



# COVID-19: lessons learnt and priorities in trauma and orthopaedic surgery

S Madanipour<sup>1</sup>, F Iranpour<sup>1,2</sup>, T Goetz<sup>3</sup>, S Khan<sup>1,3,4</sup>

<sup>1</sup>Royal Free Trust NHS Foundation Trust, UK

<sup>2</sup>Imperial College London, UK

<sup>3</sup>University of British Columbia, Vancouver, Canada

<sup>4</sup>Queen Mary University of London, UK

## ABSTRACT

The COVID-19 pandemic is the most serious health crisis of our time. Global public measures have been enacted to try to prevent healthcare systems from being overwhelmed. The trauma and orthopaedic (T&O) community has overcome challenges in order to continue to deliver acute trauma care to patients and plan for challenges ahead. This review explores the lessons learnt, the priorities and the controversies that the T&O community has faced during the crisis. Historically, the experience of major incidents in T&O has focused on mass casualty events. The current pandemic requires a different approach to resource management in order to create a long-term, system-sustaining model of care alongside a move towards resource balancing and facilitation. Significant limitations in theatre access, anaesthetists and bed capacity have necessitated adaptation. Strategic changes to trauma networks and risk mitigation allowed for ongoing surgical treatment of trauma. Outpatient care was reformed with the uptake of technology. The return to elective surgery requires careful planning, restructuring of elective pathways and risk management. Despite the hope that mass vaccination will lift the pressure on bed capacity and on bleak economic forecasts, the orthopaedic community must readjust its focus to meet the challenge of huge backlogs in elective caseloads before looking to the future with a robust strategy of integrated resilient pathways. The pandemic will provide the impetus for research that defines essential interventions and facilitates the implementation of strategies to overcome current barriers and to prepare for future crises.

## KEYWORDS

Trauma – Orthopaedics – Resource allocation – COVID-19

Accepted 14 January 2021

## CORRESPONDENCE TO

Suroosh Madanipour, E: [suroosh7@gmail.com](mailto:suroosh7@gmail.com)

## Introduction

The emergence of the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus is the single most serious public health crisis of our time. Initially, global widespread public health measures were enacted to prevent healthcare systems from being overwhelmed. Despite such measures, exponential spread occurred, in some locations overwhelming healthcare delivery.<sup>1</sup> To prevent this eventuality, hospital resources were reorganised and redeployed towards maximising intensive care and overall bed capacity.<sup>2</sup> While health systems primarily focused on ventilator and personal protection equipment (PPE) availability with most elective cases being cancelled, the orthopaedic trauma community continued to operate, tending to the reconstructive trauma that still remained ongoing and in some units increased in workload.<sup>3</sup> During this pandemic there has been an unprecedented depth of international scientific and clinical collaboration with rapid dissemination of emerging evidence. This review explores the current priorities and controversies faced in this global pandemic.

## Recent management of major incidents

Following decades of terrorist attacks,<sup>4</sup> the focus for major incidents in the UK has been on mass casualty events, with robust guidelines and escalation strategies to support this.<sup>5–7</sup> The declaration of a major incident dictates that an NHS trust is able to cancel non-urgent elective operations and expedite the discharge of medically fit patients requiring non-clinical support.<sup>8</sup> Initial treatment has historically centred on damage control resuscitative principles that have filtered from the battlefield.<sup>9</sup>

Similarly, organisation structure takes on a hierarchical framework in the military mould. On 3 March 2020 NHS England declared a level 4 incident, taking ‘command and control’ of the country’s strategic direction and coordination of healthcare resources. The initial goals were to ‘free up maximum possible inpatient and critical care capacity, prepare for the anticipated large numbers of patients requiring respiratory support, support staff and maximise their availability and remove routine burdens’.<sup>6</sup> This was successful in preparing for the initial surge in patients and for the mass

redeployment of staff. The present situation, however, is clearly manifestly different to a mass casualty incident with a rapid up scaling and equally quick standing down of emergency measures. Through a multidisciplinary approach of clinical and non-clinical staff and the fluidity and flexibility of facilitation and resource balancing, a long-term approach is needed. The orthopaedic community rose to the challenge, not only to implement the key directives of the 'level 4 incident', but also to begin to create a system-sustaining model that allows for appropriate resource allocation and ongoing optimal patient care, while minimising risks to both other patients and the team.<sup>10,11</sup> The first challenge was the restructuring of the workforce.

