Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Commentary on:
Spine Surgery in Italy in the COVID-19 Era: Proposal for Assessing and Responding to the Regional State of Emergency by **Rispoli et al. World Neurosurg 2020**
https://doi.org/10.1016/j.wneu.2020.08.001

Response to Surgical Triage in an Evolving Pandemic Based on Disease Classification and Predictive Modeling

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The COVID-19 global pandemic has had a profound effect on not only our daily way of life, but also on health care delivery and health systems worldwide. During the winter and spring of this year, health systems responded to the pandemic threat with a battery of public health measures designed to both treat and triage the ill, but also to prevent infections and, importantly, to prepare the health system itself for a surge of infected patients.[1] One of the most common mechanisms to increase health system and hospital capacity has been the cancellation or delay of scheduled and elective surgery.[2-6]

Those who argue for elective surgery postponements cite several critical benefits. First, the reduced utilization of resources such as operating room time, drug and blood products, and equipment such as ventilators allows for reallocation to treat those patients who become ill and hospitalized with COVID-19.[7] Furthermore, the reduction in staff utilization allows redeployment to areas of high demand. Although spinal surgeons may not be directly reallocated, they may be able to fill in gaps in care where colleagues in other disciplines (such as orthopedic and neurosurgical trauma care) have been called upon take on new clinical duties. Importantly, other surgical staff such as nurses and anesthesiologists can also be redeployed to clinical areas where their skills are required.

Secondly, admission of patients to hospital introduces the risk of nosocomial infection.[6,8] As the incubation period of the novel coronavirus averages around 5 or 6 days, patients may present to hospital infected without symptoms and subsequently risk further spread to others.[9] Furthermore, patients are at risk while admitted to hospital of transmission from other patients or hospital workers. Adding to the impact of this particular risk, patients who undergo surgery while ill with COVID-19 have a significantly increased mortality risk.[10]

The reallocation of resources, however, is not without consequence. In other areas of medicine, such as cardiac care,[11] the treatment of other infectious diseases such as tuberculosis and human immunodeficiency virus,[12] and even time-sensitive cancer care and stem cell transplant,[13] the shift of available clinical resources may already be having consequences and putting patients at risk of adverse outcomes from other health conditions. Additionally, the resumption of surgical and other procedural services will represent a significant logistical and clinical challenge, especially in health systems that have limited ability to add surgical capacity once the pandemic restrictions have passed.[2,6]

The overwhelming body of advice from multiple surgical societies has strongly advised complete cessation of surgical procedures that can be postponed or delayed,[4] and it appears that these guidelines have been followed,[2,6,14] with only some ambulatory procedures continuing.[8] The obvious consequence of this policy is the need to address the potential morbidity of delayed care, especially given that the timeline for the resumption of normal surgical services is far from clear. It is well established that withholding care from patients for whom surgical intervention has distinct and predictable benefit in

Key words
- COVID-19
- Emergency
- Making decision
- Spine surgery

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Citation: World Neurosurg. (2020) 143:412-414.
https://doi.org/10.1016/j.wneu.2020.08.063

order to preserve resources for future need is neither appropriate nor morally acceptable.[15]

The practice of spine surgery includes many patients with chronic clinical pathologies as well as some with acute presentations. It also varies between short procedures, such as posterior decompression operations that are often performed in an ambulatory, outpatient fashion, up to multistage, multiday procedures that incur significant morbidity and long hospital length of stay, and utilize considerable hospital resources. Given this variety, spine surgery units around the world have faced a challenge in attempting to rationalize the suspension of some surgical services while prioritizing others. There is little doubt that this challenge has been approached differently across the globe and the evidence also points to a substantial burden of anxiety and even financial stress among the spine surgical community.[14]

Several groups have attempted to define fair and objective criteria for the continuation of selected spine procedures during pandemic situations.[16-18] In addition, work was done early in the pandemic by several groups in Southeast Asia to both develop treatment plans and create standardized protocols for screening of patients requiring urgent or elective surgery.[8,16] All groups and current guidelines share certain characteristics. This includes allowing procedures for treating urgent or progressive neurological deficit, acute spinal trauma either with significant acute instability or neurologic injury, and most surgical procedures deemed necessary for oncologic indications to proceed. At least 1 group has also suggested that certain urgent but less acute surgical procedures could be transferred to alternate centralized facilities in order to avoid placing additional strain on hospitals with a large burden of care for patients with respiratory illness.[4,18]

