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The impact of the COVID-19 pandemic on spinal surgery

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Abstract

The impact of the coronavirus disease (COVID-19) pandemic on healthcare services around the world has been unprecedented. Surgical specialities, in particular, had to respond rapidly and adapt to continue to meet the needs of their patients in this ever-evolving and uncertain situation. With the cancellation of elective surgery and outpatient clinics, the majority of work carried out by spinal surgeons was obliterated. It was imperative emergency spinal care continued throughout the pandemic, with the creation of guidelines to assist spinal surgeons manage patients appropriately. Alongside assisting on the frontline, spinal surgeons had to triage referrals to ensure urgent care was still provided, undertake outpatient clinics virtually and ensure educational opportunities were available for colleagues. Paediatric spinal surgery was affected by the pandemic; although the virus did not significantly impact children to the same extent, a notable consequence of the lockdown restrictions was a reduction in GP referrals into the specialist service. In the event of any future pandemics, national spinal organizations have created guidelines to assist in the prioritization and care of spinal pathologies. While a 'return to normality' is a long way off, the impact of the past year will undoubtedly change spinal surgeons and their practice forever.

Keywords COVID-19; impact; pandemic; scoliosis; spinal deformity; spinal surgery

Introduction

In December 2019, the first case of coronavirus disease (COVID-19) was identified in Wuhan, China. The impact of this infection resulted in a global pandemic being declared by the World Health Organization (WHO) in March 2020 with over 185 countries affected by the virus. This has caused significant disruption to societal norms, placing a huge burden on global healthcare services and subsequently triggering a worldwide recession.¹ The impact of the COVID-19 pandemic is unprecedented in the modern era and the scale and severity of the disruption caused will have repercussions for years to come.

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COVID-19 characteristics

COVID-19 represents a potentially fatal disease that can cause a severe acute respiratory syndrome and as such is a major public health concern. The disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which belongs in the same family of viruses as those that caused prior endemics including Middle East respiratory syndrome coronavirus (MERS-CoV).¹ It is transmitted directly through respiratory droplets from coughing and indirectly by aerosolized particles that remain on surfaces or airborne for an extended period of time. The incubation period from exposure to developing symptoms is variable and is thought to be between 3 days and 5 days.^{1,2}

In those patients who contract COVID-19, the spectrum of clinical characteristics is highly variable, ranging from a mild, self-limiting illness through to a severe pneumonia potentially causing respiratory failure and death. For many, the symptoms of the virus tend to be non-specific and include fever, cough and fatigue. Early data from the Chinese population suggested that 80% of infected patients developed a mild-to-moderate form of the disease and only a minority developed critical or severe complications such as sepsis or acute respiratory disease syndrome (ARDS) that required intubation and ventilation.^{1,3}

The data surrounding risk factors for suffering from COVID-19 is continually being analysed but currently male patients are more likely to be affected and the majority of infected patients tend to have underlying co-morbidities such as diabetes, cardiovascular disease and cancer. Along with increasing age, suffering from a chronic medical condition is associated with a greater risk of severe morbidity and mortality.¹

Spinal surgery and COVID-19

The COVID-19 pandemic spread rapidly across the world, having a significant and detrimental impact on healthcare services internationally.⁴ In an attempt to prevent hospital systems from being overwhelmed, many services were restricted with widespread cancellation of both elective surgery and outpatient clinics. However, it was imperative that emergent and urgent clinical conditions were still identified, referred and appropriately managed by the relevant specialty throughout the ongoing pandemic. The impact on individual surgical subspecialties has rapidly become apparent, and the effects of the restrictions imposed by the pandemic on spinal surgery have been cataclysmic, with surgeons having to rapidly adapt their practices.⁴⁻⁶ In the UK, the NHS and the National Institute for Health and Clinical Excellence (NICE) created a guide for managing spinal surgery during the COVID-19 pandemic (Table 1) which has provided a proforma for triaging and prioritizing spinal care.⁷

It was widely reported that attendances at UK emergency departments (EDs) reduced by 50% and acute spinal pathologies reduced in presentation throughout the first UK national lockdown.⁸ Critical spinal conditions, such as cauda equina syndrome and spinal cord compression are surgical emergencies and any delays in patients receiving medical care promotes clinical deterioration, adverse outcomes, significant long-term morbidity and mortality. Therefore, throughout the ongoing pandemic, spinal surgeons have played a crucial role in providing care for patients with urgent spinal pathologies. It is critical that patient safety is maximized while minimizing the use of limited

healthcare resources such as intensive care unit (ICU) beds and personal protective equipment (PPE).¹