### Workforce restructuring – maximising availability

Orthopaedic surgeons faced a 'drastic cultural shift in duties and responsibilities'<sup>10</sup> with both vertical and horizontal change in workforce allocation on an international level. Redeployment occurred through all levels of staff. In London, junior surgical doctors at core training and registrar grades in Major Trauma Centres and trauma units were reallocated to medical teams as part of a wider 'COVID rota' for the peaks of the first and second waves. Consultants and registrars have continued to deliver acute trauma care while providing support to the intensive care unit (ICU). Orthopaedic experience in the safe positioning of patients has been crucial across many centres in order to prone patients.<sup>12</sup> In New York City, for weeks the global epicentre of the pandemic, and following a sharp decline in trauma admissions, whole orthopaedic and trauma units were repurposed to meet the surge in COVID patients, forming a novel ortho-medical COVID-19 management team.<sup>13</sup>

National and international resilience has been built into the workforce with units adopting team-based systems, cycling active duty and standby or remote working factions (Red, Amber and Green) in order to deliver system sustainability in the event of illness within teams.<sup>14</sup> In contrast to previous planning for mass casualties and critical incidents, there has been a recognition that the current crisis represents an ongoing and potentially indefinite change to working patterns, requiring a sustainable approach to workforce allocation and rota management, while still delivering a high standard of acute care.

### Delivering acute trauma care

One of the greatest tests for the orthopaedic community has been the delivery of safe, effective trauma care in a new, restricted and unmapped landscape. There are several challenges to face:

### Resource deficit

Many hospitals have had access to operating theatres severely restricted. For significant periods, ventilators have been redeployed for critical care with many theatres converted entirely to ICU beds to increase capacity. The anaesthetic workforce has been redeployed en-masse into intensive care rotas.<sup>15</sup> External technical support has been limited by hospital protocol and in some cases by the furloughing of staff in a struggle to maintain liquidity.<sup>16</sup> Shortages of PPE amplified reticence to operate.<sup>17</sup> Moreover, admitting ambulatory trauma patients, intubation and the undertaking of aerosol-generating procedures can increase the risk of transmission.<sup>18</sup>

### Drive for non-operative management

As the scale of the pandemic widened, the acute resource deficit, change in workforce structure and potential risk to patients and staff led to a widespread drive for the non-operative management of acute trauma.<sup>19</sup> The British Orthopaedic Association (BOA) published guidance on management.<sup>20</sup> In the case of ambulatory patients with fractures with high union rates it supported non-operative treatment and consideration of delayed reconstructive surgery. In subspecialties with a trauma burden usually considered as less emergent, this could create an imbalance in the backlog of salvage workload. The American College of Surgeons' (ACS) guidance<sup>21</sup> to reschedule all fractures greater than 4 weeks old, and all 'soft tissue injuries', has differing potential implications, for example with respect to upper limb fractures<sup>22</sup> as compared with lower limb ligamentous injuries.<sup>23</sup> This will require further consideration when allocating resources and time to delayed reconstruction. The Royal Australian College of Surgeons stated 'there is no justification to perform any procedure that can be deferred for six weeks without risk of significant harm to the patient... Opt for non-operative management wherever possible'.<sup>24</sup> While the resuscitation and management of acute polytrauma and high-energy injuries remained a clinical priority,<sup>25</sup> the BOA recommended early full weight bearing to minimise inpatient stay, and consideration of early amputation for patients unlikely to benefit from multiple re-operations for limb salvage. As the imaging modality of choice for COVID pneumonitis, access to computed tomography scanning was often minimised.<sup>19,25</sup> In a new set of circumstances, the orthopaedic trauma community accepted that the best interests of many patients were served through attentive non-operative management and consideration of delayed reconstructive options.

