massey et al., 2017, Treacy and Stayt, 2019). These describe the wider explanatory contexts or factors such as behavioural, social, personal characteristics, environment, and financial imperatives, often being complex and multifactorial. However, there remains limited understanding of which determinants are relevant in the out-of-hours context. Out-of-hours in this study is defined as the period outside standard hospital working hours

(typically 08:00-18:00, Monday to Friday), during which the primary medical staff and senior management are routinely present (European Parliament, 2003, NHS Employers, 2021).

Evidence from multiple healthcare systems indicates that patient outcomes are poorer out-of-hours. A systematic review and meta-analysis of 251 cohorts covering 28 diseases, drawing on data from North America, Europe, Australia, and other regions reported an 11% higher risk of mortality (OR 1.11, 95% CI 1.10–1.13) for out-of-hours admissions (Zhou et al., 2016). Similarly, a meta-analysis of 97 studies involving over 51 million patients found that weekend admissions were associated with a 19% higher mortality risk (RR 1.19, 95% CI 1.14–1.23) (Pauls et al., 2017). These trends are mirrored by United Kingdom (UK) data, where night admissions had a statistically significant increase in adjusted 30-day mortality by 0.6% points (OR: 1.17, 95% CI 1.10 to 1.25) compared to the day, while weekend admissions carried 32% higher odds of death for elective cases and 9% for emergency cases (Mohammed et al., 2012, Han et al., 2018). Furthermore, patients discharged from ICU out-of-hours have increased rates of in-hospital death (RR 1.39, 95% CI: 1.24–1.57, $p < 0.0001$) and unplanned ICU readmission (RR 1.30, 95% CI: 1.19–1.42, $p < 0.001$) (Vollam et al., 2018).

Collectively, these findings highlight vulnerabilities in care delivery out-of-hours across diverse healthcare settings. Despite this strong evidence, gaps exist in our understanding of what influences staff behaviour when monitoring patients and escalating care during these periods. Addressing this gap is vital because the unique characteristics of out-of-hours practice, including reduced staffing, limited senior support, and different workflow demands, shape escalation behaviours in ways that differ from daytime practice. Clarifying these contextual determinants will acknowledge inherent system and organisational differences and inform the development of targeted interventions that support timely escalation and ultimately improve patient outcomes out-of-hours.

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1.1. **Background**

Globally, acute hospitals have implemented track-and-trigger tools and rapid response system to support the early detection of clinical deterioration and enable timely intervention in inpatient ward settings (McGaughey et al., 2021). Initially developed through expert consensus, and subsequently refined, these systems were designed to reduce critical adverse events by facilitating prompt recognition and response (Hall et al., 2020).

Rapid response systems traditionally comprise two core components: the *afferent limb* for detecting clinical deterioration through vital signs monitoring, escalation of concerns and appropriate surveillance, and the efferent limb for the clinical response often involving specialist input to stabilise patients or arrange transfer to higher-level of care (Devita et al., 2006). These components are underpinned by evidence that adverse events are frequently preceded by identifiable warning signs, and that timely escalation can prevent further deterioration (De Meester et al., 2013, Andersen et al., 2016). Since inception, rapid response systems have evolved to include administration and quality improvement as additional components (Difonzo, 2019). These systems were historically focused on inpatient settings, although this is shifting and now includes a range of settings including pre-hospital.

The afferent limb is predominantly enacted by ward-based nursing staff, whose role is critical to the system's effectiveness (Jones et al., 2011). To support prompt recognition and escalation, early warning scoring systems, a form of track-and-trigger tool, were introduced to standardise patient assessment and escalation procedures (NICE, 2007, Difonzo, 2019). These tools promote monitoring of physiological parameters including blood pressure, heart rate, respiratory rate, temperature, and level of consciousness, to generate aggregate scores to guide clinical decisions (RCP, 2017). Increasing scores indicate clinical deterioration and can prompt escalation to the rapid response team for immediate intervention. Despite the widespread adoption, qualitative research in both the UK and United States of America (USA)

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report persistent behavioural and systemic inconsistencies in how healthcare staff recognise and escalate care for deteriorating patients (Ede et al., 2020, Smith et al., 2021, Dresser et al., 2023).

Understanding the behavioural and systemic factors that influence clinical decision-making is increasingly recognised as critical to enhancing the effectiveness of the rapid response system (Hall et al., 2024, Prins et al., 2025). Behavioural science and human factors frameworks offer structured approaches to identify and address these factors. For example, frameworks such as the Behaviour Change Wheel and the Systems Engineering Initiative for Patient Safety (SEIPS) model offer guides to understand behaviours by identifying contextual factors, mechanisms of change, and system-level interactions that influence processes (Michie et al., 2011, Holden and Carayon, 2021). These frameworks support the development of targeted interventions starting by mapping barriers and facilitators to intervention designs, thereby improving efficacy (Ohlsen et al., 2025).

The aim of this systematic review is to identify the determinants (i.e. wider explanatory factors including barriers and facilitators) that influence nursing staff in recognising and escalating care during out-of-hours in inpatient ward settings. Key determinants will be useful to inform future strategies to improve patient safety and clinical outcomes during out-of-hours care. Addressing these determinants is critical to adapting current systems and policies to the specific demands of out-of-hours settings and to reducing preventable adverse events.

2. Methods

The reporting of this systematic review was guided by the standards of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Statement (Page et al., 2021).

2.1. Eligibility and Study Selection

Studies were included if they described original empirical qualitative, quantitative, or mixed methods research, published in English or with an English translation available

in the database. Systematic reviews, meta-analyses/meta-syntheses, grey literature, and abstract-only publications were excluded. Included studies investigated care delivered during 'out-of-hours' periods, defined as nights, weekends, bank/public holidays, and weekday hours outside the standard working window of 08:00 to 18:00 (European Parliament, 2003, NHS Employers, 2021). However, given the exploratory nature of the review and the absence of a universally agreed definition of 'out-of-hours' care, studies were eligible if they examined time frames that overlapped with, or encompassed out-of-hours periods, provided they did not focus exclusively on defined weekday hours care. We limited inclusion to adult inpatient ward areas and excluded studies conducted in specialist areas (e.g. critical care, theatres, and emergency department), paediatrics, psychiatry, primary care, and the pre-hospital setting, because these contexts differ fundamentally from general wards in monitoring and escalation pathways (Alhmoud et al., 2021). Specialist areas use continuous physiological monitoring and specialist-led response. Paediatric areas use dedicated paediatric early warning scores, and ward-derived early warning score show limited or inconsistent validity when applied outside ward settings (Considine et al., 2013, Lambert et al., 2017, Gerry et al., 2020). Finally, recognising the varied interpretations of 'failure to rescue' in the literature (Wells et al., 2024), articles were deemed eligible if they examined nursing staff involvement in the management of clinical deterioration, encompassing monitoring, assessment and escalation processes. Full inclusion and exclusion criteria are detailed in **Supplementary File 1**.

Studies were imported initially into Rayyan®, then Covidence® online review software, which allowed independent dual-reviewer screening at each stage, with decisions blinded from each reviewer to minimise bias. Duplicates were automatically removed, followed by an additional manual check for any remaining duplicates. Ten articles were randomly selected and reviewed by two researchers (MV, JE) to check the validity of the selection criteria. The same two researchers independently and blindly screened titles and abstracts, followed by a full text screening. Regular meetings resolved conflicts, with unresolved disagreements referred to a third reviewer (DS).

MV conducted a supplementary hand-search of citations from the included articles to identify relevant studies that might have been overlooked in the primary electronic search. The identified articles then underwent the same independent and blinded screening process by the same two reviewers (MV, JE) using the established eligibility criteria. Lead authors were contacted to obtain raw data or for clarification when required.

2.2. Search Strategy

A systematic mixed-methods review was conducted. Four electronic databases through two platforms: Ovid (Embase, Medline, PsycINFO) and EBSCOhost (CINAHL), were systematically searched for relevant studies in December 2023, with no restrictions on publication date. Search terms and Medical Subject Headings (MeSH) were identified through existing literature and consultations with two librarians. The following key terms were combined and adapted for each database as needed: 'Nursing Staff' AND 'Out-of-hours' AND 'Clinical Deterioration.' An updated search was conducted in the final stages of the review to incorporate relevant literature published between January 2024 and May 2025. The detailed search strategy and terms are provided in **Supplementary File 2**.

2.3. Quality Assessment

Risk of bias (RoB) was assessed using the Newcastle-Ottawa Scale (Wells et al., 2014) for observational studies, the Critical Appraisal Skills Programme Qualitative Checklist (CASP, 2018) for qualitative studies, and the Mixed Methods Appraisal Tool (Hong et al., 2018) for mixed-methods studies. Quality assessments were conducted on all papers independently and blindly by two reviewers (MV, JE) through Covidence, with disagreements resolved through discussion until consensus was reached. The results are presented in **Supplementary File 3.**

2.4. Data Extraction

Data were extracted using Covidence, guided by a structured data extraction proforma. Key information from the studies were obtained including author(s),

publication date, country, study aims and objectives, characteristics, sampling strategies, data collection and analysis methods, the 'out-of-hours' period studied, main conclusions, limitations and determinants (facilitators and barriers) related to the recognition and escalation of deterioration from the results and documented in a data extraction proforma. The proforma was reviewed by two research team members (DS, NP), refined based on their feedback, and by comparison with similar literature. It was then piloted by two reviewers (MV, JE) on three randomly selected studies (one qualitative, one quantitative, and one mixed methods) to ensure accurate interpretation and alignment with the study designs. Following the pilot, the same two reviewers independently and blindly extracted data from the remaining studies, resolving any discrepancies through consensus discussion.

