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An Exit Strategy for Resuming Nonemergency Neurosurgery after Severe Acute Respiratory Syndrome Coronavirus 2: A United Kingdom Perspective

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INTRODUCTION: Substantial healthcare resources have been diverted to manage the effects of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic, and nonemergency neurosurgery has been effectively closed. As we begin to emerge from the crisis, we will need to manage the backlog of nonemergency neurosurgical patients whose treatment has been delayed and remain responsive to further possible surges of SARS-CoV-2 infections.

METHODS: In the present study, we aimed to identify the core themes and challenges that will limit resumption of a normal neurosurgical service after the SARS-CoV-2 pandemic and to provide pragmatic advice and solutions that could be of utility to clinicians seeking to resume nonemergency neurosurgical care. We reviewed the relevant international policies, a wide range of journalistic and media sources, and expert opinion documents to address the stated aims.

RESULTS: We have presented and discussed a range of factors that could become potential barriers to resuming full elective neurosurgical provision and important steps that must be completed to achieve pre-SARS-CoV-2 surgical capacity. We also explored how these challenges can be overcome and outlined the key requirements for a successful neurosurgical exit strategy from the pandemic.

CONCLUSION: The performance of nonemergency neurosurgery can start once minimum criteria have been fulfilled: 1) a structured prioritization of surgical cases; 2) virus infection incidence decreased sufficiently to

release previously diverted healthcare resources; 3) adequate safety criteria met for patients and staff, including sufficient personal protective equipment and robust testing availability; and 4) maintenance of systems for rapid communication at organizational and individual levels.

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 is a novel coronavirus that causes coronavirus disease 2019 (COVID-19). Since the first case in the United Kingdom on January 29, 2020, the crisis rapidly escalated to 226,463 confirmed cases and 32,692 deaths in the United Kingdom by May 12, 2020.¹ The UK government announced a nationwide lockdown, with closure of nonessential services on March 23, 2020.^{2,3} A second, closely linked strategy was “raising the line” to increase the capacity of the National Health Service, including building a 4000-bed “Nightingale” super-hospital in London using the armed forces and volunteers and mobilizing clinical academic faculty and retired staff.^{4,5} An upheaval occurred in the provision of neurosurgical services,⁶ with reallocation of healthcare resources to increase the capacity of the National Health Service (Figure 1).

At the time of writing, the United Kingdom has been on a downward trend from a daily peak of 953 deaths on April 10, 2020 to 627 deaths on May 17, 2020.¹ As the incidence of new cases and deaths decreases, it is timely to consider how we can safely and effectively restore nonemergency neurosurgical care and maintain the flexibility to adapt to any resurgence in COVID-19 cases.^{7,8} This will require a coherent and practical exit strategy.^{9,10}

Key words

- Coronavirus
- COVID-19
- Exit strategy
- Lockdown
- Neurosurgery
- Severe acute respiratory syndrome coronavirus 2
- Service provision

Abbreviations and Acronyms

COVID-19: Coronavirus disease 2019

PCR: Polymerase chain reaction

PPE: Personal protective equipment

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In the present report, we have discussed the challenges to reestablishing elective neurosurgical practice in the post-COVID-19 era and strategies for returning to a new normal.

Methods

The aim of the present report was to identify the core themes and challenges that could limit resumption of a normal neurosurgical service after the COVID-19 pandemic and to provide pragmatic advice and potential solutions that could be of utility to clinicians resuming nonemergency neurosurgical care. We undertook a review of international COVID-19 policies (political and healthcare focused), a wide range of journalistic and media sources, and expert opinion documents to address the stated aims. We have provided suggestions for how these challenges might be overcome and outlined the requirements for a successful neurosurgical exit strategy from the pandemic.

DISCUSSION

In the United Kingdom, changes to the configuration and delivery of neurosurgical services included deferral of nonurgent treatment and redeployment of neurosurgical staff to support the critical care and medical capacities for patients with COVID-19.^{11–13} The reduction in the provision of nonemergency neurosurgical care was necessary to protect patients from unnecessary exposure during hospital visits, reduce the risk to healthcare practitioners, and preserve the limited supplies of personal protective equipment (PPE). It is likely that some patients with urgent or even life-threatening neurosurgical pathologies have not sought treatment because of fears of contracting COVID-19 or fears of overloading the burdened healthcare system. In addition, some patients could have had their diagnostic tests deferred. The backlog of neurosurgical cases will vary by region. However, estimates have indicated that at least one half of all indicated neurosurgical operations have been cancelled since the start of the pandemic.¹⁴ To move from our current position to one in which we can provide the full range of urgent and elective neurosurgical care will require navigation through uncharted territory. In the present report, we have highlighted some of the major challenges that neurosurgeons will face (Figure 2) and offered a pragmatic approach for a staged return to full neurosurgical service.

