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## **Surgery & COVID-19: A rapid scoping review of the impact of COVID-19 on surgical services during public health emergencies**

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3 Surgery & COVID-19: A rapid scoping review of the impact of COVID-19 on surgical services  
4 during public health emergencies  
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3 **ABSTRACT (275/300 words)**  
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5 **Background:** Healthcare systems globally have been challenged by the COVID-19 pandemic,  
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7 necessitating the reorganization of surgical services to free capacity within healthcare systems.  
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12 **Objectives:** To understand how surgical services have been reorganized during and following  
13  
14 public health emergencies, and the consequences of these changes for patients, healthcare  
15  
16 providers and healthcare systems.  
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21 **Methods:** This rapid scoping review searched academic databases and grey literature sources to  
22  
23 identify studies examining surgical service delivery during public health emergencies including  
24  
25 COVID-19, and the impact on patients, providers and healthcare systems. Recommendations and  
26  
27 guidelines were excluded. Screening was completed in partial (title, abstract) or complete (full  
28  
29 text) duplicate following pilot reviews of 50 articles to ensure reliable application of eligibility  
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31 criteria.  
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36  
37 **Results:** One hundred and thirty-two studies were included in this review; 111 described  
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39 reorganization of surgical services, 55 described the consequences of reorganizing surgical  
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41 services and six reported actions taken to rebuild surgical capacity in public health emergencies.  
42  
43 Reorganizations of surgical services were grouped under six domains: case selection/triage, PPE  
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45 regulations and practice, workforce composition and deployment, outpatient and inpatient patient  
46  
47 care, resident and fellow education, and the hospital or clinical environment. Service  
48  
49 reorganizations led to large reductions in non-urgent surgical volumes, increases in surgical wait  
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51 times, and impacted medical training (i.e., reduced case involvement) and patient outcomes (e.g.,  
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3 increases in pain). Strategies for rebuilding surgical capacity were scarce, but focused on the  
4 availability of staff, PPE, and patient readiness for surgery as key factors to consider before  
5  
6 resuming services.  
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12 **Conclusions:** Reorganization of surgical services in response to public health emergencies  
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14 appears to be context-dependent and has far-reaching consequences that must be better  
15  
16 understood in order to optimize future health system responses to public health emergencies.  
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## ARTICLE SUMMARY

### Strengths and limitations of the study:

- This rapid scoping review provides an exhaustive and rigorous summary of the academic and grey literature regarding modifications to surgical services in response to public health emergencies, especially COVID-19.
- This study did not limit studies based on location or language of publication to ensure a worldwide pandemic had contributions from worldwide voices.
- Both quantitative and qualitative outcomes were included, with a mix of inductive and deductive data abstraction approaches to provide a comprehensive understanding of surgical services during public health emergencies.
- Studies with potential relevance to this question are emerging at an unprecedented rate in response to the COVID-19 pandemic and as such, some may not be included in the current review.

**Original protocol for the study:** As requested, the original unpublished protocol for this study is included as a supplementary file.

**Funding statement:** This study did not receive grant from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interest statement:** All authors declare that they have no competing interests in accordance with the International Committee of Medical Journal Editors uniform declaration of competing interests.

## INTRODUCTION

The novel SARS-CoV-2 (COVID-19) virus has spread across the globe with unrelenting speed. At the time of writing, over 16 million cases have been confirmed with 650,000 fatalities.<sup>1</sup> To protect the most vulnerable in our societies, efforts to curb further escalation (e.g., travel restrictions, physical distancing) have had a focal objective: to prevent surges that could overwhelm healthcare including shortages in personal protective equipment (PPE), ventilators, and hospital capacity.

Medical institutions have taken steps to maximize staff, PPE, ventilators, and intensive care unit (ICU) capacity in case public health efforts to ‘flatten the curve’ are insufficient. Most notably, surgical programs have suspended non-urgent (or ‘elective’) surgical procedures. Non-urgent surgeries are often defined as procedures for which a delay of three months or longer would not result in significant adverse effects to the patient.<sup>2 3</sup> These changes have thrust patients, providers, and healthcare organizations into previously unexplored territory.