Determinants were classified as facilitators or barriers based on whether they were described as enabling or impeding the effective timely monitoring, recognition, and escalation of clinical deterioration out-of-hours. For quantitative studies, this classification reflected reported associations with positive or negative outcomes; for qualitative studies, it was based on whether the determinant was portrayed as an enabler or barrier within the narrative data. This inductive approach aligned with the exploratory nature of the review, performed by independent reviewers, and was refined through iterative team discussion, where collective judgment was applied as to direction of determinant.

2.5. Synthesis and Integration

Data synthesis followed the Joanna Briggs Institute (JBI) Mixed Methods Systematic Review Convergent Integrated approach (Stern et al., 2020). This method facilitates the simultaneous integration of qualitative and quantitative evidence to address a review question. The process began with data transformation, in which quantitative findings such as p-values and percentages were converted into textual descriptions. This process known as 'qualitising' or referred to as direct assimilation, is based on the premise that both qualitative and quantitative data can meaningfully contribute to answer the research question (Sandelowski et al., 2006). Compared to assigning

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numerical values to qualitative data, this textual interpretation is considered less prone to error (Aromataris et al., 2024). The resulting textual data were then integrated with findings extracted directly from qualitative studies. A full list of 'qualitised' data is provided in **Supplementary File 4.**

Following transformation, integration was carried out using a qualitative synthesis approach, specifically thematic synthesis involving three key stages (Thomas and Harden, 2008). First, all extracted data, including both 'qualitised' quantitative findings and qualitative results, were coded inductively. Second, the codes were grouped into categories to form descriptive themes that captured recurring concepts. Finally, these descriptive themes were interpreted to generate analytical themes that directly addressed the review question.

To support confirmability, the synthesis began with six studies comprising two quantitative, three qualitative, and one mixed methods study, by two reviewers (MV and JE) working independently. This enabled triangulation across methodologies and maintained a transparent audit trail of coding decisions. The remaining studies were coded by one reviewer (MV), with regular meetings held with JE to support reflexivity and resolve discrepancies. This iterative process supported credibility and allowed emergent patterns to be identified. Developed codes were then organised into themes and reviewed collaboratively with two additional reviewers (DS and NP) to ensure consistency, alignment with the study aims, and analytic rigour. Themes and subthemes related to determinants were refined through ongoing peer debriefing and consensus-building.

Descriptive themes were subsequently shaped into a conceptual framework. Visual mapping of codes to themes and subthemes facilitated exploration of connections, contradictions, and gaps within the data. This process enhanced credibility, confirmability, and the depth of analysis, while also allowing examination of silences and dissonance across the evidence base.

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3. Results

3.1. Selection of articles

A total of n=3085 articles were identified through the literature search, with additional articles (n=264) found from hand-searching citations. Following removal of duplicates, titles and abstracts (n=2541) were screened using inclusion and exclusion criteria leaving n=288 papers for full-text review. One article (Duggirala, 2018) could not be obtained for full text review despite requesting it through interlibrary loans and direct contact with the author. Following full-text screening, n=26 articles were included in the final review. A flowchart illustrating the full search process is provided in **Figure 1**.

3.2. Study Characteristics

Table 1 presents an overview of the study characteristics, design, study definitions of the out-of-hours period, any referenced track-and-trigger tools. It also presents the determinants extracted, categorised as barriers or facilitators from each study.

A total of n=26 studies published between 2006 and 2025 were identified, spanning international contexts. The UK contributed the largest number of studies (n=12) (Nilsson et al., 2008, Gordon and Beckett, 2011, Hands et al., 2013, Mackintosh et al., 2014, Wood et al., 2014, Yiu et al., 2014, Kolic et al., 2015, Hope et al., 2018, Recio-Saucedo et al., 2018, Hope et al., 2019, Vollam et al., 2022, Gonem et al., 2024), followed by Australia (n=4) (Jones et al., 2006, McGain et al., 2008, Sundararajan et al., 2016, West et al., 2016), and Netherlands (n=2) (van Galen et al., 2016, Ludikhuize et al., 2021). Single studies were reported from Brazil (Boniatti et al., 2023), Lebanon (Dhaini et al., 2020), Denmark (Fuhrmann et al., 2008), the USA (Galhotra et al., 2006), China (Li et al., 2020), Switzerland (Müller et al., 2021), and Italy (Palese et al., 2014).

Among the quantitative studies (n=18), majority were record reviews examining adult inpatient outcomes (n=14) (Galhotra et al., 2006, Jones et al., 2006, Fuhrmann et al., 2008, McGain et al., 2008, Gordon and Beckett, 2011, Hands et al., 2013, Voepel-Lewis et al., 2013, Wood et al., 2014, Yiu et al., 2014, Kolic et al., 2015, Sundararajan et al., 2016, van Galen et al., 2016, Vollam et al., 2022, Gonem et al., 2024), n=4 used surveys

targeting nursing staff (West et al., 2016, Recio-Saucedo et al., 2018, Dhaini et al., 2020, Ludikhuize et al., 2021), and one study conducted a time-motion study (Müller et al., 2021). Seven studies adopted qualitative methods including ethnography (n=2) (Mackintosh et al., 2014, Li et al., 2020), interview studies (n=4) (Nilsson et al., 2008, Palese et al., 2014, Hope et al., 2018, Hope et al., 2019), and one survey inductively analysed using content analysis (West et al., 2016). The single mixed methods study (Vollam et al., 2022) integrated record review with interviews.

There was no uniform definition of the 'out-of-hours' period across the studies. However, most studies (n=17) focused specifically on night-time hours (Fuhrmann et al., 2008, McGain et al., 2008, Nilsson et al., 2008, Gordon and Beckett, 2011, Voepel-Lewis et al., 2013, Mackintosh et al., 2014, Palese et al., 2014, Yiu et al., 2014, Sundararajan et al., 2016, West et al., 2016, Hope et al., 2018, Recio-Saucedo et al., 2018, Hope et al., 2019, Chua et al., 2020, Li et al., 2020, Müller et al., 2021, Boniatti et al., 2023).

Nearly half of the studies (n=12) referenced a track-and-trigger tool for detection of clinical deterioration. The different tools outlined are versions of the Early Warning Score system, including Modified Early Warning Score (MEWS), Standardised Early Warning Score (SEWS), National Early Warning Score (NEWS) and its second version (NEWS-2) used in the UK, and digitally integrated models such as VitalPAC Early Warning Score (viEWS). The most frequently cited tool was the National Early Warning Score (NEWS) (n=4) (Yiu et al., 2014, Kolic et al., 2015, Hope et al., 2018, Hope et al., 2019), and one citing its second version (NEWS-2) (Gonem et al., 2024).

3.3. Methodological Quality of Included Studies

Most studies (n=24) were of moderate to high quality. Qualitative studies, assessed using the Critical Appraisal Skills Programme tool (CASP, 2018), did not meet all checklist criteria, with three rated 'Can't Tell' and one 'No' for recruitment strategy and researcher-participant relationships, though it was unclear if this reflected methodological or reporting limitations. Three cohort studies, evaluated with the

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Newcastle-Ottawa Scale were rated good (8/9 - 9/9), except for one (Dhaini et al., 2020) scoring 2/9 due to sampling bias and self-reported measures. Cross-sectional studies assessed using an adapted Newcastle-Ottawa Scale (McPheeters et al., 2012) scored between three and seven, with most 5/7 or 6/7, reflecting issues in sample representativeness and non-response bias. The mixed-methods study (Vollam et al., 2022) was evaluated using the Mixed Methods Appraisal Tool, but insufficient details were provided to determine if inconsistencies between qualitative and quantitative findings were adequately addressed.

3.4. Determinants of nursing staff escalating care out-of-hours

No single study exclusively examined determinants of nursing staff escalating care out-of-hours. However, five overarching themes were developed through analysis of synthesised findings across the included studies: (1) *The unique challenges and workarounds of the 'hospital at night', (2) Workforce composition and team dynamics out-of-hours, (3) Organisational oversight and adaptive strategies, (4) Clinical nursing workflow and supporting resources, and (5) Individual determinants of behaviour, strengths and limitations*. These themes along with their associated subthemes, represent the determinants of nursing staff behaviour in recognising and escalating clinical deterioration out-of-hours, and are conceptualised in **Figure 2**. It is important to note that the determinants are interacting, context-dependent, and non-linear; they do not operate as discrete or hierarchical categories but shape behaviour in combination and in response to out-of-hours conditions. **Figure 3** presents a visual representation of how the determinants were mapped onto the thematic structure.