Patient Factors

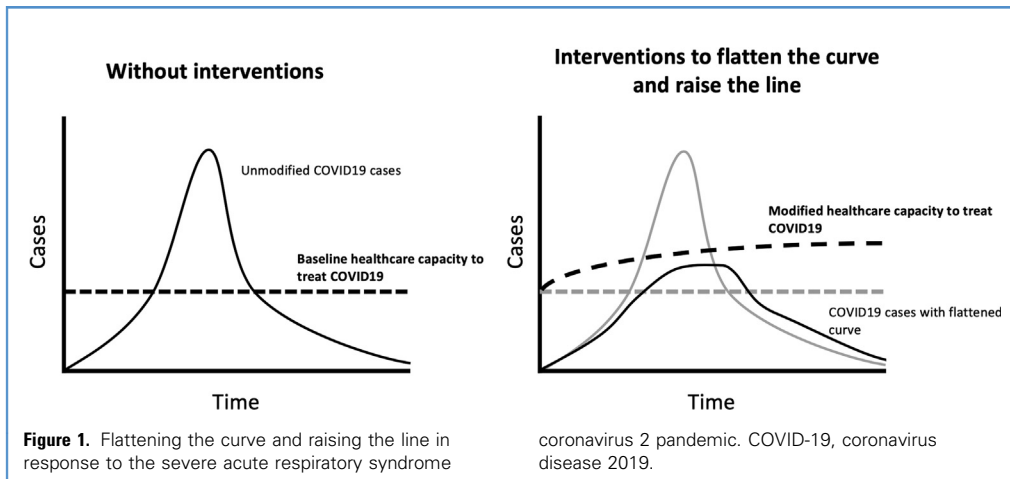
The willingness of patients to undergo surgery will be key to the resumption of elective neurosurgical services. In the absence of robust quantitative risk data, patients' confidence could be dependent on the availability of antibody tests capable of demonstrating confirmed immunity in preference to polymerase chain reaction (PCR)-based diagnostic testing.¹⁵ The current availability of antibody testing is limited, and data regarding the durability of the immunity conferred by COVID-19 infection are lacking.¹⁶ The current PCR testing for COVID-19 has a high false-negative rate.¹⁷ The chances of a false-negative test result has been reported to be as high as 16.7% and increases with the duration from the onset of symptoms.¹⁸ A large cohort study from Wuhan revealed that survivors had positive reverse transcription PCR tests for a median 20 days and that some patients could be

asymptomatic carriers.¹⁹ The availability of antibody testing would allow for risk stratification regarding the resumption of elective surgery. At the very least, patients should self-isolate for 14 days before elective procedures, be asymptomatic, and, preferably, have 2 negative COVID-19 antigen test results within a few days of the proposed surgery.

A study of patients with COVID-19 who had undergone surgery in Wuhan revealed that almost one half of the patients had required critical care admission postoperatively and 20.5% of these patients died.²⁰ These findings have raised significant concerns for elective neurosurgical practice. However, the mortality rate for COVID-19-negative patients undergoing elective surgery during a decline phase of the virus remains unclear and is likely to be much lower. Nevertheless, the potential increase in morbidity and mortality for patients choosing to undergo routine surgery at present should be clearly explained as a part of the informed consent process,²¹ especially for black and Asian minority ethnic groups.^{22,23} Other known risk factors for serious COVID-19 infection include older age, cardiovascular disease, chronic respiratory disease, diabetes, and obesity. Hence, the reintroduction of nonemergency neurosurgery might need to be stratified according to the risk profiles of different patient groups. Testing patients for COVID-19 who have been admitted for nonemergency surgery is important to minimizing patient and staff risk. Such testing has been recommended by the Royal Surgical College but has not been mandated by any legislation or governmental bodies in the United Kingdom.⁹ In our neurosurgical unit, all patients are required to undergo PCR diagnostic testing before surgery, regardless of the presence or absence of symptoms. The point at which the incidence of COVID-19 cases in the community has decreased to a sufficiently low level that testing for asymptomatic individuals will no longer be required has not been defined. However, in view of the associated risks, the incidence will need to be substantially lower than current levels and might require evidence of individual or widespread community immunity or immunization.

