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Health Services Safety
Investigations Body

Investigation report

Timely detection and treatment of cauda equina syndrome

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Emergency care, Access to care

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Contents

[Executive summary](#)

[The reference event](#)

[The national investigation](#)

[Findings](#)

[National findings](#)

[HSIB makes the following safety recommendations](#)

[HSIB makes the following safety observations](#)

[HSIB notes the following safety observations](#)

[1 Background and context](#)

[Back pain and the spine](#)

[1.2 Cauda equina syndrome \(CES\)](#)

[1.3 Management of suspected CES](#)

[2 The reference event](#)

[2.1 Initial presentations](#)

[2.2 Onset of potential 'red flag' symptoms](#)

[2.3 Diagnosis of CES](#)

[2.4 Transfer and treatment](#)

[3 Involvement of the Healthcare Safety Investigation Branch](#)

[3.1 Notification of the reference event](#)

[3.2 Decision to conduct a national investigation](#)

[3.3 Scope of investigation](#)

[3.4 Methods](#)

[3.5 Verification of findings](#)

[4 Findings and analysis of the reference event](#)

[4.1 Diagnosis](#)

[4.2 Management](#)

[HSIB notes the following safety actions](#)

[5 Findings and analysis from the wider investigation](#)

[5.1 Diagnostic challenges](#)

[5.2 Access to and timing of MRI](#)

[HSIB makes the following safety recommendation](#)

[HSIB makes the following safety observation](#)

[HSIB makes the following safety recommendation](#)

[HSIB makes the following safety recommendation](#)

[HSIB makes the following safety observation](#)

[Supporting the diagnosis of CES](#)

[HSIB makes the following safety observation:](#)

[HSIB makes the following safety recommendation](#)

[HSIB notes the following safety action](#)

[Diagnostic pathways and the role of spinal networks](#)

[HSIB makes the following safety observation](#)

[5.3 Management of CES](#)

[HSIB makes the following safety recommendation](#)

[6 Summary of findings, safety recommendations, safety observations and safety actions](#)

[Reference event findings](#)

[National findings](#)

[HSIB makes the following safety recommendations](#)

[HSIB makes the following safety observations:](#)

[HSIB notes the following safety actions](#)

[7 References](#)

[8 Appendix](#)

[8.1 Data extraction information](#)

[Providing feedback and comment on HSIB reports](#)

Executive summary

The purpose of this investigation is to support improvements in the timely identification and management of cauda equina syndrome (CES) – a rare condition caused by dysfunction of nerves at the end of a person’s spinal cord within the spinal canal. It uses a real patient safety incident involving a woman who experienced CES; this is referred to as ‘the reference event’ and was used to examine national issues.

The reference event

The reference event relates to a woman aged 32 years, who, between November 2018 and January 2019, made six visits to her general practitioner (GP) and two visits to hospital with ongoing pelvic, back and low abdominal pain. The Patient was suspected of having endometriosis (a condition where tissue similar to the lining of the womb starts to grow in other places, such as the ovaries and fallopian tubes).

In February 2019, the Patient again visited her GP, the emergency department (ED) of a local hospital and an out-of-hours GP with increasing pelvic and abdominal pain. She was also suffering from low back pain, with the pain radiating down her leg and into her calf. The out-of-hours GP diagnosed her with a slipped disc and her own GP later agreed with this diagnosis. The Patient's GP told the Patient to go to hospital if she experienced any 'red flag' symptoms for CES. Upon leaving the GP surgery the Patient thought she had had an episode of urinary incontinence (a red flag symptom) and went straight to a local ED.

At the ED, a consultant agreed with the diagnosis of a spinal disc protrusion (often referred to as a slipped disc) and documented a plan for the Patient to have an MRI scan within 1 week. The Patient had the scheduled MRI scan 4 days later and went to the ED to await the results. The MRI was thought to show spinal nerve compression, which prompted the Patient's referral to the local orthopaedic team. Later the same evening an orthopaedic doctor (that is, a doctor specialising in the musculoskeletal system) referred the Patient, via an electronic referral system, to the neurosurgery department (where doctors specialise in operating on the central nervous system - brain and spinal cord - and the peripheral nervous system) at the regional specialist spinal centre.

The referral was reviewed approximately 3 hours later when a neurosurgery registrar at the specialist unit logged on to the referral system. The registrar discussed the referral with the on-call consultant, and they arranged an emergency transfer of the Patient to the specialist centre. The consultant's view of the MRI scan was that it showed a significant degree of cauda equina compression.

The Patient was taken by emergency ambulance to the specialist centre, arriving in the early hours of Saturday morning, just over 12 hours after her MRI scan. The consultant surgeon reviewed the Patient at 09:00 hours on Saturday, but was unable to operate immediately as another surgical case took priority. The surgery was further delayed because X-ray facilities were unavailable in the operating theatre.

The Patient had surgery later the same day at 14:10 hours, where the diagnosis of 75% occlusion (blockage) of the spinal canal was confirmed. The Patient subsequently received intensive rehabilitation at a specialist rehabilitation centre. At the time of writing this report, the Patient has ongoing back pain and neurological symptoms.

The national investigation

HSIB first identified a potential safety risk associated with the diagnosis and management of CES in June 2018. At that time it was agreed to monitor the safety risk as a potential future investigation. In August 2019, HSIB became aware of ongoing safety issues in this area and identified multiple incidents using the Strategic Executive Information System (a national database of serious incidents in healthcare). The incidents included the reference event discussed in this investigation. Additional information was then gathered and the reference incident was assessed against HSIB's investigation criteria. Consequently, HSIB's Chief Investigator authorised a national investigation.

The national investigation focused on:

- assessing the resilience, consistency and reliability of the pathway(s) for patients experiencing potential red flags for CES
- seeking to understand the context and contributory factors influencing the pathway for patients with CES from their first presentation
- reviewing the national context surrounding the timely detection and treatment of spinal nerve compression (CES) in patients with back pain
- developing safety recommendations as appropriate.

The investigation:

- reviewed research and other literature relevant to each of line of enquiry
- engaged with national experts in the field of CE
- explored the systems currently used to diagnose and manage CES, and barriers to timely diagnosis and management
- engaged with multiple stakeholders and service providers.

Findings

Reference event findings

- There was a delay in obtaining an MRI for the Patient. The investigation found that the Patient waited 4 days for an MRI, despite having a red flag symptom that potentially indicated CES.
- Those interviewed had varying views about the time criticality of pathways for diagnosing CES and how quickly an MRI should be obtained. National guidance and standards do not specify diagnostic time frames, and from when the times should be measured.
- The referral process to the regional specialist spinal centre had multiple steps and therefore several opportunities for error. The investigation identified a safety risk, in that neurosurgical doctors at the specialist centre were not alerted (unless they were at their computer) when a referral was received through the electronic referral system.
- After the Patient arrived at the specialist centre, she waited for more than 10 hours for emergency surgery. The policy at that centre was not to perform non-life-threatening operations overnight, based on recognising that performance at night can be suboptimal, and the risks of operating at night can outweigh the risks of waiting until the morning.

National findings

- MRI is currently the investigation of choice for diagnosing CES. The Society of British Neurological Surgeons and the British Association of Spine Surgeons recommend a low threshold for performing MRI, and that MRI should be available at the referring hospital 24 hours a day, 7 days a week. The investigation found that many local hospitals cannot use their MRI scanners out of hours as they do not have sufficient numbers of suitably trained staff.
- National standards of care state that MRI must be undertaken as an emergency where CES is suspected. This investigation heard about and saw varying time frames for patients with suspected CES. Terms such as 'emergency scan' and 'urgent scan' are being used interchangeably with various meanings at different locations. This has resulted in confusion around the appropriate time frames for MRI and when an MRI will actually occur.
- The investigation found no National Institute for Health and Care Excellence (NICE) guidance specifically on CES. The available national information to guide clinical decision making and implement pathways is therefore based on limited

detail in national documents and local perceptions around best practice. This has resulted in variations across the country. The investigation heard that clinicians would benefit from the clear inclusion of CES in NICE guidance.

- The investigation found variations in treatment pathways across the system and within specific spinal networks. The treatment pathway for CES depends on which hospital the patient is initially assessed at. It also depends on which spinal network the patient's local hospital sits within geographically.
- Developing and embedding a clear national pathway for CES management, with appropriate tests/assessments by suitably senior staff, will support efficient referral and management. A clear pathway that ensures early communication will help the receiving hospital to start planning for the patient. Regular updates and timely MRI images will also support the process.
- Safety-netting leaflets on the symptoms associated with CES were inconsistent in their level of detail and language.

HSIB makes the following safety recommendations

Safety recommendation R/2021/139:

HSIB recommends that the British Association of Spine Surgeons, supported by the Royal College of Surgeons of England and the Royal College of Emergency Medicine, develops a decision-making tool to support the identification of patients who need an immediate MRI for suspected cauda equina syndrome (which may result in the patient being transferred for MRI if this is not immediately available at the assessing site).

Safety recommendation R/2021/140:

HSIB recommends that guidance is developed by the Royal College of Radiologists, supported by the Society and College of Radiographers, stating that all hospitals should reserve the first MRI slot of the day for patients with suspected cauda equina syndrome who do not meet the criteria for an 'emergency'/immediate scan overnight.

Safety recommendation R/2021/141:

HSIB recommends that the British Association of Spine Surgeons oversees the development of national guidance to identify how 'urgent' and 'emergency' requests for scans for suspected cauda equina syndrome are defined and prioritised.

Safety recommendation R/2021/142:

HSIB recommends that the National Institute for Health and Care Excellence updates its current low back pain guideline to include the symptoms and initial management of cauda equina syndrome. This update should include a review of the role of supplementary investigations, such as bladder scanning, in patients with suspected cauda equina syndrome.

Safety recommendation R/2021/143:

HSIB recommends that NHS England and NHS Improvement develops a national cauda equina syndrome pathway. This should define the safety-critical elements of the pathway and highlight areas that can be adapted locally.

HSIB makes the following safety observations

Safety observation O/2021/122:

It may be beneficial for all hospitals where patients with potential cauda equina syndrome may present to have access to MRI scanning and reporting 24 hours a day, 7 days a week.

Safety observation O/2021/123:

It may be beneficial for NHS spinal networks in England to implement services and processes to support timely access to MRI for patients with suspected cauda equina syndrome, in line with national guidance to be developed by the British Association of Spine Surgeons.

Safety observation O/2021/124:

It may be beneficial for hospital trusts without 24 hours a day, 7 days a week MRI provision and the potential to see patients with suspected cauda equina syndrome to consider expanding the skills of their radiographers to allow out-of-hours MRIs if required. Projects such as those described in this report may support this.

Safety observation O/2021/125:

It may be beneficial for safety-netting leaflets to be given to patients with low back and radicular pain. Leaflets should use clear and concise language, and provide clear directions as to what a patient should do if they develop red flag symptoms.

HSIB notes the following safety observations

Safety action A/2021/046:

The regional specialist spinal centre described in this report has worked with the electronic referral system manufacturer to ensure alerts are received by neurosurgical doctors. This has included doctors having a single 'baton' telephone that receives the alert, with the telephone being passed to the next doctor at shift handover.

Safety action A/2021/047:

The British Orthopaedic Association has started to develop a Standard for Trauma and Orthopaedics (BOAST) to support the diagnosis and management of cauda equina syndrome in the non-specialist setting

1 Background and context

Back pain and the spine

1.1.1 Each year, a third of UK adults will have low back pain and a fifth of these individuals will consult their GP (Airaksinen et al, 2006). Low back pain is common, mostly benign (not cancerous) and generally self-limiting. Low back pain without a specific cause can be called 'non-specific low back pain' and is commonly seen in primary and community care. Low back pain is associated with physical, psychological, social and financial costs.

1.1.2 Low back pain with a specific cause is rarer than non-specific low back pain, but can include serious conditions such as cancer, infection or inflammation. In these conditions the spinal cord itself may be damaged, resulting in neurological symptoms (including radicular pain, limb weakness, sensory loss or bladder or bowel dysfunction).

1.1.3 The spinal cord is a bundle of nerves that runs from the brain, down the spinal canal and to the lumbar area of the back. Its role as part of the central nervous system is to pass nerve signals between the brain and the rest of the body. At the lower end of the spinal cord, in the upper portion of the lumbar region (see figure 1 for spinal anatomy), the cord splits into individual nerves to form the cauda equina (Latin for 'horse's tail'; figure 2). The nerves of the cauda equina emerge from the spinal canal to supply motor, sensory and parasympathetic (involving the body's regulation of unconscious actions) functions to various parts of the pelvis and lower limbs

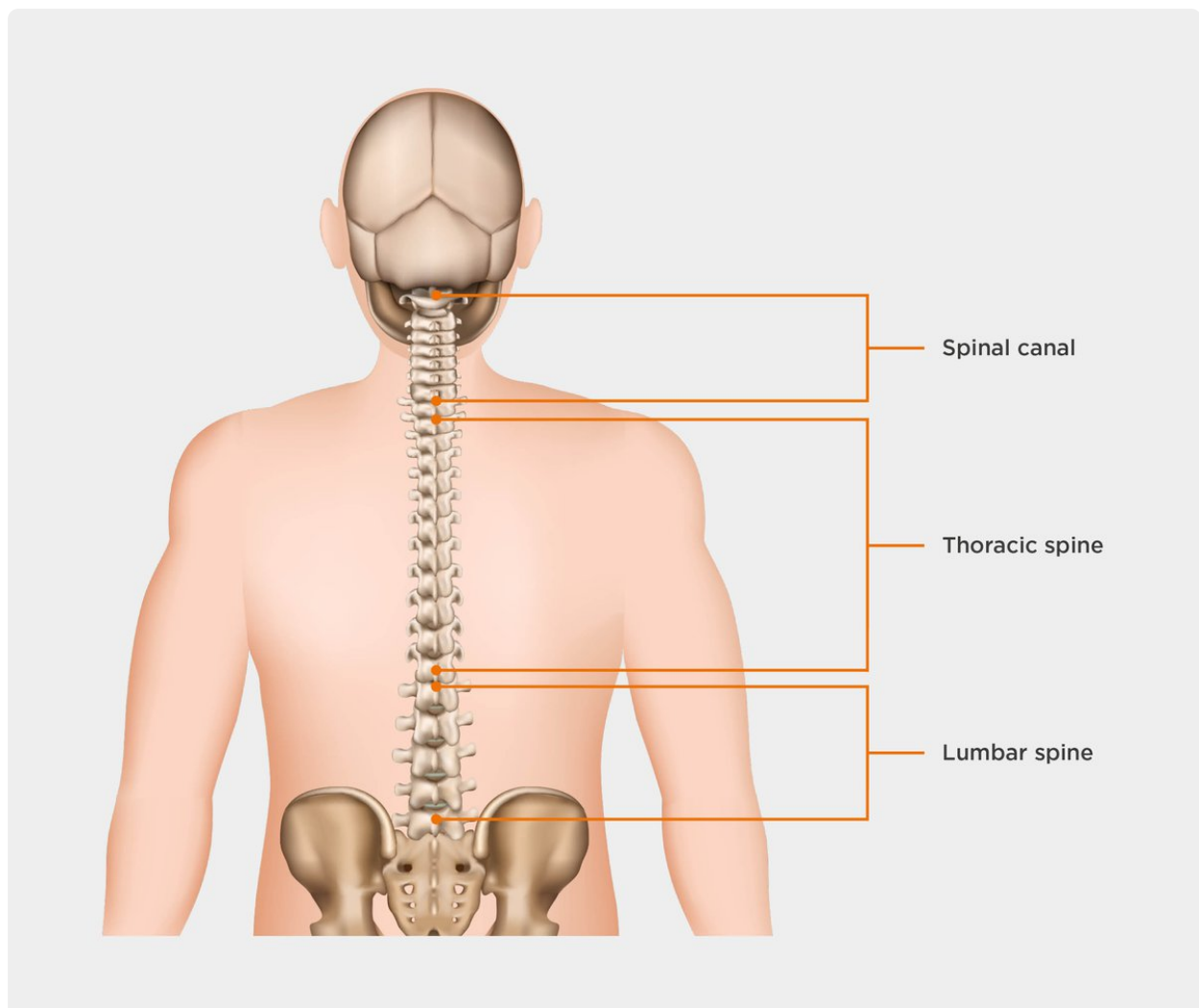


Figure 1 Anatomy of the spine (source: MedlinePlus, National Library of Medicine)

