UNDETECTED BUTTON AND COIN CELL BATTERY INGESTION IN CHILDREN
I2018/012

Independent report by the Healthcare Safety Investigation Branch

June 2019 Edition
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ABOUT HSIB


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 have the potential to cause harm to patients. The recommendations we make aim to improve healthcare systems and processes in order to reduce risk and improve safety.

Our organisation values independence, transparency, objectivity, expertise and learning for improvement.

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

OUR INDEPENDENCE

We are funded by the Department of Health and Social Care and sponsored by NHS England and NHS Improvement, but we operate independently.

Following recommendations from a parliamentary select committee in August 2018, we expect that a Bill for establishing the Health Service Safety Investigations Body (HSSIB) will be introduced to Parliament soon. The Bill will establish our full statutory independence and enshrine our right to conduct national investigations under protected disclosure. This provision, commonly known as ‘safe space’, enables staff to share their experience of a patient safety incident without fear of reprisal. It does not prevent us from sharing important details with families, regulators or organisations about an incident or to address immediate risks to patient safety.

The Health Service Safety Investigations Bill will also establish our responsibility for NHS maternity investigations that meet specific criteria. Full information about the draft Bill is available on the Department of Health and Social Care website.

A NOTE OF ACKNOWLEDGEMENT

We are grateful to the parents of the child whose tragic experience is central to this report, for their support and involvement.
OUR INVESTIGATIONS

Our team of investigators and analysts have diverse experience working in 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

Our national investigations can encompass any patient safety concern that occurred within NHS-funded care in England after 1 April 2017. We consider the requirement to investigate potential incidents or issues based on wide sources of information including that provided by healthcare organisations and our own research and analysis of NHS patient safety systems.

We decide what to investigate based on the scale of risk and harm, the impact on individuals involved and on public confidence in the healthcare system, as well as the potential for learning to prevent future harm. We welcome information about patient safety concerns from the public, but we do not replace local investigations and cannot investigate on behalf of families, staff, organisations or regulators.

Our investigation reports identify opportunities for relevant organisations with power to make appropriate improvements through:

- ‘Safety recommendations’ made with the specific intention of preventing future, similar events.
- ‘Safety observations’ with suggested actions for wider learning and improvement.

Our reports also identify actions required during an investigation to immediately improve patient safety. Organisations subject to our safety recommendations are requested to respond to us within 90 days. These responses are published on our investigation pages.

Find out more in the investigations section.

MATERNITY INVESTIGATIONS

From 1 April 2018, we became responsible for all patient safety investigations of maternity incidents occurring in the NHS which meet criteria for the Each Baby Counts programme.

The purpose of this programme is to achieve rapid learning and improvement in maternity services, and to identify common themes that offer opportunity for system-wide change. For these incidents HSIB’s investigation replaces the local investigation, although the trust remains responsible for Duty of Candour and for referring the incident to us.

We work closely with parents and families, healthcare staff and organisations during an investigation. Our reports are provided directly to the families involved and to the trust. The trust is responsible for actioning any safety recommendations we make as a result of these investigations.

We have been operating in all trusts since 1 April 2019. Our longer-term aim is to make safety recommendations to national organisations for system-level improvements in maternity services. These will be based on common themes arising from our trust-level investigations.

Find out more in the maternity investigations section.
EXECUTIVE SUMMARY

The reference event

The parents of a three-year-old child became concerned about her health and contacted the NHS 111 service in the early hours of a Friday morning in 2017. The father reported that his daughter had pain in her stomach and chest area following an episode of vomiting; she was not eating and was crying frequently in between periods of sleep. She was referred to the primary care out-of-hours (OOH) service, which provided telephone advice, and the child remained at home.

A further call to NHS 111 was made the following day (Saturday morning). The child had similar symptoms with the addition of throat pain and the parents remained concerned. She was again referred to the primary care OOH service and, on this occasion, she was seen by a general practitioner (GP). This took place at a treatment centre located at the Emergency Department in a nearby hospital. The GP referred the child to a paediatric assessment unit (PAU) at the same hospital for a review by a specialist registrar (SpR)\(^1\) in paediatrics, where she was diagnosed with tonsillitis. She was prescribed antibiotics and discharged home.

Five days later the family visited their GP, as there was no improvement in their daughter’s condition and she had a raised temperature. The child was once again referred to the PAU at the local hospital; further antibiotics were prescribed by the same doctor they had seen previously, and the family went home. Three days later, a 999 call was made as the child was reported to be "unable to see". Following an assessment by two ambulance paramedics, the child remained at home under the care of her parents. In the early evening of the same day, a second 999 call was made when the child suddenly became unconscious and started to bleed. When the paramedics arrived, she was found to be in cardiac arrest and bleeding heavily from her nose and mouth. Resuscitation attempts continued in the ambulance and on arrival at the local hospital, but the child did not survive.

A postmortem examination revealed a 23mm diameter lithium battery lodged in the child’s oesophagus (foodpipe). The swallowed battery had eroded the tissue and caused a fistula (abnormal connection) between the oesophagus and the aorta leading to the catastrophic haemorrhage (bleeding).

National investigation

HSIB was notified of the reference case by a Senior Coroner, who issued a Regulation 28 Report to several bodies (including HSIB) following an inquest. The notification by the Coroner raised specific concerns relating to the ingestion (swallowing) of button/coin cell batteries by children under the age of five years. The HSIB investigators gathered additional information and assessed the incident against its investigation criteria (see section 3.2).

The national investigation focused on:

1. reviewing the current processes for the identification and treatment of button/coin cell battery ingestion in children under the age of five years, including the management of associated non-specific symptoms when ingestion is unknown
2. reviewing communication and information sharing between NHS 111, primary care services, out-of-hours, acute and ambulance services
3. reviewing how ambulance services assess and manage paediatric cases in relation to non-specific symptoms.

Findings

The investigation found:

1. Button/coin cell batteries of 16mm in diameter and above can lodge in the oesophagus of young children causing serious harm or death due to a chemical reaction which erodes tissue. There is currently no commercially available technological solution to render such a battery inert when not in use.
2. While there are product safety regulations for children’s toys, there are no equivalent safety regulations for household items to ensure button/coin cell batteries are secured in battery compartments and cannot be accessed by small children.
3. While reputable coin cell manufacturers use child-resistant packaging for their lithium coin cell battery products, child-resistant button/coin cell battery packaging is not used by all product manufacturers or retailers.
4. The requirement to place product warnings on packaging is part of the International Electrotechnical Commission standards. However, there is currently no directive to place warnings or information on product packaging regarding the

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\(^1\) A specialist registrar is a junior doctor who has completed two years of foundation training but is still in training in a speciality area of medicine.

\(^2\) The Coroners and Justice Act 2009 allows a coroner to issue a Regulation 28 Report to an individual, organisations, local authorities or government departments and their agencies where the coroner believes that action should be taken to prevent further deaths.
serious consequences of a young child ingesting a button/coin cell battery.

5 There is local and regional guidance, as well as National Institute for Health and Care Excellence guidance relating to elements of acute illness in the under-five age group. The investigation also found examples of guidance developed internationally. However, there is currently no national clinical decision support for suspected or known ingestion of button/coin cell batteries in children.

6 The relevant pathways used by NHS 111 did include the possible ingestion of a button/coin cell battery in children, but only when ingestion of a foreign body was known.

7 If the ingestion of a foreign body is known, there is a question within the NHS 111 ‘Object, Ingested or Inhaled’ pathway. A question would be asked regarding what object had been ingested and this would include a prompt for batteries and button/coin cell batteries. This question would only be asked after various symptoms had been ruled out due to the hierarchal nature of NHS pathways, in which serious symptoms are ruled out first. In cases where symptoms indicate that an urgent response is required, there would be no further questions asked.

8 The healthcare information systems involved were limited in their ability to share information.

9 There is a lack of clarity about the roles and responsibilities of supervisor and supervisee paramedics, which can impact on the team dynamic. There is no nationally available guidance regarding supervision for paramedics and other grades of patient-facing ambulance staff.

10 There are no standardised national guidelines that provide guidance for ambulance staff on when to safely convey (take to hospital), refer and discharge children under five years.

11 Although the risks associated with batteries and specifically button/coin cells have been published by the battery industry for the past 10 years, the severity of harm caused by such batteries becoming lodged in a young child’s oesophagus are not widely understood by the public.

12 In the UK there is no accurate data to capture the incidence of button/coin cell battery ingestion and the level/type of harm caused in young children.

**HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATIONS**

**Recommendation 2019/034:**
It is recommended that the Department for Business, Energy and Industrial Strategy develops a strategy to improve button/coin cell battery safety, to include producing a fast-track standard covering/considering battery design, product casing, packaging and safe retailing practices.

**Recommendation 2019/035:**
It is recommended that the Royal College of Paediatrics and Child Health develop a key practice point within a decision support tool for suspected or known ingestion of button/coin cell batteries, and to be supported in this development by the Royal College of Emergency Medicine.

**Recommendation 2019/036:**
It is recommended that the Association of Ambulance Chief Executives agrees guidance that can inform its members on the competency and authority for staff to convey, refer and discharge children under five years who are subject to 999 calls.

**Recommendation 2019/037:**
It is recommended that the College of Paramedics develops supervision guidance for paramedics, applicable to all relevant practice settings.

**Recommendation 2019/038:**
It is recommended that the Department for Business, Energy and Industrial Strategy highlights to the general public the dangers of button/coin cell batteries.

**HSIB MAKES THE FOLLOWING SAFETY OBSERVATIONS**

**Observations:**
There is limited connectivity and interoperability across healthcare information technology systems. This can impact on the availability and quality of information regarding patients’ clinical history, previous contact with healthcare professionals or services and past interventions.

It would be beneficial for a review to be undertaken of the content of the Advanced Paediatric Life Support course, and any similar courses hosted by other providers, to ensure that the management and issues associated with the ingestion of button/coin cell batteries is strengthened as required in response to this report.
It may be beneficial for a study to be conducted on the potential for hand-held metal detectors to be used as a non-invasive screening tool for non-specific clinical presentations in children under five years.

There appear to be opportunities to reduce the variation in provision of and access to clinical leadership in the ambulance sector, when compared with the general management structure.

The provision of protected time for paramedics and other grades of patient-facing ambulance staff to undertake supervision and clinical updates is limited. This may impact upon the maintenance of staff competency and may limit trusts’ ability to disseminate learning opportunities.

Information could be collected by a surveillance study of all children attending emergency departments with button/coin cell battery ingestion, to better understand incidence and outcomes.

**SAFETY ACTIONS CARRIED OUT**

**Safety actions:**

In relation to the ingestion of anything ‘harmful or poisonous’, NHS Pathways has now included button/coin cell battery in the supporting information so that a specific prompt is provided.

NHS Digital and the Priority Dispatch Corporation have reviewed all relevant pathways associated with the possible ingestion of button/coin cell batteries in children.


Public Health England, Community Practitioners and Health Visitors Association, Royal College of Midwives, Royal College of Nursing, and School and Public Health Nurses Association have cascaded safety messages regarding the potential dangers of button/coin cell batteries through their networks.

The General Medical Council has developed a blog, integral to which is the safety message: ‘The dangers of button battery ingestion: a safety message’.
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1 BACKGROUND AND CONTEXT

1.1 Button and coin cell batteries

1.1.1 These batteries are cells with a cylindrical shape in which the overall height is less than the diameter. Button and coin cell batteries are distinguishable by shape, size (diameter and thickness), voltage and chemical properties.

Button batteries are usually thicker and smaller in diameter than coin cell batteries and look like buttons. They do not contain lithium and generally operate at 1.5 volts (International Electrotechnical Commission, 2019). Button batteries may be found in the following devices: hearing aids, smaller toys, laser pointers and calculators.

**FIG 1 BUTTON BATTERIES**

Coin cell batteries are thinner and larger in diameter than button batteries and look like coins. They contain lithium and have a nominal 3 volt output. Coin cell batteries can retain their charge for several years, potentially causing harm if swallowed even when they do not contain enough charge to power a product. They may be found in the following devices: remote controls, key fobs, bike lights, sensors, scales and medical devices.

**FIG 2 COIN CELL BATTERIES, 23MM DIAMETER**

This was the type of lithium battery swallowed by the child involved in the reference event.

1.1.2 Consultant paediatricians advised the investigation that button/coin cell batteries “look like sweets” to children and, if ingested (swallowed), the child may experience a tingling sensation on the tongue which reinforces this belief (Royal Society for the Prevention of Accidents, 2018).

**FIG 3 POSTER HIGHLIGHTING THE SAFETY RISKS OF BUTTON/COIN CELL BATTERIES TO CHILDREN**

Image courtesy of the Department for Business, Energy and Industrial Strategy.

1.1.3 Children under the age of five are at the highest risk of injury as a result of swallowed batteries, due to their tendency to put things in their mouths and their inability to articulate their actions (Wallace et al, 2017). The majority of severe injuries and deaths involve children younger than three years (Fuentes et al, 2014).

1.1.4 The British and Irish Portable Battery Association advised the investigation that the battery industry warns about the potential for batteries of 16mm diameter or above becoming lodged in the oesophagus (foodpipe) of younger children. This is because of the smaller diameter of a child’s oesophageal lumen (open cavity). Older children and adults are not at risk in the same
way because of the way the body changes as it grows. This makes it less likely that a battery will become wedged in the oesophagus; instead it will travel to the stomach and be passed in the stool. In the case of coin cells, in addition to the diameter, the voltage of the battery (3 volts) is a significant factor.

Figure 4 below illustrates the three areas where the oesophagus naturally narrows, highlighting where oesophageal lodgement (objects getting stuck in the oesophagus) may occur. The oesophagus is most at risk as it has weak peristalsis (alternate muscular contraction and relaxation).

Figure 5 is an anatomical illustration of the oesophagus and the proximity of other structures in the body. A button/coin cell battery lodged in the oesophagus can erode into the aorta, trachea (windpipe) or lung.

**FIG 4&5 ANATOMICAL REPRESENTATION OF OESOPHAGEAL LODGMENT AND PROXIMITY OF OTHER STRUCTURES**

More than 50% of serious outcomes due to button/coin cell battery ingestion occur after an unwitnessed ingestion, in which case there is likely to be a delay in recognition and diagnosis (Litovitz et al, 2010). Batteries lodged in the oesophagus can cause severe tissue damage and perforation within two hours, the damage continuing even if the battery is removed. Children sustaining such injuries require long-term care and multiple operations and procedures to correct the damage caused (The Conversation, 2018). If the battery is not detected and removed, delayed complications may occur including the formation of an abnormal connection between the oesophagus and a major blood vessel, with subsequent massive haemorrhage (bleeding) causing death (Litovitz et al, 2010). The risk is present with both charged and used cells, the latter potentially having sufficient electrical charge to harm a child if swallowed, even if there is insufficient charge to power a product.

1.1.6 Swallowed lithium coin cell batteries can cause serious internal burns, which occur due to the generation of an electric current. This hydrolyses (breaks down) tissue fluids and produces sodium hydroxide (caustic soda) at the coin cell battery’s negative pole, causing rapid liquefaction necrosis (tissue corrosion). A coin cell battery must become lodged or impacted to allow enough sodium hydroxide to accumulate at one site for damage to occur. Pressure necrosis may combine with sodium hydroxide to erode through tissue (Wright et al, 2017).

