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An Exit Strategy for Resuming Non-Emergency Neurosurgery after SARS-CoV-2: a UK Perspective.

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Neurosurgical Exit Strategy for SARS-CoV-2

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Abbreviations

COVID-19	Coronavirus disease 2019
FFP3	Filtering face piece 3
NHS	National Health Service
PCR	Polymerase chain reaction
PPE	Personal protective equipment
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
UK	United Kingdom

Abstract

Introduction

Substantial healthcare resources have been diverted to deal with the effects of the Coronavirus SARS-CoV-2 pandemic, and non-emergency neurosurgery has been effectively shut down. As we start to emerge from the crisis, we need to deal with the backlog of non-emergency neurosurgical patients whose treatment has been delayed, whilst remaining responsive to further possible surges of infection.

Aims & Method

This article aims to identify core themes and challenges that limit resumption of a normal neurosurgical service after the SARS-CoV-2 pandemic, and to provide pragmatic advice and solutions that may be of utility to clinicians looking to resume non-emergency neurosurgical care. We reviewed relevant international policies, a wide range of journalistic and media sources, and expert opinion to address the stated aims.

Results

We present and discuss a range of factors that may act as potential barriers to resuming full elective neurosurgical provision, along with important steps that must be overcome to achieve pre-COVID-19 surgical capacity. We also explore how we may overcome these challenges and outline key requirements for a successful neurosurgical exit strategy from the pandemic.

Conclusion

Recommencing non-emergency neurosurgery can start once minimum criteria have been fulfilled, these must include:

1. A structured prioritization of surgical cases
2. Incidence of virus infection should fall sufficiently to release previously diverted healthcare capacity
3. Adequate safety criteria met for patients and staff including sufficient personal protective equipment and robust testing
4. Maintenance of systems for rapid communication at organizational and individual levels

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a novel coronavirus that causes coronavirus disease 2019 (COVID-19). Since the first case in the United Kingdom (UK) on 29th January 2020 the crisis rapidly escalated to 226,463 confirmed cases and 32,692 deaths in the UK on 12th May 2020.¹ The UK government announced a nationwide “lockdown” with closure of non-essential services on the 23rd March 2020.^{2,3} A second closely-linked strategy was ‘raising the line’, increasing the capacity of the National Health Service (NHS), including building a 4000 bed ‘Nightingale’ super-hospital in London utilising the armed forces, volunteers, and mobilising clinical academics and retired staff.^{4,5} There was an upheaval in the provision of neurosurgical services,⁶ with reallocation of healthcare resources to increase the capacity in the NHS (**figure 1**).

Figure 1. Flattening the curve and raising the line in response to the SARS-CoV-2 pandemic

At the time of writing, the UK is on a downward trend from a daily peak of UK 953 deaths on 10th April 2020 to 627 deaths on 17th May 2020.¹ As the incidence of new cases and deaths fall it is timely to look at how we safely and effectively restore non-emergency neurosurgical care, whilst maintaining the flexibility to adapt to any resurgence in COVID-19 cases.^{7,8} This requires a coherent and practical ‘exit strategy’.^{9,10} We discuss the challenges to re-establishing elective neurosurgical practice in the post-COVID-19 era, and how to return to a new normal.

Aims and Methods

The aim of this article is to identify core themes and challenges that may limit resumption of a normal neurosurgical service after the SARS-CoV-2 pandemic, and to provide pragmatic advice and potential solutions that may be of utility to clinicians looking to resume non-emergency neurosurgical care. We undertook a review of international COVID-19 policies (political and healthcare focussed), a wide range of journalistic and media sources, and expert opinion to address the stated aims. We suggest how we might overcome these challenges and outline the requirements for a successful neurosurgical exit strategy from the pandemic.