One of the difficulties in comparing the approach of different groups is the interpretation of the impact that the delay may have on patient outcomes. Unlike triage during wartime or other natural disasters, where the timeline for the resumption of services may be clearer, no such guidance exists during the current pandemic. Several groups have indicated that surgical treatment that can be delayed for more than 4 weeks could and perhaps should be postponed.[4] Others, however, make the argument that delaying care now may simply result in more difficult decisions having to be made later if resources are not immediately made available.[5] Whereas the decision to proceed with surgical care for those patients with acute neurological injury such as cervical myelopathy or metastatic epidural spinal cord compression may be clear, measuring this impact in other spinal pathologies such as lumbar stenosis is far more difficult to interpret.[19] This presents the spine surgeon with a situation of significant moral hazard as they feel pressure to advocate for their own patients. Formal structured and objective guidelines that are highly responsive are required to resolve these difficult conflicts and ethical dilemmas.[15]

In their paper, Rispoli et al.[20] have introduced several important and novel concepts to address this challenge. These principles were developed as the pandemic took hold in northern Italy. Similar to other authors, they have defined spinal pathologic diagnoses into those which are considered urgent and less urgent. More importantly however, they utilize a so-called heat map technique that is based not only on the hospital occupancy or overall population prevalence of disease but rather a combination of the intensive care unit (ICU) occupancy by patients suffering from COVID-19 as well as the doubling time in the population at large. Although numerous data points are truly required to estimate the trajectory of the novel infectious disease, the authors here attempt to predict the utilization of resources as the pandemic evolves. Understanding that incubation period and hospital length of stay may be impossible to predict over the longer term in the broader population, this approach potentially identifies points in time when the health system may be able to tolerate the added burden of additional elective surgical care.[7,9]

The novelty of this work is not that it provides any further rationale or refinement of placing spinal pathologies into different categories based on urgency. At the onset of the pandemic, when resources were restricted globally, this factor was the only information required to triage patients. The novel approach discussed in this work is the introduction of a decision-making scheme that is both objective but also measures three factors: (1) the urgency of the clinical problem, (2) the current load on critical care beds, and (3) the predicted future need for resources. The use of parameters such as doubling time and ICU capacity have been used in other epidemiological models.[21] The result is a model with 2 specific advantages. First, the system is objective rather than discretionary. Second, it can more safely predict the potential need for diverting hospital resources away from elective surgery in the near future, and can help policy makers to restart surgical care earlier as doubling time lengthens before a marked reduction in hospital and ICU occupancy can easily be measured. As the restrictions on health care resources are likely to become cyclical periods of opening and closing, this latter benefit is particularly important.[22]

The importance of this type of work cannot be overstated. At the time of writing, many countries are experiencing a resurgence of novel coronavirus infections and many health care systems, which had begun to resume normal activity, are once again facing strain.[23,24] In the early phases of the pandemic, advice to the medical community was abundantly clear to halt all nonessential medical procedures. It is equally clear now, however, that as the pandemic continues to evolve, the treatment (including surgical care) for musculoskeletal conditions such as spinal pathology cannot be postponed indefinitely. The enormous burden of disease for these issues mandates a rational approach to assessing the risk of withholding treatment compared with the potential consequence of impeding the care of those who may become ill in the future with COVID-19.[25] It is likely that it will be years before health systems can return to the prior normal state and public health measures can be completely relaxed. The ability of systems that provide surgical care to remain nimble with an impartial distribution of surgical and nonsurgical resources will be critical to the health of patients and populations.