While governing bodies such as colleges and academies of surgery have made recommendations to alter surgical service delivery in response to COVID-19, they have not always provided explicit instructions on how programs should operationalize the recommendations. As such, approaches to surgical triage and service delivery remain unclear: who has done what where, and why? Further, the impacts of adopting these recommendations on surgical programs, and more importantly, the physical and psychological well-being of patients and healthcare providers have only been hypothesized.<sup>4</sup> Lastly, as COVID-19 begins to release its grip on the world and the post-pandemic recovery begins, programs will be tasked with rebuilding the surgical capacity necessary to reschedule and resume the backlog of postponed procedures. Evidence distilled from the experiences of others in the context of COVID-19 and



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3 other public health emergencies (i.e., H1N1, Ebola, SARS) is needed to guide approaches to  
4 surgical service delivery.  
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8 To enable evidence-informed reorganization and resumption of non-urgent surgeries  
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10 post-COVID-19 and for future public health emergencies, we conducted a rapid scoping review  
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12 to synthesize relevant and available literature. Our aim was to understand how surgical services  
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14 were reorganized in response to COVID-19 and other public health emergencies; how  
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16 reorganization impacted patients, healthcare providers, and health systems; and what approaches  
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18 have been taken to resume surgical service delivery.  
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## 23 24 **METHODS**

### 25 26 **Study Design**

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28 This scoping review followed the Joanna Briggs Institute methodology and Preferred  
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30 Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews  
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32 (PRISMA-ScR) checklist.<sup>5 6</sup> The rapidly evolving situation of the current COVID-19 pandemic  
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34 demanded a similarly rapid evidence synthesis. Therefore, methodological concessions  
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36 recommended by the World Health Organization and Cochrane guidance for rapid reviews were  
37  
38 made.<sup>7 8</sup> This review addressed three questions: 1) How have surgical services been reorganized  
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40 in response to public health emergencies? 2) What are the patient-, healthcare provider-, and  
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42 system-level consequences of reorganizing surgical services? and 3) What approaches were used  
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44 for resuming surgical services?  
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### 51 52 **Search Strategy**

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3 The search strategy was developed by two investigators (CO, KS) and refined by others  
4 with context expertise in surgery and literature review methodology (JNK, AKR). The search  
5 strategy included subject headings, keywords, and synonyms identifying public health  
6 emergencies in general and specific public health emergencies (Ebola, SARS-CoV1, H1N1,  
7 MERS), and surgery; and were tailored for each database (Appendix A). Given the exploratory  
8 nature of the review we did not filter by study design or publication type, and since the impacts  
9 of a pandemic spans many countries there were no language restrictions.

10  
11 We used the search strategy to search MEDLINE (including Epub Ahead of Print, In-  
12 Process & Other Non-Indexed Citations) and Embase from inception until May 8, 2020.  
13 Anticipating pertinent information may not be published (i.e., joint statements,  
14 recommendations, and guidelines from surgical colleges) we supplemented the database search  
15 with a structured grey literature search including targeted website searching, advanced and  
16 general Google searching, and contact with knowledge experts (Appendix A).<sup>9</sup> The reference  
17 lists of included studies were screened for relevant studies not otherwise captured.

## 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 **Study Selection**

39  
40 Titles and abstracts were reviewed by one of two independent reviewers with a third,  
41 independent reviewer screening 25% of randomly selected references in duplicate. Full texts of  
42 studies considered potentially eligible at title/abstract screening phase by at least one reviewer  
43 were reviewed in duplicate by two reviewers for eligibility. Any disagreement between  
44 reviewers at the full text screening phase was resolved through discussion and did not necessitate  
45 a third reviewer. If studies were excluded at the full text screening phase, the reason for  
46 exclusion was noted. Full text articles meeting eligibility criteria were included and data were  
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3 abstracted using a standardized data abstraction form (Appendix B). At both stages of screening,  
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5 a pilot sample of 50 articles were jointly reviewed by both reviewers to ensure reliable  
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7 application of eligibility criteria between reviewers.  
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## 12 **Study Eligibility**

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14 Studies were eligible for inclusion if they discussed alterations to surgical services during  
15  
16 public health emergencies and reported: 1) reorganization of surgical services, 2) impact of  
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18 reorganizing surgical services on patients, healthcare providers, or healthcare system or 3)  
19  
20 approaches to resuming surgical capacity. Studies of any design or publication date were eligible  
21  
22 for inclusion. Studies in any language were eligible, but consistent with rapid review methods,  
23  
24 studies not easily translated by authors were excluded from the data synthesis, although citations  
25  
26 are still provided. Studies were excluded if they described: only urgent interventions arising  
27  
28 during a hospital admission (e.g., emergency tracheostomy, caesarean section), settings beyond  
29  
30 in-patient acute care (e.g., outpatient clinics including dental clinics), surgical services beyond a  
31  
32 public health emergency without comparison to public health emergencies, healthcare services  
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34 not specifically related to surgical service.  
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40 Notably, our intention was to include guidelines that made recommendations regarding  
41  
42 provision of surgical services; however, a high-quality review of guidelines was published<sup>10</sup>  
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44 during the preparation of this review and as such, we chose to exclude guidelines.  
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## 49 **Data Extraction**