Referrals and triage

Spinal surgeons across the world had to rapidly adapt to the evolving pandemic to ensure patients with acute spinal pathologies were identified and appropriately treated. The British Orthopaedic Association (BOA) and British Association of Spine Surgeons (BASS) created a referral pathway guideline for spinal disorders during the COVID-19 pandemic (Figure 1).⁹ Back pain is one of the most common spinal referrals from the EDs, but one British spinal unit reported a 20% reduction in acute spinal referrals from EDs during the initial phase of the COVID-19 lockdown in comparison to the same period in 2019. It is assumed that fewer patients presented due to concerns of catching the virus or overburdening the health system.¹⁰

The North American Spine Society (NASS) developed guidance on triaging spinal conditions (Table 2), with similar guidelines published from the American College of Surgeons (ACS) and the Royal College of Surgeons of England (RCS).¹ A three-tier classification system was created to triage the need for spinal surgery into elective, urgent or emergent cases.¹¹ Elective procedures where pain and dysfunction can be managed

through non-operative measures were suspended.¹ Pathologies including adolescent idiopathic scoliosis, degenerative disc disease and stable isthmic spondylolisthesis were assessed as being low priority and postponed indefinitely. Spinal conditions deemed to fall into the urgent criteria, such as myelopathy and spinal infections that fail medical management, require surgical treatment at a time that is not clearly discerned although expedited intervention is essential.¹¹ Emergent cases with progressive or severe neurological deficit, with risk of spinal instability including fracture, dislocations and acute spinal cord injury received the usual, expedient surgical management throughout the pandemic.^{1,7}

Recommendations such as those published by the NASS, regarding the management of spinal conditions were implemented at the discretion of local healthcare authorities.¹ However, spinal surgeons have reportedly served as patient advocates in most situations following the introduction of such austere and draconian measures due to the ongoing global pandemic that totally overwhelmed any available healthcare resources.⁷

Elective surgery

Elective spinal surgery is unique in relation to other elective orthopaedic work as the prolonged delay in surgical treatment of

Clinical guide for the management of patients requiring spinal surgery during the COVID-19 pandemic⁷

Stage	Situation	Action	Likely conditions
Stage One	Cancellation of routine elective surgery Emergency and urgent elective surgery continues	Review all elective spinal surgical waiting lists by responsible consultant to identify patients at risk of neurological deterioration Consultant should contact all urgent patients identified and plan a date for surgery All patients, not at risk of neurological deterioration should not undergo surgery at this time Emergency surgery should continue without restriction	Cervical myelopathy Thoracic myelopathy Intradural tumours Bilateral sciatica with confirmed radiological compression
Stage Two	Emergency surgery only	All referrals from non-spinal centres to tertiary spinal centres should be reviewed by a consultant All patients requiring imaging (including MRI) should have this performed at their local hospital 24/7 to prevent unnecessary transfer of patients Only patients requiring emergency surgery that cannot be treated locally should be transferred between hospitals	Spinal fractures Spinal infection Metastatic spinal cord compression Cauda equina Traumatic spinal cord injuries
Stage Three	Selective emergency spinal surgery only	Only patients with ASA<3 who will not require level 2 or 3 care postoperatively and a reasonable chance of neurological recovery Patients with metastatic spinal cord compression should be treated non-operatively and should not be offered surgical treatment at this time	Proven cauda equina syndrome Fracture/dislocation spine Epidural abscess with deteriorating neurology

ASA, American Society of Anesthesiologists; COVID-19, coronavirus disease.