3.4.1. *The unique challenges and workarounds of the 'hospital at night'*

Ten studies (Nilsson et al., 2008, Gordon and Beckett, 2011, Voepel-Lewis et al., 2013, West et al., 2016, Hope et al., 2018, Recio-Saucedo et al., 2018, Hope et al., 2019, Li et al., 2020, Müller et al., 2021, Vollam et al., 2022) identified determinants influencing the escalation of care specific to the characteristics of night work ('the night'), including the distinct environment and organisational challenges, along with

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physiological changes to patients and staff, and key differences in workflows between in-hours and out-of-hours shifts.

3.4.1.1. The nature of night-time work

Eight out of ten studies highlighted the impact of night-time work on the ability of nursing staff to monitor vital signs, identify clinical deterioration, and escalate care (Nilsson et al., 2008, Gordon and Beckett, 2011, Voepel-Lewis et al., 2013, West et al., 2016, Hope et al., 2018, Recio-Saucedo et al., 2018, Hope et al., 2019, Li et al., 2020). Nursing staff reported that patient assessments were difficult at night due to a restricted clinical environment (Nilsson et al., 2008, West et al., 2016, Hope et al., 2018). Visibility was reported as limited from a dimly lit environment and staff highlighted reliance on audible cues such as listening for breathing instead of conducting a full assessment (Nilsson et al., 2008, Hope et al., 2019). Nurses described making decisions to delay admitting new patients onto the ward by placing them in temporary locations such as corridors or treatment rooms to ensure a quiet atmosphere and avoid disturbing other patients (Nilsson et al., 2008).

Among the ten studies, six identified a common tension between balancing patient sleep with essential monitoring and assessments (Nilsson et al., 2008, Gordon and Beckett, 2011, Voepel-Lewis et al., 2013, Hope et al., 2018, Recio-Saucedo et al., 2018, Hope et al., 2019). Nilsson et al. (2008) explored the unique challenges of night-time nursing, and found that ensuring a restful environment was a priority for nurses who believed it was important for patients to sleep at night so they could engage with daytime activities more effectively. Nurses had to balance adherence to monitoring protocols with a reluctance to disturb patients' rest (Gordon and Beckett, 2011, Hope et al., 2018). Similarly, Voepel-Lewis et al. (2013) reported gaps in night-time monitoring despite the use of continuous pulse oximetry devices, as nurses often disabled alarms to minimise disruptions.

3.4.1.2. Physiological effects of the night

Night-time posed unique challenges for both patients and nursing staff (Nilsson et al., 2008, West et al., 2016, Hope et al., 2018, Hope et al., 2019). Patients with dementia often experienced confusion and agitation, which occasionally led to them being excluded from vital signs monitoring, resulting in signs of deterioration being missed (Hope et al., 2018, Hope et al., 2019). Across studies, patients were reported to be more disoriented, aggressive, and emotionally distressed at night, requiring additional staff that were not always available (Nilsson et al., 2008, West et al., 2016). Physiological changes in nursing staff performance were also reported due to fatigue, resulting in slower reflexes and delayed responses, potentially compromising patient safety (West et al., 2016).

3.4.1.3. Diurnal workflow variation

Hospital workflows at night were reported to differ from daytime operations in task prioritisation, communication, and staffing (Nilsson et al., 2008, West et al., 2016, Müller et al., 2021, Vollam et al., 2022). Day shifts involved frequent interruptions from visitors and multidisciplinary teams, requiring constant coordination. In contrast, night shifts provided fewer disruptions, allowing nurses to more efficiently deliver care as planned (West et al., 2016). However, they also faced challenges such as balancing administrative tasks in preparation for the next day alongside patient care including hygiene and weighing particularly at 05:00 to 07:00 (Nilsson et al., 2008, Müller et al., 2021, Vollam et al., 2022).

3.4.2. Workforce composition and team dynamics out-of-hours

3.4.2.1. Staffing and workforce

Of the studies reporting on the influence of the clinical team out-of-hours, ten studies identified staffing levels and skill mix as key challenges (Galhotra et al., 2006, Nilsson et al., 2008, Mackintosh et al., 2014, Palese et al., 2014, Wood et al., 2014, Kolic et al., 2015, West et al., 2016, Ludikhuize et al., 2021, Vollam et al., 2022, Boniatti et al., 2023). The studies reported reduced nursing staffing and a high proportion of junior or inexperienced nursing staff working out-of-hours. One study specified that night staffing was reduced by a third to half compared to daytime (Wood et al., 2014). Tasks

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typically performed during the day were managed by fewer staff at night (Nilsson et al., 2008), with the responsibility for monitoring vital signs and escalating care shown to be placed more on healthcare assistants, who often reported high workloads (Mackintosh et al., 2014). Redeploying nurses and reliance on temporary staff during out-of-hours shifts were reported to mitigate staffing shortages but increased the risk of error in unfamiliar environments (Kolic et al., 2015, West et al., 2016).

Low nurse-to-patient ratios at night (reaching up to 20-22 patients per nurse) limited timely patient assessments, linked to delays in escalation of care (Palese et al., 2014). Staffing levels were linked to the difficulty in maintaining the frequency of observations required by the local protocol, with associated delays in escalations (Kolic et al., 2015, Vollam et al., 2022). It was also observed that maintaining consistent nurse-to-patient ratios across day and night shifts suggests more Medical Emergency Team (MET) or rapid response team activations and comparable patient outcomes (Galhotra et al., 2006, Boniatti et al., 2023). Additionally, nursing leadership during out-of-hours was reported as reduced, with fewer to no nurse educators and nurse specialists available (West et al., 2016). Nurses reported relying on critical care outreach teams and advanced clinical practitioners for additional expertise and support out-of-hours (Mackintosh et al., 2014).

Four studies also highlighted challenges with reduced medical team coverage (West et al., 2016, Ludikhuize et al., 2021, Vollam et al., 2022, Boniatti et al., 2023). Ludikhuize et al. (2021) reported that medical staff were responsible for more than 50 patients during nights and weekends, contributing to slower responses to deterioration. Vollam et al. (2022) found that only a quarter of medical reviews were performed out-of-hours, with West et al. (2016) supporting that the majority conducted by junior doctors resulting in delays to senior medical reviews and decision-making. Conversely, in settings with a 24/7 intensivist-led rapid response team, the response was consistent across day and night shifts (Boniatti et al., 2023).

3.4.2.2. Healthcare Team Interactions

Eleven studies found unique changes to team characteristics out-of-hours including role expectations, the culture around monitoring and escalation, communication during out-of-hours, and the degree of familiarity among team members (Galhotra et al., 2006, Nilsson et al., 2008, Gordon and Beckett, 2011, Hands et al., 2013, Mackintosh et al., 2014, van Galen et al., 2016, West et al., 2016, Hope et al., 2018, Recio-Saucedo et al., 2018, Li et al., 2020, Ludikhuize et al., 2021).

Registered nurses (RNs) acknowledged their general responsibility for patient assessment and escalation decisions and identified that healthcare assistants were not solely responsible for measuring vital signs (Nilsson et al., 2008, Hope et al., 2018, Recio-Saucedo et al., 2018). However, Mackintosh et al. (2014) found hierarchical structure exists between RNs and healthcare assistants with monitoring tasks often delegated to healthcare assistants, while nurses retaining the responsibility for escalating care to the medical team. Challenges in team dynamics between medical and nursing staff were also highlighted, with a noted sense of disconnection between these professionals in the out-of-hours context (West et al., 2016). Nurses delayed escalation of care if the doctor on shift was a 'locum' who was unfamiliar with the patient (Nilsson et al., 2008), and nursing staff often reported stress when working with doctors with whom they had not established a rapport (Li et al., 2020). Fear of blame or criticism from doctors created hesitancy from nurses to raise concerns, particularly after midnight, contributing to delays in escalation of care (Li et al., 2020). Additionally, communication difficulties, particularly with the use of telephones, frequently led to confusion and frustration from both nursing and medical teams (Galhotra et al., 2006, Mackintosh et al., 2014).

An additional determinant influencing team interactions, identified across five studies, was the culture surrounding monitoring and escalation during out-of-hours shifts. Galhotra et al. (2006) and Ludikhuize et al. (2021) found that rapid response team use decreased by approximately 50% during these periods, attributing this to staff being more likely to call the rapid response team during the day, and inadequate role-modelling by senior clinicians. Gordon and Beckett (2011) found that in high-acuity

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areas such as Acute Assessment Units, more frequent measurement of vital signs was conducted. In contrast, van Galen et al. (2016) reported that certain vital parameters, such as pain and urine output, were often omitted due to local custom and practice.

