The Surgical Health Services Research Agenda for the COVID-19 Pandemic

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As the world responds to the COVID-19 pandemic, United States (US) surgical departments are taking unprecedented action to optimize clinical resources and protect staff and patients from potential infection. The pandemic response has profoundly affected the surgical care delivery system with widespread deferral of elective surgical procedures, staff redeployment across disciplines, rapid changes to operating room protocols, and extensive adoption of telehealth for pre and postoperative care. The impact of these changes on the long-term function of the US surgical system remains unknown. The current pandemic may substantially change long-term population health and surgical needs, including potential COVID-19 surgical sequelae, health consequences of deferred elective surgery, and changes in population health outcomes from social distancing policies. In light of these sweeping changes to the surgical care delivery system, we propose the following surgical outcomes and policies. In light of these sweeping changes to the surgical care delivery system and health services research agenda. In addition to ongoing translational and basic science research, our proposed research priorities can rapidly inform the healthcare system’s response to the COVID-19 pandemic and prepare for future pandemics and other catastrophic disruptions to the health care delivery system by anticipating capacity gaps and optimal resource allocation.

SURGICAL SAFETY

Guidelines for safe surgical care during the pandemic have rapidly evolved, driven by differential considerations based on a patient’s COVID status (confirmed, suspected, unknown). Given early lack of testing and personal protective equipment (PPE) in the US, there were concerns the supply chain, and not clinical best practice, was driving hospital guidelines for surgical safety. It is still unclear what PPE is required for safe surgical care of COVID-19 patients, or the degree of protection afforded by reused or improvised PPE. High-quality data are needed to inform immediate guidelines for surgical safety. Notably, there has been controversy regarding safety of laparoscopic surgery in COVID-19 patients given concern that venting or evacuation of aerosolized particles and smoke would potentially increase exposure risk of those in the operating room.

Long-term guidelines for pre-operative COVID-19 screening are essential for safe return to routine surgical care. The current COVID-19 response highlights the need for ongoing assessments of surgical team preparation, structure, communication, and infection control to prepare operating room teams for the next pandemic.

WORKFORCE AND CLINICAL CAPACITY

The widespread impact of COVID-19 on surgical departments illustrates the importance of surgical care in the overall healthcare system. Due to the resource-intensive nature of surgery and the clinical revenue generating role of surgical care, much of the hospital workforce—surgeons, anesthesiologists, perioperative nurses, surgical technologists, and central processing staff—and physical plant—operating rooms, preop units, postanesthesia care units, surgical wards, surgical intensive care units—are designed around delivery of ambulatory and inpatient surgical care. Surgery programs are a source of surge capacity during the COVID-19 response, both in terms of inpatient bed capacity and clinical personnel, with many surgeons redeployed to focus on critical care or staffing COVID-19 procedure teams. The immediate and downstream implications of this response on surgical care and the broader US healthcare system are unclear and should be examined for both intended and unintended consequences.

PATIENT OUTCOMES

COVID-19 and the resulting pandemic response broadly impact short- and long-term health outcomes for surgical patients. Effects on patients with COVID-19 and those with other conditions whose surgical care has been disrupted warrant further investigation. An international cohort of COVID-19 surgery patients was established early in the pandemic response to support research on surgical outcomes in this population. There are 3 key areas in which typical clinical courses and outcomes are poorly understood. First, in patients acutely ill from COVID-19, we do not know how many patients acutely ill from COVID-19, we do not know how many survivors end-organ failure requiring surgical intervention, nor outcomes of these interventions. Second, in the general population requiring elective or emergency surgery, some will have asymptomatic or incidentally diagnosed COVID-19. The outcomes of surgery in these patients are unclear, with some case series suggesting a mortality rate as high as 20%. Third, the impact of delaying elective surgery on long-term patient outcomes and hospital capacity once departments “reopen” has yet to be characterized. When these...
TABLE 1. Priority Research Questions

**Workforce and Clinical Capacity**
What additional human resources, material goods (eg, PPE, durable medical equipment) and hospital capacity (eg, hospital and intensive care unit bed availability) are available for COVID-19 response due to cessation of elective care? How does redeployment of surgical clinicians for COVID-19 care impact the surgical capacity of departments, hospital, and hospital networks during and after the COVID-19 pandemic? Across healthcare delivery regions (eg, hospital referral regions, states), what are the minimum necessary resources needed (eg, clinical staff, operating rooms, PPE) to meet urgent surgical care needs during the pandemic? Among surgeons and other surgical clinicians caring for COVID-19 patients, what are the workforce losses due to (1) quarantine of infected clinicians, (2) hospitalization and convalescence of clinicians with severe COVID-19 disease, and (3) clinician mortality due to COVID-19? What are the short- and long-term health outcomes (eg, COVID-19 disease and sequelae, PTSD, anxiety, depression) of surgical clinicians redeployed to care for COVID-19 patients, how do these outcomes impact workforce capacity? What are the minimum necessary resources (eg, personnel, acute and long term care beds, durable equipment, disposable/consumable goods) and estimated timeline for safely resuming elective surgical care? What resources does the surgical delivery system need to prepare for future pandemics?