### Strategic changes – orthopaedic networks

Regional and national strategic changes have occurred to usual pathways in established trauma networks in order to maximise inpatient bed capacity for COVID-19 patients and minimise the burden on critical care units. In North and Central London, multiple acute hospitals redirected trauma patients requiring operative management

to a tertiary referral centre normally utilised for complex elective, cancer and paediatric surgery.<sup>26</sup> This was particularly effective in ensuring ongoing surge capacity in trusts continuing to provide care to COVID-19 patients, but also in the effort to shield vulnerable and elderly fragility fracture patients themselves and enable timely intervention. In the UK, clear national guidance on fragility fractures stated that 'confirmed or suspected coronavirus infection is not a reason to delay or cancel surgery' and that prompt treatment may reduce length of stay.<sup>27</sup>

Hub and spoke orthopaedic networks have been used to great effect for severely injured trauma patients,<sup>28</sup> and the future of complex elective surgery could exist in a similar model.<sup>29</sup> The rapid and effective logistical turnaround demonstrated to realise such strategic change is a testament to what can be achieved when such networks are implemented.

### Outpatient care – virtual clinics, telemedicine and the future?

The need to safeguard patients and staff has seen the accelerated expansion and delivery of virtual clinics, telemedicine and minimisation of face-to-face contact. This technology has been available for some time.<sup>30</sup> There has been widely accepted evidence that virtual appointments do not impact on patient satisfaction, and can significantly reduce foot fall, while adequately triaged and selected fracture clinic appointments have been shown to be safe, cost effective and reproducible.<sup>31,32</sup> In the elective setting, patients have demonstrated further enthusiasm for accessible and timely telehealth consultations.<sup>33</sup> In-person visits can be limited to first postoperative reviews and urgent cases, and preoperative 'joint school' can be completed virtually. Crowded waiting rooms, and hospital visits for those most at risk, may not be desirable for many months or even years to come. It is important that we come to accept this. The telehealth revolution will enable the ongoing delivery of safe outpatient care, and now is the opportunity for health systems to widely embrace, evaluate and adapt. Importantly we must ensure that this is done without patients perceiving that corners are being cut, concerns are being ignored or that care is substandard.

### Delivery of elective care

Restructuring and prioritisation of services has enabled the ongoing delivery of acute trauma care; however, globally the response to surges in caseload have been to cancel or postpone all but the most urgent elective cases. This has caused an unacceptable backlog in care. Clearly this will cause an impact on the ever-expanding untreated cohorts of both scheduled and undiagnosed patients with chronic musculoskeletal disease.<sup>34</sup> The long-term consequences of this remain unknown.

As the first peak of new cases and daily deaths in the UK began to decline in May, NHS England called for a move to the second stage in the response, including a return to routine elective surgery.<sup>35</sup> A carefully considered approach was implemented, in order to safeguard patients and staff. Early reports from Wuhan were encouraging, with strict adherence to protocol enabling 50 spinal surgeries on COVID positive patients with no subsequent infection of healthcare workers.<sup>36</sup> However, there remained concerns over safety, after a study of arthroplasty cases performed in Northern Italy revealed a 1.2% COVID mortality rate after patients contracted SARS-CoV-2 during rehabilitation.<sup>37</sup>

Guidelines for the resumption of elective surgery were set out by the BOA, RCS, ACS and the American Society of Anesthesiologists. An international consensus group of 77 physicians in orthopaedic surgery, infectious disease, microbiology, virology and anaesthesia set out a roadmap for resuming elective surgery.<sup>38</sup> Recommendations were categorised in to key factors:

#### Timing

There should be a sustained reduction in the rate of new COVID-19 cases in the region in question before undergoing the resumption of elective work.<sup>38,39</sup>

#### PPE

Hospitals should be satisfied that adequate PPE is available for the number and type of procedure to be performed, and does not risk outstripping supply in critical care areas.