**FIG 6 ILLUSTRATION OF EROSION CAUSED BY BUTTON/COIN CELL BATTERIES (ON HAM)**

Image courtesy of Wright et al, 2017
1.2 **NHS 111**

1.2.1 NHS 111 services were introduced in 2013 and 2014 for patients with urgent medical concerns. NHS 111 is staffed by trained call advisors, supported by clinicians, who use the NHS Pathways triage system to direct patients to the most appropriate available service, both in and out of hours. NHS England describes the purpose of NHS 111 as:

- giving advice on self-care
- connecting patients to a nurse, emergency dentist or GP
- booking patients a face-to-face appointment
- connecting patients to local services.

1.2.2 NHS 111 services can be provided by ambulance services, private providers and other NHS trusts.

1.3 **NHS Pathways**

1.3.1 NHS Pathways is a programme that provides the Clinical Decision Support System used in NHS 111 and half of English ambulance services (NHS Digital, 2018a). This triage system supports the remote assessment of over 13 million calls per year. These calls are managed by non-clinical specially trained call handlers who refer the patient on to suitable services based on the patient’s health needs at the time of the call. These call handlers are supported by clinicians who are able to provide advice and guidance or who can take over the call if the situation requires it. The system is built around a clinical hierarchy, meaning that life-threatening problems assessed at the start of the call trigger ambulance responses, progressing through to less urgent conditions which require a less urgent response (or disposition) in other settings.

1.3.2 All NHS 111 call handlers undergo training by clinicians, educational and information technology specialists to ensure they use the system safely and effectively. NHS Pathways uses up-to-date clinical evidence to design the triage questions, and these are reviewed regularly by clinical experts.

1.3.3 The safety of the clinical triage process endpoints resulting from a 111 or 999 assessment using NHS Pathways is overseen by the National Clinical Governance Group, hosted by the Royal College of General Practitioners. This group is made up of representatives from the relevant medical royal colleges. Senior clinicians from the colleges provide independent oversight and scrutiny of the NHS Pathways clinical content.

1.3.4 Alongside this independent oversight, NHS Pathways ensures its clinical content and assessment protocols are consistent with the latest advice from bodies that provide evidence and guidance for medical practice in the UK, in particular, they are consistent with the latest guidelines from:

- National Institute for Health and Care Excellence
- Resuscitation Council (UK)
- The UK Sepsis Trust.

1.4 **Medical Priority Dispatch System**

1.4.1 The Medical Priority Dispatch System (MPDS) is a computerised triage system used by some English ambulance trusts to categorise and prioritise 999 calls. MPDS is produced by the Priority Dispatch Corporation in the USA which is licensed to publish and maintain the system in the UK.

1.4.2 MPDS triage involves the caller being asked a series of questions by a non-clinically qualified call taker, based on prompts and questions generated by the system and the responses given. The responses to the questions are analysed by the system and a final category is given based on the ‘chief complaint’ (the major symptom the patient is experiencing). The system also provides a priority for the call, from the most urgent, life-threatening problems such as unconsciousness or cardiac arrest, through to minor problems requiring self-care advice only.

1.5 **Language Line**

1.5.1 Language Line is a multi-language confidential interpreter service that is available to NHS 111 health advisors and callers (NHS, 2017). This is an intermediary service that uses conference call technology to join a consultation. There is a Standard Operating Procedure for NHS 111 staff to use when it is apparent that a caller requires interpreting services. The health advisor ascertains which language the caller requires and will then place the caller on hold
while contacting an interpreter. If there is a family member or friend of the patient able to act as interpreter, this is accepted providing this person is above the age of 12. Language Line is also used by ambulance, secondary care and primary care services. Where Language Line is not used, similar translation services are available.

1.6 Primary Care out-of-hours service

1.6.1 The Primary Care out-of-hours service provides urgent primary care services between 18:30 hours and 08:00 hours on weekdays, and 24 hours a day at weekends and bank holidays (NHS, 2018a).

1.7 The Office for Product Safety and Standards

1.7.1 The Office for Product Safety and Standards (OPSS) was created in January 2018 by the Department for Business, Energy and Industrial Strategy to enhance protection for consumers and the environment and drive increased productivity, growth and business confidence. OPSS has been given the responsibility for identifying consumer risks and managing responses to product recalls and repairs. It co-ordinates the national system that oversees product recalls and provides local authorities that enforce product safety legislation with scientific and technical intelligence and incident management support.

1.8 The Royal Society for the Prevention of Accidents

1.8.1 The Royal Society for the Prevention of Accidents is a charity dedicated to the prevention of accidental death and injuries and works collaboratively with those affected by death and injury, and with health professionals and industry partners, to achieve that goal.

1.9 The British and Irish Portable Battery Association

1.9.1 The British and Irish Portable Battery Association (BIPBA) is the trade association for the portable battery industry in the UK. The current members of BIPBA include Panasonic, Duracell, Energizer, Sony, GP Batteries and Varta.

1.10 The Child Accident Prevention Trust

1.10.1 The Child Accident Prevention Trust is a charity dedicated to reducing preventable accidents in children and young people.

1.11 Use of the term ‘supervision’ in the ambulance service, and how it is used in this report

1.11.1 The Cambridge Dictionary defines supervision as:

‘The act of watching a person or activity and making certain that everything is done correctly, safely, etc.’

1.11.2 In the context of healthcare, supervision is often prefixed with ‘clinical’ or ‘professional’ to denote the specific activities associated with preparing and optimising healthcare professionals using a range of methods.
1.11.3 The ambulance service in the UK, in common with all healthcare providers, provides supervision for its staff. However, due to the nature of the work undertaken by paramedics and other clinicians in the ambulance sector, supervision exists in a variety of domains. These domains include the following, although the list is not exhaustive:

• operational/management supervision – which covers aspects of work such as driving, manual handling, processes (for example, making safeguarding referrals), or following return to work after a period of absence

• clinical/professional supervision – direct supervision of clinical care, reflection, action learning, supporting audit, probationary periods, undergraduate placement

• remote supervision – providing senior clinical oversight to support decision making and safe care (for example, helping junior staff make decisions on whether to convey a patient to hospital).

1.11.4 In this report, the supervision domain most relevant to the investigation is clinical/professional supervision, and the reader should consider this wherever the word ‘supervision’ is used.

1.11.5 The development of operational/management supervision and remote supervision is already subject to development within the NHS in response to the recommendations made within ‘Lord Carter’s review into unwarranted variation in NHS ambulance trusts’ (NHS Improvement, 2018).
2 THE REFERENCE EVENT

Day 1: Friday, 01:14 hours

2.1.1 The parents of a three-year-old child contacted the NHS 111 service, concerned about her health. The child’s father spoke to an NHS 111 health advisor3 and there was initial difficulty in ascertaining the correct spelling of the child’s name and other demographic details, including confusion regarding her date of birth. As a result, the health advisor questioned the father about the language he spoke. It was established that he spoke English, although it was not his first language. It was also determined that the family had changed address very recently.

2.1.2 The father reported his daughter had pain in her stomach, which had started during the evening after an episode of vomiting. In addition, he reported she was not eating and was crying frequently between periods of sleep. The child was asleep during the initial part of the call and the father was asked to wake her (to check she could be woken), following which she started to cry.

2.1.3 Following a series of questions, prompted by the NHS Pathways triage system, the father reported his daughter was complaining of pain in her chest area and stomach, but pointing everywhere on her body. He explained that she was asking them to rub her chest region and that his wife reported hearing some sounds in her stomach. When asked about bowel motions, and whether the child had passed "a bowel motion that looks like redcurrant jelly", the father said she had passed a motion like jelly, but it was not red. The health advisor asked, "okay, could she have taken anything that could be harmful or poisonous?" and based on the father’s response, the foreign body ingestion line of questioning was then closed.

2.1.4 The outcome of the call was for the primary care out-of-hours (OOH) service to contact the parents within two hours. Interim care advice4 was provided and the call ended, having lasted for 16 minutes in total. A record of the consultation was sent electronically to the OOH provider’s computer system.

2.1.5 A nurse advisor from the primary care OOH service spoke to the child’s father. She checked demographics and the history of the child’s illness, as relayed by NHS 111. Advice was provided regarding the administration of paracetamol to help with the stomach pain and how to respond if this was not effective or if other symptoms developed.

2.1.6 The parents were offered an appointment with a general practitioner (GP) at a treatment centre in a nearby hospital, which the father declined as he had no transport. He agreed to try and give the paracetamol first to see whether this was effective at relieving his daughter’s pain.

Day 2: Saturday, 11:18 hours

2.1.7 The father called NHS 111 for a second time regarding his daughter’s stomach pain. He said she had vomited after having some food, following which she had not eaten and was complaining of stomach pain.

2.1.8 The father said he had called back as his daughter was still complaining of stomach pain despite having been given paracetamol. He added that the main symptoms were the stomach pain and pain in her throat region. In addition, he reported that his daughter “was not taking any food”. These symptoms had been present for one and a half days and the parents were concerned because the pain appeared to be severe.

2.1.9 Questions regarding vomiting had to be repeated and clarified, at which point the health advisor asked the father if he wanted an interpreter to make sure they were answering the questions correctly, but he opted to continue in English.

2.1.10 In relation to a bowel motion looking like red currant jelly, the father responded as he had done during the first call, saying: “It’s not red no, it’s jelly like.”

2.1.11 The outcome of the call was a second referral to the primary care OOH service. The call concluded after 10 minutes with the health advisor providing advice on pain relief, intake of fluids, hygiene advice and how to prevent the spread of any potential infection.

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3 The health advisor is a non-clinical trained professional who uses pre-scripted questions to fill out an electronic form.
4 Interim care advice includes pain relief administration; drinking fluids; hygiene advice; how to prevent the spread of any potential infection; and some ‘watch for’ 999 symptoms.
A record of the consultation was sent electronically to the OOH provider’s computer system.

Day 2: Saturday, 11:42 hours

The father spoke to a nurse advisor from the primary care OOH provider. He described a history of abdominal pain and a raised temperature (which is the first time this is mentioned), in addition to a sore throat, urine that smelt unusual and a reduced oral intake.

The nurse advisor recommended a face-to-face appointment with a doctor (GP) within six hours and she booked the child an appointment at a treatment centre, located in the emergency department in a local hospital.

Day 2: Saturday, approximately 13:50 hours

The OOH GP took a history and examined the child. She was said to be alert and awake with a slightly raised temperature (37.6 degrees centigrade), but all other observations were within normal range. The GP undertook a physical examination and found the child’s abdomen to be soft and non-tender and her throat slightly inflamed (although there was no pus).

A urine sample was collected and checked with a urine dipstick. This revealed that the sample was strongly positive for blood cells, and according to the family’s account, blood was visible in their daughter’s urine. There was only a trace of leucocyte and protein; and the sample was negative for nitrite (which would have been positive if there had been an infection). In addition, it was strongly positive for ketones.

The GP was unsure if the clinical picture was suggestive of a significant kidney condition. He was concerned about the child being unwell, vomiting and the presence of red blood cells and ketones in the urine, so he contacted the on-call Specialist Registrar (SpR) at the hospital to discuss the case. It was decided that the child should be admitted to the Paediatric Assessment Unit (PAU) at the hospital. The parents agreed with the plan; they were given a referral letter detailing the consultation and directed to the PAU. At the time of this incident, the PAU was located in the same hospital building as the treatment centre, so the parents, the child and her brother were able to walk from one area to the other.

Day 2: Saturday, approximately 16:00 hours

The child was seen in the PAU by a staff nurse at 16:04 hours. She noted that the child had been referred by the GP with a three-day history of a sore throat, abdominal pain and reduced appetite. Her initial assessment observations were within normal limits, apart from a slightly raised temperature of 37.6 degrees centigrade. A urine dipstick showed significant amounts of ketones and blood, trace of protein and leucocytes. A urine sample was collected and sent for urgent analysis, which demonstrated the child did not have a urinary tract infection (the result was reported on day three). The Staff Nurse recalls that while in the PAU, the child appeared to be happy, playing outside on bikes with her brother and parents.

At 17:30 hours, the child was reviewed by the SpR who, following assessment, diagnosed her with pustular tonsillitis (she had white spots on her left tonsil). Local anaesthetic spray was given to ease the child’s sore throat and she drank 200mls of juice. The family recollect that they had to ask for a straw, as their daughter was unable to drink fluids without one at this time, due to being unable to swallow properly.

During her stay in the PAU, the child’s temperature increased to 38.1 degrees centigrade, so paracetamol was given. At the point of discharge, her temperature had decreased to 37.4 degrees centigrade.

At 19:19 hours, the child was discharged home with local anaesthetic spray and antibiotics. A 10-day course of oral antibiotics was prescribed but only one bottle was supplied (a five-day course), in accordance with PAU policy at the time. The parents were advised that they would need to contact their GP for a further supply.

Advice was provided to the parents on discharge in relation to monitoring the child’s temperature and giving paracetamol if required. The parents were advised that the PAU had 24-hour open access and they were

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1 Leucocyte and protein could indicate that the child had a urine infection or a kidney condition.
2 Interim care advice includes pain relief administration; drinking fluids; hygiene advice; how to prevent the spread of any potential infection; and some ‘watch for’ 999 symptoms.
3 The paediatric assessment unit (PAU) is a 24-hour, short-stay unit designed to provide specialist assessment and observation of a child’s condition by paediatric doctors and nurses.
provided with the ward contact details should they have any concerns.

**Day 6: Wednesday, unknown time**

2.1.23 The child’s father informed the investigation that he attended hospital (PAU) and spoke to a nurse at the nurses’ station about his daughter running out of antibiotics, as the initial supply was running out and they needed a further supply. He said the hospital informed him that he needed to go to his GP to get a new prescription.

**Day 7: Thursday, 11:30 hours**

2.1.24 The parents booked an appointment to see a GP at their local medical practice due to ongoing concerns regarding their daughter. The family attended and were seen at 12:24 hours. During the consultation, the GP recorded that the child had become unwell one week previously with a temperature, sore throat and abdominal pain. The GP also noted that the child had been seen at the hospital previously and diagnosed with pustular tonsillitis. The initial supply of antibiotics prescribed by the hospital had run out the day before, so an additional bottle was required to complete the 10-day course.

2.1.25 The GP noted the parents’ ongoing concern about their daughter’s symptoms, which were documented as reduced oral intake, reduced urine output, ongoing raised temperature and some complaints of abdominal pain. The child was said to have been tolerating a very small amount of food and there was no history of diarrhoea. The GP recorded her examination findings, which were within normal limits except for a raised temperature of 38.0 degrees centigrade, mild abdominal tenderness and slight redness of her throat. The GP described the child as “moving easily but was sitting quietly”. The parents recollection was that their daughter was becoming less active, and much quieter.

In view of the persistent raised temperature for seven days and no clear focus of infection, the GP felt that she required further assessment and review at the hospital.

**Day 7: Thursday, 12:58 hours**

2.1.26 The Sister in charge of the children’s ward at the local hospital took the referral from the child’s GP. She noted on her SBAR8 form that the GP was concerned about the child’s temperature still being raised, in addition to her reduced dietary intake and urine output. The Sister also documented that the child had been commenced on antibiotics for tonsillitis, five days previously. The observations that the GP had taken were relayed to the Sister, all of which were in normal range except her temperature, which was 38.0 degrees centigrade. The Sister agreed for the child to be seen and assessed in the PAU, so the parents were given a referral letter by the GP to take with them to hospital.

**Day 7: Thursday, 16:55 hours**

2.1.27 The Staff Nurse in the PAU tried to call the parent’s mobile phone as they had still not arrived by this time. However, the phone was not answered, and the Staff Nurse was unable to leave a message as the voicemail was full.

**Day 7: Thursday, 17:20 hours**

2.1.28 The child and her family attended the PAU. They had brought food and other supplies, as they intended to remain at the hospital until their daughter had been reviewed.