Table 1

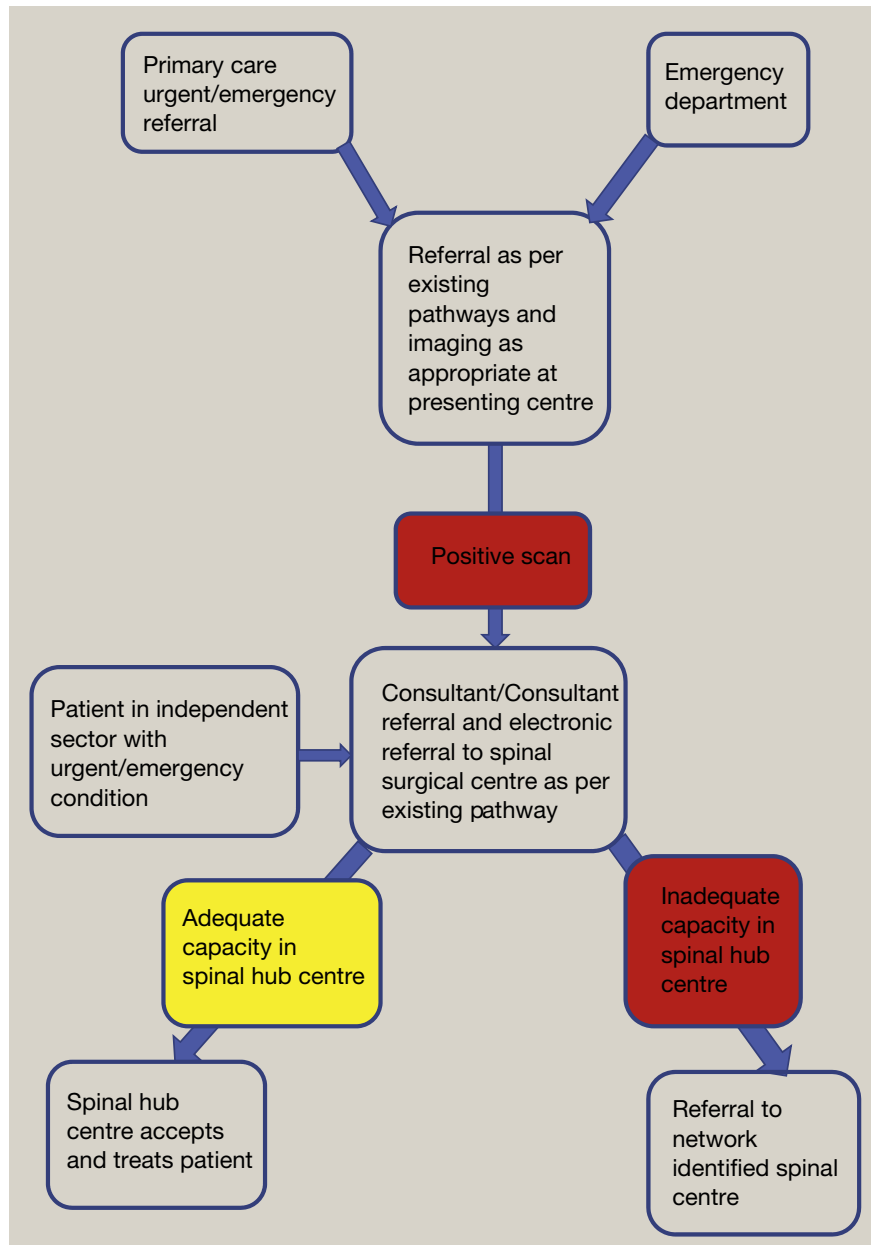


Figure 1 NHS Spine referral pathway during the coronavirus disease pandemic. Adapted from reference 9.

currently stable spinal conditions, can potentially lead to irreversible neurological damage, loss of function and detrimentally impact on quality of life, if treatment does not occur in a timely fashion. During the initial COVID-19 pandemic, spinal surgeons were responsible for achieving the fine balance of reducing but not completely cancelling all surgical cases while prioritizing patients with urgent and emergent conditions alongside identifying patients potentially at risk of deterioration in the future.

In one institution the total number of spinal surgeries performed during the first lockdown decreased by 53% in comparison to the same period last year. Prior to the pandemic, elective spinal surgery made up 58% of all procedures as opposed to only 11% elective procedures carried out during lockdown. There were no elective procedures specifically undertaken for congenital or degenerative spinal disorders during the lockdown period,

whereas prior to COVID-19, these operations accounted for 28% of all spinal procedures performed.^{1,2} Preoperative COVID-19 testing was a pre-requisite for those undergoing any spinal surgery. When surgery was deemed to be an emergency and there was insufficient time to process a COVID-19 test, patients were assumed to be COVID-19 positive until proven otherwise.^{1,2} When this is the case, postoperative testing should be performed and once a negative result was returned, patients can then be managed appropriately. It was also recommended that any patient who developed a postoperative fever received further COVID-19 testing.¹²

