



Investigation report

Recognising and responding to critically unwell patients

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Theme:

Communication and decision making, Hospital care

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Executive summary

The reference event

A 58-year-old woman was transported to an Emergency Department (ED) by ambulance with severe abdominal pain, 13 days after she had undergone emergency surgery for a perforated duodenal ulcer. During her stay in the ED, her observations (temperature, blood pressure, pulse, respiration rate, oxygen saturation and levels of response) were recorded regularly. The patient's initial observations in the ambulance and the ED showed a rapid heart rate and low blood pressure.

Whilst in the ED, the patient's blood pressure decreased further. She received intravenous fluid and her blood pressure showed some sign of improvement but remained low. The patient's physiological observations continued to be monitored and, following a review by the surgical registrar, she was admitted to a surgical ward after spending seven hours in the ED.

Approximately two and a half hours after the patient was admitted to the surgical ward, she deteriorated, and the Critical Care Outreach Team (CCOT) was called. She was assessed by the CCOT and other senior medical staff before being transferred to the Intensive Care Unit (ICU). Despite treatment, the patient continued to deteriorate and died a few hours later.

The national investigation

HSIB was notified anonymously about the reference event. There were specific concerns raised relating to the limited recognition and response to the seriousness of the patient's condition. The investigation reviewed the care the patient received in the ED and surgical ward to understand why there had been limited recognition and response to indications that her condition was deteriorating. After gathering additional information and assessing the incident against the HSIB's investigation criteria, a decision was made to progress to a national investigation.

The national investigation reviewed relevant research and safety literature relating to recognition and response to deteriorating patients, engaged with national subject matter advisors and consulted with professional bodies.

The national investigation explored the human factors which may influence recognition and response to a patient who is critically unwell.

It focused on:

- situation awareness and decision making
- patient assessment models for the emergency department
- the number of publications and guidelines available to clinicians and the use of the National Early Warning Score (NEWS).

A number of other issues were identified that have provided some peripheral learning but were not explored further in this investigation.

Findings from the reference event

- There were interrelated and systemic contributory factors that influenced decision making and why the patient's deterioration was not sufficiently recognised or responded to.
- The staffing structure of the ED may not be best for ensuring patients are seen by the right person in an appropriate timeframe.
- Information about the patient was dispersed across a variety of documentation and clinical staff. The design and presentation of this information did not support staff in making a complete and accurate assessment of the patient.
- Staff may rely on tools such as Early Warning Scores (EWS), especially when working in a busy and complex environment. There tended to be a focus on the latest physiological observations and staff could have been falsely reassured when the EWS indicated the patient may be improving.
- The information that was communicated across the patient's care eroded at each stage of the patient's care pathway.
- Escalation of the patient's deterioration was not optimal because of problems with the availability of staff and the way in which the Critical Care Outreach Team was utilised. One of the Trust's escalation policies also differed to that recommended by the Royal College of Physicians National Early Warning Score (NEWS) guidance. It was found these issues were not unique to the Trust where the reference event occurred.
- There was some ambiguity as to which specialty had clinical responsibility for the patient's care once she was referred to the surgical team.

Findings from the national investigation

- There are a number of factors that can influence situation awareness and thus decision making. Improving decision making and situation awareness is not simple. The system needs to be designed to support information/awareness getting to the places it needs to be.
- There has been no formal evaluation for the usability of NEWS in the various clinical settings into which it has been introduced, particularly in respect to the human factors that influence its use.
- Research suggests that NEWS can place a high demand on medical staff and the current escalation protocols may not be achievable owing to a task versus resource mismatch.
- There are multiple organisations producing publications and guidance on the recognition and response to a patient who is deteriorating. The large number of publications and guidance is likely to add complexity and make it difficult for trusts and staff to manage the 'deteriorating patient'.
- National policy such as the '4-hour standard' (the maximum length of time a patient should be in the ED) may be adversely influencing behaviours with a focus on meeting the performance standards.

HSIB makes the following safety recommendations

Safety recommendation R/2019/032:

The Royal College of Physicians NEWS advisory group continues to evaluate the implementation and use of NEWS2, including but not limited to:

- The use of NEWS2 in practice, in particular the consistency of recording, the consistency of response, and the communication of patient measurements between healthcare professionals.
- The effectiveness of NEWS2 in identifying a patient's level of acute illness in different care settings and patient groups.
- The presentation of NEWS2 information and how this supports clinicians to identify trends, particularly in electronic records.
- The guidance and training on the use of NEWS2 as part of clinical assessment and patient monitoring.

Safety recommendation R/2019/033:

NHS England/NHS Improvement should expand the remit of the Cross-System Sepsis Programme Board to include physical patient deterioration, involving additional stakeholders as required.

HSIB makes the following safety observations

Observations:

- NEWS2 is not intended to be a stand-alone tool. Instead, it is intended to be combined with other relevant charts, clinical investigation results and notes together with clinical observations of the patient. There may be benefits to staff being trained in this approach and systems being designed to support bringing relevant information together.
- There may be benefits to including the historical data from NEWS2 graphs and charts, together with other key information, during a patient handover.
- There would be benefits to trusts ensuring they are using the latest version of the NEWS2 observation chart and protocols. Any recommended changes to early warning scores, documentation or use would benefit from being tested in practice before widespread implementation.

1 Background and context

1.1 Historical data and guidance

1.1.1 Problems in recognising and responding to patients who are deteriorating is a major source of severe harm and preventable death in hospitals.

1.2 Scale of the issue

1.2.1 A 2007 National Patient Safety Agency (NPSA) report entitled, 'Recognising and responding appropriately to early signs of deterioration in hospitalised patients' [1] reviewed 576 national reports of incidents resulting in death, submitted to the National Reporting and Learning System (NRLS) in 2005. It identified that inadequate recognition of, or response to, deterioration was a

contributory factor in 11% of patient deaths. A paper by Donaldson et al., (2014) based on a study of 2,010 incident reports suggests that the mismanagement of deterioration was the highest category of harm caused to patients in hospital [2].

1.2.2 A 2012 study³ of hospital deaths found that 26% of preventable deaths were related to failures in clinical monitoring. These included failures to act upon abnormal test results, failures to establish monitoring systems and failures to respond to such systems.

1.2.3 In 2016 NHS Improvement published 'The adult patient who is deteriorating: sharing learning from literature, incident reports and root cause analysis investigations'⁴. 7% of the patient safety incidents reported to the NRLS in 2015 by acute trusts, and reported as resulting in severe harm or death were related to failure to recognise or act on deterioration. Following this, the prevention of patient deterioration was declared a priority for the Patient Safety Collaboratives by NHS Improvement.

1.2.4 The investigation reviewed national incident reports in the Strategic Executive Information System (StEIS) from 01/04/2017-31/03/2018. 5% (968) of incidents reported were categorised as 'sub-optimal care of the deteriorating patient meeting serious incident criteria'. It is likely that further incidents relating to patient deterioration have been reported under other categories and that many others were not formally reported.

1.3 Contributory factors

1.3.1 The NPSA's 2007 publication identified the following factors which contributed to the problems associated with recognising and responding to the deteriorating patient:

- the challenges presented by competing demands
- ineffective team-working and leadership
- breakdown in verbal and written communication.
- insufficient training on the relevance of observation
- failure to successfully implement relevant policies and procedures.

1.3.2 A review of 31 investigations by NHS Improvement³ found that failure to escalate a deterioration was cited in 65% of reports. Other common problems were:

- failure to undertake observations
- failure to instigate appropriate treatment

- inadequate communication
- failure to accurately record observations
- failure to accurately calculate early warning scores.

1.3.3 Factors which contributed to the failings identified by NHS Improvement's report include low staffing levels, a shortage of monitoring equipment and reduced quality of handovers where electronic observation systems had been introduced.

1.4 Early Warning Scores

1.4.1 The National Institute for Health and Care Excellence (NICE) published a clinical guideline in 2007 with best practice advice on the care of adult patients within acute hospitals. Key recommendations were that adult patients arriving at hospital should have:

- their physiological observations recorded at initial assessment
- a clear plan which stipulates how often observations are to be recorded
- monitoring using a physiological track and trigger system
- staff caring for them who are competent in monitoring, measurement, interpretation and prompt response to the acutely unwell patient.

1.4.2 Since the NICE 2007 report, one of the main initiatives that supports clinical staff to recognise the deteriorating patient has been the development and implementation of a National Early Warning Score (NEWS). An early warning score is a guide used by clinicians to help alert them to potential deterioration in a patient's condition. It is represented by a numerical value derived from measures of the patient's vital signs.

1.4.3 In July 2012, the Royal College of Physicians (RCP) report 'National Early Warning Score (NEWS): Standardising the assessment of acute-illness severity in the NHS' identified that multiple early warning systems existed across the UK and reported on the work that they had undertaken to standardise these.

1.4.4 The physiological parameters that form the basis of NEWS include:

- respiratory rate
- oxygen saturations
- temperature
- systolic blood pressure

- pulse rate
- level of consciousness.

1.4.5 Each parameter is measured and documented; the higher the score, the more the parameter varies from the expected value (see Appendix 1 for example NEWS chart).

1.4.6 The combined score indicates the required frequency of monitoring and the expected clinical response. The report uses three trigger levels (Figure 1).

1.4.7 The RCP also provided a NEWS scoring system (Figure 2). In December 2017, the RCP introduced an update to NEWS; NEWS2. The reference event occurred in 2017, when the 2012 version of NEWS was still in use.

Figure 1: Recommended clinical response to NEWS triggers [5]

NEW SCORE	FREQUENCY OF MONITORING	CLINICAL RESPONSE
0	MINIMUM 12 HOURLY	<ul style="list-style-type: none"> • Continue routine NEWS monitoring with every set of observation
1-4	MINIMUM 4-6 HOURLY	<ul style="list-style-type: none"> • Inform registered nurse who must assess the patient • Registered nurse to decide if increased frequency of monitoring and/or escalation of clinical care is required
5 OR MORE OR 3 IN 1 PARAMETER	INCREASED FREQUENCY TO A MINIMUM OF 1 HOURLY	<ul style="list-style-type: none"> • Registered nurse to urgently inform the medical team caring for the patient • Urgent assessment by a clinician with core competencies to assess acutely ill patients • Clinical care in an environment with monitoring facilities
7 OR MORE	INCREASED FREQUENCY TO A MINIMUM OF 1 HOURLY	<ul style="list-style-type: none"> • Registered nurse to immediately inform the medical team caring for the patient - this should be at least at Specialist Registrar level • Emergency assessment by a clinical team with critical care competences, which also includes a practitioner/s with advanced airway skills • Consider transfer of Clinical care to level 2 or 3 care facility , i.e. higher dependency or ITU

Figure 2: The NEWS scoring system [5]

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Respiration Rate	<8		9-11	12-20		21-24	>25
Oxygen Saturations	<91	92-93	94-95	>96			
Any Supplemental Oxygen		Yes		No			
Temperature	<35.0		35.1-36.0	36.1-38.0	38.1-39.0	>39.1	
Systolic BP	<90	91-100	101-110	111-219			>220
Heart Rate	<40		41-50	51-90	91-110	111-130	>131
Level of Consciousness				A			V, P, or U

1.4.8 The NICE guideline was updated in October 2018 to incorporate the use of NEWS2.

1.4.9 National advice was that trusts could develop their own escalation policies but that the scoring should be consistent, and the policy should align with the RCP national standard.

EWS use at the hospital where the reference event occurred

1.4.10 The Emergency Department (ED) used a locally modified early warning score which they called 'NEWS' although the thresholds for the scoring were different to those recommended by the RCP. The observation charts used by the surgical ward were different to those used in the ED and did align with the RCP NEWS scoring.

1.5 4-hour standard for EDs

1.5.1 In 2000, the NHS Plan [6] introduced a standard that, 'By 2004, no-one should be waiting more than four hours in accident and emergency from arrival to admission, transfer or discharge.' An NHS England objective is for 95% of people attending ED to be seen, admitted or discharged within four hours. Trusts are monitored according to their compliance with this standard and can be penalised for breaches of it.

1.6 ED patient pathway at reference event hospital

1.6.1 Patients arriving in EDs are quickly assessed on arrival to determine the seriousness of their condition and assign treatment priorities. Various structured approaches are used for this, but the Manchester Triage Scale was in use at the reference event Trust and is widely used across the National Health Service (NHS).

Figure 3: Manchester Triage Scale [7]

MANCHESTER TRIAGE SCALE		
1	IMMEDIATE RESUSCITATION	Patient requires immediate treatment for preservation of life
2	VERY URGENT	Seriously ill or injured patient whose life are not in immediate danger
3	URGENT	Patient with serious problems, but apparently stable condition
4	STANDARD	Patient who is not in immediate danger or distress
5	NON-URGENT	Patient whose condition is not true accident or emergency

1.6.2 Normal practice in the Trust where the reference event occurred was that at the time of initial ED assessment, patient details, triage category and clinical notes were recorded on paper documentation. Patient details were also inserted into an electronic patient management system to help track all patients in the department, their location, and their waiting time.