**Payment and Delivery System**
What is the direct financial impact of delaying elective surgical care to hospitals, and outcomes including hospital closures, personnel layoffs, and decreased access to care for patients? How do preexisting hospital structure, payer agreements, and payer mix affect financial outcomes and hospital viability? How do COVID-19 and federal or state stimulus packages affect financial viability, closures, and layoffs at private surgical practices, ambulatory surgical centers, and surgical departments at hospitals? How might COVID precipitate changes in payment models or insurance coverage, and how will these changes affect surgeons and patients with surgical conditions?

**Patient Outcomes**
Does deferral of elective surgery during the COVID-19 pandemic adversely impact outcomes for non-COVID patients, compared to patients with surgical interventions after prepandemic timelines and standards of care? What are the changes in healthcare costs and quality associated with the use of virtual care/telehealth for pre and postoperative care? For patients with active COVID-19 disease at the time of surgery, are short- and long-term health outcomes different than outcomes for otherwise similar non-COVID surgical patients undergoing the same procedures? Is the COVID-19 pandemic and response associated with delayed presentation or reduced diagnosis of surgical conditions? Which surgical conditions were found to be more common and which surgical conditions were found to be less common as a result of social distancing and/or delays in seeking or receiving care? Does postponement of emergency general surgery or use of nonoperative interventions to manage emergency general surgical conditions during the pandemic adversely impact outcomes for non-COVID patients, compared to emergency general surgery after prepandemic standards of care? Are outcomes from surgical conditions different for patients with active COVID-19 disease undergoing surgical management, compared to otherwise similar patients with COVID-19 disease with nonoperative management of a surgical condition? Do COVID-19 survivors have different long-term surgical care needs or risks associated with surgery, compared to otherwise similar patients without a history of COVID-19 disease? How do social distancing and other COVID-19 interventions change incidence and severity of traumatic injury, by mechanism and intent? Does COVID-19 and resulting changes to organization and practice of surgery impact medical students’ choice of specialty and/or the decision to pursue a career in surgery?

**Surgical Safety**
How do changes in operating room standards for PPE implemented to extend resources for COVID-19 care impact safety of surgical clinicians? How can surgical delivery be adjusted to maximize safety for surgeons, other health care providers, and patients? What is the minimum necessary PPE for each type of surgical procedure? What is the safety of improvised and/or reused PPE? How can surgical clinicians better prepare for future pandemics and what are national needs for surgical safety training, pandemic preparation, and equipment?

**Training and Professional Development**
What clinical personnel gains are associated with early graduation/promotion and licensing/credentialing of trainees? Do deferral of elective surgical care and efforts to minimize occupation COVID-19 exposure for surgical trainees reduce total case volume, and do such reductions adversely impact clinical performance or early career development? Were surgical critical care rotations effective preparation for taking care of COVID-19 patients? Do aspects of COVID-19 pandemic control measures (eg, travel restrictions, reduced case volume, delayed/missed continuing medical education opportunities) impact surgeon and trainee opportunities for career development, promotion, and retention? How do changes to surgical practices (including occupational infection risk), training, and professional development in response to COVID-19 impact surgeons’ family structure (ie, partnering, childbearing, care giving responsibilities)? How does family structure impact surgeons’ role in the COVID-19 response? Does COVID-19 and resulting changes to organization and practice of surgery impact medical students’ choice of specialty and/or the decision to pursue a career in surgery?

**Surgical Disparities and Economic Hardship**
Do changes to surgical system capacity and practices in response to COVID-19 disproportionately impact underserved and/or vulnerable populations, create new disparities in surgical care, and/or exacerbate existing disparities in surgical care/outcomes? Is elective surgery deferment and eventual reinitiation the same across all demographic groups or are certain groups delayed more than others? How will rising unemployment and other economic hardship affect insurance status and ability to pay any out-of-pocket expenses for surgical care? How are safety net hospitals and minority serving hospitals affected by COVID-19 in terms of staff reductions or closures and how does that affect access for surgical care for underserved populations in the US? Do minoritized, low income, rural, and other marginalized populations realize the same benefits from surgical systems as a reservoir for healthcare capacity during the pandemic, compared to well served populations? What is the access to virtual care across different demographic groups, and how does differential access affect ability to temporize or triage elective surgical conditions?
operations are ultimately performed, it is possible surgeons will encounter more advanced (or inoperable) disease, or the volume of deferred surgery will overwhelm surgical system capacity. Additionally, accredited trauma centers have an ongoing obligation to conduct injury prevention research and outreach tailored to the needs of communities they serve as social distancing impacts the epidemiology of traumatic injury.