Surgical Factors

Preventing the spread of COVID-19 infection to the surgical team requires adequate preoperative testing efficacy and the correct use of PPE, including gloves, gowns, eye protection, and a suitable respirator or filtering face piece 3 mask. In the early stages of the pandemic, there was a critical shortage of these items.^{24–26} Even with PPE, however, $\leq 9\%$ of cases of COVID-19 in Italy and 20% in Lombardy were among healthcare workers.²⁷ Protecting the surgical team is of paramount importance, both for personal physical and psychological well-being and to prevent transmission to other patients. Three procedures have been specifically identified as high risk: intubation and extubation; operations that expose the respiratory or gastrointestinal tract; and the use of instruments that create aerosols, such as drills, debridors, electrocautery,²⁸ and ultrasonic aspirators.²⁹ Endoscopic transnasal procedures are particularly high risk and can even spread aerosols through the air-handling system into hospital corridors.^{30–32} Finally, the risk to subsequent patients undergoing surgery in the same operating theater after a previous COVID-19-positive procedure has not been accurately defined. However, institutional guidance has suggested that a period of

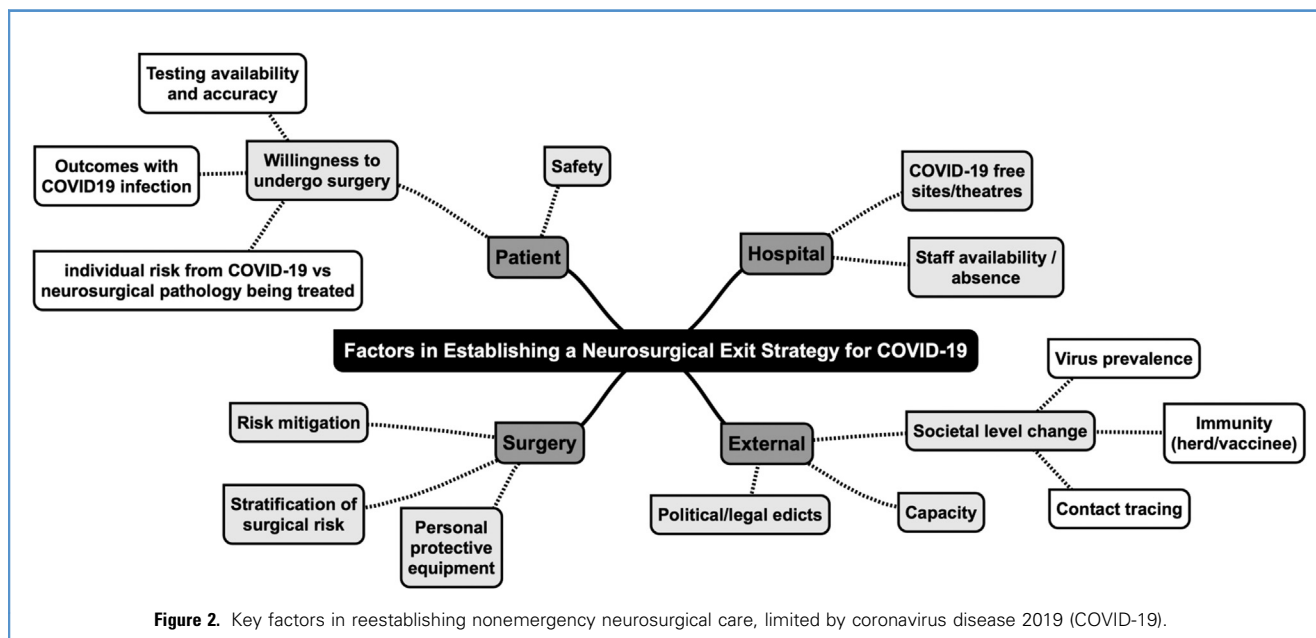


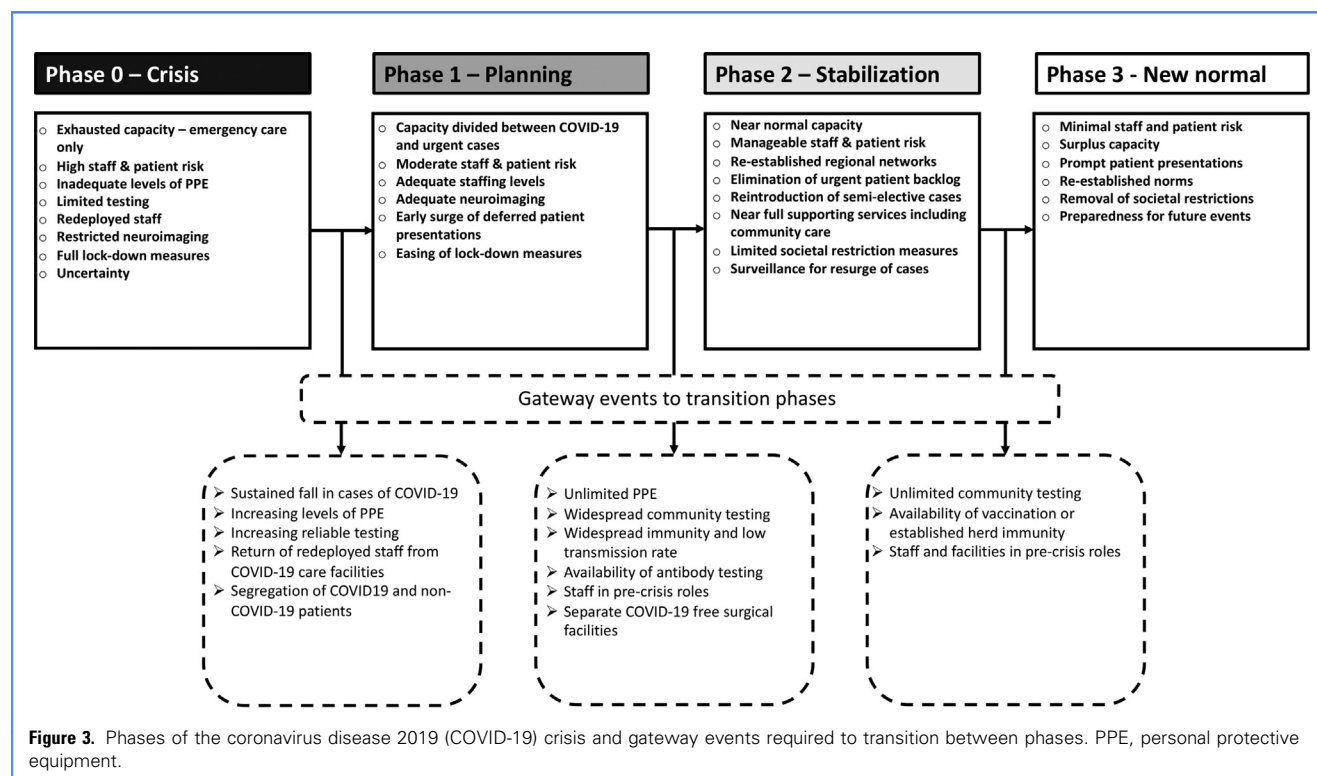
time should be included in scheduling patients to allow air-handling systems to clear any residual virus.¹⁷

Hospital Factors

The COVID-19 crisis has challenged healthcare resources around the world. The uncertainty surrounding the scale and timing of further peaks has made it difficult to plan ahead as hospitals seek to restore elective services and maintain readiness for a potential escalation of COVID-19 infections. At the outset of the crisis, surgical and anesthetic staff were redeployed,³³ and resources such as masks, gowns and ventilators were diverted to manage the pandemic.