1.6.3 The electronic patient management system listed patients in waiting time order. The waiting time was colour-coded to highlight those patients whose wait was approaching four hours, and those where the wait had already breached that standard. ED junior doctors selected a patient for assessment in waiting time order, unless others had a higher priority.

1.7 Hospital at Night Team

1.7.1 'Hospital at Night' teams are multidisciplinary teams that staff hospitals at out of hours to reduce dependence on junior doctors. They have additional competencies to deal with a wide range of interventions [8].

1.8 Critical care outreach team

1.8.1 'Critical care outreach teams (CCOT) offer intensive care skills to patients with, or at risk of, critical illness receiving care in locations outside of the intensive care unit' [9]. The model of Critical Care Outreach Teams varies between hospitals. CCOT are composed of clinical (mainly nursing) staff with a background in intensive

and critical care. CCOT's support clinical areas across hospitals in assessing, managing, and treating patients who are critically unwell and at risk of significant deterioration.

2 The reference incident

2.1.1 A 58-year-old woman contacted the NHS 111 service at 12:04 hours on the Sunday of a bank holiday weekend because of severe abdominal pain. Thirteen days previously she had undergone emergency surgery at her local hospital for a perforated duodenal ulcer. She had been discharged from hospital six days previously.

2.1.2 An ambulance was despatched and arrived at her home at 12:28 hours. A friend was with her. The ambulance crew recorded that she looked pale, "very slight and skeletal" and was in pain. Her heart rate was 118 beats per minute, blood pressure (BP) 92/54 millimetres of mercury (mmHg), respiratory rate (RR) 18 per minute, oxygen saturations 98% breathing room air, temperature 36.5 degrees Celsius and pain score 8/10 (indicating severe pain). The crew recorded that they had elevated her legs to increase her BP and administered paracetamol. She also inhaled nitrous oxide (Entonox) for pain relief.

2.1.3 There were conflicting accounts of her symptoms from the patient and from her friend. The patient denied weight loss and said that she had been eating normally. Her friend told the crew that she had been in pain since her hospital discharge, had frequent vomiting, had lost a lot of weight and had not taken the medication that had been prescribed. (She later told the investigation that the patient was generally sceptical about doctors and hospitals and had more faith in complimentary therapists, and that she had needed a lot of persuasion to ring the ambulance). The ambulance crew recorded that she was "non-compliant".

2.1.4 She was transferred to her local hospital's Emergency Department (ED), arriving at 13:21 hours and was seen by the ED triage nurse at 13:28 hours. Her heart rate was recorded as 116, blood pressure 90/52, temperature 36.5, and pain score 6/10. She was noted to be in severe abdominal pain. The triage nurse determined that she should be treated as a category 3 patient (urgent but stable) and she was placed in a side room where she waited with her friend.

2.1.5 An ED staff nurse took blood tests and monitored her observations hourly while she was waiting to see a doctor. At 14:10 hours her BP was 141/84, heart rate 118, temperature 36.9, oxygen saturations 98% and RR 18.

2.1.6 At 15:05 hours the blood test results became available. Serum sodium was 139 mmol/L, urea 4.9 mmol/L and C Reactive Protein (CRP) 4, which are all within the expected range. Creatinine was low (35 umol/L) as was serum potassium (3.4mmol/L). The lactate was 1.3. The haematology sample was haemolysed and couldn't be analysed. The blood results were hand-written in the notes but not commented upon.

2.1.7 At 15:10 hours her BP was 122/87 and heart rate was 120; other observations had not significantly changed.

2.1.8 She was assessed by an ED junior doctor (a Junior Clinical Fellow or JCF) at 16:01 hours. He noted the history of abdominal pain and the conflicting accounts of vomiting from her and her friend. He recorded that she looked pale and "very dehydrated"; she had sunken eyes, reduced skin turgor and low urine output (all of which are signs of deterioration). He found that her abdomen was tender to palpation, noted that she had been "non-compliant" with medication and had expressed concerns to her friend about the effectiveness of hospitals.

2.1.9 At 16:10 hours her BP was 110/50 and heart rate was 110; other observations had not significantly changed.

2.1.10 Shortly after this time there was an undocumented review of the patient by the JCF and the ED consultant; it was reported to the investigation that this had occurred because the patient had wanted to discharge herself from hospital and that the consultant had been asked to persuade her against this. The consultant did not clinically assess the patient at this time.

2.1.11 The JCF did not document a management plan but the patient was prescribed ondansatron (a drug that prevents vomiting) and one litre of Hartmann's solution to be administered by intravenous infusion "stat" (as quickly as possible), to treat dehydration. The infusion was started at 16:45 hours and blood tests were repeated at 16:50 hours.

2.1.12 Observations at 17:25 hours were BP 91/56, heart rate 143 and oxygen saturations 98%. The patient was moved to another bed so she could be more closely observed, and her care was taken over by a different nurse.

2.1.13 At 18:00 hours her BP was 108/59, heart rate 128 and oxygen saturations 96%. At 18:15 hours 5mg of morphine was given by IV injection (for pain). The repeat blood test results became available at 18:23 hours; sodium was 139mmol/L, urea 6.1mmol/L, creatinine 58umol/L, and CRP 8. The potassium could not be

determined because the sample was unsuitable. As a comparison, the baseline result available from the patient's previous admission to hospital were; sodium 138mmol/L; potassium 3.9mmol/L; urea 1.4mmol/L; and, creatinine 32umol/L.

2.1.14 Haemoglobin was significantly elevated at 180g/DL (the expected range is 118 to 148) as were haematocrit at 50.7% (range 36-46) and neutrophils ($12.3 \times 10^9/L$, range 1-7 to 7.5). Globulin was low at 22g/L (25-35) and phosphate elevated at 2.0mmol/L (0.8 to 1.4). Other blood results were unremarkable. It is unclear if these results were seen and taken into account at the time.

2.1.15 By 18:45 hours her BP had fallen again to 80/49 with heart rate 119. Nursing notes indicate that, as a result of the low BP, a second litre of Hartmann's solution was prescribed at 18:45 hours and administration began at 19:15 hours. By 19:30 hours BP had risen to 109/62 and heart rate had fallen to 112.

2.1.16 At 19:45 hours, the Surgical Registrar assessed the patient; he had been delayed in the operating theatres since the time of referral. Records of this assessment were brief, but the investigation was told that the surgical registrar thought that there was a possibility of a post-operative abscess and asked for a CT scan (Computerised Tomography scan) of abdomen to be ordered and the patient to be prescribed antibiotics, analgesics and intravenous pantoprazole. It is unclear if she was aware of the fluctuations in vital signs or of the blood test results.

2.1.17 At 20:00 hours the nursing shift in the ED changed. At 20:10 hours, the nurse who had just arrived on shift documented that the patient's BP had "improved" to 105/60 and that heart rate had "reduced" to 114. Her Early Warning Score was 3 and it was documented that the surgical registrar was aware of this.

2.1.18 At 20:35 hours, this nurse made a call to pass on details of the patient to nurses on one of the surgical wards, as there were plans to transfer her there. At 20:40 hours she was transferred to the surgical ward, accompanied by a porter.

2.1.19 Shortly after her arrival on the surgical ward, the nurses noted that she had been prescribed an antibiotic (amoxicillin) to which she was allergic, so they did not administer it. A healthcare assistant (HCA) attempted to record the patient's vital signs but was unable to obtain a BP recording, so he informed a surgical ward nurse (N1) of this. The exact sequence of events is then unclear, but the investigation was told that there were several unsuccessful attempts over the next hour by the HCA and N1 to obtain BP recordings. They informed the nurse in charge (NIC) and attempted to contact the Foundation Year 2 (FY2) doctor but he was busy in the operating theatres and did not respond. On one occasion the patient refused to let them attempt to check her BP until pain relief was given. Staff were also assisting

the patient in using a bedpan and changed her gown when it became wet from vomiting. At 21:35 hours the NIC and N1 administered intravenous antibiotics. NIC made further attempts to obtain the patient's BP but was unsuccessful. He informed the FY2 doctor of this at approximately 22:40 hours and contacted the Critical Care Outreach Team (CCOT) at 23:00 hours.

2.1.20 At 23:10 hours, a CCOT nurse assessed the patient. She recorded that she was conscious but looked pale and very unwell. She was cachectic and had cold peripheries. The CCOT nurse noted that the patient's haemoglobin (Hb) had been 180g/L on admission (implying severe dehydration). At this time the patient was catheterised, and urine output monitoring initiated. The RR was 32 and temperature was recorded as 28 degrees Celsius. BP and oxygen saturations were both unrecordable. She noted that the patient had vomited brownish fluid. The surgical FY2 arrived on the ward at 23:15 hours and at 23:18 hours the Intensive Care Unit (ICU) registrar arrived.

2.1.21 At 23:26 hours, while the CCOT nurse was with her, the patient's level of consciousness deteriorated, and her RR reduced. A cardiac arrest call was made, meaning that a full emergency resuscitation team was called urgently to the ward. Between 23:26 hours and 00:10 hours adrenaline, metaraminol and intravenous fluids were administered to increase her blood pressure. Blood gases taken at 23:48 hours confirmed a severe metabolic acidosis. Her conscious level improved and the team decided to admit her to the ICU having discussed with the ICU consultant and the consultant surgeon. The working diagnosis at the time was shock secondary to presumed intra-abdominal sepsis as a result of her surgery.

2.1.22 She was transferred to the ICU at 00:10 hours. She was sedated and artificially ventilated. A nasogastric tube was inserted into her stomach and 400-500 mls of "offensive fluid" was aspirated from this (implying that there was obstruction to her stomach emptying). Treatment to maintain her blood pressure was administered by continuous infusion but her systolic BP remained less than 70mmHg despite continuous infusion of adrenaline and noradrenaline intended to improve this. At 03:50 hours the team decided to withdraw active treatment and the patient died at 04:45 hours.

2.1.23 A post mortem examination found no evidence of intra-abdominal sepsis but found dense adhesions (scar tissue) in the abdomen, presumed to be a result of the previous perforated duodenal ulcer. The adhesions had caused partial obstruction to the duodenum. The cause of death was given by the pathologist as shock secondary to small bowel obstruction as a result of adhesions.

3 Involvement of the Healthcare Safety Investigation Branch

3.1 Referral of reference event and decision to investigate

3.1.1 An anonymous referral was made to HSIB on 4 July 2017. Following an initial scoping investigation, the Chief Investigator authorised a full investigation on the 3 October 2017. The event met the following criteria:

Outcome Impact - What was, or is, the impact of the safety issue on people and services across the healthcare system?

3.1.2 Insufficient recognition and response to a patient who is deteriorating can result in severe harm or death.

Systemic Risk - How widespread and how common a safety issue is this across the healthcare system?

3.1.3 Between 5% and 26% of incidents which result in severe harm or death are due to patient deterioration not being sufficiently recognised or responded to. As such, this case reflects a national systemic issue.

Learning Potential - What is the potential for an HSIB investigation to lead to positive changes and improvements in patient safety across the healthcare system?

3.1.4 There is a wealth of literature and guidance on the recognition and response to patient deterioration – but despite this, the problem continues. There is an opportunity for greater understanding of the human factors that are influential in these circumstances.

3.2 Investigation process and methodology

3.2.1 Several methodologies were used in this investigation:

- Review of patient hospital records, hospital policies, procedures and practice.
- Contextual observations of the ED at the hospital where the reference event occurred and one other Trust.
- Interviews with staff involved in the patient's care.
- Interviews with staff who were responsible for oversight of the ED and surgical wards at the Trust where the reference event occurred.

- Literature review.
- Sequential Timed Event Plotting (STEP)[10] diagram relating to the reference event. STEP shows the task process, the tasks performed and the interaction between patients and elements of the system (e.g. documentation, equipment, IT systems) over time. STEP is particularly useful for analysis and representing distributed teamwork or collaborated activity.
- Actor and AcciMap of reference event. AcciMap [11] is an incident analysis method which identifies factors within the system that influenced the occurrence of the reference event. The analysis model used focuses on identifying relationships between the different levels of the system which include government policy and budgeting; regulatory bodies and associations; local area management; physical processes and actor activities; and, equipment and surroundings [12].
- Observation of a cross-department simulation exercise involving ambulance crew, ED and Intensive Care Unit staff.
- Interviews and personal communication with relevant national organisations and subject matter advisors.

3.2.2 This report took a human factors approach and the investigation methods described above are typical of a human factors investigation. Human factors, 'is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimise human well-being and overall system performance' [13].

3.2.3 A human factors expert was commissioned to assist with the analysis.

4 Findings and analysis at the hospital where the reference event occurred

4.1 Consideration of sepsis

4.1.1 The Trust's serious incident report considered that sepsis may have been a factor in the patient's death. As such, this investigation commissioned an independent opinion from a microbiology and infection control expert.

4.1.2 The microbiology expert concluded that the presence of Strep Mitis in blood cultures was likely to be a skin contaminant and not likely to be an indication of sepsis. His view was that death was due to shock secondary to hypovolaemia and metabolic derangement as a result of vomiting.