A review of the spinal services in Singapore during the COVID-19 lockdown highlighted that all spinal deformity and revision surgery was cancelled, and that minimally invasive surgical procedures associated with a short hospital stay and

North American Spine Society triage for spinal surgery during the coronavirus disease pandemic¹¹

Category	Clinical consideration	Recommendation
Emergent	Progressive or severe neurologic deficit due to neurologic compression from any cause Spinal instability at risk of causing neurologic injury from any cause Epidural abscess requiring surgical decompression Postoperative wound infection	Do not delay treatment
Urgent	Myelopathy due to spinal stenosis, with recent progression Spinal infection that fail medical management Persistent neurologic deficit due to neurologic compression Spinal conditions with intractable pain, severe functional limitations or excessive opioid use.	Proceed if local healthcare guidelines permit and resources available to safely perform the procedure
Elective	Spinal conditions were pain and dysfunction can be managed without procedural intervention Scoliosis or kyphosis correction Symptomatic instrumentation or pseudoarthrosis	Consider postponing procedure and treatment

Table 2

significantly reduced intraoperative blood loss were prioritized. In the postoperative period, discharges were expedited to downstream rehabilitation facilities to maximize the number of hospital beds available. Due to the cancellation of elective procedures, emergency spinal surgery for trauma or tumour cases continued with the adequate anaesthetic and nursing staff and perioperative care and support, which highlighted the importance of resource conservation and redirection during a time of crisis.¹³

The impact of COVID-19 on spinal surgery in European institutions was evident.^{14,15} The French Spine Society generated guidelines classifying surgical priorities based on a three-tier scale of urgency and necessity. All patients admitted for spinal surgery underwent COVID-19 polymerase chain reaction (PCR) testing and those with symptoms suggestive of COVID-19 underwent a preoperative CT scan in both France and Italy. During the initial COVID-19 lockdown in Europe, the total number of spinal procedures carried out halved in comparison to the previous year in both French and Italian tertiary spinal centres.¹⁵ The number of trauma patients fell dramatically during the COVID-19 pandemic in comparison to 2019, whereas cases remained static for those presenting with spinal infections or tumours compared to the previous year. Furthermore, minimally invasive procedures were preferential, wherever possible, to limit the potential need for ICU beds and reduce operating time with experienced and skilled surgeons performing the majority of cases.¹⁴ Spinal units in France and Italy were able to provide the same standard of care despite the worldwide pandemic for patients who required urgent and non-deferable spinal surgery.^{14,15}

Although the cancellation of elective surgeries has had a significant impact on waiting times, it has avoided potential prolonged postoperative inpatient stays for patients, thus reducing

the burden on limited hospital resources. Furthermore, by suspending elective patient admissions to hospital, the risk of nosocomial COVID-19 transmission has been reduced.¹

Preoperative guidelines

Many institutions have generated preoperative guidelines for patients requiring spinal surgery. Firstly, spinal surgeons must triage the individual patient's needs for spinal surgery. Patients who are classified as in need of surgery must then be screened for COVID-19 symptoms and undergo preoperative COVID-19 PCR testing. Those who require urgent spinal surgery and present with symptoms suggestive of COVID-19 must undergo a preoperative chest CT scan. The one caveat is in an emergency setting where patients must go straight to theatre without delay for COVID-19 testing and as such they must be treated as a positive patient until appropriate testing is carried out in the postoperative period. While guidelines have been established to provide surgeons with standard approaches to take, it is recognized that each clinical situation is unique and additional factors must be considered in individual cases.¹⁴