³⁴ Despite the increased workload in critical care, total bed usage throughout hospitals was dramatically lower,³⁵ in part because of rationing of services by providers, but also because of reduced demand as the public stayed away from hospitals. In

the first month of the COVID-19 lockdown in the United Kingdom, emergency attendance had decreased by 29% and admissions by 23%.³⁶ The withdrawal of profitable healthcare services to enable treatment of patients with COVID-19, together with a large amount of unused surge capacity, placed considerable financial strain on hospitals.³⁷ A number of approaches have been suggested to help facilitate the delivery of regular services. The University of California, San Francisco, reported their experience using a 4-stage surge system with a progressive reduction in scheduled operating theater activity to correspond with the increasing levels of COVID-19 cases in the hospital and community.¹² One of the most immediate solutions would be to create dedicated COVID-19-free patient pathways, diagnostic rooms, and operating theaters.³⁸ Also staffing models could be used to provide dedicated “contaminated” and “clean” surgical teams.³⁹





On a larger scale, some networks have proposed the treatment of COVID-19-free patients in separate facilities entirely, either by using private sector capacity or repurposing some facilities into “cold” COVID-19-free sites for elective surgery.⁴⁰ Concomitant with reintroducing elective surgery, outpatient clinics will need to be reestablished in a controlled and socially distancing manner, and adequate supply chains for PPE must be available for when the number of elective surgeries increases.