The same SpR who had seen the child on day two was at the nurses’ station when the family arrived. On recognising the SpR, the father approached the nurses’ station to talk to her. He recalled explaining to the SpR that his daughter was not eating and had a sore throat and the response was that this was an issue for the GP to deal with.

The SpR reported that she reviewed the GP’s referral letter and observed the child playing in the waiting area. She recalled that although the parents had expressed concern about their daughter’s condition, she believed their focus was on getting the antibiotics for their daughter to complete the 10-day course. In her words, on observing the child playing, she appeared “well in herself”. Based on this, the SpR stated that there was no indication that the original diagnosis was incorrect.

2.1.29 The child had not been clerked in (the through the process of being admitted by a doctor) and therefore no admission or discharge documentation was completed, and no observations were taken during

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8 SBAR is a communication tool, used to capture Situation (one sentence description of need); Background (details of current problem); Assessment (clinical evaluation) and Recommendation (interpretation and solution). It was used at the reference event hospital for taking referrals from GPs or other healthcare professionals.
her attendance. She was prescribed the remaining five days of antibiotics to complete the course and went home, via the pharmacy department.

**Day 10: Sunday, 09:44 hours**

2.1.30 A 999 call was made as the child said to her parents that she was “unable to see”. The father informed the investigation his daughter was conscious but saying she could not see and was becoming distressed. The incident was categorised as an emergency and summarised as: ‘unconscious, near fainting episode.’ An ambulance was dispatched with a double paramedic crew under emergency conditions, arriving at 09:54 hours. Paramedic 1 was primarily responsible for the child’s care. Paramedic 2 was observing Paramedic 1 as part of the routine appraisal process.

2.1.31 The Paramedics were met by the child’s father, who led them upstairs to the family’s flat. They recalled that the “body language from both parents appeared calm”.

2.1.32 As the Paramedics entered the flat, the child was lying awake on a mattress. Her mother was sitting on the floor beside her. The Paramedics asked the parents to take their daughter through to the lounge area so that they could assess her. The child’s father picked her up and carried her through to the other room.

2.1.33 The Paramedics received no information relating to the primary care or hospital attendances other than the antibiotic prescription. They therefore conducted an assessment and took a verbal history from the father.

2.1.34 The Paramedics described the child as being bright and alert. They were satisfied that the results of their observations and examination fell within normal ranges. They were assured that the previously prescribed medication was working as expected due to the absence of a high temperature. Following assessment and discussion with the father, the child remained at home with her family.

**Day 10: Sunday, 18:13 hours**

2.1.35 A second 999 call was made for the child who was now in cardiac arrest, following a massive haemorrhage (bleed) from her mouth and nose. The ambulance service arrived with multiple resources including an advanced paramedic. Advanced life support was given at the scene and the child was taken to the local emergency department. However, resuscitation was unsuccessful, and the child was pronounced deceased at 19:15 hours.

2.1.36 Post-mortem examination identified a 23mm coin cell battery lodged in the child’s mid oesophagus, at the level of the fifth to sixth thoracic vertebra (Figure 8). This had resulted in erosion of the wall of the oesophagus and the formation of an oesophageal-arterial fistula (an abnormal connection between the oesophagus and an artery).

**FIG 8** EXAMPLE X-RAY SHOWING LOCATION OF LODGED COIN CELL BATTERY

2.1.37 Following the post-mortem, the parents searched their home and found a coin cell battery missing from an infrequently used remote control. It has not been possible to identify when the battery was ingested.

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9 Observation shifts were routine in the reference event Trust for paramedics, taking place four times per year as part of the appraisal process. They involved the paramedic spending time with their supervisor.
3 INVOLVEMENT OF THE HEALTHCARE SAFETY INVESTIGATION BRANCH

3.1 Referral of the reference event

3.1.1 HSIB was notified of the reference case by a Senior Coroner, who issued a Regulation 28 Report to several bodies (including HSIB) following an inquest. The notification by the Coroner raised specific concerns relating to the ingestion of button/coin cell batteries by children under the age of five years.

3.2 Decision to investigate

3.2.1 Following an initial scoping investigation, the Chief Investigator authorised a full investigation as the incident met HSIB’s criteria:

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

Coin cell battery ingestion in the under-five age group can cause death or life-changing injuries. Detectability is difficult when ingestion is unknown partly because of the age of the child (their level of speech development means they have difficulty articulating their actions), but also due to the variety of non-specific symptoms associated with ingestion.

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

In relation to systemic safety deficiency, coin cell batteries are increasingly being used in household items, many of which have unsecured battery compartments (Child Accident Prevention Trust, 2018).

The actual incidence in the UK is unknown because data is collected as part of a wider category of foreign object ingestion. Data on button/coin cell batteries is collected in other countries; in the USA, over 3,500 incidents of battery ingestion are reported each year and in Australia, approximately 20 cases per week.

The National Reporting and Learning System (a central database of patient safety incident reports) was searched on 15 May 2018 for incidents reported between 1 May 2008 and 1 May 2018. (See Appendix A for details of the search terms used.) There were 39 reported patient safety incidents relating to accidental button/coin cell battery ingestion in children aged from birth to seven years. Just over a quarter related to children with mixed symptoms and unknown ingestion; of these, 21% resulted in ‘moderate’ harm, ‘severe’ harm or ‘death’.

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

Information gathered by HSIB suggested that button/coin cell battery ingestion in children was the most challenging type of foreign body ingestion to diagnose, due to both the lack of clear symptoms and the wide variety of outcomes from no harm to death (Leinwand et al, 2016). This is further complicated in patients where the battery ingestion was not witnessed, and non-specific symptoms hinder diagnosis, in a situation where severe harm can occur despite early diagnosis (Fuentes et al, 2014).

HSIB determined that there were opportunities to share learning at a national level to positively influence processes and practices to prevent accidental button/coin cell battery ingestion in young children, in addition to improving detection when ingested and battery safety.

3.2.2 The scope of this investigation relates to the ingestion of button/coin cell batteries in the under-five age group, when the battery becomes lodged in the oesophagus. Based on harm and detectability, the investigation has excluded:

- batteries that pass through the digestive tract
- batteries that are lodged in the airway (as this would cause more obvious and

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10 The Coroners and Justice Act 2009 allows a coroner to issue a Regulation 28 Report to an individual, organisations, local authorities or government departments and their agencies where the coroner believes that action should be taken to prevent further deaths.
immediate symptoms, which would be acted upon as an emergency)

- batteries inserted into an ear, nose or other orifice
- ingestion/insertion by people in other age groups, either accidentally or intentionally (self-inflicted harm).

3.3 Evidence gathering and methods used

3.3.1 A range of methods were used in this investigation, including:

- review of patient clinical records, hospital policies, procedures and practice regarding foreign object ingestion at the Trusts the child came into contact with prior to the reference event occurring
- interviews with staff within the paediatric service at the Acute Trust the child attended with her parents and paramedic staff at the Ambulance Trust who responded to the initial 999 call made by the parents
- review of Trust staff statements provided to the Coroner
- review of the Acute and Ambulance Trusts’ internal Serious Incident Investigation reports
- review of national patient safety incident and serious incident data
- literature reviews on button/coin cell batteries (incidence, clinical implications of ingestion and manufacturing changes), the protective coating of coin cell batteries, and the use of public health campaigns
- interviews and meetings with acute and ambulance trusts within England that have introduced different initiatives to improve foreign body ingestion detection
- interviews, calls and email correspondence with relevant national organisations and subject matter advisors, both clinical and non-clinical
- engagement of a human factors\(^\text{11}\) advisor to consider certain aspects of the case
- engagement of a cultural advisor
- communication with an international specialist regarding coin and button cell battery safety.

**Analytical tools**

3.3.2 Analysis of this event was informed by the Australian Transport Safety Bureau (ATSB) model, developed in 2008 (Australian Transport Safety Bureau, 2008). The model is a derivative of the concept of organisational accidents, introduced by James Reason. This describes a hierarchy of organisational and local conditions that harbour latent risks, and unsafe acts which combine with these conditions and result in an accident. It encompasses Reason’s well-known ‘Swiss cheese’ model of systemic defences or barriers at each level, which may be incomplete and fail when the ‘holes’ in the barriers line up (Reason, 1997).

3.3.3 These models capture the following key concept: that many of the causal factors that lead to a failure at the ‘sharp end’ (in this case, undetected ingestion of a button/coin cell battery) may be far removed from where the error occurred, within the organisation or the wider system.

\(^{11}\) Human factors is a scientific discipline combining the domains of psychology, sociology and ergonomics. Human factors investigators examine the influences of systems, process, environmental and social factors on decision-making and behaviours.
3.3.4 A diagrammatic representation of the ATSB model is shown in Figure 9.
4 FINDINGS AND ANALYSIS IN RELATION TO NATIONAL AND LOCAL POLICY

The HSIB investigation team interviewed frontline staff and managers within the Trusts where the incident occurred. The investigation reviewed the child’s clinical records, and Trust policies and national guidance, to understand what actions were taken and how these aligned with both the Trusts’ and national expectations. The investigation identified factors relevant to the child’s care and treatment.

4.1 NHS Pathways Clinical Decision Support System

4.1.1 The NHS Pathways system is built in modules, the first being Module 0. This seeks to identify immediate, life-threatening conditions which require emergency intervention, before moving on to subsequent modules. Module 1 is then used to signpost the patient to the right level of care. Module 1 starts with a body map (Figure 10) and, depending on the answers given by the caller, this then opens up other pathways (Figure 11).

**FIG 10 BODY MAP**

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4.1.2 Information received from NHS Digital indicates that at the time of the incident, NHS 111 was in the process of moving from NHS Pathways ‘Release 12’ to ‘Release 13’.

4.1.3 The ‘Vomiting and/or Nausea’ pathway includes the question: ‘Have they taken anything harmful or poisonous?’ In the reference event, the answer to this question was negative due to the unknown ingestion of the coin cell battery. This question was not explored further because of the father’s response.

4.1.4 If the answer to the question relating to the ingestion of anything harmful or poisonous had been ‘yes’ or ‘not sure’, and if there was severe or moderate abdominal pain already declared, this would have resulted in the dispatch of an ambulance. If there was no abdominal pain, the caller would be asked whether the patient had taken anything harmful or poisonous. If the answer to this question was ‘yes’ or ‘not sure’, the caller would then be asked if the patient is confused. A positive response to the confusion question results in the dispatch of an emergency ambulance. If there was no abdominal pain or confusion but the answer to the question relating to the ingestion of anything harmful or poisonous was ‘yes’ or ‘not sure’, the advice would be to attend an emergency treatment centre within one hour.
4.1.5 If ingestion of a foreign body was known, there is a question within the ‘Object, Ingested or Inhaled’ pathway (question 4 in the table below) which asks what object had been ingested and prompts batteries and button/coin cell batteries as a possible answer. The question relating to the specific object ingested is asked following a positive response to the question: ‘Has he/she brought up any blood?’ An emergency ambulance would be dispatched if bleeding was confirmed. If the response to ‘Has he/she brought up any blood?’ was negative, the question regarding the object ingested would be asked and the patient would be advised to attend an emergency treatment centre within one hour.

4.1.6 In relation to the battery prompt, there is additional information specifying that this is referring to any battery, including button/coin cell batteries, and an explanation that swallowed or inhaled batteries can cause serious internal damage. An ambulance would be dispatched for all the above scenarios, except for the confirmed ingestion of a coin, where the patient would be advised to attend an emergency treatment centre within one hour.

4.2 Analysis of the NHS 111 calls

4.2.1 There were two calls from the child’s father to NHS 111, the first on a Friday at 01:14 hours and the second on the following day (Saturday) at 11:18 hours.

4.2.2 A review of the transcript of the first NHS 111 call showed that the health advisor followed the pathway ‘Vomiting and/or Nausea’ and asked the question: “Has she taken anything that could be harmful or poisonous?” The Health Advisor had available to her the explanatory note to the question which was: ‘To find out if symptoms might be due to swallowing a possibly toxic (poisonous) substance.’

There were also on screen prompts available to the Health Advisor as follows:

- ‘This means anything that may be harmful or poisonous, whether taken accidentally or deliberately
- This means domestic and industrial products, street drugs or plant material
- IN CHILDREN ONLY this also means alcohol.’

4.2.3 The child’s father responded by detailing the food that his daughter had eaten. The Health Advisor again tried to clarify by saying that she was referring to domestic cleaning products. The father appeared to be confused by the question and it had to be repeated several times, the final question referring to bleach only. The Health Advisor was re-phrasing the question to aid understanding, but in doing so, the father responded to the bleach aspect of the question only, rather than anything that may be harmful or poisonous. The foreign body ingestion line of questioning was then closed.

4.2.4 A review of the transcript of the second NHS 111 call showed that the Health Advisor followed the same pathway, but the father responded in the negative to the first question relating to whether his daughter had taken anything harmful or poisonous. This line of enquiry was then closed, and advice was provided in relation to the next steps.
4.2.5 The father’s response regarding whether his daughter had taken anything harmful or poisonous was correct according to his knowledge at the time (Fig 13 explores the human factors elements relating to this). However, this line of enquiry being closed at the outset changed the subsequent process in respect of how the child was examined and treated. There was no compelling reason for any of the clinicians to suspect the child had ingested something hazardous.

**FIG 13 PERSPECTIVE FROM A HUMAN FACTORS SUBJECT MATTER ADVISOR**

In the reference event, the parents did not witness the battery being swallowed and there was no visible evidence of any missing batteries. Therefore, they answered negatively to the question relating to taking anything harmful or poisonous. As occurred in this case, parents and carers may on some occasions be unaware of a hazardous ingestion having taken place. There is currently no human factors literature on workload in households. However, anecdotal and experiential evidence shows that attention can be partly or wholly diverted away from a child in conducting essential household tasks, such as preparing food. At such times, a potentially hazardous item, in this case an infrequently used remote control, may be more in line of the sight of the child than an adult. Whilst parents/carers may genuinely believe that nothing hazardous has been ingested, it is unrealistic to expect this to be factually correct on all occasions due to other competing responsibilities (as outlined above).

4.3 Abnormal signs and symptoms: NHS Pathways

4.3.1 During the second call, the father said “...she was not taking any food...”. This was not pursued further at this point by the Health Advisor, who returned to the original line of questioning, which was to capture demographic and contact details.

4.3.2 Later in the same call, the father again reported that: “...she is saying she cannot take any food like, she is not taking much any food”. The Health Advisor asked the father whether this was attributable to the sore throat and he responded by saying that the pain was alternating between throat and stomach. The Health Advisor appears to interpret the inability to eat as being a consequence of the abdominal pain and this line of questioning was not explored further. A Consultant in Paediatric Emergency Medicine told the investigation that a child reporting an inability to eat solid food was a significant factor due to the possibility of a blockage in the oesophagus. The investigation has been advised that unwell children have a reduced appetite but can eat if they wish. On this occasion, it was not determined whether the child could eat, but did not have an appetite or whether there was a problem with swallowing properly, namely if the child attempted to eat they could not swallow food properly. The response from the father to the NHS 111 Health Advisor indicated the child could not eat, which the parents have subsequently verified during a family meeting. The child was unable to eat solid food or drink from a cup as she was having difficulty swallowing; she could however drink with the aid of a straw.

4.3.3 During two separate NHS 111 calls, the father reported “jelly like” stools (on questioning). The Health Advisor ascertained that the stool was not red in colour and then moved on to the next line of questioning. The investigation has determined that the child had a soft/loose consistency stool, which is what her father had interpreted as being like jelly.

4.3.4 In relation to detecting abnormal signs and symptoms during the first NHS 111 call, the questioning established that there had been no vomiting of any red blood, dark brown vomit like coffee grounds, or blood streaked faeces. It was also reported there had been no diarrhoea or rectal bleeding. During the second NHS 111 call, the Health Advisor established that there had been no vomiting of any red blood, so this was not explored further.