Discussion

In the UK changes to configuration and delivery of neurosurgical services included deferral of non-urgent treatment, and redeployment of neurosurgical staff to support critical care and medical capacity for COVID-19 patients.^{11,12,13} Reduction in the provision of non-emergency neurosurgical care has been necessary to protect patients from unnecessary exposure during hospital visits, reduce risks to healthcare practitioners, and to preserve limited supplies of personal protective equipment (PPE). It is likely that there is a group of patients with urgent or even life-threatening neurosurgical pathologies who have not sought attention due to fears of COVID-19 or overloading the burdened healthcare system, or perhaps have been subject to deferral of diagnostic tests. The backlog of neurosurgical cases will vary by region but estimates are that at least half of all indicated neurosurgical operations have been cancelled since the start of the pandemic.¹⁴ To move from our

current position to one of in which we can provide the full range of urgent and elective neurosurgical care will require navigation through uncharted territory. Here we highlight some of the major challenges that neurosurgeons will face (summarised in **figure 2**) and offer a pragmatic approach for a staged return to full neurosurgical service.

Figure 2. Key factors in re-establishing non-emergency neurosurgical care, limited by COVID-19

Patient factors

The willingness of patients to undergo surgery will be a key driver for the resumption of elective neurosurgical services. In the absence of robust quantitative risk data, patient confidence may be dependent on the availability of antibody tests capable of demonstrating confirmed immunity in preference to polymerase chain reaction (PCR) based diagnostic testing.¹⁵ Current availability of antibody testing is limited and data regarding the durability of immunity conferred by COVID-19 infection is lacking.¹⁶ The current PCR testing for COVID-19 carries 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 RT-PCR tests for a median 20 days, and some patients may be asymptomatic carriers.¹⁹ The availability of antibody testing would allow risk stratification for the resumption of elective operating. At the very least, patients should self-isolate for 14 days prior to elective procedures, be asymptomatic, and preferably have two negative COVID-19 antigen tests within a few days of proposed surgery.

COVID-19 positive patients undergoing surgery in Wuhan revealed that almost half of the patients required critical care admission postoperatively and 20.5% of these patients died.²⁰ This raises significant concerns for elective neurosurgical practice but the mortality rate in 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 in patients choosing to undergo routine surgery at this point in time should be clearly explained as part of the informed consent process²¹, particularly for black and Asian minority ethnic groups.^{22,23} Other known risk factors for serious COVID-19 infection include increasing age, cardiovascular disease, chronic respiratory disease, diabetes, and obesity. Hence, re-introduction of non-emergency neurosurgical operations may need to be stratified based on the risk profiles of different patient groups. Testing of patients who are admitted for non-emergency surgery is important for minimising patient and staff risk. It is recommended by the Royal Surgical College but is not mandated by any legislation or governmental bodies in the UK⁹. In our neurosurgical unit all patients are currently required to undergo PCR diagnostic testing before surgery regardless of symptoms. The point at which the incidence in community cases falls to a sufficiently low level that testing for asymptomatic individuals is no longer required has not been defined. However, in view of the associated risks it will have to be substantially lower than current levels and may require evidence of individual or widespread community immunity or immunisation.

Surgical factors

Preventing spread of infection to the surgical team relies on pre-procedure testing efficacy and the correct use of PPE – gloves, gowns, eye protection, and a suitable respirator or filtering face piece 3 (FFP3) mask. In the early stages of the pandemic there was a critical shortage of these items.^{24–26} Even with PPE, however, up to 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 also 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 tracts; and use of instruments that create aerosols, such as drills, debriders, electrocautery²⁸ and ultrasonic aspirators.²⁹ Endoscopic transnasal procedures are particularly high risk, and may even spread aerosols through the air-handling system into hospital corridors.^{30–32}

The risk to subsequent patients undergoing surgery in the same operating theatre after a previous COVID-19 positive procedure has not been accurately defined but institutional guidance suggests that we allow a period of time for air-handling systems to clear 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 makes it difficult to plan ahead as hospitals seek to restore elective services whilst maintaining readiness for potential escalation of COVID-19 infections. At the outset of the crisis surgical and anaesthetic staff were re-deployed,³³ and resources such as masks, gowns and ventilators were diverted to manage the pandemic.³⁴ Despite the increased work-load in critical care, total bed utilisation across the board was dramatically lower,³⁵ partly due to 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 UK, emergency attendances were reduced by 29% and admissions by 23%.³⁶ The withdrawal of profitable healthcare services in favour of treating COVID-19 patients, 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: University of California, San Francisco have reported their experience using a four stage surge system with progressive reduction in scheduled theatre activity to correspond with increasing levels of COVID-19 in the hospital and community¹²; one of the most immediate solutions is to create dedicated COVID-19-free patient pathways, diagnostics and operating theatres³⁸; also staffing models can 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 utilising private sector capacity or repurposing some facilities into ‘cold’ COVID-19-free sites for elective surgery.⁴⁰ Concomitant to re-introducing elective surgeries, out-patient clinics will need to be re-established in a controlled and socially-distanced manner, and adequate supply chains for PPE need to be procured for when elective surgeries increase.