4.2 Delays in clinical assessment in the Emergency Department (ED)

4.2.1 The model of care in the ED was based on a nurse triage being conducted following handover of the patient by the ambulance service. Following triage, patients waited to be assessed by a junior doctor and would only be escalated to a consultant or referred to a specialist team if deemed necessary. The investigation observed that this could lead to delays, especially when patients required input from specialist teams who were not immediately available.

4.2.2 When assessed at triage, the patient's physiological observations showed a rapid heart rate (116) and low BP (BP) (90/52). The patient was assigned triage category 3, which meant that her condition was recognised as serious, but apparently stable.

4.2.3 The patient underwent her first medical assessment at 16:01 hours, after having spent around two hours 40 minutes in the ED. Although not formally documented, interviews with staff indicate that the patient was seen by the ED Consultant at approximately 16:30 hours and was referred to the surgical team at 17:25 hours.

4.2.4 At 17:25 hours there was only one on-call surgical registrar. It was the Sunday of a bank holiday weekend. The Surgical Registrars had responsibility for all the surgical patients in the hospital as well as covering the operating theatres and referrals from the ED. As such, a high demand was placed on them.

4.2.5 The Surgical Registrar was dealing with other patients at the time and did not see the patient until 19:45 hours, two hours and 20 minutes after she had been referred and seven hours and 20 minutes after arrival at the ED.

4.2.6 The investigation considered whether the patient could have been referred sooner to the surgical team. This is particularly relevant, as there were two on-call surgical registrars at the time the patient arrived in the ED and only one by the time she was referred.

4.2.7 Patient assessment models for ED were explored as part of the national investigation.

4.3 Response to high ED Early Warning Score (EWS)/deterioration

4.3.1 There was evidence from the patient's blood tests from the outset that she was dehydrated. The elevated haemoglobin level was an indicator of severe dehydration (180g/L). However, it appears that the first person to recognise this was the CCOT nurse at 23:10 hours. Her renal function was documented as 'normal' on admission and this may have given false reassurance to clinicians. The patient had a low Body Mass Index or BMI (15 when recorded during the previous admission) and so the readings of urea and creatinine which would be 'normal' for people with a BMI within a normal range, may have been elevated for her. Her reading for urea was 1.6 on her discharge six days early, so the admission figure of 4.9 was an elevation on this.

4.3.2 From 14:10 hours, when the patient's first ED EWS was calculated, to 16:10 hours, her ED EWS score was 2 (which local guidelines indicate to be a low clinical risk of deterioration) and had remained stable.

4.3.3 At 17:10 hours the patient's ED EWS rose to 7 as a result of a drop in her BP. According to the Trust's escalation policies, she was then considered at high clinical risk.

4.3.4 The actions for ED EWS of 7 or more states:

- observations were to be increased (continuous or every 30 minutes)
- urine and fluid balance were to be charted
- the Nurse in Charge was to be informed urgently
- the Nurse in Charge was to inform a doctor and discuss the patient with a registrar or consultant
- the 'Hospital at Night' service and CCOT were to be informed if relevant and the patient reviewed by the CCOT
- to consider sepsis as a cause.

4.4 Multiple escalation policies

4.4.1 The hospital where the reference event occurred had two escalation policies. One was available on the hospital's IT system; the other was printed on the front cover of the observation chart for the surgical ward.

4.4.2 The two different escalation policies in use across the Trust give conflicting advice on how to respond to a rise in EWS indicators. The frequency of monitoring may have been influenced by the policy that the staff nurse was most familiar with.

4.4.3 The Trust told the investigation that by March 2019, the Trust will have standardised the escalation plan for ED and wards across all its sites based on the national NEWS2 guidance.

HSIB makes the following safety observation

Observation:

- There would be benefits to trusts ensuring they are using the latest version of the NEWS2 observation chart and protocols. Any recommended changes to early warning scores, documentation or use would benefit from being tested in practice before widespread implementation.

4.5 Staff actions

4.5.1 The actions taken by the clinical staff when the patient's ED EWS rose to 7 were not documented. Interviews with staff indicated the following:

- The first ED nurse caring for the patient, interpreted the decrease in BP as postural hypotension (a decrease in BP when rising from a sitting or lying position). The patient had got up to use the commode and the nurse thought that she was dehydrated from vomiting, which can cause postural hypotension.
- The Staff Nurse stated that he alerted the JCF and Consultant who were both nearby and reported that he showed them the patient's low BP reading. The Staff Nurse reported both the JCF and Consultant came in to see the patient.
- The Staff Nurse repeated the patient's physiological observations at 17:25 hours (in-line with one of the Trust's NEWS escalation policies); her ED EWS at this point was 4. Between 17:25 hours and 18:00 hours the Staff Nurse moved the patient to a higher dependency area of the ED where her care was taken over by a different nurse.
- The JCF and Consultant do not recall being informed of the patient's high ED EWS but confirmed that they came to see the patient. They described the purpose of their review as being to persuade her to remain in hospital and receive treatment as she had expressed a wish to leave. During the initial assessment of the patient at 16:01 hours, the JCF said he found her challenging

to deal with because she was saying she wanted to leave the hospital. The JCF had only been working at the Trust for a week, so sought assistance from the Consultant to persuade her to stay in hospital.

4.5.2 The patient's medical notes indicate the JCF and Consultant may have visited the patient prior to her high ED EWS. As such, the JCF and Consultant may not have been aware of the patient's deterioration and therefore did not have this information when referring her to the surgical registrar.

4.5.3 The way in which a problem is presented (or framed) can influence how a person understands and processes the information and so influence the solution that is selected for solving the problem. This is a type of cognitive bias known as a 'framing effect' [14], [15]. It is possible that the way in which the issue with the patient had been presented to the consultant (i.e. the JCF had assessed her but was having difficulties as she did not wish to remain in hospital) could have influenced the way the situation was approached and meant the consultant's attention may not have been focused on clinically assessing the patient.

4.5.4 The patient's ED EWS continued to fluctuate and, in line with the Trust's escalation policies, the second ED Staff Nurse documented that he had informed the Nurse in Charge and the Surgical Registrar.

4.6 Escalation and contingency planning

4.6.1 The investigation observed that there was no evidence that a plan was made for how frequently the patient should be monitored following her high ED EWS. There was also no contingency plan for what to do if senior clinicians were unavailable following escalation of a high ED EWS.

4.6.2 Unclear guidance and locally agreed protocols risk variation in practice (even within the same Trust) and can lead to escalation protocols which are not optimal. Escalation of NEWS was explored further as part of the wider national investigation.

4.7 Escalation to the Critical Care Outreach Team (CCOT)

4.7.1 When the patient's ED EWS rose, the Trust escalation policies indicated that the Critical Care Outreach Team (CCOT) should have been called.

4.7.2 The Trust's CCOT policy applied to the wards and the ED but because of resource constraints; the custom and practice was to only provide the CCOT service to the wards. It was perceived that there were adequate numbers of suitably trained doctors in the ED who could be called upon to deal with deteriorating patients.

4.7.3 An expert in improvement and change in emergency care told the investigation that the issue described above is occurring nationally and that it is variable across Trusts whether the ED routinely escalates a deteriorating patient to the CCOT or not. This was explored further during the national investigation.

4.8 Clinical responsibility for patients

4.8.1 The investigation observed that individual doctors and nurses had different understandings of clinical responsibility in the event of patient deterioration once they have been referred to a specialist team. The ED Consultant involved in the reference event told the investigation that all patients within the ED would remain the responsibility of the emergency medicine consultant until moved or discharged and that nursing observation continued.

4.8.2 On the day of the reference event, the JCF referred the patient to the Surgical Registrar at 17:25 hours but was not aware of when the Surgical Registrar would be able to see the patient. The perception of the JCF was that the patient was now the responsibility of the Surgical Registrar. The investigation was told this was standard practice for junior doctors where the reference event occurred. As such, the JCF did not handover the care of the patient to another ED doctor prior to the end of his shift at 18:00 hours.

4.8.3 Discussion with an expert in improvement and change in emergency care revealed that issues around the clinical responsibility for patients who have been referred to other departments is not unique to this case and represents a national issue.

4.9 Fluctuations in ED Early Warning Score (ED EWS)

4.9.1 The patient's ED EWS fluctuated throughout her stay in the ED. When her BP dropped, her ED EWS increased to 7. At 16.10 hours she was prescribed one litre of Hartmann's solution to be infused over two hours. During the infusion her BP increased and her ED EWS reduced. Figure 4 demonstrates the patients EWS score throughout her time in the ED.

Figure 4: The patient's ED EWS observation chart

		Date	Time																	
		TEMPERATURE		≥39																
		Write figure in box		38 - 38.9	26.9	26.6	36.4	36.0	36.6											
				36 - 37.9																
				35.1 - 35.9																
				≤35.0																
INITIAL OBS	BLOOD PRESSURE		220																	
Pupil Size	Systolic BP only used for score		210																	
1mm ●	Systolic		190																	
2mm ●	Diastolic		180																	
3mm ●			170																	
4mm ●			160																	
5mm ●			150																	
6mm ●			140																	
7mm ●			130																	
8mm ●			120																	
	PULSE		110																	
	Mark with: ●		100																	
			90																	
			80																	
			70																	
			60																	
			50																	
			40																	
			30																	
			20																	
			10																	
			0																	
NEWS SCORE	RESPIRATIONS		30																	
RED 3	Mark with: ●		25																	
YELLOW 2			20																	
GREEN 1			15																	
			10																	
			5																	
			0																	
	SPO₂		> 98%																	
			94 - 95%																	
			92 - 93%																	
			< 91%																	
	Inspired O ₂																			
	AVPU		Alert: A																	
			Unresponsive: V P U																	
	TOTAL NEWS																			
EYES	Spontaneously		4																	
	Speech		3																	
	Pain		2																	
	None		1																	
VERBAL	Orientated		5																	
	Confused		4																	
	Inappropriate words		3																	
	Incomprehensible sounds		2																	
	None		1																	
MOTOR	Obeyes commands		6																	
	Localises pain		5																	
	Withdrawal pain		4																	
	Flexion to pain		3																	
	Extension to pain		2																	
	None		1																	
	Glasgow Coma Scale (GCS) TOTAL																			
PUPILS	Reactive + Unreactive -		L																	
	Closed c		R																	
SIGNATURE / INITIALS																				

4.9.2 The infusion of Hartmann’s solution was initiated at 16:45 hours and was likely to have finished by 18:45 hours; the point at which the patient’s BP was decreasing and consequently her ED EWS increased again. Another litre of Hartmann’s solution was commenced at 19:15 hours and the patient’s BP increased again, and her ED EWS reduced to 3. The patient remained on fluids until she was transferred from the ED to the surgical ward, and her ED EWS remained at 3.

Correlation between ED EWS and other documented clinical information

4.9.3 There was no evidence that the improvement in the patient's ED EWS was correlated with the infusion of the Hartmann's solution. There was no evidence that the underlying cause of the patient's BP repeatedly falling, and her persistent tachycardia was considered, or her management altered as a result of repeated assessment.

4.9.4 A factor that may have contributed to staff not appreciating the relationship between the ED EWS and other clinical information is that the ED EWS observation chart and other clinical information such as the fluid and drugs chart were on separate pieces of paper. The charts were stored along with the ED medical records in a central area.

4.9.5 Although the paperwork for each patient was generally stored together, the investigation observed that paperwork related to a patient would sometimes become separated. Having information in different locations increases the likelihood that information may be missed and/or not interpreted along with other pieces of information that might enhance the holistic view of the patient.

Sensitivity of ED EWS

4.9.6 Figure 4 demonstrates the ED EWS identified the patient had deteriorated, and her clinical risk was high. However, staff told the investigation that they were reassured by the reduction in her ED EWS which they regarded evidence of improvement. The investigation observed that there was variability in the perception of staff as to how unwell the patient was, although she did not appear critically unwell to some. She was described as alert, orientated and not how they expected a deteriorating patient to be. The staff's perception of the patient, in conjunction with the dispersed information across documentation and geography, appears to have contributed to difficulties in detecting the patient's critical condition and taking effective action.

Focus on latest ED EWS (not on ED EWS trend)

4.9.7 There were indications that staff may have focused on the latest physiological observations and resulting ED EWS as opposed to examining the overall trend.

4.9.8 Despite the instability of the patient's ED EWS since 17:10 hours, staff considered the patient to be a low risk patient, because of her ED EWS of 3, and transferred her to the surgical ward with a porter but without a clinical escort. The ED Adult Handover of Care checklist that was sent to the surgical ward stated the

patient's ED EWS was 3. Apart from the ED EWS chart, the adult handover of the care checklist does not include a section that describes the stability of the patient's physiological observations and did not specify if the patient's fluctuating ED EWS had been discussed. Interviews with the Nurse in Charge and the Surgical Ward Nurse revealed they were not aware of the patient's fluctuating ED EWS.