The principles outlined in these guidelines allowed for the creation of 'green' COVID-free pathways to minimise risk to patients, staff and society as a whole and to allow a return to elective work.<sup>40</sup> Maintaining such pathways has also necessitated reduced staff movement between COVID and non-COVID sites, reduced visiting and rigorous infection control measures.<sup>41</sup>

#### Testing

Patients should undergo and demonstrate negative RT-PCR test for SARS-CoV-2 within 2 to 7 days of surgery while hospitals should be aware of testing requirements and limitations. Vaccination status should be considered before consideration of exposing a patient during an elective admission.

#### Patients and prioritisation

Patients should be risk stratified and those with significant comorbidities scheduled after healthier patients, until mass vaccination has suppressed transmission. An evaluation should be made not only of the urgency of the procedure, but of expected length of stay, procedure duration, workforce requirement and likely critical care and rehabilitation requirements, in order to create a prioritisation framework.<sup>42</sup>

Social distancing must be maintained, including the avoidance of shared surgical bays. Preoperative assessment should include special attention to COVID-19. Patients

should continue to self-isolate in the preoperative period.<sup>58</sup> Patient preference should be taken into account also, with shared decision making and understanding of risks and benefits.<sup>42</sup>

### Outpatient elective surgery

In appropriately selected patients, outpatient arthroplasty has been demonstrated to be safe and effective.<sup>43</sup> In upper limb surgery, the use of wide awake local anaesthetic no tourniquet (WALANT) protocols has already become prevalent and can reduce the rate of inpatient stay.<sup>44</sup> With a stratified patient cohort and appropriate coordination between the multidisciplinary team, including the use of regional anaesthesia to minimise transmission risks, inpatient bed capacity and resources can be preserved with outpatient fast-track pathways.<sup>45</sup> Now is the time to embrace such change enthusiastically.

Efficiency, however, is unlikely to return quickly, with units reporting a doubling of turnover times.<sup>41</sup> This will have implications for patients but also for hospital reimbursement and for industry partners. In the US, some hospitals have experienced increasing costs and decreasing revenues that threaten their financial viability.<sup>46</sup> In the UK, government borrowing has risen to the highest level since the Second World War, and well above the financial crisis peak. Though NHS debt was 'written-off' in one stroke in April<sup>47</sup>, we must remain vigilant to the challenges that budget pressures of this magnitude will create in the coming years.

### Training

Elective surgeries have been postponed, and during lockdowns, trauma case volume has dwindled, resulting in an inevitable global impact on orthopaedic education and training.<sup>48</sup> Trainees and consultants alike have had to reengage with and relearn certain 'lost arts' of active non-operative fracture management including manipulation, plaster moulding and reduction aids.<sup>19</sup> In lieu of the traditional 'trauma meeting' forum for discussion, didactic and interactive teaching has continued through videoconferencing and webinars. Many clinical trials have experienced pauses, though journal clubs have continued remotely.

Simulation training has been demonstrated to facilitate and amplify training performance,<sup>49</sup> but there is a paucity of evidence to suggest that simulation alone can suitably redress the impact of reduced caseload for trainees. While the traditional methods of apprenticeship remain safe and effective,<sup>50</sup> there can be little substitute for the 'real thing', and the requirement for minimum case numbers will stand. Successful horizontal workforce reallocation to differing specialties and environments has illustrated the potential feasibility of 'broad-based specialty training' and a more holistic approach to training of orthopaedic surgeons as part of a cohesive group of hospital specialties.

### Conclusion

At the time of writing, the UK and much of the world is still gripped in huge surges of inpatient demand for COVID-19 care. A great deal of uncertainty remains, even with hope of deliverance in the form of the mass vaccination programmes that are under way in many countries. 'Business as usual' in orthopaedics is unlikely to resume anytime soon. We must continue to adapt and innovate in order to deliver high standards of care to our patients. Innovation in healthcare is hard but the huge support and drive in the current climate opens new opportunities to implement strategies to make long-lasting improvement.