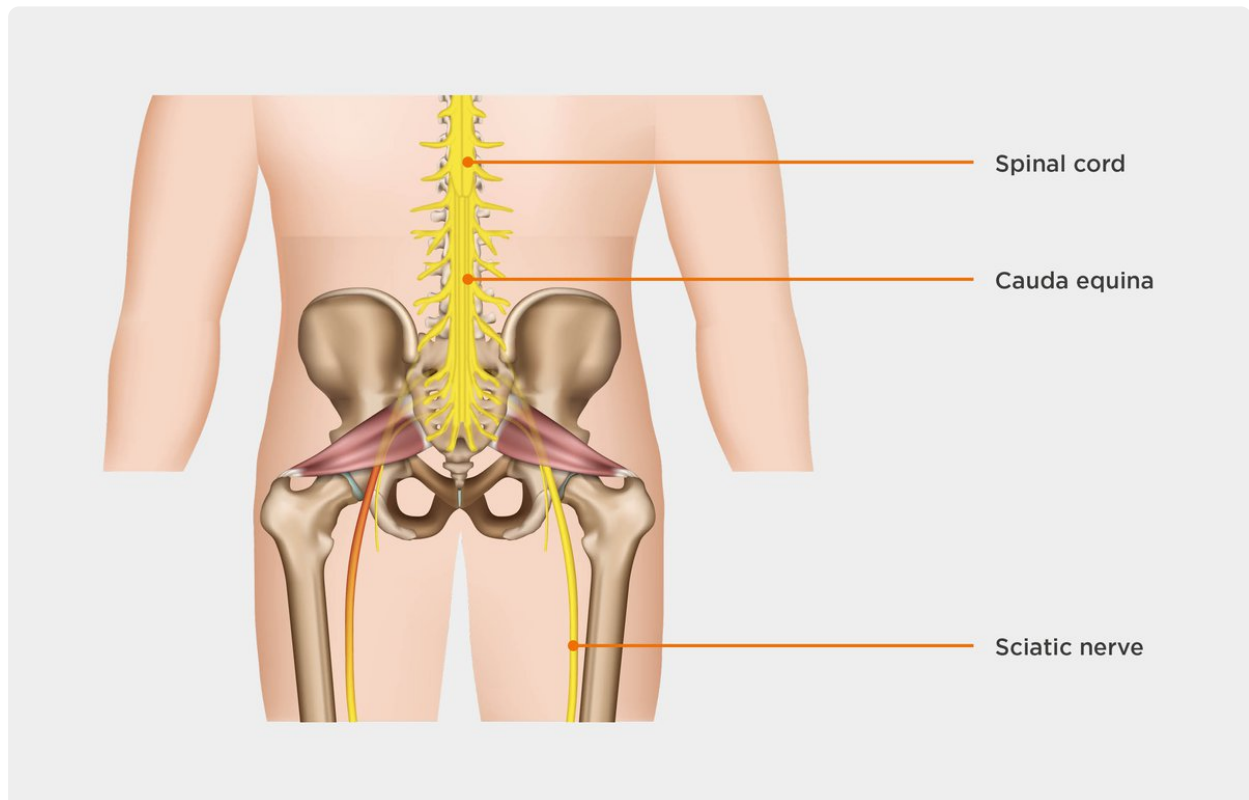


Figure 2 Spinal cord and cauda equina (source: MedlinePlus, National Library of Medicine)

1.2 Cauda equina syndrome (CES)

1.2.1 CES is a rare complication of narrowing of the spinal canal at the level of the cauda equina. It is characterised by a collection of symptoms resulting from the compression of the nerves of the cauda equina.

1.2.2 CES is most commonly caused by herniation (protrusion) of a lumbar intervertebral disc (see figure 3) compressing and irritating the nerves at the lower lumbar and upper sacral (below the lumbar level) spinal levels (Barraclough, 2021; Kapetanakis et al, 2017). CES can also result from infection, inflammation or cancer.

People with CES can present with (Kapetanakis et al, 2017):

- low back pain
- sciatica (severe pain radiating along the sciatic nerve and into the buttock and leg on one or both sides)
- reduced sensation in the 'saddle' area (buttocks, inner thighs and perineum)
- reduced sexual function
- loss of control over passing faeces
- loss of control over passing urine, or retention of urine

- leg weakness

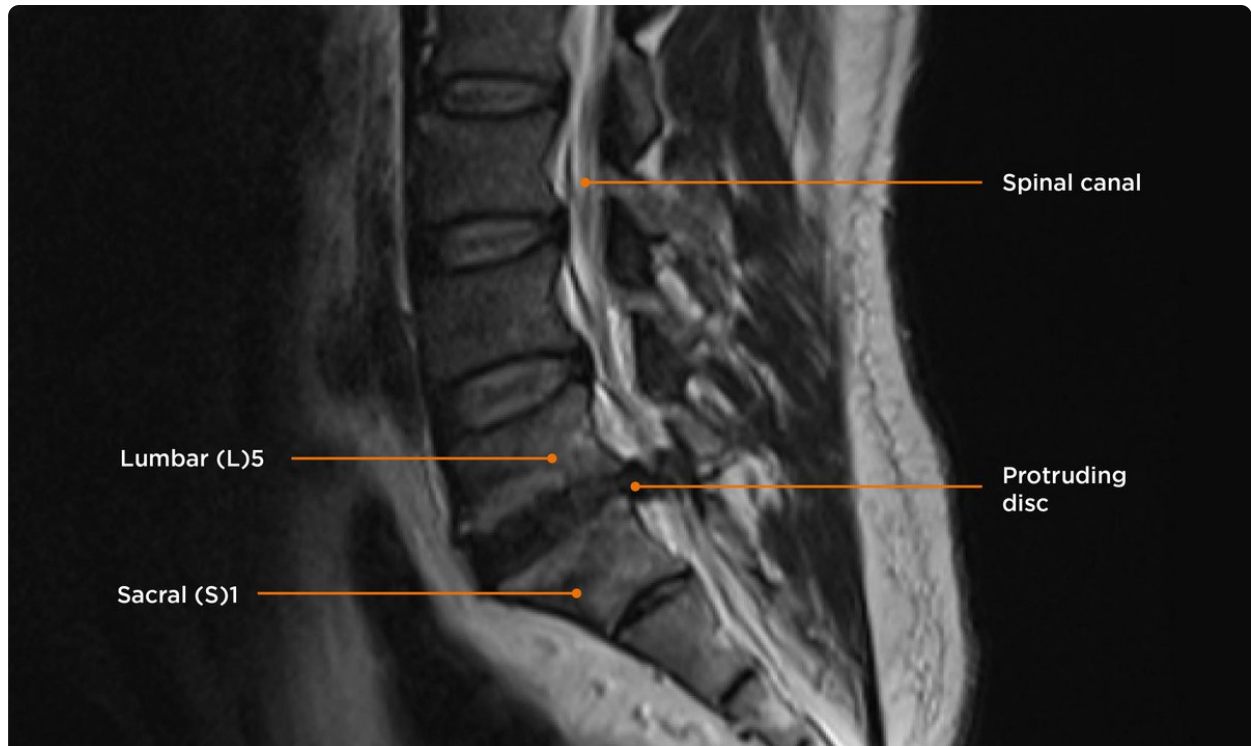


Figure 3 MRI showing a large protruding intervertebral disc pressing on the spinal cord at the lower lumbar area (image courtesy of Radiopaedia.org).

1.2.3 CES can have an acute (fast) onset due to a sudden cause or following chronic back pain, or it can be slow and progressive. The challenge for healthcare professionals is to differentiate between non-specific low back pain and serious conditions that require emergency intervention, such as CES. If not managed quickly, CES can lead to permanent problems with passing faeces and urine, sexual dysfunction or paralysis.

1.2.4 The number of people affected by CES is unclear. CES has not always been clearly defined, which makes it difficult to compare older studies. However, the evidence suggests that CES is a rare cause of back pain in people attending emergency departments (EDs), with an incidence of 1.0 to 1.9 per 100,000 population (Woodfield et al, 2018). The cost of CES-related litigation claims for 2014/15 to 2015/16 was £68m (Hutton, 2019).

1.3 Management of suspected CES

Diagnosis

1.3.1 In 2018, standards of care for patients presenting with suspected CES were developed by the Society of British Neurological Surgeons and the British Association of Spine Surgeons (SBNS/BASS). These state that:

‘A patient presenting with back pain and/or sciatic pain with any disturbance of their bladder or bowel function and/or saddle or genital sensory disturbance or bilateral leg pain [pain in both legs] should be suspected of having a threatened or actual CES.’

(Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018)

1.3.2 The National Institute for Health and Care Excellence (NICE) previously commissioned a Clinical Knowledge Summary (2020) describing symptoms and signs that should prompt urgent referral for investigation of CES.

These ‘red flags’ include:

- sciatica (severe pain in the buttock and leg) on both sides of the body
- severe or progressive neurological deficit (numbness) in both legs
- difficulty initiating micturition (urination) or impaired sensation of urinary flow; urinary retention with overflow urinary incontinence (incomplete bladder emptying)
- loss of sensation of rectal fullness; faecal incontinence
- perianal, perineal or genital sensory loss (reduced sensation or pins and needles in the buttocks, inner thighs or perineum)
- laxity of the anal sphincter.

1.3.3 Because a reliable diagnosis cannot be made using just the signs and symptoms of CES, the SBNS/BASS standards of care say clinicians should have a ‘low threshold’ for requesting an emergency MRI scan and that MRI must be available at the referring hospital 24 hours a day, 7 days a week (24/7) (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018). MRI is a form of imaging that uses magnets to generate three-dimensional images of the inside of a person’s body. Guidelines specify that MRI should be performed at the hospital to which the patient first presents and before any discussion with spinal services.

1.3.4 The Getting it Right First Time (GIRFT) programme (a national programme that aims to improve the treatment and care of patients) included CES in its 2019 'National speciality report on spinal services' (Hutton, 2019). The report refers to the SBNS/BASS 'Standards of care for investigation and management of cauda equina syndrome' and the 'Evaluation of national treatment and investigation of cauda equina' (ENTICE) publication (Fountain et al, 2019). ENTICE collected data from 28 spinal emergency units in the UK, covering

4,441 referrals made in the 6 months from 1 October 2017 to 31 March 2017. ENTICE reported the following findings:

- Overall, 63% of referrals to emergency spinal units for suspected CES were made without an MRI scan.
- Nearly a quarter (23%) of patients referred without an MRI scan were transferred to an emergency unit for an MRI.
- When an emergency MRI was indicated, there were significant differences in the time taken to get the MRI. The median time to MRI at an emergency spinal unit was 4 hours if the patient was referred from within the same unit, around 7 hours if they were transferred from outside the hospital and around 13 hours if performed at a referring hospital.

1.3.5 The findings from GIRFT and ENTICE show that the SBNS/BASS standards of care for accessing emergency MRI are not being met, with significant variation across the country. The GIRFT report identified this as being due to a limited availability of out-of-hours radiography support for MRI. GIRFT therefore recommended that hospital trusts follow the SBNS/BASS standards of care and, where they cannot provide the resources for out-of hours MRI, should work within their trust to set up local networks.

1.3.6 Diagnosis and management of CES is supported in England by regional spinal networks (United Kingdom Spine Societies Board, 2018). NHS England and NHS Improvement defines the roles of such operational delivery networks. Spinal networks are composed of spinal hubs with 24/7 emergency spinal services; spinal partner hospitals, which may offer spinal services but not 24/7 care; non-spinal partner hospitals; and other affiliated partners. The role of the networks is to support working among regional organisations, and to define and implement patient pathways over a wide geographical area to ensure access to specialist resources and expertise. Figure 4 shows an example regional spinal network.

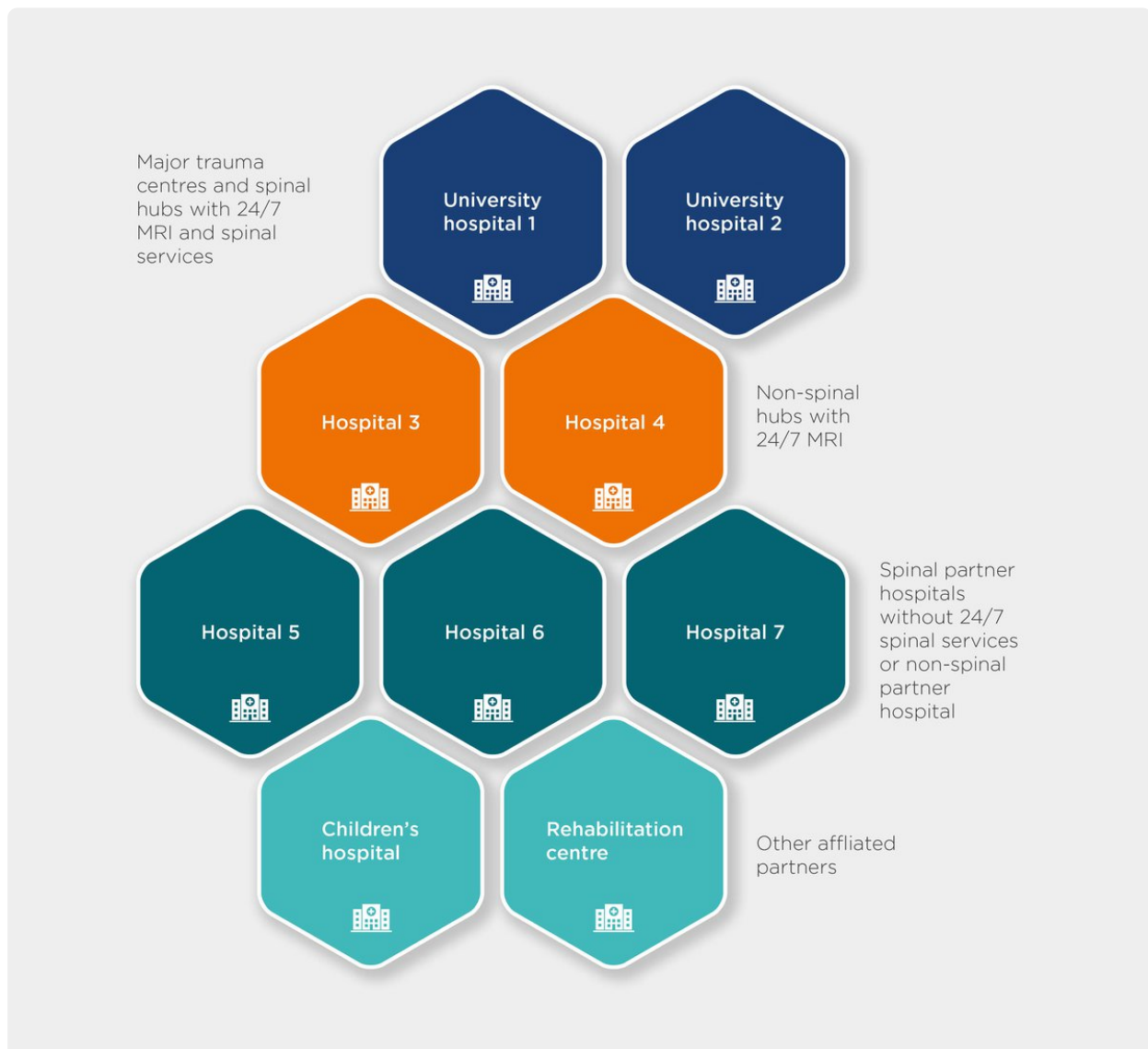


Figure 4 Example spinal network map showing the various hospitals and their capabilities

Treatment

1.3.7 Following MRI of a patient with suspected CES, there are several potential outcomes, including: CES is confirmed; CES is excluded, but another condition is found; or there is nothing found to explain the symptoms and signs being experienced by the patient.