3.4.3. Organisational oversight and adaptive strategies

Twelve studies highlighted the influence of organisational structures, processes, resource availability, and oversight during out-of-hours periods on nursing staff' ability to recognise and escalate patient deterioration (Galhotra et al., 2006, Nilsson et al., 2008, Mackintosh et al., 2014, Palese et al., 2014, Wood et al., 2014, van Galen et al., 2016, West et al., 2016, Hope et al., 2018, Hope et al., 2019, Dhaini et al., 2020, Vollam et al., 2022, Boniatti et al., 2023). Specifically, administrative responsibilities such as bed management demanded substantial attention from nursing staff due to the limited presence of managerial personnel overnight (West et al., 2016, Hope et al., 2019). While West et al. (2016) found that nurses perceived the reduced presence of managers out-of-hours as leading to fewer interruptions to planned care, Mackintosh et al. (2014) reported that this shift in responsibility limited nurses' time for delivering direct patient care. Müller et al. (2021) further supported these findings, observing that nursing staff spent less time performing clinical assessments overnight compared to daytime hours.

In a study examining patterns and variations in implicit care rationing across different times in an acute hospital, lower patient-turnover during weekends and holidays was associated with improved nursing responses to monitoring alarms (Dhaini et al., 2020). However, admissions during shift changes or handovers (typically falling outside normal working hours) increased the risk of missed or delayed monitoring of vital signs, contributing to higher in-hospital mortality (Wood et al., 2014, Hope et al., 2019, Boniatti et al., 2023). Limited ICU bed availability often led to premature discharges out-of-hours, placing additional strain on ward staff (van Galen et al., 2016, Vollam et al., 2022). Nurses have reported developing strategies to manage these pressures, such as cohorting patients closer to the nurses' station or ensuring the presence of bedside healthcare assistants (Galhotra et al., 2006, Mackintosh et al., 2014, Palese et

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al., 2014). However, ineffective cohorting by placing patients in less visible areas, was found to lead to unnoticed deterioration (Galhotra et al., 2006).

3.4.3.1. The organisation's awareness of out-of-hours care

While organisations monitored compliance to oversee operations (Hope et al., 2018), compliance targets often led to covert behaviours, such as manipulating healthcare records to prevent alarm triggers and using system loopholes (Hope et al., 2019). When effectively implemented, auditing practices showed harm reduction strategies and enhance executive engagement in patient safety initiatives (Mackintosh et al., 2014). Structural reforms, like those observed by Nilsson et al. (2008), suggest that aligning conditions for night and day shifts can improve staff efficiency and patient outcomes.

3.4.4. Clinical nursing workflow and supporting resources

Twenty-two studies identified key workflow-related factors that influence nursing staff' ability to escalate care during out-of-hours, including handover, information exchange, patient monitoring, assessment, and the escalation of clinical deterioration. (Galhotra et al., 2006, Jones et al., 2006, McGain et al., 2008, Gordon and Beckett, 2011, Hands et al., 2013, Voepel-Lewis et al., 2013, Mackintosh et al., 2014, Palese et al., 2014, Wood et al., 2014, Yiu et al., 2014, Kolic et al., 2015, Sundararajan et al., 2016, van Galen et al., 2016, West et al., 2016, Hope et al., 2018, Recio-Saucedo et al., 2018, Hope et al., 2019, Li et al., 2020, Müller et al., 2021, Vollam et al., 2022, Boniatti et al., 2023, Gonem et al., 2024). The availability and effectiveness of supporting resources, such as healthcare technology, documentation, and track-and-trigger tools, also played a critical role throughout the clinical workflow.

3.4.4.1. Handover

Handover, the communication of care from one professional to another, a process that typically occurs during out-of-hours periods, was reported in three studies, all of which reported instances of information loss (Palese et al., 2014, van Galen et al., 2016, Vollam et al., 2022). Palese et al. (2014) found that handovers were often

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conducted away from patients, requiring nurses to rely on memory, which increased the risk of miscommunication or omission of critical details. Additionally, a disconnect between handover discussions and actual patient conditions was common, with nurses noting an implicit bias towards using cumulative historical data over real-time assessment findings, which led to potentially deteriorating patients being overlooked (Palese et al., 2014). Unclear handovers caused ambiguity around important information such as vital signs monitoring frequency, due to poor-quality documentation, which was less comprehensive at night than during the day (van Galen et al., 2016, Vollam et al., 2022).

3.4.4.2. Monitoring, Assessment and Escalation

McGain et al. (2008) observed more frequent documentation lapses during evening and night shifts. Sundararajan et al. (2016) found that many observations, particularly the respiratory rate, remained incomplete at night, while Mackintosh et al. (2014) identified a 'dip' in observation rates, especially for pain scores, during these times. Palese et al. (2014) noted that night-shift nurses struggled to detect subtle signs of deterioration due to limited patient contact and Galhotra et al. (2006) emphasised that sleeping patients may not exhibit visible signs of deterioration, such as mental status alteration, and delaying recognition of worsening conditions. Studies on out-of-hours ICU admissions and discharges reported fewer observations, longer delays in initial observations and fewer subsequent checks (Wood et al., 2014, Vollam et al., 2022). Additionally, Hands et al. (2013) found fewer recorded observations, irrespective of the Early Warning Score, and poor adherence with vital signs monitoring. Structured practices such as set observation rounds, which are predetermined times for conducting vital signs measurements, were found to improve the consistency and accuracy of vital sign documentation (Hands et al., 2013).

Four studies found that out-of-hours, nurses valued the Early Warning Score tool with its protocolised nature reducing cognitive burden by standardising monitoring intervals and alleviating uncertainty (Mackintosh et al., 2014, van Galen et al., 2016, Hope et al., 2018, Hope et al., 2019). However, other studies reported delays or

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inappropriate responses to Early Warning Score alerts during out-of-hours shifts (Voepel-Lewis et al., 2013, Kolic et al., 2015, Boniatti et al., 2023, Gonem et al., 2024). Night nursing staff were reported as believing that Early Warning Score tools often failed to capture subtle signs of deterioration, such as minor behavioural or physiological changes (Mackintosh et al., 2014, Palese et al., 2014) and nurses were reluctant to escalate concerns until a pattern of worsening symptoms emerged (Li et al., 2020). Notably, Gonem et al. (2024) observed that out-of-hours escalations were more frequently driven by isolated, markedly abnormal vital signs (e.g., respiratory rate or consciousness level) or rising oxygen requirements than the high total Early Warning Score meeting protocol-defined escalation thresholds.

3.4.4.3. Supporting resources aiding workflow

Healthcare technology advancements, such as automated observations, support prompt recognition of clinical deterioration by reducing scoring errors and providing reminders (Mackintosh et al., 2014, Kolic et al., 2015, Hope et al., 2019). However, reliance on these systems was found to introduce additional, new risks, including hospital information technology (IT) server downtime-related safety gaps, where system failures or outages compromised timely detection, and alarm fatigue, where repeated alerts led to desensitisation and reduced response rates (Voepel-Lewis et al., 2013, Yiu et al., 2014). Despite these innovations, out-of-hours documentation by medical and nursing staff remained inconsistent, leading to uncertainty in management and escalation (McGain et al., 2008, Li et al., 2020, Müller et al., 2021, Vollam et al., 2022). Additionally, unclear treatment escalation plans in patient notes, including 'Do-Not-Attempt Cardiopulmonary Resuscitation' (DNACPR) orders, further contributed to delays in seeking timely treatment and appropriate care (Palese et al., 2014, van Galen et al., 2016).

3.4.5. Individual determinants of behaviour, strengths and limitations

Sixteen studies reported determinants at the level of individual staff members that influenced care of clinically deteriorating patients out-of-hours (Fuhrmann et al., 2008, McGain et al., 2008, Nilsson et al., 2008, Gordon and Beckett, 2011, Hands et

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al., 2013, Mackintosh et al., 2014, Yiu et al., 2014, Kolic et al., 2015, Sundararajan et al., 2016, van Galen et al., 2016, Hope et al., 2018, Recio-Saucedo et al., 2018, Dhaini et al., 2020, Li et al., 2020, Ludikhuize et al., 2021, Müller et al., 2021) . These determinants included knowledge, skills, decision-processes, and emotions. Additionally, contextual factors were reported such as perceived workload and prioritisation.

3.4.5.1. Knowledge and Skills of Early Warning Score system and Clinical Decision-Making

Errors in Early Warning Score calculation contributed to missed deterioration triggers, with widespread inaccuracies reported out-of-hours (Kolic et al., 2015, van Galen et al., 2016). One study found that only 1% (4 out of 477) of vital sign sets were correctly documented at night prior to ICU admission (van Galen et al., 2016). Clinical expertise also influenced escalation decisions as experienced nurses who worked out-of-hours reported relying on clinical judgment rather than Early Warning Score alone (Recio-Saucedo et al., 2018). Cognitive biases reportedly impacted patient monitoring with long-stay patients or those with DNACPR orders receiving fewer checks due to perceived stability or futility of care (McGain et al., 2008, Gordon and Beckett, 2011, Hope et al., 2018). Additionally, clinical assessments illustrated that staff had developed a perceived hierarchical weighting of clinical cues with pulse rate being measured significantly more often than blood pressure before patient deterioration (Sundararajan et al., 2016). Additionally, respiratory rate and rising oxygen support more consistently prompted escalation to medical teams (Gonem et al., 2024).