External Regulation and Guidance

At a national level, guidance has been issued to encourage deferment of nonacute cases from the UK government³ and the Surgical Royal Colleges.⁴¹ The Royal College of Surgeons (England) has recommended that specific operations should be classified by their urgency.⁴¹ Priority level 1a includes emergency operations required within 24 hours of patient presentation. Priority 1b includes urgent operations required within 72 hours of patient presentation. Priority level 2 operations can be deferred for ≤ 4 weeks; level 3 procedures can be delayed for ≤ 3 months; and level 4 includes nonurgent procedures that can be delayed for > 3 months without harm to the patient.⁴¹ The Society of British Neurological Surgeons has issued guidance that most craniofacial disorders, closed dysraphism, skeletal dysplasia, stable oncological disease, epilepsy, spasticity, and functional surgery should be postponed for 3–6 months, where possible,⁴² and that the threshold should be higher for surgical treatment of poor-grade subarachnoid hemorrhage in the elderly and, perhaps, a more conservative approach in neuro-oncology⁴³

and neurotrauma.⁴⁴ Neurosurgeons and operating theater schedulers will need to change from a mindset of maximal postponement to a balanced position in which patients are assessed individually and less urgent surgeries can begin to be performed once again.

Although the total hospital bed usage dramatically decreased during the pandemic,³⁵ crossing over the peak of COVID-19 infections does not automatically equate to the release of this capacity to deliver routine care. Hospital planners must be reassured that sufficient responsiveness exists in the system to manage a possible second peak as the lockdown comes to an end. To cope with a potential surge, dedicated “cold” sites and overflow units could be created. However, the most sustainable method for elective neurosurgery will be the widespread availability of testing and contact tracing and, in the longer term, the development of herd immunity through vaccination or saturation of infected case numbers.⁴⁵ A simplified schematic of the potential phases of the COVID-19 crisis and key gateway events required to transition toward a new normal state are presented in **Figure 3**.

CONCLUSION

Many factors will determine the timing and speed of the reintroduction of everyday neurosurgery. Therefore, the surgical exit strategies for COVID-19 lockdown will vary among hospitals and countries. It will not be possible to have all measures in place before beginning nonemergency neurosurgery. Therefore, it would be reasonable to introduce elective neurosurgery again once the following minimum criteria have been fulfilled:

1. Prioritization of cases

Class 1 (emergency and urgent) operations should be performed in any case, with suitable PPE according to local guidance. Class 3 and 4 operations can wait; therefore, it will be crucial to identify those operations that are class 2 (those required within 4 weeks) as the first group to reintroduce. The number of class 2 operations required will determine the level of additional service requirements for exiting the lockdown scenario.^{47,46}

2. Decreased incidence of COVID-19 infection

The number of infected cases must have been declining to allow the release of sufficient healthcare resources for class 2 priority surgeries to begin. A spare capacity in hospital beds should be available, and medical and nursing staff should be sufficiently rested to allow a return to normal service. Because most elective services would have been cancelled to allow staff to tend to the increased emergency workload during the initial surge of COVID-19 infection, after passing the COVID-19 peak, an obvious hiatus should have occurred when the staff have noted an easing of the workload and can be released early to spend more time at home or take annual leave. During this hiatus, attention should be given to starting elective neurosurgical services at an appropriate time and maintaining a level of responsiveness should a second peak of COVID-19 infection occur. The availability of surgeons and anesthetists, intensive care and floor capacity, adequate staffing levels, and reestablishment of diagnostic and imaging services will be crucial in this phase.

3. Testing for COVID-19

Testing of patients who have been admitted for nonemergency surgery is important to minimize patient and staff risk. If no

testing is available, all operations should continue with full PPE according to the local protocols, and endoscopic transnasal surgery should be avoided unless time critical. If a patient has a negative test result, the level of appropriate PPE should be decided in accordance with the local protocols. Comprehensive testing will allow for risk stratification of patients and is important for informed consent and to reassure the staff.

4. Coordination of strategy

One of the key recent improvements during the COVID-19 pandemic has been the development of rapid lines of communication among governments, regional networks, and local hospital management, clinicians, nurses, and essential health-care support workers. These systems should continue, especially to maintain responsiveness to an everchanging environment.

Remember to look up at the stars and not down at your feet. Try to make sense of what you see and wonder about what makes the universe exist. Be curious. And however difficult life may seem, there is always something you can do and succeed at. It matters that you don't just give up.

Professor Stephen Hawking

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Ciaran S. Hill: Conceptualization, Writing - original draft, Writing - review & editing. **William R. Muirhead:** Writing - original draft. **Vejay N. Vakharia:** Writing - original draft. **Hani J. Marcus:** Writing - original draft. **David Choi:** Writing - original draft, Writing - review & editing, Supervision.

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