1.3.8 Where CES is confirmed, immediate referral to and treatment by an appropriate surgical service is required. This service may be provided by spinal neurosurgery or spinal orthopaedic surgeons. The SBNS/BASS standards of care state:

'Nothing is to be gained by delaying surgery and [surgery] should be undertaken at the earliest opportunity, considering the duration and clinical course of symptoms and signs, and the potential for increased morbidity while operating in the night.'
(Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018)

1.3.9 If the patient is not suspected of having CES or is not found to have CES on MRI then they should be made aware of how to access clinical advice if their symptoms deteriorate. This is known as 'safety netting'. Safety netting is a regularly used and important part of any clinical encounter where the diagnosis is uncertain and the person needs to know when and how to seek further advice. The clinician should communicate their uncertainty and follow-up plans in a way that the patient understands (Jones et al, 2019)

2 The reference event

This investigation used the following patient safety incident, referred to as 'the reference event', to examine delays in the diagnosis and management of cauda equina syndrome (CES).

2.1 Initial presentations

2.1.1 Between November 2018 and the end of January 2019 the Patient, a 32-year-old woman, saw her general practitioner (GP) six times and visited two hospitals with ongoing pelvic, back and low abdominal pain. Various tests were undertaken to rule out appendicitis, ovarian cysts and pneumonia. The Patient was suspected of having endometriosis (a condition where tissue similar to the lining of the womb starts to grow in other places, such as the ovaries and fallopian tubes) and an outpatient ultrasound scan was arranged to help with the diagnosis.

2.1.2 At the beginning of February 2019, the Patient went to her GP with increasing pelvic pain. She was also suffering from low back pain with radiation of the pain down her leg and into her calf. The GP described the Patient as "crying in pain". The GP noted, in the Patient's medical record, that a recent hospital admission indicated the pain was likely to be a result of endometriosis with possible neural (nerve) involvement. In the GP notes, the Patient's abdomen was described as tender. This suggested the pain was from the abdomen.

2.1.3 The following day, the Patient visited the emergency department (ED) of her local hospital. ED records show that the Patient was experiencing abdominal pain, pelvic pain and right-sided back pain. The pain was documented in the medical notes as radiating to her back, groin and down her legs. The Patient did not report any bowel or bladder symptoms. She was seen by a gynaecology doctor and admitted to the gynaecology ward. The Patient's medical records show that her pain settled with intravenous morphine, and the following day she was discharged with a diagnosis of probable endometriosis. The documented plan was for further diagnostic tests and she was advised on managing her pain. Her medical notes indicate she was prescribed a variety of medicines to help with her pain: paracetamol, amitriptyline for nerve-related buttock and leg pain, hyoscine butylbromide (Buscopan) for spasms, naproxen and oral morphine.

2.1.4 The medical records show that 2 weeks later, the Patient telephoned NHS 111 complaining of further low back pain and shooting pains down her legs. She was given an appointment with an out-of-hours GP at a local hospital.

The GP assessed her and, while a diagnosis was not recorded in the notes, the Patient told the investigation that the GP diagnosed a slipped disc and advised her to follow up with her own GP.

2.2 Onset of potential 'red flag' symptoms

2.2.1 The following day the Patient visited her own GP. The clinical notes record the Patient as experiencing low back pain radiating into her right thigh, with numbness and pins and needles in her left thigh ('bilateral symptoms'; that is, pain on both sides of the body). The GP documented that the Patient was not experiencing saddle paraesthesia (abnormal sensation in the buttocks, inner thighs and perineum) and had not lost control of her bowel or bladder function. The GP noted that the Patient was awaiting a laparoscopy (keyhole surgery) for endometriosis. The GP performed a straight leg raise test, in which the Patient was asked to lie on her back and lift each leg individually. She was able to straighten her leg to 10 degrees; pain at this angle could be suggestive of nerve root irritation or possible entrapment (Camino Willhuber and PiuZZi, 2021). The plan was for further blood tests, to continue with the medicines prescribed by the out-of-hours GP and to refer the Patient for physiotherapy. The Patient told the investigation that the GP talked to her about red flag symptoms and told her to go straight to hospital if any occurred.

2.2.2 Upon leaving the GP surgery the Patient thought she had an episode of incontinence. She told the investigation:

“We walked out of the doctor’s and I looked at my Husband and he looked at me, and he said, ‘I’m taking you to A&E,’ and actually with that I said ... ‘I think my knickers are a bit wet,’ which my pelvic floor never had any problems.”

2.2.3 The Patient went straight to a local ED in line with the red flag advice from her GP. At the ED she was triaged by an advanced nurse practitioner, who gave the Patient a full neurological examination following local back pain guidance. The nurse recorded ongoing back pain that had worsened over the last week. It was also recorded that the Patient was now experiencing numb legs, spasms, right-sided pelvic and back pain, and altered sensation in her right leg, and had a hard and tense right calf. She was noted to have no urinary or faecal incontinence (despite the reason for presentation being an episode of incontinence). A history of back pain and endometriosis (the Patient had not yet undergone any tests to confirm this) was recorded.

2.2.4 The Patient was assessed by an ED consultant, who agreed with the diagnosis of a spinal disc protrusion and the neurological examination undertaken by the triage nurse. The Patient told the investigation that the consultant undertook a rectal examination; this is not documented in the clinical notes. The consultant noted that the Patient said that passing urine “feels odd”. His documented plan was for the Patient to have an MRI scan of her back as an outpatient within 1 week. The patient told the investigation that the consultant tried to get her an MRI scan that day, but was told there was no availability. She was therefore booked in for a scan 4 days later. She was again informed about red flags and discharged home.

2.3 Diagnosis of CES

2.3.1 The Patient attended her planned outpatient MRI appointment on a Friday afternoon. The scan was completed at 15:15 hours, after which the Patient went to the ED to await the results. The Patient told the investigation that, while in the ED, she received a telephone call from a consultant with the MRI results. The consultant asked her to remain at the hospital as they were querying whether she needed to be referred to a specialist spinal centre. The MRI was considered to show L5/S1 spinal nerve compression (see previous figure 3 for an example MRI).

2.3.2 The Patient was triaged in the ED at 17:00 hours and seen by a doctor at 17:45 hours. The ED doctor diagnosed S1 nerve root compression and referred the Patient to the orthopaedic team. The orthopaedic registrar was in the operating

theatre at the time and asked the ED to start the referral process to the regional specialist spinal centre. A subsequent assessment titled 'neurology' records the clinical impression as 'S1 nerve root compression, not currently cauda equina.'

2.3.3 At 19:12 hours an orthopaedic doctor referred the Patient, using an electronic referral system, to the neurosurgery department at the regional specialist spinal centre. The hospital policy is that referrals should be accompanied by a telephone call to the neurosurgery registrar at the specialist centre. There is no record of a call taking place.

2.3.4 At 22:00 hours, the referral was picked up when a neurosurgery registrar at the specialist unit logged on to the electronic referral system. At 22:55 hours the registrar sent the on-call consultant a copy of the MRI images to review. The consultant telephoned the registrar 2 minutes later to discuss the case, and asked for them to arrange for the Patient to be transferred to the specialist centre as an emergency. The consultant's view of the MRI scan was that it showed an acute central disc prolapse (protrusion of the disc into the spinal canal) with almost 75% occlusion (blockage) of the spinal canal and a significant degree of cauda equina compression.

2.4 Transfer and treatment

2.4.1 At this time the Patient was on an orthopaedic ward of her local hospital, where she had a tube inserted into her bladder at 23:40 hours due to difficulty passing urine. She was found to have 1 litre of urine in her bladder. This is an abnormally full bladder and was likely caused by urinary retention, possibly from spinal nerve compression. The Patient was taken by emergency ambulance to the specialist centre, arriving at 03:45 hours (Saturday).

2.4.2 At the specialist centre, the consultant surgeon reviewed the Patient at 09:00 hours and explained the diagnosis of CES and the need for emergency surgery. It was not possible to start the surgery immediately as another surgical case needed to be prioritised.

2.4.3 At 12:10 hours on Saturday the surgery was further delayed because X-ray facilities, which were needed for the operation, were unavailable in the operating theatre. The consultant surgeon told the investigation that the radiographer was covering three operating theatres and there was only one other radiographer in the hospital that day. Records suggest there were three radiographers covering adult operating theatres that day and one covering paediatric operating theatres, which is the full staffing complement.

2.4.4 A radiographer became available around 14:00 hours and surgery commenced at 14:10 hours. The surgery took place more than 12 hours after the neurosurgery consultant's diagnosis of 75% occlusion of the spinal canal. The Patient returned to a neurosurgical ward following surgery and was transferred to her local hospital 5 days later. She subsequently received intensive rehabilitation at a specialist rehabilitation centre.

2.4.5 The Patient's case was raised as a serious incident by both the local hospital where the Patient had the MRI scan and the regional specialist spinal centre where the Patient underwent surgery, and they subsequently undertook a joint investigation.

2.4.6 At the time of writing this report, the Patient had ongoing back pain and neurological symptoms (primarily urinary issues).

2.4.7 The Patient told the investigation that her experience has had an impact on her mental health, as well as her physical health. She said that while in her local hospital, receiving step-down care following her surgery, she had real difficulties in coping with the magnitude of the life-changing condition for which she had undergone emergency surgery. She told the investigation that she was finding it difficult to access support for her mental health, and had asked to be referred for support on a number of occasions.

3 Involvement of the Healthcare Safety Investigation Branch

This section outlines how HSIB identified the patient safety risk relating to delays in the diagnosis and treatment of cauda equina syndrome (CES). It shows how the issue meets the criteria HSIB uses to decide whether to go ahead with a national investigation, and the methods and evidence used in the investigation process

3.1 Notification of the reference event

3.1.1 HSIB first identified a potential safety risk associated with the diagnosis and management of CES in June 2018. This followed a search for incidents using the Strategic Executive Information System. At the time, it was agreed to monitor the safety risk as a potential future investigation.

3.1.2 In August 2019 the BBC ran a story: ‘The little-known spinal injury “costing the NHS millions”’ (Coleman, 2019). This highlighted the ongoing safety issues associated with delays to CES diagnosis. As a result, the Strategic Executive Information System was again searched for incidents involving the event description key words ‘cauda equina’ occurring between 1 April 2017 and 23 July 2019. This returned 27 records involving missed diagnoses, delayed diagnoses and incorrect MRI reporting. The incidents included the reference event described in this investigation.

3.2 Decision to conduct a national investigation

3.2.1 Following a preliminary investigation, HSIB’s Chief Investigator authorised a national investigation based on the HSIB patient safety risk criteria.

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

- CES can result in significant physical impairment, including paralysis, nerve damage to the bladder and/or bowel and sexual dysfunction. These physical impairments can cause significant psychological harm and have an impact on a person’s domestic, social and work life.
- CES is associated with high rates of litigation as a result of long-term physical and psychological harm to patients. Overall, 23% of litigation claims for spinal surgery in England between 2013/15 and 2015/16 related to CES (Hutton, 2019). In addition, patients with inadequately managed CES require long-term care, with resulting costs to the health and social care systems. The cost of CES-related litigation claims for 2014/15 to 2015/16 was £68 million (Hutton, 2019). More than half (57%) of patients involved in litigation relating to CES had symptoms of incomplete or complete CES at first presentation. A further 39% had bilateral radiculopathy (symptoms in both legs) which is a ‘red flag’ for CES.

Many cases of suspected CES are not confirmed on subsequent imaging. However, due to the national guidelines requiring timely imaging, individuals with suspected CES must be transferred to a centre with available MRI. This can impact on services already at capacity (for example, ambulance and imaging).

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

- CES is rare, but a major source of harm. This is compounded by the difficulty of making a diagnosis of CES, as there is poor correlation between clinical signs and symptoms and subsequent MRI findings.
- There are systemic risks associated with accessing effective care pathways for the rapid assessment, diagnosis, communication/referral, transfer, imaging, follow up and access to operative management for patients with suspected or confirmed CES.
- Litigation claims for 2014/15 to 2015/16 related to: delay or failure of diagnosis (58 claims); delay or failure in treatment (22 claims); failures in obtaining an MRI (17 claims); issues with referral or transfer (10 claims); standards of surgical procedures to treat CES (8 claims) (Hutton, 2019).

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

- The investigation was an opportunity to explore the challenges to diagnosing CES, beyond signs and symptoms. These include factors that both inhibit and support prompt diagnosis, irrespective of where the patient first presents.
- Referral networks for the diagnosis and management of CES span multiple care boundaries and regions. HSIB is well placed to explore these transitions of care and the factors that may contribute to delays.

3.3 Scope of investigation

3.3.1 After the preliminary investigation, it was agreed that the national investigation would:

- assess the resilience, consistency and reliability of the pathway(s) for patients experiencing potential 'red flags' for CES
- seek to understand the context and contributory factors influencing the pathway for patients with CES from first presentation
- review the national context surrounding the timely detection and treatment of spinal nerve compression (CES) in patients with back pain
- develop safety recommendations, as appropriate.

3.4 Methods

Investigative approach

3.4.1 The investigation was conducted between October 2019 and March 2021 (paused between March and September 2020 due to COVID-19).

3.4.2 HSIB uses a standard process in all its investigations:

- Gather all relevant evidence.
- Establish the factual circumstances leading up to the reference event.
- Analyse the evidence.
- Identify which safety factors are contributory to the reference event.
- Identify which safety issues are likely to contribute to future, similar events, nationally. These inform the wider investigation (see section 5).
- Develop safety recommendations and safety observations to reduce identified safety risks.

Investigation team

3.4.3 The HSIB investigation team consisted of staff with a knowledge of healthcare systems. The team members had experience and skills in:

- healthcare investigation methods
- human factors/safety science
- emergency care and rheumatology medicine
- physiotherapy
- healthcare law.

3.4.4 The team was supported by subject matter advisors, comprising:

- a consultant spinal surgeon
- a consultant in emergency medicine
- An advanced physiotherapy practitioner for spinal services and the Emergency Department (ED).

All were familiar with the management of possible CES and national standards of care (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018). Evidence gathering for the reference event.

3.4.5 The investigation into the reference event was informed by:

- review of the Patient's clinical records across the different care settings
- review of relevant local and national guidance, policies and procedures
- review of published academic literature relevant to the safety risk
- visits to and observation at the local and specialist hospitals where the Patient received care.

3.4.6 In addition, formal interviews using a semi-structured approach were undertaken with:

- the Patient
- the Patient's GP and the out-of-hours GP who she saw
- clinical staff in the ED of the Patient's local hospital
- clinical and managerial staff in spinal and neurosurgery at the regional specialist spinal centre
- allied clinical staff, such as those working in radiology, risk and governance at both the local hospital and the regional specialist spinal centre
- the manufacturer of the electronic referral system.

3.4.7 The investigation faced some limitations in accessing information. For example, local incident data was requested, specific to delayed MRI scans or delayed diagnosis of CES. However, the current coding of incident reports did not allow easy extraction of this data.

Analysis of the reference event

3.4.8 Multiple methods of analysis were used to triangulate different data sources and verify findings using more than one source.

The analysis aimed to understand:

- how the management of potential CES is currently prescribed or imagined to be completed
- how the system constrained or supported staff to deliver the work required in the context of the reference event.

3.4.9 These aims were achieved by creating interview and observation schedules using the Systems Engineering Initiative for Patient Safety (SEIPS; see section 3.4.12).