Theatre set-up

When COVID-19 is confirmed or suspected in a patient that requires emergency spinal surgery, there are a number of considerations required. There should be a dedicated theatre set aside for COVID-19 positive patients that ideally uses a negative pressure airflow system. Intubation and extubation are thought to be the riskiest components of spinal surgery for the transmission of COVID-19.¹ Therefore, the use of video laryngoscopy is recommended to maximize the distance between the patient and anaesthetizing doctor, as described in COVID-19 anaesthetic

guidelines.¹⁶ All non-essential equipment should be removed and only the minimum number of required personnel for a procedure to proceed safely should be present in theatre throughout the operation, with a limitation on staff traffic entering and exiting. The surgeon should be experienced, and procedural training of registrars, fellows or residents should take a backseat. In addition, the surgical technique used should ideally be minimally invasive and the patient placed in a prone position, in an attempt to reduce viral transmission through bodily fluids and respiratory droplets. Standard surgical PPE should be used with the addition of a respirator face mask and consideration in individual cases given to the use of a surgical hood/helmet.¹ Intraoperative use of electrocautery, electric drills and burrs should be minimized due to the risk of generating aerosol particles.¹³ Following the procedure, the use of post-operative recovery areas is not recommended for COVID-19 positive patients, to try and minimize the risk of nosocomial spread and there should be 1 hour downtime between cases to allow for thorough decontamination of the operating theatre.¹

Outpatient clinic

Across the UK, due to the COVID-19 crisis, the majority of face-to-face outpatient clinics were initially cancelled. All non-emergency outpatient appointments were recommended to be undertaken through tele-medicine technology.^{1,12} Referrals to spinal outpatient clinics for conditions including osteoporosis compression fractures and back pain without neurological compromise were postponed.¹³ For clinical appointments that were assessed to require in person assessment, within the hospital, a COVID-19 screening assessment was developed for a patient which included thermal screening, contact and travel history and COVID-19 symptom checker.^{1,12} At one British specialist tertiary orthopaedic institution, virtual consultations accounted for 87% of all outpatient appointments during the initial COVID-19 lockdown. Patient and clinician satisfaction were high for the use of virtual consultations when implemented during the pandemic.¹⁷ A national survey of orthopaedic outpatient clinics during the pandemic highlighted widespread cancellation of elective clinics with non-urgent appointments postponed. The few elective clinics that did continue for assessment of urgent presentations, ran through the use of telephone or virtual consultations, in the majority of cases.¹⁸ The return to normal outpatient clinics is a long way off and thus, the use of technology for consultations is likely to continue for the time being.

Paediatric spinal services

Paediatric spinal services were significantly impacted in the wake of the COVID-19 pandemic. Spinal surgeons were responsible for prioritizing paediatric spinal procedures, with cases categorized based on surgical urgency in the USA (Table 3).¹⁹ For class-1 cases, the recommendation was that surgery should continue throughout the crisis while ensuring appropriate use of PPE and preoperative COVID-19 testing. Class-2 procedures can be undertaken when local virus levels are stable, and children's hospitals have adequate capacity. For class-3 cases, it is agreed that these procedures should only be performed when the local COVID-19 patient numbers are falling. Class-4 cases that are complex in nature, but whose outcome

will not be affected by delaying surgery, should wait until near the end of the current pandemic.¹⁹

There are a number of factors that need to be taken into account for individual paediatric spinal cases prior to surgery being scheduled including length of expected hospital stay, medical comorbidities, especially those impacting on pulmonary function and an underlying neuromuscular condition that has contributed to the spinal deformity.¹⁹ For paediatric spinal services to continue during the COVID-19 pandemic, balancing the individual patient's surgical need against local virus level is critical to ensure safety for all involved. In general, spinal services that operate in dedicated paediatric hospitals have managed to restore following the initial lockdown and then maintain a large proportion of their surgical and outpatient activity, as the impact of the COVID-19 pandemic has been limited in this age groups when compared to adults.

The Scottish National Spine Deformity Service (SNSDS) accepts referrals from all Scottish NHS Health Boards, thus serving as the central spinal centre for around 1.5 million children. The number of referrals received by the SNSDS during the first COVID-19 lockdown reduced by 64% in comparison to the same period in 2019. Consequently, because of this decline in referrals, the waiting time for a new patient to be assessed by a spinal surgeon fell from an average of 10.8 weeks to 6.5 weeks. The majority of referrals into this national service are received from other secondary care specialities and due to the reduction in outpatient clinics, fewer children were referred onto the specialist spinal service. Furthermore, with the national mantra to stay at home and with the closure of schools, paediatric spinal conditions will have gone unnoticed as many are often identified by teachers or physical education instructors within schools. While children with uncomplicated spinal conditions were reviewed during the pandemic, the most vulnerable patient group with complex syndromic or neuromuscular spinal conditions are likely to be at greatest risk of deterioration as a result of shielding advice encouraging these patients to remain at home with their specialist review and decision on spinal treatment being subsequently delayed.²⁰