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51 Data were abstracted by one reviewer, and verified by a second reviewer, using a  
52  
53 standardized data abstraction form (Appendix B). Data included: date of publication, country,  
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3 study design, definition of non-urgent surgery, characteristics of study sample (if applicable),  
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5 outcomes of interest for the three research questions, detailed below.  
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## 10 **Outcomes of Interest**

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12 Our primary outcomes were reorganization of surgical services, impact of reorganization  
13 and resuming surgical services. We intentionally included a broad array of outcomes and used an  
14 inductive approach to data abstraction to gain a comprehensive understanding of surgical  
15 services and the impact during public health emergencies.  
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21 We collected qualitative data from studies reporting on changes to surgical programming,  
22 conceptualized into five categories: changes to triage criteria or case selection, changes to PPE  
23 practices, workforce changes, changes to patient care, changes to resident and fellow education,  
24 and environmental changes. Qualitative and quantitative data on the impact of reorganization of  
25 surgical services was organized by impact on: patients, providers and healthcare system. To  
26 illustrate temporal changes, data preceding, during and after the precipitating event were  
27 collected whenever possible. Quantitative variables of interest included: adverse events  
28 (including morbidity and mortality), primary care and emergency department visits, number of  
29 hospital and ICU admissions, length of hospital and ICU stay, number of surgical procedures  
30 performed and number of procedures cancelled, care costs, and wait times for non-urgent  
31 surgery. Qualitative variables included narrative description of patient or physician experience,  
32 written descriptions of changes to physician remuneration, or comments surrounding surgical  
33 waitlist composition. Qualitative data was also collected on details of efforts to rebuild capacity  
34 to surgical services.  
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### Study Quality (Risk of Bias) Assessment

Given the aim of a rapid scoping review is not to appraise evidence but to map the available literature,<sup>11</sup> quality appraisal of included studies was not performed.

### Data Synthesis, Analysis and Reporting

Study and sample data were summarized narratively in a data table and using descriptive statistics where appropriate. We decided *a priori* to use a random effects model for meta-analysis if there was sufficient data on the impact of changes to surgical services to pool, however this was not feasible. Instead, descriptive statistics were used to synthesize the quantitative outcomes. Data were synthesized and presented separately for each of the three research questions.

### Patient and Public Partnership

Patients and the public were not involved in the conception or analysis of this review.

## RESULTS

### Search Results

A total of 3 013 unique scholarly articles and 106 sources of grey literature were identified, of which 702 were considered eligible for full text review. After full text review, 120 studies and five documents from the grey literature were included. Screening of the reference lists of included articles led to seven additional studies being included for a total of 132 included studies. Thirty-seven studies contributed data to more than one of the research questions resulting in the qualitative synthesis of 111 studies assessing alterations to service delivery, 55 studies evaluating the consequences of these changes, and six studies enumerating their

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3 procedures for rebuilding capacity (Table 1). The flow of evidence sources within the study is  
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5 detailed in Figure 1. One Spanish language study was translated for inclusion,<sup>12</sup> but two studies  
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7 could not be readily translated therefore they are not included in the synthesis.<sup>13 14</sup>  
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## 11 12 **Description of Studies**

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15 The majority of included studies were published in 2020 about COVID-19 (87.9%,  
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17 n=116); fewer studies were related to other public health emergencies: SARS (7.58%, n=10),  
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19 Ebola (2.27%, n=3), H1N1(1.52%, n=2), and MERS (0.76%, n=1). Over two thirds of the  
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21 included studies (74.2%) emerged from the countries hit earliest by COVID-19; China (14.4%,  
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23 n=19), Singapore (8.33%, n=11), Italy (19.7%, n=26), and the USA (31.8%, n=41). While many  
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25 studies described the experiences of their surgical departments as a whole, oncology (15.9%,  
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27 n=21), orthopedics (13.6%, n=18), and neurosurgery (11.4%, n=15) were the specialties most  
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29 prominently represented. Summaries of descriptive study information are shown in Figure 2.  
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## 35 **Reorganization of Surgical Service**