Interview data and observation notes were transcribed and thematically coded, based on the SEIPS framework. The investigation established consensus and used a consistent approach to coding and interpreting data sources.

3.4.10 Using the collected data, the investigation developed visualisations of the systems involved in the Patient's pathway and a timeline of the events. This helped the investigation to identify communications, interactions, timings and decisions that influenced the Patient's experience.

3.4.11 The findings were considered in the context of local and national guidance and practices either reported or detailed in the research literature. This approach, in discussion with the subject matter advisors, enabled the investigation to describe, in detail, how the current systems and pathways influenced this reference event.

SEIPS

3.4.12 SEIPS was first described by Carayon et al (2006) as a framework for understanding the structures, processes and outcomes in healthcare and the relationships between them (see figure 5) (Holden et al, 2013; Carayon et al, 2006). It is a systems engineering approach with human factors principles embedded within it.

3.4.13 SEIPS describes how work systems (that is, the external environment, organisation, internal environment, tools and technology, tasks and people) contribute to work processes (including physical, cognitive and social/ behavioural aspects) and lead to outcomes

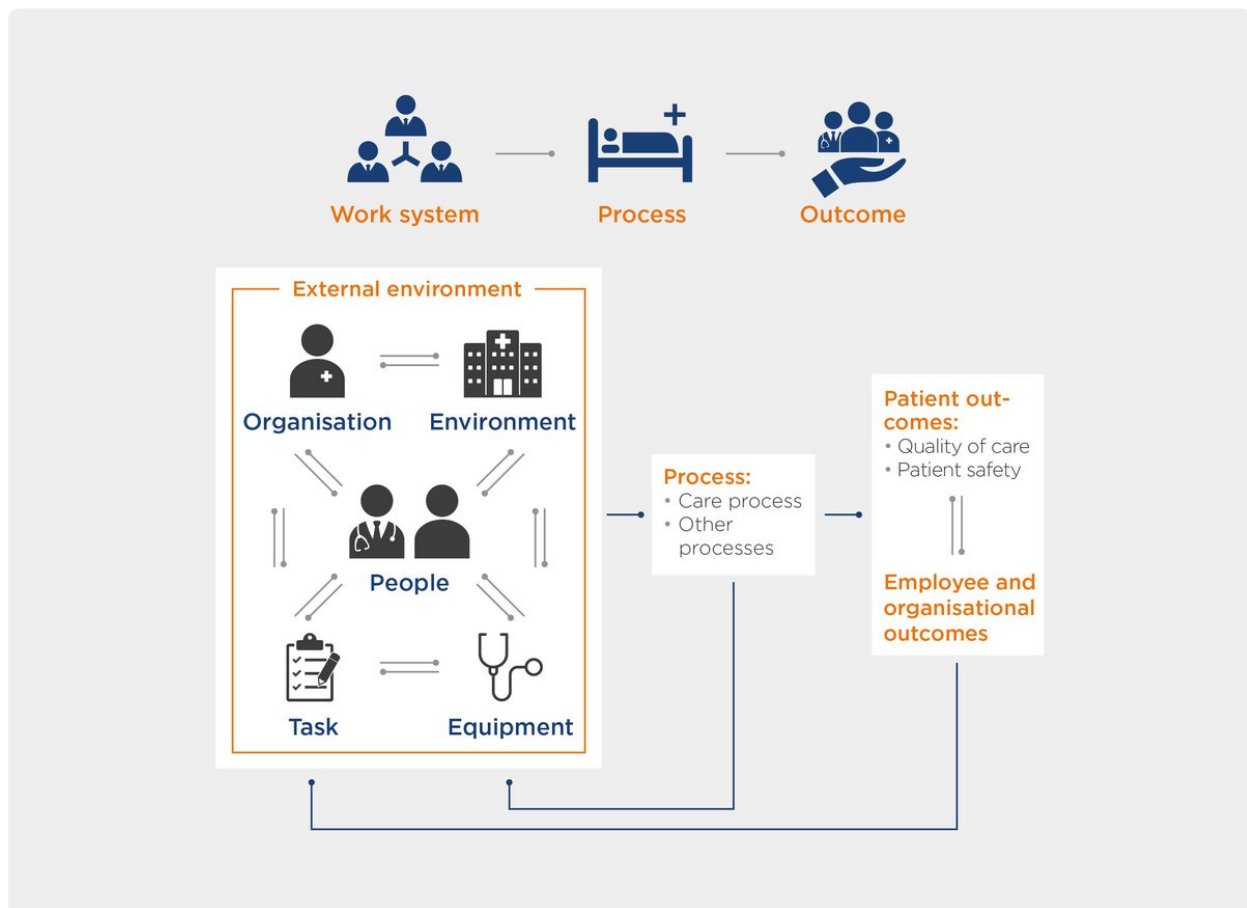


Figure 5 The Systems Engineering Initiative for Patient Safety framework (SEIPS) adapted from Holden et al (2013)

National investigation

3.4.14 Following investigation of the reference event, the HSIB investigation and executive teams discussed the potential for national learning. The investigation team identified and explored various sources of evidence to collect further data and understand the reference event in the national context. This involved:

- reviewing peer-reviewed papers
- engaging with multiple stakeholders
- engaging with service providers
- joining CES-related webinars

3.5 Verification of findings

3.5.1 The findings were shared with the healthcare organisations involved in the reference event. This allowed the investigation's interpretation of the findings to be checked for factual accuracy and sense. The findings and draft safety

recommendations of the investigation were presented to the stakeholder groups, who contributed to the verification and design of the final safety recommendations. Data verification and understanding were tested throughout the investigation process.

3.5.2 Further verification and sense checking were achieved by consulting with influential national organisations and stakeholders, including, professional bodies (see table 1).

Table 1 National stakeholders that engaged with the investigation

National bodies and organisations	Individual experts and advisors
<p>National Institute for Health and Care Excellence</p> <p>NHS England (spinal and radiology services)</p> <p>NHS Resolution</p> <p>GIRFT for Spinal Surgery</p> <p>GIRFT for Emergency Medicine</p> <p>Society of Radiographers</p> <p>Royal College of Radiologists</p> <p>Health and Care Professions Council</p> <p>British Orthopaedic Association’s Trauma Committee</p> <p>British Association of Spine Surgeons</p> <p>Royal College of Emergency Medicine</p>	<p>Consultant spine surgeon</p> <p>Consultant in emergency medicine</p> <p>Advanced physiotherapy practitioner for spinal services and the ED</p> <p>Network manager for a spinal network</p>

4 Findings and analysis of the reference event

The reference event allowed the investigation to explore factors that contributed to delays in diagnosing and managing cauda equina syndrome (CES). This section describes the findings of the reference event analysis, focusing on key points in the Patient’s pathway. Figure 6 provides a high-level description of a pathway for a patient presenting with back and/or sciatic pain that may lead to a diagnosis of CES.

4.1 Diagnosis

The effectiveness of the diagnostic pathway

4.1.1 The investigation found that the Patient’s diagnosis of low back pain secondary to CES may have been protracted. This was influenced by the fact that clinicians involved with her care up until the end of February 2019 considered her symptoms to have a gynaecological origin. When the Patient began complaining of low back pain radiating down her leg and into her calf at the start of February 2019, the general practitioner (GP) documented that a recent hospital admission had advised that it was likely endometriosis with possible neural involvement. The investigation was unable to identify why clinicians considered endometriosis as the cause of the pain.

4.1.2 The Patient first received a full neurological examination at the end of February 2019, when she was triaged in the emergency department (ED) by an advanced nurse practitioner following local back pain guidance. On all previous occasions she had been triaged using local abdominal pain guidance and therefore did not receive a neurological examination. This was confirmed by the Patient’s records and interviewee testimony. The allocation to specific ED pathways previously focused the diagnosis on an abdominal cause, and removed consideration of alternative causes and the need to examine other body systems.

4.1.3 In the geographical area of the reference event, patients with back pain can be referred into a local musculoskeletal service, which has an acute back pain service to assess and treat episodes of back and leg pain. This did not happen in the reference event, again because clinicians considered the Patient’s pain to have either a gynaecological or abdominal origin. The investigation noted that when the Patient’s pain was instead thought to be related to her back, she was still not referred to the musculoskeletal service; the investigation was unable to establish why this was the case.



Figure 6 High-level description of a pathway for a patient presenting with suspected CES

4.1.4 As the Patient's back pain progressed, she reported that passing urine "feels odd". Urinary symptoms associated with low back pain can be 'red flags' for CES. The sensation did not appear to be further explored by clinicians to establish whether it represented a red flag for a serious condition. At that time, red flags regarding urinary issues, as defined in the National Institute for Health Care Excellence (NICE) commissioned Clinical Knowledge Summary (2017) (which provide summaries of the current evidence base and practical guidance on best practice), focused on urinary incontinence. Therefore, the Patient's description was unlikely to have been seen as a red flag.

4.1.5 Since the reference event, the Clinical Knowledge Summary (2020) has been updated with further clarification of the red flags for CES and now refers to difficulty initiating micturition or impaired sensation of urinary flow and urinary retention with overflow urinary incontinence. A framework for the early recognition of CES from the National Backpain Pathway – Clinical Network (a member of the United Kingdom Spine Societies Board) also clearly lists 'Difficulty initiating micturition or impaired sensation of urinary flow' as a symptom that can help to identify CES (National Backpain Pathway – Clinical Network, 2020). The Patient's symptoms were aligned with these general descriptions of urinary symptoms.

Accessing a timely MRI scan

4.1.6 In comparison with national standards of care (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018) for patients presenting with symptoms/signs as seen in the reference event, there was a delay in obtaining an MRI for the Patient. MRI is the imaging tool of choice for diagnosing CES. The investigation found that the Patient waited 4 days for an MRI despite having a red flag symptom (urinary incontinence) that was potentially indicative of CES. The Patient told the investigation that the consultant tried to arrange an MRI on the day she visited the ED, but that the earliest scan available was 4 days later. The medical notes recorded that the scan would take place within 1 week.

4.1.7 The investigation asked the ED consultant whether he thought, at the time, that the Patient needed a scan that day. He responded: "Probably not, because generally speaking one of the difficulties with this hospital is we don't have a 24/7 MRI scan service and it's quite difficult to get scans outside working hours, MRI scans, unless there's really, a sort of really definite case ... It has been an ongoing point of discussion here because if we thought someone really had cauda equina we would at that stage probably refer them to [the specialist centre]."

4.1.8 During this investigation of the reference event, there was a lack of consensus among clinicians nationally about the criteria for an emergency MRI scan. Clinicians at the hospital where the reference event took place told the investigation that there was no local policy and that individual clinicians therefore have varying thresholds for referral. The investigation was also told that the seniority and experience of the person requesting the MRI may influence the likelihood of a patient being allocated a timely MRI slot. Interviewees agreed that while the need for a scan should be driven by presenting symptoms, issues such as limited out-of-hours access does impact on decision making when suspecting CES.

4.1.9 In order to diagnose CES, a clinician needs to consider a patient's clinical presentation in conjunction with MRI findings. Standards of care from the Society of British Neurological Surgeons and the British Association of Spine Surgeons (SBNS/ BASS) state:

'A patient presenting with back pain and/or sciatic pain with any disturbance of their bladder or bowel function and/or saddle or genital sensory disturbance or bilateral leg pain should be suspected of having a threatened or actual CES...The reliability of clinical diagnosis of threatened or actual CES is low and there should be a low threshold for investigation with an emergency MRI scan at the request of the examining clinician and MRI must be available at the referring hospital 24/7.'

(Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018)

4.1.10 Those interviewed as part of the investigation had varying views about the time criticality of pathways for the diagnosis of CES and how quickly an MRI should be obtained; the meaning of 'urgent' and 'emergency' was not clear to staff. National standards of care and guidance standards (Clinical Knowledge Summary, 2020; National Institute for Health and Care Excellence, 2020; Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018) do not specify diagnostic time frames or from when the times should be measured. A subject matter advisor told the investigation that it is difficult to specify when the "clock should start" with suspected CES cases. The investigation heard that the clock should start when CES is suspected, but there were different views on whether this should be the suspicion of a generalist or specialist.

4.1.11 In December 2018, the SBNS/BASS stated that because of the urgency and difficulty in diagnosing CES, there should be a low threshold for an MRI for patients suspected of having the condition and that MRI scanning must be available 24/7 at

the patient's referring hospital (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018). However, despite agreeing with the need for immediate MRI following review by a senior clinician, the Royal College of Radiologists (2019) acknowledged that most local general hospitals do not have the staff required for a 24/7 MRI scanning service. Instead, the College suggested that emergency networks should be formed so that patients with suspected CES can be readily transferred to a neighbouring hospital that does have capacity to deliver a 24/7 MRI service.

4.1.12 The investigation found that the threshold for an MRI scan can be difficult for patients to meet, especially when patients with incomplete CES present with vague symptoms. At the time of the incident, the NICE commissioned Clinical Knowledge Summary for suspected spinal cord compression set a high threshold for urgent investigation (Clinical Knowledge Summary, 2017), which often meant that patients' symptoms did not meet the criteria for an urgent MRI scan, or that by the time their symptoms did meet the criteria, the neurological damage may have been irreversible. The Clinical Knowledge Summary has since been updated (2020).

4.1.13 In the reference event, the investigation was unable to clearly identify what follow-up arrangements were made for communicating the results of the MRI to the Patient, given that the MRI was requested by an ED consultant. The investigation heard about the importance of locally defining clear and timely follow-up arrangements to ensure no delay in acting on scan results.

4.1.14 A clinician at the hospital where the reference event took place told the investigation that the radiographer had asked the Patient to go to the ED to wait for her results. The Patient told the investigation that the ED consultant had telephoned her while she was waiting in the ED because he had reviewed her results and was concerned. The Patient told the investigation:

"I had been speaking to [her GP] ... and I said, 'I have been offered an MRI scan.' And he said, 'Good, don't leave that hospital until you've got your results, because they can take a few weeks to come back.' ... The radiographer said to me, 'Oh, what do you want us to do with your results?' ... I said, 'I want them sent to ED because I'm going to go there now, to the consultant who sent me for this MRI, and wait for my results.'"

4.2 Management

Referral from the local to specialist centre

4.2.1 The investigation found the referral process from the local hospital to the regional specialist spinal centre had multiple steps and therefore several opportunities for error. The investigation also found that there was a delay in the specialist centre picking up the referral for the Patient's suspected CES.

4.2.2 Staff at the hospital where the reference event took place use a specific electronic referral system to refer patients with suspected CES to the regional specialist spinal centre. At the time of the reference event, the process was that the local hospital completed an electronic referral and then telephoned the on-call registrar at the specialist centre to alert them to the new referral. The on-call registrar at the specialist centre would then log on to the electronic referral system to review the referral and the MRI images, and decide whether to transfer the patient for surgery or undertake further tests. Staff at the specialist centre said they would always expect an urgent referral to be accompanied by a telephone call.

4.2.3 In the reference event, the investigation did not find evidence that a telephone call had accompanied the electronic referral. Therefore, the specialist centre registrar only became aware of the referral when they happened to log in to the electronic referral system 3 hours after the referral had been made. The referring hospital was unable to explain why a telephone call had not been made, but told the investigation that they had previously experienced telephone connectivity issues with the specialist centre.

4.2.4 As part of the investigation into the reference event, the investigation team spoke with one of the developers of the electronic referral system. They said that the system at the specialist hospital is able to send an alert to the on-call registrar's telephone when an electronic referral is made. The investigation found that this feature was not functioning at the time of the investigation. According to the developer, this may have been because no telephone had been registered with the system; alerts had not been activated; or the signal was poor.

4.2.5 Overall, the investigation found that the referral process relied on several actions occurring to ensure a referral was rapidly acted on. The process relied on staff remembering to undertake an action (the telephone call) while also undertaking other work within the ED, thereby increasing the risk of error.