Medical education and training

At the onset of the COVID-19 pandemic, the training of registrars/residents was halted, with teaching sessions stopped and operating time almost non-existent. All trainees were faced with uncertainty regarding the impact on their progression and training, especially with redeployment and theatre time significantly reduced, it was critical that training requirements were modified or suspended during such uncertain times.¹³ As the lockdown restrictions with social distancing continued, it was essential training was re-started, thus there was a transition towards gradually reintroducing educational talks and seminars using videoconferencing technology. This allowed teaching to be carried out in an informal manner, reinforcing a sense of camaraderie during uncertain times, and enabling trainees to join in remotely, allowing for educational sessions to carry on around work commitments.¹³ With a reduction in the spinal surgery caseload due to widespread cancellation of elective procedures and the reduced number of patients on each operating list, this enabled more time to be spent on each case for training of the

Paediatric spinal surgery triage during the coronavirus disease pandemic¹⁹

Indication for treatment

Class 1 – Emergency	Class 2 – Urgent	Class 3 – Semi-Urgent	Class 4 – Elective
Cauda equina and/or nerve-root deterioration	Early-onset scoliosis growing instrumentation insertion	Early onset scoliosis growing instrumentation lengthening	Early onset scoliosis growing instrumentation final fusion
Epidural abscess	Corrective spinal casting for scoliosis	Stiff neuromuscular scoliosis posterior spinal fusion	Adolescent idiopathic scoliosis posterior spinal fusion, Risser 5
Unstable spine fractures	Fusion in traction	Stiff neuromuscular scoliosis posterior spinal fusion	Flexible neuromuscular scoliosis posterior spinal fusion
Myelopathic pathology (e.g. tumour and instability)	Adolescent idiopathic spinal fusion (Risser 0, open triradiate cartilage, Sanders 3)		
Tumour resection timed with chemotherapy and/or radiation	Chest-wall expansion		

Classification according to severity. Class 1: emergency cases; class 2: urgent cases requiring surgery within 2 months; class 3: semi-urgent cases requiring surgery in 2–4 months; class 4: elective cases requiring surgery in 4–6 months.

Table 3

resident/registrar/fellow with close supervision from experienced spinal surgeons.²¹

Continuous professional development (CPD) and up-to-date training for established spinal surgeons has also been allowed to continue through web-based teaching sessions, courses, and targeted tutorials. Face-to-face peer contacts which encourage stimulating scientific discussions, visits to spinal centres in order to attend surgeries and learn new techniques or technologies, as well as opportunities to participate in cadaver labs have not been possible during the present restrictions imposed on travel and social interaction by the COVID-19 pandemic. It is expected that as the pandemic is controlled over time with the large-scale community immunizations producing immunity across the world population, such stimulating professional and teaching activities will be allowed to resume. Meanwhile, many national and international spinal meetings are organized online and still attract large numbers of delegates. Even with the return to some sense of normality once we have learned to live with the virus and have controlled its morbidity, it is expected that experiences acquired during the pandemic on the use of modern technology and web-based training will become part of our long-term armamentarium of medical teaching which in its online format becomes open and accessible to a much wider audience around the globe.

Current recommendations

Recommendations for managing a spinal service during the present situation or in a future pandemic were created by a British spinal institution.¹⁰ These include ensuring a 24-hour on-call spinal care pathway is available to prevent unnecessary transfer of patients to other hospitals especially out-of-hours and generating a clinical proforma to prioritize urgent spinal cases.

As part of this set of recommendations, it has been suggested that all spinal patients are routinely screened and tested for COVID-19 prior to elective surgery; it has also been advised establishing a separate trauma operating list for patients in need of urgent spinal surgery.¹⁰

Conclusion

The impact of the COVID-19 pandemic has been felt across the globe with ramifications on all aspects of healthcare. In particular, surgeons have been affected due to the widespread cancellation of the majority of their workload. Spinal surgeons had to rapidly adapt their services to ensure emergency care continued with minimal disruption while maximizing healthcare resource conservation. Across the world, many organizations created guidelines to assist in the triaging of spinal surgery care throughout the ongoing pandemic. Currently, the global situation continues to evolve and the return to normal service provision still appears a long way off. ◆

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