Recognition of the acutely ill infant

Independent report by the Healthcare Safety Investigation Branch I2018/024

December 2021
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About HSIB

We conduct independent investigations of patient safety concerns in NHS-funded care across England. Most harm in healthcare results from problems within the systems and processes that determine how care is delivered. Our investigations identify the contributory factors that have led to harm or the potential for harm to patients. The safety recommendations we make aim to improve healthcare systems and processes, to reduce risk and improve safety.

We work closely with patients, families and healthcare staff affected by patient safety incidents, and we never attribute blame or liability.

Considerations in light of coronavirus (COVID-19)

We have adapted some of our national investigations, reports and processes to reflect the impact that COVID-19 has had on our organisation as well as the healthcare system across England.

A note of acknowledgement

We are grateful to Mohammad’s Mother and Aunt for sharing their experiences. We would also like to thank the Trust and members of staff who participated in the investigation process and openly shared their perceptions of the incident with us.
About Mohammad

Mohammad was a very much-loved little boy and his parents had waited for 13 years to conceive. Photograph after photograph shows a smiling, happy and bright-eyed baby boy. Mohammad had already been on his first holiday to Jordan to meet his extended family. Mohammad will be remembered with such love and the family hope that this report will ensure his short life is never forgotten.

About this report

This report is intended for healthcare organisations, policymakers and the public to help improve patient safety in relation to recognition of the acutely ill infant and child because it is especially difficult to distinguish between simple viral illnesses and life-threatening bacterial infections in very young patients.

For readers less familiar with this area of healthcare, medical terms are explained in section 1.
Our investigations

Our investigators and analysts have diverse experience of healthcare and other safety-critical industries and are trained in human factors and safety science. We consult widely in England and internationally to ensure that our work is informed by appropriate clinical and other relevant expertise.

We undertake patient safety investigations through two programmes:

National investigations

Concerns about patient safety in any area of NHS-funded healthcare in England can be referred to us by any person, group or organisation. We review these concerns against our investigation criteria to decide whether to conduct a national investigation. National investigation reports are published on our website and include safety recommendations for specific organisations. These organisations are requested to respond to our safety recommendations within 90 days, and we publish their responses on our website.

Maternity investigations

We investigate incidents in NHS maternity services that meet criteria set out within one of the following national maternity healthcare programmes:

• Royal College of Obstetricians and Gynaecologists’ ‘Each Baby Counts’ report
• MBRRACE-UK ‘Saving Lives, Improving Mothers’ Care’ report.

Incidents are referred to us by the NHS trust where the incident took place, and, where an incident meets the criteria, our investigation replaces the trust’s own local investigation. Our investigation report is shared with the family and trust, and the trust is responsible for carrying out any safety recommendations made in the report.

In addition, we identify and examine recurring themes that arise from trust-level investigations in order to make safety recommendations to local and national organisations for system-level improvements in maternity services.

For full information on our national and maternity investigations please visit our website.
Executive summary

Background

This investigation examined patient safety issues related to the ability of healthcare professionals to recognise when an infant or young child is seriously ill. Infants and children who have a fever without an apparent cause are of particular concern to healthcare professionals because it is especially difficult to distinguish between simple viral illnesses and life-threatening bacterial infections. It is also very difficult to identify early signs or symptoms that could lead to sudden deterioration in unwell infants and children. Unlike adults, infants and children are able to cope with potentially overwhelming infection for a period of time without showing any signs that they are seriously ill or getting worse. Recognition of acutely unwell infants and children is complex and quick diagnosis is important as their health can deteriorate rapidly. In addition, opinions on how to reliably identify deterioration in infants and children vary at regional and national levels. This safety issue impacts across the boundaries of many NHS services which see and/or provide advice, guidance and care to infants, children, and their parents.

This investigation used the following real event, referred to as ‘the reference event’, to examine the patient safety issues associated with recognising acute illness in infants and children. The reference event follows the care of Mohammad, a baby who sadly died of septicaemia, which is a bacterial infection in the bloodstream. Septicaemia is closely associated with sepsis, a life-threatening response to infection that can affect a person’s whole body, leading to tissue damage, organ failure and death.

The reference event

Mohammad was a previously well baby boy aged 3 months. Mohammad lived with his Mother and maternal Aunt. Mohammad’s Father lived in Jordan. Mohammad and his Mother had recently visited Jordan for a month, returning to the UK on 5 September 2018.

On 6 September 2018, Mohammad’s Mother contacted a health visitor. She was upset that Mohammad was unsettled, crying and had vomited after being fed. His Mother told the health visitor that Mohammad had had a cold and colic (prolonged and intense crying) for a few days and that he had been vomiting for a week. The health visitor observed Mohammad’s Mother giving him a feed, which he took well, and advised her to start Mohammad on anti-reflux milk – a type of milk formula which is thickened to prevent babies bringing up the milk during or after a feed.
On the afternoon of 10 September 2018 Mohammad seemed unsettled, so his Mother tried feeding him a small amount of baby rice. Mohammad vomited and went blue/pale in colour and started grunting.

At 18:57 hours that day Mohammad’s Aunt called NHS 111. The NHS 111 decision pathway resulted in a ‘category 2’ ambulance being sent (ambulance responses are categorised as 1 Life threatening, 2 Emergency, 3 Urgent, and 4 Less urgent).

The ambulance crew assessed Mohammad, gave him paracetamol (because he had a raised temperature) and took him to the nearest emergency department (ED), arriving at 20:04 hours. Mohammad was triaged by a paediatric nurse (a nurse specialising in the care of children) and transferred to a paediatric bed in the resuscitation area for urgent review in line with the local treatment pathway for sepsis. While in the ED, the cause of his feverish illness and vomiting was unknown, although it was considered likely to be a mild viral illness and not related to sepsis. Mohammad was transferred to the paediatric observational ward of the hospital at approximately 23:15 hours. He was discharged with a diagnosis of likely bronchiolitis (a viral lower respiratory tract infection) at 23:45 hours. His Mother was given advice to contact the ward if she had any concerns.

At approximately 03:40 hours Mohammad’s Mother contacted the ward stating that he had developed a rash. The nurse receiving the call could hear a high-pitched continual cry and advised her to call an ambulance immediately. A 999 call was made at 03:41 hours, which resulted in a ‘category 1’ ambulance being dispatched. The ambulance crew did not consider that Mohammad was seriously ill so did not conduct a ‘blue light’ emergency transfer to hospital. Mohammad was admitted to the ED at approximately 04:40 hours.

He suffered a respiratory and then cardiac arrest at 05:28 hours. Staff attempted to resuscitate him for 42 minutes but were unsuccessful and stopped at 06:10 hours. Mohammad died of septicaemia caused by meningococcus (serogroup B) bacteria.

The national investigation

The investigation considered existing guidance on caring for an infant that is described as ‘unwell’. There is already research evidence on the multiple factors that contribute to clinical deterioration in infants and children being missed. The Royal College of Paediatrics and Child Health has clustered these factors into four themes:

- parent/carer engagement
- healthcare professionals’ training
• not responding to physiological changes

• failures within the healthcare system.

The investigation considered these four themes along with published evidence and research. The investigation acknowledged that the following known facts were applicable to the reference event:

• Meningococcal disease is a significant cause of serious illness and death in children.

• Research has shown that it can be difficult to distinguish between infants and children who are brought into hospital with mild viral illnesses and those who have serious bacterial infections such as meningococcal disease.

• Evidence in the research literature refers to the difficulty of being able to identify clinical deterioration in infants and children with serious illness.

• Research identifies that Paediatric Early Warning Score (PEWS) systems are widely used around the world to monitor the health of infants and children, although there is a lack of consensus about which system is most useful. In addition, there is no early warning score that will always detect deterioration in infants or children.

• Research shows that existing early warning scores are not sensitive or specific enough to help health professionals to distinguish between a seriously unwell infant/child and one with a mild viral illness. Changes in vital signs (for example temperature, heart rate and respiratory rate) may be predictors of deterioration in an infant or child but they may also simply reflect that a child is unwell but not at significant risk.

• Evidence confirms that clinical experience and judgement remain essential for the detection of deterioration in an infant or child whose vital signs are within, or only slightly outside, the expected ranges.

• Infants and young children may have fever and vomiting associated with irritability, drowsiness and confusion. They may be very hard to assess and evidence supports that parent’s anxieties about their child’s state of responsiveness and alertness must always be taken seriously.
• Assessment of skin colour and people being asked if patients are ‘pale’ or if their lips have ‘turned blue’ are not useful approaches for patients with non-white skin. In addition, descriptions of rashes focus on redness or paleness, both of which are more difficult to recognise in a patient with non-white skin.

• The use of medicines to reduce temperature may mask the symptoms of serious illness in infants and children.

• Research highlights that emergency departments and paediatric assessment wards are already extremely busy with increasing numbers of admissions, while the number of children developing a serious bacterial infection is not increasing.

• National standards for the care of children in emergency care settings exist, however there are known challenges faced by some hospitals in recruiting the workforce needed to meet the standards.

The investigation’s core objective was to understand decision making and why decisions made sense to the clinicians at the time. The investigation sought to understand how work demands and constraints in the healthcare system as a whole, interacted to influence the way staff worked on the night of Mohammad’s admission.

**Findings**

The investigation found:

• The existing systems for triage do not always take into account the colour of a patient’s skin. This may influence a healthcare professional’s assessment of an infant’s/child’s physical signs.

• The investigation identified that the information to support clinical decision making is not always available to staff when they are assessing patients. This includes trends in an infant’s/child’s PEWS, which are not always considered.

• Staffing standards that relate to the treatment of children in EDs cannot always be met due to workforce challenges, particularly in hospitals without a dedicated paediatric ED.

• Sometimes parents describe feeling powerless when trying to articulate their concerns for their child. Some healthcare professionals do not always consider or listen to what parents are telling them.
• There is variation in the level of detail provided to families on identifying deterioration in their infant or child after discharge from hospital.

• The Association of Ambulance Chief Executives are not currently involved in the ongoing national work to develop early warning scores for infants and children.

• Undergraduate training for paramedics on the identification of sick infants/children is variable across England.

• There is inconsistency across English ambulance services in training for ambulance personnel, including paramedics and non-registered clinicians, on the identification of sick infants/children.

HSIB makes the following safety recommendations

The intent of the first recommendation is to ensure that community health services, NHS 111 providers, the English ambulance service and primary care services are engaged in future development of an early warning score system for infants/children and that their approach to adopting PEWS will be included within the NHS System-wide Paediatric Observations Tracking (SPOT) Programme:

**Safety recommendation R/2021/165:**
HSIB recommends that the Chair of the NHS System-wide Paediatric Observations Tracking (SPOT) Programme ensures that the Association of Ambulance Chief Executives, community NHS 111 providers and primary care services are integral members of the NHS SPOT Programme.

The intent of the following recommendation is that NHS providers deploying commercial systems to implement SPOT will ensure they are compliant with the standards once developed:

**Safety recommendation R/2021/166:**
HSIB recommends that NHSX develops national standards describing the electronic deployment of the NHS System-wide Paediatric Observations Tracking (SPOT) e-PEWS (the digital version of the Paediatric Early Warning Score tool), in collaboration with the NHS England and NHS Improvement SPOT Programme. This should include specifications for data capture, calculation of the score and escalation status, and also the display of the information and connectivity with other digital systems.
Safety recommendation R/2021/167:
HSIB recommends that the Chair of the NHS System-wide Paediatric Observations Tracking (SPOT) Programme ensures that any resources produced include examples of children and young people with non-white skin showing signs of serious illness.

The intent of the following recommendation is to support the continuing professional development of the clinical ambulance service workforce:

Safety recommendation R/2021/168:
HSIB recommends that the Association of Ambulance Chief Executives works together with the ambulance services to share best practice in relation to paediatric training, education resources, frequency and types of training, and that it collates and shares areas of best practice.

Safety recommendation R/2021/169:
HSIB recommends that the College of Paramedics works with partners and higher education providers to develop, agree and implement standards for paediatric education for the future ambulance service workforce.

HSIB makes the following safety observations

Safety observation O/2021/137:
It may be beneficial if the research studies recommended by the National Institute for Health and Care Excellence are conducted in primary care and secondary care to determine whether examination or re-examination after a dose of antipyretic (temperature reducing) medication is of benefit in differentiating between children with a serious illness and those with other conditions.

The intention of the following safety observation is to enable healthcare professionals to see an infant’s/child’s PEWS and the interventions which may have influenced it:

Safety observation O/2021/138:
It may be beneficial if NHS England and NHS Improvement’s System-wide Paediatric Observations Tracking (SPOT) Programme considers visual representation of critical information (such as a clinical intervention administered) and the potential impact of these interventions on an infant’s/child’s PEWS.
Safety observation O/2021/139:
It may be beneficial if further research and observational studies are carried out to examine how listening to parents [or taking on board parents’ views/concerns] impacts on clinical decision making and recognition of the sick infant/child.

The intention of the following safety observation is to ensure that educational materials for parents are consistent in terms of quality of content, messaging and advice, and that they benefit all community groups:

Safety observation O/2021/140:
It may be beneficial if the current resources and educational materials available to parents and carers on assessment, advice and guidance for the unwell infant/child, for example mobile apps, are reviewed and governed through a national assurance process.

The intention of the following safety observation is to consider the current and ongoing risks associated with the challenges some hospitals face in recruiting the workforce needed to meet national standards for delivering care to children in emergency care settings. This assessment could be based on the standards published by the Royal College of Paediatrics and Child Health in 2018, entitled ‘Facing the future: standards for children and young people in emergency care settings’.

Safety observation O/2021/141:
It may be beneficial if there is system-wide assessment of the capacity of the medical and non-medical workforce to support safe and sustainable staffing in emergency departments caring for children in England.

The intention of the following safety observation is to identify all clinical staff working in the ambulance service that have accessed ‘Spotting the sick child’ or equivalent training as an education resource and find out how often it has been accessed, and to highlight any gaps in training needs for recognition of the acutely ill infant/child:

Safety observation O/2021/142:
It may be beneficial if the 10 English ambulance services review and assess their paediatric training provision and report this assessment to their trust board.
Contents

1 Background and context 14
2 The reference event 23
3 Involvement of the Healthcare Safety Investigation Branch 33
4 Analysis and findings - the reference event 38
5 Analysis and findings - the wider investigation 54
6 Summary of findings, safety recommendations and safety observations 73
7 References 78
8 Appendix - Record of Mohammad’s observations during his first admission to hospital 85
1 Background and context

1.1 Infants visiting emergency departments with a fever (high temperature)

1.1.1 Feverish illness is very common in young children, with between 20% and 40% of parents reporting such an illness each year (National Institute for Health and Care Excellence, 2014). It usually indicates an underlying infection. Fever is the commonest reason for an infant/child to be taken to the doctor and is also the second most common reason for an infant/child being admitted to hospital (National Institute for Health and Care Excellence, 2014). Despite advances in healthcare, infections remain the leading cause of death in children under the age of 5 years (National Institute for Health and Care Excellence, 2019a).

1.1.2 Infants and children with fever that has no obvious cause are of particular concern to healthcare professionals because it is especially difficult to distinguish between mild viral illnesses and life-threatening bacterial infections in this patient group. As a result, there is a perceived need to improve the recognition, assessment and immediate treatment of feverish illnesses in children (National Institute for Health and Care Excellence, 2019a).

1.1.3 The fever in under 5s pathway (National Institute for Health and Care Excellence, 2021) covers the assessment and early management of fever with no obvious cause in children under 5 years of age. It aims to improve clinical assessment and help healthcare professionals diagnose serious illness among young children who attend primary or secondary care services with a fever. The assessment uses a traffic light grading system to identify children at high, intermediate, and low risk of serious illness (National Institute for Health and Care Excellence, 2019b).