4.10 Computerised Tomography (CT) scan request process

4.10.1 There was a significant delay in the patient undergoing a CT scan. The delay was due to:

- perceived restrictions and the 'usual' protocol for when and by whom a CT scan could be requested
- the CT scan approval process
- confusion as to the location of the patient.

4.10.2 By the time a CT scan was requested, approved and the patient was ready to be collected for the scan, she was not stable enough to move to radiology.

4.10.3 A CT was not ordered for the patient until 20:47 hours, seven hours after she had arrived in the ED. The ED Consultant who saw the patient reported that he had thought that she would require a CT scan, however, usual practice was that ED doctors would normally only request CT for certain conditions, e.g. trauma, pulmonary embolism or renal colic. For abdominal CT scans, the specialty was required to see the patient before requesting a CT.

4.10.4 The process for requesting a CT was clarified with the ED Clinical Lead, Clinical Director for radiology and with the hospital's ED guidelines handbook. The investigation found that ED doctors were permitted to request any CT they thought was clinically appropriate. However, there were restrictions on what CTs could be requested by more junior staff. Abdominal pain was not listed in the ED guidelines handbook as a condition that a junior doctor could request a CT for without discussion and authorisation with a consultant.

4.10.5 By the time the patient was seen by the surgical team, the CT was running an 'out of hours' service. The radiology computer system recorded that the patient's CT scan request was received by the radiographer and accepted by the tele-radiology service at 23:15 hours (two hours 28 minutes after the request was made). Radiology staff reported there had been some confusion about where the patient was in the hospital.

4.10.6 The Emergency Medicine Operational Handbook: The Way Ahead was released in December 2011[16] and states that:

'The use of CT provides early, prompt and detailed assessment of patients with neurological, thoracic and abdomino-pelvic pathologies. The College recommends that a CT scanner should be available within or immediately adjacent to the ED. This facility should be available 24 hours a day. Protocols should be agreed with colleagues in radiology regarding the referral process for CTs for head injury, stroke, pulmonary embolus, major trauma and abdominal pain. Such CTs should be reported immediately.'

4.11 Deterioration on the surgical ward

Escalation to nurses

4.11.1 At the time the patient arrived, the Surgical Ward Nurse was conducting the drugs round and so asked the Healthcare Assistant (HCA) to obtain the patient's physiological observations. The HCA reported they had difficulties obtaining an oxygen saturation and BP readings. The HCA tried to attach the oxygen saturation probe to different locations on the patient (hands, big toes) and used the BP cuff on both arms but could not obtain a reading. The HCA experienced the same problems with a different machine. The HCA informed the Surgical Ward Nurse of his inability to obtain the patient's BP and oxygen saturation, although this did not result in immediate escalation. The level of concern that the Surgical Ward Nurse may have had in relation to the severity of the patient's condition could have been influenced by the fact she had been transferred from the ED without clinical escort.

Focus on care of patient, not patient status

4.11.2 The patient was on the surgical ward for approximately two hours and 20 minutes before it was recognised that she was critically unwell. There was evidence that during this time, the staff were giving her personal care, but they did not recognise the severity of her condition.

4.11.3 The HCA reported that on two occasions he informed the Surgical Ward Nurse that he was experiencing difficulties in obtaining the patient's physiological observations. When the Surgical Ward Nurse came to see the patient, she reported that the patient was requesting pain relief and did not want anything done to her until pain relief had been given. The Surgical Ward Nurse found that analgesia (painkillers) were not prescribed. The Surgical Ward Nurse asked the Nurse in

Charge to contact the Junior Doctor responsible for the surgical ward to prescribe painkiller. However, he was in the operating theatre so was unable to action the request at that time.

4.11.4 Interviews and statements indicate the surgical ward staff were focused on individual tasks associated with caring for the patient rather than reviewing her overall clinical status. For example, they reported they had issues with her intravenous line which kept becoming dislodged from her vein, they assisted her with using a bed pan, they then cared for her when she began vomiting and changed her gown because it was wet. Factors that may have contributed to the limited oversight on the patient's clinical status were:

- Surgical ward staff had limited information about the patient following the verbal handover from the ED. As such, they were not fully aware of the patient's clinical risk.
- The Surgical Ward Nurse had not reviewed the patient's ED notes because she was busy with other tasks and so was not aware of the patient's clinical risk.
- Both the Surgical Ward Nurse and the HCA reported that the patient did not seem to be a patient who was deteriorating to them. She was reported to be alert, responsive and talking, so they did not perceive her as very unwell.
- Some of the nurses on the surgical ward that evening had limited experience.

4.11.5 Once it was recognised the patient was critically unwell, the CCOT were informed. She was reviewed immediately and shortly after by the surgical Junior Doctor and Intensive Care Team.

4.12 Handover and erosion of information (distributed situation awareness)

4.12.1 Distributed situation awareness considers how the system can be viewed, as a whole, by taking into account the information held by the actors, for example, medical records, people, and the way in which they interact[17].

4.12.2 A Sequential Timed Event Plotting (STEP) diagram was created for the reference event. The STEP highlights the key transactions that occurred from the time the patient and her friend called NHS 111, to the point of her admission to the Intensive Care Unit. The transactions include the tasks performed, the communication between patient and staff, and the interaction with other elements of the system such as medical records and IT systems.

4.12.3 The STEP for the reference event shows at least 30 different actors were involved (staff and other elements of the system such as medical records, and test results), with multiple interactions between those actors.

4.12.4 Hospital records show 186 patients attended the ED on the day of the reference event. In total, 387 patients attended the ED and Urgent Care Centre on the day of the reference event. Although there would have been a continuous flow of patients through the department, the figures highlight the volume of patients involved. With the number of transactions and actors involved, the investigation concluded it was likely the transfer of information, and distributed situation awareness, would sometimes break down.

4.12.5 The investigation found that information was dispersed across paperwork, presented in different formats (written and verbal), and the STEP analysis demonstrates how information was also dispersed across multiple different actors. As such, there is an increased likelihood that information may be missed and/or not correlated with another piece of information and so detract from the ability to take a holistic view of the patient.

4.12.6 Considering just the physiological observations and their interpretation, it was noted:

- The ambulance service did not use NEWS or ED EWS (at the time of the reference event). Physiological observations were recorded on their patient assessment form.
- The triage nurse used the Manchester Triage system and did not use NEWS or ED EWS to assess how unwell the patient was. Physiological observations were recorded on the casualty assessment card.
- The ED Staff Nurse began an ED EWS observation chart once the patient was his responsibility. The chart is separate to the ambulance patient assessment form and casualty assessment card.
- The formats for displaying the physiological observations on the ambulance form, casualty assessment card and ED EWS observation chart and surgical wards NEWS observation chart were all different.
- The ED Adult Handover of Care checklist only recorded the latest ED EWS, not the trend or previously high ED EWS.
- The surgical ward commenced a fresh NEWS observation chart, which differed to the ED EWS observation chart the ED used.

4.12.7 Studies have shown that observation chart design can have a substantial impact on the accuracy of interpreting physiological observations and reduce the time to recognise abnormal observations[18], [19]. The manner in which information was presented to clinicians in the reference event did not facilitate the ease with which they could accurately interpret and appreciate the range of physiological data recorded for the patient. Information does not appear to have transitioned smoothly across the patient's care pathway.

4.12.8 The responsibility for the patient's care was transferred between staff on several occasions as a result of multiple moves within the ED, shift changes in staff and admission to the surgical ward. During these handovers important information about the patient should have been transferred. The key handovers occurred between:

- Ambulance Crew to ED Triage Nurse
- Triage Nurse to the first Nurse caring for the patient
- First and second Nurse caring for the patient
- Second and third Nurse caring for the patient
- JCF referral to Surgical Team
- Surgical Registrar to another Surgical Registrar
- Third Nurse caring for the patient to the Nurse in Charge on the surgical ward
- Surgical Ward Nurse in Charge to the Surgical Ward Nurse
- Surgical Ward Nurse to the HCA and vice versa.

4.12.9 The ED medical record, ED EWS chart, Fluid and Drugs chart, and ED nursing notes were the actors that consistently held the majority of information about the patient. However, the documentation contained a lot of information which was dispersed, and important relevant information was mixed amongst less relevant information. For example, the Fluid and Drugs chart had a section where physiological observations could be added, however, because the ED EWS chart is used instead, this was not completed.

4.12.10 Staff interacted with the carded medical record, ED EWS chart, Fluid and Drugs chart, and ED nursing notes whilst the patient was in the ED, however, this documentation was not referred to when she arrived on the surgical ward. As the patient's journey progressed from the ED to the surgical ward, awareness of her condition and the amount and accuracy of information passed on appeared to erode.

4.12.11 Prior to the patient's transfer to the surgical ward, a telephone handover was conducted between the Staff Nurse caring for the patient and the Surgical Ward Nurse in Charge. According to the statement he wrote shortly after the reference event occurred, the Nurse in Charge was told the patient was being admitted with abdominal pain. He was informed she had recently undergone surgery to repair a perforated duodenal ulcer. He recalled the patient's ED EWS was 3 and the latest individual physiological observations had also been provided to him over the phone.

4.12.12 When the patient arrived on the ward he gave a verbal handover to the Surgical Ward Nurse who would be caring for the patient. The Surgical Ward Nurse reported she was told the patient had been admitted with abdominal pain and vomiting with a plan for a CT scan. The Nurse stated that no other information was provided, and she thought a diagnosis would be made following the CT scan.

4.12.13 There was no evidence that the Nurse in Charge of the surgical ward or the Surgical Ward Nurse were specifically made aware of the patient's fluctuating physiological observations. The Surgical Ward Nurse reported she was busy with other patients when the patient arrived on the surgical ward, so she did not check the patient's notes from the ED.

4.12.14 Problems in handover, communication and flow of information bring well-known risks to patient safety. Several studies have shown handovers have the potential for communication failure which could pose a threat to patient safety[20], [21], [22], [23]. As such, the breakdown in communication and distributed situation awareness is not unique to the reference event.

4.13 Other human factors associated with ED and surgical ward

Overview

4.13.1 This section discusses additional human factors that were identified in relation to the reference event. The aim of this section is to describe some of the factors that can influence staff performance, behaviours and the ability to make the correct decision. These factors are not unique to this case and could be a factor in any incident. The human factors associated with the ED are explored further as part of this national investigation.

Multi-tasking

4.13.2 Some multi-tasking may be beneficial to performance. However, too much multi-tasking, especially when tasks are difficult can be detrimental to performance[24], [25]. Too much multi-tasking may have been a factor in why the patient's deterioration was not sufficiently recognised or acted upon. The ED nurses were caring for around four patients at any one time. Senior emergency staff such as the nurse in charge and consultant were maintaining oversight of all patients across the whole ED which, could include 50-60 patients at a time. The acuity of patients was also reported to be high in the ED, adding complexity to tasks. The Surgical Ward Nurse was looking after two four-bedded bays and the Nurse in Charge was responsible for all 28 beds as well as being specifically allocated to look after four patients.

4.13.3 Multitasking, particularly when managing a high number of tasks, can significantly impact on the quality of patient care in the ED. A study by Singh (2014) [26] found lower levels of multi-tasking were associated with improved care; however, higher levels led to a smaller number of identified diagnoses and increased the likelihood a patient would have to revisit the ED within 24 hours.

4.13.4 An observational study[27] found nurses were multitasking 34% of their time and experienced many interruptions (between 4.3 and 18 per hour). The authors stated that an interruptive and multi-task driven environment is conducive to errors.

Patient factors

4.13.5 Documentation from ambulance and ED staff recorded that the patient had not been compliant in taking her medication following her previous discharge. Her friend who accompanied her to hospital told staff that the patient was sceptical about doctors and hospitals and had more faith in complimentary medicine. Both the ambulance crew and the JCF had recorded in the medical records that she had been 'non-compliant'. There were inconsistent accounts given by the patient and her friend of her symptoms. Whilst in the ED, the patient had expressed a wish to leave and was persuaded to remain by the JCF and ED consultant.

4.13.6 When asked why she had attended the ED she stated it was because her friend was concerned about her. The friend voiced her concerns about the patient to both the JCF and the Consultant.

4.13.7 Staff reported that the patient did not 'look' or present like a typical patient who was deteriorating. She presented as a patient who was unlikely to deteriorate. As such, their judgement may have been biased into thinking she was not as unwell as she was. The way in which people assess the likelihood of an uncertain event or

outcome (for example, 'is this patient deteriorating?') is usually through a limited number of heuristics principles[28]. Heuristics are general strategies that typically produce a correct solution[29] and are useful in everyday life, but they can lead to systematic errors or biases. We are most susceptible to bias when using a fast and intuitive thinking style as opposed to a slower, more deliberate and analytical thinking style[30].

4.14 Summary of reference event findings

4.14.1 The investigation identified several interrelated and systemic contributory factors which influenced decision making and staff actions during the patient's stay in hospital. The factors identified influenced why her deterioration was not sufficiently recognised or responded to in a timely manner.

4.14.2 There was limited availability of the on-call surgical team who were either attending to other patients or in theatre. The number of staff on the surgical ward and in the ED were deemed appropriate by the Trust's investigation. However, the workload was reported to be high and the findings from the reference event investigation indicate there was a task versus resource mismatch.