3.4.5.2. Contextual Factors Influencing Behaviour

Competing demands ingrained within the nursing role, such as preparing medications and assisting with hygiene, were prioritised over monitoring vital signs and conducting proactive assessments out-of-hours (Nilsson et al., 2008, Mackintosh et al., 2014, Dhaini et al., 2020, Müller et al., 2021). Despite awareness of overdue vital signs, time constraints and perceived workload pressures prevented staff from completing them on time (Fuhrmann et al., 2008, Recio-Saucedo et al., 2018, Li et al., 2020, Ludikhuize

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et al., 2021). Additionally, high acuity fatigue resulting from constant exposure to a high prevalence of critically ill patients, led to desensitisation, reduced vigilance, and non-adherence to escalation policies (Hands et al., 2013, Yiu et al., 2014, Gonem et al., 2024)

4. Discussion

This is the first comprehensive mixed-methods review to examine the determinants influencing nursing staff' recognition and response to clinical deterioration during out-of-hours. Several key determinants across different system levels were identified from diverse perspectives across 26 studies. The findings highlight the unique constraints and complexity of out-of-hours care, including challenges which fall outside the control of nursing staff, and demand systemic reform. Acknowledging these differences is crucial for developing targeted improvements to strengthen patient safety out-of-hours.

This systematic review underscores the unique challenges of the 'hospital at night' environment and its impact on recognising and responding to clinical deterioration. Nursing staff operate under suboptimal conditions (e.g. diminished lighting, noise restrictions, and competing clinical and administrative demands) (Nilsson et al., 2008, West et al., 2016), yet existing literature inadequately explores how these constraints shape clinical decision-making during night shifts. While global patient safety initiatives have prioritised interprofessional communication and staffing reforms (NHS England, 2019, WHO, 2024b), specific night-time challenges are often overlooked. This limits our understanding of how staff adapt to night-time pressures while maintaining patient safety. Future research should explore how staff navigate operational and clinical responsibilities at night to maintain patient safety in complex conditions including human factors methods such as systems design thinking (Carayon et al., 2014) to analyse distinct night elements.

A key determinant identified in this review was the conflict between thorough patient assessment and preserving a restful environment, where nursing staff deprioritise

vital signs monitoring to avoid disturbing patients (Nilsson et al., 2008, Gordon and Beckett, 2011, Hope et al., 2018, Recio-Saucedo et al., 2018). This practice manifests a fundamental ethical and clinical dilemma of balancing the importance of continuous physiological surveillance and patient-centred nursing practice, which prioritises human experience (McCance and McCormack, 2025). Nursing staff find themselves in a complex act of advocacy weighing immediate patient comfort and dignity against potential clinical risk. Moreover, concerns about disturbing or provoking aggression in confused patients, particularly older adults who often experience night-time agitation (Cipriani et al., 2015) further contribute to nursing staff deprioritising vital signs monitoring at night. Such tendency carries significant risk, particularly as the ageing population (WHO, 2024a) increases the likelihood of acute hospital beds being occupied by older patients potentially making the delivery of high-quality night-time care more challenging. These challenges highlight limitations of rigid, one-size-fits-all monitoring protocols and calls for a paradigm shift toward flexible context sensitive alternatives. Emerging evidence suggests unobtrusive monitoring technologies (e.g. wearable pulse oximetry, respiratory patches) could help reconcile patient safety with restorative sleep. Voepel-Lewis et al. (2013) found these technologies facilitate timely nursing interventions at night, also supported by a meta-analysis by Areia et al. (2021) demonstrating their effectiveness in reducing ICU admissions and rapid response team activations. However, their use in general wards during night shifts remains under-examined and their implementation may be challenging in resource-limited settings.

As this review demonstrates, these challenges are compounded by the reported reduced staffing levels out-of-hours which makes nursing job role expectations and responsibilities, particularly around monitoring and escalation of clinical deterioration challenging to fulfil. Mackintosh et al. (2014) reported that healthcare assistants often perform monitoring tasks out-of-hours while RNs focus on direct care, reinforcing hierarchical divisions. In a recent ethnographic study, Carroll et al. (2024) further observed that this task-based division of labour continues to create role ambiguity, especially in the measurement and interpretation of vital signs by healthcare

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assistants and RNs. This task-shifting raises patient safety concerns, given healthcare assistants' limited training and the well-documented correlation between understaffing and adverse outcomes (Aiken et al., 2017, Griffiths et al., 2019). The Francis Report (2013) further cautions against unsupervised healthcare assistant care, highlighting risks inherent in role dilution. With the World Health Organisation (2023) projecting a global nursing shortfall of 4.5 million by 2030, healthcare systems must urgently clarify role delineation, invest in workforce upskilling, and adopt team-based models that leverage the strengths of both RNs and healthcare assistants.

This review reveals a concerning trend of lower rapid response team activation during out-of-hours periods, despite these being higher-risk times compared to in-hours. While studies (Yiu et al., 2014, Kolic et al., 2015, Boniatti et al., 2023) have quantified this disparity, the sociocultural and interprofessional dynamics underpinning it remain poorly understood. Existing research not specific to out-of-hours context suggests that hierarchical dynamics between nurses and doctors significantly influence rapid response team activation decisions, highlighting nurses' challenges in escalating care, including the need to provide clear evidence of deterioration (Chua et al., 2020). Similarly, Li et al. (2020) emphasised that effective night-time nurse-doctor communication requires careful coordination of process, timing, and content. However, this can be compounded by low out-of-hours staffing, exacerbating interprofessional tensions (West et al., 2016, Ludikhuize et al., 2021). These dynamics can lead to delays, where nurses attempt to manage clinical deterioration before escalation (Sprogis et al., 2023). Enhancing interprofessional collaboration through high-fidelity simulation-based education could enhance the competence and confidence in escalating deteriorating patients out-of-hours. Evidence suggests such training strengthens collaborative skills, builds confidence in managing critical conditions, and bridges the gap between theory and real-world clinical decision-making (Ju et al., 2022, Santesson et al., 2024).

At an individual level, this review highlights deficits in clinical capabilities such as miscalculations of Early Warning Score as key contributors to delayed escalations.

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While such errors may prompt calls for enhanced training, evidence suggests that conventional training alone rarely leads to sustained behavioural change or improved patient outcome (Connell et al., 2016). In contrast, investment in high-reliability automation systems such as electronic vital signs monitoring and notification platforms that are engineered to support consistent clinical performance have been shown to reduce human error, improve rapid response team activation, and enhance patient outcomes including shorter hospital stays (Subbe et al., 2017, Holmes et al., 2024). These findings underscore the need to move beyond knowledge-based interventions and instead explore practice-change.

Finally, our findings reveal that emotional and psychological barriers such as fear of blame and reluctance to escalate care impede timely clinical escalation. Multiple studies, although not specific to out-of-hours, reported that staff hesitate to initiate escalation due to concerns about negative responses including fear of being perceived as incompetent for activating rapid response teams (Chua et al., 2020, Peerboom et al., 2022, Wright et al., 2023). This requires transformative organisational change that prioritises psychological safety where escalation processes are reframed as safety mechanisms rather than assessments of individual competence (Grailey et al., 2021). Senior clinicians and nursing management play a pivotal role in this cultural shift by modelling supportive escalation behaviours and encouraging routine feedback or debriefing following escalation events. This interprofessional approach not only improves patient safety but also fosters more resilient and engaged clinical teams (Li et al., 2020, Hitchner et al., 2023).

4.1. **Implications for Current Practice**

This review identifies key determinants influencing nursing staff escalating care out-of-hours, many of which extend beyond clinical into behavioural, emotional and systemic domains. These findings reinforce the need for theory-informed, context-sensitive targeted interventions to enhance patient safety.

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To support effective implementation, healthcare organisations should draw on behavioural science and human factors frameworks to design interventions that are feasible, impactful, and embedded in safety science. For instance, frameworks such as the Capability, Opportunity, Motivation – Behaviour (COM-B) model (West and Michie, 2020) could further explore and explain why training alone may be insufficient in enhancing escalation out-of-hours and why emotional and psychological barriers such as fear of criticism and cognitive overload, must be explicitly addressed in intervention design. Similarly, a Human Factors perspective may highlight system-level influences such as the hospital-at-night environment, resource pressures and team dynamics. The extended model of Systems Engineering Initiative for Patient Safety (SEIPS 2.0) can help illustrate how work systems shape clinical processes and outcomes and how these systems continually adapt.

Organisations must begin by mapping local barriers and leveraging facilitators within their specific context to develop appropriate targeted strategies that enhance monitoring and recognition of clinical deterioration. This includes strengthening communication pathways, clarifying role expectations, and fostering psychological safety. Workforce shortages, workload pressures, and systemic inefficiencies call for urgent policy reforms, including optimised staffing models and improved skill mix out-of-hours. **Supplementary File 5** provides a detailed breakdown of modifiable barriers and corresponding recommendations, derived through independent coding and iterative synthesis.