1.2 Meningococcal disease

1.2.1 Meningococcal disease is the term used for infections caused by the bacterium meningococcus. Meningococcal disease is a global problem. It causes death in around 1 in 10 cases and is the leading cause of death from infection in early childhood in the UK (National Institute for Health and Care Excellence, 2012).
1.2.2 Meningococcal infection can cause meningitis and meningococcal septicaemia (infection of the bloodstream). Both of these diseases can lead to meningococcal sepsis, a reaction to infection that causes a person’s body to damage its own tissue and organs. Meningococcal septicaemia and meningococcal sepsis are severe and life-threatening diseases that have a peak incidence in the first year of life (Pathan et al, 2003).

1.2.3 Early symptoms of meningitis and septicaemia may be similar to a cold or flu (fever, vomiting, irritability and restlessness) (Public Health England, 2017).

1.2.4 Since infection can progress from initial symptoms to death within hours, individuals must be diagnosed as early as possible. Within the first 4 to 6 hours of the onset of meningococcal disease, children have non-specific symptoms such as fever, poor feeding or decreased appetite, nausea, vomiting, and irritability (Thompson et al, 2006). A rash may develop and at first the rash may be mild and subtle. The rash usually occurs in the later stages when the disease becomes more serious.

1.2.5 For children with a rash, the glass test is a simple test for meningococcal infection that is recommended by various groups including Public Health England. It involves pressing the side of a clear drinking glass firmly against the rash to establish whether the rash fades and loses colour under pressure. If the rash does not fade and change colour under pressure (sometimes referred to as non-blanching), this may be a sign that it is due to meningococcal infection (or meningitis).

1.2.6 NICE guidance advises healthcare professionals to consider meningococcal disease in any child who has fever and a non-blanching rash, particularly if any of the following features are present:

- an ill-looking child
- marks on the skin larger than 2mm in diameter (purpura; a non-blanching rash of purple spots on the skin)
- neck stiffness (National Institute for Health and Care Excellence, 2019a)
a capillary refill time (CRT) of 3 seconds or longer. CRT is a simple test to measure the time in seconds for the colour to return to a patient’s skin after pressure is applied. The standard technique for measurement of CRT is to press for 5 seconds on a patient’s fingertip or toe, or on the centre of their sternum, and count the seconds it takes for colour to return (Meningitis Research Foundation, 2018a).

1.2.7 Newborns and babies may not have, or it may be difficult to notice, the classic symptoms listed above. Instead, babies may be slow or inactive, irritable, vomiting, feeding poorly or have bulging in the soft part of the skull (Centers for Disease Control and Prevention, 2017). Symptoms can occur in any order and some may not appear at all. Parents are advised to trust their instinct and seek advice urgently if they are in any doubt (Public Health England, 2017).

1.3 National guidance to support the identification of seriously ill patients

1.3.1 Reviews of research literature have shown that a significant proportion of child deaths could have been avoided if the right pathway of care had been followed at point of contact with the NHS. The ‘Why children die’ report (Wolfe et al, 2014) reinforces the importance of high-quality clinical assessment, showing there were cases of children who died because the severity of their illness was not recognised at an early stage.

1.3.2 In 2015 NHS England published a cross-system sepsis action plan to improve outcomes for people with sepsis (NHS England, 2015a). Guidance published by the National Institute for Health and Care Excellence (NICE) (2017), ‘Sepsis, recognition, diagnosis and early management’, was published and updated in September 2017. The NICE guidance includes risk stratification tools to support decision making. A national Commissioning for Quality and Innovation (CQUIN) measure for sepsis (NHS England, 2015b) was intended to incentivise providers to improve their identification and timely treatment of sepsis. In June 2018, the CQUIN was reported to be having a positive change with timely treatment increasing from 58% to 80%. NHS England produced a second cross-system sepsis action plan in 2017 which contained a summary of the key actions that health and care organisations across the country are expected to take to improve identification and treatment of sepsis (NHS England, 2017). From April 2017 to March 2019 the CQUIN indicators on sepsis and antimicrobial resistance were combined into a single indicator focused on reducing the impact of serious infections (NHS England, 2017).
1.3.3 The Royal College of Emergency Medicine’s best practice standards – as set out in ‘Emergency department care’ (Royal College of Emergency Medicine, 2017) – has 50 professional standards, 4 of which relate to the care of children. Children under 1 year old are recognised as a high-risk group and when attending healthcare services with acute illness these children should be subject to timely review by suitably experienced clinicians.

1.3.4 Standards set out by the Royal College of Paediatrics and Child Health (2015a) state that children should be seen in a timely way by a senior clinician with the right skills and competencies. These standards were updated in June 2018 (Royal College of Paediatrics and Child Health, 2018a).

1.3.5 The Royal College of Paediatrics and Child Health standards state that initial assessment should be a brief triage assessment conducted by an appropriately trained nurse or doctor and should follow a standardised system. The purpose of initial assessment is to establish the priority order in which patients should be seen. For example, the Paediatric Manchester Triage System (Manchester Triage Group, 2014) is a paediatric version of the Manchester Triage System (MTS) which is the most common method of triage in hospital emergency departments. The MTS includes indicative times within which it is recommended that patients are assessed, according to the category to which they are assigned.

1.3.6 There are national standards that relate to infants/children whose vital signs are outside the expected ranges. These include:

- All infants, children and young people presenting with a medical illness should have a set of vital signs recorded, including temperature, respiratory rate, heart rate, blood pressure, oxygen saturation (the level of oxygen in a patient’s blood), Glasgow Coma Scale (GCS) or Alert, Voice, Pain, Unresponsive (AVPU) scale (which measure levels of consciousness), and capillary refill time (see 1.2.6) (Royal College of Nursing, 2017; Royal College of Emergency Medicine, 2016).

- Children who have vital signs outside the expected ranges at initial triage assessment should have their observations repeated within 60 minutes (Royal College of Paediatrics and Child Health, 2018a).

- Any child with vital signs outside the expected ranges identified at triage should have these observations repeated within 60 minutes or earlier for serious conditions (Royal College of Emergency Medicine, 2016).
1.4 **Sepsis 6 pathway**

1.4.1 The ‘Sepsis 6’ care pathway is a part of the UK Sepsis Trust’s recommended approach to diagnosing and treating sepsis. The UK Sepsis Trust is dedicated to reducing the number of people who die unnecessarily from sepsis in the UK each year (The UK Sepsis Trust, 2021).

1.4.2 The UK Sepsis Trust developed a paediatric screening tool and action tool which can be applied to all children under 5 years who have a suspected infection or have clinical observations outside of expected ranges (The UK Sepsis Trust, 2018). If the tool indicates that there is a red flag for sepsis it recommends the immediate implementation of the Sepsis 6 actions, which are:

- Give the patient oxygen to maintain levels.
- Obtain intravenous (IV) access (sometimes intraosseous (IO) access may be required, which involves giving fluids and medication into the marrow of the bone) and take bloods and blood cultures to identify the source of the underlying infection.
- Give IV/IO antibiotics.
- Give IV/IO fluids and check lactate levels. (Lactate is produced when there are low oxygen levels in a patient’s body tissue; high lactate levels can be an indicator of sepsis).
- Seek senior paediatric expertise.
- Consider medications to help the heart to beat more forcefully (inotropic support).

1.5 **Assessment of vital signs**

1.5.1 Vital signs are frequently recorded in infants and children who attend emergency departments (Royal College of Paediatrics and Child Health, 2018a). Vital signs include:

- heart/pulse rate
- respiratory rate and effort (whether the child is breathing easily or with difficulty)
- blood pressure
• oxygen saturation
• capillary refill time
• level of consciousness
• temperature
• weight and height.

1.5.2 Vital signs that are outside expected ranges may indicate that a patient is at risk of serious illness or death. The detection of vital signs outside of expected ranges, followed by appropriate escalation and response, can avoid patient deterioration and improve patient outcomes (Royal College of Emergency Medicine, 2016).

1.5.3 NICE guidance on early recognition and management of sepsis recommends assessing temperature, heart rate, respiratory rate, blood pressure, level of consciousness and oxygen saturation in young people and adults (National Institute for Health and Care Excellence, 2016).

1.5.4 Specifically, the guidance for children under 5 refers to measuring blood pressure if heart rate or capillary refill time is not within the expected range, using a correctly sized blood pressure cuff (National Institute for Health and Care Excellence, 2016).

1.6 Paediatric Early Warning Score (PEWS)

1.6.1 The Paediatric Early Warning Score (PEWS) system is designed to identify infants and children at risk of clinical deterioration. The aim is to monitor, detect and prompt an urgent response to signs of deterioration in order to prevent serious illness and death (Thomas-Jones et al, 2018). It can be used by staff at all levels to escalate care for sick patients.

1.6.2 Early warning scores are generally defined as bedside ‘track and trigger’ tools to help alert staff to clinically deteriorating children by periodic observation of vital signs, generation of a numeric score and predetermined criteria for escalating urgent assistance with a clear framework for communication. In using these physiological track and trigger systems, the goal is to ensure timely recognition of patients with potential or established critical illness and to ensure a timely and appropriate response from skilled staff (Lambert et al, 2017).
1.7 NHS 111 triage

1.7.1 The NHS Pathways telephone triage system supports non-clinical call handlers to assess the healthcare needs of callers to urgent and emergency services (NHS Digital, 2020). It is a clinical decision support system comprising an interlinked series of algorithms, or pathways, that link clinical questions and care advice, leading to clinical endpoints. During a call, it presents the call handler with a series of questions to ask the caller. Based on the answers given by the caller, the most appropriate clinical response with a specific level of care and time frame is reached. To direct a patient to the most appropriate care, questions are asked in a clinical hierarchy; questions to identify potentially life-threatening symptoms are asked early in the call, progressing through to questions about less urgent symptoms. The NHS Pathways system is owned by the Department of Health and Social Care, commissioned by NHSX and delivered by NHS Digital.

1.8 999 triage

1.8.1 When an ambulance service receives a 999 call, an electronic system is used by a non-clinical call handler to triage and prioritise the response required. Two such 999 triage systems are in use across the UK. Four ambulance services use the NHS Pathways system described above. Six ambulance services use the Advanced Medical Priority Dispatch System (AMPDS), an internationally recognised system that is hosted in the US.

1.8.2 Each system has protocols for different urgent and emergency situations. There is a pre-defined set of questions to ask the caller to help prioritise the level of response required, and standard instructions and advice are given to callers while they await clinical advice or an ambulance response. There is an expectation that the system-generated questions, instructions and advice are followed in a systematic way, without deviation from the script (unless a clinician is involved in a call and independent clinical judgement can be used).

1.9 Ambulance response times

Table 1 shows the target ambulance response times set out by NHS England (2018). The levels of urgency range from category 1 (for life-threatening situations) to category 4 (for less urgent problems).
<table>
<thead>
<tr>
<th>Category</th>
<th>Headline description</th>
<th>Sub description</th>
<th>Average response target</th>
<th>90th percentile response target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Life threatening</td>
<td>A time critical life-threatening event requiring immediate intervention or resuscitation.</td>
<td>7 minutes</td>
<td>15 minutes</td>
</tr>
<tr>
<td>2</td>
<td>Emergency</td>
<td>Potentially serious conditions that may require rapid assessment and urgent on-scene intervention and/or urgent transport.</td>
<td>18 minutes</td>
<td>40 minutes</td>
</tr>
<tr>
<td>3</td>
<td>Urgent</td>
<td>An urgent problem (not immediately life threatening) that needs treatment to relieve suffering and transport or assessment and management at the scene with referral where needed within a clinically appropriate timeframe.</td>
<td>None</td>
<td>2 hours</td>
</tr>
<tr>
<td>4</td>
<td>Less-urgent</td>
<td>Problems that are less urgent but require assessment and possibly transport within a clinically appropriate timeframe.</td>
<td>None</td>
<td>3 hours</td>
</tr>
</tbody>
</table>
1.10 Decision making

1.10.1 Clinical decision-making is often complex, and there are multiple models which explain how people make decisions. The way a decision is made can depend on the knowledge, strategies and skills held by the decision maker. For example, experts tend to use a more intuitive or pattern-recognition-based decision-making style which relies on their previous experience, whereas novices tend to take a more analytical approach to decision making (Kahneman, 2011; Klein et al, 1993). Decision making is also driven by the context in which the decision is made, as factors relating to the workplace scenario (for example, allocation of resources and task priorities) can shape, support and constrain performance (Chartered Institute of Ergonomics and Human Factors, n.d.).

1.10.2 All decision models recognise the importance of information gathering and that high-quality, relevant information is likely to produce a better decision (Chartered Institute of Ergonomics and Human Factors, n.d.). The investigation has considered decision making throughout Mohammad’s care, considering the people who were making the decisions, the context in which the decisions were made and the quality of the information provided.
2 The reference event

This investigation used the following patient safety incident, referred to as ‘the reference event’, to examine the issue of how to recognise when an infant is acutely ill and differentiate between a viral illness and a more serious, life-threatening bacterial illness.

2.1 Local context

2.1.1 The reference event involved an NHS Trust with acute and community services and an ambulance service. The acute service has a 24-hour emergency department (ED), with a co-located paediatric emergency department which operates between 08:00 hours and 22:00 hours.

2.2 Details of the event

Background

2.2.1 Mohammad was a previously well baby boy aged 3 months. Mohammad lived with his Mother and maternal Aunt. Mohammad’s Father lived in Jordan. Mohammad and his Mother had recently visited Jordan for a month, returning to the UK on 5 September 2018.

2.2.2 Mohammad received his first set of immunisations on 26 July 2018, which included the meningitis B (MenB) vaccine. He had missed his 12-week immunisations (diphtheria, tetanus, pertussis, polio, haemophilus influenzae type B (Hib) and hepatitis B, rotavirus) due to being abroad; however, a new date for these had been arranged. His second MenB vaccination was not due for another 2 weeks, when he would be 16 weeks old (Public Health England, 2017).

2.2.3 On 6 September 2018, Mohammad’s Mother contacted the health visitor; she was upset because Mohammad was unsettled and crying. She requested a home visit as she was worried about Mohammad vomiting after feeds. Mohammad’s Mother reported to the investigation that she told the health visitor that he had had a cold and colic (prolonged and intense crying) for a few days, and that he had been vomiting feeds for a week.

2.2.4 The health visitor described to the investigation that Mohammad was “absolutely fine”, having carried out a full assessment of him. She recalled his Mother holding him and giving him a feed which he took well. The health advisor advised her to start Mohammad on anti-reflux milk. This is a type of milk formula which is thickened to prevent babies bringing up the milk during or after a feed.
2.2.5 On the afternoon of 10 September 2018, Mohammad seemed unsettled and so his Mother tried feeding him a small amount of baby rice. Mohammad’s Mother described that he vomited and went blue/pale in colour and started grunting.

**Call to NHS 111**

2.2.6 Mohammad’s Aunt telephoned NHS 111 at 18:57 hours; the call lasted just under 8 minutes. The call handler used the NHS Pathways triage system to assess Mohammad’s symptoms so that they could select the appropriate response to his healthcare needs.

2.2.7 Mohammad and his Mother could be heard in the background of the call. He was experiencing a range of symptoms. Mohammad’s Aunt told the call handler that he:

- was on anti-reflux milk
- had “gone really yellow”
- had been violently sick
- had been fed baby rice just before being sick
- was struggling to breathe and was “making grunting noises”
- was “warm”.

2.2.8 After hearing the answers to the initial questions, the call handler asked: “Right, out of all the symptoms that he has got, what’s yours and mum’s main concern for him today?” Mohammad’s Mother and Aunt were heard talking; their response was: “It’s just the colour of his skin and the breathing”. The call handler responded: “Alright, so unfortunately we can only assess one so you would have to pick between the two, what is the main concern?” The response to this was “the breathing”.