External regulation and guidance

At a national level, guidance has been issued to encourage deferment of non-acute cases, from UK government³ and the Surgical Royal Colleges.⁴¹ The Royal College of Surgeons (England) recommend that specific operations should be classified by their urgency: priority level 1a are emergency operations which are needed within 24 hours; priority 1b are urgent operations, needed within 72 hours; priority level 2 operations are those which can be deferred for up to 4 weeks; level 3 operations can be delayed up to 3 months; level 4 operations are non-urgent and can be delayed for more than 3 months without harm.⁴¹ The Society of British Neurological Surgeons (SBNS) has issued guidance that most craniofacial disorders, closed dysraphism, skeletal dysplasias, stable oncological disease, epilepsy, spasticity and functional surgery should be postponed by 3 to 6 months where possible,⁴² and that there should be a higher threshold for surgical treatment of poor grade subarachnoid haemorrhages in the elderly, and perhaps a more conservative approach in neuro-oncology⁴³ and neurotrauma.⁴⁴ Neurosurgeons and theatre schedulers will now need to ‘change gear’ from a mindset of maximal postponement to a balanced position where cases are assessed individually and less urgent surgeries begin to be delivered once again.

Although total hospital bed utilisation has been dramatically lower during the pandemic than usual,³⁵ crossing over the peak does not automatically equate to the release of this capacity to deliver routine care. Hospital planners need to be reassured that there is sufficient responsiveness in the system to handle a possible second peak, as the lockdown comes to an end. To cope with a potential surge, dedicated “cold” sites and overflow units might be created. However the most sustainable way forwards for elective neurosurgery is 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 In **figure 3** we present a simplified schematic of the potential phases of the COVID-19 crisis along with key gateway events required to transition towards a new normal state.

Figure 3. Phases of the COVID-19 crisis and gateway events required to transition between phases

Conclusion

There are many factors that will determine the timing and speed of re-introduction of everyday neurosurgery, and therefore surgical exit strategies for COVID-19 lockdown will vary between hospitals and countries. It will not be possible to have all measures in place prior to recommencing non-emergency neurosurgery, and therefore it is reasonable to start introducing elective neurosurgery again once the following minimum criteria have been fulfilled:

1. *Prioritisation 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, and therefore it is crucial to identify operations that fall into class 2 (those needed within 4 weeks) as the first group to re-introduce. The number of class 2 operations needed will determine the level of additional service requirement for exiting the lockdown scenario.^{41,46}

2. *Decreased incidence of COVID-19 infection.* The number of infected cases must be on the decline to release sufficient healthcare resources for class 2 priority surgeries to restart. There should be spare capacity in hospital beds, and medical and nursing staff should be sufficiently rested to allow return of normal service. Since most elective services would have been cancelled to allow staff to tend to an increased emergency workload during the initial surge of COVID-19 infection, after passing the peak there should be an obvious hiatus when staff notice an easing of the workload and may 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, whilst maintaining a level of responsiveness should there be a second peak of COVID-19 incidence. Availability of surgeons and anaesthetists, intensive care and ward capacity, adequate staffing levels, and re-establishment of diagnostic and imaging services will be crucial in this phase.
3. *Testing for COVID-19.* Testing of patients who are admitted for non-emergency surgery is important for minimising patient and staff risk. If no testing is available, then all operations should continue with full PPE according to local protocols, and endoscopic trans-nasal surgery should be avoided unless time-critical. If a patient has a negative test, then the level of appropriate PPE should be decided according to local protocols. Comprehensive testing will allow risk stratification for patients and is important for informed consent, and also for reassurance of staff.
4. *Co-ordination of strategy.* One of the key recent improvements during the COVID-19 pandemic has been the development of rapid lines of communication between government, regional networks and local hospital management, clinicians, nurses, and essential healthcare support workers. These systems need to continue, to maintain responsiveness to an ever-changing 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