4.14.3 The structure of the ED in which patients are initially seen by a junior doctor and subsequently by a more senior doctor or specialty doctor may not be optimal for ensuring patients are seen by the right person in an appropriate timeframe.

4.14.4 The patient's deterioration was not recognised as expected. The factors that contributed to the limited recognition were:

- Information was dispersed across different staff groups and documentation types. This increased the likelihood that key information was missed and potentially limited a holistic assessment of the patient's clinical condition.
- There tended to be a focus on the latest physiological observations as opposed to the trend. This was due to factors such as limited cognitive capacity due to high workload and the design of documentation.
- The ED EWS trend identified the patient was deteriorating but may have also falsely reassured staff that she was improving.
- Staff did not perceive the patient as critically unwell. They reported she was responsive, alert and orientated. She did not 'look' or present like a patient who was critically unwell.
- The information that was communicated across the patient's care eroded at each stage, resulting in limited awareness of her clinical risk.

- The nursing staff on the surgical ward focused on caring for the patient's individual needs as opposed to making a complete assessment of her overall clinical condition.

4.14.5 The escalation of the patient's high ED EWS was not optimal. This was a result of problems associated with the availability of staff and the way in which the CCOT was utilised. One of the Trust's escalation policies also differed to that recommended by the Royal College of Physicians NEWS guidance. It was found these issues were not unique to the Trust where the reference event occurred.

4.14.6 There was some ambiguity over the ownership and responsibility of the patient's care once she was referred to the surgical team. As such, the patient was not handed over to another doctor within the ED, and she was not re-reviewed by a doctor when her ED EWS continued to fluctuate.

5 Findings and analysis from the wider investigation

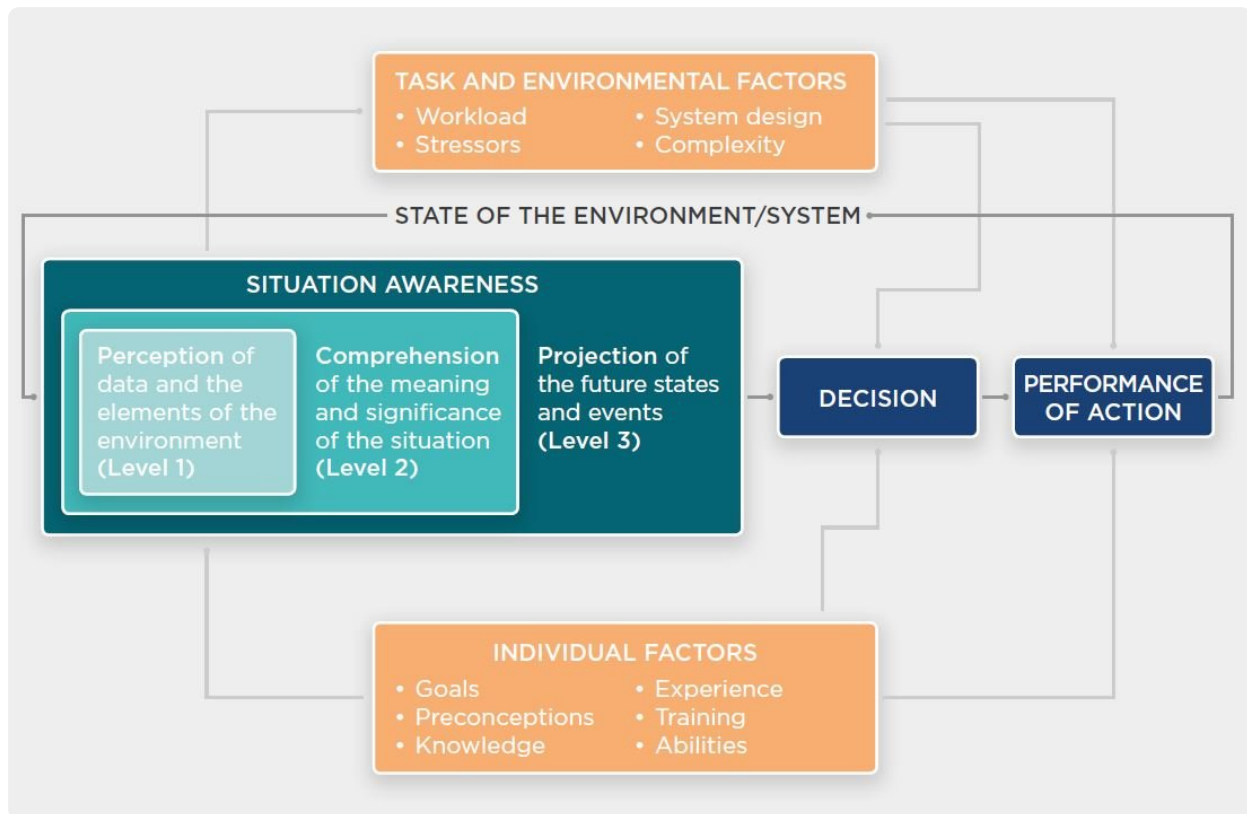
5.1 Situation awareness

Background

5.1.1 The investigation considered if efforts to improve situation awareness may assist in recognition and response to critically unwell patients.

5.1.2 Situation awareness forms the basis for decision making. According to Endsley (1995)[31], 'Situation awareness is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.' Endsley's (1995) three-level model of situation awareness is frequently cited in literature (Figure 5). The model describes three hierarchical levels:

Figure 5: Diagram of Endsley's (1995) model of situation awareness



- **Level 1 situation awareness: Perception of the Elements in the Environment.** Level 1 situation awareness involves the perception of information from the environment. Endsley (1995) describes the first step in achieving situation awareness to perceive the status, attributes, and dynamics of relevant elements in the environment.
- **Level 2 situation awareness: Comprehension of the Current Situation.** Level 2 is based on synthesis of the range of data perceived in Level 1. It goes beyond simply being aware of the elements that are present to include understanding the significance of those elements and their relevance to the person's goals and objectives. The range of data is prioritised and weighted. Previous experience and recognition of patterns is also used to help form an understanding of the current situation.
- **Level 3 situation awareness: Projection of Future Status.** Level 3 is about the ability to forecast future states or anticipate the results of current events, including actions or inactions. The accuracy of Level 3 situation awareness is dependent on the precision gained in both Level 1 and Level 2 situation awareness.

Applying situation awareness to healthcare

5.1.3 In healthcare, Level 1 situation awareness would be the process of getting and perceiving information such as the patient's medical history, physical examination, diagnostic tests, electronic monitors and information from colleagues.

5.1.4 The investigation found issues which may make it difficult for clinicians to obtain Level 1 situation awareness as follows:

- Information is dispersed across documentation, with relevant and irrelevant information being presented together.
- There are multiple systems where information is held.
- There is a large amount of documentation.
- Documentation can become separated.
- Individuals may hold situation awareness, which is not held elsewhere in the system, for example, it has not been documented or sufficiently communicated.
- There can be breakdown in communication and flow of information throughout a patient's pathway owing to multiple transfers of care.

5.1.5 Level 2 situation awareness would be about understanding the significance of the information gathered from elements such as the history, physical examination and diagnostic tests. This comprehension allows the clinician to make a judgement about the patient.

5.1.6 The speed and accuracy with which Level 2 situation awareness is achieved will depend on the knowledge and experience of the clinician involved. As such, it is likely that a more senior clinician may be better at achieving Level 2 situation awareness. However, more experienced clinicians may have also developed norms and biases which could influence decision-making.

5.1.7 The context of the experience gained is also key. For example, an experienced cardiologist will not necessarily achieve optimal Level 2 situation awareness for a respiratory issue.

5.1.8 Level 3 situation awareness in healthcare is about anticipating the outcomes; for example, anticipating what the likely outcome would be if a course of treatment is conducted, or recognising what could happen if action is not taken.

5.1.9 Level 3 situation awareness is considered a characteristic of a skilled expert [32]. A skilled expert in healthcare would be a senior or highly specialist clinician. However, even experts and highly trained decision makers could make an incorrect decision if their situation awareness is incomplete or inaccurate. Anticipating the outcomes is also a very demanding task at which people are generally poor [33].

5.1.10 There are numerous factors that can influence situation awareness, many of which have been detailed in this report, these include:

- workload
- communication and handover of information
- time pressures
- cognitive bias
- fatigue
- cue salience (how prominent information is in the environment)
- experience levels of the clinician
- number of patients and patient turnover
- time constraints and performance measures such as the 4-hour standard imposed on A&E departments
- interruptions and distractions
- feedback mechanisms (how performance is fed back to clinicians to enable them to learn and develop)
- design of systems and processes.

Applying situation awareness to Early Warning Score (EWS) tools

5.1.11 EWS systems could be considered as a tool to help staff to gain situation awareness, even when they have limited experience or expertise.

5.1.12 EWS prompts staff to gather important physiological information and presents it together to support Level 1 situation awareness. EWS then synthesises physiological information to show which physiological parameters are unusual and convert the parameters into a score to aid understanding if a patient is deteriorating. EWS can also support Level 3 situation awareness. EWS predict poor outcomes and so supports people who may not have the knowledge and experience to project the future state of a patient potentially deteriorating.

5.1.13 However, to gain a full awareness of what an EWS is portraying, EWS information must be correlated with other clinical information. Using an EWS tool on its own does not necessarily result in successful achievement of Level 1, 2 and 3 situation awareness, as demonstrated by the reference event.

Improving decision making and situation awareness conclusion

5.1.14 The situation awareness model and findings from the investigation demonstrate that improving decision making and situation awareness is not simple. There are many factors which can influence an individual's situation awareness and consideration must also be given to distributed situation awareness [17]. By placing the emphasis on the system, it allows the system to be designed so that the required information/awareness is in the places it needs to be [34].

5.2 Patient assessment models for Emergency Department (ED)

5.2.1 Based on the situation awareness model described in the previous section, the investigation considered if bringing expert decision-making earlier in the patient pathway could positively impact on patient care and improve the flow of patients through the ED.

5.2.2 Experts are more likely to be able to gather and perceive the right information; to understand that information; and, project the potential outcome. Experts are also more likely to identify gaps in the information they have which can then prompt the required information to be gathered.

5.2.3 Subject matter advisors told the investigation of a number of ways in which EDs are structured across acute units. The Royal College of Emergency Medicine also acknowledge in their 'Initial Assessment of Emergency Department Patients. Service Design and Delivery' [35] guidance document that processes for initially assessing patients are likely to vary between EDs because of differences in systems in different locations.

5.2.4 The investigation identified two models that brought expert decision-making earlier in the patient assessment process and were recommended by two emergency medicine subject matter advisors; Rapid Assessment and Treatment (RAT), and streaming.

Rapid Assessment and Treatment (RAT)

5.2.5 A 2012 paper by NHS Interim Management and Support called, 'Rapid Assessment and Treatment Models in Emergency Departments' [36] suggests that EDs consider implementing RAT models.