2.2.9 The call handler selected ‘breathing problems, breathlessness or wheeze’ in the NHS Pathway system. This selection prompted the call handler to ask further questions about Mohammad’s breathing.
2.2.10 His Mother and Aunt indicated that Mohammad was showing signs of abdominal recession as they stated that his tummy underneath his ribs was sucking in with every breath. The information indicated that Mohammad was in respiratory distress (that is, he was struggling to breathe) so a ‘category 2’ ambulance was called (see 1.9). The ambulance arrived at Mohammad’s home in 16 minutes which is within the average response target of 18 minutes for category 2 (NHS England, 2018).

Assessment by ambulance crew 1

2.2.11 Once the ambulance crew was with Mohammad, they gathered information about Mohammad’s medical history from his Mother and Aunt who were both together with Mohammad. The information that the paramedic documented on the Patient Reporting Form (PRF) was that:

- he had suffered with gastric reflux
- his milk was changed a week ago
- his Mum had introduced baby rice that evening and he had vomited three times since then.

2.2.12 The ambulance crew undertook two sets of observations 15 minutes apart, which included Mohammad’s pulse, respiratory rate, blood pressure (on one occasion), temperature, oxygen saturation and blood glucose levels.

2.2.13 The crew noted that Mohammad had a raised heart rate (180 and 182 beats per minute; expected range 110 to 160) and slightly raised respiratory rate (40 breaths per minute; expected range 30 to 40). It was documented that he did not have a tracheal tug (sucking in at the front of the throat, which is a sign of respiratory distress). It was documented that there was no wheeze. The crew did not record any other signs of respiratory distress, for example grunting or nasal flaring. The crew administered oral liquid paracetamol to treat his raised temperature of 38.6°C, which he did not vomit back.

2.2.14 A decision was made to take Mohammad to hospital for further assessment. The crew transported Mohammad and his Mother to the nearest emergency department (ED). They arrived at the ED at 20:04 hours. An emergency ‘blue light’ transfer was not deemed necessary.
Arrival and triage at the ED

2.2.15 The ambulance crew stayed with Mohammad and his Mother until he was seen by the triage nurse 29 minutes after arrival. The ambulance crew and his Mother told the ED triage nurse that Mohammad had been given baby rice that evening and had vomited a few times afterwards and that he had also brought some phlegm up, had gone pale and was grunting.

2.2.16 The Trust was using a modified version of the Brighton Paediatric Early Warning Score (PEWS) (Monaghan, 2005). The ED triage nurse’s initial assessment found that Mohammad had a PEWS of 6 (his temperature was 39°C, a heart rate of 195 beats per minute, and a respiration rate of 52 breaths per minute). According to Trust policy, this meant that ‘Nurse in Charge and Senior Doctor to see immediately. Consider SEPSIS bundle [the recommended steps for treating sepsis]’.

2.2.17 The ED triage nurse told the investigation that Mohammad did not look unwell. She recalled that he was alert, responsive, his eyes were bright, his eyes were following her around, and that he was smiling. He was not pale or grunting. However, when assessing his vital signs, it was found that his temperature was high, as was his pulse and respiratory rate, although he had no abdominal recession and no tracheal tug.

2.2.18 Mohammad was triaged as very urgent (triage category 2). All the cubicles in the paediatric ED were full at the time. However, there was a paediatric bed available in the resuscitation area of the ED so the ED triage nurse took him there.

Assessment in the ED resuscitation area

2.2.19 The ED triage nurse verbally handed over Mohammad’s care to the nursing staff in the resuscitation area, which included details of his high temperature, fast heart rate and high PEWS. She asked the nursing staff to request that he be seen by the paediatric team.

2.2.20 The assessment by the nurses when Mohammad arrived in the resuscitation area included observing his vital signs. They felt that he looked well but noted that he had a high temperature and that his Mother had explained that he had had some cold-like symptoms previously. At 20:45 hours Mohammad’s PEWS was 4. The required actions on the Trust PEWS pathway were: ‘Nurse in charge and Senior Doctor review. Consider informing Consultant. Consider SEPSIS bundle’.
2.2.21 One of the nurses recalled that they initiated a call to a locum middle-grade doctor, who was classed as the senior doctor for the ED (not specifically paediatrics), “because his [Mohammad’s] tachycardia [fast heart rate] and temperature had hit the trigger for sepsis”.

2.2.22 The ED medical records indicate that at 21:13 hours Mohammad was reviewed by a locum middle-grade ED doctor. The ED doctor recorded in the electronic medical record at 21:26 hours that Mohammad looked well, was alert and smiling. He assessed his breathing and noted that his respiratory rate was 52 breaths per minute. There was no intercostal recession (indrawing of the chest wall between the ribs) and ‘good air entry’. Mohammad was recorded as ‘pink’ in colour, his effort of breathing was described as normal, his SpO2 (blood oxygen saturation) was 100% and he was described as having normal heart sounds. A full body examination was performed; no neck stiffness was noted, and no rash was evident.

2.2.23 The plan documented was to collect a capillary blood gas (to ascertain Mohammad’s lactate levels), and to refer Mohammad for paediatric assessment due to his high temperature. The ED doctor documented a potential working diagnosis of ‘?infection ?cause’. The capillary blood gas results were available at 21:29 hours; however, these were not known to any of the healthcare staff (including ED staff and the on-call paediatric team) caring for Mohammad during his admission.

2.2.24 At the time the referral was made to the paediatrics team, it was the staff’s shift handover time. A decision was made that as Mohammad looked well, they would wait until the handover was completed and then come down to assess him. Approximately 10 to 15 minutes later there were conversations between paediatric medical staff and ED staff to decide whether Mohammad could be sent to the observational area (OA) in the paediatric department, in a different part of the hospital to the ED, for his assessment.

2.2.25 The locum middle-grade ED doctor re-assessed Mohammad to see if he was fit to transfer to the paediatric OA. On reviewing him again, he observed that Mohammad was crying and had a raised temperature and pulse. A decision was made for the specialty-grade doctor in paediatrics to attend ED and assess Mohammad rather than transfer him to the ward.
2.2.26 At 21:30 hours Mohammad’s PEWS was 1 and therefore the plan was to continue normal observations according to the PEWS action pathway. However, by 22:15 hours his PEWS rose again to 4, for which the PEWS action pathway states: ‘Nurse in Charge and Senior Doctor review. Consider informing Consultant. Consider SEPSIS bundle’. There was no consultant present in the department and none was called.

**Assessment by specialty-grade doctor in paediatrics**

2.2.27 It is recorded in the medical records that Mohammad was reviewed by a speciality-grade doctor in paediatrics at 22.30 hours in the ED resuscitation area. The doctor spoke to Mohammad’s Mother and took a history which included that she had tried him with a bit of baby rice, but he immediately coughed, spluttered, had a bit of a vomit and had gone pale. It was noted, as part of Mohammad’s medical history, that he had had a bit of a cough and had been ‘snotty’ for a couple of days but with no high temperature. It was recorded that his Mother was worried that she had caused him to choke by giving him the rice.

2.2.28 The doctor recorded that when Mohammad was asleep he was ‘... pink and well perfused [good colour/blood supply], chest clear. No wheeze/added sounds. No recession. Mild tracheal tug and mild intermittent grunting. Heart rate 170-180 at rest [which is faster than the expected rate for a baby aged 3 months]’. However, when Mohammad was awake it was recorded that he was ‘... unsettled, crying, HR [heart rate] 200’. The doctor checked Mohammad’s skin and looked under his nappy; there was no evidence of a rash.

2.2.29 The doctor’s impression was that Mohammad had a choking episode and possibly early stages of bronchiolitis (lower respiratory tract infection) or a viral illness. A plan was made to prescribe ibuprofen to reduce his temperature, as it had risen to 38.1C, and to observe him in the paediatric OA. The doctor documented in Mohammad’s paper medical records that if his temperature and heart rate reduced then they were happy for him to go home.

2.2.30 The doctor told the investigation that they explained to Mohammad’s Mother about his heart rate being increased because of his temperature and that they would admit him to the children’s ward for further observation. She gave his Mother information about what to do if Mohammad’s condition did not improve, changed, or if she had further concerns about him. The doctor highlighted to her to look out for increased effort to breathe.
**Observation in the OA and discharge**

2.2.31 Before Mohammad was transferred from the ED to the OA, an ED nurse working in the resuscitation area provided a verbal handover, via telephone, to a nurse in the OA. The handover information was then relayed to the senior nurse in the OA. The handover was supplemented by a paediatric department handover sheet.

2.2.32 The handover sheet gave the reason for Mohammad’s attendance as ‘choked on baby rice/cyanosed [a bluish/purple colour to the skin]’. Three temperature recordings were documented, and it was also recorded that ibuprofen had been given. The handover sheet also had one set of heart rate and respiratory rate observations and one PEWS of 4 with the recommendation written as ‘review’.

2.2.33 A nurse was required to accompany Mohammad’s Mother on the transfer because of his PEWS. As the resuscitation area was busy, a registered adult nurse from another area of the ED was called to take Mohammad to the OA. She attended the resuscitation area and was given a brief handover; she was aware that the OA had already had a telephone handover. The nurse’s recall of the verbal handover was that Mohammad had been generally unwell. During interview she stated that Mohammad’s Mother told her that “he has not been himself”.

2.2.34 The OA nurse checked and recorded in the nursing admission record Mohammad’s temperature (36.9C), heart rate (149 beats per minute), respiratory rate (40 breaths per minute) and oxygen saturation (100%). All were within the expected ranges for his age. It was documented that he had a PEWS of 0, there was no recession, wheeze or grunting. Mohammad was asleep when the observations were being taken. The OA nurse discussed her assessment of Mohammad with the registrar and a decision was made that he was safe to be discharged home with 24 hours open access to the OA (meaning the Mother could contact the ward directly if she was worried and bring Mohammad straight back to the ward to be seen). The nurse recorded ‘Mum happy to take home’.

2.2.35 The specialty-grade doctor in paediatrics who had seen Mohammad in the ED recorded in the medical records at 00:15 hours that Mohammad’s observations at the time of her visit were within the expected ranges and that he was sleeping. It was recorded that there was no grunting and no increased work of breathing. The medical record entry stated: “I have spoken to Mum – happy to go home”. Mohammad was discharged at 23:45 hours and his Mother was given safety-netting advice (advice about signs and symptoms to look
out for and what action to take should they occur). She was also given an advice leaflet which stated ‘any worries in the next 24 hours contact ward’; it also contained the ward telephone numbers. The GP discharge letter referred to Mohammad being admitted to the ED after a choking episode at home with no further episodes in the ED. The ED letter referred to a ‘low grade fever and mild work of breathing with occasional cough. Has two-day history of coryzal [common cold] symptoms. Treated as likely bronch [bronchiolitis].’

Call to the OA and 999

2.2.36 At approximately 03:40 hours on 11 September 2019, Mohammad’s Mother contacted the OA; the nurse who had previously discharged Mohammad answered the call. Mohammad’s Mother told the nurse that he had developed a rash that looked like red blisters on his body/forehead and had started to go blue around the lips. The OA nurse could hear a high-pitched continual cry and advised her to call 999 immediately.

2.2.37 Mohammad’s Aunt called 999 at 03:41 hours. She described to the call handler that Mohammad had “spots everywhere” and “blue lips”. The call handler was told that Mohammad had been discharged from the children’s ED at 23:45 hours the previous night with a virus. His Aunt then described that since he had got home, he had developed new symptoms which included a rash, spots, blue lips and two episodes of diarrhoea. Mohammad could be heard with a high-pitched scream throughout the call.

2.2.38 A category 1 ambulance was requested (see 1.9).

Assessment by ambulance crew two

2.2.39 The information collated during the 999 call was transmitted electronically through incremental text messages to the ambulance crew’s data screen. This included the Mother’s concerns of ‘spots everywhere, blobs of birthmarks everywhere, lips are going blue’. The messages also included that Mohammad was a male aged 3 months, was conscious and had agonal/ineffective breathing (was gasping for air). Both crew members told the investigation that during the journey they had considered the potential for meningitis and reviewed their aide memoire on this topic while travelling to the scene.
2.2.40 On arrival at 03.51 hours, the ambulance crew assessed Mohammad and heard his Mother’s concerns about his lips turning blue, the increasing rash and two episodes of diarrhoea. The crew recorded that Mohammad had ‘new spots’ on his forehead and chest. They also recorded that there was no evidence of abdominal recession, no tracheal tug, his lips were not blue, and his chest sounds were clear and equal, indicating there was no evidence of breathing difficulties.

2.2.41 Mohammad’s vital signs were within the expected ranges and he was described to be alert with no obvious signs of pain and played with the paramedic’s finger. The crew members were not able to measure Mohammad’s blood glucose as there was not enough blood produced by the pin prick test. Their assessment included a ‘glass test’ (see 1.2.5). The emergency medical technician pressed the glass against the three spots observed; the result was deemed as “inconclusive”.

2.2.42 When Mohammad was transferred into the back of the ambulance, he was attached to a Lifepak 15c machine. The Lifepak records and displays a patient’s heart rhythm, heart rate, blood pressure and oxygen levels on a screen. This was thought to be at 04:11 hours as detailed in the ambulance trust’s local investigation.

2.2.43 The crew did a second set of observations at 04:33 hours which suggested that Mohammad was alert, had an oxygen saturation of 99%, a heart rate of 162 beats per minute and a respiratory rate of 32 breaths per minute.

2.2.44 Based on their assessment, the ambulance crew took Mohammad, in the arms of his Mother, to hospital under normal driving conditions (that is, not under emergency ‘blue light’ conditions). They left the family home at 04:28 hours and arrived at the ED at 04:40 hours.

**Second ED attendance**

2.2.45 On arrival at the ED, the paediatric triage was closed so the ambulance crew went to the adult triage to hand Mohammad’s care over to a nurse. A nurse who had previously dealt with Mohammad happened to be passing, could see from the colour of his legs from under the blanket that Mohammad looked unwell, and took him to the resuscitation area immediately.
2.2.46 Mohammad was assessed in the resuscitation area and an emergency resuscitation call was made to summon more help. Mohammad was noted to be unwell, pale, and floppy with a non-blanching rash over his body (a rash that did not fade under pressure). Some of his vital signs were outside of expected ranges; his respirations were noted to be raised at 78 breaths per minute (expected range 30 to 40), his temperature was 34.6°C (expected range 36.6°C to 37.2°C), and his capillary refill time was 8 seconds (expected capillary refill time is usually less than 2 seconds). The on-call consultant was called and attended. Mohammad’s health continued to deteriorate and he went into respiratory and cardiac arrest at 05:28 hours. Resuscitation attempts were stopped at 06:10 hours, as Mohammad was not responding. His Mother was present in the resuscitation area throughout this time.

2.2.47 The cause of death documented on the post-mortem report was infection with meningococcus (serogroup B).
3 Involvement of the Healthcare Safety Investigation Branch

This section of the report outlines how HSIB was alerted to the issue of recognising the acutely ill infant. It describes the criteria HSIB used to decide whether to go ahead with the investigation, and the methods and evidence used in the investigation process. HSIB conducted an initial scoping investigation which determined that the patient safety concern met the criteria for a national investigation.

3.1 Notification of the reference event and decision to investigate

3.1.1 HSIB identified the patient safety risk related to recognising that an infant is acutely unwell and at risk of serious illness following routine review of incidents reported to the Strategic Executive Information System (StEIS). StEIS is a national database for reporting serious safety incidents in healthcare. HSIB prioritised this theme as a safety risk for investigation following assessment against HSIB’s referral criteria.

3.1.2 HSIB reviewed relevant incidents reported on StEIS to identify the reference event. A StEIS search was then conducted to understand whether similar events had been reported. This search produced 23 relevant results in a 1-year period, with 4 reports commenting on interpretation of Paediatric Early Warning Scores (PEWS).