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Figure 1. Flattening the curve and raising the line in response to the SARS-CoV-2 pandemic

At the time of writing, the UK is on a downward trend from a daily peak of UK 953 deaths on 10th April 2020 to 627 deaths on 17th May 2020.¹ As the incidence of new cases and deaths fall it is timely to look at how we safely and effectively restore non-emergency neurosurgical care, whilst maintaining the flexibility to adapt to any resurgence in COVID-19 cases.^{7,8} This requires a coherent and practical ‘exit strategy’.^{9,10} We discuss the challenges to re-establishing elective neurosurgical practice in the post-COVID-19 era, and how to return to a new normal.

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The aim of this article is to identify core themes and challenges that may limit resumption of a normal neurosurgical service after the SARS-CoV-2 pandemic, and to provide pragmatic advice and potential solutions that may be of utility to clinicians looking to resume non-emergency neurosurgical care. We undertook a review of international COVID-19 policies (political and healthcare focussed), a wide range of journalistic and media sources, and expert opinion to address the stated aims. We suggest how we might overcome these challenges and outline the requirements for a successful neurosurgical exit strategy from the pandemic.

Discussion

In the UK changes to configuration and delivery of neurosurgical services included deferral of non-urgent treatment, and redeployment of neurosurgical staff to support critical care and medical capacity for COVID-19 patients.^{11,12,13} Reduction in the provision of non-emergency neurosurgical care has been necessary to protect patients from unnecessary exposure during hospital visits, reduce risks to healthcare practitioners, and to preserve limited supplies of personal protective equipment (PPE). It is likely that there is a group of patients with urgent or even life-threatening neurosurgical pathologies who have not sought attention due to fears of COVID-19 or overloading the burdened healthcare system, or perhaps have been subject to deferral of diagnostic tests. The backlog of neurosurgical cases will vary by region but estimates are that at least half of all indicated neurosurgical operations have been cancelled since the start of the pandemic.¹⁴ To move from our

current position to one of in which we can provide the full range of urgent and elective neurosurgical care will require navigation through uncharted territory. Here we highlight some of the major challenges that neurosurgeons will face (summarised in **figure 2**) and offer a pragmatic approach for a staged return to full neurosurgical service.

Figure 2. Key factors in re-establishing non-emergency neurosurgical care, limited by COVID-19

Patient factors

The willingness of patients to undergo surgery will be a key driver for the resumption of elective neurosurgical services. In the absence of robust quantitative risk data, patient confidence may be dependent on the availability of antibody tests capable of demonstrating confirmed immunity in preference to polymerase chain reaction (PCR) based diagnostic testing.¹⁵ Current availability of antibody testing is limited and data regarding the durability of immunity conferred by COVID-19 infection is lacking.¹⁶ The current PCR testing for COVID-19 carries 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 RT-PCR tests for a median 20 days, and some patients may be asymptomatic carriers.¹⁹ The availability of antibody testing would allow risk stratification for the resumption of elective operating. At the very least, patients should self-isolate for 14 days prior to elective procedures, be asymptomatic, and preferably have two negative COVID-19 antigen tests within a few days of proposed surgery.