Restarting services can be seen as a unique chance to execute large-scale healthcare structuring plans such as the Hub and spoke orthopaedic networks for complex elective surgery.<sup>29</sup> Tech-based innovation can include implementing telemedicine to provide patients with safer, easier access to healthcare services and to reduce cost. Wider use of surgical planning methods may reduce operating time and possibly costs by reducing the inventory. Various phone and computer applications are being used to reduce face-to-face physical therapy, to measure and improve outcomes. These significant changes will provide trauma and orthopaedic (T&O) departments with the incentive to produce meaningful research to define essential interventions and implement strategies to overcome future crises.

Even as vaccines reduce the pressure on healthcare systems, we must accept that seasonal viral epidemics are unlikely to disappear, nor are the enormous challenges of ageing populations in developed economies. There will be ongoing winter crises, respiratory viruses and new healthcare challenges including the recruitment and retention of the workforce. It is clear that elective orthopaedic work must be uncoupled and adequately ring fenced from acute hospitals in order to meet the vast, growing workload in musculoskeletal care. Further high-quality research must be directed towards adequately and efficiently meeting this demand, especially in the context of global recession.

There is no doubt that there is a vast amount of work to be done in both the acute trauma and elective setting. In this paper we have tried to highlight issues in T&O practice during the COVID-19 era. It is important to use the ever-expanding body of evidence and work together with the wider healthcare community to build resilience for the future and deliver effective care.

### References

1. Remuzzi A, Remuzzi G. COVID-19 and Italy: what next? *Lancet* 2020; **395**: 1225–1228.
2. Stevens S, Pritchard A. Next steps on NHS response to COVID-19. <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/urgent-next-steps-on-nhs-response-to-covid-19-letter-simon-stevens.pdf> (cited December 2020).
3. Giorgi PD, Gallazzi E, Capitani P *et al.* How we managed elective, urgent, and emergency orthopedic surgery during the COVID-19 pandemic. *Bone & Joint Open* 2020; **1**: 93–97.