4.4 Abnormal signs and symptoms: primary and secondary care

4.4.1 In relation to national guidelines regarding examination, the General Medical Council states:

*You must provide a good standard of practice and care. If you assess, diagnose or*

12 ‘Redcurrant jelly’ stools are an indication of intussusception, a condition that can occur in childhood where the intestine folds back on itself and causes an obstruction.
treat patients, you must: adequately assess the patient’s conditions, taking account of their history (including the symptoms and psychological, spiritual, social and cultural factors), their views and values; where necessary, examine the patient.”
(General Medical Council, 2014)

4.4.2 The Royal College of Paediatric and Child Health (2015) specifies that children should be seen in a timely manner by a senior clinician with the right skills and competencies.

4.4.3 A urine sample tested by the out-of-hours (OOH) General Practitioner (GP) revealed that the sample was strongly positive for blood cells in addition to a sample tested by a nurse on the Paediatric Assessment Unit (PAU) which showed a significant amount of blood (recorded as ‘3+ blood’). However, other than recording the findings, there appeared to be no further investigation into why this abnormal finding was present. The OOH GP told the investigation that blood in the urine may be a symptom of general ill health, in particular a viral illness.

4.4.4 When he examined the child, the OOH GP considered the assessment of the clinical picture to be suggestive of a more serious type of kidney condition (NHS, 2016). This led to a phone call to the Specialist Registrar (SpR) at the hospital. The OOH GP told the investigation that for routine referrals to the PAU, he would contact the bleep holder (an internal paging system), who was usually a nurse or junior doctor. In this case, he felt sufficiently concerned to speak to the SpR directly. However, when the child arrived on the PAU, the OOH GP’s concerns in relation to a kidney problem were not explored further. It was not possible to establish why this line of enquiry was not pursued.

4.4.5 A Consultant in Paediatric Emergency Medicine advised the investigation that there are usually “red flags” for possible button/coin cell ingestion which include a small bleed prior to the terminal event, blood in the vomit or dark stools. In relation to the reference event, the following information from records and statements indicates that there were no such red flags:

- The OOH GP documented that on day two, the child had vomited twice after food, but he recorded that there was no mention of blood in the vomit.
  - The SpR on the PAU recorded in the medical records that the child’s vomit had been yellowish in colour and there had been no blood or mucous.
  - The SpR documented that there was no diarrhoea, but there was no mention of whether the parents were asked about blood in the stools.
  - The child’s GP recorded in the referral letter to the hospital that there had been no history of diarrhoea, but there was no further mention of the child’s stools or vomiting during the consultation on day seven.

4.4.6 On medical examination, the OOH GP noted that the child had a slightly inflamed throat, but no pus on the tonsils and no tender glands on her neck. The OOH GP told the investigation if his medical examination and findings had indicated tonsillitis, he could have treated the child with antibiotics without referral to hospital, as he regularly sees patients with viral and bacterial tonsillitis. He also said that in most cases antibiotics are effective within 48 hours and the symptoms resolve in patients with tonsillitis, which did not occur in this case.

4.4.7 When the SpR first encountered the child on day two, the child had been admitted to the PAU by a nurse and observations had been taken. The SpR described conducting a thorough assessment of the child. With no reason to suspect the ingestion of a hazardous body, she concluded that the child had bacterial tonsillitis, a diagnosis which the SpR described as most closely matching her symptoms. Tonsillitis is common in children, and a description of seeing pustules, combined with the raised temperature, is likely to have influenced the diagnosis.

The parents informed the investigation that they did not need to challenge the doctor’s judgement, saying they “could only believe the doctor, as they are the professional”.

4.4.8 Following a referral from the GP on day seven (the child’s second PAU attendance), no observations were undertaken, or examination carried out, and records were
not completed. Analysis showed that this was due to several factors:

• There was a lapse in time of just over four hours between the GP referral and attendance at the PAU. During this time, the bed allocated for the child was given to another patient who attended the PAU from the Emergency Department.

• The child attended outside of normal working hours and the external desk was not staffed. Outside of normal working hours, the booking-in process occurs at the nurses’ station and is conducted by a member of the ward staff. On this occasion, the same SpR who saw the child previously was at the nurses’ station. The father recognised the SpR and started to discuss his daughter’s condition, thus inadvertently bypassing the normal booking-in procedure. He recalled being asked to take a seat while a discussion took place between the SpR and other staff at the nurses’ station, reviewing the GP letter that the child’s father had provided to the SpR.

• The doctor then prescribed further antibiotics. In a statement from the parents, they recalled feeling that the SpR hastened and ended their discussion with her by saying that the pharmacy department was about to close, and they should rush to collect the second dose of medication. The child’s father considered that day seven was a turning point in his daughter’s treatment. He felt that, as this was the third visit to PAU within six days, his daughter should have received a more thorough assessment of her ongoing pain and raised temperature.

4.4.9 The SpR described that she had not been expecting the child to return to the PAU on day seven. This was the first departure from ‘work-as-imagined’ as the child had not been clerked in, nor had admissions documentation been completed at the time that the SpR was approached by the family.

4.4.10 At the time, the SpR had been on duty for almost nine hours on what she recalls as a busy day for the PAU. She described that she had been working “long days” on the paediatric unit on day seven and had been additionally covering the neonatal unit. The SpR described that while there were other doctors on duty, they were junior, and she had not seen a consultant on the unit that day.

4.4.11 Having conducted what the SpR described as a thorough examination of the child on day two, and having, in her words, “no reason to suspect that the original diagnosis was wrong”, she observed the child playing. A human factors subject matter advisor told the investigation that “witnessing a child at play can create a compelling but potentially false notion that a child may be healthier than they actually are, which can be referred to as ‘wellness bias’”. This may, in certain circumstances, override any other information, particularly if this ties in with earlier theories or diagnoses.

4.4.12 Although the SpR was presented with evidence that the GP and the parents were concerned, confirmation bias is highly compelling, and this may have affected her judgement at the time. Confirmation bias means that other theories and suggestions that disagree with our theory at the time are often more likely to be disregarded (Reason and Hobbs, 2003; Oswald and Grosjean, 2004). Seeing the child play on day seven may have led to confirmation bias that the child had sufficiently improved as a reaction to the antibiotics, confirming the SpR’s original theory. Information from the American Academy of Pediatrics (2018) suggests that, in certain contexts, when a patient has been examined in the recent past by the same person and little pathology was found, there is a tendency to be overly reassured by that earlier examination.

4.4.13 Familiarity bias may also have played a role in the SpR’s decision-making. She had already examined the child and, to that extent, was familiar with her. It is likely that this familiarity resulted in the father directly approaching the SpR at the nurses’ station on the second visit to the PAU (day seven). This is one of the points at which the SpR’s task started to depart from ‘work-as-imagined’ towards ‘work-as-done’, as no admission paperwork had been completed (this is ordinarily undertaken before the SpR is consulted). Being familiar with a situation means that we are less likely to apply objective assessment or judgement, instead relying on previous knowledge.

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13 “Work-as-imagined (WAI) refers to the various assumptions, explicit or implicit, that people have about how their or others’ work should be done. Work-as-done (WAD) refers to how something is actually done, either in a specific case or routinely. There is a difference between how work is ‘imagined,’ or thought of, and how work is actually done. This may or may not be problematic” (Hollnagel, 2017).
4.4.14 It is likely that the combination of familiarity and confirmation biases provided the SpR with a potential reason not to further examine the child. It probably made sense at the time that it would be more expedient to provide the additional antibiotics required to allow the child to complete the course. Hollnagel (2010) refers to this as the ‘Efficiency Thoroughness Trade-off’, where the most expedient route to task completion is utilised. This trade-off may also have been influenced by the fact that the pharmacy was shortly due to close (to the public) that day.

4.4.15 The SpR said she recalled the father emphasising the need for antibiotics. Biases such as those discussed can adversely interfere with the way information is heard, responded to, encoded and processed, in order to make decisions. Biases can also affect the way in which details are remembered. Biases can make what is believed to be an accurate recollection entirely flawed as they have been encoded incorrectly. The SpR’s recollection that the father wanted antibiotics as a priority could have matched her mental model at the time, which was that the child was not seriously unwell.

4.4.16 Tversky and Kahneman (1974) described three heuristics (rules or mental shortcuts) that are used to make judgements under uncertainty, one of which is representativeness. In this case, it relates to the SpR’s judgement that the child’s clinical signs and symptoms were in all probability representative of tonsillitis. Another heuristic is the availability of instances or scenarios, which may relate to the frequency of the diagnosis of tonsillitis when compared to one of an ingested battery, and the plausibility of this diagnosis given the symptoms. Tversky and Kahneman (1974) state that the heuristics lead to errors and that ‘a better understanding of these heuristics and of the biases to which they lead could improve judgments and decisions in situations of uncertainty’.

4.4.17 It is not clear whether foreign body ingestion would have been considered as a differential diagnosis with the history as given, the ongoing presumption of tonsillitis, and the relative lack of knowledge among healthcare professionals of the risks associated with button/coin cell battery ingestion.

4.5 Wellbeing bias in Paramedics

4.5.1 The Paramedics described arriving at a comparatively calm scene when they first attended the child’s home on day 10. They told the investigation this was contrary to the scene that commonly awaits them when attending children with acute serious illness or injury. From the Paramedics’ perspective, the calmness was suggestive of the child not being seriously unwell.

4.5.2 Both Paramedics described the child’s observations as being all within normal parameters. She was also described as being “alert, orientated and appeared in no distress” at the time. Based on this, neither of the Paramedics believed there was major cause for concern.

4.5.3 In relation to ‘work-as-imagined’, a decision-making tool used by the Ambulance Trust in the reference event dictates that all children under five be conveyed (taken) to the appropriate healthcare facility. However, from the child’s observations she was assessed as being reasonably well and following discussions with the parents, a decision was made not to take the child to hospital. Furthermore, the Paramedics described the family as stating that they would rather stay at home. Based on the child’s “not unwell” presentation and their observations and examination, the paramedics had no reason to suspect that the child had ingested a battery and was critically ill.

4.5.4 However, the father described his daughter as becoming weaker and more lethargic as time progressed, with the symptoms occurring intermittently. He said she was much quieter than normal and wanting to be close to her parents. The father told the investigation that his daughter tried to respond to a ‘high five’ as the Paramedics left, but her first attempt missed and had to be repeated, which the father felt was out of character.

4.6 Communication between NHS services and the family

4.6.1 The child was born in Andhra Pradesh in India, and the family’s first language was Telugu. The child’s father moved to the UK from South India in August 2015 to work. His
wife and two children joined him in October 2016. The family had only lived in the region where the event occurred for four weeks prior to this event.

4.6.2 The child’s father called NHS 111 twice and spoke to the Health Advisor, Nurse Advisor for the OOH service and other healthcare professionals. The Health Advisor at NHS 111 (first call) asked early in the call what language he spoke, and the father asked to continue the call in English. The Health Advisor raised the issue of translation services as there appeared to be confusion relating to the recorded date of birth for the child and some of the demographic questions had to be repeated. During the second call, the father struggled to answer one of the questions asked by the Health Advisor and consequently he was asked if he would like an interpreter, but he declined and said he wanted to continue in English. The Nurse Advisor at the OOH service ascertained from the child’s father that the child’s mother did not speak English, but an interpreter was not offered to enable the mother to participate in the consultation.

4.6.3 Despite the ability to communicate in English, there appears to be a disconnect between the healthcare professionals’ perception of the child’s condition and the father’s concerns during interactions with both 111 and 999 services. This was ascertained following interviews with the staff involved in the event and from listening to the NHS 111 and 999 calls.

4.6.4 During face-to-face communication with healthcare professionals, it is apparent that the father was able to converse with the staff. Both GPs involved in the child’s care said that child’s father spoke good English and did not require an interpreter. The SpR recalled that the father communicated with her in English and interpreted for his wife. The Paramedics recollect the father spoke “reasonably good English” and they felt that they had obtained a full history from him. They said they would have used the translation service if they had had any concerns. However, the child’s mother could only state that she did not speak English. Paramedic 1 stated that the father translated their conversations for his wife.

4.6.5 The parents informed the investigation that the healthcare professionals spoke to them and not to their daughter. The child’s father confirmed that she could speak English and “was able to explain herself”, so could have been part of the clinical interactions with medical, nursing and paramedic staff.

4.7 Contacts with healthcare professionals

4.7.1 In the reference event, there were 10 contacts with healthcare services over 10 days. Figure 14 illustrates these contacts and the broad premise for each action, including referrals and clinical decision points, and highlights areas where intervention may have changed the outcome. The parents were able to
appropriately navigate around the healthcare system, escalating as required when concern for their daughter increased.

4.8 Information sharing between NHS 111, primary medical services, out-of-hours, acute and ambulance services

4.8.1 Electronic documentation completed by the OOH GP service contained a ‘Consultation Summary’ and the pathway documentation from the NHS 111 calls. The Consultation Summary stated: “Conscious, illness, warm to touch, abdominal pain associated with vomiting, apparent severe pain.” Figure 15 provides an overview of key information that was documented during the father’s first two calls to NHS 111.

Consultation by out-of-hours GP

4.8.2 In relation to information flow, there is a technical link (via the OOH electronic system) from NHS 111 to the primary care OOH provider, but there is no digital transfer of information to the Acute Provider or Ambulance Service organisations. The OOH GP told the investigation that he looks at the information captured by the NHS 111 triage system and the nurse history as this prevents repetitive questioning and helps to build a clinical picture. NHS 111 automatically populates the patient’s history on the OOH GP record.

4.8.3 The history and examination were recorded. The GP’s recollection was that the family’s main concern was a raised temperature, abdominal pain and vomiting, adding that the
family gave a detailed medical history. Based on his clinical findings, the OOH GP made a provisional diagnosis of a urine infection. The episode was coded on the electronic system as “Fever NOS” (not specified).

4.8.4 After the GP had spoken to the SpR at the Acute Trust and a decision had been made to admit the child via the PAU, he gave a detailed letter to the parents containing all the findings to give to the hospital staff. This was essentially a print-out of the consultation and was generated because there is no link in the electronic system between the OOH GP service and the hospital.

Consultation with general practitioner

4.8.5 The family had recently moved address within the region at the time of the event and were not registered with their local medical practice. The Medical Practice was not digitally linked to the OOH GP service or the hospital the family attended, so the detailed accounts of the child’s illness obtained by NHS 111 could not be transferred electronically beyond the OOH GP service. Had the family been registered there, the GP would have received a summary of the NHS 111 call by 08:00 hours on the day following the contact.

4.8.6 The workaround was that a fax was sent containing relevant information from the electronic system. This enabled the GP at the local medical practice to review the referral letter from the OOH GP, which she recalled as memorable because the provisional diagnosis was a urinary tract infection, which is uncommon in children.

4.8.7 During the consultation with the child, the GP had to retake and record the history from the parents again on the electronic system that the medical practice used. At the end of the appointment, the GP drafted a referral letter to the hospital, which was essentially a copy of the consultation. Due to the lack of a digital link to transfer the information electronically, the GP gave a paper copy of this letter to the parents to take to the hospital.

Attendance at the Paediatric Assessment Unit

4.8.8 At the Acute Trust, an electronic patient record system is used for staff to enter information. Clinicians can record a patient’s history, observations and assessments contemporaneously. The hospital had no access to the history taken by NHS 111 and therefore decisions were all made based on observations by the nursing staff, the history from the parents, the SBAR note recorded by the children’s ward sister, and the GP letter.