COVID-19 positive patients undergoing surgery in Wuhan revealed that almost half of the patients required critical care admission postoperatively and 20.5% of these patients died.²⁰ This raises significant concerns for elective neurosurgical practice but the mortality rate in 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 in patients choosing to undergo routine surgery at this point in time should be clearly explained as part of the informed consent process²¹, particularly for black and Asian minority ethnic groups.^{22,23} Other known risk factors for serious COVID-19 infection include increasing age, cardiovascular disease, chronic respiratory disease, diabetes, and obesity. Hence, re-introduction of non-emergency neurosurgical operations may need to be stratified based on the risk profiles of different patient groups. Testing of patients who are admitted for non-emergency surgery is important for minimising patient and staff risk. It is recommended by the Royal Surgical College but is not mandated by any legislation or governmental bodies in the UK⁹. In our neurosurgical unit all patients are currently required to undergo PCR diagnostic testing before surgery regardless of symptoms. The point at which the incidence in community cases falls to a sufficiently low level that testing for asymptomatic individuals is no longer required has not been defined. However, in view of the associated risks it will have to be substantially lower than current levels and may require evidence of individual or widespread community immunity or immunisation.

Surgical factors

Preventing spread of infection to the surgical team relies on pre-procedure testing efficacy and the correct use of PPE – gloves, gowns, eye protection, and a suitable respirator or filtering face piece 3 (FFP3) mask. In the early stages of the pandemic there was a critical shortage of these items.^{24–26} Even with PPE, however, up to 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 also 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 tracts; and use of instruments that create aerosols, such as drills, debriders, electrocautery²⁸ and ultrasonic aspirators.²⁹ Endoscopic transnasal procedures are particularly high risk, and may even spread aerosols through the air-handling system into hospital corridors.^{30–32}

The risk to subsequent patients undergoing surgery in the same operating theatre after a previous COVID-19 positive procedure has not been accurately defined but institutional guidance suggests that we allow a period of time for air-handling systems to clear 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 makes it difficult to plan ahead as hospitals seek to restore elective services whilst maintaining readiness for potential escalation of COVID-19 infections. At the outset of the crisis surgical and anaesthetic staff were re-deployed,³³ and resources such as masks, gowns and ventilators were diverted to manage the pandemic.³⁴ Despite the increased work-load in critical care, total bed utilisation across the board was dramatically lower,³⁵ partly due to 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 UK, emergency attendances were reduced by 29% and admissions by 23%.³⁶ The withdrawal of profitable healthcare services in favour of treating COVID-19 patients, 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: University of California, San Francisco have reported their experience using a four stage surge system with progressive reduction in scheduled theatre activity to correspond with increasing levels of COVID-19 in the hospital and community¹²; one of the most immediate solutions is to create dedicated COVID-19-free patient pathways, diagnostics and operating theatres³⁸; also staffing models can 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 utilising private sector capacity or repurposing some facilities into ‘cold’ COVID-19-free sites for elective surgery.⁴⁰ Concomitant to re-introducing elective surgeries, out-patient clinics will need to be re-established in a controlled and socially-distanced manner, and adequate supply chains for PPE need to be procured for when elective surgeries increase.

External regulation and guidance

At a national level, guidance has been issued to encourage deferment of non-acute cases, from UK government³ and the Surgical Royal Colleges.⁴¹ The Royal College of Surgeons (England) recommend that specific operations should be classified by their urgency: priority level 1a are emergency operations which are needed within 24 hours; priority 1b are urgent operations, needed within 72 hours; priority level 2 operations are those which can be deferred for up to 4 weeks; level 3 operations can be delayed up to 3 months; level 4 operations are non-urgent and can be delayed for more than 3 months without harm.⁴¹ The Society of British Neurological Surgeons (SBNS) has issued guidance that most craniofacial disorders, closed dysraphism, skeletal dysplasias, stable oncological disease, epilepsy, spasticity and functional surgery should be postponed by 3 to 6 months where possible,⁴² and that there should be a higher threshold for surgical treatment of poor grade subarachnoid haemorrhages in the elderly, and perhaps a more conservative approach in neuro-oncology⁴³ and neurotrauma.⁴⁴ Neurosurgeons and theatre schedulers will now need to ‘change gear’ from a mindset of maximal postponement to a balanced position where cases are assessed individually and less urgent surgeries begin to be delivered once again.

Although total hospital bed utilisation has been dramatically lower during the pandemic than usual,³⁵ crossing over the peak does not automatically equate to the release of this capacity to deliver routine care. Hospital planners need to be reassured that there is sufficient responsiveness in the system to handle a possible second peak, as the lockdown comes to an end. To cope with a potential surge, dedicated “cold” sites and overflow units might be created. However the most sustainable way forwards for elective neurosurgery is 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 In **figure 3** we present a simplified schematic of the potential phases of the COVID-19 crisis along with key gateway events required to transition towards a new normal state.