4.2.6 The investigation also heard about usability issues with the electronic referral system from the referring hospital's perspective. The software developers were not aware of these issues. There was a gap between how the developers believed their software was being used and how users told the investigation they use it in practice.

4.2.7 The investigation into the reference event identified a safety risk associated with the lack of an alert sent to neurosurgical doctors at the specialist hospital when a referral was received by the electronic referral system. This was shared with the specialist hospital and the manufacturer of the electronic referral system for action. As a result, HSIB noted the following safety action.

HSIB notes the following safety actions

Safety action A/2021/046:

The regional specialist spinal centre described in this report has worked with the electronic referral system manufacturer to ensure alerts are received by neurosurgical doctors. This has included doctors having a single 'baton' telephone that receives the alert, with the telephone being passed to the next doctor at shift handover.

Timely access to the operating theatre

4.2.8 The investigation heard that the on-call consultant at the specialist centre recognised the need for an emergency transfer for the Patient, and she was transferred by emergency ambulance. The Patient arrived at the specialist centre at 03:45 hours, then waited for more than 10 hours for emergency surgery. The centre's policy is not to undertake operations for conditions that are not life threatening overnight, based on recognition that the performance of surgeons at night can be suboptimal and the risks of operating can outweigh those of waiting until the morning (Royal College of Surgeons of England, 2007; National Confidential Enquiry into Patient Outcome and Death, 2003).

4.2.9 The plan was for the Patient to undergo surgery as the first case of the day at 09:00 hours. However, an emergency operation on a child was prioritised in the morning. There was limited available operating theatre space because it was a Saturday.

4.2.10 Once the paediatric procedure had finished and the surgeon was able to access the operating theatre to start the operation, there was no radiographer available for imaging in the operating theatre. This caused a further 2-hour delay to the Patient's surgery. A timeline is shown in figure 7.

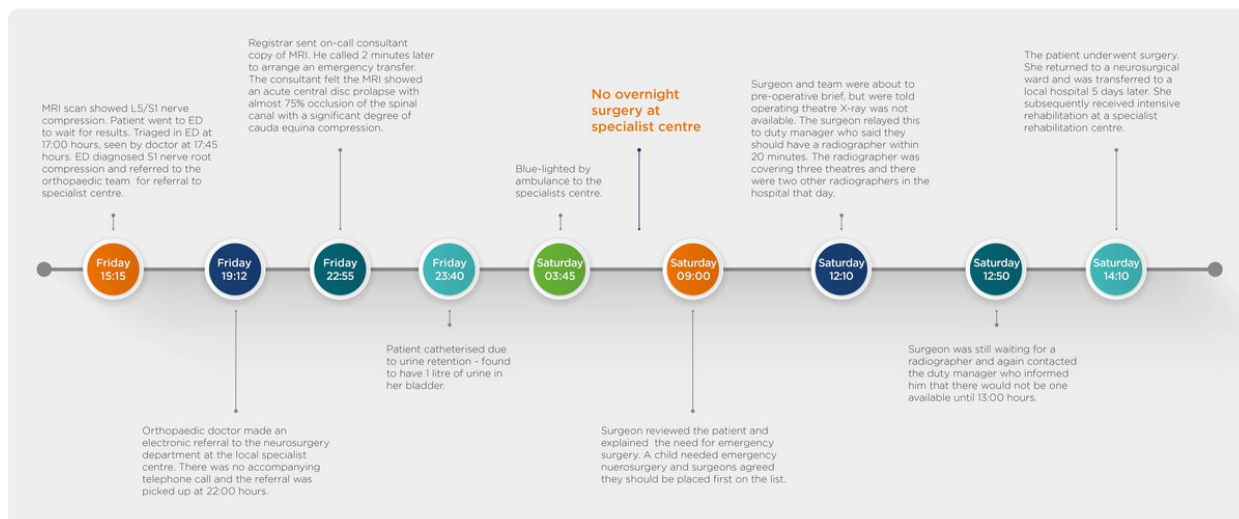


Figure 7 Timeline of the events affecting the Patient from MRI to surgery

4.2.11 The investigation acknowledges the need to manage surgical risk appropriately and that there are recognised hazards when operating out of hours. However, the observed requirement for rapid MRI and transfer potentially places other health services, in this case emergency ambulances, under increased pressure if a patient is then not going to have surgery until a later time.

4.2.12 The SBNS/BASS standards of care state:

‘Nothing is to be gained by delaying surgery and potentially much to be lost. Decompressive surgery should be undertaken at the earliest opportunity, taking into consideration the duration of pre-existing symptoms and the potential for increased morbidity whilst operating in the small hours.’

(Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018)

The investigation notes the use of the phrase ‘earliest opportunity’; this is vague and open to interpretation.

Relationships and culture

4.2.13 The investigation was told that local hospitals cannot use their MRI scanners out of hours as they do not have enough suitably trained staff to provide such a service. The investigation heard that the inability of the local hospital to access MRI 24/7 was a cause of tension between that hospital and the specialist centre. It was described that local hospitals want to transfer patients to the specialist centre for

an MRI when they cannot access one in their own hospital, whereas the specialist centre would prefer patients to have received a scan before being transported. This is explored further in section 5.

4.2.14 The investigation heard about longstanding cultural differences between the different specialties delivering spinal care at the specialist centre, which make collaborative working challenging. Historical differences were described in areas including on-call rotas and views on how emergency spinal services are delivered between the neurosurgical on-call service and the orthopaedic/spinal on-call service. Clinicians within the specialist centre told the investigation that this tension is not unique to their particular centre (for example, Thomas, 2021). The specialist centre has taken significant steps to improve the situation and create a more unified department.

5 Findings and analysis from the wider investigation

This section describes the findings of the national investigation and is mapped to figure 6 in section 4.

The national investigation considered the following areas associated with cauda equina syndrome (CES):

- diagnostic challenges
- access to and timing of MRI
- supporting the diagnosis of CES
- national guidance
- diagnostic pathways and the role of spinal networks
- safety netting and communication with patients.

This investigation focuses on the diagnosis and management of CES. In the reference event, the Patient attended an emergency department (ED). This is representative of where patients with symptoms of CES often present, either directly or following referral from primary care. Section 5 focuses on the contributory systemic factors influencing assessment and treatment decisions across the spectrum of healthcare. While this section predominantly focuses on ED presentation, the investigation considers that the findings and safety recommendations are applicable across health settings

5.1 Diagnostic challenges

Non-specific back pain or CES?

5.1.1 The framework for the early recognition of CES from the National Backpain Pathway – Clinical Network (2020) states: ‘All patients with acute or deteriorating back (with or without radicular) pain should be assessed for CES.’ In addition, national standards of care are clear that:

‘A patient presenting with back pain and/or sciatic pain with any disturbance of their bladder or bowel function and/or saddle or genital sensory disturbance or bilateral leg pain should be suspected of having a threatened or actual CES.’ (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018).

The investigation was told that, while the standards of care are clear, their application in practice is challenging. CES may be missed for various reasons, such as the following points that were described to the investigation and found in the academic literature:

- CES is rare (Hoeritzauer et al, 2020). Some clinicians may never see a case in their professional life, depending on their specialty.
- Presentation of CES is sometimes not as clear as described in standards or textbooks. There is no set clinical pattern (National Backpain Pathway – Clinical Network, 2020), and patients often find it difficult to describe their symptoms and identify the time of onset.
- Symptoms of CES are often seen in other spinal and non-spinal conditions. For example, bowel and bladder symptoms are common in patients with spine conditions but without CES (Lieberman et al, 2018).
- Even patients who present with the classic symptoms of CES may turn out not to have CES (Hoeritzauer et al, 2020; Balasubramanian et al, 2010).
- GPs have limited time to undertake a comprehensive assessment (10-minute consultations).
- It can be difficult to access spinal or neurosurgical advice.
- There is a lack of standardised diagnostic criteria and management pathways (Comer et al, 2020).

5.1.2 Suspecting CES relies on effective history taking and clinical examination. Patients presenting with low back pain and sciatica should have a comprehensive assessment to exclude specific causes of low back pain such as cancer, infection or inflammation, and to identify complications such as CES (National Institute for Health and Care Excellence, 2020).

'Red flags' for CES

5.1.3 The National Institute for Health and Care Excellence (NICE) provides guidance on low back pain and sciatica, but the guidance does not consider the evaluation of CES (National Institute for Health and Care Excellence, 2020). The Clinical Knowledge Summary commissioned by NICE does provide a summary on CES red flags in sciatica (Clinical Knowledge Summary, 2020). Red flags are those symptoms and signs of serious conditions that may overlap with sciatica and be misdiagnosed as something less serious. If red flags are identified, admission or urgent referral for specialist assessment is recommended.

5.1.4 Red flags for CES appear to be more specific than sensitive (that is, they are more able to exclude patients without CES than to correctly identify patients with CES), so when present should be considered justification for urgent management (Dionne et al, 2019). Red flags are potentially useful to support a suspicion of serious spinal pathology, but a historical lack of consistency and clarity of the red flags has potentially resulted in the over-investigation of patients without serious pathology and, conversely, false reassurance in those with underlying serious pathology (Finucane et al, 2020).

5.1.5 The diagnostic accuracy of red flags has been challenged in the research literature. Cook et al (2018) gave several reasons why red flag screening does not work: red flags neither rule out nor identify serious pathology; variability in definitions limits research and clinical progress; and clinicians do not routinely screen for red flags (rather, they manage the low back pain condition they see). The role of red flags in guidelines has also been challenged, with guidelines often endorsing different red flags without reporting on their diagnostic accuracy (Cook et al, 2018), and not providing clarity on the lead times for intervention or how to weigh up the various signs and symptoms (Barracough, 2021).

5.1.6 Urinary incontinence or retention are commonly quoted as red flags for CES, but the investigation heard that where these are present, irreversible neurological damage has likely already occurred. While red flags may be useful, Barracough (2021) has noted that:

'Ideally, prescriptive advice would describe early features of CES, not late or irreversible features such as urinary and faecal incontinence.'

Todd (2017) found that 32% of red flags for CES actually indicate later, irreversible damage and could be instead termed 'white flags' (indicating 'surrender' as treatment will be too late).

Accuracy of symptoms and signs in CES

5.1.7 The investigation heard from healthcare staff that CES is often considered as a diagnosis, but that it is difficult to differentiate CES from less serious back pain. It is very difficult to identify CES on symptoms and signs alone (Balasubramanian et al, 2010; Domen et al, 2009). This is highlighted by studies showing that patients with symptoms consistent with CES rarely have this diagnosis confirmed on an MRI scan. For example, only around 20% of patients with clinical features of CES actually have evidence of the condition on MRI (Hoeritzauer et al, 2020; Balasubramanian et al, 2010). This low percentage is replicated in practice, with the investigation hearing that one spinal network identified CES in just 15% of MRIs undertaken on patients with clinical features of CES.

5.1.8 Certain symptoms may be more suggestive of CES, such as those related to rectal incontinence and urinary retention or where there are bilateral symptoms. However, some researchers have advocated for the use of MRI to identify or rule out CES in the absence of these symptoms (Domen et al, 2009; Bell et al, 2007). The fear of missing CES likely drives the request for an MRI on all patients presenting with lower back pain and bowel or bladder symptoms (Todd, 2017).

5.1.9 More recently, research has identified that a 'combination of physical examination findings of lower sacral function is an effective means of ruling out CES and, with further study, may eliminate the need for MRI in many patients reporting back pain and bowel or bladder dysfunction' (Zusman et al, 2020). However, the investigation heard that it is very challenging to rule out CES completely without an MRI, because no individual symptom is able to accurately predict significant disc prolapse.

5.2 Access to and timing of MRI

5.2.1 MRI is currently the investigation of choice for diagnosing CES. National standards of care state there should be a low threshold for MRI to be undertaken, and that MRI should be available at the referring hospital 24 hours a day, 7 days a week (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018).

Deciding whether an MRI is required

5.2.2 The investigation searched the Strategic Executive Information System for serious incidents related to CES during 2020 using a free-word search for 'cauda' in the description field (11 March 2021). After reviewing the results, eight incidents associated with delays to CES diagnosis were identified. While the Strategic Executive Information System does not include full investigation details, themes included: symptoms/signs not prompting consideration of CES in primary care, musculoskeletal physiotherapy, NHS 111 and EDs; delays to clinical review of symptoms; delays to organisation of MRIs; and delays to acting on MRI results.

5.2.3 The investigation was given examples of patients who had an MRI and were found not to have CES, and of patients where CES was dismissed, resulting in no MRI, and who were subsequently found to have CES and to have experienced neurological harm. The investigation heard of the need to identify CES at the incomplete stage, before irreversible damage is caused. This means having a low threshold for undertaking an MRI, knowing that many patients will not be diagnosed with CES. MRI is an expensive and limited resource, but is the only resource that can truly enable the diagnosis of CES to be made or ruled out. There is conflict between the ease of access to MRI and the non-specific symptoms and signs of CES that warrant an MRI. This is compounded by a lack of clarity around definitive selection criteria for MRI (Bell et al, 2007). Time frames for undertaking an MRI

5.2.4 If a patient's symptoms are suggestive of CES, an immediate emergency referral via local pathways is needed for further management as the prognosis is time dependent (National Backpain Pathway – Clinical Network, 2020). National standards of care state that 'MRI must be undertaken as an emergency' (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018) where CES is suspected. However, the investigation heard about and saw varying time frames being followed for patients with suspected CES. Terminology such as 'emergency scan' and 'urgent scan' are being used interchangeably with various meanings, depending on the location. The investigation found no set time frames defined for emergency and urgent scans in guidelines.

5.2.5 The investigation looked at three spinal networks in England and how they manage suspected CES. This included reviewing their criteria and time frames for requesting an MRI for a patient with suspected CES:

- Spinal network 1: emergency referral is needed for patients with acute onset or progressive symptoms (less than 72 hours) and the patient should have an MRI within 2 hours of presentation; urgent next-day scan (no later) is needed for patients with recent-onset non-progressive symptoms (onset more than 72 hours to less than 2 weeks); urgent 'within 48 hours' scan is needed for patients with chronic and non-progressive symptoms.
- Spinal network 2: patients with suspected CES should have an urgent MRI within 4 hours of admission.
- Spinal network 3: two pathways, depending on the geographical area of the hospital: 1) MRI must be completed and reported within 6 hours of first presentation where there is suspected CES and urinary retention or a post void volume of 200ml or more on bladder scan; 2) MRI must be completed and reported within 6 hours of presentation where there is suspected CES.

5.2.6 The investigation found different guidance for clinicians about which patients require emergency versus urgent MRI scans and the time frames within which they should be undertaken. This has also been recognised in the research literature (Bell et al, 2007). Some guidance splits patients by low or high suspicion of CES; however, this is in conflict with the national standards of care, which state that there should be a low threshold for investigation with an emergency MRI (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018). Time frames for MRI are further affected by the variability observed around when best to operate on a patient with CES.

5.2.7 The variation highlights the difficulties in knowing when patients with symptoms suggestive of CES should have an MRI, and balancing this with available resources. The investigation heard that available guidance on resolving the tension between the national standards of care and available resources is vague, resulting in varied local practices and processes. The evidence gathered by the investigation suggests that a decision-making tool could support practitioners in determining which patients require an emergency MRI. This may mean that the patient needs transferring to another hospital if it is out of hours and the assessing hospital does not have 24/7 access to MRI. Such a tool may also help practitioners to assess whether patients can safely remain at the assessing hospital until the first MRI slot the next morning (see later sections).

5.2.8 To support clinicians in practice, increased clarity is required on the symptoms and examination findings that should prompt immediate imaging for suspected CES. The Royal College of Emergency Medicine (2020), in a position statement on CES, has described its support 'for further research into the diagnosis of CES both to define those clinical features which most accurately predict CES and the need for MRI.'