3.1.3 HSIB contacted the Trust where the reference event took place and a scoping investigation was undertaken. The purpose of scoping investigations is to explore the identified patient safety risk(s), and to consider the practicality and value of proceeding to a national investigation. The Trust welcomed HSIB’s involvement and fully collaborated with information gathering.

3.1.4 During the scoping phase of the investigation, a further StEIS search was undertaken to understand the reported numbers of incidents similar to the reference event over a longer time period. This returned 27 relevant results, highlighting issues with unexpected patient deterioration after admission to or discharge from hospital. A similar search was also performed using the National Reporting and Learning System which returned 29 relevant results, the majority of which described unexpected deterioration following admission or discharge.
3.2 Decision to conduct a national investigation

3.2.1 Following preliminary information gathering, HSIB concluded that the safety issues identified by the analysis of the scoping investigation met the criteria for investigation. HSIB’s Chief Investigator authorised a national investigation. A summary of the analysis against HSIB’s investigation criteria is given below.

Outcome impact – what was, or is, the impact of the safety issue on people and services across the healthcare system?

3.2.2 The reference event highlighted some of the risks associated with the recognition and care of sick infants. The report of the Confidential Enquiry into Maternal and Child Health (2008) identified the need for all healthcare professionals to be able to recognise serious illness in children. There continued to be reports of deaths of infants and children and relatively fit people in whom sepsis was not recognised and treated quickly enough (NHS England, 2017).

3.2.3 Section 1 provides a detailed background of feverish illness in infants and children. Children with fever without an obvious cause are of particular concern to healthcare professionals because it is especially difficult to distinguish between simple viral illnesses and life-threatening bacterial infections in this group of patients. As a result, there is a perceived need to improve the recognition, assessment and immediate treatment of feverish illnesses in children (National Institute for Health and Care Excellence, 2019a).

Systemic risk – how widespread and how common a safety issue is this across the healthcare system?

3.2.4 The global burden of sepsis is difficult to ascertain, although a scientific publication estimated that in 2017 there were 48.9 million cases and 11 million sepsis-related deaths worldwide, which accounted for almost 20% of all global deaths (Rudd et al, 2020). In 2017, almost half of all global sepsis cases occurred among children, with an estimated 20 million cases and 2.9 million global deaths in children under 5 years of age (Rudd et al, 2020).

3.2.5 This safety issue impacts across the boundaries of many NHS services which see and/or provide advice, guidance and care to infants/children and their parents. This includes providers of pre-hospital care and specifically ambulance personnel who have limited paediatric expertise and training.
3.2.6 There is however no single validated tool for identifying sepsis or risk of sepsis in infants and children. Every emergency department treating children should have an established early warning system (Royal College of Paediatrics and Child Health, 2018b). A systematic review identified that Paediatric Early Warning Scores (PEWS) are widely used internationally. However, empirical evidence revealed a lack of consensus on which PEWS system is most effective or useful (Lambert et al, 2017).

Learning potential – what is the potential for an HSIB investigation to lead to positive changes and improvements to patient safety across the healthcare system?

3.2.7 There are opportunities for HSIB to complement existing workstreams to quickly identify infants and children who are seriously ill or getting sicker, so that they receive rapid treatment to improve their condition. Investigating the safety issue from a different perspective could result in system-wide safety recommendations and improvements.

3.3 Investigation scope

The investigation’s core objective was to understand decision making and why decisions made sense at the time. The investigation sought to understand how work demands and system constraints interacted to influence the way staff worked on the night of Mohammad’s admission. This included an understanding of:

- the assessments of Mohammad
- the use of early warning scores
- consideration of sepsis
- the importance of listening to parents.

3.4 Evidence gathering

3.4.1 The investigation was extended due to the COVID-19 pandemic, which restricted the investigation team’s work.

3.4.2 Multiple sources of evidence were gathered and analysed by the investigation, including:

- a review of Mohammad’s clinical records and national guidance and standards regarding recognition of acutely ill infants and children
• meetings with Mohammad’s Mother and Aunt
• interviews with staff members either directly or indirectly involved in the reference event
• a review of the Trust’s internal serious incident investigation reports
• a review of literature relevant to the safety risks.

Appreciative inquiry

3.4.3 The investigation conducted appreciative inquiry conversations with parents of infants, children and young people. Appreciative inquiry is promoted as an approach to exploring and bringing about change in social systems. Using an appreciative inquiry approach removed the boundaries of power and authority associated with ‘roles’.

3.4.4 The aim was to explore when parents and/or carers felt they were listened to. The investigation created a set of questions for parents and held a focus group with trainee doctors working in paediatrics.

Stakeholder engagement

3.4.5 Stakeholders across the healthcare system were contacted and interviewed to establish their perspective on the national context. These included:

• NHS England and NHS Improvement National Patient Safety Team
• Royal College of Paediatrics and Child Health
• Department of Health and Social Care
• Health Education England
• Public Health England
• NHS provider organisations
• charitable organisations.
3.5 Methods used to analyse the evidence

3.5.1 The investigation used multiple analysis tools including:

- the Systems Engineering Initiative for Patient Safety (SEIPS) (Holden et al, 2013; Carayon et al, 2006)
- the Functional Resonance Analysis Method (FRAM) (Hollnagel, 2018).

3.5.2 FRAM was the main method used for evidence analysis. FRAM aims to reflect risks within complex systems. It does this by describing variability in the functions within the system and looks to model what is needed for everyday performance to go right. FRAM involves exploring ‘work as done’ with frontline staff to identify the ‘functions’ that are being performed. A function is defined as ‘the activities - or set of activities - that are required to produce a certain outcome’ (Hollnagel, 2018).

In doing this, FRAM develops a model of the core functions to illustrate how they are linked, how variability might occur, and how this may affect outcomes. To achieve this, links are created between functions by identifying six specific aspects of each function: input, output, preconditions, resources, controls and time factors (see figure 1).

Figure 1 Aspects of functions used in the FRAM model
4 Analysis and findings – the reference event

The investigation explored each phase of Mohammad’s care in detail to understand why healthcare staff did not recognise that Mohammad was acutely ill and at risk of deterioration. The analysis and findings for each phase are discussed in this section. The investigation identified gaps within the flow of information and its availability to healthcare professionals throughout Mohammad’s care; however, this theme has been covered by multiple HSIB reports and was not covered in detail within this report. The themes that are analysed in more detail in this section are:

• the assessments of Mohammad
• ambulance crew training and use of early warning scores
• consideration of sepsis
• listening to parents.

4.1 The assessments of Mohammad

Health visitor

4.1.1 Mohammad’s Mother described him as having been unsettled, crying and irritable, that he had had a cold and colic for a few days and that he had been vomiting. However, the health visitor had no concerns that Mohammad was unwell based on her assessment. He was displaying non-specific signs and symptoms which are common in viral infections but may be present in bacterial meningitis (Thompson et al, 2006).

NHS 111

4.1.2 The decision to choose breathing as the main problem enabled a suitable course of action for Mohammad’s healthcare needs, which was in keeping with outcomes referred to in ‘The use of primary and secondary care services by children and young people following contact with NHS 111 – investigating the experience and patient flow of four common conditions’ (Royal College of Paediatrics and Child Health, 2015b).

4.1.3 Assessing Mohammad’s healthcare needs during the NHS 111 call was difficult. The script used by an NHS 111 call handler helps them, as a non-clinician, to gather key information about the patient and their symptoms so that they can direct them to the appropriate advice
and course of action. The NHS 111 Pathway only allowed for a main concern to be addressed. The investigation noted that Mohammad was displaying a lot of symptoms and prioritising the most serious was difficult for his Mother and Aunt.

**Ambulance crew 1**

4.1.4 The crew members had access to Joint Royal Colleges Ambulance Liaison Committee (JRCALC) guidelines (Association of Ambulance Chief Executives and Joint Royal Colleges Ambulance Liaison Committee, 2016) to support their assessment. The paramedic crew referred to the expected ranges for vital signs in infants aged 3 months and compared Mohammad’s reading in relation to these. There is also a mobile app of the JRCALC guidelines (Association of Ambulance Chief Executives and Joint Royal Colleges Ambulance Liaison Committee, n.d.) and on this there is a ‘page for age’ reference. This includes information on expected ranges for vital signs at birth, at 1, 3, 6, 9, 12 and 18 months, then every year of age up until the age of 11.

4.1.5 The expected range for heart rate in an infant aged 3 months is 110 to 160 beats per minute – Mohammad’s was raised at 180 and 182 beats per minute. Mohammad’s respiratory rate was at the upper end of the expected range and his temperature was elevated at 38.6°C.

4.1.6 The crew recognised that some of Mohammad’s vital signs were not within expected ranges and considered it could be indicative of an infection, although at the time of assessment they were not thinking of a serious underlying sepsis. The ambulance crew members were not aware from the NHS 111 call of Mohammad’s breathing difficulties, reported as grunting and sucking in of his abdomen under his ribs. Evidence indicates that his breathing difficulties were no longer apparent when the ambulance crew assessed him.

4.1.7 The rationale for attending hospital was that Mohammad’s temperature was raised and the local paramedic and community care pathway guidance stated that infants of his age (3 months) with a raised temperature are to be taken to hospital for further assessment. The decision to transfer Mohammad to the nearest emergency department is in keeping with the latest best practice guidance on conveyance of children by operational ambulance clinicians in face-to-face settings (Association of Ambulance Chief Executives, 2021).
The emergency department

4.1.8 The Royal College of Paediatrics and Child Health has published standards for children in emergency care settings (Royal College of Paediatrics and Child Health, 2018a). This provides healthcare professionals and service planners with clear standards of care that are applicable to children in urgent and emergency care settings. At the time of Mohammad’s attendance in the emergency department (ED), some of the standards that relate to the treatment of children in EDs were met; however, some of the standards were not met. Some of the standards are below.

Examples of standards that were met:

- ‘Every emergency department treating children must have their qualified staff trained in infant and child basic life support (BLS)’ – staff on duty in the ED were trained in paediatric basic life support.

- ‘Every emergency department treating children has an established Early Warning System [EWS]’ – the Trust had a paediatric EWS in place and Mohammad did have his Paediatric Early Warning Score (PEWS) calculated and recorded.

- ‘Policies in place for the escalation of care for critically unwell children’ – the Trust had an escalation policy in place.

Examples of standards that were not met:

- ‘Every emergency department treating children must be staffed with a Paediatric Emergency Medicine (PEM) consultant with dedicated session time allocated to paediatrics’. The ED did not have a paediatric emergency medicine consultant with dedicated session time allocated to paediatrics. The investigation was told that consultant paediatric staff attend the ED for about four shifts every week to support learning and ensure “there’s visible presence” in the department.

- ‘Every emergency department treating children must be staffed with two registered children’s nurses’. At the time of Mohammad’s admission there was only one registered children’s nurse in the ED until 20:00 hours, however due to workload on the evening Mohammad was admitted, she worked later than her planned shift finish time. After this time there were no registered children’s nurses on shift until the following day. The investigation was told that the Trust did not have enough registered children’s nurses to meet this standard. The investigation was told that a business case for additional paediatric nurses, in line with the national standards, was being developed.
‘Every emergency department treating children must have a member of staff with an Advanced Paediatric Life Support (APLS) (or equivalent) training on duty at all times’. An APLS course is a nationally recognised training course that provides the knowledge and skills necessary for the recognition and effective treatment and stabilisation of children with life-threatening emergencies. It uses a structured, sequential approach to training and is usually a 2-day course which is in addition to basic life support training. The triage nurse was APLS trained; however, after she had left the department, no other staff working in the ED at the time of Mohammad’s attendance fulfilled this standard. Staff told the investigation that there were not enough staff trained in APLS or equivalent to fully meet this standard.

‘Developing a flexible nursing workforce with both paediatric and adult emergency care skills, for example with appropriate rotational training, is key (especially in smaller units)’. The investigation was told that rotational posts were planned with the paediatric department, but that rotational posts had not started at the time Mohammad was in hospital.

**ED triage nurse**

4.1.9 The ED triage nurse was a Registered Sick Children’s Nurse and was experienced in assessing and caring for sick infants and children.

4.1.10 The ED triage nurse recognised that although Mohammad did not look unwell, some of his vital signs were outside of the expected range. The nurse described a ‘gut feeling’ that something was not right with Mohammad. He was appropriately triaged as very urgent (Manchester Triage Group, 2014) based on his vital signs.

4.1.11 The interpretation of Mohammad’s symptoms differed between the ambulance crew and the triage nurse. However, at the point of triage assessment, Mohammad’s vital signs, including respiratory rate, temperature and heart rate, had all deteriorated.

4.1.12 The PEWS action pathway for Mohammad’s PEWS of greater than 5 (his score was 6) states ‘nurse in charge and senior doctor review immediately. Consider SEPSIS bundle’.

4.1.13 The Trust has a local Sepsis Screening and Action Tool for children under the age of 5 who present to the ED ‘with a suspected infection or who have clinical observations outside of normal limits’. The tool asks three questions and if all three questions are answered with a yes, then the sepsis 6 pathway should be started (see 1.4). Mohammad had a PEWS
of greater than 4 so the answer to the first question, ‘Is child feverish or looking sick?’, was ‘yes’. The answer to the second question, ‘Could this be infection?’ was the ‘yes, but source unclear at present’. The final question asks, ‘Is ONE red flag present?’ – Mohammad had a heart rate of 195 beats per minute which met the criteria for ‘severe tachycardia’. The triage nurse told the investigation that she did not start the sepsis 6 pathway herself at this point as her action was to transfer Mohammad to the paediatric bed in the resuscitation area. She had other patients in triage to see and a queue was building.

4.1.14 The triage nurse described at interview that her immediate decision to take Mohammad to the resuscitation area was because she thought the sepsis 6 pathway would be implemented there.

Nurses in the ED resuscitation area

4.1.15 When Mohammad arrived in the resuscitation area his assessment included observing his vital signs.

4.1.16 The two nurses working in the resuscitation area said it was “very busy” when Mohammad was admitted, with four other patients described as being very poorly.

4.1.17 The initial assessment by the nurses resulted in them thinking Mohammad was not acutely unwell and the Trust’s Sepsis Screening and Action Tool for children under 5 years was not implemented. They did however request that the locum middle-grade ED doctor review Mohammad based on the higher-than-expected temperature and heart rate.

4.1.18 One of the nurses caring for Mohammad stated his high temperature and fast heart rate reduced in response to the administration of medicines. The nursing staff did not think Mohammad had sepsis but thought he had a more common viral-type illness, and that this may have been a factor in his inability to take his food properly.

Doctor in the ED resuscitation area

4.1.19 The locum ED middle-grade doctor received a medical history from the Mother and assessed Mohammad’s vital signs. Mohammad’s latest PEWS (calculated 28 minutes earlier) was 4. The doctor stated at interview that while there were no indicators of key concern at the time of his assessment, he did not want to discharge Mohammad because of his age, temperature, and his high PEWS at triage.
Specialty-grade doctor in paediatrics

4.1.20 The investigation analysed the clinical notes made by the specialty-grade doctor in paediatrics and found that Mohammad was displaying signs and symptoms which indicated he was unwell and was at risk of deterioration at the time of the specialty-grade doctor’s assessment at 22:30 hours.

4.1.21 The investigation assessed Mohammad’s symptoms against the Brighton PEWS and found he would have a PEWS of 8 at this time. He would have also raised a red flag for initiation of the sepsis 6 pathway in line with the Trust’s Sepsis Screening and Action Tool for children under 5 years. The assessment of Mohammad’s vital signs indicated his PEWS was greater than 4, so the first box would be a yes for ‘Is child feverish or looking sick?’.

The second question, ‘Could this be infection?’ would have met the ‘yes, but source unclear at present’. He had a red flag in that it was documented he had a mild tracheal tug and mild intermittent grunting. He also had a higher-than-expected heart rate; when he was awake, it was recorded that he was unsettled and crying with a heart rate of 200 beats per minute (his heart rate ‘at rest’ was recorded as 170 to 180 beats per minute).