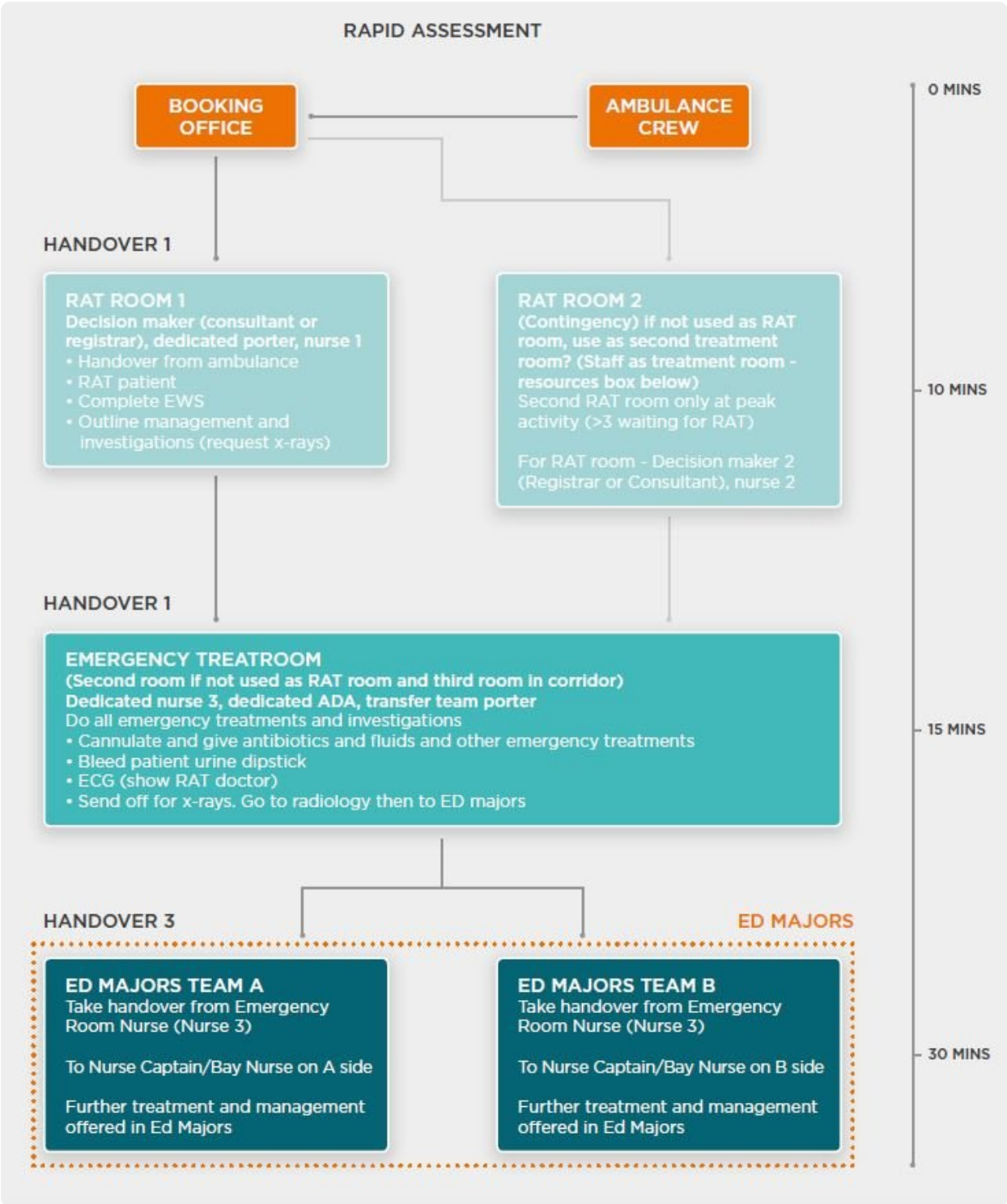
5.2.6 RAT is an early assessment of patients within the ED by a team led by a senior doctor. The RAT team initiate investigations and the treatment plan for a patient. RAT removes the triage and initial junior doctor assessment from the ED patient pathway. Instead the patient sees a doctor who is able to assess the patient, define a treatment plan and, if necessary, admit the patient to hospital or refer them to a specialist team. Nurses and junior doctors in the RAT team can then begin implementing the care plan. An outline of the RAT process is shown in Figure 6.

5.2.7 The advantages of the RAT model are detailed in the 2012 paper; notably:

- a senior doctor who is initially focused on assessing a patient's clinical status
- ordering diagnostic tests promptly
- earlier referral to a specialist team
- rapid initiation of a treatment plan such as administering fluids, antibiotics and pain relief
- reducing the clinical risk associated with prolonged waits for a senior review.

5.2.8 Issues related to RAT are also outlined in the 2012 paper including the difficulty in implementing the model in poorly staffed departments. The RAT process places a high demand and intensity of work on senior clinicians leading to clinician fatigue. Not all patients require senior medical review and so pathways need to be flexible to ensure valuable senior clinician resource is not wasted. It is recognised by the Royal College of Emergency Medicine that evidence about the effectiveness and benefits of RAT is currently scarce.

Figure 6: Outline of the RAT process



Streaming

5.2.9 Streaming aims to improve efficiency and effectiveness by allocating patients to different areas, services, pathways or processes, ideally within 15 minutes of the patient's arrival in the ED. Streaming ensures that patients are directed to the appropriate location or service so that the correct team manages their clinical needs. There are two types of streaming [37]:

- Simple streaming. This will typically involve taking a brief history and physiological observations. It may be combined with triage and calculation of a NEWS. The patient can then be directed to the appropriate area of the department or specialist service.
- Complex streaming. This involves a more detailed assessment and investigations (such as requesting blood or radiological tests) to bring the clinical decision-making processes forward. The patient's priority and acuity are assessed, as well as ensuring the patient is managed by the right service within an appropriate timeframe.

5.2.10 In the reference event, streaming was limited to directing the patient to the right area of the ED, which in her case was the 'Majors' area. However, streaming could have enabled the patient to be referred immediately to the surgical team and for diagnostic tests to be conducted earlier in the process.

Patient assessment models conclusion

5.2.11 Models such as RAT and streaming may improve patient care. They do this by ensuring decisions are made earlier in the process by a senior clinician and key information is identified that can help build situation awareness. However, improving initial patient assessment is not as simple as placing expert clinicians earlier in the patient pathway. Those experts still require the system to be optimised to allow Level 1, 2 and 3 of situation awareness to be successfully achieved. If the system is not optimised to aid situation awareness, there is an increased likelihood of error in recognising and responding to critically unwell patients, even with expert clinicians.

5.3 ED context

The nature of ED and its susceptibility to error

5.3.1 The ED is a busy, complex and dynamic environment. Those working in the ED have to navigate, negotiate, agree and implement a multitude of clinical pathways and patient management arrangements across a wide range of clinical specialities.

Studies have found the ED has the highest proportion of preventable errors (between 53% and 83%, in comparison with estimates of 27% to 51% for hospital-based events), which are most commonly cited as diagnostic errors [38].

5.3.2 The pressures EDs are experiencing are well documented in the media, particularly during winter months. For example, the Royal College of Emergency Medicine (RCEM) recently responded to January 2019 figures showing the worst ever four-hour performance and highest number of emergency admissions. RCEM's president stated that EDs are in a 'chronic crisis mode' [39].

5.3.3 There are a range of characteristics of the ED that predispose it to higher rates of human error [40], some of these include:

- a high turnover and volume of undifferentiated patients
- diversity of clinical conditions and requirements for level of care
- time constraints
- multiple distractions and interruptions
- limited historical and diagnostic information from which to make decisions
- shift work, with staff working different shift times
- multiple tasks which can rapidly change
- high level of diagnostic uncertainty
- high cognitive load
- high levels of activity
- inexperience of some physicians and nurses
- poor feedback.

5.3.4 The range of characteristics that predispose the ED and its staff to making errors, increase the likelihood a critically unwell patient may not be recognised and responded to sufficiently.

Workload

5.3.5 It is well documented in academic literature and in the media that EDs are under a significant amount of pressure where workload is high. The workload is attributed to a range of factors including a high turnover and volume of patients, some of which are very sick and require increased monitoring and care. The number of attendances at Type 1 EDs has increased by 9.1% between 2011-12 and 2017-18 [41]. Type 1 EDs are consultant led 24 hour departments with full resuscitation

facilities and can receive accident and emergency patients [42]. The increased number of patients is placing an additional cognitive load on clinicians, who now have a greater number of patients under their care and require more decisions to be made in the same period of time [43].

5.3.6 Advances in medical and information technology (for example, electronic medical records and whiteboard systems) have also meant that EDs are required to manage more information than ever before and input more data. Staff can become overloaded with data, which can affect their ability to process information. Those staff whose experience is limited are particularly vulnerable to information overload. Overall, high workload is a stressor that can result in the narrowing of attention, information being filtered out and/or reduce the capacity in working memory available to perform a task [44]. As such, high workload can negatively influence the ability to make appropriate decisions and task performance.

5.3.7 The investigation visited two EDs to observe work practices. It was found that the number of patients per staff member could vary significantly throughout a shift. On one occasion there was only one nurse to cover 12 patient cubicles because the other three nurses were transferring patients to other areas of the hospital. The remaining Nurse was experiencing observably increased workload and pressure as a result. During these periods, it was observed staff struggled to achieve all required tasks, including taking regular observations.

5.3.8 It was observed the Nurse in Charge would rapidly move from one task to the next and was provided with a lot of verbal information. The Nurse in Charge stated that she tried to remember everything she had been told, however, she would at times forget. The manner in which she coped with the amount of information she was given was by making notes, however, this was not always possible.

Interruptions and distractions

5.3.9 Staff working in the ED experience frequent interruptions and distractions. A study by Laxmisan, et al., (2007)[45] showed on average there is an interruption every 9 minutes for attending physicians (consultants) and every 14 minutes for residents (junior doctors).

5.3.10 Observation of a nursing station in an ED by the investigation revealed the Nurse in Charge was frequently interrupted. The sources of interruption and distraction were telephone calls, calling for porters, directing porters, allocating staff tasks, dealing with patients and families, finding beds in the hospital or the community to transfer patients to, chasing up diagnostic tests, and discussion of patient treatment plans with doctors and nurses.

5.3.11 The combination of interruptions with conducting multiple tasks could be a potential source of error[46]. Laxmisan et al., (2007)⁴⁵ found that multitasking is an integral skill developed by personnel working in ED. However, it may fail to be an effective mechanism for the smooth running of the ED when a large number of tasks demand the attention of the staff.

Noise

5.3.12 During observations, the investigation noted that EDs are noisy environments. Studies have found that noise levels in EDs can range between 45 and 73 decibels[47], [48], [49]. The noise levels in EDs are such that they can interfere with concentration[50], patient care, and both patient and staff well-being whilst in the ED⁴⁹. The noise levels in EDs are such that they could be a potential source of stress and could negatively influence communication.

5.4 4-hour standard for the ED

5.4.1 Evidence gathered during interviews with staff and through observations of EDs revealed that staff feel under pressure to achieve discharge, or admit patients, in order to achieve the 4-hour standard.

5.4.2 It was observed in the ED where the reference event occurred that the patient management system displayed which patients were close to breaching the 4-hour standard as the most prominent indicator. How information is displayed can influence how staff prioritise tasks. For example, prioritising a patient who is close to breaching the 4-hour standard may lead to prioritising patients for operational reasons rather than on clinical need.

5.4.3 A paper by Professor Matthew Cooke (2013)[51] highlights that while focused targets can drive improvement, for example, the 4-hour standard can help reduce crowding and reduce mortality, there can also be an over-focus on the target. He states 'The target has on occasions resulted in perverse actions aimed at solely achieving that target and forgetting the reason it was created – to reduce unacceptable delays that can result in worse outcomes...'

5.5 Staffing

5.5.1 It was not within the scope of this investigation to investigate staffing issues in depth. The Royal College of Emergency Medicine (RCEM) highlighted the recent work undertaken to address this issue. In October 2017, Health Education England (HEE), NHS England (NHSE), NHS Improvement (NHSI) and RCEM published a workforce plan for EDs [52].

5.6 National Early Warning Score (NEWS)

5.6.1 The Trust where the reference event occurred was using a locally-modified Early Warning Score (EWS) in the ED. Although the scoring was different to NEWS and NEWS2, the reference event highlighted how EWS tools are being used and implemented in practice. The investigation considered that the findings were applicable to other EWS tools.

5.6.2 There is a national drive to standardise the use of NEWS2 in all clinical areas. As such, the national investigation focused on NEWS and NEWS2.

Endorsement of NEWS and NEWS2

5.6.3 NEWS (2012) was used widely across the acute healthcare sector. A recent survey found 95% of acute organisations were using an EWS system and the majority were using the NEWS [53]. On 25 April 2018, a patient safety alert was issued by NHSE and NHSI stating that all acute and ambulance trusts should use NEWS2 and it should be fully adopted by March 2019 [54]. An update to NICE clinical guideline 50 in October 2018 now includes the use of NEWS2.

Benefits and limitations

5.6.4 One of the key benefits of NEWS and NEWS2 is that it provides standardisation across the NHS and a common language to communicate the physiological condition of a patient between staff. Clinicians, particularly bank and agency staff, move between trusts and so it is beneficial if they do not have to learn local scoring systems and associated escalation protocols.

5.6.5 Many of the potential benefits of a standardised NEWS have been reported by the Royal College of Physicians (RCP) however [55] there is little stated about the limitations of the tool. The NEWS (2012) guidance acknowledges ongoing evaluation and evolution would be required. Since the introduction of NEWS, the RCP has sought feedback from its users and identified several areas for improvement, which have been incorporated into NEWS2 [70].

EWS Evaluation

5.6.6 An evaluation which compared NEWS with 33 other EWS systems has been conducted by the NEWS Development Group [56].

5.6.7 The evaluation assessed the NEWS and EWS ability to discriminate patients at risk of cardiac arrest, unanticipated admissions to intensive care and death within 24 hours of a EWS value. The study found that NEWS was statistically reasonable for discriminating patients at risk of cardiac arrest and good at discriminating patients at risk of unanticipated admission to intensive care and death.

5.6.8 A number of independent studies have supported the use of EWS (including NEWS) in the ED. The studies [57], [58], [59], [60], [61], [62] have shown that EWS, in general, seems to predict adverse patient outcomes, including the need for admission to hospital or the intensive care unit, the length of hospital stay and mortality.

5.6.9 The NEWS Development group evaluation concluded NEWS was superior to the other 33 EWS systems. However, the results of the study show that false alarms and misses will occur. False alarms are when the NEWS incorrectly predicts the patient is critically unwell or worsening. Misses are when the NEWS incorrectly predicts the patient is stable or improving.