Attendance at child’s home by Paramedics

4.8.9 The two Paramedics who attended were not aware of the previous contacts with NHS 111, the OOH GP service, the GP or the hospital due to the lack of connectivity and interoperability of clinical systems. This resulted in a lack of information flow between the different services.

HSIB MAKES THE FOLLOWING SAFETY OBSERVATION

There is limited connectivity and interoperability across healthcare information technology systems. This can impact on the availability and quality of information regarding patients’ clinical history, previous contact with health care professionals or services and past interventions.

4.9 Assessment and management of non-specific symptoms by the ambulance service

Contact with the ambulance service

4.9.1 On day 10 the Paramedics were working a 12-hour shift (06:45 to 18:45 hours) on a double-crewed ambulance. Paramedic 1 was being observed by a more senior paramedic (Paramedic 2) as part of a routine programme linked to annual appraisal requirements.

4.9.2 In the reference event, there was a lack of clarity over the roles and responsibilities of the supervisor and supervisee, which may have had an impact on the team dynamic between the two Paramedics. There is no nationally derived guidance or standards for supervision relating to paramedic practice. Therefore, individual employers, such as ambulance trusts, rely on their own locally developed guidance and often limit supervisory activity to direct observation. Some ambulance trusts undertake direct supervision in this way (as a two-person crew configuration) while others use a supernumerary model where a supervisor accompanies a crew as a third member.
4.9.3 The Paramedics had attended one other patient prior to the child. The workload was described as normal for the region which allowed for adequate time between 999 calls for supervisory discussion between Paramedic 1 and Paramedic 2. The Paramedics described normally being away from the ambulance station for the majority of the shift, with just 30 minutes at the station for a meal break. Ambulance crews often do not get their 20-minute afternoon break and will work through to the end of their shift.

4.9.4 The 999 call from the child’s parents was received at 09:44 hours. It was triaged using the Medical Priority Dispatch System (MPDS). The purpose of MPDS is to establish the nature of the call and its urgency, and it allows call operators to provide structured advice to callers before the ambulance arrives (Priority Dispatch, n.d.). The MPDS determinant (based on the category and severity) also allows the ambulance service to establish the required speed of response. Response time standards are set by NHS England (Table 1)

Initially the response priority given for the 999 call in the reference event was the lowest priority response. This was subsequently upgraded to the second highest priority (Category 2), once it was recognised that the patient was a child.

4.9.5 The call was passed to the ambulance at 09:48 hours, appearing on the screen as “unconscious, near fainting episode”. When the Paramedic crew arrived at the family’s home, they only had minimal information available to them. They had been told the approximate age and gender of the patient and the initial assessment taken from the 999 call, which was that the child had suffered a loss of consciousness. The Paramedics stated that 999 call information passed to them rarely matched the clinical condition of the patient once they were on scene. To mitigate this, it was essential that the Paramedic crew took a detailed medical history and conducted a full set of observations to assist them in making their initial assessment of the patient’s condition.

4.9.6 The Paramedics arrived at the child’s home address within seven minutes of receiving the 999 call. An initial assessment was carried out to ensure the child did not require immediate life-saving intervention, after which the father was asked to carry her from the bedroom to the lounge so that a more detailed assessment could be completed.

4.9.7 One of the Paramedics asked to see the hospital documentation, but only medication-related information was given to the crew to review. Consequently, the Paramedics received virtually no information regarding the family’s previous contacts with healthcare professionals and services. They started again with obtaining a history from the child’s father and conducted a physical assessment of the child. They were both satisfied there were no abnormal findings identified on examination. The child was discharged from the care of the Paramedics and remained at home with her family. No onward referral was made to the GP or other health services.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>MEAN (ALL CALLS)</th>
<th>90TH PERCENTILE OF CALLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1 (immediately life-threatening calls, such as cardiac arrest)</td>
<td>Within 7 minutes</td>
<td>Within 15 minutes</td>
</tr>
<tr>
<td>Category 2 (serious, but not immediately life-threatening calls, such as for strokes or sepsis)</td>
<td>Within 18 minutes</td>
<td>Within 40 minutes</td>
</tr>
<tr>
<td>Category 3 (urgent calls, such as for patients needing pain relief)</td>
<td>N/A</td>
<td>Within 120 minutes</td>
</tr>
<tr>
<td>Category 4 (urgent calls needing advice either face to face, or over the telephone)</td>
<td>N/A</td>
<td>Within 180 minutes</td>
</tr>
</tbody>
</table>
Analysis of the ambulance service contact

4.9.8 A review of the documentation relating to the attendance by the two Paramedics on day 10 at 09:54 hours identified that the Paramedics had not taken a complete history of the child’s health, including her current illness. Limited observations were also recorded and there were omissions in respect of the clinical assessment. The documented clinical assessment focused on ruling out the signs and symptoms suggestive of sepsis.

Incomplete history taking

4.9.9 The Paramedics obtained a history from the child’s father and documented this on the patient report form (PRF). It was recorded that the child had been unwell for approximately one week. Antibiotics had been prescribed seven days previously and the parents were advised by the PAU to continue with the course of antibiotics and administer pain relief as required. The parents reported the child was more lethargic and she was taking fluids but had a reduced appetite. Part of the PRF states the following:

‘Pt [patient] receiving Calpol PRN [as required], no D&V [diarrhoea and vomiting], no LOC [loss of consciousness], alert, a little clingy…Pt has been prescribed abx [sic] [antibiotics] for? throat/chest infection.’

4.9.10 The symptoms reported to NHS 111 of chest/abdominal pain and vomiting were different to those reported on the 999 call. It was noted the child had not required any paracetamol for pain on this day, although the pain had been intermittent resulting in her becoming distressed on occasions and then more settled. The father told the investigation team that this scenario typified what had been happening during the nine days his daughter had been unwell; her condition would fluctuate, as the pain increased and then subsided.

4.9.11 There is no evidence of further exploration of the reports that the child was “unable to see”, other than Paramedic 1 documenting on the PRF that there was no loss of consciousness. The child’s father provided the investigation with a vivid description of his daughter sitting waving her arms in a distressed state saying that she could not see.

4.9.12 Both Paramedics told the investigation that they had not received any formal training in the skill of taking a comprehensive health history. A Senior Paramedic at the Trust stated he was not aware of any formal training relating to history taking, despite this being essential in the presence of non-specific symptoms.

Limited observations recorded

4.9.13 One set of observations was taken and recorded on the PRF. The respiratory rate was 22 breaths per minute; oxygen saturations were 98%; temperature was 37.3 degrees centigrade and the heart rate was 102 beats per minute. All were within normal parameters. In addition, the Glasgow Coma Scale score was recorded as 15, indicating that the child was alert and responding normally.

4.9.14 The child’s blood pressure, capillary refill time, pupil reactions and pain score were not documented. Due to the father reporting that his daughter had a reduced appetite, Paramedic 2 attempted to obtain a blood glucose reading by pricking the child’s heel. However, this was unsuccessful due to insufficient blood being collected and the procedure was not repeated as the child became too distressed. This was not documented on the PRF.

4.9.15 The observations were not repeated; the investigation was informed that this would have been expected practice given the timeframe the Paramedics were with the child (31 minutes) and the decision not to convey the child to hospital or refer her to another healthcare professional. Information from the Ambulance Trust indicated that the expectation was for at least two sets of observations to be obtained.

Clinical assessment

4.9.16 In his examination of the child, Paramedic 1 ruled out sepsis as a possible diagnosis. This is reflected in the PRF, which documents the Paramedics’ concern regarding possible sepsis, for example inspecting for sinister rashes and looking for photophobia (sensitivity to light). Paramedic 1 documented an assessment of the child’s chest as being clear upon auscultation (listening with a stethoscope) with equal breath sounds and no abnormalities such as wheezes or crackles.
4.9.17 The Paramedics did not inspect the child’s throat. Paramedic 1 told the investigation that they did not carry out an examination of the throat due to the child not displaying any signs that would indicate an airway concern (visual examination of the throat with a torch and tongue depressor is not standard practice for paramedics at graduate/first-registration level). Review of the PRF does not suggest the paramedic team had any suspicion that a foreign body could have been ingested and instead they focused on excluding common, serious or life-threatening conditions.

4.9.18 At this time the child had been unwell from an assumed infection for longer than a week and was receiving treatment for tonsillitis. Concerns were still being raised by her parents that she was unwell, with no obvious cause to explain all her symptoms. Paramedic 1 recalled the child reported pain on swallowing, but that she was not behaving like a child in pain and she appeared well. The impression of both Paramedics was that the child had tonsillitis and they were reassured she was improving with the antibiotics. It is possible that the existing diagnosis of tonsillitis and ongoing treatment for this condition influenced their decision making. The evidence for this was that her observations were normal and nothing of note had been found on examination. No history or examination was documented relating to the concerns made during the 999 call regarding loss of consciousness or being “unable to see”.

4.9.19 The child’s father had demonstrated an understanding of the NHS urgent care system, contacting the GP in-hours, the OOH GP, urgent care and NHS 111. The Paramedics reported being unsure why the child’s father had made the decision to call 999 on this occasion, however they did not explore this directly with the father during their consultation. The child’s father informed the investigation that he called the emergency number due to a sudden deterioration in his daughter’s condition. He described feeling relieved when the Paramedics promptly attended and assured his wife, perceiving that their attendance meant that something would be done.

4.9.20 In relation to local conveyance guidance (guidance on whether to take a patient to hospital following a 999 call), the Ambulance Trust that attended the incident provided clinicians with tools to assist them in decision making, with ‘Paramedic Pathfinder’ being the tool most commonly used. It provides guidance to clinicians on the correct disposition of patients14, the potential outcomes being:

- red, indicating transportation to an emergency department is required due to the patient’s presenting complaint
- amber, indicating that the patient is suitable to have a delayed assessment for up to two hours and can be referred to an established GP referral pathway or other alternatives such as an urgent care centre
- blue, indicating that the patient can be discharged from care, with or without the need for onward referral.

4.9.21 The tool was available and in everyday use at the Ambulance Trust attending the child but was not used by all ambulance trusts. It was printed on all PRFs and clinicians were required to document the Paramedic Pathfinder outcome on the PRF. Decision-making support was available if required through the clinical support hub, an access point where senior clinicians can be accessed to ask for advice.

4.9.22 The Ambulance Trust policy required children under the age of five years to be conveyed to hospital. However, the child was not conveyed or referred following the Paramedics’ attendance at 09:54 hours, and senior clinical advice was not sought to discuss this decision.

4.9.23 Paramedic 1 told the investigation that he had discussed the treatment options with the child’s father, including transportation to hospital and GP referral. It was documented that the father was happy to continue with the ongoing treatment (antibiotics and pain relief) for his daughter and for her to remain at home. It is possible that the lack of time-critical signs/symptoms displayed by the child and the calmness of the parents may...

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14 Disposition from scene may be conveyance to hospital, referral to another service in the community, or discharge from care.
have influenced the Paramedics in reaching this decision. From the father’s perspective, he trusted the healthcare professionals’ judgement and was therefore assured that his daughter was well enough to remain at home.

4.9.24 Paramedic 1 stated that the parents were offered additional advice following the decision to leave the child at home and were told to call 999 or NHS 111 again if necessary. Paramedic 1 told the investigation that they gave the family further assurance, noting that the child appeared well when they left and was engaging with them. The PRF did not however contain a documentary record of the advice given to the family (often referred to as ‘worsening care advice’) and there was also no clearly documented ‘safety netting’ advice recorded. The Paramedics gave a copy of the PRF to the child’s father and left the family home at 10:23 hours.

*‘Worsening care advice’ and ‘safety netting’ are instructions for patients/carers to follow based on specific scenarios.*
5 ANALYSIS AND FINDINGS FROM THE WIDER INVESTIGATION

5.1 Button/coin cell battery safety and product design

Battery design

5.1.1 Kramer et al (2015) states that although button batteries have been used for nearly 30 years, early experience with ingestion did not result in serious injury/death. Data published by the USA National Capital Poison Center\(^{16}\) in 1992 demonstrated a prevalence rate for severe harm of 0.1% and no deaths. However, since then the clinical picture has changed; in 2010 there was a reported prevalence rate for severe harm of 0.8%, with 13 deaths being reported as a result of ingestion. This indicates that while the incidence has not changed significantly, the level of harm has. Kramer highlighted that in all cases of significant harm, there were oesophageal injuries.

5.1.2 The literature suggests that morbidity and mortality (illness and death) following battery ingestion in children has worsened for two key reasons (Kramer et al, 2015). The first is the transition to lithium cells, which have an increased voltage compared to the previously used alkali batteries. Secondly, the diameter of the battery has increased, which heightens the risk of it becoming lodged in a child’s oesophagus.

5.1.3 The British and Irish Portable Battery Association (BIPBA) has informed the investigation that button/coin cell battery diameters have not increased in size in recent years since 16mm, 20mm and 23mm coin cells have been around for over 25 years. BIPBA advised the investigation that the apparent increase in incidents can be explained by the increase in technology using coin cells, thus making them more prevalent in the home.

5.1.4 A button/coin cell battery coating technology is being developed in the USA, which is designed to deactivate the battery’s power upon ingestion. This provides a potential design change to mitigate the risks of button/coin cell battery ingestion. An illustration of the battery coated in the material\(^{17}\) is shown in Figure 16, alongside two control batteries, all immersed in saline. The development and commercial application are currently ongoing.

5.1.5 BIPBA told the investigation that the button/coin cell battery industry is supporting other research into safer battery design specifically concentrating on making packaging safer.

5.1.6 Fuentes et al (2014) suggested establishing a maximum size by manufacturers to reduce the risk of oesophageal lodgement. None of the more severe consequences of battery ingestion have been reported in the smaller diameter batteries. Coin cells smaller than 20mm are currently on the market. Coin cells of 16mm diameter are widely available. BIPBA advised that the technology does not currently exist to make coin cells smaller while still being effective.

Product casing design

5.1.7 Wallace et al (2017) stated that preventing a child from ingesting a button battery should be the key goal. Litovitz et al (2010) elaborated on this by saying that although a change in the clinical approach to battery ingestion was required to avoid misdiagnosis or delayed treatment, prevention of ingestion would be more effective than improved treatment. The publication discussed the importance of checking and securing the battery compartment of all household products, storing batteries out of a child’s reach and sight, and not allowing children to play with them. This is pertinent when considering that foreign body ingestions in children are some of the most challenging clinical scenarios facing clinicians (Kramer et al, 2015; Leinwand et al, 2016).

\(^{16}\) The National Capital Poison Center, founded in 1980, is an independent, private, not-for-profit organisation whose mission is to prevent poisonings, save lives, and limit injury from poisoning.

\(^{17}\) Technology and product features had not been finalised at the time of report publication, and therefore it can only be disclosed that the end product of the battery coating technology has been made possible by “advanced material science”. 
In a 2010 cohort study of button/coin cell battery ingestion, 61.8% of batteries were removed directly from a product (Litovitz et al, 2010). Therefore, changes that have the greatest potential to eliminate cases of battery ingestion could be implemented by product manufacturers.

The Australian Competition and Consumer Commission developed the Industry Code for Consumer Goods that Contain Button Batteries. This is a voluntary code intended to guide suppliers in making responsible decisions regarding button battery safety throughout the procurement, design, development and retailing of devices powered by button batteries (Australian Competition and Consumer Commission, 2016). Recommendations from this code include:

- redesigning products so that they use alternative power sources
- labelling to allow consumers to select products based on the battery type
- warning labels to clearly notify consumers of the risk to children if ingested and to refer them to ‘Poisons Information’ service for assistance, if required
- redesigning products so that the batteries are not accessible to young children.