4.1.22 The specialty-grade doctor in paediatrics reported at interview that Mohammad was intermittently crying, which can be an indicator of serious illness, but that he did settle and was asleep for most of her examination. As such, she stated that she was not worried about him being particularly irritable.

4.1.23 The locum ED middle-grade doctor told the investigation that he had returned to see Mohammad and had spoken with the specialty-grade doctor in paediatrics who was with Mohammad at the time. The ED doctor reported that the specialty-grade doctor in paediatrics was happy that Mohammad was fine and was considering sending him home. The ED doctor highlighted that he was not keen for Mohammad to go home due to his age and the symptoms he had had when he arrived at the ED. Following their discussion, he reported that the specialty-grade doctor in paediatrics said that she may keep Mohammad in for observation overnight and a plan was made to transfer him to the observational area (OA) in the paediatric department. The investigation heard from Mohammad’s mother who stated that she was worried about him going home and the doctor agreed to observe him on the ward for a bit longer.

OA and decision to discharge

4.1.24 One set of vital signs was taken in OA. The nurse told the investigation that when she assessed Mohammad he was settled, and she did not wish to wake him. The nurse checked and recorded Mohammad’s temperature
(36.9°C), heart rate (149 beats per minute) and respiratory rate (40 breaths per minute) and his oxygen saturation was recorded as 100%. The nurse told the investigation she did not take his blood pressure because this may have disturbed him. Mohammad’s vital signs were within expected ranges and so it was not considered by staff to be an issue that his blood pressure reading was not obtained.

4.1.25 National Institute for Health and Care Excellence (NICE) guidance on assessment and initial management of fever in under 5s (2019a) refers to observation in hospital, ‘when a child has been given antipyretics [medicine to lower their temperature], do not rely on a decrease or lack of decrease in temperature at 1–2 hours to differentiate between serious and non-serious illness’. Mohammad was administered paracetamol at 19:48 hours by the ambulance crew and then ibuprofen at 22:35 hours. He was discharged at 23:45 hours which was 1 hour and 10 minutes after the administration of an antipyretic.

4.1.26 A subject matter advisor for the investigation considered the NICE guidance and acknowledged that the paracetamol and ibuprofen that Mohammad had previously been administered may have caused his vital signs to fall within expected ranges. This would have resulted in a lower PEWS without necessarily addressing Mohammad’s true underlying condition. As such, it may have falsely reassured staff that Mohammad was improving and influenced their decision to discharge Mohammad home.

999 call

4.1.27 The role of the call handler was to progress through the script to establish the category of dispatch required and that immediate actions were executed efficiently.

Ambulance crew 2

4.1.28 The ambulance crew consisted of a newly qualified paramedic and an emergency medical technician (EMT), an emergency responder who supports a paramedic. The ambulance crew members did not have clinical concerns about Mohammad based on their assessment. The newly qualified paramedic was aware that the EMT had more years of practical experience than her and delegated some clinical tasks to him; this included clinical assessment of vital signs and the glass test.
4.1.29 Both the paramedic and EMT reported examining the rash on Mohammad’s skin and the EMT conducted the glass test which was recorded as ‘spots not fading on glass test’. The paramedic told the investigation that they had considered that the rash may be chickenpox or an allergic reaction. The EMT told the investigation that it was difficult to see the rash because Mohammad had dark skin. According to the Meningitis Research Foundation (2021b), ‘the darker the skin the harder it is to see a septicaemic rash so check lighter areas like the palms of hands and soles of feet or look inside the eyelids and the roof of the mouth’. The EMT stated that he checked Mohammad’s palms of hand and soles of feet and could not see a rash on them. The paramedic reported that the “lighting wasn’t great and I remember getting my pen torch out to have a closer look [at the rash]”. As such, the lighting in the room where Mohammad was assessed may have been an additional factor that made assessing his rash more difficult.

4.1.30 The paramedic reported that Mohammad had “yellowy diarrhoea” stools in his nappy. Diarrhoea can be a symptom of meningitis (Meningitis Research Foundation, 2018c). However, the paramedic told the investigation that loose stools are hard to differentiate in an infant aged 3 months as they are normally loose and yellow in colour.

4.1.31 The data from the Lifepak 15c machine (see 2.2.42) was reviewed by the ambulance service serious incident investigation team. The Lifepak 15c electronic records indicate that Mohammad was deteriorating, and his oxygen saturations and heart rate were outside of the expected ranges. This data recorded that at 04:26 hours, Mohammad’s oxygen saturation was 93% and heart rate was 70 beats per minute. At 04:31 hours the recorded data states oxygen saturation of 86% and a heart rate of 58 beats per minute. These are lower than the expected range and a heart rate of less than 60 beats per minute would be classed as a red flag for sepsis. The data from the Lifepak 15c contradicted the recorded observations written on the Patient Reporting Form (PRF) during Mohammad’s transfer to hospital. The PRF shows that at 04:33 hours the crew recorded an oxygen saturation of 99% and a heart rate of 162 beats per minute.

4.1.32 The EMT’s own assessment of Mohammad’s vital signs did not trigger a concern that Mohammad was seriously unwell as his temperature, respiratory rate and oxygen levels were within expected ranges and his heart rate was only a little faster than the expected range. The vital signs did not trigger any amber or red flags for sepsis. In addition, the inability to obtain blood for a blood glucose reading was not identified as a red
flag of poor blood flow and potential peripheral shutdown. There was not a discussion about administration of antibiotics. The EMT told the investigation: “… he didn’t have a temperature; he didn’t have any of what I would call ‘red flags’ or illness at the time”. The EMT did not notice that Mohammad had reduced oxygen levels and a much lower than expected heart rate for his age on the monitor and said he was not alerted to this by the Lifepak through an audible alarm. The EMT told the investigation he was only aware of the different readings when the ambulance trust shared the findings of its local serious incident investigation.

4.1.33 The investigation was told that a reliable heart rate reading for a child aged 3 months can be difficult as the probes do not fit well. The investigation was told that this is well known to ambulance staff and their main assessment is the visual observation and physical assessment of vital signs rather than a reliance on the monitor.

Second ED attendance

4.1.34 The nursing staff observed a clear widespread rash which they described as petechial (a rash that is usually flat and has been described as looking like small bruises). Mohammad’s vital signs were not within expected ranges. His temperature was recorded in the medical records to be 34.6C which can be a sign of sepsis. Mohammad was rushed to the resuscitation area and further calls for help were made.

4.1.35 The investigation was told that the spots were coming up quickly. It is reported widely in academic papers that a rash can manifest very quickly in patients with sepsis (Thompson et al, 2006). According to the Association of Ambulance Chief Executives (n.d.) a rash can be a very late sign of serious illness and by the time a rash is present, resuscitative attempts may be too late. The Meningitis Research Foundation (2018a) states, ‘it is crucial to remember that the underlying meningitis or sepsis may be very advanced by the time a rash appears. The rapidly evolving haemorrhagic ‘text book’ rash may be a very late sign; it may be too late to save the child’s life by the time this rash is seen’.

4.2 **Ambulance crew training and use of early warning scores**

**Ambulance crew training for recognition of acutely ill infants**

4.2.1 During interviews, the ambulance crews who attended following the NHS 111 and 999 calls described that their training in recognition of acutely ill infants was self-directed and was optional. It did not form part of their mandatory training.

4.2.2 At interview both ambulance crews were able to describe signs to look for in an infant or child with sepsis and they referred to the JRCALC 2016 manual for signs and symptoms. However, the investigation noted that while the first crew recognised that Mohammad was pale, this was not interpreted as a high-risk sign (National Institute for Health and Care Excellence, 2019a).

**Ambulance trust’s use of early warning scores**

4.2.3 There are various Paediatric Early Warning Score (PEWS) systems available; however, at the time of the incident, the ambulance service did not use a PEWS system.

4.2.4 The region’s ambulance service used the National Early Warning Score (NEWS) system to help its staff identify critically unwell adults. However, NEWS is a tool which is designed for use with adults and cannot be reliably used when assessing infants or children. The ambulance crew’s clinical observations chart on the PRF includes a column for NEWS but they did not score Mohammad against this given his age.

4.2.5 The investigation reviewed the ‘Febrile illness in children guideline’ within the JRCALC app, as Mohammad had a fever. Fever is recognised as ‘the most common paediatric presentation and suggests underlying infection’ (Association of Ambulance Chief Executives, n.d.). The guideline’s key points include that significant tachycardia (fast heart rate) suggests sepsis and advises the use of the NICE ‘traffic light’ system (National Institute for Health and Care Excellence, 2019a). There is also reference to the fact that ‘major’ childhood illnesses (including life-threatening conditions such as meningococcal disease and sepsis) may typically present with relatively innocent features that can easily be mistaken for minor illness.

4.2.6 The first crew noted that Mohammad was pale in colour although he was alert and taking in his surroundings. Mohammad’s heart rate of greater than 160 beats per minute is classed as an amber or intermediate risk. His temperature did not flag as an intermediate/amber risk as it was not above 39°C.
4.2.7 If the first ambulance crew had used the same tool as the hospital at the time of their assessment, Mohammad would have scored 4 which would indicate ‘nurse in charge and senior doctor review. Consider informing Consultant. Consider sepsis bundle’. This may have affected the handover to the triage nurse in the ED and the urgency with which Mohammad was treated. The availability and variability in the use of tools, which provide a trigger to act based on vital signs, may affect clinical decision making in ambulance services.

4.2.8 At the time of the interviews, the ambulance service was doing a phased roll-out of a new system for assessing infants and children, called the Paediatric Observation Priority Score (POPS). However, the ambulance crew described the roll-out of POPS as “piecemeal”, and that it had mainly been introduced to the senior team. None of the ambulance crew members had received training in the use of POPS at the time of the incident, and not all of the crew had received training when the investigation interviews were conducted 3 months after the reference event.

4.2.9 The ambulance crew followed their pathfinder guidance on admitting Mohammad to hospital, as he fitted into the ‘exclusion criteria’ – that is, anyone under 5 where an ambulance has been called out to them via an NHS 111 or a 999 call must be admitted to hospital.

4.3 Consideration of sepsis

Detectability of underlying condition and variability in screening tools

4.3.1 There are various tools to detect whether children are at risk of serious illness and/or to detect sepsis. The investigation retrospectively assessed Mohammad against several national and local tools to identify what his risk of serious illness was at each point of his care pathway. During this process the investigation identified inconsistencies with definitions of high-risk/red flag warnings.

4.3.2 Using the different tools available, Mohammad’s symptoms varied from points during the pathway where he was showing high-risk (red flag) features of serious illness, or intermediate-risk (amber flag) symptoms and at other times, such as when he was discharged from hospital, his symptoms were low risk (green flag). According to the NICE guideline (2019a), Mohammad’s varying symptoms when he was assessed face to face by clinicians provided conflicting and potentially confusing cues to staff as to how seriously ill he was.
4.3.3 Mohammad did have a slightly raised lactate of 2.2 which appears not to have been reviewed by medical staff. NICE guidance 2016 states that two or more moderate to high-risk criteria and a raised lactate suggests that a patient should be treated as high risk.

4.3.4 During Mohammad’s initial assessments, the ambulance crew, ED triage nurse, resuscitation area staff, ED doctor and paediatric staff all reported that Mohammad did not look unwell. As such, there is the possibility that their judgement may have been biased into thinking he was not as unwell as he was. Therefore, the detectability of Mohammad’s clinical condition and risk level was difficult to diagnose until he went into hospital the second time.

4.3.5 NICE guidance (2016) includes appropriate emphasis on clinical judgement to ensure patients are not treated as having suspected sepsis inappropriately. The way in which people assess the likelihood of an uncertain event or outcome (for example, is this patient deteriorating or seriously unwell?) is usually through a limited number of heuristic principles (Tversky and Kaheman, 1974). Heuristics are general decision making strategies that typically produce a correct solution (Matlin, 2002) and are useful in everyday life, but they can lead to systematic errors or biases (Tversky and Kaheman, 1974).

4.3.6 NICE guidance (2016) includes: ‘Measure blood pressure of children under 5 years if heart rate or capillary refill time is abnormal …’ Mohammad’s heart rate was higher than the expected range for his age. A blood pressure reading was not recorded in hospital.

4.3.7 Distinguishing between a simple viral illness and life-threatening infections such as meningococcal septicaemia is known to be challenging (National Institute for Health and Care Excellence, 2012) because the classic signs of meningitis (neck stiffness, bulging fontanelle (the soft spaces between the plates of a young baby’s skull) and high-pitched cry) are often absent in infants with bacterial meningitis. Children and young people with bacterial meningitis often have non-specific symptoms and signs including fever, vomiting, irritability and upper respiratory tract symptoms (Public Health England, 2017).

4.3.8 The second ambulance crew’s assessment that Mohammad was not unwell based on his vital signs, the ‘inconclusive’ glass test and a perception of chicken pox, influenced their subsequent actions, namely: not transferring Mohammad urgently to hospital; not sending a pre-alert to the hospital that Mohammad would be attending; and not seeking out immediate assistance on arrival at the ED.
Adherence to the Trust’s sepsis pathway

4.3.9 The ED triage nurse was aware that a temperature of 39°C in an infant aged 3 months and Mohammad’s fast heart rate and respiratory rate put him in at least an intermediate-risk group for serious illness in line with NICE guidance (2019a).

4.3.10 It was reported by the Trust that the sepsis pathway required that a ‘sepsis sticker’ be placed into the patient’s notes and evidence indicates this sticker was not present. The purpose of the sepsis sticker is to alert healthcare professionals that the infant/child is at risk of sepsis.

4.3.11 The investigation found that in general there was variability in the sticker being placed or not. It was reported by Trust staff that placing the sepsis sticker in the notes was sometimes not done when the department was busy. On the night Mohammad was assessed in the ED, it was described as really busy, suggesting that there were competing goals and demands on staff which may have impeded the placing of the sepsis sticker.

4.3.12 There is also evidence to indicate that the sepsis sticker was not placed because the ED triage nurse’s main focus was on ensuring that Mohammad received appropriate care quickly. The ED triage nurse stated upon review of their notes: “I can tell that I’ve cut it [Mohammad’s assessment] short because I’ve written down what his history was, I’ve written his obs [observations] down and I’ve moved him straight to Resus [the resuscitation area].”

4.3.13 The triage nurse had expected that by placing Mohammad in the resuscitation area he would be put on the sepsis pathway and monitored closely.

4.3.14 The ED doctor reported that he could not recall sepsis being mentioned by the nurses or seeing a sepsis sticker on Mohammad’s medical notes. He reported that he was aware that the sepsis pathway should be considered given Mohammad’s high PEWS but that Mohammad had recovered so quickly that he did not think he had sepsis. The ED doctor reported that he thought Mohammad may be suffering with a viral illness, for which antibiotics would not be very effective, and wanted time to re-assess Mohammad.

4.3.15 The Trust’s paediatric Sepsis Screening and Action Tool for children under 5 years identifies a capillary lactate of greater than 2 millimoles per litre (mmol/L) as a red flag. Mohammad had a lactate of 2.2mmol/L; this was not reviewed by medical staff. In addition, Mohammad’s heart rate did trigger as a red flag using the same tool. Mohammad did have a PEWS of greater than
4; he could have had an infection, even though the source was unclear at the time of assessment, and he did have at least one red flag present which indicates a ‘red flag for sepsis’ and to ‘start the sepsis 6 pathway’.

4.3.16 There is no evidence that sepsis was considered by other healthcare professionals. The absence of the sepsis sticker and Mohammad’s fluctuating vital signs and symptoms between assessments led to a confused clinical picture.

4.4 Listening to parents

4.4.1 There is evidence in the medical notes that staff were highlighting Mohammad’s choking episode as a key concern and so their perceptions of his Mother’s concerns could have influenced their decision making. The family’s perception is that they trusted what staff were telling them but that they were ultimately not listened to.