Figure 3. Phases of the COVID-19 crisis and gateway events required to transition between phases

Conclusion

There are many factors that will determine the timing and speed of re-introduction of everyday neurosurgery, and therefore surgical exit strategies for COVID-19 lockdown will vary between hospitals and countries. It will not be possible to have all measures in place prior to recommencing non-emergency neurosurgery, and therefore it is reasonable to start introducing elective neurosurgery again once the following minimum criteria have been fulfilled:

1. *Prioritisation 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, and therefore it is crucial to identify operations that fall into class 2 (those needed within 4 weeks) as the first group to re-introduce. The number of class 2 operations needed will determine the level of additional service requirement for exiting the lockdown scenario.^{41,46}

2. *Decreased incidence of COVID-19 infection.* The number of infected cases must be on the decline to release sufficient healthcare resources for class 2 priority surgeries to restart. There should be spare capacity in hospital beds, and medical and nursing staff should be sufficiently rested to allow return of normal service. Since most elective services would have been cancelled to allow staff to tend to an increased emergency workload during the initial surge of COVID-19 infection, after passing the peak there should be an obvious hiatus when staff notice an easing of the workload and may 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, whilst maintaining a level of responsiveness should there be a second peak of COVID-19 incidence. Availability of surgeons and anaesthetists, intensive care and ward capacity, adequate staffing levels, and re-establishment of diagnostic and imaging services will be crucial in this phase.
3. *Testing for COVID-19.* Testing of patients who are admitted for non-emergency surgery is important for minimising patient and staff risk. If no testing is available, then all operations should continue with full PPE according to local protocols, and endoscopic trans-nasal surgery should be avoided unless time-critical. If a patient has a negative test, then the level of appropriate PPE should be decided according to local protocols. Comprehensive testing will allow risk stratification for patients and is important for informed consent, and also for reassurance of staff.
4. *Co-ordination of strategy.* One of the key recent improvements during the COVID-19 pandemic has been the development of rapid lines of communication between government, regional networks and local hospital management, clinicians, nurses, and essential healthcare support workers. These systems need to continue, to maintain responsiveness to an ever-changing 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

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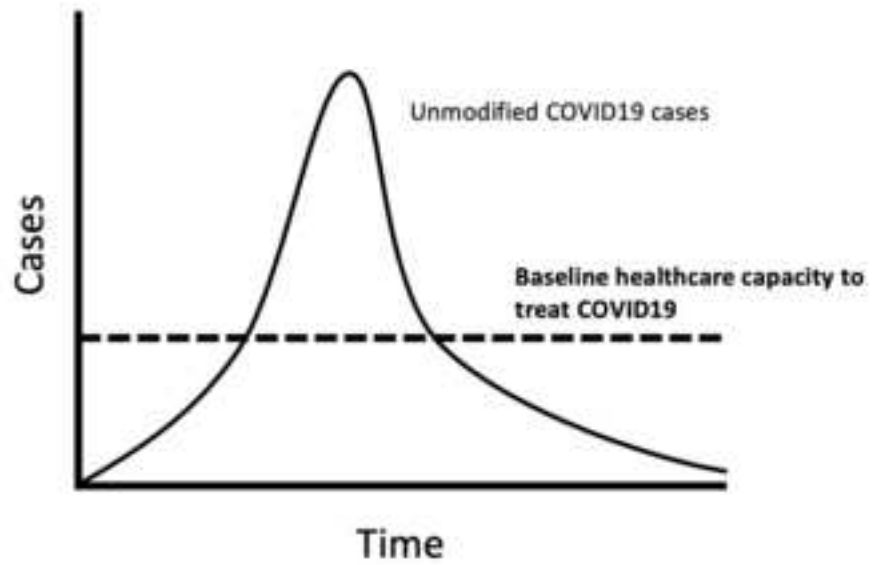
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Without interventions



Interventions to flatten the curve and raise the line