The Code describes a child-resistant battery compartment as:

- a battery compartment (or other enclosure) that is secured such that it requires a tool to gain access to the batteries, or
- a battery compartment that requires two or more independent and simultaneous actions to remove its cover.

The Sydney Morning Herald (2018) reported that doctors and consumer groups are putting pressure on the Australian Federal Government to legislate against the sale of products that do not have a child-resistant battery compartment. The Australian Federal Treasury is evaluating the costs of introducing a new safety standard and considering who should be liable when products are faulty.

In the USA, data from the National Capital Poison Center highlighting an increase in morbidity and mortality due to battery injuries resulted in the development of the 2008 Consumer Product Safety Improvement Act (Laulicht et al, 2014). This legislation mandates toy safety standards and requires batteries to be inaccessible in toys designed for children under three years. In 2011, the Button Cell Battery Safety Act was introduced to Congress, with the aim of mandating warning labels and more secure battery compartments on additional products, including items such as remote controls and watches. This legislation was, however, not enacted and as such, in the USA, restrictions on battery compartments are only mandated on toys for children under three (Laulicht et al, 2014).

The European Toys (Safety) Regulations 2011, which set out standards for toys for children up to and including 36 months, stipulate that battery compartments must be secure, so they cannot be opened by a child and the battery exposed. Although the batteries in toys that comply with the regulations are safely secured, there have been several cases in the UK where unsafe toys have been available for sale. Lincolnshire County Council reported one such case on its website on 18 January 2018 (Lincolnshire County Council, 2018). The responsibility for enforcement of the regulations is devolved to local authority trading standards services.

There is no equivalent of the European Toys (Safety) Regulations 2011 for general household electrical items in the UK. Button/coin cell batteries are regulated under the General Product Safety Regulations (GPSR) which require them to be ‘safe for normal use’. Some products containing button/coin cell batteries, including remote controls, also fall under this regulation. It is the manufacturers’ responsibility to ensure their products are safe before they are placed on the market.

The Retail Products Policy Adviser at the British Retail Consortium told the investigation that the batteries of toys intended for children under three years must be secured in a child-resistant compartment as per the GPSR. Compliance is checked by inspection and by a test involving an attempt to gain access to the battery.
compartment by manual means. It should not be possible to open the cover unless at least two independent movements are applied simultaneously. There is also testing to ensure the battery compartment will not open spontaneously when the product is dropped. Currently, household electrical products containing button/coin cell batteries are not subject to the same battery compartment requirements as mandated for toys. Battery compartment covers may be opened using one independent movement or could open if the product was inadvertently dropped.

5.1.15 The Retail Products Policy Adviser at the British Retail Consortium told the investigation that the safety hazards posed by using button/coin cell batteries in consumer products has been highlighted in recent years. This is an area receiving attention in terms of risk assessment for all products using these types of batteries. There is no specific requirement for battery security in household products containing these types of batteries, unlike the toy safety requirements regulating toys.

Battery packaging and disposal

Litovitz’s 2010 cohort study identified that 8% of ingested button/coin cell batteries were obtained directly from the manufacturers’ packaging (Litovitz et al, 2010). The design of packaging is not always child resistant. BIPBA and the Child Accident Prevention Trust (CAPT) advised the investigation that battery manufacturers are working to make battery packaging child resistant with individually sealed compartments, so that only one battery is accessible at a time.

5.1.16 Battery and product packaging and instructions offer an opportunity to educate and warn consumers about the potential hazards associated with batteries. BIPBA and CAPT have said that some battery manufacturers already place warning notices and icons on the packaging of small batteries and appropriate warning symbols on the batteries. There is further scope for industry-wide standards to mandate a warning regarding the serious complications that may follow the ingestion of batteries, including advising consumers to obtain urgent medical attention if a battery is swallowed.

5.1.17 The Retail Products Policy Adviser at the British Retail Consortium has advised that the next version of the International Electrical Standard IEC62115 Electrical Toy – Safety has additional labelling requirements for button and coin cell batteries regarding the potential safety risk. This standard is likely to be adopted as the next revision of European Standard EN62115 Electrical Toy – Safety in the European Union. This revision is not yet published but the additional labelling below will be a requirement.

5.1.18 The Retail Products Policy Adviser at the British Retail Consortium has advised that the next version of the International Electrical Standard IEC62115 Electrical Toy – Safety has additional labelling requirements for button and coin cell batteries regarding the potential safety risk. This standard is likely to be adopted as the next revision of European Standard EN62115 Electrical Toy – Safety in the European Union. This revision is not yet published but the additional labelling below will be a requirement.

5.1.19 EN62115 stipulates electric toys using replaceable coin batteries should carry a number of warnings, both on the packaging, and on the usage instructions. The standard includes:

- ‘WARNING: Contains coin battery. Hazardous if swallowed – see instructions.

- ‘WARNING: This product contains a coin battery. A coin battery can cause serious internal chemical burns if swallowed.

- ‘WARNING: Dispose of used batteries immediately. Keep new and used batteries away from children. If you think batteries might have been swallowed or placed inside any part of the body, seek immediate medical attention.’

5.1.20 A 2010 cohort study identified that in 30% of reported ingestions the ingested button/coin cell batteries were found outside the product or discarded (Litovitz et al, 2010). The larger coin cell batteries have a shelf-life of 10 years and often contain enough residual charge to cause injury, even when they do not have sufficient current to power a device (Kramer et al, 2015). Careful disposal is critical using the recycling facilities that are available for lithium and alkali batteries.

Retail practices

5.1.21 The Australian Competition and Consumer Commission (2016) Industry Code for Consumer Goods that Contain Button Batteries urges retailers to consider only selling products containing button/coin cell batteries that comply with the safety requirements in the Code. Retailers are also encouraged to consider the height at which they display
button batteries for sale, to ensure they cannot be reached by young children. The Code also states that information must be available at point of sale (including online) indicating that the product (or any included peripheral device) requires button batteries to operate and that these are hazardous to young children.

5.1.22 In the UK, there is currently no similar safety code for batteries or requirement for high-street retailers to display button/coin cell batteries at a level not accessible to children.

**HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATION**

**Recommendation 2019/034:**
It is recommended that the Department for Business, Energy and Industrial Strategy develops a strategy to improve button/coin cell battery safety, to include producing a fast-track standard covering/considering battery design, product casing, packaging and safe retailing practices.

5.2 Detection of button/coin cell batteries when ingestion is unknown

**Signs and symptoms of ingestion**

5.2.1 Children can ingest a button/coin cell battery without coughing or choking, as they are easily swallowed due to their size and shape. Detectability is even more challenging if the ingestion is unobserved. Literature quoted by Wright et al (2017) suggested that unobserved ingestion comprises 40% of cases. In addition, the child may be unable to communicate what they have swallowed (due to their age) or may be reluctant to do so for fear of reprisal (Wright et al, 2017).

5.2.2 Once the button/coin cell battery starts to erode tissue, the symptoms experienced by children are non-specific (Child Accident Prevention Trust, 2018), which could hinder diagnosis (Fuentes et al, 2014). Subject matter advisors told the investigation that a child who has swallowed a coin cell battery may have one or more of the following symptoms:

- chest pain
- burning sensation in the chest
- difficulty swallowing
- painful swallowing
- vomiting
- retching (gagging)
- persistent drooling
- dark or bloody stools.

5.2.3 Button/coin cell battery ingestion may not be obvious or symptomatic until there are overt signs of harm. Chiari’s triad (Heckstall and Hollander, 1998) describes the presentation of a fistula (abnormal connection) between the oesophagus and the aorta as:

1. mid chest pain
2. a sentinel (unexpected) bleed
3. a catastrophic bleed after a symptom-free interval.

5.2.4 Wright et al quoted the results of an American study in which 70% of children who died as a result of button/coin cell battery ingestion presented with haematemesis (blood in vomit) or melaena (blood in stools) in the days or hours before their fatal haemorrhage. Smaller sentinel bleeds can be followed by catastrophic exsanguination (massive loss of blood to a degree sufficient to cause death) (Wright et al, 2017).

**HSIB MAKES THE FOLLOWING SAFETY OBSERVATION**

It would be beneficial for a review to be undertaken of the content of the Advanced Paediatric Life Support course, and any similar courses hosted by other providers, to ensure that the management and issues associated with the ingestion of button/coin cell batteries is strengthened as required in response to this report.

**Early closure of hazardous ingestion line of enquiry**

5.2.5 The investigation identified that in the reference event, the button/coin cell battery wasn’t identified until the child’s post-mortem. CAPT has indicated that this delayed identification of battery ingestion has also caused serious complications and death in other cases in the UK and abroad (Child Accident Prevention Trust, 2018). This is attributed to a lack of specific symptoms for battery ingestion, which can be misinterpreted as more common conditions, such as bronchiolitis (viral chest infection) in younger children (Chessman et al, 2017) and tonsillitis.
5.2.6 The human factors subject matter advisor reflected that the similarity and availability heuristic (rules or mental shortcuts) may be of influence here for clinicians. The symptoms they assessed were similar in presentation (similarity heuristic) to more common illnesses they frequently saw (availability heuristic), as opposed to the less commonly occurring (Feufel and Flach, 2019). It was likely that the doctor was drawn heuristically towards a diagnosis of tonsillitis based on the clinical signs and would have used her diagnostic acumen to test any assumptions.

None of the clinicians had any reason to suspect a hazardous ingestion as opposed to there being a lack of other differential diagnoses (Elstein and Schwarz, 2002), which could each have been tested deductively.

Guidance for clinicians

5.2.7 Management of an ingested button/coin cell battery requires early diagnosis, therefore suspecting ingestion in children with non-specific symptoms is crucial (Fuentes et al, 2014). Children who swallow button/coin cell batteries will often present with non-specific symptoms that are not resolving with treatment, as occurred in the reference event. Obtaining a thorough history from parents/carers or potential witnesses to the ingestion will help in identifying a foreign body. The investigation found that a chest x-ray image will be undertaken whenever ingestion is suspected, even in the presence of non-specific symptoms, if foreign body ingestion cannot be ruled out by clinical history. A chest x-ray image may identify the round foreign body with double-ring shadow or double density, which can differentiate a battery from a coin, although interpretation can be challenging as it could be falsely thought to be a coin.

5.2.8 According to Leinwand et al (2016), the complexity and potential severity that each button battery ingestion case represents has resulted in paediatric and emergency departments developing clinical care pathways to rapidly assess and manage them. The USA National Capital Poison Center (2018a) has developed a Button Battery Ingestion Triage and Treatment Algorithm (Appendix B). Although the USA guideline is quoted most frequently in the literature, there are other examples of similar guidance internationally (Children’s Hospital Colorado, 2018; Dire, 201).

5.2.9 One subject matter advisor shared a regional Guideline for Ingestion of Button Batteries by Children, which is intended for use by any hospital team caring for infants and children across the Paediatric Critical Care Network region. A subject matter advisor has similarly shared an Emergency Department Medical Guideline on Swallowed Foreign Bodies from a children’s Trust, which was developed with the Trust’s paediatric surgery department. In summary, there is local and regional guidance in place in secondary care and regional teams. However, there is currently no protocol consistently used by trusts to improve the detectability of unknown button/coin cell battery ingestion.

5.2.10 Changes in clinical approach could improve primary diagnosis and reduce cases of missed diagnosis or misdiagnosis. This highlights a need to identify clear detection methods, raising the index of suspicion in children such as the one involved in the reference event.

HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATION

Recommendation 2019/035:
It is recommended that the Royal College of Paediatrics and Child Health develop a key practice point within a decision support tool for suspected or known ingestion of button/coin cell batteries, and to be supported in this development by the Royal College of Emergency Medicine.

Use of hand-held metal detectors for detecting foreign bodies

5.2.11 A subject matter advisor told the investigation that most paediatric centres do not advocate routine chest x-rays for children presenting with non-specific symptoms, to reduce unnecessary x-ray exposure. The investigation identified a number of emergency departments that were using hand-held metal detectors (HHMDs) to detect potential non-hazardous foreign body ingestion (for example coins).
5.2.12 A Consultant in Emergency Medicine has written a paper (unpublished), entitled ‘The Hunt for Swallowed Treasure: Use of Hand-held Metal Detectors for Investigation of Ingested Metal Foreign Bodies in Children’ (2016). This consultant informed the investigation that metal detectors are sensitive to detect button/coin cell batteries, as well as being cheap, non-invasive and easy to use. However, her experience of their use has been in relation to detecting non-hazardous foreign bodies and not button/coin cell batteries.

5.2.13 A similar study, based in a children’s hospital in the USA, found HHMDs to be accurate in detecting and locating metallic foreign bodies (Nation and Jiang, 2016). However, none of the subjects in the study, had swallowed a button battery. Despite this, the study proposed the use of HHMDs as a screening tool in paediatric emergency triage, particularly where ingestion of a button battery was suspected or could not be ruled out. A 2004 systematic review of studies that looked at detection of coins ingested by children using HHMDs (Lee et al, 2005) concluded that HHMDs represented an ‘accurate, radiation free and cost-effective method of identifying and localising coins ingested by children.’

5.2.14 In a recent survey of practice by Paediatric Emergency Research in the United Kingdom and Ireland (PERUKI), half of the participating paediatric emergency departments used HHMDs to identify the presence and to locate the position of swallowed metallic foreign bodies in children. Most departments who used HHMDs relied on them to make clinical decisions about non-hazardous foreign bodies such as coins. However, only one department used HHMDs to make clinical decisions about hazardous foreign bodies such as button batteries. There was concern that using HHMDs alone for button batteries may miss some ingestions based on existing evidence, and the consequences of a missed ingestion may be catastrophic. The survey concluded that HHMDs are used primarily in children with coin ingestion where they can expedite the patient journey and potentially avoid the need for x-rays. A number of clinicians who took part in the survey expressed concerns regarding the use of HHMDs, as they are not registered medical devices.

5.2.15 The Australian Paediatric Surveillance Unit commenced a study in December 2017 titled ‘Severe Injury Related to Disc Battery’. PERUKI is planning to replicate this study.
across its membership, looking at all children attending emergency departments with button/coin cell battery ingestion.

5.2.16 It is evident that practice using HHMDs is currently driven by a patient’s clinical history. There is potential for HHMDs to be used as a non-invasive screening tool in cases of non-specific clinical presentation and/or symptoms that are not resolving, to exclude ingestion of a foreign body, including for patients without a history of ingestion. The investigation has not found any studies evaluating the use of HHMDs as medical devices to screen children presenting with non-specific symptoms.

**HSIB MAKES THE FOLLOWING SAFETY OBSERVATION**

It may be beneficial for a study to be conducted on the potential for hand-held metal detectors to be used as a non-invasive screening tool for non-specific clinical presentations in children under five years.

### 5.3 Communication and information sharing across healthcare providers

5.3.1 Individual providers, such as OOH services, have ‘repeat caller’ protocols (NHS Digital, 2019), which create a flag for patients representing in a short time period. These repeat caller protocols are not used across systems or between organisations, which means that multiple contacts with health services may not be detected where different providers are used.

5.3.2 Data sharing across and between services is challenging, as data is held in a variety of formats on different computer systems. The NHS digital strategy recognises that the provision to share information electronically needs to be improved, as parts of the service rely on paper-based systems. This was evident in the reference event. NHS England is leading the Global Digital Exemplar programme (NHS England, n.d.) that is designed to collate and digitise health systems. This aims to give clinicians quicker access to accurate information and provide patients with better access to their health records.