**PAYMENT AND DELIVERY SYSTEM**

COVID-19 is instigating several changes to healthcare delivery and payment systems, including a rapid shift towards virtual visits to provide care for patients while maintaining social distancing. Although this shift is driven in part by federal changes to Medicare telehealth regulations, individual states regulate commercial insurance and physician licensing, creating a patchwork implementation of telehealth and providing opportunities to study the effect of reimbursement changes on surgical providers' adoption of telehealth and implications on continuity of care. Additionally, elective surgical care drives clinical revenue for many surgery programs. The implications of postponing elective surgeries on financial viability of safety-net hospitals and surgeon practices remains unknown. Potential spillover effects of COVID-19 on access to surgical care should be examined as part of an ongoing research effort. Similarly, it remains unknown how COVID-19 will affect performance under alternative payment models such as accountable care organizations and bundled payments. Quantifying whether postponing elective surgery decreases overall demand for surgical care will be crucial to evaluate the financial impact of COVID-19 on providers. Lastly, hospital management and organization structures associated with successful COVID-19 response should be evaluated to establish and disseminate best practices in preparation for a future pandemic.

**TRAINING AND PROFESSIONAL DEVELOPMENT**

Despite the shift towards early specialization in general surgery, this pandemic has highlighted benefits of broad training for general surgeons, with trauma surgeons staffing critical care units, and subspecialty general surgeons cross-covering for emergency general surgery. Redeployment of general surgeons for critical care and procedural services should be evaluated to inform graduate medical education and board certification policies. Additionally, COVID-19 has affected surgical training for students, residents, and fellows. Clinical redeployment and cancellation of elective surgery have reduced surgical case volume, but may increase exposure to critical care and other competencies. There may potentially be a need to accelerate the transition to competency-based as opposed to case requirement-based curricula. Similarly, for medical students, many clinical rotations have been suspended, but some students are gaining valuable experience through redeployment in public health and healthcare delivery roles. Health services researchers should examine the impact of these changes on trainees' readiness for independent surgical practice. Conference travel restrictions and changes to interview schedules may have cascading effects on students' choice of specialty, residency applications, and training programs' ability to match applicants. On the other hand, many virtual learning resources have emerged, and researchers should examine the effectiveness of innovative solutions to supplement missed training opportunities.

**DISPARITIES AND ECONOMIC HARDSHIP**

Surgical disparities in the US based on race, ethnicity, socioeconomic status, and insurance status are well established and may be magnified by the pandemic, both due to wide reaching economic impacts of social distancing and disparities in COVID-19 mortality and morbidity. Costs of medical care for COVID-19 may be catastrophic for many people, regardless of insurance status, leading policymakers to carve out new, unprecedented payment policies eliminating cost-sharing for COVID-19 testing and/or treatment. Safety net hospitals serving at risk populations may be at high risk for financial loss from both uncompensated care and deferral of revenue-generating elective surgery. These factors could exacerbate hospital closures with a potential decrease in access to care for vulnerable populations. The variation in federal and state policy response may allow for a natural experiment through which to study how these policies on insurance access and coverage may impact disparities. Surgical health services researchers should prioritize evaluating these effects to inform state and federal policy.

**GLOBAL SURGERY**

Low- and middle-income countries (LMICs) confront all the challenges listed above, but generally with fewer resources. Challenges and the response posed by COVID-19 will vary across LMICs based on prepandemic variation in surgical disease prevalence, supply chain limitations, national health systems, and healthcare workforce capacity of surgeons, anesthetists, and obstetricians. For example, some countries with a longstanding history of training associate clinicians to support the surgeons, anesthetists, and obstetrician workforce may be able to utilize existing frameworks to rapidly scale up their perioperative workforce. Additionally, countries utilizing community health workers to aid in active case finding of infectious disease among remote populations may be better equipped to monitor for community spread if testing kits are available. However, overburdening of hospitals in high-income countries around the world has shown everyone is vulnerable to outstripping local delivery systems. For the billions of people living in LMICs who do not have access to timely, affordable, and safe surgical care the risk of pandemic disease requiring intensive care resources is particularly devastating. In restructured resource settings, additional tradeoffs and rationing of care may be needed to provide care for COVID-19 patients, and the effects of resource allocation decisions needs to be evaluated.

**CONCLUSIONS**

COVID-19 will profoundly affect the US surgical system, including changes to healthcare infrastructure, payment systems, safety standards, clinical training, and population health. Research addressing the broad concepts outlined in Table 1 should be applied to the full range of surgical conditions across all surgical specialties to assess sociodemographic and organizational factors associated with differential COVID-19 outcomes. Surgical health
services research has a vital role in understanding and informing current pandemic response, supporting return to prepandemic surgical functions, and preparing for future disasters, including resurgence of COVID-19 and emergence of other pandemic disease.

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