4.4.2 The family’s experience of having difficulty communicating their concern and the feeling of not being heard is not unique. A report which explored factors that affect the timing of admission to hospital for children with serious infectious illness found that:

‘Once parents present with their child to secondary care there are difficulties in communicating their concerns to health professionals and in being heard against a background of high levels of demand in a hierarchical system where professionals hold all the power’.

(Neill et al, 2020)

Communicating family concern

4.4.3 Mohammad’s Mother and Aunt reported that they were really concerned for him and although they reported that they had stated this to staff, they also found it difficult to explain their concerns at times. For example, there is evidence in the initial NHS 111 call that it was sometimes difficult for Mohammad’s Aunt to describe his symptoms.

4.4.4 His Mother also felt that her concerns were not taken seriously by the specialty-grade doctor in paediatrics and the second ambulance crew that attended their home.

4.4.5 Staff were asked about their understanding of what Mohammad’s Mother’s concerns were. The perception staff had of his Mother’s concerns were:
• She was primarily concerned about Mohammad’s choking episode after giving him baby rice and having potentially caused him harm. They did not perceive that she was concerned about Mohammad’s clinical condition.

• That she was an anxious Mother. The staff who interacted directly with her reported making efforts to reassure and try to calm her.

4.4.6 It is acknowledged in national guidance that parents and guardians can provide useful context regarding how a child is in comparison to their usual state (Royal College of Nursing, 2017). Parents reporting concern for their children and how this is considered in clinical decision making is explored further as part of the wider national investigation in section 5. This was also reflected in interviews with Trust staff who reported that listening to parents’ concerns is important.

Concern about discharge

4.4.7 There is a discrepancy between the account of Mohammad’s family and that of the specialty-grade doctor in paediatrics, in relation to his discharge from hospital. His Mother reported to the investigation that she was extremely unhappy about the plan to discharge Mohammad from hospital and did not want Mohammad to go home. The Mother queried his symptoms from her perspective, which contrasted with being told Mohammad had a viral illness with a cold. His Aunt described how his Mother had phoned her and was concerned that he was being discharged. The Aunt told the investigation that she had suggested to her that if the professionals were happy then to come home.

4.4.8 According to Mohammad’s medical records, the specialty-grade doctor in paediatrics documented at the time of discharge, ‘Mum happy to take home’. The doctor told the investigation that when she reassessed Mohammad in the OA, the Mother remained anxious about potentially having harmed Mohammad by feeding him baby rice. The doctor reported that she offered that Mohammad could stay in overnight, but that she perceived that his Mother was not keen to stay and was happy to go home. The nurse stated at interview that she understood that the Mother was happy to go home and the nursing record at 23:45 hours stated, ‘Mum happy to take home’.

4.4.9 The doctor gave Mohammad’s Mother verbal safety-netting advice (advice on what to do if Mohammad’s condition deteriorated) and thought that the Mother was happy with and understood the advice provided.
4.4.10 Research suggests that safety-netting advice is varied and that there is no information for parents about what ‘getting worse’ means (Neill et al, 2020).

4.4.11 The safety-netting advice, provided on discharge, influenced the Mother’s decision to call the OA ward when Mohammad developed a rash.

4.4.12 The Mother told the investigation she remembered them giving her a piece of paper and that prompted her to ring the ward.

**Ambulance crew perception of parental concerns**

4.4.13 The second ambulance crew documented on the PRF under ‘history’, ‘spots everywhere, and blue lips’. The PRF reported that ‘Mum states baby looks pale’. However, Mohammad’s symptoms at the time of the crew’s assessment did not appear to align with the history of information recorded on the PRF or his Mother’s concerns. Mohammad’s Mother reported to the investigation that she was very scared and that there were “spots coming up everywhere”. She described feeling desperate for the ambulance crew to take Mohammad to hospital. The crew described her as “anxious” and stated that they tried to reassure her and had “succeeded to a point”. The EMT reported that the Mother “had calmed down a bit” by the time they were in the ambulance. The EMT said that it was not unusual to encounter anxious parents and that it was “a natural reaction”.

4.4.14 Parents’ concerns are considered as part of some paediatric assessment tools such as the NICE (2019b) traffic light system for identifying risk of serious illness and the sepsis screening tool for under 5s (The UK Sepsis Trust, 2018). The tools the ambulance crew members were using to inform their assessment did not factor in parents’ concerns.

4.4.15 The JRCALC guidance available at the time of the reference event refers to the difficulty of diagnosing meningitis and that it can be very hard to assess, and as such parents’ anxieties should be taken seriously (Association of Ambulance Chief Executives and Joint Royal Colleges Ambulance Liaison Committee, 2016). It is unclear whether the crew referred to this specific part of the guidance.
5 Analysis and findings – the wider investigation

This section sets out the findings of the investigation’s analysis of the issue of recognition of the acutely ill infant in the context of the wider healthcare system. This element of the investigation considered national policy and guidance and the regulations that govern this aspect of medical care. The findings are presented within the following themes:

• detectability of underlying condition
• variation in decision aids/tools that are used/available to aid detection of the acutely ill infant
• use of medication to reduce temperature and its effect on clinical signs and symptoms
• parental and professional concern
• resources and demands in emergency departments treating children
• research on use of bio-markers to identify serious infection
• prehospital management of infants and children requiring emergency care.

5.1 Detectability of underlying condition

5.1.1 The UK has a higher death rate among young people than the European average for preventable deaths from common infections and respiratory conditions (Ward et al, 2020). Most deaths during childhood occur during the first year of life (Royal College of Paediatrics and Child Health, 2020a). Infection is a major cause of childhood illness and death from 0 to 5 years. The report of the Confidential Enquiry into Maternal and Child Health (2008) found that infectious illness was ‘the single largest cause of death in children dying of an acute physical illness’ constituting ‘20% of the deaths overall’. Many of the deaths are avoidable as infections such as pneumonia and meningococcal disease are amenable to treatment, if treated in time (Wolfe et al, 2011).

5.1.2 Evidence exists that the number of children attending emergency departments (EDs) is increasing (Royal College of Paediatrics and Child Health, 2018a) but the number of children with a serious bacterial infection is not increasing, which is a fundamental challenge. The absence of signs that an infant’s or child’s health is deteriorating can result in missed
opportunities to provide the necessary care to give the best possible chance of survival and avoiding harm. Recognising and responding to patient deterioration relies on a whole-systems approach.

5.1.3 Evidence refers to multiple factors that contribute to deterioration in children being missed and has previously been clustered into four themes (Royal College of Paediatrics and Child Health, 2018a; 2018b):

- parent/carer engagement
- healthcare professionals’ training
- not responding to physiological changes
- failures within the healthcare system.

5.2 Variation in decision aid/tools that are used/available to aid detection of acutely ill infant

**Early warning scoring systems**

5.2.1 Paediatric Early Warning Scores (PEWS) are widely used internationally. However, evidence revealed a lack of consensus on which PEWS tool is most effective or useful (Lambert et al, 2017). There are also regional and internal hospital variations of PEWS.

5.2.2 The application of early warning systems is more challenging in paediatric patients compared to adults for several reasons, including:

- variation in age-specific thresholds for normal and abnormal physiology from birth to adulthood
- infants and children are able to ‘compensate’ – that is, cope with potentially overwhelming infection for a period of time without showing any symptoms of serious illness, making it difficult to spot an acutely ill infant/child early
- when infants and children decompensate – that is when their body can no longer cope with the infection and their condition worsens – this often happens very rapidly
- they have lower rates of serious illness and death compared with adults
- infants and young children may be unable to articulate how or what they feel or find it difficult to do so.
5.2.3 In England there is no single validated tool for identifying an acutely unwell infant/child. However, Scotland, Northern Ireland and Ireland have rolled out standardised PEWS tools across inpatient settings (Roland et al, 2021).

5.2.4 No early warning scoring system or guidance has evidence of a high sensitivity and specificity at correctly identifying a seriously unwell infant/child and one with a mild viral illness. Adherence to scores and guidance may help identify a seriously unwell infant, however, there is a risk of over treatment and/or not identifying them. Changes in vital signs may be predictors of clinical deterioration in an infant or child; however, they may also simply reflect that a child is unwell but not at significant risk. Unfortunately, previous attempts at determining outcome or disposition have always had low specificity due to the extreme range of normal variation in children’s physiology and very low incidence of adverse outcomes (Roland et al, n.d.).

5.2.5 The NICE guidance for fever in under 5s (National Institute for Health and Care Excellence, 2019a) aims to improve clinical assessment and help healthcare professionals diagnose serious illness among young children with fever who attend primary and secondary care services. It prompts the individual who is assessing the infant/child to think ‘could this be sepsis?’ if a child presents with a fever and symptoms or signs that indicate possible infection. The guidance on sepsis recognition, diagnosis and early management would then be followed (National Institute for Health and Care Excellence, 2017).

5.2.6 The NICE sepsis guidance has been described to have poor sensitivity and specificity (Roland and Snelson, 2018), which also applies to the traffic light system used in the NICE guidance to identify the risk of serious infectious illness (National Institute for Health and Care Excellence, 2019b). Many under 5s will attend with fever and have moderate or high-risk features of sepsis but do not go on to have a serious infectious illness. The investigation heard from paediatricians working in hospitals that the traffic light system and sepsis guidance is not always adhered to and if it was, EDs treating children would have to investigate and refer a substantial proportion of the children they see, leading to crowded departments and more admissions to hospital for observation than beds available.

5.2.7 The use of a validated PEWS tool may aid individual and team situation awareness of the children at risk of clinical deterioration, particularly for junior staff or those new to caring for infants, children, and young people.
However, it is acknowledged that PEWS will not identify all children at risk of deterioration, either due to the speed or the mechanism of deterioration. Therefore, it is essential that all clinical staff are trained to recognise common patterns of deterioration with or without the use of a PEWS tool and not just use the score for reassurance (Royal College of Nursing, 2017).

5.2.8 The PEWS Utilisation and Mortality Avoidance (PUMA) study, a multi-centre study to identify the requirements for a standardised PEWS tool, began soon after this investigation started. The purpose was to:

- develop an evidence-based improvement programme to optimise the effectiveness of PEWS in different inpatient contexts
- evaluate the feasibility and potential effectiveness of the programme in predicting clinical deterioration and triggering timely interventions (Thomas-Jones et al, 2018).

5.2.9 The PUMA study examined the features of both scores and systems and other factors that may be implemented to reduce harm, serious illness and death in children whose health deteriorates while they are inpatients.

5.2.10 A PEWS programme board was also established in June 2018 with representation from NHS England and NHS Improvement, the Royal College of Paediatrics and Child Health, and the Royal College of Nursing, to review the need for a standardised national PEWS tool in England. In 2020, this was formally launched as the NHS SPOT (System-wide Paediatric Observations Tracking) Programme led by the NHS England Children and Young People’s Transformation Programme team (Peng, 2021).

5.2.11 The SPOT board agreed it would focus first on developing a system that worked in an acute inpatient hospital setting. This approach mirrors how the National Early Warning Score 2 (NEWS 2), a tool for adult patients, was developed (Royal College of Physicians, 2017). The initial draft timeline, shown in figure 2, suggests national roll-out of paper and digital versions of the SPOT system in inpatient settings will take place in early 2022. The investigation was told in October 2021 that the trialling of the national PEWS chart and score will begin in 40 organisations, initially for inpatient services, and that roll-out is planned for spring/summer 2022. This delay is due to the impact of COVID-19 and an increase in admissions of children and young people with respiratory syncytial virus (RSV) which is a common virus affecting the respiratory system.
Figure 2 Draft timeline for the launch of the SPOT Programme

Spring 2021
- Participating test sites informed
- Finalise prototype chart design and escalation document
- Piloting launch event for testing sites

Summer 2021
- Develop training and educational requirements
- Piloting launch event for testing sites

Autumn 2021
- National roll-out of paper and e-SPOT into inpatient settings
- Publish final inpatient piloting report

Winter 2021
- Publish inpatient SPOT guidance document

Early 2022
- Scoping adaptation for non-inpatient settings

- Spring 2021
- Summer 2021
- Autumn 2021
- Winter 2021
- Early 2022

- Scoping adaptation for non-inpatient settings
5.2.12 The investigation has been told that the proposed national PEWS chart will include the wording ‘Think! Sepsis’ at various points, with clearly signposted areas in which to mark the risk of sepsis. This is to encourage health professionals to be mindful of the risk of sepsis during the assessment and recording of observations. In addition, the investigation has been told that a training video and e-learning module will be provided on how to use the new PEWS tool which assumes that clinical staff understand how to recognise common patterns of clinical deterioration in children. Additional resources, for example linking to current NICE guidelines and other training, are expected to be used to support the delivery of healthcare staff training on how to take vital measurements in children. This training will describe the importance of assessment of the vital physiological parameters.

5.2.13 The final stage of the standardised PEWS is anticipated to require a system-wide approach across sustainability and transformation partnerships or integrated care systems, including more systemic action to enable healthcare professionals to identify acute serious illness outside of hospital settings. In addition, it will identify a standardised approach to educating staff in recording observations (objective and subjective) in primary, secondary, and tertiary (specialised) care. It will include national principles for ‘standards for escalation’ and will include a route map to electronic data collection for each trust. The objective is to develop a system of scoring and escalation which delivers a flexible but synergistic approach to acute clinical deterioration in infants, children and young people (Roland et al, 2021).

5.2.14 The investigation was told that a digital specification is required for the electronic version of SPOT, e-PEWS, and this will include standards on how providers of electronic systems must capture, codify and display the information for use in the NHS. The development of an e-PEWS model ties in with the aim in the NHS Long Term Plan of embedding digital services (NHS England and NHS Improvement, 2019). With standardisation, system-wide data collection and IT system interoperability, individual and collective physiological and other results will be visible across the system and will follow the patient from one care setting to the next (Roland et al, 2021).

5.2.15 The investigation spoke to the Association of Ambulance Chief Executives in May 2021 and there was a concern that this organisation was not engaged in the national PEWS development work.
The intent of the following recommendation is to ensure that community healthcare providers, NHS 111 providers, the English ambulance service and primary care services are engaged in the future development of an early warning score system for infants/children and that their approach to adopting PEWS will be included within the NHS System-wide Paediatric Observations Tracking (SPOT) Programme:

HSIB makes the following safety recommendations

**Safety recommendation R/2021/165:**
HSIB recommends that the Chair of the NHS System-wide Paediatric Observations Tracking (SPOT) Programme ensures that the Association of Ambulance Chief Executives, community NHS 111 providers and primary care services are integral members of the NHS SPOT Programme.

The intent of the following recommendation is that NHS providers deploying commercial systems to implement SPOT will ensure they are compliant with the standards once developed.

**Safety recommendation R/2021/166:**
HSIB recommends that NHSX develops national standards describing the electronic deployment of the NHS System-wide Paediatric Observations Tracking (SPOT) e-PEWS (the digital version of the Paediatric Early Warning Score tool), in collaboration with the NHS England and NHS Improvement SPOT Programme. This should include specifications for data capture, calculation of the score and escalation status, and also the display of the information and connectivity with other digital systems.

**Assessing skin colour**

5.2.16 The existing systems for triage in primary and secondary care do not always take into account the colour of a patient’s skin. This may influence a healthcare professional’s assessment of an infant’s or child’s physical signs. In addition, the environment in which ambulance personnel work before arriving at hospital can be challenging. Lighting may be poor even inside a house, sometimes making it difficult or even impossible, to assess a child’s colour (Jewkes, 2006).