HSIB makes the following safety recommendation

Safety recommendation R/2021/139:

HSIB recommends that the British Association of Spine Surgeons, supported by the Royal College of Surgeons of England and the Royal College of Emergency Medicine, develops a decision-making tool to support the identification of patients who need an immediate MRI for suspected cauda equina syndrome (which may result in the patient being transferred for MRI if this is not immediately available at the assessing site)

Availability of MRI

5.2.9 The UK has fewer MRI scanners per capita than other European countries (6.1 per million compared with an EU average of 15.4 per million) (Robertson, 2017). This situation has remained relatively unchanged for the last decade, despite an increased demand for MRI scans. In April 2012, there were 170,000 MRI scans undertaken a month; by March 2019, this had risen to 320,000 (Halliday et al, 2020).

5.2.10 Each hospital has an average of 2.8 MRI scanners (Halliday et al, 2020). More than 25 trusts have only one machine and some have none. The highest number per trust is nine and the median is two.

5.2.11 Staff in the local hospital where the Patient in the reference event had her MRI told the investigation that time could be saved if MRI scans showing significant findings were automatically uploaded to the imaging system ready for referral to the specialist centre, rather than the clinician having to call the radiologist and ask for them to be uploaded. Discussions with consultants at surgical centres found that, while they require an MRI scan to take place before transfer, they are willing to receive the MRI images and make a decision about management based on those images, rather than waiting for the MRI to be reviewed and interpreted by a radiologist.

5.2.12 The reference event investigation and wider national investigation found that the availability of MRI as a resource may influence decision making when requesting imaging and allocating MRI slots. Several hospital trusts in England do not have an MRI machine running 24/7 or do not have access to MRI out of hours, although the investigation was unable to identify specific numbers of trusts without 24/7 access. The investigation heard several reasons for this lack of resources:

- Nationally, there are not enough trained radiographers to operate MRI scanners.
- Trusts may not have sufficient radiography staff to operate the MRI scanner out of hours.
- MRI scanners may be owned by independent providers who use them for other patient lists out of hours.

5.2.13 The investigation findings echo those of the Getting it Right First Time (GIRFT) programme, which reported that:

‘... the principal reason for patients with suspected CES not receiving timely MRI scans is a lack of out of hours radiography support in referring units ... in many instances a radiographer may not be available to operate the scanner.’

(Hutton, 2019)

The Royal College of Emergency Medicine (2020) has also reported that most hospitals with an ED are currently unable to access MRIs in a timely fashion or 24/7.

5.2.14 The findings highlight that despite clear expectations from multiple sources for all hospitals where patients may present with CES to have 24/7 MRI (Royal College of Emergency Medicine, 2020; Hutton, 2019; Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018), this is not the case in practice. The investigation notes, however, that the availability of 24/7 MRI provides the infrastructure for rapid diagnosis of CES where it is suspected. HSIB therefore makes the following safety observation in the knowledge that its implementation across all hospitals may be challenging. The other recommendations and observations in this report are intended to mitigate the safety risk where 24/7 MRI is not available.

HSIB makes the following safety observation

Safety observation O/2021/122:

It may be beneficial for all hospitals where patients with potential cauda equina syndrome may present to have access to MRI scanning and reporting 24 hours a day, 7 days a week

Mitigating the risk of limited 24/7 MRI access

5.2.15 While trusts and spinal networks work to achieve 24/7 MRI access, the investigation looked at what other interventions might be immediately undertaken to mitigate risk. The investigation heard that some hospitals reserve the first MRI slot of each day for patients with suspected CES who have arrived overnight, but where an immediate MRI was not thought to be required. This enables the patient to remain at their local hospital for an MRI, and still be transferred to the specialist centre for surgery that morning if required. The need to move patients for MRI scanning should become the exception, not the norm.

5.2.16 In the reference event, the Patient underwent an emergency transfer by ambulance in the night but did not have surgery until the following afternoon. The investigation was told this was not an isolated event. The investigation also heard about difficulties with returning patients to the referring hospital if the scan was negative for CES because of transport availability.

5.2.17 Reserving the first MRI slot of the day for patients presenting with suspected CES can prevent unnecessary ambulance transfers in the middle of the night. Where the scan identifies CES, clear pathways can lead to timely transfer and intervention. The investigation was told that few other conditions would require the first MRI slot of the day, but these should be recognised and defined locally.

HSIB makes the following safety recommendation

Safety recommendation R/2021/140:

HSIB recommends that guidance is developed by the Royal College of Radiologists, supported by the Society and College of Radiographers, stating that all hospitals should reserve the first MRI slot of the day for patients with suspected cauda equina syndrome who do not meet the criteria for an 'emergency'/immediate scan overnight.

5.2.18 In the reference event, the Patient told the investigation that the assessing ED consultant had tried to organise a same-day MRI. Following consultation with the radiology department, it was established (although not documented) that this was not possible. The Patient therefore waited 4 days for an outpatient MRI scan.

5.2.19 The investigation found varying definitions of 'urgent' and 'emergency' across trusts and spinal networks, resulting in confusion around the appropriate time frames for MRI. This again influences shared decision making, which has been addressed, in part, through the above safety recommendation (R/2021/139) to develop a decision-making tool. That recommendation will be enhanced if:

1. there is clear guidance on the time frames for MRI and clarification of definitions such as 'urgent' and 'emergency'; and
2. spinal networks implement service changes to ensure the nationally defined time frames can be met.

HSIB makes the following safety recommendation

Safety recommendation R/2021/141:

HSIB recommends that the British Association of Spine Surgeons oversees the development of national guidance to identify how 'urgent' and 'emergency' requests for scans for suspected cauda equina syndrome are defined and prioritised.

HSIB makes the following safety observation

Safety observation O/2021/123:

It may be beneficial for NHS spinal networks in England to implement services and processes to support timely access to MRI for patients with suspected cauda equinasyndrome, in line with national guidance to be developed by the British Association of Spine Surgeons.

Supporting the diagnosis of CES

MRI radiographer provision

5.2.20 The investigation heard that there is a shortage of radiographers across the various imaging modalities, but particularly in MRI. A 2020 report from the Royal College of Radiologists found that demand for complex CT and MRI scans is growing at three times the speed of the radiologist workforce, and that this will impact on the already stretched radiographer workforce (Royal College of Radiologists, 2020).

5.2.21 The GIRFT report describes some ways in which trusts are trying to address the deficit in MRI-trained radiographers (Hutton, 2019). The report cites a study published by the John Radcliffe Hospital in Oxford regarding their move to train all band 6 radiographers in basic MRI so that, when working to undertake out-of-hours CT scans, they can cross-cover into MRI (Hauptfleisch et al, 2013). The study states that band 6 radiographers with no previous MRI experience usually need 3 weeks working in MRI to become proficient, and continual rotations through MRI every 12–15 weeks. Such an approach allowed out-of-hours MRI without any incremental cost to existing out-of-hours CT services.

5.2.22 The Health and Care Professions Council (HCPC) told the investigation that a current project is exploring more advanced practice roles, as their roles are not clearly defined and there are no consistent career pathways. For radiographers, the HCPC provide proficiency standards but not specific skills expected of, for example, MRI radiographers. In contrast, the Society & College of Radiographers (n.d.) has published information about the role of the radiographer in MRI, highlighting the specialist knowledge and skills required.

HSIB makes the following safety observation:

Safety observation O/2021/124:

It may be beneficial for hospital trusts without 24 hours a day, 7 days a week MRI provision and the potential to see patients with suspected cauda equina syndrome to consider expanding the skills of their radiographers to allow out-of-hours MRIs if required. Projects such as those described in this report may support this.

5.2.23 The investigation spoke with the GIRFT Clinical Lead for Emergency Medicine, who has considered the cost of having 24/7 access to a local MRI scanner. He described how the MRI scanner is not switched off, so 24/7 access would have minimal impact on the running costs of the machine. In addition, he said that the costs associated with off-site reporting of MRI scans are relatively low. The main cost would be related to paying for trained MRI radiographers (who, the investigation acknowledges, are in short supply).

5.2.24 The GIRFT Clinical Lead for Emergency Medicine estimated that, in his Trust, to change to a 24/7 on-call service would require three extra band 6 radiographers to allow for backfill of staffing should the radiographer be called in overnight. This would cost approximately £148,000 per year. This figure is significantly lower than the typical costs associated with a single delayed diagnosis of CES (average cost per litigation claim of £810,000 between 2013/14 and 2017/18) (Moulton, 2021).

5.2.25 The investigation also heard of other factors that need to be considered and addressed to support safe provision of a 24/7 MRI service (Society & College of Radiographers, 2019). From the patient perspective, a patient may not be able to undergo an MRI. Clinical reasons for a person not to have an MRI include, among others, the presence of a pacemaker, implant and previous metal in the eye (MRIsafety.com, n.d.). Patients may also be claustrophobic, making the confined space of an MRI a challenge.

5.2.26 MRIs also require reporting, which is traditionally undertaken by a radiologist. Reporting can take time and is not always conclusive of a diagnosis of CES. Radiology reporting again requires resources. The research literature describes potential opportunities for MRI-reporting radiographers (Lockwood and Dolbear, 2018).

Additional tests to support suspicion of CES

5.2.27 Diagnosing CES is difficult without an MRI. Other types of clinical investigation have been explored to determine whether they can help to support or reject a suspected diagnosis of CES. One example is nerve-conduction studies (using an electromyography to show if there is a blockage of the nerve pathway), but these are invasive and resource intensive.

5.2.28 Bladder scanning was described to the investigation. Bladder scanning uses ultrasound to determine how much urine is in the bladder. In patients with suspected CES, this is useful to identify if a patient is unable to urinate completely or only partially empties their bladder; both are signs of urinary retention. Bladder scanning is already included in some spinal network CES pathways, including one in which it is a mandated step prior to MRI. Bladder scanning is not included in NICE guidance (National Institute for Health and Care Excellence, 2020) or in the Society of British Neurological Surgeons and the British Association of Spine Surgeons (SBNS/BASS) standards of care for CES (Society of British Neurological Surgeons/ British Association of Spine Surgeons, 2018).

5.2.29 A consultant spinal surgeon told the investigation that bladder scanning can be better than human assessment in predicting CES. It may be a useful additional point-of-care test to help identify patients who are more likely to have CES, as indicated by urinary retention; it does not replace MRI. In one study, reported to be the largest prospective evaluation of suspected CES to date, use of post-void residual volume was shown to support diagnostic accuracy (Katzouraki et al, 2020). However, there has also been resistance to the use of bladder scanning, with concerns about the medicolegal consequences of deferring MRI on the basis of a bladder scan. The financial savings from deferring a scan 'would not be so impressive if the missed cauda equina syndrome resulted in litigation' (Machin et al, 2018).

5.2.30 The investigation was unable to identify any definitive test, other than MRI, to support the diagnosis of CES; this is also reflected in the research literature and national guidelines. Investigations such as bladder scanning may add to the information available to clinicians when deciding whether they suspect CES, but they are not definitive. Concerns were shared with the investigation that these tools should not be used to avoid or delay MRI in suspected cases.

National guidance

5.2.31 The investigation found no NICE guidance specifically on diagnosing or managing CES. The available national information that guides clinical decision making and the implementation of pathways is therefore based on limited detail in

national documents and local perceptions of best practice. This has resulted in variations across the country, with the addition, or not, of investigatory tools such as bladder scanning. The investigation interprets this as limited evidence of agreed best-practice approaches to the diagnosis of suspected CES. The investigation also heard that clinicians would benefit from the clear inclusion of CES in NICE guidance.

HSIB makes the following safety recommendation

Safety recommendation R/2021/142:

HSIB recommends that the National Institute for Health and Care Excellence updates its current low back pain guideline to include the symptoms and initial management of cauda equina syndrome. This update should include a review of the role of supplementary investigations, such as bladder scanning, in patients with suspected cauda equina syndrome.

5.2.32 The investigation engaged with the British Orthopaedic Association's Trauma Committee as part of its exploration around national guidance. Discussions highlighted the challenges of patients with suspected CES being seen by non-specialist healthcare practitioners or hospitals. The British Orthopaedic Association Standards for Trauma and Orthopaedics (BOASTs) are short summary standards relevant to trauma and orthopaedics, aimed at helping support the diagnosis and management of particular conditions. It was agreed that the current standards are generic, and that more specific standards are required for the non-specialist frontline practitioner (such as GPs and ED staff). The British Orthopaedic Association's Trauma Committee agreed to develop a BOAST for CES. The investigation heard of the need to ensure that relevant specialties contribute to developing guidance and standards.

HSIB notes the following safety action

Safety action A/2021/047:

The British Orthopaedic Association has started to develop a Standard for Trauma and Orthopaedics (BOAST) to support the diagnosis and management of cauda equina syndrome in the non-specialist setting.

Diagnostic pathways and the role of spinal networks

First contact practitioners (FCPs) and the suspicion of CES

5.2.33 Patients with symptoms of potential CES may present to healthcare services through non-specialist routes, including EDs, general practice, physiotherapy, NHS 111/999 or FCPs. An FCP is an experienced physiotherapist or osteopath who has the advanced skills necessary to assess, diagnose and recommend treatment or referral for musculoskeletal (MSK) problems on a patient's first contact with healthcare services.

5.2.34 Nationally, various guidance and pathways have been published to support the management of patients with low back pain seeing healthcare professionals.

Examples include the following:

- The NHS England Pathfinder Project has developed a generic pathway for managing low back pain and radicular pain (NHS England, 2017). A key objective of the pathway is to identify serious pathology via red flags and indicate appropriate management. Implementation of the pathway has shown positive results, with a 'significant reduction in community physiotherapy, x-rays and MRI scanning and in referrals into secondary care ... [and] improvement of patient management' (NHS England, 2017).
- The National Backpain Pathway – Clinical Network (2020) framework for the early recognition of CES in primary care and musculoskeletal (MSK) interface services describes that 'all patients with acute or deteriorating back (with or without radicular) pain should be assessed for CES, in primary care' and the red flags and actions to take if identified.

5.2.35 The investigation heard that these pathways are positive additions to the management of low back pain and identification of CES as they help standardise processes. They also support non-specialist practitioners in recognising CES. However, it was also heard that the reliance on non-specialist practitioners to identify such a rare condition will result in false-positive and false-negative cases. A GP, for example, may see only one patient with CES in their entire career, making recognition challenging (Greenhalgh et al, 2016).

5.2.36 The investigation was told that identifying patients who truly have CES requires early assessment by appropriate decision makers. Examples of these decision makers include spinal surgeons and senior trainee doctors, spinal physiotherapists and MSK FCPs. MSK FCPs are often physiotherapists or osteopaths with additional training to act as a diagnostic clinician working with patients with

undifferentiated and undiagnosed MSK problems in primary care (Health Education England and NHS England, 2018; Health Education England, n.d.). This would include identifying and referring patients with suspected CES.

5.2.37 The NHS Long Term Plan sets out strategies for the whole of England's patient population to have direct access to MSK FCPs by 2023/24 (NHS, 2019). MSK FCPs provide expert assessment, checks for red flags, advice on self-management, prescribing, investigation, triage and referral (see figure 8) (NHS England and NHS Improvement, 2019). NHS England has supported pilots across the country to provide early access to MSK FCPs for patients with back or joint pain, without having to wait to see a GP or receive a hospital appointment (NHS England, n.d.).