4. House of Commons Library. Terrorism in Great Britain: the statistics. <https://commonslibrary.parliament.uk/research-briefings/cbp-7613/> (cited December 2020).
5. London Assembly. Report of the 7 July review committee. <https://researchbriefings.files.parliament.uk/documents/CBP-7613/CBP-7613.pdf> (cited December 2020).
6. NHS England. Concept of operations for managing mass casualties. <https://www.england.nhs.uk/wp-content/uploads/2018/03/concept-operations-management-mass-casualties.pdf> (cited December 2020).
7. NHS England National Emergency Preparedness Resilience and Response Unit. NHS England emergency preparedness, resilience and response framework. <https://www.england.nhs.uk/wp-content/uploads/2015/11/epr-framework.pdf> (cited December 2020).
8. Johnson C, Cosgrove J. Hospital response to a major incident: initial considerations and longer term effects. *BJA Educ* 2016; **16**: 329–333.
9. Moran CG, Webb C, Brohi K et al. Lessons in planning from mass casualty events in UK. *BMJ* 2017; **359**: j4765.
10. Mauffrey C, Trompeter A. Lead the way or leave the way: leading a department of orthopedics through the COVID-19 pandemic. *Eur J Orthop Surg Traumatol* 2020; **30**: 555–557.
11. Stinner DJ, Lebrun C, Hsu JR et al. The orthopaedic trauma service and COVID-19 – practice considerations to optimize outcomes and limit exposure. *J Orthop Trauma* 2020; **34**: 333–340.
12. Houston J, Smith D, Nguyen A, Puntis M. Proning in COVID-19: What, Why, How? A brief for orthopaedic surgeons. *Transient J Trauma, Orthop Coronavirus* 2020. <https://www.boa.ac.uk/resources/knowledge-hub/proning-in-covid-19-what-why-how-a-brief-for-orthopaedic-surgeons.html> (cited December 2020).
13. Konda SR, Dankert JF, Merkow D et al. COVID-19 Response in the global epicenter: converting a New York City level 1 orthopedic trauma service into a hybrid orthopedic and medicine COVID-19 management team. *J Orthop Trauma* 2020; **34**: 411–417.
14. Schwartz AM, Wilson JM, Boden SD et al. Managing resident workforce and education during the COVID-19 pandemic: evolving strategies and lessons learned. *JBJS Open Access* 2020; **5**: e0045.
15. NHS England. Redeploying your secondary care medical workforce safely. [https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/Redeploying-your-secondary-care-medical-workforce-safely\\_26-March.pdf](https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/Redeploying-your-secondary-care-medical-workforce-safely_26-March.pdf) (cited December 2020).
16. Stryker CA. Zimmer Biomet & more. How 12 device companies are controlling costs during COVID-19: Becker's Spine Review. <https://www.beckersspine.com/orthopedic-a-spine-device-a-implant-news/item/48787-stryker-zimmer-biomet-more-how-8-device-companies-are-controlling-costs-during-covid-19.html> (cited December 2020).
17. Public Health England. Considerations for acute personal protective equipment (PPE) shortages. <https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/managing-shortages-in-personal-protective-equipment-ppe> (cited December 2020).
18. Peng PWH, Ho PL, Hota SS. Outbreak of a new coronavirus: what anaesthetists should know. *Br J Anaesth* 2020; **124**: 497–501.
19. NHS England. Clinical guide for the management of trauma and orthopaedic patients during the coronavirus pandemic. <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/C0274-Specialty-guide-Orthopaedic-trauma-v2-14-April.pdf> (cited December 2020).
20. British Orthopaedic Association. BOAST – Management of patients with urgent orthopaedic conditions and trauma during the coronavirus pandemic. <https://www.boa.ac.uk/resources/covid-19-boasts-combined.html> (cited December 2020).
21. American College of Surgeons. COVID-19 guidelines for triage of orthopaedic patients. <https://www.facs.org/covid-19/clinical-guidance/elective-case/orthopaedics> (cited December 2020).
22. Woltz S, Krijnen P, Schipper IB. Plate fixation versus nonoperative treatment for displaced midshaft clavicular fractures: a meta-analysis of randomized controlled trials. *J Bone Joint Surg Am* 2017; **99**: 1051–1057.
23. Hantes M, Fylos A, Papageorgiou F et al. Long-term clinical and radiological outcomes after multiligament knee injury using a delayed ligament reconstruction approach: a single-center experience. *Knee* 2019; **26**: 1271–1277.
24. Royal Australian College of Surgeons. RACS guidelines for the management of surgical patients during the COVID-19 pandemic. <https://umbraco.surgeons.org/media/5137/racs-guidelines-for-the-management-of-surgical-patients-during-the-covid-19-pandemic.pdf> (cited December 2020).
25. NHS England. Clinical guide for the management of major trauma patients during the coronavirus pandemic. <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/C0070-specialty-guide-major-trauma-clinical-guide-27-march-2020.pdf> (cited December 2020).