5.6.10 The evaluation report recognises the NEWS limitations stating:

‘NEWS should not be regarded as the sole solution to detecting patient deterioration. Rather, its use should be the minimum required for monitoring patients and should be used to alert staff to the need to assess a patient further. It should be used alongside, rather than instead of, other ‘triggers’, e.g., symptoms such as chest pain; signs such as diaphoresis; other assessment scores such as the Glasgow Coma Scale; and nurse or family concern. The successful implementation of NEWS will be challenging to organisations and will not in itself necessarily change the outcomes for patients unless all other components of the ‘Chain of Prevention’ are present, and work efficiently and effectively.’

5.6.11 The NEWS2 guidance [70] recognises having a national standardised approach, such as NEWS, will aid future research and so there is potential to conduct a robust and formal evaluation of NEWS and its application in various clinical settings such as the ED.

5.6.12 The investigation discussed NEWS evaluation with a deteriorating patient research expert. The expert highlighted the evaluation of NEWS was an ‘all observations’ analysis looking at outcomes within 24 hours of an individual observation set, therefore not limited to the ‘last’ observation set. NEWS escalation protocols are based on the most recent score, not the highest score in a given period. The escalation protocols indicate that patients who ‘trigger’ require a review and clinical judgement to decide the best course of action. As such, for patients

with a varying NEWS, when the score is at a low point (after the patient may have received some treatment to manage their symptoms) the protocols may result in reassurance, despite a previously high score. NEWS guidance states that the trend in score provides an indication of the patient's recovery and return to stability. Therefore, staff may interpret a reducing NEWS as the patient's condition improving, when in fact they may only be responding to management of symptoms, rather than treatment of underlying cause, which still needs escalation.

5.6.13 The investigation observed that NEWS appears to be used as a tool to help identify those patients who are sickest at a particular moment in time. This is not the way in which NEWS has been evaluated or was intended to be used. The evaluations categorise NEWS as a risk identification tool. As such, the risk needs to be appropriately assessed and monitored, continuing through the patient's journey until it is appropriate for patients to warrant a lower risk category.

Presentation of EWS information on electronic systems

5.6.14 The investigation identified issues on how EWS information is displayed on electronic systems. During observations in the ED, electronic patient record systems were observed. For each patient, only the latest EWS observation was displayed on the patient overview screen and when their individual record was opened. To view the trend of the patient's EWS, staff had to open a separate page, and so deliberately seek the information, rather than the information being prominently and easily displayed.

5.6.15 The way that the information is displayed within some electronic systems does not provide easy access to the individual observations that have contributed to the score. It is therefore more challenging for clinicians to identify trends in deterioration and the individual observations of most concern.

5.6.16 In addition, the trend displayed the EWS totals and was not presented in a way as clear as a colour coded EWS chart, where the distinction between the different physiological observations could be seen.

5.6.17 NEWS2 guidance concentrates on maintaining the score calculation, triggers and response requirements but contains nothing about maintaining and/or standardising the visual layout and presentation of NEWS2 on electronic systems.

Future review of NEWS2

5.6.18 The Royal College of Physicians NEWS Advisory Group has been set up to review the implementation and evidence around NEWS2. It will:

- Review and monitor the uptake and implementation of NEWS2, consolidating evidence of good practice and identifying any challenges related to implementation.
- Review emerging evidence relating to clinical deterioration and advise whether new evidence warrants that NEWS guidance should be revised.
- Recommend further research and evaluation in this field.
- Review and respond to clinical enquiries.
- Provide oversight of the NEWS e-learning module and app developed by OCB Media, and link to other learning materials.
- Provide insight into national and international developments relating to NEWS, deteriorating patients, and sepsis and advise on how the RCP should respond or engage.

HSIB makes the following safety recommendation

Recommendation 2019/032:

The Royal College of Physicians NEWS advisory group continues to evaluate the implementation and use of NEWS2, including but not limited to:

- The use of NEWS2 in practice, in particular the consistency of recording, the consistency of response, and the communication of patient measurements between healthcare professionals.
- The effectiveness of NEWS2 in identifying a patient's level of acute illness in different care settings and patient groups.
- The presentation of NEWS2 information and how this supports clinicians to identify trends, particularly in electronic records.
- The guidance and training on the use of NEWS2 as part of clinical assessment and patient monitoring.

HSIB makes the following safety observation

Observation:

- NEWS2 is not intended to be a stand-alone tool. Instead, it is intended to be combined with other relevant charts, clinical investigation results and notes together with clinical observations of the patient. There may be benefits to staff being trained in this approach and systems being designed to support bringing relevant information together.
- There may be benefits to including the historical data from NEWS2 graphs and charts, together with other key information, during a patient handover.
- There would be benefits to trusts ensuring they are using the latest version of the NEWS2 observation chart and protocols. Any recommended changes to early warning scores, documentation or use would benefit from being tested in practice before widespread implementation.

5.7 Escalation actions following a NEWS trigger

5.7.1 Escalation guidance differing to that outlined in NEWS 2012 and Acute Care Toolkit 6 is not unique to the Trust where the reference event occurred. The National Institute for Health Research, the Collaboration for Leadership in Applied Health Research and Care (CLAHRC) Wessex and Portsmouth Hospitals NHS Trust conducted a study examining policies and guidelines of 55 organisations regarding what actions were expected of staff following an early warning score trigger. Considerable variation was found between the expected actions required in response to a deteriorating adult patient. The study demonstrated the lack of standardisation in how care is 'escalated' which could result in variation in practice.

Escalation and response requirements from a suitable clinician

5.7.2 An important aspect of escalating a patient who appears to have deteriorated is that they are reviewed by a suitably qualified and experienced clinician in a timely manner. The Acute Care Toolkit 6 [63] recommends that a patient with a NEWS of 5-6 or a score of 3 in any one parameter, is reviewed urgently by the registered nurse responsible for the patient and the medical team involved within 15 minutes.

5.7.3 For a NEWS 7 or more, the Acute Care Toolkit 6 recommends immediate involvement of the medical team at ST3 level (Specialist Trainee, third year) or above. However, as demonstrated by the reference event, the appropriate clinician

may be informed of a patient whose NEWS is high, but owing to competing demands, cannot attend in a timely manner. It is also not clear what the actions and contingency plan should be if a staff member is unable to get a timely response from the level of doctor required. Guidance indicates that the Critical Care Outreach Team (CCOT) or Hospital at Night Team may be an option, but these teams can also be under-resourced and unavailable.

5.7.4 The investigation explored the potential demand NEWS triggers place on clinicians. An audit conducted by the 2013 Society for Acute Medicine Benchmarking Audit (SAMBA)[64] found that 16% of over 2,000 acutely presenting patients had a NEWS of 5 or more. Greengross and Beaumont [65] stated for a typical 1000 bed hospital, 17% of observations set will score ViEWS [66]/NEWS as 5 and 7% will score 7 and above. Due to the same patients escalating more than once within a 24 hour period, this can equate to about 700 escalated scores per day. Greengross and Beaumont highlight in their editorial response, the resource requirement to meet the RCP recommended escalation protocols may not be sustainable.

5.7.5 The demand NEWS triggers place on medical staff appears to be high and hospitals may be struggling to meet recommended escalation protocols within current levels of resource. During two independent discussions with patient deterioration subject matter advisors, it was suggested 'clinical concern' could be added to the decision to escalate.

5.7.6 Two studies have shown that there are potentially ten 'changes of concern' criteria that could be used to provide richer clinical information for clinicians to recognise early deterioration. Some of the criteria include noisy breathing, inability to talk in sentences, agitation, new or increasing pain, new symptom and new observation. The studies highlight the validity of these 'changes of concern' and suggest they should be investigated further, however, the studies also show there may be ways to encourage use of clinical judgement and make a more holistic assessment of a patient.

Critical care outreach

5.7.7 One escalation action is to contact the CCOT or Rapid Response Team. The National Institute for Health and Care Excellence (NICE) recommend in NG94 Chapter 27: Critical Care Outreach Teams [67], that organisations should, 'Consider providing access to critical care outreach teams (CCOTs) for people in hospital who

have, or are at risk of, acute deterioration, accompanied by local evaluation of the CCOT service.’ However, the investigation found limitations around the provision of this service.

5.7.8 The Guidelines for the Provision of Intensive Care Services [68], NEWS [69] and NEWS2 [70] guidance state that each organisation should have appropriately trained CCOT or Rapid Response Teams who are available 24/7. According to NEWS guidance, these personnel should be free of other clinical responsibilities. NEWS, NEWS2, the ‘How to Guide’ for Reducing Harm from Deterioration [71], and Guidelines for the provision of Intensive Care Services, also highlight the requirement for critical care outreach cover or a clinician with critical care competencies to assess a patient at certain NEWS ‘trigger’ levels.

5.7.9 Evidence from the reference event highlights these CCOT may not be used, or called upon, owing to a lack of resource. NICE’s review of the critical outreach literature for the development of NICE guideline 94, Chapter 27, found there is much inconsistency in how critical CCOTs are composed (e.g. nurse-led or doctor-led). There is also variation in the way in which CCOTs are accessed, and if the teams operate as a 7 day, 24 hour service, or only cover certain periods of time. NICE guideline 94 also acknowledges implementing CCOTs would require significant resource and may not provide much cost saving.

5.7.10 If there is not adequate resource in place to enable staff to escalate and respond to deterioration triggers in a timely manner, ‘failure to escalate’ is likely to continue as a contributory factor in serious incidents involving a ‘deteriorating patient’. Due to the lack of large scale studies, it is likely more research is required to establish the levels of staff and other resource required to meet current escalation guidance.

5.8 Volume of publications and guidance

5.8.1 Focus on recognition and response to a patient who is deteriorating has increased significantly since papers on the subject began emerging in the 1960s and 70s. The investigation reviewed the deteriorating patient literature and found that in the 1990s, these tended to focus on failure to act on physiological deterioration with some analysis on the causes of suboptimal care. However, from 2000 onwards the literature moved to focusing on the recognition of patients who are deteriorating, establishing a correct diagnosis and initiating appropriate therapy. Persistent problems with acting upon physiological observations are still highlighted.

5.8.2 The investigation observed that amongst the 150+ papers produced each year, there are approximately 22 key research papers and 23 key national publications offering guidance and recommendations on the topic of the deteriorating patient (see Appendix 2). The large number of papers and guidance publications is likely to add complexity. The complexity makes it difficult for both Trusts and staff to implement guidance and understand how best to mitigate failure to recognise and respond to the 'deteriorating patient'.

5.8.3 Where large amounts of guidance exist, there is more likely to be variation in practice because there is no single standardised approach (except for NEWS2). It is likely the large amount of guidance stems from the complex structure of the NHS system. There were fifteen key stakeholders at the wider organisation or regulatory level that were likely to be influential in the recognition and response to deteriorating patients. The organisations included (but were not limited to):

- NHS England
- NHS Improvement
- Care Quality Commission
- Royal College of Physicians
- Royal College of Emergency Medicine
- Royal College of Surgeons
- Royal College of Nursing
- Royal College of Radiologists
- Faculty of Intensive Care Medicine
- National Institute for Health and Care Excellence (NICE)
- General Medical Council
- The Nursing and Midwifery Council
- Clinical Commissioning Groups
- National Confidential Enquiry into Patient Outcomes and Death (NCEPOD)
- Health Education England.

5.9 National board for driving improvement for recognition and response to patient deterioration

5.9.1 In 2015, NHS England convened a Cross-System Sepsis Programme Board which brought together experts to drive improvement in the identification and treatment of sepsis. The successful delivery of the outputs of their Sepsis Action plan [72] saw an increase in sepsis assessment plus timely treatment for patients attending in-patient areas and, more significantly, the ED [73].

5.9.2 The investigation found there are many interrelated factors and system issues which contribute to problems with recognition and response to patient deterioration. Based on the findings from this investigation and discussions with subject matter advisors, it was concluded that a systems approach was required to improve recognition and response to a critically unwell patient. The investigation considered it would be beneficial to bring together experts and key stakeholders in patient deterioration to provide strong leadership, standardisation and a more unified approach to driving improvement in recognition and response to deterioration. The concept of forming a national board or expanding the remit of the Cross-System Sepsis Programme Board was proposed to a range of stakeholders, including:

- The Royal College of Physicians
- The Faculty of Intensive Care Medicine
- The Royal College of Emergency Medicine
- NHS Improvement
- An expert in improvement and change in emergency care
- A national clinical advisor for sepsis and deterioration.

5.9.3 Overall, the stakeholders agreed a national board would be useful and following discussions with the NHSI Patient Safety Team, it was concluded that the remit of the Cross-System Sepsis Programme Board should be expanded.

Recommendation 2019/033:

NHS England/NHS Improvement should expand the remit of the Cross-System Sepsis Programme Board to include physical patient deterioration, involving additional stakeholders as required.