Future research should prioritise design and evaluation of multi-faceted, tailored interventions that target modifiable factors, integrating behavioural and human factors insights to ensure feasibility and impact within resource-constrained healthcare systems. Integrating these disciplinary perspectives may enable healthcare organisations to strengthen escalation processes and deliver safer, more effective out-of-hours inpatient care.

4.2. **Limitations**

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The exploratory and narrative nature of this review relied on reviewer interpretation and may limit reproducibility or reduce reliability for evidence-based decision-making. The inclusion criteria excluded studies not published in English or in non-peer-reviewed sources, which may have omitted relevant evidence. There is no consensus on the definition of out-of-hours, nor 'failure to rescue' and may not fully align with interpretations across all healthcare systems.

We elected not to include medically-focused databases (Scopus [lacks targeted indexing for qualitative or nursing-focused studies], Pubmed [we used Medline], Cochrane [given the known paucity of trials in this area]) given the focus was on nursing-centred practices.

The focus on ward-based nursing staff limits applicability to other settings, such as paediatrics or emergency departments. There were no randomised controlled trials identified for inclusion, which limits causal interpretations and risk of bias due to possible confounders in the quantitative studies. The 'qualitisation' of numerical findings risks poor estimation of statistical heterogeneity. Methodological weaknesses in some included studies could affect the robustness of the synthesised evidence.

This review also has several strengths. The study selection used dual independent blinded processes. Both quantitative and qualitative studies were incorporated, enabling a comprehensive synthesis of evidence. No publication date restrictions were applied, including an updated search, ensuring a broad temporal scope. Despite its limitations, this review provides valuable insights into the determinants of nursing staff escalating care out-of-hours and identifies critical gaps for future research. The findings should be interpreted with consideration of the contextual constraints outlined above.

5. Conclusion

This systematic review novelly highlights the complex factors influencing nursing staff's ability to escalate care out-of-hours. This highlights a need to strengthen nurse

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education around escalation, foster psychological safety and ensure optimal technology integration, and develop clear communication pathways to improve clinical decision-making and teamwork. In addition, contextual factors such as addressing workforce shortages and workload pressures, and addressing systemic inefficiencies (e.g. rigid protocols, reduced clinical leadership presence) requires policy reform, including optimised staffing models and improved skill mix out-of-hours. With the increasing demand for hospital services and limited resources, it is crucial to support nursing staff to ensure optimal patient outcomes out-of-hours, beyond simply mortality to include experiences of care.

Supplementary data

Supplementary data associated with this article can be found, in the online version, at (*link pending publication*).

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Figure 1. PRISMA flowchart

Figure 2. Conceptual illustration of determinants influencing nursing staff behaviour in recognising and escalating clinical deterioration out-of-hours.

The iceberg metaphor is used to depict how factors may be less visible in routine practice. The vertical arrangement does not imply a hierarchy of importance or influence and reflects the authors' interpretive synthesis rather than empirical ranking.

Figure 3. Visual mapping of themes and subthemes

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Table 1. Summary of studies

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Boniatti et al., 2023, Brazil	To evaluate the frequency of rapid response team (RRT) calls by time of day and their association with in-hospital mortality.	Retrospective Cohort study Record Review	All patients with RRT calls during study period	Nighttime (19:00 to 6:59)	NIL	(1) RRT activations with increased odds of death during handover times (2) Decreased staff worry activations at night compared to in the day	(1) Same nurse-patient ratio for day and night (2) Activations around vital signs rounds (3) 24/7 intensivist led RRT	(1) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing and Workforce (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Disruptions and Distractions (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring, Assessment and Escalation
Dhaini et al., 2020, Lebanon	To explore: (a) prevalence of rationing of care per type of shift; (b) between-individual, between-service and between-shifts variability of rationing of care; (c) trends and variability of rationing of care across time per type of shift and its relation to key work environment factors (self-perceived workload and staffing adequacy)	Longitudinal Study Survey	Registered Nurses	Nights (no time frame), Weekends and Holiday	NIL	(1) Higher prevalence of missed nursing care during the night shift. (2) Perceived staff workload and staffing (3) Addressing patient concerns or calls lower on weekends than weekdays	(1) Prompt response to patient alarms and offer more support to patients on weekends/holidays due to decreased patient turnover	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Contextual Factors Influencing Behaviour (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Patient Turnover Effects on Nursing Workload

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Fuhrmann et al., 2008 Denmark	To estimate the incidence, staff awareness and subsequent mortality of patients with abnormal vital signs on general wards in a Danish university hospital	Prospective observational incidence study Record Review	All patients admitted in the chosen wards; and nurses working in the wards	Evening (16:00 to 21:30)	NIL	(1) Nursing staff were unaware of the patients' abnormal vital signs	NIL	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Contextual Factors Influencing Behaviour
Galhotra et al., 2006 United States	To study the impact of time of day, day of week and level of patient monitoring on medical emergency team (MET) activation	Retrospective observational study Record Review	All Cardiac Arrest and MET events	Night (19:00 to 06:59) Weekends (Saturday and Sunday)	NIL	(1) Staffing level (2) Willingness to make a call (3) Stockpiled patients unobserved (4) sleeping patients not manifest obvious outward changes in condition (5) Family members more present in the day	(1) Continuous monitoring associated with more activation of MET (2) increased propensity for staff to call for MET in the day (3) Higher MET activations during ward rounds	(1) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing and Workforce; Healthcare Team Interactions (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES : Digital Organisational Visibility of Deterioration; Cohorting/Logistical Surveillance (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring, Assessment and Escalation; Supporting resources aiding workflow

Journal Pre-proof

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Gonem et al., 2024 United Kingdom	In an acute respiratory inpatient population: (a) To establish what proportion of high NEWS-2 scores lead to an urgent medical review in the out-of-hours setting, and to determine what factors are associated with the decision to escalate or de-escalate a given NEWS-2 alert; (b) To understand how often NEWS-2 fails to detect deteriorating patients in hospital, by establishing the proportion of urgent out-of-hours medical reviews, relating to an acute physiological disturbance, which do not reach the NEWS-2 escalation threshold of ≥5; (c) To establish what proportion of urgent out-of-hours medical reviews lead to a significant change in treatment, and to determine what factors are associated with medical reviews that result in a change in treatment; and (d) To determine the inpatient mortality rate	Retrospective Observational Study Record Review	Adult patients with clinical deterioration out-of-hours	Monday-Friday (17:01 to 08:59); Weekends	National Early Warning Score 2 (NEWS-2)	(1) Triggering observations (NEWS-2 ≥5) were unlikely to be followed with an out of hours escalation.	(1) Rising or Elevated Oxygen requirement - more likely to be escalated (2) Single, markedly abnormal vital signs (level of consciousness and respiratory rate) were more likely to prompt escalation than a collection of mildly deranged parameters.	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision-Making; Contextual Factors Influencing Behaviour (2) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES:: Escalation

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
	for patients who received an urgent out-of-hours medical review compared with those who did not							

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Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Gordon and Beckett, 2011 United Kingdom	To quantify the proportion of unwell patients who did not have SEWS correctly calculated or recorded, and which parameters were omitted	Prospective Observational Study Record Review	Patients with overnight clinical concern necessitating review by medical staff or H@N team	Night (no time frame)	Standardised Early Warning Score (SEWS)	(1) Total SEWS not calculated / miscalculated therefore missing identification of "trigger" (2) Agitated patients (3) Patients with longer stay = less frequent observations (4) Nursing staff less willing to wake patients up to perform observations; did not think it was clinically indicated to perform observations at night (5) Urine output frequently missed; RR as frequently missed observations; Neurological status not recorded due to reluctance to disturb patient / labour intensive	(1) Intensive educational programme (2) Culture that patients are much more unwell (cohorted in acute assessment unit)	(1) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Healthcare Team Interactions (2) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring / Assessment (3) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work (4) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Knowledge and Skills of EWS; Clinical Decision Making

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Hands et al., 2013 United Kingdom	To study the pattern of the recording of vital signs observations throughout the day and examine its relationship with the monitoring frequency component of the clinical escalation protocol	Retrospective Observational Study Record Review	All adult inpatient areas	Weekends and Nights (no time frame)	VitalPAC Early Warning Score (ViEWS)	(1) Infrequent vital signs measurement at night (2) Reduced vital signs measurement night (3) Inconsistent adherence and to "time to next observations" at night (4) "Time to next observations" longer at night vs day (5) Higher ViEWS score did not have measurement within 6 hours	(1) Peak of measurement of observations during observation rounds (2) Sicker patients (viEWS >9) were more likely to have vital signs measured throughout the night	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making; Contextual Factors Influencing Behaviour (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Healthcare Team Interactions (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment