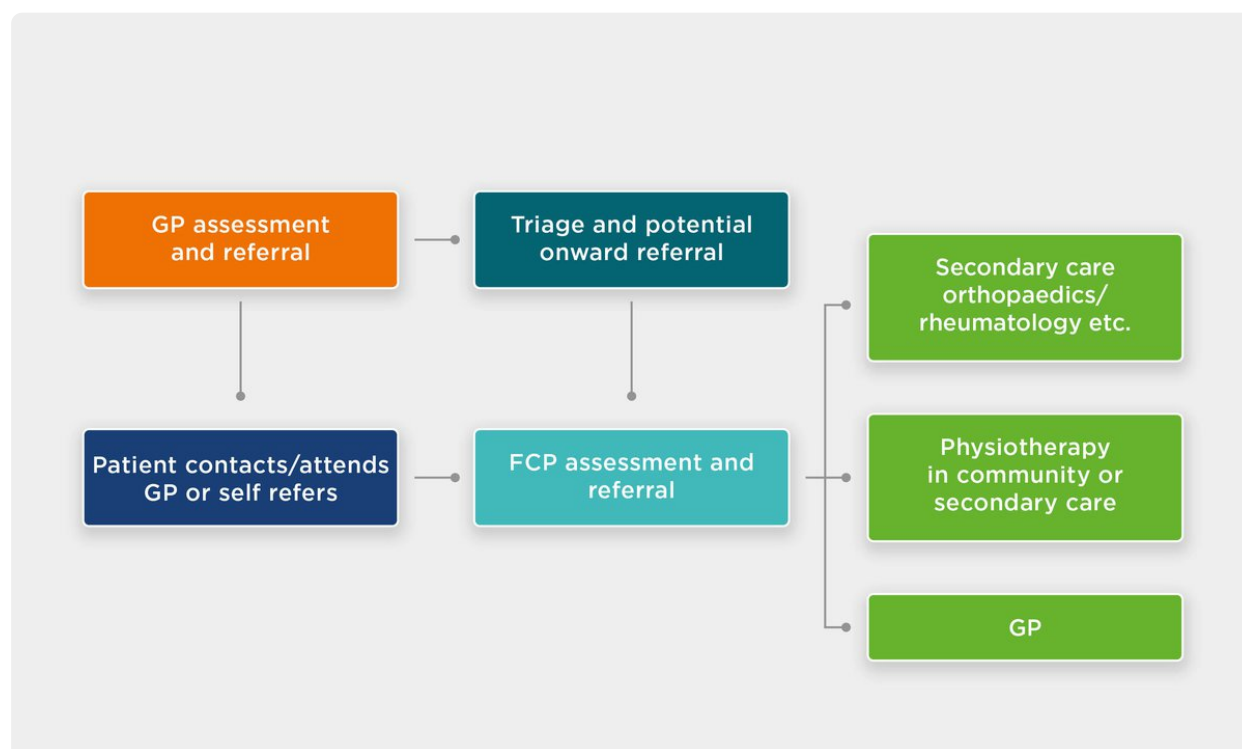


Figure 8 Example pathway for MSK FCP services (adapted from NHS England and NHS Improvement, 2019)

5.2.38 Work to date around the MSK FCP model has demonstrated potential benefits by moving musculoskeletal therapists (experienced physiotherapists and osteopaths) expertise to the beginning of the MSK pathway. Benefits have included: improved use of diagnostic capacity, with cost reductions in X-rays and MRI scans ordered by GPs; patients receiving specific self management advice; evidence of good patient experiences; fewer referrals to consultant-led services; and a reduced MSK workload for GPs (NHS England and NHS Improvement, 2019; NHS England, n.d.).

5.2.39 The investigation heard from an advanced physiotherapy practitioner who described the current situation managing patients with symptoms of CES at the Trust where he works and the Trust's proposed plans. The practitioner said that suspected CES places a high burden on specialist services. He said that although there is an average of 1 or 2 referrals to the orthopaedic on-call service each day, the referrals often cluster in groups, with up to 10 or more cases a day – many of which will not be confirmed as CES. As a result, they are aiming to help primary-care clinicians to better identify suspected CES earlier in the process. This will include introducing a system that activates a referral for an emergency MRI while the patient is still in the primary-care setting, thereby reducing the time spent waiting for an MRI in the ED. The team is also developing a local mechanism for planned MRI slots for suspected CES cases. They are aware that, on average, they have two potential CES referrals per day, and will therefore aim to have two planned MRI slots per day.

Attending EDs with suspected CES

5.2.40 Patients with low back pain commonly present to EDs. The Royal College of Emergency Medicine (2016) recognises that 'the level of clinical risk is very high because ED clinicians are required to make critical decisions under conditions of considerable uncertainty with limited information, limited resources and limited time.' The College has therefore advocated for increasing the number of emergency medicine consultants, with the long term aim of involving a consultant in the care of every ED patient.

5.2.41 Working towards consultant-led care, the Royal College of Emergency Medicine has developed standards for particular patient groups whose cases should be reviewed by an emergency medicine consultant before discharge. The patient groups are those who present 'with a risk of life-threatening disease that may not be immediately appreciated by less experienced staff' (Royal College of Emergency Medicine, 2016). While CES is not necessarily life threatening, it has the potential to significantly impact life in a way that may be limiting.

Accessible language to explore symptoms of CES

5.2.42 Suspicion of CES relies on the questions asked by the clinician and how they interpret the patient's description of their symptoms. The investigation heard that the personal nature of some CES-associated symptoms (such as urinary and faecal incontinence) can cause embarrassment for both those asking and answering the questions. They may also influence when a patient seeks help.

5.2.43 Clinicians told the investigation about the difficulties in describing the symptoms of CES in a clear, unambiguous way. This is important for the diagnosis of suspected CES and when giving safety-netting advice to patients who are discharged. The research literature also indicates that patients experiencing CES symptoms may find it difficult to clearly articulate their symptoms or not understand what concerning symptoms to look out for (Greenhalgh et al, 2016). The reference event also highlighted the importance of clarifying the potential significance of symptoms for patients, as the Patient in the reference event was not aware of the potential severity of her condition.

5.2.44 It is important to use language familiar to the public in order to support an understanding of the symptoms of CES. Greenhalgh et al (2016) developed a CES cue card to help clinicians ask questions (see figure 9) and a CES card for patients setting out the warning signs of CES. The cue card focuses on issues associated with bladder, bowel and sexual function, as research has highlighted these symptoms as important in the timely diagnosis of CES (Sun et al, 2014).

Figure 9 Cue card for clinicians for CES symptoms using the patient voice (adapted from Greenhalgh et al, 2016)

- Loss of feeling/pins and needles between your inner thighs and genitals.
- Numbness in or around your back passage or buttocks.
- Altered feeling when using toilet paper to wipe yourself.
- Increasing difficulty when you try to urinate.
- Increasing difficulty when you try to stop or control your flow of urine.
- Loss of sensation when you pass urine.
- Leaking urine or recent need to use pads.
- Not knowing when your bladder is either fully or empty.
- Inability to stop a bowel movement or leaking.
- Loss of sensation when you pass a bowel motion.
- Change in ability to achieve an erection or ejaculate.
- Loss of sensation in genitals during sexual intercourse.

Any combination of the above warning signs could be symptoms of cauda equina syndrome.

Safety netting and communication with patients

5.2.45 Safety netting is a regularly used, and important, part of any clinical encounter where there is uncertainty in a diagnosis and the person needs to know when and how to seek further advice. There is limited research into what patients understand and want from safety-netting advice, but the clinician should communicate uncertainty and follow-up plans in a way that can be understood (Jones et al, 2019).

5.2.46 Several CES safety-netting leaflets and information resources were reviewed during this national investigation. The level of detail and language were found to vary considerably. Where a diagnosis is uncertain, the investigation learned that providing safety-netting information to patients is a key clinical intervention to manage uncertainty and ensure patients return when appropriate for review.

5.2.47 The importance of effective safety netting has increased during the COVID-19 pandemic. This has been identified in other HSIB investigations (Healthcare Safety Investigation Branch, 2021). With a move to virtual consultations and a reluctance on the part of patients to access healthcare services, safety netting is needed to support patients in monitoring their symptoms over time until the diagnosis becomes more certain (Greenhalgh et al, 2020).

The language used to support patient understanding of safety netting is an important component of this (Greenhalgh et al, 2016). The investigation heard that the language should be clear and concise, and the readability level considered. Advice also needs to be given in a consistent way. One positive example the investigation heard was where MRI departments issued safety netting leaflets following a scan.

HSIB makes the following safety observation

Safety observation O/2021/125:

It may be beneficial for safety-netting leaflets to be given to patients with low back and radicular pain. Leaflets should use clear and concise language, and provide clear directions as to what a patient should do if they develop red flag symptoms.

5.3 Management of CES

The role of spinal networks in managing CES

5.3.1 Spinal services are delivered through 'spinal networks', which consist of a combination of local general hospitals and specialist spinal centres (see figure 4). For different spinal conditions, the spinal networks have agreed pathways for patients to access the most appropriate services in a timely way, irrespective of which hospital they were initially assessed at. This supports equitable access to services.

5.3.2 The role of spinal networks is to help define standards and pathways to improve access and care for patients presenting with spinal conditions both electively and in emergency situations across the region.

- Core principles include: facilitating the delivery of patient care by implementing national and regional policies and pathways (for example, the National Low Back and Radicular Pain Pathway) (NHS England, 2017)
- reducing unnecessary variations in surgical practice
- providing and co-ordinating staff education
- engaging in workforce planning for future service provision.

5.3.3 The investigation found variations in treatment pathways across the system and within specific spinal networks. The treatment pathway for CES depends on which hospital the patient is initially assessed at. It also depends on which spinal network the patient's local hospital geographically sits within.

5.3.4 There is a need to reduce geographical inequality in the diagnosis and management of CES by introducing a national CES pathway that allows local adaptation while enforcing agreed safety-critical elements. The investigation acknowledges there is a national low back pain pathway (NHS England, 2017), but considers there to be a need for a specific pathway focusing on CES.

5.3.5 Developing and embedding a clear national pathway for CES management – with appropriate tests/assessments by suitably senior staff – will help to ensure surgery is performed in a timely way. A clear pathway that ensures early communication from the referring hospital to the specialist spinal centre will help the receiving hospital start to plan for the patient. Regular updates and timely MRI images will also support the process.

HSIB makes the following safety recommendation

Safety recommendation R/2021/143:

HSIB recommends that NHS England and NHS Improvement develops a national cauda equina syndrome pathway. This should define the safety-critical elements of the pathway and highlight areas that can be adapted locally.

Timeliness of surgical intervention for CES

5.3.6 This investigation primarily focused on the timely detection of CES. However timely surgical intervention, once CES is diagnosed, is imperative for achieving the best outcome for the patient.

5.3.7 In the reference event, the Patient was 'urgently' transferred shortly after 03:00 hours, some 10 hours after her MRI had been reported, even though the specialist centre did not operate on CES patients overnight. While the SBNS/BASS standards of care say that nothing can be gained by delaying surgery (Society of British Neurological Surgeons/British Association of Spine Surgeons, 2018) and medicolegal concerns may prompt immediate surgery, the investigation has seen and heard that, in practice, operations for CES are not always undertaken during the night.

5.3.8 In the reference event, the plan was for the Patient to go into surgery first thing in the morning; however, another emergency meant that her surgery was delayed.

5.3.9 The evidence suggests that if suspected CES is confirmed by a timely MRI, this will help to ensure the patient undergoes a timely transfer and surgery.

6 Summary of findings, safety recommendations, safety observations and safety actions

Reference event findings

- There was a delay in obtaining an MRI for the Patient. The investigation found that the Patient waited 4 days for an MRI, despite having a red flag symptom that potentially indicated CES.

- Those interviewed had varying views about the time criticality of pathways for diagnosing CES and how quickly an MRI should be obtained. National guidance and standards do not specify diagnostic time frames, and from when the times should be measured.
- The referral process to the regional specialist spinal centre had multiple steps and therefore several opportunities for error. The investigation identified a safety risk, in that neurosurgical doctors at the specialist centre were not alerted (unless they were at their computer) when a referral was received through the electronic referral system.
- After the Patient arrived at the specialist centre, she waited for more than 10 hours for emergency surgery. The policy at that centre is not to perform non life-threatening operations overnight, based on recognising that performance at night can be suboptimal, and the risks of operating at night can outweigh the risks of waiting until the morning.

National findings

- MRI is currently the investigation of choice for diagnosing CES. The Society of British Neurological Surgeons and the British Association of Spine Surgeons recommend a low threshold for performing MRI, and that MRI should be available at the referring hospital 24 hours a day, 7 days a week. The investigation found that many local hospitals cannot use their MRI scanners out of hours as they do not have sufficient numbers of suitably trained staff.
- National standards of care state that MRI must be undertaken as an emergency where CES is suspected. This investigation heard about and saw varying time frames for patients with suspected CES. Terms such as ‘emergency scan’ and ‘urgent scan’ are being used interchangeably with various meanings at different locations. This has resulted in confusion around the appropriate time frames for MRI and when an MRI will actually occur.
- The investigation found no National Institute for Health and Care Excellence (NICE) guidance specifically on CES. The available national information to guide clinical decision making and implement pathways is therefore based on limited detail in national documents and local perceptions around best practice. This has resulted in variations across the country. The investigation heard that clinicians would benefit from the clear inclusion of CES in NICE guidance.
- The investigation found variations in treatment pathways across the system and within specific spinal networks. The treatment pathway for CES depends on which hospital the patient is initially assessed at. It also depends on which spinal network the patient’s local hospital sits within geographically.

- Developing and embedding a clear national pathway for CES management, with appropriate tests/assessments by suitably senior staff, will support efficient referral and management. A clear pathway that ensures early communication will help the receiving hospital to start planning for the patient. Regular updates and timely MRI images will also support the process.
- The investigation found that safety-netting leaflets on the symptoms associated with CES were inconsistent in their level of detail and language.

HSIB makes the following safety recommendations

Safety recommendation R/2021/139:

HSIB recommends that the British Association of Spine Surgeons, supported by the Royal College of Surgeons of England and the Royal College of Emergency Medicine, develops a decision-making tool to support the identification of patients who need an immediate MRI for suspected cauda equina syndrome (which may result in the patient being transferred for MRI if this is not immediately available at the assessing site).

Safety recommendation R/2021/140:

HSIB recommends that guidance is developed by the Royal College of Radiologists, supported by the Society and College of Radiographers, stating that all hospitals should reserve the first MRI slot of the day for patients with suspected cauda equina syndrome who do not meet the criteria for an 'emergency'/immediate scan overnight.

Safety recommendation R/2021/141:

HSIB recommends that the British Association of Spine Surgeons oversees the development of national guidance to identify how 'urgent' and 'emergency' requests for scans for suspected cauda equina syndrome are defined and prioritised

Safety recommendation R/2021/142:

HSIB recommends that the National Institute for Health and Care Excellence updates its current low back pain guideline to include the symptoms and initial management of cauda equina syndrome. This update should include a review of the role of supplementary investigations, such as bladder scanning, in patients with suspected cauda equina syndrome.

Safety recommendation R/2021/143:

HSIB recommends that NHS England and NHS Improvement develops a national cauda equina syndrome pathway. This should define the safety-critical elements of the pathway and highlight areas that can be adapted locally.

HSIB makes the following safety observations:

Safety observation O/2021/122:

It may be beneficial for all hospitals where patients with potential cauda equina syndrome may present to have access to MRI scanning and reporting 24 hours a day, 7 days a week.

Safety observation O/2021/123:

It may be beneficial for NHS spinal networks in England to implement services and processes to support timely access to MRI for patients with suspected cauda equina syndrome, in line with national guidance to be developed by the British Association of Spine Surgeons.

Safety observation O/2021/124:

It may be beneficial for hospital trusts without 24 hours a day, 7 days a week MRI provision and the potential to see patients with suspected cauda equina syndrome to consider expanding the skills of their radiographers to allow out-of-hours MRIs if required. Projects such as those described in this report may support this.

Safety observation O/2021/125:

It may be beneficial for safety-netting leaflets to be given to patients with low back and radicular pain. Leaflets should use clear and concise language, and provide clear directions as to what a patient should do if they develop red flag symptoms.