5.2.17 Assessment of skin colour and people being asked if patients are ‘pale’ or if their lips have ‘turned blue’ are not useful approaches for a patient with non-white skin and, as a result, their care may be compromised. A book was published in 2020 by a second-year medical student to educate students and essential allied healthcare professionals on the importance of recognising that certain clinical signs do not show in the same way on darker skin (Mukwende et al, 2020). The author describes that:
‘… this is something which is not commonly practiced in medical textbooks as there is a ‘white skin bias’. It is important that we as future healthcare professionals are aware of these differences so that we don’t compromise our care for certain groups. It is essential we begin to educate others so they are aware of such differences and the power of the clinical language we currently use’. (College of Paramedics, 2020)

5.2.18 Other sources of guidance on assessing an infant or child make reference to non-white skin. For example, the Meningitis Research Foundation specifically states that a rash may be more difficult to spot on dark skin, but may be visible in paler areas, especially the soles of the feet, palms of the hands, abdomen, or on the conjunctivae (tissue around the eyes) or palate (Meningitis Research Foundation, 2018a; 2018c). Descriptions of rashes also focus on redness or pallor, both of which are more difficult to recognise in darker skin tones or may not be present at all (Skin Deep, 2021).

5.2.19 The investigation has been told by NHS Digital that NHS Pathways now explicitly considers skin tone in the supporting information which call handlers use to ensure appropriate responses to triage questions. The investigation was informed that:

‘… a specific project was undertaken in early 2021 to look at racial equality in NHS Pathways questions. Further enhancements were made in Release 27 (deployed in June 2021); following extensive user research, changes were made to ensure questions are inclusive for all skin tones’. (personal communication, 26 October 2021)

5.2.20 The Skin Deep project (Skin Deep, 2021) is led by the international medical education team Don’t Forget the Bubbles and the Royal London Hospital. The aim is to develop a free, open-access bank of high-quality photographs of medical conditions in patients with a range of skin tones for use by healthcare professionals and the public. The team behind Skin Deep hopes that with time, this will improve education and recognition of conditions in patients with any skin tone, reducing inequalities and improving patient care by ensuring that all children receive a timely diagnosis regardless of their skin colour.

**HSIB makes the following safety recommendation**

**Safety recommendation R/2021/167:**
HSIB recommends that the Chair of the NHS System-wide Paediatric Observations Tracking (SPOT) Programme ensures that any resources produced include examples of children and young people with non-white skin showing signs of serious illness.
5.3 Use of medication to reduce temperature and its effect on clinical signs and symptoms

5.3.1 Medications that reduce a patient’s temperature (antipyretics) are widely used in primary and secondary care settings by parents and healthcare professionals. There is limited research literature relating to the use of antipyretics in infants and children with a fever and the potential for these medicines to affect diagnosis by masking symptoms.

5.3.2 It is generally agreed that these medicines should be administered when the infant/child has a fever and is distressed or uncomfortable, as this can also reduce parental anxiety. In August 2017, NICE amended its guidance to highlight that clinicians should not use a response to antipyretic therapy alone as a means to differentiate between serious and non serious infection (National Institute for Health and Care Excellence, 2019a). NICE highlights in its guidance that the use of antipyretic medicines could affect clinicians’ ability to differentiate between bacterial and viral conditions, and that reduction of a fever may lead to the incorrect conclusion that the patient is recovering (National Institute for Health and Care Excellence, 2019a). In addition, the Meningitis Research Foundation (2018a) advises that a ‘fever that subsides after antipyretics cannot be dismissed as viral in origin’. It is however, generally accepted that use of these medicines is to alleviate symptoms, rather than affect the outcome of conditions where fever is a symptom.

5.3.3 The NICE Guideline Development Group has recommended that studies be conducted in primary and secondary care to determine whether examination or re-examination after a dose of antipyretic medication is of benefit in differentiating between children with a serious illness and those with other conditions. The investigation has been advised that such studies have not been conducted at the time of writing this report (personal communication, 22 June 2021).

HSIB makes the following safety observations

Safety observation O/2021/137:
It may be beneficial if the research studies recommended by the National Institute for Health and Care Excellence are conducted in primary care and secondary care to determine whether examination or re-examination after a dose of antipyretic (temperature reducing) medication is of benefit in differentiating between children with a serious illness and those with other conditions.
The intention of the following safety observation is to enable healthcare professionals to see an infant’s/child’s PEWS and the interventions which may have influenced it.

**Safety observation O/2021/138:**
It may be beneficial if NHS England and NHS Improvement’s System-wide Paediatric Observations Tracking (SPOT) Programme considers visual representation of critical information (such as a clinical intervention administered) and the potential impact of these interventions on an infant’s/child’s PEWS.

### 5.4 Parental and professional concern

5.4.1 There is a plethora of research that recognises that parents and carers know their children best and can be acutely aware that their child is unwell or ‘just not right’, sometimes before the child’s vital signs start to move outside the expected ranges for their age.

5.4.2 The concerns of parents, families and caregivers, while classed as subjective data, are now included in many scoring parameters in PEWS tools (The Royal College of Paediatrics and Child Health, 2018a). Concern on the part of a parent/carer should merit appropriate consideration and may require escalation, and national guidance on assessing infants and children reflects this. This has been acknowledged by national bodies, including:

- National Institute for Health and Care Excellence
- NHS England and NHS Improvement
- Royal College of Paediatrics and Child Health
- Royal College of Nursing
- Association of Ambulance Chief Executives
- charitable organisations.

5.4.3 The investigation heard from parents whose children had experienced or died from serious infection. Common themes from these parents were around their “gut feeling” and also feeling “tired and anxious”. One parent said: “I couldn’t clearly articulate that I am very worried about my child, I haven’t seen him like this before”. Another parent was concerned about the ‘weight-validity’ of her concerns as she recognised she was using emotional language and that “the level of ignorance we had as parents is a real factor in knowing how to triage your child”.

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5.4.4 The power dynamic between parents and healthcare professionals was described as a form of being silenced and with an assumption that parental anxiety was wrong. Examples included:

- “I felt disempowered and silenced and it was left as a gut feeling”.
- “... it felt like they thought we were just young and overreacting”.
- “... no-one listened to me – I’ve already got a son and I knew from day one there was something wrong with her”.

5.4.5 One set of parents suggested that to elicit a better understanding, healthcare professionals would be better asking how parents “feel” about their child rather than asking more direct closed questions like, ‘are they about the same or worse?’. Other factors influencing parents was not wanting to waste doctors’ precious time and the culture of, “stiff upper lip, retaining control and not showing I am afraid” and “the doctors know best”. This is in keeping with other published findings around parents’ ‘help-seeking behaviours’ and fear of bothering healthcare professionals and fear of wasting doctors’ time (Carter et al, 2020).

5.4.6 Another concern expressed by parents was that while written notes in healthcare records have validity with healthcare professionals, parents’ concerns are not always written down and therefore the validity of their observations can be missed. Unequal power between parents and healthcare professionals was highlighted in the recent ‘Before arrival at hospital’ (BeArH) report (Neill et al, 2020), particularly in relation to parents’ struggle to be heard. An ED doctor explained in the report that ‘I don’t think you should necessarily be influenced that much by what they (parents) say’.

5.4.7 Some parents thought their difficulties in being heard were related to being labelled ‘panicky first-time parents’, or to their difficulty in describing symptoms. In addition, parents do not always recognise symptoms of serious illness and the significance of parents’ phrases describing their unwell child were reported to be missed by health professionals. Parents’ powerlessness was seen in their distress when they were unable to secure help for their child. The repeated reports of parents being criticised in encounters with health professionals was deemed in the BeArH report to require further research to establish what is perceived as criticism and how this can be avoided in future.

5.4.8 Parent and professional concern has been factored into the SPOT Programme. It also forms a ‘standalone’ section on the national PEWS scoring system to make it independent of the score and will be considered in addition to the score given its importance.
5.4.9 The need for staff to ask parents questions in a meaningful way to understand clinical risk is not unique to the care of infants and children. This issue exists in other healthcare contexts and presents challenges to ensure an accurate description of symptoms. Efforts to develop tools and approaches to capture how to ask questions reliably, using language understood by both patients and clinicians, is vital to extract information about defined symptoms, and will assist clinicians in judging risk based on the answers received (Greenhalgh et al, 2016).

5.4.10 The BeArH report (Neill et al, 2020) identified that doctors and nurses would benefit from the development of professional skills in attending to, and addressing, parents’ concerns.

5.4.11 Staff that the investigation spoke to were consistent in their perception that the times that parents reported good care and feeling heard were when the unit was well staffed and when there were manageable numbers of patients. Staff described the importance of listening to parental concerns. One staff member stated: “... we try regardless, try and listen, that child is the most special thing in their lives, my role is to listen, they know their child better than anybody”.

5.4.12 Staff stated that having enough time is important, as it enables them to go beyond the facts of the history given and undertake a more holistic understanding of the feelings of children and their parents. This statement linked with a parent’s suggestion that using ‘feelings-based’ language will help tease out the feelings of anxiety and concern. Staff told the investigation that “the way people describe something may not be the way we interpret it, for example he’s very tired meant I’m worried about his breathing”.

5.4.13 The investigation held a focus group with paediatric doctors in training. One of their key concerns was that while listening to parents was very important, the busy paediatric environment did not lend itself to enabling them to do this well. Staff became emotional when talking about times of increased admission and fewer staff, saying that sometimes it “feels impossible to manage the workload”.

5.4.14 Studies have shown that the ‘gut feelings’ of primary care clinicians of something wrong in children even when unexplained by clinical assessment had a high specificity and high positive likelihood ratio for serious infectious illness. Clinical experience and judgement remain essential for the detection of deterioration in an infant or child whose vital signs are within or only just outside the expected ranges. This finding was consistent across age and diagnostic groups and was independent of the presence of fever (Van den Bruel et al, 2012).
5.4.15 In addition, a review of decision making in acute paediatric care concluded that:

‘... one of the most significant factors in decision-making, the development and application of tacit knowledge, is poorly understood and is a potential area for research which may greatly influence the improvement of decision-making in paediatrics’. (Roland and Snelson, 2018)

**HSIB makes the following safety observation**

**Safety observation O/2021/139:**
It may be beneficial if further research and observational studies are carried out to examine how listening to parents [or taking on board parents’ views/concerns] impacts on clinical decision making and recognition of the sick infant/child.

**Safety-netting advice**

5.4.16 The investigation identified through a review of the research and its own observations that parents think better information on serious illness would help, particularly if this was in easy-to-see formats. This was also highlighted in the BeArH report (Neill et al, 2020), which identified that parents miss signs of serious illness.

5.4.17 Safety-netting advice is the information and advice provided to parents to ensure they are aware of general and specific risks relating to their child’s health and know when to contact healthcare professionals again (Roland et al, 2014). This advice may be given verbally or through leaflets and is tailored to risks considered by staff most relevant to the parent. Research suggests that people’s recall of medical information given verbally can be as low as 25% (Sanberg et al, 2012). In addition, content of safety-netting advice has been found to be varied and rarely recorded (Jones et al, 2013).

5.4.18 The investigation was told about commercially produced and available mobile apps that provide health information for parents/carers of children. This includes information about common childhood illnesses and signs and symptoms to look for. The process for developing these apps and how they are evaluated are outside the remit of this investigation.

5.4.19 The apps included:

- HANDi app (HANDi, 2021)
- CATCH app (common approach to children’s health) (CATCH, 2021).
5.4.20 The investigation followed the pathway for a feverish child in one of the apps and it provided advice and guidance as well as directing the parent to The UK Sepsis Trust’s leaflet, ‘Spotting sepsis and serious illness in children’ (The UK Sepsis Trust, 2021).

5.4.21 ASK SNIFF (Acutely Sick Kids Safety Netting Interventions for Families or Spotting the Sick Child for Families) is a programme of research that focuses on the development of safety-netting interventions to help families determine when to seek help from a health professional for an acutely sick child (ASK SNIFF, 2021). The programme’s aim is to work with parents and health professionals to develop video-based information resources to help families with young children understand signs and symptoms of acute illness, so that they can spot when their child is sick. These resources are also intended to support communication between families and health professionals.

**HSIB makes the following safety observation**

The intention of the following safety observation is to ensure that educational materials for parents are consistent in terms of quality of content, messaging and advice, and that they benefit all community groups:

**Safety observation O/2021/140:**

It may be beneficial if the current resources and educational materials available to parents and carers on assessment, advice and guidance for the unwell infant/child, for example mobile apps, are reviewed and governed through a national assurance process.

5.5 **Resources and demands in emergency departments treating children**

5.5.1 In April 2017, NHS England announced plans for a modernised and improved urgent and emergency care service for the future (Willett, 2017). Standards for emergency care of children, including safe staffing levels, have been defined by the Royal College of Nursing. Children and young people have a right to be cared for by nurses who have the right knowledge and skills to meet their needs, including specific requirements in an ED (Royal College of Nursing, 2021; Royal College of Paediatrics and Child Health, 2018a; Royal College of Emergency Medicine, 2017).
5.5.2 The investigation found that EDs are set up differently across England and that some trusts find it challenging to achieve the standards. It is especially challenging for trusts that do not have a dedicated paediatric ED and at a time when the NHS is facing unprecedented demand for its services. The number of people going to an ED has risen substantially over time. In 2018/19 there were 24.8 million attendances at EDs – the equivalent of 68,000 attendances each day on average. Between 2011/12 and 2018/19, ED attendances grew on average by 2.1% each year and increased by 3.3 million (16%) in total. This is the equivalent of an extra 9,200 ED attendances each day (The Kings Fund, 2018). This data represents the time period that Mohammad was admitted to hospital. The investigation recognises the situation will have changed significantly since then, especially in light of the COVID-19 pandemic.

5.5.3 There are further challenges in meeting the standards for children’s emergency care due to staffing issues. A workforce census published by the Royal College of Paediatrics and Child Health (RCPCH) (2020b) cited that child health staff in EDs reported that workforce shortages were their top concern. Data collected from all 191 organisations providing paediatric services in the UK found 84% of 166 respondents who answered this question felt staffing gaps posed a risk to services and children. The RCPCH estimated that there was a need to recruit 850 more paediatric consultants in the UK to meet service demand. The RCPCH also found there was an 11% rota vacancy rate for foundation year doctors and 14.6% vacancy rate for middle-grade doctors between autumn 2017 and summer 2018. On 1 February 2019 the president of the RCPCH reported to the Health Service Journal that, while incidences of children attending EDs are increasing, paediatrician training numbers have dropped. He said: ‘We don’t think the maths adds up’. The investigation is aware that the RCPCH has looked at the impact of the COVID-19 pandemic on child health services (Royal College of Paediatrics and Child Health, 2021; 2020c) and has found they are under extreme pressure.

5.5.4 The Care Quality Commission has reported on the challenges in paediatric staffing in EDs and produced a brief guide supported by the RCPCH. The guide discusses mitigating actions EDs can take if they cannot meet the recommended nursing staffing levels (Care Quality Commission, 2018).

5.5.5 The investigation was told by a subject matter advisor that while the number of children visiting EDs is increasing the number of children diagnosed with a serious bacterial infection is not increasing and this is a fundamental challenge. This was also cited in research which states that despite fewer children with serious infections attending children’s EDs, hospital admissions of children with feverish illness have increased (Irwin et al, 2016).
5.5.6 The investigation heard from current healthcare staff who described extreme pressures in assessing the increasing numbers of children being admitted to hospital. One doctor described how this results in ‘work as done’ being different to ‘work as imagined’ by policy makers. One example given was the implementation of the sepsis pathway if a child triggered two or more amber signs on the traffic light system. The investigation was told that ‘if this was implemented for all children, the system would break down. Most of the time, it is a viral illness, but it is like finding the needle in the haystack’ (personal communication, 2021).

5.5.7 Staffing to ensure that safe and effective care can be delivered is currently a national priority for the Royal College of Nursing (2021). The perception of a high workload is created when there is a reduction in resources, or insufficient time available to do the work required to the standard desired by an individual (Young et al, 2015). A greater time pressure will increase the likelihood of trade-offs being made by staff to ensure all work and targets are achieved to an acceptable level of performance. One consequence of this is an increase in the effort required and the stress experienced by staff (Hollnagel, 2009; Hancock and Warm, 1989).