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Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Hope et al., 2018 United Kingdom	To explore why adherence to early warning score protocol-led observation schedules is poorer at night by analysing nurses' accounts of decision-making about taking vital sign at night.	Qualitative interpretative study Interviews	Registered Nurses	Night (no time frame)	National Early Warning Score (NEWS)	(1) Balancing sleep and taking vital signs (2) Use of judgment to decide which observations are necessary (3) Patients whom staff judged were nearing the end of life, but not formally registered on end-of-life pathway (4) Patients with COPD: staff expecting their oxygen saturations to be lower at baseline (5) Patients with dementia / Alzheimer's / confusion fighting staff (6) Part of the night shift culture and work is seen as settling the ward down	(1) Vital signs observations viewed as core piece of nursing work (2) Appearance of patient, gut feeling (3) Family & visitor views (4) Ward specific protocols (5) Hospital level target setting (6) Social expectations to have "fresh" observations for the day	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Healthcare Team Interactions; Family (3) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES : Use of Monitoring Compliance Data (4) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment; Track and Trigger Tools (6) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work; Physiological Effects of the Night on Patients

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Hope et al., 2019 United Kingdom	To explore how electronic data were used to performance manage ward'• level nursing compliance with a EWS protocol.	Qualitative interpretative study Interviews	Hospital nursing staff	Night (no time frame)	National Early Warning Score (NEWS)	(1) Competing demands (2) Infrequent observations schedules for patients with chronic conditions such as COPD (3) Omitting vital signs measurements at night (4) Medical outliers (5) Challenging behaviour of agitated patients / with dementia (6) Compliance targets implemented = created covert behaviours invisible in the protocol (7) Inability to report omissions due to feeling penalised	(1) Strategies developed for taking vital signs observations at night causing minimal distress (2) External reminders via device (3) Ward performance targets (4) Short EWS intervals (5) Pressure from ward managers	(1) ENVIRONMENTAL: Disruptions and Distractions (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Use of Monitoring Compliance Data (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment; Healthcare Technology; Track and Trigger Tools (4) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work; Physiological Effects of the Night on Patients

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Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Jones et al., 2006 Australia	To describe the timing of cardiac arrest detection in relation to episodes of Medical Emergency Team (MET) review and routine nursing observations	Retrospective observational study Record Review	All emergency calls from a log book maintained by switchboard operators	OOH not specified; evaluated 24 x 1 hour intervals Although correlations were made according to nursing and medical procedures Medical shift: 08:00 - 18:00 Nursing handover: 07:00; 13:00; 21:00	NIL	NIL	(1) peak levels of cardiac arrest detection corresponds to the timing of routine nursing observations	(1) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Track and Trigger Tools

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Kolic et al., 2015 United Kingdom	To assess the association between the appropriate use of NEWS and out-of hours activity.	Prospective Observational Study Record Review	Adult patients (age >16) admitted in two acute medical wards	Night (21:01 - 08:59), Weekends	National Early Warning Score (NEWS)	(1) Track-and-Trigger Tool Scoring errors not generating aggregate score (2) Nighttime work with lower frequency of vital signs monitoring (3) Staffing out-of-hours: Lower staffing; More junior staff members; Temporary staff not familiar of the workplace (4) Unavailability of medical diagnostic equipment (5) Inappropriate / inadequate clinical response against the local protocol on the weekends and nights (6) Reduced number of senior doctors	(1) Automated observation calculation decreased errors in scoring	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Knowledge and Skills of EWS (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Escalation; Healthcare Technology

Journal Pre-proof

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Li et al., 2020 China	To explore the general phenomenon and psychological experience of the special background communication in night shift medical staff and provides better reference for night shift communication between doctors and nurses	Phenomenological Exploration Study Observation; Interviews	Staff working night shifts	Night (no time frame)	NIL	(1) Lack of communication between nurses and doctors at night (2) Busy doctors / difficult to call after midnight, the doctor is sleeping (3) Doctors' expectations on nurses to "deal with situations" prior escalation (4) Reluctance to call for help from the medical team: Need to wait for collective number of reports prior calling; Nurse embarrassed to call; Reported conditions criticised; may be less stressful to communicate with a low ranking doctor; senior doctor will feel that your problem is not important (5) Busy doctors / difficult to call after midnight (6) Poor medical documentation after operation	NIL	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Contextual Factors Influencing Behaviour; Feelings and Emotional Response (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Healthcare Team Interactions (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Escalation; Healthcare Record / Documentation (5) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Ludikhuize et al., 2021 Netherlands	To analyse current clinical practice and adherence to the RRS protocol in the Netherlands: to gain insight into potential areas for improvement of the so-called "afferent arm" (deterioration detection and activation) of the RRT	Multicentre cross-sectional Study Survey	Healthcare providers in medical and surgical wards across 9 hospitals in the Netherlands	OOH: 18:00-08:00; and weekends	Modified Early Warning System (MEWS)	(1) Higher nurse to patient ratio at night (2) Higher doctor to patient ratio at night: Medical doctor could be responsible for over 50 patients per shift; Consultants responsible for over 75 patients (3) Delayed response from medical workforce may be delayed due to high workload (4) Low utilisation of RRT OOH (5) Unwritten rules and cultural practices in care	(1) Highest nurse-patient ratio = highest number of activations	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Contextual Factors Influencing Behaviour (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce; Healthcare Team Interactions

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Müller et al., 2021 Switzerland	To log the activities of registered nurses and nursing assistants on a visceral surgery ward	Descriptive observational time-motion study Observation	Nursing staff (Nurses and Nursing Assistants)	Night (7pm - 7:30am); Evening shift (2pm - 11pm)	NIL	(1) Staff spent much less time performing clinical assessments overnight (2) Planning, coordination and delegated medical tasks took up most of the time (3) Less relational care and non-medication interventions (4) Less opportunities for knowledge updating; Less time for supervision of staff (5) Admission interviews were rare and brief (6) Electronic documentation took a large work time in night vs day (7) Double nurse-patient ratio at night (8) Less communication and care coordination at night	NIL	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Feelings and Emotional Response (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Disruptions and Distractions (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES:: Healthcare Record / Documentation (4) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': Diurnal Workflow Variation

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Mackintosh et al., 2014 United Kingdom	To explore the social and institutional processes associated with the practice of rescue, and implications for the implementation and effectiveness of rapid response systems (RRSs) within acute health care.	Ethnography Observation; Interviews	Healthcare Staff; Patients and relatives in chosen wards	Night (no time frame)	Early Warning System (EWS)	(1) HCAs delegated all observations; staffing issues (2) Inconsistency in the frequency of observations at night (3) Nurses too busy with other tasks (e.g. medications, direct patient-care, bed-making) (4) EWS can constraint escalation of care where tacit markers are not taken seriously; heirarchy of clinical cues (5) "Blame" behaviour affecting decision-making process (6) Frustrations when handover is not at par (7) Inability to pursuade higher ups in the organisation of OOH staff credibility	(1) EWS used as a healthcare language; mediating healthcare heirarchy (2) Electronic healthcare record reducing risk of error (3) HCAs positioned at bedisde (4) IAT offerred realtime surveillance, providing mangement the ability to audit work (5) Presence of CCOT as a support resource for staff	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Contextual Factors Influencing Behaviour; Feelings and Emotional Response (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce; Healthcare Team Interactions (3) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Disruptions and Distractions; Cohorting/Logistical Surveillance; Use of Monitoring Compliance Data; Organisational Awareness of "Night Work"; Digital Organisational Visibility of Deterioration (4) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment; Escalation; Healthcare Technology; Track and Trigger Tools

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
McGain et al., 2008 Australia	To describe the quality of postoperative documentation of vital signs and of medical and nursing review and to identify the patient and hospital factors associated with incomplete documentation.	Retrospective Audit of Patient Records Record Review	Adult patients post surgical operations	Evening (no time frame)	NIL	(1) Longer patient length of stay = less likely documentation (2) Medical reviews less frequently documented on weekends; lack of routine rounds (3) Nursing reviews less frequently documented in the evening (4) Incomplete observations and Heirarchy of clinical cues with RR less likely to be documented	(1) Presence of a PCA = likely to have vital signs recorded	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making (2) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Healthcare Record / Documentation; Track and Trigger Tools

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Nilsson et al., 2008 United Kingdom	To describe the night nursing staff's working experiences	Descriptive Qualitative Research Design Interviews	Permanent Night Nursing Staff	Night (no time frame)	NIL	(1) Task carried out by fewer staff at night (2) "awfully hardwork between five and seven" (e.g. washing, weighing, changing) (3) Patient misconception about nightwork; they do not want to be nuisance (4) Subdued environment (e.g. working in silence, in dim light, restricted inspection) (5) Balancing sleep and assessment (6) Hightened anxiety of patients at night (7) Telephone communication / handover leading to misunderstanding	(1) Special relationships between RNs and Ens (2) Organisational and structural changes reduced differences between day and night work (3) Admissions at night allowing assessment	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making; Contextual Factors Influencing Behaviour (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce; Healthcare Team Interactions (3) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Organisational Awareness of "Night Work" (4) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work; Physiological Effects of the Night on Patients; Diurnal Workflow Variation