HSIB notes the following safety actions

Safety action A/2021/046:

The regional specialist spinal centre described in this report has worked with the electronic referral system manufacturer to ensure alerts are received by neurosurgical doctors. This has included doctors having a single 'baton' telephone that receives the alert, with the telephone being passed to the next doctor at shift handover.

Safety action A/2021/047:

The British Orthopaedic Association has started to develop a Standard for Trauma and Orthopaedics (BOAST) to support the diagnosis and management of cauda equina syndrome in the non-specialist setting.

7 References

Airaksinen, O., Brox, J. I., Cedraschi, C., Hildebrandt, J., Klaber-Moffett, J., Kovacs, F., Mannion, A. F., Reis, S., Staal, J. B., Ursin, H. and Zanoli, G. (2006) Chapter 4. European guidelines for the management of chronic nonspecific low back pain. *European Spine Journal*, 15 (Suppl 2), S192-S300.

Balasubramanian, K., Kalsi, P., Greenough, C. G. and Kuskoor Seetharam, M. P. (2010) Reliability of clinical assessment in diagnosing cauda equina syndrome. *British Journal of Neurosurgery*, 24 (4), 383-386.

Barraclough, K. (2021) Cauda equina syndrome. *BMJ (Clinical Research Ed.)*, 372, n32.

Bell, D. A., Collie, D. and Statham, P. F. (2007) Cauda equina syndrome: what is the correlation between clinical assessment and MRI scanning? *British Journal of Neurosurgery*, 21 (2), 201-203.

Camino Willhuber, G. O. and Piuze, N. S. (2021) Straight Leg Raise Test. Treasure Island (Florida): StatPearls Publishing.

Carayon, P., Schoofs Hundt, A., Karsh, B.-T., Gurses, A. P., Alvarado, C. J., Smith, M. and Flatley Brennan, P. (2006) Work system design for patient safety: the SEIPS model. *Quality & Safety in Health Care*, 15 (Suppl 1), i50-58.

Clinical Knowledge Summary. (2017) Back pain – low (without radiculopathy): red flag symptoms and signs [Online]. National Institute for Health and Care Excellence. Available at [https://cks.nice.org.uk/topics/back-pain-low-without radiculopathy/how-up-to-date-is-this-topic/changes/](https://cks.nice.org.uk/topics/back-pain-low-without-radiculopathy/how-up-to-date-is-this-topic/changes/) (original unavailable online).

Clinical Knowledge Summary. (2020) Back pain – low (without radiculopathy): red flag symptoms and signs [Online]. National Institute for Health and Care Excellence. Available at [https://cks.nice.org.uk/topics/back-pain-low-without radiculopathy/diagnosis/red-flag-symptoms-signs](https://cks.nice.org.uk/topics/back-pain-low-without-radiculopathy/diagnosis/red-flag-symptoms-signs) (Accessed 25 February 2021).

Coleman, C. (2019) The little-known spinal injury ‘costing the NHS millions’, BBC News, 19 August [Online]. Available at <https://www.bbc.co.uk/news/health-49235474> (Accessed 24 March 2021).

Comer, C., Finucane, L., Mercer, C. and Greenhalgh, S. (2020) SHADES of grey – the challenge of ‘grumbling’ cauda equina symptoms in older adults with lumbar spinal stenosis. *Musculoskeletal Science & Practice*, 45, 102049.

Cook, C. E., George, S. Z. and Reiman, M. P. (2018) Red flag screening for low back pain: nothing to see here, move along: a narrative review. *British Journal of Sports Medicine*, 52 (8), 493-496.

Dionne, N., Adefolarin, A., Kunzelman, D., Trehan, N., Finucane, L., Levesque, L., Walton, D. M. and Sadi, J. (2019) What is the diagnostic accuracy of red flags related to cauda equina syndrome (CES), when compared to magnetic resonance imaging (MRI)? A systematic review. *Musculoskeletal Science & Practice*, 42, 125-133.

Domen, P. M., Hofman, P. A., van Santbrink, H. and Weber, W. E. J. (2009) Predictive value of clinical characteristics in patients with suspected cauda equina syndrome. *European Journal of Neurology*, 16 (3), 416-419.

Finucane, L. M., Downie, A., Mercer, C., Greenhalgh, S. M., Boissonnault, W. G., Pool-Goudzwaard, A. L., Beneciuk, J. M., Leech, R. L. and Selfe, J. (2020) International framework for red flags for potential serious spinal pathologies. *The Journal of Orthopaedic and Sports Physical Therapy*, 50 (7), 350-372.

Fountain, D. M., Davies, S. C. L., Woodfield, J., Kamel, M., Majewska, P., Edlmann, E., Jamjoom, A. A. B., Hoeritzauer, I., Waqar, M., Mahoney, D. E., Vyas, D., Schramm, M. W. J., Solomou, G., Dawkes, F. E. C., Grant, H. K., Attwood, J. E., Boukas, A., Ballard, D. J., Toman, E., Sanders, M. I., Cheserem, B., Sinha, S. and Statham, P.; British

Neurosurgical Trainee Research Collaborative; Neurology and Neurosurgery Interest Group. (2019) Evaluation of nationwide referral pathways, investigation and treatment of suspected cauda equina syndrome in the United Kingdom. British Journal of Neurosurgery, 0 (0), 1-11.

Greenhalgh, S., Truman, C., Webster, V. and Selfe, J. (2016) Development of a toolkit for early identification of cauda equina syndrome. Primary Health Care Research & Development, 17 (6), 559-567.

Greenhalgh, S., Finucane, L. M., Mercer, C. and Selfe, J. (2020) Safety netting; best practice in the face of uncertainty. Musculoskeletal Science & Practice, 48, 102179.

Halliday, K., Maskell, G., Beeley, L. and Quick, E. (2020) Radiology: GIRFT programme national specialty report [Online]. Available at <https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2020/11/GIRFT-radiology-report.pdf> (Accessed 12 May 2021).

Hauptfleisch, J., Meagher, T. M., King, D., López de Heredia, L. and Hughes, R. J. (2013) Out-of-hours MRI provision in the UK and models of service delivery. Clinical Radiology, 68 (5), e245-e248.

Health Education England. (n.d.) First contact practitioners and advanced practitioners in primary care: (musculoskeletal). A roadmap to practice [Online]. Available at <https://www.hee.nhs.uk/sites/default/files/documents/A%20Roadmap%20to%20Practice.pdf> (Accessed 2 March 2021).

Health Education England and NHS England. (2018) Musculoskeletal core capabilities framework for first point of contact practitioners [Online]. Available at <https://skillsforhealth.org.uk/wp-content/uploads/2021/01/Musculoskeletal-framework.pdf> (Accessed 2 March 2021).

Healthcare Safety Investigation Branch. (2021) Maternal death: learning from maternal death investigations during the first wave of the COVID-19 pandemic [Online]. Available at <https://www.hsib.org.uk/investigations-cases/maternal-death-national-learning-report> (Accessed 11 May 2021).

Hoeritzauer, I., Wood, M., Copley, P. C., Demetriades, A. K. and Woodfield, J. (2020) What is the incidence of cauda equina syndrome? A systematic review. Journal of Neurosurgery: Spine, 1-10.

Holden, R. J., Carayon, P., Gurses, A. P., Hoonakker, P., Hundt, A. S., Ozok, A. A. and Rivera-Rodriguez, A. J. (2013) SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, 56 (11), 1669-1686.

Hutton, M. (2019) Spinal services. GIRFT programme national specialty report [Online]. Available at <https://gettingitrightfirsttime.co.uk/wp-content/uploads/2019/01/Spinal-Services-Report-July19-N-FINAL.pdf> (Accessed 23 March 2021).

Jones, D., Dunn, L., Watt, I. and Macleod, U. (2019) Safety netting for primary care: evidence from a literature review. *The British Journal of General Practice*, 69 (678), e70-e79. Kapetanakis, S., Chaniotakis, C., Kazakos, C. and Papathanasiou, J. V. (2017) Cauda equina syndrome due to lumbar disc herniation: a review of literature. *Folia Medica*, 59 (4), 377-386. Katzouraki, G., Zubairi, A. J., Hershkovich, O. and Grevitt, M. P. (2020) A prospective study of the role of bladder scanning and post-void residual volume measurement in improving diagnostic accuracy of cauda equina syndrome. *The Bone & Joint Journal*, 102-B (6), 677-682.

Lieberman, E. G., Boone, R. M., Radoslovich, S., Haj, V., Hiratzka, J., Marshall, L. M. and Yoo, J. U. (2018) Prevalence of preoperative lower urinary tract symptoms in patients undergoing elective lumbar spine surgery. *Spine*, 43 (19), E1152-E1156. Lockwood, P. and Dolbear, G. (2018) Image interpretation by radiographers in brain, spine and knee MRI examinations: findings from an accredited postgraduate module. *Radiography*, 24 (4), 370-375.

Machin, J. T., Hardman, J., Harrison, W., Briggs, T. W. R. and Hutton, M. (2018) Can spinal surgery in England be saved from litigation: a review of 978 clinical negligence claims against the NHS. *European Spine Journal*, 27 (11), 2693-2699. Moulton, C. (2021) Emergency medicine. GIRFT programme national specialty report. Pre-publication.

MRIsafety.com. (n.d.) The list [Online]. Available at http://www.mrisafety.com/TMDL_list.php (Accessed 7 June 2021).

National Backpain Pathway – Clinical Network. (2020) Early recognition of cauda equina syndrome: a framework for assessment and referral for primary care/MSK interface services. United Kingdom Spine Societies Board [Online]. Available at <https://www.ukssb.com/nbpcn-ces-framework> (Accessed 11 May 2021).

National Confidential Enquiry into Patient Outcome and Death. (2003) Who operates when? II [Online]. Available at <https://www.ncepod.org.uk/2003wow.html> (Accessed 11 May 2021).

National Institute for Health and Care Excellence. (2020) Low back pain and sciatica in over 16s: assessment and management. NICE guideline [NG59] [Online]. Available at <https://www.nice.org.uk/guidance/ng59> (Accessed 25 February 2021).

NHS. (2019) NHS long term plan [Online]. Available at <https://www.longtermpplan.nhs.uk> (Accessed 11 March 2021).

NHS England. (n.d.) Musculoskeletal: helping people with painful bone and joint conditions see the right person [Online]. Available at <https://www.england.nhs.uk/elective-care-transformation/best-practice-solutions/musculoskeletal> (Accessed 11 March 2021).

NHS England. (2017) Trauma programme of care: NHS England. National low back and radicular pain pathway 2017 [Online]. Available at https://ba17bc65-2f2f-4a2f-9427-cd68a3685f52.filesusr.com/ugd/dd7c8a_caf17c305a5f4321a6fca249dea75ebe.pdf (Accessed 26 February 2021).

NHS England and NHS Improvement. (2019) Elective care high impact interventions: first contact practitioner for MSK services [Online]. Available at <https://www.england.nhs.uk/wp-content/uploads/2019/05/elective-care-high-impact-interventions-first-contact-practitioner-msk-services-specification.pdf> (Accessed 3 February 2021).

NHS Resolution. (2018) Claims notified to NHS Resolution, 2013/14 to 2017/18. Cited in GIRFT Emergency Medicine National Report. (Anticipating publication date 2021).

Robertson, R. (2017) How does the NHS compare internationally? Big election questions [Online]. Available at <https://www.kingsfund.org.uk/publications/articles/big-election-questions-nhs-international-comparisons> (Accessed 11 May 2021).

Royal College of Emergency Medicine. (2016) Quality in emergency care committee standard. Consultant sign-off (June 2016) [Online]. Available at https://www.rcem.ac.uk/docs/Consultants%20Sign%20off/Consultant%20Sign%20Off_June%202016.pdf (Accessed 25 February 2021).

Royal College of Emergency Medicine. (2020) Position statement: cauda equina syndrome. [Online]. Available at [https://www.rcem.ac.uk/docs/Cauda%20Equina%20-%20position%20statement%20\(Feb%202020\).pdf](https://www.rcem.ac.uk/docs/Cauda%20Equina%20-%20position%20statement%20(Feb%202020).pdf) (Accessed 24 March 2021).

Royal College of Radiologists. (2019) 24/7 access to MRI scans for cauda equina syndrome [Online]. Available at <https://www.rcr.ac.uk/posts/247-access-mri-scans-cauda-equina-syndrome> (Accessed 5 November 2020).

Royal College of Radiologists. (2020) Radiologist census underlines ongoing toll of workforce shortages [Online]. Available at <https://www.rcr.ac.uk/posts/radiologist-census-underlines-ongoing-toll-workforce-shortages-0> (Accessed 11 May 2021).

Royal College of Surgeons of England. (2007) Separating emergency and elective surgical care: recommendations for practice.

Society of British Neurological Surgeons/British Association of Spine Surgeons. (2018) Standards of care for investigation and management of cauda equina syndrome (CES).

Society & College of Radiographers. (n.d.) The role of the radiographer in magnetic resonance imaging [Online]. Available at https://www.sor.org/getmedia/7dbe1752-25fe-4f00-b435-9ab11a54eff0/magnetic_resonance_imaging_info_a4.pdf (Accessed 7 July 2021).

Society & College of Radiographers. (2019) Safety in magnetic resonance imaging [Online]. Available at https://www.sor.org/getmedia/b7d1db7a-5b04-492e-ad4d-6b188f0d9cb0/safety_in_magnetic_resonance_imaging_3.pdf_2 (Accessed 7 July 2021).

Sun, J.-C., Xu, T., Chen, K.-F., Qian, W., Liu, K., Shi, J.-G., Yuan, W. and Jia, L.-S. (2014) Assessment of cauda equina syndrome progression pattern to improve diagnosis. *Spine*, 39 (7), 596-602.

Thomas, R. (2021) Exclusive: consultant 'cliques' and 'unacceptable behaviours' put patients at risk [Online]. Available at <https://www.hsj.co.uk/university-hospitals-birmingham-nhs-foundation-trust/exclusive-consultant-cliques-and-unacceptable-behaviours-put-patients-at-risk/7029844.article> (Accessed 11 May 2021).

Todd, N. V. (2017) Guidelines for cauda equina syndrome. Red flags and white flags. Systematic review and implications for triage. British Journal of Neurosurgery, 31 (3), 336-339.

United Kingdom Spine Societies Board. (2018) Regional spinal networks [Online]. Available at <https://www.ukssb.com/rsn-networks-and-leads> (Accessed 11 May 2021).

Woodfield, J., Hoeritzauer, I., Jamjoom, A. A. B., Pronin, S., Srikandarajah, N., Poon, M., Roy, H., Demetriades, A. K., Sell, P., Eames, N. and Statham, P. F. X. (2018) Understanding cauda equina syndrome: protocol for a UK multicentre prospective observational cohort study. BMJ Open, 8 (12), e025230.

Zusman, N. L., Radoslovich, S. S., Smith, S. J., Tanski, M., Gundle, K. R. and Yoo, J. U. (2020) Physical examination is predictive of cauda equina syndrome: MRI to rule out diagnosis is unnecessary. Global Spine Journal [Online ahead of print]. DOI: 10.1177/2192568220948804.

8 Appendix

8.1 Data extraction information

Source data	StEIS - Strategic Executive Information System
Date of extraction	01 October 2019
Date used for qualifying extraction	1 April 2017 to 23 July 2019
Categorical filters	Nil
Free text terms	'cauda equina' in event description field
Other notes	27 results
Community pharmacy	Pharmacy was owned by a small, independent chain of pharmacies and provided an electronic prescription service

Source data	StEIS - Strategic Executive Information System
Date of extraction	11 March 2021
Date used for qualifying extraction	1 January 2020 to 31 December 2020
Categorical filters	Nil

Free text terms	'cauda' in event description field
Other notes	8 results of interest
Community pharmacy	Pharmacy was owned by a small, independent chain of pharmacies and provided an electronic prescription service

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