6 Summary of HSIB findings, safety recommendations and observations

Findings from the reference event:

- There were interrelated and systemic contributory factors which influenced decision making and explain why the patient's deterioration was not sufficiently recognised or responded to.
- The structure of the Emergency Department (ED) may not be optimal for ensuring patients are seen by the right person, in an appropriate timeframe.
- Information about the patient was dispersed across a variety of documentation and clinical staff. The design and presentation of information did not support staff in making a complete and accurate assessment of the patient.
- Staff may rely on tools such as Early Warning Scores (EWS), especially when working in a busy and complex environment. There tended to be a focus on the latest physiological observations and staff could have been falsely reassured when EWS indicated the patient may be improving.
- The information that was communicated across the patient's care eroded at each stage.
- Escalation of the patient's deterioration was not optimal because of problems with the availability of staff and the way in which the Critical Care Outreach Team (CCOT) was utilised. One of the Trust's escalation policies also differed to that recommended by the Royal College of Physicians National Early Warning Score (NEWS) guidance. It was found these issues were not unique to the Trust where the reference event occurred.
- There was some ambiguity over the clinical responsibility of the patient's care once they were referred to the surgical team.

Findings from the national investigation:

- There are numerous factors that can influence situation awareness and thus decision making. Improving decision making and situation awareness is not simple and requires emphasis on designing the system to support information and awareness getting to the places it needs to be.
- There has been no formal evaluation for the usability of NEWS in the various clinical settings into which has been introduced, particularly in respect to the human factors that influence its use.

- NEWS appears to place a high demand on medical staff and current escalation protocols may not be achievable, owing to a task versus resource mismatch.
- There are multiple organisations producing publications and guidance on the recognition and response to a patient who is deteriorating. The large number of publications and guidance is likely to add complexity and make it difficult for trusts and staff in managing the 'deteriorating patient'.
- National policy such as the '4-hour standard' may be adversely influencing behaviours with a focus on meeting the performance standards.

HSIB makes the following safety recommendations

Recommendation 2019/032:

The Royal College of Physicians NEWS advisory group continues to evaluate the implementation and use of NEWS2, including but not limited to:

- The use of NEWS2 in practice, in particular the consistency of recording, the consistency of response, and the communication of patient measurements between healthcare professionals.
- The effectiveness of NEWS2 in identifying a patient's level of acute illness in different care settings and patient groups.
- The presentation of NEWS2 information and how this supports clinicians to identify trends, particularly in electronic records.
- The guidance and training on the use of NEWS2 as part of clinical assessment and patient monitoring.

Recommendation 2019/033:

NHS England/NHS Improvement should expand the remit of the Cross-System Sepsis Programme Board to include physical patient deterioration, involving additional stakeholders as required.

HSIB makes the following safety observations

Observations:

- NEWS2 is not intended to be a stand-alone tool. Instead, it is intended to be combined with other relevant charts, clinical investigation results and

notes together with clinical observations of the patient. There may be benefits to staff being trained in this approach and systems being designed to support bringing relevant information together.

- There may be benefits to including the historical data from NEWS2 graphs and charts, together with other key information, during a patient handover.
- There would be benefits to trusts ensuring they are using the latest version of the NEWS2 observation chart and protocols. Any recommended changes to early warning scores, documentation or use would benefit from being tested in practice before widespread implementation.

7 Appendices

Appendix 1: Example of a NEWS chart [74]

NEWS KEY 0 1 2 3		NAME:		D.O.B.:		ADMISSION DATE:	
DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME
RESPIRATORY RATE	205	3					
	21-24	2					
	12-20	1					
	9-11	3					
	5-8						
SpO ₂	94-95	1					
	92-93	2					
	89-91	3					
	85-88						
Inspired O ₂ %	21	2					
	16	1					
	11	3					
	6						
TEMP	38.5	1					
	38	2					
	37.5	3					
	37						
	36.5						
	36						
	35.5						
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Appendix 2: Example of a NEWS2 chart

NEWS Key 0 1 2 3		FULL NAME		DATE OF BIRTH		DATE OF ADMISSION	
DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME
A+B Respirations Breathlessness		225	3				
		21-24	2				
		18-20					
		15-17					
		12-14	1				
		9-11	3				
		5-8					
A+B SpO ₂ Scale 1 Oxygen saturation (%)		235	1				
		94-95	2				
		92-93	3				
		50					
C SpO ₂ Scale 2 Oxygen saturation (%) Low SpO ₂ (11-17) High SpO ₂ (95-96) High SpO ₂ (93-94) High SpO ₂ (253) High SpO ₂ (85-92) High SpO ₂ (85-87) High SpO ₂ (84-85) High SpO ₂ (55%)		257	3				
		95-96	2				
		93-94	1				
		253					
		85-92					
		85-87	1				
		84-85	2				
		55%	3				
D Air/oxygen?		A=Air	2				
		O ₂ L/min					
		Device					
C Blood pressure Systolic Diastolic Mean Systolic (if only)		220	3				
		201-210					
		161-200					
		141-160					
		121-140					
		111-120	1				
		91-100	2				
		81-90	3				
		71-80					
		61-70					
		51-60					
		41-50	1				
		31-40	3				
		50					
C Pulse Beats/min		213	3				
		121-130	2				
		111-120	1				
		101-110					
		91-100					
		81-90					
		71-80					
		61-70					
		51-60					
		41-50	1				
		31-40	3				
		50					
D Alert Confusion Comatose Soporose Stuporose (no use of brackets)		Alert					
		Confusion					
		V	3				
		P					
		U					
E Temperature °C		28.1	2				
		38.1-38.0	1				
		37.1-38.0					
		36.1-37.0					
		35.1-36.0	1				
		25.0	3				
NEWS TOTAL							
Monitoring Frequency							
Escalation of care Y/N							
Initials							

Appendix 2: Key 'deteriorating patient' national publications and guidance

Number	Name of Publication	Author	Published date	Link
1	Themes and recommendations common to all hospital specialties	NCEPOD	2018	https://www.ncepod.org.uk/CommonThemes.pdf
2	Emergency and acute medical care in over 16s Quality Standard	NICE	September 2018	https://www.nice.org.uk/guidance/qs174
3	CQUIN: Reducing the impact of serious infections (Antimicrobial Resistance and Sepsis)	NHSE	April 2018	https://www.england.nhs.uk/nhs-standard-contract/cquin-17-19/
4		NICE		https://www.nice.org.uk/guidance/ng94

Number	Name of Publication	Author	Published date	Link
	Emergency and acute medical care in over 16s NICE Guideline		March 2018	
5	NEWS2: Standardising the assessment of acute-illness severity in the NHS.	RCP	December 2017	https://www.rcplondon.ac.uk/projects/outputs/na-warning-score-news-2
6	The adult patient who is deteriorating: sharing learning from literature, incident reports and root cause analysis investigation	NHSI	July 2016	https://improvement.nhs.uk/documents/176/Deterioration_in_adults_report_7july.pdf
7	Patient Safety Alert 'Resources to support safer care of the deteriorating patient (adults and children)	NHSI	July 2016	https://improvement.nhs.uk/documents/177/Patient_Safety_Alert_Stage_2_-_Deterioration_resources_July_2016_v2.pdf
8	Safer system framework for recognising and responding to children at risk of deterioration	NHSI & RCPCH	July 2016	https://www.rcpch.ac.uk/resources/safe-system-f-risk-deterioration
9	NHS 5 year forward view	NHSE/ CQC / HEE/ Monitor / PHE	October 2014	https://www.england.nhs.uk/publication/nhs-five
10		SIGN	May 2014	http://www.sign.ac.uk/pdf/SIGN139.pdf

Number	Name of Publication	Author	Published date	Link
	Care of the deteriorating patients			
11	Time to act, severe sepsis: rapid diagnosis and treatment saves lives	PHSO	September 2013	https://www.ombudsman.org.uk/sites/default/files/Time_to_act_report.pdf
12	Review into the quality of care and treatment provided by 14 hospital trusts in England: overview report	Keogh/ NHSE	July 2013	www.nhs.uk/NHSEngland/bruce-keogh-review/Pages/reports.aspx
13	Acute care toolkit 6: The medical patient at risk	RCP	May 2013	https://www.rcplondon.ac.uk/guidelines-policy/acute-care-toolkit/6-the-medical-patient-at-risk
14	NEWS - standardising the assessment of acute-illness severity in the NHS	RCP	July 2012	https://www.rcplondon.ac.uk/file/9559/download
15	Improving the detection and response to patient deterioration	NICE	February 2011	https://www.nice.org.uk/sharedlearning/improving-detection-and-response-to-patient-deterioration
16	10 for 2010	NPSA	2010	No current version of webpage. Cached version takes some time to load: http://cc.bingj.com/cache.aspx?q=10+for+2010+patient+safety&d=49914795&u=http://www.npsa.nhs.uk/10for2010/Pages/10for2010.aspx&w=panhzrqtB4vd3NVNBcM
17	The 'How to Guide' for Reducing Harm from Deterioration	Patient Safety First	September 2008	https://www.norf.org.uk/Resources/Documents/Resources%20documents/patientsafetyfirst.nhs.uk%20%20Deterioration%20from%20Deterioration

Number	Name of Publication	Author	Published date	Link
18	Recognising and responding to early signs of deterioration in hospitalised patients	NPSA	November 2007	www.nrls.npsa.nhs.uk/resources/?entryid45=598
19	Acute medical care: the right person, in the right setting - first time	RCP	October 2007	https://www.acutemedicine.org.uk/wp-content/uploads/2007/10/RCP-Acute-Medicine-Task-Force-Report.pdf
20	Acutely ill patients in hospital: Recognition of and response to acute illness in adults in hospital	NICE	July 2007	https://www.nice.org.uk/Guidance/CG50
21	The fifth report from the Patient Safety Observatory: Safer Care for the Acutely Ill Patient: learning from serious incidents	NPSA	2007	www.nrls.npsa.nhs.uk/resources/?EntryId45=598
22	An Acute Problem? A report of the National Confidential Enquiry into Patient Outcome and Death (2005)	NCEPOD	2005	http://www.ncepod.org.uk/2005report/summary.pdf
23	Acute medicine: making it work for patients. A blueprint for organisation and training. Report	RCP	2004	Link no longer available

Number	Name of Publication	Author	Published date	Link
	of a Working Party of the Royal College of Physicians			

Key Deteriorating Patient Research Papers and Articles

Number	Name of Publication	Author	Published date	Link
1	Vital sign documentation in electronic records: The development of workarounds	Stevenson et al	August 2016	http://journals-sagepub-com.authproxy.bma.o
2	Factors affecting response to national early warning score (NEWS).	Kolic et al	May 2015	https://s3.amazonaws.com/academia.edu.doc/fzh46l.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&content-disposition=inline%3B%20filename%
3	Validation of NEWS in prehospital setting	Silcock et al	April 2015	https://www.researchgate.net/profile/Kevin_Ro270967042_Validation_of_the_National_Early_Validation-of-the-National-Early-Warning-Score
4	Impact of introducing an electronic physiological surveillance system on hospital mortality.	Schmidt et al	Jan 2015	https://researchportal.port.ac.uk/portal/files/2
5	Detection and management of the deteriorating ward patient: an evaluation of nursing practice	Odell	Jan 2015	https://onlinelibrary.wiley.com/doi/abs/10.1111

Number	Name of Publication	Author	Published date	Link
6	Into the Night: Factors affecting response to abnormal Early Warning Scores out-of-hours and implications for service improvement.	Yiu et al	June 2014	https://europepmc.org/abstract/med/2494056
7	Can we do more for our deteriorating patients? Audit of 24-48 hours pre critical care emergency admissions from ward areas.	Chamberlain et al	June 2014	https://insights.ovid.com/anaesthesia/anes/20
8	Implementing the national early warning score (NEWS) for identification of deteriorating patients and measuring adherence to protocol.	Mukhal et al.	Oct 2013	https://www.ejinme.com/article/S0953-6205(1
9	Review into the quality of care and treatment provided by 14 hospital trusts in England: overview report	Keogh/ NHSE	July 2013	www.nhs.uk/NHSEngland/bruce-keogh-review/
10	Preventable deaths due to problems in English acute hospitals: a	Hogan et al.	August 2012	https://qualitysafety.bmj.com/content/qhc/21/

Number	Name of Publication	Author	Published date	Link
	improve compliance with an Early Warning Score protocol.			
16	Does earlier detection of critically ill patients on surgical wards lead to better outcomes?	Subbe, R Coll. Surg Engl	July 2005	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC
17	A confidential study of deaths after emergency medical admission: issues relating to quality of care	Seward et al	2003	http://www.clinmed.rcpjournals.org/content/3/5
18	Unexpected deaths and referrals to intensive care of patients on general wards. Are some cases potentially avoidable?	McGloin et al.	1999	https://europepmc.org/abstract/med/1040257
19	Confidential inquiry into quality of care before admission to intensive care	McQuillan et al.	1998	https://www.bmj.com/content/316/7148/1853
20	National Confidential Enquiry into	John Lunn	1994	https://rd.springer.com/article/10.1007%2FBF

Number	Name of Publication	Author	Published date	Link
	Perioperative Deaths			
21	Developing strategies to prevent in-hospital cardiac arrest: analysing responses of physicians and nurses in the hours before the event.	Franklin et al	1994	https://europepmc.org/abstract/med/8306682
22	Clinical antecedents to in-hospital cardiopulmonary arrest	Schein et al	1990	https://www.sciencedirect.com/science/article

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