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Palese et al., 2014 Italy	To explore nurses' narratives of unexpected patient deaths during night shifts	Qualitative: Narrative Inquiry Interviews	Nurses who had found a patient who had died unexpectedly during a night shift	Night (21:00 to 07:00)	NIL	(1) High nurse:patient ratio (2) No routine schedule for RNs OOH; no protected time in patient assessment (3) Handover conducted away from the patient (4) Patients deteriorated were not among cases mentioned by the previous shift (5) Having competing tasks at the same time (6) Confused and disoriented patients (7) No personal caregivers / informal surveillance from relatives (8) High turn-over of nurses (9) Physician available with no specific knowledge about the patients	(1) Nurses placing patients at risk closer to the nurses' station; Sorting and combining patients to be reviewed (2) Having confused patients gave nurses the chance to check on others (3) Specific surveillance protocols (4) Structured handover	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Contextual Factors Influencing Behaviour; Feelings and Emotional Response (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce; Family (3) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Cohorting/Logistical Surveillance (4) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Handover; Monitoring/Assessment; Escalation; Healthcare Record / Documentation; Track and Trigger Tools

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Recio-Saucedo et al., 2018 United Kingdom	To improve the understanding of factors affecting patient surveillance at night through a description of the characteristics of bedside staff (i.e., nurses and midwives) working night shifts and their views in relation to performing vital signs observations and to explore the relationships between healthcare staff characteristics and the conduct of vital signs observations at night	Exploratory descriptive study Survey	Bedside Staff (Nurses, Midwives, Student Nurses, Healthcare Assistants)	Night (no time frame)	Early Warning Score System (EWS)	(1) Half of the respondents agreed to waking up patients for observations; others disagreed; (2) Difficult to predict which patients will require observations (3) Skill mix rarely or never appropriate; not enough staff to complete observations (4) Exclusive night workers perceived that professional knowledge over protocol guided tasks during nights	(1) Staff agreed CSW were not responsible for conducting observations (2) Student nurses prioritising observations at night (3) Prioritisation by experienced nurses	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making; Contextual Factors Influencing Behaviour (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Healthcare Team Interactions (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment; Escalation (4) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work
Sundararajan et al., 2016 Australia and New Zealand	(1) To determine the prevalence of ALF, its diurnal variation and associated effects on outcomes for ward patients who had an unanticipated ICU admission. (2) To the diurnal variation in patient	Point Prevalence Observational study` Record Review	Patients with unanticipated ICU admissions;	Night-time (18:00 to 07:59)	NIL	(1) Incomplete sets of observations (2) PR was measured more frequently than BP	NIL	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making (2) CLINICAL NURSING WORKFLOW AND SUPPORTING

Journal Pre-proof

Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
	monitoring for all unplanned ICU admissions and whether this was related to the risk of ALF occurrence							RESOURCES: Monitoring/Assessment
vanGalen et al., 2016 Netherlands	(1) To identify the healthcare worker-, organisational-, technical,- disease- and patient- related causes that contribute to acute unplanned ICU admissions from general wards using a Root-Cause Analysis Tool called PRISMA-medical (2) to assess the adherence to a Track and Trigger system to identify deterioration on general hospital wards in patients eventually transferred to the ICU.	Retrospective Observational Study Record Review	50 Consecutive patient records of unplanned ICU admissions from general wards	Not specific, but with timeframes for unplanned ICU admissions: - 24:00-06:00 - 18:00-24:00	Modified Early Warning Score (MEWS)	(1) Incorrect MEWS Calculation (2) Unclear handovers (3) Parameters not measured because "no one else does it" (4) Unclear DNR policy (5) No coordination with healthcare team (6) Lack of ICU beds (7) Not following protocol	(1) Prescribed vital signs frequency (2) Observations done at set time (3) Use of track-and-trigger system	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Knowledge and Skills of EWS (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Healthcare Team Interactions (3) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Systems Operational Pressures OOH (4) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Handover; Healthcare Record / Documentation; Track and Trigger Tools

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Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Voepel-Lewis et al., 2013 United States	(1) To escribe the nature of, and nurse response time to, pulse oximetry monitoring desaturation alarms, (2) To examine unit and hospital factors associated with longer response times and missed alarms, (3) To describe the association between response time, missed alarms, patient interventions and outcomes.	Prospective, observational study Record Review	Postoperative patients	Evening, night (no time frame)	NIL	(1) High false alarm rate; paging burden (2) Longer response time in the night (3) Disabling the devices at night (4) Overreliance on notifications	NIL	(1) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Escalation; Healthcare Technology (2) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work
Vollam et al., 2022 United Kingdom	Map the discharge process and describe the consequences of out-of-hours discharge to inform practice changes to reduce the impact of discharge at night.	Mixed Methods Interviews; Record Review	Patients discharged from ICU, their families, and staff involved in their care.	OOH 16:00 - 07:59	Early Warning Score (EWS)	(1) Premature ICU discharges OOH (2) Lack of specialists at night (3) Stretched workforce and High workload (4) Poor handover (5) Delay to first medical review from ICU discharge (6) Infrequent observations	(1) Critical Care Outreach Review	(1) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Systems Operational Pressures OOH (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Handover; Monitoring/Assessment; Healthcare Record / Documentation (4) THE UNIQUE CHALLENGES AND

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Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
								WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': Diurnal Workflow Variation

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Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
West et al., 2016 Australia	To develop a conceptual model that facilitates a broader understanding of the perceived effects of night work for night working nurses.	Inductive qualitative content analysis Survey	Registered Nurses working Night shifts	Night (23:00-07:00)	NIL	(1) Diurnal workflow variation (2) Absence of visitors and relatives (3) Absence of other healthcare colleagues; Less support from nurse educators and nurse specialists; less medical cover at night (4) Unsafe staffing / inadequate skillmix (5) Less direct contact with patients; don't get to know their patients well at night (6) Administrative tasks (7) Fatigue; Delayed reflexes and responses at night (8) Redeployment (9) Confused patients; High falls risk; Aggressive patients (10) Staff with lack of training / clinical experience due to	(1) Access to IT systems and notes (2) Night as more relaxed and quiet (3) Less disruptions from management	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Feelings and Emotional Response (2) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce; Healthcare Team Interactions; Family (3) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Organisational Awareness of "Night Work"; Systems Operational Pressures OOH; Disruptions and Distractions (4) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment; Healthcare Technology (5) THE UNIQUE CHALLENGES AND WORKAROUNDS OF THE 'HOSPITAL AT NIGHT': The Nature of Nighttime Work; Physiological Effects of the Night on Patients; Physiological Effects of the

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Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
						inability to attend regular courses in the day (11) Poor communication		Night on Staff; Diurnal Workflow Variation

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Study author, year, country	Aim/Objective(s)	Study Design Data Collection Method(s)	Population Description	Out-of-hours (OOH) period studied	Track and Trigger Tool referenced	Determinants (from extracted data)		Themes and Subthemes (identified by authors)
						Barriers to Recognition / Escalation of Clinical Deterioration	Facilitators to Recognition / Escalation of Clinical Deterioration	
Wood et al., 2014 United Kingdom	To investigate possible factors related to patient monitoring to explain the higher mortality rates associated with after-hours transfers compared with daytime transfers from critical care units to the wards	Prospective exploratory study Record Review	Patients transferred from critical care unit to ward	18:00 to 07:59 (Monday - Sunday)	NIL	(1) Reduced frequency of monitoring (2) Lower staffing levels (3) After-hours transfer from critical care (4) Delayed first set of observations from transfer from criticalcare	NIL	(1) WORKFORCE COMPOSITION AND TEAM DYNAMICS OUT-OF-HOURS: Staffing/Workforce (2) ORGANISATIONAL OVERSIGHT AND ADAPTIVE STRATEGIES: Systems Operational Pressures OOH; Disruptions and Distractions (3) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Monitoring/Assessment
Yiu et al., 2014 United Kingdom	To establish response of staff to patients scoring National Early Warning Score (NEWS) of six or above and to identify patient and environmental factors affecting escalation by nursing staff	Prospective review of patient records Record Review	Adult patients with NEWS ≥6	Night (20:30-08:00)	National Early Warning Score (NEWS)	(1) Alert fatigue (2) Highest rates of triggers = lowest rates of escalation (3) Existing comorbidities (e.g. COPD) associated with decreased escalation rate	(1) Triggers with sepsis had escalation protocol implemented	(1) INDIVIDUAL DETERMINANTS OF BEHAVIOUR, STRENGTHS AND LIMITATIONS. : Clinical Decision Making; Contextual Factors Influencing Behaviour (2) CLINICAL NURSING WORKFLOW AND SUPPORTING RESOURCES: Escalation; Healthcare Technology; Track and Trigger Tools

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Declaration of interests

☐ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☒ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Misha Denise Virtudazo reports financial support was provided by National Institute for Health and Care Research. Misha Denise Virtudazo reports a relationship with National Outreach Forum that includes: board membership. Natalie Pattison reports a relationship with National Outreach Forum that includes: board membership. Duncan Smith reports a relationship with National Outreach Forum that includes: board membership. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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