REFERENCES

1. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*. 2020;323:1239-1242.
2. Soreide K, Hallet J, Matthews JB, et al. Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services [e-pub ahead of print]. *Br J Surg*. 2020. https://doi.org/10.1002/bjs.11670, accessed September 3, 2020.
3. Ross SW, Lauer CW, Miles WS, et al. Maximizing the calm before the storm: tiered surgical response plan for novel coronavirus (COVID-19). *J Am Coll Surg*. 2020;230:1080-1091. e1083.
4. Moletta L, Pierobon ES, Capovilla G, et al. International guidelines and recommendations for surgery during Covid-19 pandemic: a systematic review. *Int J Surg*. 2020;79:180-188.
5. COVIDSurg Collaborative. Global guidance for surgical care during the COVID-19 pandemic [e-pub ahead of print]. *Br J Surg*. 2020. https://doi.org/10.1002/bjs.11646, accessed September 3, 2020.
6. Brindle ME, Doherty G, Lillemoe K, Gawande A. Approaching surgical triage during the COVID-19 pandemic. *Ann Surg*. 2020;272:e40-e42.
7. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City Area. *JAMA*. 2020;323:2052-2059.
8. Chang Liang Z, Wang W, Murphy D, Po Hui JH. Novel coronavirus and orthopaedic surgery: early experiences from Singapore. *J Bone Joint Surg Am*. 2020;102:745-749.
9. Lauer SA, Grantz KH, Bi Q, et al. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. *Ann Intern Med*. 2020;172:577-582.
10. Lei S, Jiang F, Su W, et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. *EClinicalMedicine*. 2020:100331.
11. Metzler B, Siostrzonek P, Binder RK, Bauer A, Reinstadler SJ. Decline of acute coronary syndrome admissions in Austria since the outbreak of COVID-19: the pandemic response causes cardiac collateral damage. *Eur Heart J*. 2020;41:1852-1853.
12. Adepoju P. Tuberculosis and HIV responses threatened by COVID-19. *Lancet HIV*. 2020;7:e319-e320.
13. Burki TK. Cancer care in the time of COVID-19. *Lancet Oncol*. 2020;21:628.
14. Louie PK, Harada GK, McCarthy MH, et al. The Impact of COVID-19 Pandemic on Spine Surgeons Worldwide. *Glob Spine J*. 2020;10:534-552.
15. Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of COVID-19. *N Engl J Med*. 2020;382:2049-2055.
16. Zou J, Yu H, Song D, Niu J, Yang H. Advice on standardized diagnosis and treatment for spinal diseases during the coronavirus disease 2019 pandemic. *Asian Spine J*. 2020;14:258-263.
17. Prost S, Charles YP, Allain J, et al. French Spine Surgery Society guidelines for management of spinal surgeries during COVID-19 pandemic. *World J Clin Cases*. 2020;8:1756-1762.
18. Donnally CJ 3rd, Shenoy K, Vaccaro AR, Schroeder GD, Kepler CK. Triaging spine surgery in the COVID-19 era. *Clin Spine Surg*. 2020;33:129-130.
19. Bailey CS, Gurr KR, Bailey SI, et al. Does the wait for lumbar degenerative spinal stenosis surgery have a detrimental effect on patient outcomes? A prospective observational study. *CMAJ Open*. 2016;4:E185-E193.
20. Rispoli R, Giorgiutti F, Egidi L, Cappelletto B. Impact of COVID-19 mitigation measures on patients with spine disease in Friuli Venezia Giulia. *J Neurosurg Sci*. 2020;64:410-412.
21. Weissman GE, Crane-Droesch A, Chivers C, et al. Locally informed simulation to predict hospital capacity needs during the COVID-19 pandemic. *Ann Intern Med*. 2020;173:21-28.
22. Chowdhury R, Heng K, Shawon MSR, et al. Dynamic interventions to control COVID-19 pandemic: a multivariate prediction modelling study comparing 16 worldwide countries. *Eur J Epidemiol*. 2020;35:389-399.
23. World B. US entering 'different' phase of Covid-19 outbreak. Available at: https://www.bbc.com/news/world-us-canada-53632649. Accessed August 3, 2020.
24. World B. Melbourne lockdown to keep a million workers home. Available at: https://www.bbc.com/news/world-australia-53632980. Accessed August 3, 2020.
25. GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 2017;390:1211-1259.

Conflict of interest statement: All authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Citation: World Neurosurg. (2020) 143:412-414. https://doi.org/10.1016/j.wneu.2020.08.063

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