26. Group NCLCC. Covid-19 North Central London (NCL) System Update. <https://www.northlondonpartners.org.uk/stp-news/ncl-update-covid-19-1-april-2020/107818> (cited December 2020).
27. NHS England. Clinical guide for the perioperative care of people with fragility fractures during the Coronavirus pandemic. <https://static1.squarespace.com/static/5e6613a1dc75b87df82b78e1/t/5e7b2d9f284dccc611e0b9391/1585130911931/NHSE-Fragility-Fractures-Coronavirus.pdf> (cited December 2020).
28. Moran CG, Lecky F, Bouamra O et al. Changing the system – major trauma patients and their outcomes in the NHS (England) 2008–17. *E Clinical Medicine* 2018; **2-3**: 13–21.
29. Ahmed SS, Haddad FS. Networks in orthopaedics. *Bone Joint J* 2020; **102-B**: 273–275.
30. Grona SL, Bath B, Busch A et al. Use of videoconferencing for physical therapy in people with musculoskeletal conditions: a systematic review. *J Telemed Telecare* 2018; **24**: 341–355.
31. Sathiyakumar V, Apfeld JC, Obremesky WT et al. Prospective randomized controlled trial using telemedicine for follow-ups in an orthopedic trauma population: a pilot study. *J Orthop Trauma* 2015; **29**: e139–e145.
32. Breathnach O MOR, Conlon B, Kiernan C, Sheehan E. Trauma assessment clinic: virtually a safe and smarter way of managing trauma care in Ireland. *Injury* 2019; **50**: 898–902.
33. Cheng O, Law NH, Tulk J, Hunter M. Utilization of telemedicine in addressing musculoskeletal care gap in long-term care patients. *J Am Acad Orthop Surg Glob Res Rev* 2020; **4**: e19.00128.
34. Harris IA, Hatton A, Pratt N et al. How does mortality risk change over time after hip and knee arthroplasty? *Clin Orthop Relat Res* 2019; **477**: 1414–1421.
35. NHS England. Second phase of NHS response to COVID-19. <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/04/second-phase-of-nhs-response-to-covid-19-letter-to-chief-exec-29-april-2020.pdf> (cited December 2020).
36. Hua W, Zhang Y, Wu X et al. Spinal surgery and related management on patients with COVID-19: experience of a regional medical centre in Wuhan. *Bone & Joint Open* 2020; **1**: 88–92.
37. D'Apolito R, Faraldi M, Ottaiano I, Zagra L. Disruption of arthroplasty practice in an orthopedic center in northern Italy during the coronavirus disease 2019 pandemic. *J Arthroplasty* 2020; **35**: S6–S9.
38. Parvizi J, Gehrke T, Krueger CA et al. Resuming elective orthopaedic surgery during the covid-19 pandemic: guidelines developed by the international consensus group (icm). *J Bone Joint Surg Am* 2020; **102**: 1205–1212.
39. American Society of Anesthesiologists. Joint Statement: Roadmap for Resuming Elective Surgery after COVID-19 Pandemic. <https://www.asahq.org/about-asa/newsroom/news-releases/2020/04/joint-statement-on-elective-surgery-after-covid-19-pandemic> (cited December 2020).
40. British Orthopaedic Association. Re-starting non-urgent trauma and orthopaedic care: Full guidance. <https://www.boa.ac.uk/resources/boa-guidance-for-restart-full-doc-final2-pdf.html> (cited December 2020).
41. Oussedik S, Zagra L, Shin GY et al. Reinstating elective orthopaedic surgery in the age of COVID-19. *Bone Joint J* 2020; **102-B**: 807–810.
42. NHS London. *Recommending surgical and interventional medical services prioritisation framework: a pan London approach*. 2020.
43. Pollock M, Somerville L, Firth A, Lanting B. Outpatient total Hip arthroplasty, total knee arthroplasty, and unicompartmental knee arthroplasty: A systematic review of the literature. *JBJS Rev* 2016; **4**: 01874474–201612000-00004.
44. O'Neill N, Abdall-Razak A, Norton E et al. Use of wide-awake local anaesthetic No tourniquet (WALANT) in upper limb and hand surgery: A systematic review protocol. *Int J Surg Protoc* 2020; **20**: 8–12.
45. Lie SA, Wong SW, Wong LT et al. Practical considerations for performing regional anesthesia: lessons learned from the COVID-19 pandemic. *Can J Anesth* 2020; **67**: 885–892.
46. Zeegen EN, Yates AJ, Jevsevar DS. After the COVID-19 pandemic: returning to normalcy or returning to a new normal? *J Arthroplasty* 2020; **35**: S37–S41.
47. Care DoHaS. NHS to benefit from £13.4 billion debt write-off. <https://www.gov.uk/government/news/nhs-to-benefit-from-13-4-billion-debt-write-off> (cited December 2020).
48. Kogan M, Klein SE, Hannon CP, Nolte MT. Orthopaedic education during the COVID-19 pandemic. *J Am Acad Orthop Surg* 2020; **28**: e456–e464.
49. Vaghela KR, Lee J, Akhtar K. Performance on a virtual reality DHS simulator correlates with performance in the operating theatre. *Surg Technol Int* 2018; **33**: sti33/1040.
50. Singh P, Madanipour S, Fontalis A et al. A systematic review and meta-analysis of trainee- versus consultant surgeon-performed elective total hip arthroplasty. *EFORT Open Rev* 2019; **4**: 44–55.