5.3.3 There are information sharing initiatives in place that share information across primary, acute and social care settings, however this is not universal or consistent. To improve this, NHS England is working with several Local Health and Care Record Exemplars to establish a local record that enables authorised staff to access information about patients’ contacts with NHS services. These exemplars will be required to work to national standards so that relevant information can be accessed as a patient moves between organisations and areas of the country.

**Effectiveness of communication NHS Pathways**

5.3.4 The governance of NHS Pathways is overseen by the National Clinical Governance Group, hosted by the Royal College of General Practitioners. This group consists of representatives from the relevant medical royal colleges. Senior clinicians from the colleges provide further independent oversight and scrutiny of the NHS Pathways clinical content. Alongside this independent oversight, NHS Pathways ensures its clinical content and assessment protocols are consistent with the latest advice from other national bodies that provide evidence and guidance for medical practice in the UK, such as the National Institute of Health and Care Excellence.

5.3.5 NHS 111 Pathways are regularly updated using clinical evidence, which inform the NHS 111 question algorithms.

**NHS Pathways information for button/coin cell battery ingestion**

5.3.6 In the NHS Pathways ‘Vomiting and/or Nausea’ pathway, the question asking if anything harmful or poisonous had been taken did not include reference to button/coin cell battery in the supporting information. Likewise, the ‘Object, Ingested or Inhaled’ pathway did not prompt the parent to consider whether their child had swallowed anything hazardous such as a battery. This would only be identified either through directly witnessed ingestion or examining the potential of likely unwitnessed ingestion. There is a question within the ‘Object, Ingested or Inhaled’ pathway that asks what object has been ingested and this refers directly to button/coin cell batteries.
THE FOLLOWING SAFETY ACTIONS HAVE BEEN IMPLEMENTED

In relation to the ingestion of anything ‘harmful or poisonous’, NHS Pathways has now included button/coin cell battery in the supporting information so that a specific prompt is provided.

NHS Digital and the Priority Dispatch Corporation have reviewed all relevant pathways associated with the possible ingestion of button/coin cell batteries in children.

5.4 Assessment and management of paediatric cases by ambulance services

What the investigation has identified:

5.4.1 When paramedics arrive on scene following receipt of a 999 call, they are provided with only basic and often limited information. They are given the incident location, age of the patient and symptoms paraphrased from the initial 999 call as entered by the non-clinical call taker. They are not given, nor have consistent access to, any previous recent medical contacts with health professionals.

5.4.2 In the absence of an obvious medical condition and/or non-specific symptoms, paramedics must start each encounter with basic checks for life-threatening conditions and managing any they identify. After an initial assessment, the following tasks are then undertaken:

• a structured primary and secondary survey
• obtaining a detailed history about the patient
• system-based assessment
• physiological measurement
• diagnostic reasoning
• care planning
• treatment.

Paramedics must also decide on the best and most appropriate next steps for the patient; to convey to hospital, refer the patient for onward further care, or discharge the patient from their care.

5.4.3 Interviews with the Paramedics involved in the reference case and discussions with senior paramedics at the Trust, revealed a concern that taking a patient history and the diagnosis of unwell children were not covered in the training completed by the Paramedics who attended the incident.

5.4.4 Paramedics are trained in taking a patient history as part of their undergraduate curriculum, which is further developed in postgraduate specialist and advanced practice role education. Nevertheless, not all paramedics are university educated and therefore may not have undertaken any formal training in taking a history, including that of children. However, these paramedics would have followed the Institute of Health and Care Development vocational paramedic training route.

5.4.5 In some ambulance trusts, when a child has had previous contacts with healthcare professionals, the policy is to convey to hospital regardless of the assessment made by the paramedics attending the patient. Other ambulance trusts have blanket conveyance policies for children under a certain age, ranging from under one year through to under 16 years. As the 999 call handling system is remote from other healthcare systems, information about previous contacts with healthcare professionals is not passed electronically and paramedics are therefore reliant on a comprehensive history being obtained from the patient.

5.4.6 Ambulance crews are also not aware of how many previous contacts patients may have had with the wider healthcare system. Having this information may assist with developing a plan of care for the patient.

Diagnosing unwell children

5.4.7 The UK Ambulance Service Clinical Practice Guidelines (Joint Royal Colleges Ambulance Liaison Committee, Association of Ambulance Chief Executives, 2019) state that: ‘Assessment priorities include the detection of respiratory distress, circulatory impairment or decreased consciousness.’

5.4.8 Paramedics who practice at first level and have not undertaken specialist or advanced development are trained as generalists whose role is to detect and treat acute, life-threatening conditions. More recently, there have been changes to the profile of patients calling 999, with more patients with lower-acuity illness or injury, or problems relating to long-term health conditions calling the ambulance service. Paramedics

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21 Some ambulance trusts have locally developed care planning registers and/or access to Summary Care Records via the control room.

22 First-level practice means that the paramedic has not undertaken any postgraduate/post-registration study.
are well positioned and trained to treat children with sudden acute illness or injury, to stabilise them and then transport them to a place of definitive care. However, they require additional postgraduate training to manage patients with complex, urgent care presentations. Cases of children presenting with apparent low-acuity problems can be complex and may require an expert medical opinion. However, the majority of these patients’ symptoms resolve spontaneously, and their conditions are benign and mild in nature, usually associated with the kinds of illnesses common in pre-school aged children.

5.4.9 The paramedics in the reference event decided to discharge the patient from care, and not seek further opinion or make an onward referral. Although the common terminology in the ambulance sector of ‘conveyance’ and ‘non-conveyance’ is used, the latter phrase describes more than a default action to not convey the patient to a care setting. Instead, non-conveyance covers a range of potential outcomes, such as discharge, referral, refusal, delayed conveyance, signposting, and self-care advice. In the reference event, the Paramedics discharged the patient, in effect terminating the episode of care without providing onward referral or follow-up.

5.4.10 Clinical practice in the ambulance sector involves working remotely and to some degree in isolation. This lack of supervision may lead to an overreliance at an organisational level on the individual paramedic or crew. Ambulance trusts have operational command structures, but this is often not balanced with the provision of clinical leadership.

5.4.11 A number of subject matter advisors told the investigation that there was variation across ambulance trusts in the policies regarding conveyance of children and access to clinical leadership. It is recognised that transporting all children for whom a 999 call has been made to emergency departments is not practical.

5.4.12 Measures should be taken to provide oversight and support to ensure children are not discharged and/or not followed up without proper consideration of the potential risks to the patient. Consideration should be given to conveying children where a full history and/or examination has not been (or cannot be) completed (as in the reference event). Conveying children to hospital in these circumstances would result in an experienced paediatric or emergency medicine team seeing the patient in a suitable facility.

**HSIB MAKES THE FOLLOWING SAFETY OBSERVATION**

There appear to be opportunities to reduce the variation in provision of and access to clinical leadership in the ambulance sector, when compared with the general management structure.

5.4.13 The findings from the reference event relating to the practice of supervision and observational shifts suggests there is a lack of standardisation and guidance.

5.4.14 Deciding which children are safe or suitable for discharge from the care of non-specialist/advanced paramedics in the community is challenging.

**HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATION**

**Recommendation 2019/036:**

It is recommended that the Association of Ambulance Chief Executives agrees guidance that can inform its members on the competency and authority for staff to convey, refer and discharge children under five years who are subject to 999 calls.

**Postgraduate training, supervision, and maintenance of competency**

5.4.15 Paramedics are required to maintain their professional development in line with their regulatory obligations. There is an expectation that employers work with their healthcare professionals to ensure their clinical workforce is safe and fit for purpose. A key aspect of maintaining safe clinical practice is supervision; having time to refresh existing knowledge and skills, and acquiring new knowledge and skills.

5.4.16 The investigation identified that ambulance sector staff had inconsistent access to supervision and this was limited to observational working. Time allocated to refresher training was limited to between two and four days, often covering only high-level or mandated topics (such as manual handling, safeguarding and resuscitation).
5.4.17 Supervision in healthcare covers a range of activities, including direct supervision of practice by a peer or senior colleagues, but also peer-led discussion, reflection and other types of activity.

5.4.18 Clinical supervision is defined as ‘an accountable process which supports, assures and develops the knowledge skills and values of an individual group or team’ (Skills for Care and Children’s Workforce Development Council, 2007). It promotes the following in relation to the delivery of patient care:

- ‘Reflection’
- ‘Discussion’
- ‘Professionalism’
- ‘Support’

5.4.19 Guidance by the Care Quality Commission (2018) makes the following statement regarding supervision:

‘Clinical supervision can help ensure that people who use services and their carers receive high quality care at all times from staff who are able to manage the personal and emotional impact of their practice’.

5.4.20 Supervision can take place in practice, at the patient’s side or remotely. If away from the clinical setting, supervision may occur through activities such as peer-based case review, learning sets, appraisal, personal development planning, and other ad hoc supervisory sessions which may focus on skills or dissemination of new information or knowledge.

5.4.21 Aside from the process of supervision, the safety-critical nature of the care provided by ambulance services suggests an imbalance between operational and training time. There may be opportunities for ambulance trusts to further assure themselves of the ongoing competency of their staff by adopting standards for supervision, provided by a relevant professional body.

5.4.22 Ambulance trusts are required to meet performance standards and therefore must balance the need for operational productivity while maintaining the highest levels of patient safety.

**HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATION**

**Recommendation 2019/037:**
It is recommended that the College of Paramedics develops supervision guidance for paramedics, applicable to all relevant practice settings.

5.5 The dangers associated with button/coin cell batteries and their ingestion are not universally recognised

**National initiatives to raise awareness**

5.5.1 Individual agencies have instigated national initiatives in recent years to raise awareness of the risks and dangers associated with button/coin cell batteries.

5.5.2 In 2014, the Organisation for Economic Co-operation and Development highlighted the risks caused by button/coin cell batteries. This included raising awareness of the issue at an International Product Safety Week (Organisation for Economic Co-operation and Development, 2014).

5.5.3 A Patient Safety Alert was issued (NHS England, 2014) relating to the ingestion of button batteries. The incidents described in the alert demanded an urgent response when a button battery was known to have been swallowed. It further highlighted the need to consider the possibility of prior button battery ingestion where a child had symptoms such as bleeding from the mouth or nose, haematemesis (blood in vomit), haemoptysis (coughing up of blood) and respiratory difficulties. The alert asked NHS providers to:

- identify if delays in recognising and treating ingested button batteries had occurred
- to consider if local action was required to ensure prompt recognition and treatment
- to distribute the alert and share any learning.
5.5.4 In February 2015, Public Health England (PHE) published a Child Safety Update (Public Health England, 2015). This emphasised the dangers caused by ingesting button/coin cell batteries, the action required and sources of further information, including the Child Accident Prevention Trust website, which contains advice and resources for professionals.

5.5.5 In 2018 one of PHE’s priority programmes included information and guidance in relation to unintentional injury prevention. The programme included several associated published resources, which include warnings relating to button/coin cell batteries (Public Health England, 2018a).

5.5.6 The National Poisons Information Service provided the investigation with an overview of call enquiries received from healthcare professionals and the severity of poisoning incidents associated with button/coin cell batteries (National Poisons Information Service, 2018).

5.5.7 The Royal College of Emergency Medicine (RCEM) has raised awareness of button/coin cell ingestion risks in recent years; some of the key initiatives being:

- support for a national awareness raising day with RoSPA in October 2017, highlighting button/coin cell batteries as key issues in accident prevention for the very young
- the issuing an RCEM Safety Alert to all UK emergency departments in 2014
- the issuing of a request to the NHSE Patient Safety Board regarding an alert on haematemesis due to a button battery ingestion in 2013, and collaboration with NHSE on the patient safety alert subsequently issued in 2014
- the sharing of local protocols for button battery ingestion, developed by Birmingham Children’s Hospital in 2013.

5.5.8 The Royal Society for the Prevention of Accidents (RoSPA) provides online advice about button/coin cell batteries. The advice includes an explanation of the potential dangers, the precautions parents can take to protect their children and what parents should do if their child swallows a button/coin cell battery (Royal Society for the Prevention of Accidents, 2018). In relation to activity prior to and since the reference event, RoSPA:

- set up a blog in 2016
- uses Facebook and Twitter on a regular basis to reach both practitioners and families
- includes information in the literature/resources directed towards parents and carers
- has produced five press releases which include button/coin cell batteries in the subject matter
- has given several media interviews on the issue
- supports campaigns that are led by other organisations
- raises awareness with health professionals via newsletters, conferences and training.

5.5.9 In addition, considerable national awareness raising work has been undertaken by the Child Accident Prevention Trust (CAPT). Since 2014 this has included:

- producing and regularly updating online safety advice
- producing a series of online articles
- producing a film featuring a father whose daughter died after swallowing a spare button battery (over 106,000 views on YouTube)
- promoting its online content to approximately 15,000 practitioners who subscribe to CAPT safety updates
- using Facebook and Twitter to reach parents and practitioners with safety advice
- issuing press releases, giving media interviews and securing media coverage
- producing and distributing printed flyers and posters

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23 The National Poisons Information Service (NPIS) a national service, approved by the UK Department of Health and commissioned by Public Health England, that provides expert advice on all aspects of acute and chronic poisoning.
• featuring button/coin cell batteries in the printed and online educational resources for Child Safety Week, CAPT’s annual national awareness campaign

• raising awareness via its training courses for practitioners

• developing an online session plan to enable practitioners to raise awareness with parents

• alerting bodies such as Public Health England and the Institute of Health Visiting to the risks associated with button batteries.

Since June 2017, CAPT has been working in partnership with the British and Irish Portable Battery Association (BIPBA) to ensure the technical accuracy of its safety advice and to support its work to improve battery safety.

5.5.10 BIPBA has been working to raise awareness of coin cell battery risks among the general public and clinicians. It published guidance on its website and worked with clinicians to understand their concerns. The industry has also launched a Europe-wide information video, highlighting the risks associated with coin cells. BIPBA is currently in the process of drafting graphical materials in conjunction with CAPT which shows where coin cells can be found within the home.

Safety campaigns

5.5.11 Child deaths are still occurring due to button/coin cell battery ingestion despite the variety of national initiatives to raise awareness of the potential risks and dangers of button/coin cell batteries to children. There has been no centrally co-ordinated, government or industry-led campaign.

5.5.12 The investigation reviewed how mass media campaigns can change health behaviour. Wakefield et al (2010) identified that mass media campaigns can produce positive changes or prevent negative changes in health-related behaviours across large populations. The paper highlighted that the likelihood of success is increased by the application of multiple methods of dissemination. It also identified that campaigns can be more effective when they are carefully planned and tested with target audiences.

5.5.13 Mahony, writing in the British Medical Journal, highlighted that evidence of long-term behavioural change from media campaigns has been hard to study and quantify, with much of the evaluation based on website hits and tweets. Only 1% of previous papers assessing the impact of marketing campaigns have looked specifically at behavioural change (British Medical Journal, 2015).

5.5.14 On 19 December 2018, the European Battery Association launched an animation entitled Button Battery Safety, to guide parents in the safe use and storage of button batteries in the home, and safe battery disposal (European Battery Association, 2018).

THE FOLLOWING SAFETY ACTIONS HAVE BEEN IMPLEMENTED


The General Medical Council has developed a blog, integral to which is the safety message: ‘The dangers of button battery ingestion: a safety message’.

5.5.15 Discussion between the Department for Business, Energy and Industrial Strategy, the British Standards Institute, the British Retail Consortium, the British and Irish Portable Battery Association and national safety bodies highlighted that there was a lack of public awareness in relation to the danger of button battery ingestion in children under the age of five years. This demonstrates a requirement for a nationally led campaign.

HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATION

Recommendation 2019/038:

It is recommended that the Department for Business, Energy and Industrial Strategy highlights to the general public the dangers of button/coin cell batteries.
5.6 Data availability

5.6.1 In the USA, over 3,500 incidents of button/coin cell battery ingestion are reported each year and these incidents may be considerably under-reported (American Academy of Pediatrics, 2015). Data from the USA National Poison Data System and National Battery Ingestion Hotline illustrates the moderate, major or fatal outcomes from battery ingestion (Figure 18). These figures show that the percentage of these cases suffering moderate, major or fatal outcomes has increased three-fold from 2005 to 2017 (Litovitz et al, adopted and adapted by National Capital Poison Center, 2018b).

5.6.2 The Australian Competition and Consumer Commission (2016) has cited that the incidence of button/coin cell battery ingestion is approximately 20 per week throughout Australia. In 2018, there were nine cases of serious injuries reported in New South Wales and Queensland (Sydney Morning Herald, 2018).

5.6.3 An American study spanning 18 years (Litovitz et al, 2010) found 208 cases of 20mm lithium cell battery ingestion in children under six years of age; 12.6% of these cases resulted in serious complications or death. The study reported that the average age of children who ingest button/coin cell batteries is 3.8 years old.

5.6.4 Most button battery ingestions are benign, passing through the gut without a problem. This means that understanding the incidence is difficult since reporting is likely to detect the ingestions that are known and those that cause harm or death and not these benign events (Litovitz et al, 2010b).

5.6.5 Across the literature, there is agreement that incidence of button/coin cell battery ingestion and associated morbidity and mortality has increased over the last one to two decades (American Academy of Pediatrics, 2015; Sharpe et al, 2012; Leinwand et al, 2016; Litovitz et al, 2010; National Capital Poison Center, 2018b). This is believed to be associated with an increase in the use of button/coin cell batteries in a range of household products, not just in children’s toys.

5.6.6 The literature search conducted for this investigation provided no comparable data for the UK that captures the incidence of button/coin cell battery ingestion cases and the level/type of harm caused by ingestion in children under five years old. However, there is evidence of four child deaths in the UK in 2013/14 following button battery ingestion (Wright et al, 2017).

FIG 18 BUTTON BATTERY INGESTIONS – FREQUENCY AND SEVERITY FOR MODERATE, MAJOR, AND FATAL OUTCOMES IN THE USA, 1985-2017
5.6.7 The investigation has identified that understanding the true incidence within the UK is difficult as the data is currently not centrally collated. NHS Hospital Episode Statistics data (NHS Digital, 2018b) and Office for National Statistics mortality data (Office for National Statistics, 2018) classify injury causes using the International Classification of Diseases (ICD) code. However, there is no obvious ICD code for button/coin cell battery ingestion.

5.6.8 The Child Death Review (CDR) process has been a statutory requirement placed upon Local Safeguarding Children Boards since 2008 and is delivered through Child Death Overview Panels (CDOPs). Data is collected for individual child deaths using a set of statutory forms, however this data has never been collated in one place. There are currently 93 CDOPs across the country and each one holds its own records and statistics on the child deaths it has reviewed. There has been no national guidance on data retention and consequently there is variation in the amount of historical data retained.

5.6.9 CDOPs are required to provide an annual statistical return to the Department of Health and Social Care. This is an aggregate return which gives basic details on the cases reviewed by each CDOP that year. This data has been collected consistently since 2008 by the Department for Education, which had the responsibility for overseeing CDOPs until 2017. This data is high level and describes the number of child deaths due to trauma, without specificity of cause of death.

National Child Mortality Database

5.6.10 In 2017, the Healthcare Quality Improvement Partnership commissioned a National Child Mortality Database (NCMD) on behalf of NHS England. The NCMD was commissioned following the publication of an article which described a higher child mortality rate in the UK compared with other developed countries. It is anticipated that the database will enable NHS England to understand causes of child mortality and help determine what interventions could be introduced in order to make improvements. In addition, there was a drive to improve the consistency of data collection across CDOPs and to collate this nationally. The development of the NCMD aims to address these data issues. Work commenced on 1 April 2018 and it is anticipated that data will start to be collected from CDOPs from 1 April 2019 onwards. CDOPs will be required to provide their data to the NCMD.

5.6.11 In addition to the development of the NCMD, a Consultant in Paediatric Emergency Medicine has advised the investigation of planned and ongoing work in respect of collecting information about button/coin cell battery ingestion cases.

Firstly, a national consultant paediatrician survey of children admitted with button/coin cell battery ingestion, who have required a procedure, is planned through the British Paediatric Surveillance Unit (BPSU). Integral to this is raising awareness of the BPSU work to all paediatric surgeons, and ear, nose and throat surgeons via their associations. Secondly, work is ongoing to interrogate existing data sources such as the Paediatric Intensive Care Audit Network and the Child Death Overview Panels, to ensure serious outcomes are identified.

However, there is scope for a surveillance study of all children attending emergency departments with button/coin cell battery ingestion, whether admitted or discharged, and with complications or not. This would provide an indication of the numbers of children affected and the degree of harm caused by the ingestion.

HSIB MAKES THE FOLLOWING SAFETY OBSERVATION

Information could be collected by a surveillance study of all children attending emergency departments with button/coin cell battery ingestion, to better understand incidence and outcomes.
SUMMARY OF HSIB FINDINGS, SAFETY RECOMMENDATIONS AND OBSERVATIONS

Findings
The investigation found:

1. Butt/on/coin cell batteries of 16mm in diameter and above can lodge in the oesophagus of young children causing serious harm or death due to a chemical reaction which erodes tissue. There is currently no commercially available technological solution to render such a battery inert when not in use.

2. While there are product safety regulations for children’s toys, there are no equivalent safety regulations for household items to ensure button/coin cell batteries are secured in battery compartments and cannot be accessed by small children.

3. While reputable coin cell manufacturers use child resistant packaging for their lithium coin cell battery products, child-resistant button/coin cell battery packaging is not used by all product manufacturers or retailers.

4. The requirement to place product warnings on packaging is part of the International Electrotechnical Commission standards. However, there is currently no directive to place warnings or information on product packaging regarding the serious consequences of a young child ingesting a button/coin cell battery.

5. There is local and regional guidance, as well as National Institute for Health and Care Excellence guidance relating to elements of acute illness in the under-five age group. The investigation also found examples of guidance developed internationally. However, there is currently no national clinical decision support for suspected or known ingestion of button/coin cell batteries in children.

6. The relevant pathways used by NHS 111 did include the possible ingestion of a button/coin cell battery in children, but only when ingestion of a foreign body was known.

7. If the ingestion of a foreign body is known, there is a question within the NHS 111 ‘Object, Ingested or Inhaled’ pathway. A question would be asked regarding what object had been ingested and this would include a prompt for batteries and button/coin cell batteries. This question would only be asked after various symptoms had been ruled out due to the hierarchal nature of NHS pathways, in which serious symptoms are ruled out first. In cases where symptoms indicate that an urgent response is required, there would be no further questions asked.

8. The healthcare information systems involved were limited in their ability to share information.

9. There is a lack of clarity about the roles and responsibilities of supervisor and supervisee paramedics, which can impact on the team dynamic. There is no nationally available guidance regarding supervision for paramedics and other grades of patient-facing ambulance staff.

10. There are no standardised national guidelines that provide guidance for ambulance staff on when to safely convey (take to hospital), refer and discharge children under five years.

11. Although the risks associated with batteries and specifically button/coin cells have been published by the battery industry for the past 10 years, the severity of harm caused by such batteries becoming lodged in a young child’s oesophagus are not widely understood by the public.

12. In the UK there is no accurate data to capture the incidence of button/coin cell battery ingestion and the level/type of harm caused in young children.

HSIB MAKES THE FOLLOWING SAFETY RECOMMENDATIONS

Recommendation 2019/034:
It is recommended that the Department for Business, Energy and Industrial Strategy develops a strategy to improve button/coin cell battery safety, to include producing a fast-track standard covering/considering battery design, product casing, packaging and safe retailing practices.
Recommendation 2019/035:
It is recommended that the Royal College of Paediatrics and Child Health develop a key practice point within a decision support tool for suspected or known ingestion of button/coin cell batteries, and to be supported in this development by the Royal College of Emergency Medicine.

Recommendation 2019/036:
It is recommended that the Association of Ambulance Chief Executives agrees guidance that can inform its members on the competency and authority for staff to convey, refer and discharge children under five years who are subject to 999 calls.

Recommendation 2019/037:
It is recommended that the College of Paramedics develops supervision guidance for paramedics, applicable to all relevant practice settings.

Recommendation 2019/038:
It is recommended that the Department for Business, Energy and Industrial Strategy highlights to the general public the dangers of button/coin cell batteries.

The provision of protected time for paramedics and other grades of patient-facing ambulance staff to undertake supervision and clinical updates is limited. This may impact upon the maintenance of staff competency and may limit trusts’ ability to disseminate learning opportunities.

Information could be collected by a surveillance study of all children attending emergency departments with button/coin cell battery ingestion, to better understand incidence and outcomes.

HSIB MAKES THE FOLLOWING SAFETY OBSERVATIONS

Observations:
There is limited connectivity and interoperability across healthcare information technology systems. This can impact on the availability and quality of information regarding patients’ clinical history, previous contact with healthcare professionals or services and past interventions.

It would be beneficial for a review to be undertaken of the content of the Advanced Paediatric Life Support course, and any similar courses hosted by other providers, to ensure that the management and issues associated with the ingestion of button/coin cell batteries is strengthened as required in response to this report.

It may be beneficial for a study to be conducted on the potential for hand-held metal detectors to be used as a non-invasive screening tool for non-specific clinical presentations in children under five years.

There appear to be opportunities to reduce the variation in provision of and access to clinical leadership in the ambulance sector, when compared with the general management structure.

SAFETY ACTIONS CARRIED OUT

Safety actions:
In relation to the ingestion of anything ‘harmful or poisonous’, NHS Pathways has now included button/coin cell battery in the supporting information so that a specific prompt is provided.

NHS Digital and the Priority Dispatch Corporation have reviewed all relevant pathways associated with the possible ingestion of button/coin cell batteries in children.


Public Health England, Community Practitioners and Health Visitors Association, Royal College of Midwives, Royal College of Nursing, and School and Public Health Nurses Association have cascaded safety messages regarding the potential dangers of button/coin cell batteries through their networks.

The General Medical Council has developed a blog, integral to which is the safety message: ‘The dangers of button battery ingestion: a safety message’.
The National Reporting and Learning System (NRLS) was searched on 15 May 2018 for incidents reported between 1 May 2008 and 1 May 2018. Search terms used were ‘button batter’ OR [‘batter’ AND ‘lithium’]. This returned 296 results, which were then filtered to show only those reported as relating to patients between birth and seven years old. This refined the results to 53 reported incidents, 39 of which represented cases of accidental button battery ingestion.

The Strategic Executive Information System (StEIS) was searched on 15 May 2018 for incidents reported between 1 April 2017 and 14 May 2018. The search term ‘button batter’ returned one result which was not relevant to accidental button battery ingestion in children. The search term ‘lithium batter’ returned eight results; seven of these were self-inflicted harm, one involved a child accidentally ingesting a foreign object which was found to be a button battery. The search term ‘batter’ returned 15 results, only one of which was relevant as described above.
**8 APPENDIX B - BUTTON BATTERY INGESTION TRIAGE AND TREATMENT ALGORITHM (NATIONAL CAPITAL POISON CENTER, 2018A)**

### Suspect a battery ingestion in these situations

- "Coin" ingested. Check AP x-ray for battery’s double-rim or halo-effect and lateral view for step off.

### Battery ingestion known or suspected

- **NPO until esophageal position ruled out by x-ray.**
  - Patient ≤ 12 y and battery > 12 mm
  - Take up to 5 min to determine imprint code (or diameter) of companion or replacement battery.
  - Consult National Battery Ingestion Hotline at 202-625-3333 for assistance with battery identification and treatment.
- **Patient > 12 y and battery ≤ 12 mm**
  - X-ray immediately to locate battery (batteries lodged in esophagus may cause serious burns in 2 h. Batteries in the esophagus may be asymptomatic initially. Do not wait for symptoms.
- **Patient > 12 y and battery ≥ 12 mm**
  - Are all these conditions met? a
    - Patient is entirely asymptomatic and has been so since ingestion.
    - Only one battery ingested.
    - ≤ 12 mm diameter determination is certain.
    - No pre-existing esophageal disease.
    - Patient or caregiver is reliable, mentally competent, and agrees to promptly seek evaluation if symptoms develop.

### Tips, Pitfalls & Caveats

- **X-ray immediately to locate battery:** Batteries lodged in esophagus may cause serious burns in 2 h. Batteries in the esophagus may be asymptomatic initially. Do not wait for symptoms.
- **Was a magnet co-ingested?**
  - Yes
  - Battery ≤ 15 mm cell ingested by child < 6 y
  - X-ray 4 d after ingestion (or sooner if symptoms develop). If still in stomach, remove endoscopically (even if asymptomatic).
  - After removal, if mucosal injury was present, observe for and anticipate delayed complications: tracheoesophageal fistula, esophageal perforation, mediastinitis, vocal cord paralysis, tracheal stenosis or tracheomalacia, aspiration pneumonia, amyotonia, lung abscess, pneumomediastinum, or exanguination from perforation into a large vessel.

### Symptomatic patient, no ingestion history

- Consider battery ingestion if:
  - Airway obstruction or wheezing
  - Drooling
  - Vomiting
  - Chest discomfort
  - Difficulty swallowing, decreased appetite, refusal to eat
  - Coughing, choking or gagging with eating or drinking

### Definitive determination of the battery diameter

- c If battery diameter is unknown, estimate it from the radiograph, factoring out magnification (which tends to overestimate diameter).

### Batteries in Stomach

- Immediate removal of batteries lodged in the esophagus. Serious burns can occur in 2 h.
- Do not delay because patient has eaten. Prefer endoscopic removal (instead of retrieval by balloon catheter or magnet affixed to tube) for direct visualization of tissue injury. Inspect mucosa for extent, depth and location of tissue damage. Note position of battery and direction of negative pole faces.

### After removal, if there is gastric battery ingestion

- Anticipate specific complications based on injury location, battery position and orientation (negative pole). Determine length of observation, duration of esophageal rest, need for serial imaging or endoscopy/bronchoscopy based on severity and location of injury. Monitor patients at risk of perforation into vessels as inpatients with serial imaging and stool guaiacs. Intervene early to prevent fatality. Monitor for respiratory symptoms, especially those associated with swallowing, to diagnose TE fistulas early. Expect perforations and fistulas to be delayed up to 18 d after battery removal and esophageal strictures delayed weeks to months.

**FIGURE 4**

Triage and treatment guideline for button-battery ingestions. AP indicates anteroposterior; NPO, nil per os. a NPO. Anesthesia may be required for removal. b Radiograph abdomen, esophagus, and neck. Batteries above the range of the radiograph have been missed. If battery is in esophagus, obtain anteroposterior and lateral views to determine orientation of negative pole. If ingestion is suspected and no battery is visualized on radiographs, check ears and nose. c If battery diameter is unknown, estimate it from the radiograph, factoring out magnification (which tends to overestimate diameter).
9 APPENDIX C - REFERENCES


Great Ormond Street Hospital. (2016) The devastating impact of button batteries. [Online] Available at: https://www.youtube.com/watch?v=zkulle5remU


FURTHER INFORMATION

More information about HSIB – including its team, investigations and history – is available at www.hsib.org.uk

If you would like to request an investigation then please read our guidance before submitting a safety awareness form.

@hsib_org is our Twitter handle. We use this feed to raise awareness of our work and to direct followers to our publications, news and events.

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