HSIB makes the following safety observation

The intention of the following safety observation is to consider the current and ongoing risks associated with the challenges some hospitals face in recruiting the workforce needed to meet national standards for delivering care to children in emergency care settings. This assessment could be based on the standards published by the Royal College of Paediatrics and Child Health in 2018, entitled ‘Facing the future: standards for children and young people in emergency care settings’.

Safety observation O/2021/141:
It may be beneficial if there is system-wide assessment of the capacity of the medical and non-medical workforce to support safe and sustainable staffing in emergency departments caring for children in England.

5.6 Research on use of biomarkers to identify serious infection

5.6.1 Beyond the neonatal period, all-cause and infection-related childhood mortality rates have declined by 26% and 31% respectively over the past decade. However, infection continues to contribute to one in five childhood deaths (Ferreras-Antolin et al, 2020). Meningococcal disease is recognised as a global problem and death rates are high. Since infection can progress from initial symptoms to death within hours, individuals must be diagnosed as early as possible.
5.6.2 The investigation considered new and emerging guidance to support the identification of infants and children at risk of serious infection. The NICE diagnostic assessment programme considers new technologies and has examined biomarkers and molecular testing for sepsis, for example procalcitonin (PCT) and C-reactive protein (CRP). These are inflammatory markers released into the bloodstream when there is a bacterial infection (National Institute for Health and Care Excellence, 2015). The investigation was told that it is recommended or encouraged that further research in children and/or newborns is undertaken.

5.6.3 The investigation was advised of the ADAPT-Sepsis Trial (Biomarker-guided duration of antibiotic treatment in hospitalised patients with suspected Sepsis) (National Institute for Healthcare Research Health Technology Assessment Programme, 2021). This research study is finding out whether the antibiotic treatment given to patients with sepsis can be safely reduced following the close daily monitoring of CRP and PCT. The trial is anticipated to take 4 years and is currently ongoing.

5.7 Prehospital management of infants and children requiring emergency care

5.7.1 Only about 10% of emergency calls made to the ambulance service are for children and only about 5% of these cases will require ambulance staff to perform resuscitation. The need for paediatric emergency care in the community is therefore rare, but when it is required, the response must be prompt and effective (Jewkes, 2001). There remains the challenge however of training ambulance staff and retention of skills.

5.7.2 Paramedic training in paediatrics only became obligatory in 2001 and training is still not required for emergency medical technicians (Jewkes, 2006). The investigation heard from ambulance service staff that training in the recognition of acute illness in infants and children is minimal compared to that of adults. The investigation has been told that an e-learning module, ‘Spotting the sick child’, is advised but not mandatory. In addition, there is no universal standard for undergraduate teaching, with some university courses describing scenario-based training and attaching student paramedics to children’s wards in hospitals, and others having classroom-based teaching. The investigation was told that the average paramedic has 3 years of training of which 2 days is in paediatric care (personal communication, 17 April 2019).

5.7.3 NHS England and NHS Improvement is focusing on education and training for community pharmacists, community nurses, healthcare assistants and health visitors on recognition of sepsis. Health Education
England has developed educational modules on sepsis for community pharmacists and healthcare assistants. In addition, the regular inclusion of sepsis within relevant resuscitation courses will help to embed knowledge about sepsis among hospital clinicians (NHS England, 2017). No evidence was found which related specifically to ambulance staff training.

5.7.4 The investigation reviewed the information available to ambulance staff, including the JRCALC Clinical Guidelines (Association of Ambulance Chief Executives and Joint Royal Colleges Ambulance Liaison Committee, 2016), the JRCALC Clinical Practice Guidelines app for mobile phones and tablets (Association of Ambulance Chief Executives, n.d.) and a pocket guide. The investigation observed that the guidelines available offer a simple ‘key points’ section followed by detailed sections on assessment and management along with links to national guidance and assessment tools.

5.7.5 The BeArH report (Neill et al, 2020) identified that ambulance crews and call handlers in NHS 111 and 999 would benefit from further education in the assessment of acutely ill children.

5.7.6 The investigation identified a gap in training at undergraduate paramedic level and then in the initial and continuing paediatric training for ambulance staff.

HSIB makes the following safety observation

The intention of the following safety observation is to identify all clinical staff working in the ambulance service that have accessed ‘Spotting the sick child’ or equivalent training as an education resource and find out how often it has been accessed, and to highlight any gaps in training needs for recognition of the acutely ill infant/child:

**Safety observation O/2021/142:**
It may be beneficial if the 10 English ambulance services review and assess their paediatric training provision and report this assessment to their trust board.
HSIB makes the following safety recommendations

The intent of the following recommendation is to support the continuing professional development of the clinical ambulance service workforce.

**Safety recommendation R/2021/168:**
HSIB recommends that the Association of Ambulance Chief Executives works together with the ambulance services to share best practice in relation to paediatric training, education resources, frequency and types of training, and that it collates and shares areas of best practice.

**Safety recommendation R/2021/169:**
HSIB recommends that the College of Paramedics works with partners and higher education providers to develop, agree and implement standards for paediatric education for the future ambulance service workforce.
6 Summary of findings, safety recommendations and safety observations

6.1 What is already known

The investigation considered existing guidance on caring for an infant that is described as ‘unwell’. There is already research evidence on the multiple factors that contribute to clinical deterioration in infants and children being missed. The Royal College of Paediatrics and Child Health has clustered these factors into four themes:

- parent/carer engagement
- healthcare professionals’ training
- not responding to physiological changes
- failures within the healthcare system.

The investigation considered these four themes along with published evidence and research. The investigation acknowledged that the following known facts were applicable to the reference event:

- Meningococcal disease is a significant cause of serious illness and death in children.
- Research has shown that it can be difficult to distinguish between infants and children who are brought into hospital with mild viral illnesses and those who have serious bacterial infections such as meningococcal disease.
- Evidence in the research literature refers to the difficulty of being able to identify clinical deterioration in infants and children with serious illness.
- Research identifies that Paediatric Early Warning Score (PEWS) systems are widely used around the world to monitor the health of infants and children, although there is a lack of consensus about which system is most useful. In addition, there is no early warning score that will always detect deterioration in infants or children.
• Research shows that existing early warning scores are not sensitive or specific enough to help health professionals to distinguish between a seriously unwell infant/child and one with a mild viral illness. Changes in vital signs (for example temperature, heart rate and respiratory rate) may be predictors of deterioration in an infant or child but they may also simply reflect that a child is unwell but not at significant risk.

• Evidence confirms that clinical experience and judgement remain essential for the detection of deterioration in an infant or child whose vital signs are within, or only slightly outside, the expected ranges.

• Infants and young children may have fever and vomiting associated with irritability, drowsiness and confusion. They may be very hard to assess and evidence supports that parent’s anxieties about their child’s state of responsiveness and alertness must always be taken seriously.

• Assessment of skin colour and people being asked if patients are ‘pale’ or if their lips have ‘turned blue’ are not useful approaches for patients with non-white skin. In addition, descriptions of rashes focus on redness or paleness, both of which are more difficult to recognise in a patient with non-white skin.

• The use of medicines to reduce temperature may mask the symptoms of serious illness in infants and children.

• Research highlights that emergency departments and paediatric assessment wards are already extremely busy with increasing numbers of admissions to, while the number of children developing a serious bacterial infection is not increasing.

• National standards for the care of children in emergency care settings exist, however there are known challenges faced by some hospitals in recruiting the workforce needed to meet the standards.

6.2 Findings

The investigation found:

• The existing systems for triage do not always take into account the colour of a patient’s skin. This may influence a healthcare professional’s assessment of an infant’s/child’s physical signs.
The investigation identified that the information to support clinical decision making is not always available to staff when they are assessing patients. This includes trends in an infant’s/child’s PEWS, which are not always considered.

Staffing standards that relate to the treatment of children in EDs cannot always be met due to workforce challenges, particularly in hospitals without a dedicated paediatric ED.

Sometimes parents describe feeling powerless when trying to articulate their concerns for their child. Some healthcare professionals do not always consider or listen to what parents are telling them.

There is variation in the level of detail provided to families on identifying deterioration in their infant or child after discharge from hospital.

The Association of Ambulance Chief Executives are not currently involved in the ongoing national work to develop early warning scores for infants and children.

Undergraduate training for paramedics on the identification of sick infants/children is variable across England.

There is inconsistency across English ambulance services in training for ambulance personnel, including paramedics and non-registered clinicians, on the identification of sick infants/children.

**HSIB makes the following safety recommendations**

The intent of the first recommendation is to ensure that community health services, NHS 111 providers, the English ambulance service and primary care services are engaged in future development of an early warning score system for infants/children and that their approach to adopting PEWS will be included within the NHS System-wide Paediatric Observations Tracking (SPOT) Programme:

**Safety recommendation R/2021/165**

HSIB recommends that the Chair of the NHS System-wide Paediatric Observations Tracking (SPOT) Programme ensures that the Association of Ambulance Chief Executives, community NHS 111 providers and primary care services are integral members of the NHS SPOT Programme.
The intent of the following recommendation is that NHS providers deploying commercial systems to implement SPOT will ensure they are compliant with the standards once developed:

**Safety recommendation R/2021/166:**
HSIB recommends that NHSX develops national standards describing the electronic deployment of the NHS System-wide Paediatric Observations Tracking (SPOT) e-PEWS (the digital version of the Paediatric Early Warning Score tool), in collaboration with the NHS England and NHS Improvement SPOT Programme. This should include specifications for data capture, calculation of the score and escalation status, and also the display of the information and connectivity with other digital systems.

**Safety recommendation R/2021/167:**
HSIB recommends that the Chair of the NHS System-wide Paediatric Observations Tracking (SPOT) Programme ensures that any resources produced include examples of children and young people with non-white skin showing signs of serious illness.

The intent of the following recommendation is to support the continuing professional development of the clinical ambulance service workforce:

**Safety recommendation R/2021/168:**
HSIB recommends that the Association of Ambulance Chief Executives works together with the ambulance services to share best practice in relation to paediatric training, education resources, frequency and types of training, and that it collates and shares areas of best practice.

**Safety recommendation R/2021/169:**
HSIB recommends that the College of Paramedics works with partners and higher education providers to develop, agree and implement standards for paediatric education for the future ambulance service workforce.

**HSIB makes the following safety observations**

**Safety observation O/2021/137:**
It may be beneficial if the research studies recommended by the National Institute for Health and Care Excellence are conducted in primary care and secondary care to determine whether examination or re-examination after a dose of antipyretic (temperature reducing) medication is of benefit in differentiating between children with a serious illness and those with other conditions.

The intention of the following safety observation is to enable healthcare professionals to see an infant’s/child’s PEWS and the interventions which may have influenced it:
Safety observation O/2021/138:
It may be beneficial if NHS England and NHS Improvement’s System-wide Paediatric Observations Tracking (SPOT) Programme considers visual representation of critical information (such as a clinical intervention administered) and the potential impact of these interventions on an infant’s/child’s PEWS.

Safety observation O/2021/139:
It may be beneficial if further research and observational studies are carried out to examine how listening to parents [or taking on board parents’ views/concerns] impacts on clinical decision making and recognition of the sick infant/child.

The intention of the following safety observation is to ensure that educational materials for parents are consistent in terms of quality of content, messaging and advice, and that they benefit all community groups:

Safety observation O/2021/140:
It may be beneficial if the current resources and educational materials available to parents and carers on assessment, advice and guidance for the unwell infant/child, for example mobile apps, are reviewed and governed through a national assurance process.

The intention of the following safety observation is to consider the current and ongoing risks associated with the challenges some hospitals face in recruiting the workforce needed to meet national standards for delivering care to children in emergency care settings. This assessment could be based on the standards published by the Royal College of Paediatrics and Child Health in 2018, entitled ‘Facing the future: standards for children and young people in emergency care settings’.

Safety observation O/2021/141:
It may be beneficial if there is system-wide assessment of the capacity of the medical and non-medical workforce to support safe and sustainable staffing in emergency departments caring for children in England.

The intention of the following safety observation is to identify all clinical staff working in the ambulance service that have accessed ‘Spotting the sick child’ or equivalent training as an education resource and find out how often it has been accessed, and to highlight any gaps in training needs for recognition of the acutely ill infant/child:

Safety observation O/2021/142:
It may be beneficial if the 10 English ambulance services review and assess their paediatric training provision and report this assessment to their trust board.
7 References


Chartered Institute of Ergonomics and Human Factors. (n.d.) Coping with complexity: a resource to support pre-registration and early career pharmacists in clinical decision-making.


HANDi. (2021) HANDi paediatrics app.


Meningitis Research Foundation. (2018c) Meningococcal meningitis and sepsis.


Royal College of Paediatrics and Child Health. (2015b) The use of primary and secondary care services by children and young people following contact with NHS 111 – investigating the experience and patient flow of four common conditions.


Royal College of Physicians. (2017) National Early Warning Score (NEWS) 2: standardising the assessment of acute illness severity in the NHS. Updated report of a working party.


# Appendix

Record of Mohammad’s observations during his first admission to hospital

PEWS = Paediatric Early Warning Score  
AVPU = Alert, Voice, Pain, Unresponsive – a scale to measure and record a patient’s level of consciousness  
n/r = no reading taken

<table>
<thead>
<tr>
<th>Time and location</th>
<th>PEWS</th>
<th>AVPU</th>
<th>Temperature</th>
<th>Heart rate</th>
<th>Respiratory rate</th>
<th>Oxygen saturation</th>
<th>Capillary refill time</th>
<th>Blood pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>19:28 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambulance</td>
<td>n/r</td>
<td>Alert</td>
<td>38.6°C (paracetamol given)</td>
<td>180</td>
<td>40</td>
<td>100%</td>
<td>Less than 2 seconds</td>
<td>90/</td>
</tr>
<tr>
<td>19:45 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambulance</td>
<td>n/r</td>
<td>Alert</td>
<td>n/r</td>
<td>182</td>
<td>38</td>
<td>100%</td>
<td>Less than 2 seconds</td>
<td>90/</td>
</tr>
<tr>
<td>20:25 hours</td>
<td></td>
<td></td>
<td>39°C</td>
<td>195</td>
<td>52</td>
<td>100%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>Triage</td>
<td>6</td>
<td>Alert</td>
<td></td>
<td>178</td>
<td>45</td>
<td>97%</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>20:45 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Resuscitation area</td>
<td>4</td>
<td>Alert</td>
<td>39.1°C</td>
<td>170</td>
<td>52</td>
<td>97%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>21:30 hours</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Resuscitation area</td>
<td>1</td>
<td>Alert</td>
<td>37.7°C</td>
<td>170</td>
<td>52</td>
<td>97%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>22:15 hours</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resuscitation area</td>
<td>4</td>
<td>Alert</td>
<td>38.1°C (ibuprofen given)</td>
<td>180</td>
<td>n/r</td>
<td>96%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>23:15 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Observation area</td>
<td>0</td>
<td>Asleep</td>
<td>36.9°C</td>
<td>149</td>
<td>40</td>
<td>100%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>04:00 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambulance</td>
<td>n/r</td>
<td>Alert</td>
<td>36.4°C</td>
<td>168</td>
<td>32</td>
<td>99%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>04:33 hours</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Ambulance</td>
<td>n/r</td>
<td>Alert</td>
<td>n/r</td>
<td>162</td>
<td>32</td>
<td>99%</td>
<td>Less than 2 seconds</td>
<td>n/r</td>
</tr>
<tr>
<td>Hospital resuscitation area</td>
<td>9</td>
<td>Voice</td>
<td>34.6°C</td>
<td>161</td>
<td>78</td>
<td>Unrecordable</td>
<td>Greater than 8 seconds</td>
<td>121/75</td>
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</table>
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