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38 A number of themes emerged from the 108 studies describing reorganization of surgical  
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40 services. Nearly all studies reported partial, with most reporting full cessation of non-urgent  
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42 surgeries at their centre, albeit with varying definitions of “non-urgent” (e.g., can be safely  
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44 postponed for 3 months) and “urgent” (e.g., patient would have adverse outcome if not  
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46 completed within 7 days). Changes to service delivery were focused on six domains: case  
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48 selection/triage, PPE regulations and practice, workforce composition and deployment,  
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50 outpatient and inpatient patient care, resident and fellow education, and the hospital or clinical  
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3 environment (Table 2). The three domains that were most frequently reported (case  
4 selection/triage, patient care, and workforce) are described in greater detail below.  
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10 *1. Changes to Case Selection and Triage Procedures.* The “where” of surgery is described  
11 above; however, the issue of what patients can safely undergo which surgical procedures was  
12 also discussed in the included studies. We identified cancelling or postponing “non-urgent”  
13 surgeries was almost universal. Most often hospitals cancelled surgeries via telephone or text  
14 message, but some studies identified that patients initiated their own surgical cancellations due to  
15 concerns with safety and contamination. While urgent surgeries were triaged according to  
16 routine practice, new triage decisions were made for non-urgent (including oncology)  
17 procedures. Methods for triaging non-urgent procedures varied across studies, from the use of  
18 guideline supported checklists of eligible procedures to virtual multidisciplinary meetings where  
19 the treating surgeon presented details of the case (e.g., patient characteristics, acuity, imaging) to  
20 a larger group representing many surgical specialties to reach consensus on each case.  
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38 *2. Changes to Patient Care.* Sixty-two studies reported complete cessation or marked reduction  
39 of in-person, non-urgent outpatient clinic visits. In these studies, only urgent patients and those  
40 requiring post-operative suture or staple removal were granted in-person visits under strict  
41 conditions including mask wearing, negative symptom check, history or temperature pre-  
42 screening. Studies specific to COVID-19 almost universally filled the resulting care gap for  
43 patients deemed “non-urgent” using telephone or video-based telemedicine. Interfaces used  
44 include, but were not limited to Zoom, WeChat, Facetime, telephone, and SMS text messaging.  
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54 A reported advantage of telemedicine was the ability to not only follow-up with returning  
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3 patients but to also continue consultations and establish contact with new patients who would  
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5 require care when non-urgent surgeries resumed. While some admitted a historical reluctance to  
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7 transition to video-based telemedicine and reported early concerns with their ability to establish  
8  
9 secure connections with patients, frequently their worries faded with use and many reported  
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11 telemedicine would remain integrated in their practices beyond the pandemic.  
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17 *3. Changes to the Workforce.* Fourteen of the included studies describe changing the workforce  
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19 into a minimum of two teams; a “contaminated” team providing care to infected patients and a  
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21 “clean” team managing those not infected. When these teams were kept separate from one  
22  
23 another both inside and outside of the hospital setting, surgical departments were able to  
24  
25 continue managing the inevitable emergencies (as well as non-urgent procedures in some  
26  
27 settings) without cross contamination during the public health emergencies. New work rotations  
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29 and shift schedules were created to ensure this structure was sustainable, often with extra  
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31 healthcare providers designated to replace those with exposures and to provide adequate time off  
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33 to prevent burnout. This practice was only possible with wards, operating rooms, and pathways  
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35 (i.e. corridors, elevators) that are separated under the same “clean” and “contaminated”  
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37 designation. In the most extreme case, entire hospitals were designated for each patient group, as  
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39 was done by Singapore during SARS<sup>15</sup> and Italy during COVID-19.<sup>16</sup>  
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### 47 **Impact of Reorganizing Surgical Services**

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49 Of the 55 studies with data relevant to this question, 42 were focused on changes in  
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51 surgical volumes with six reporting changes to surgical waitlist time or composition, four  
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53 underlining changes to resident and fellow involvement in surgery, and two showing changes in  
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3 patient pain, anxiety, and depression. These recurring outcome measures are summarized below  
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5 with data for all studies relevant to this question shown in Appendix C.  
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10 *Changes in Surgical Volumes.* Thirty-seven studies provided data for this outcome, with 37.8%  
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12 (n=14) reporting a greater than 75% reduction and 70.3% (n=26) reporting a greater than 50%  
13  
14 reductions in their overall or site specific non-urgent surgical volumes (Figure 3a). Not all  
15  
16 studies reported reductions; as one study from an oncology “hub” hospital in Italy reported a  
17  
18 20% increase in their surgical volumes, likely due to more cases being diverted to their hospital  
19  
20 during the COVID-19 pandemic.<sup>17</sup>  
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26 *Changes in Resident/Fellow Involvement in Surgical Activities.* Four studies<sup>18-21</sup> reported on this  
27  
28 outcome; two survey-based case series, one resident-level case study and one study containing  
29  
30 both survey and case log data. The reductions in surgical involvement for residents are shown by  
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32 quartile in Figure 3b.  
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38 *Changes to Waitlist Length and Composition.* Five studies<sup>22-26</sup> reported data for this outcome.  
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40 One centre reported a 64% increase in length of their minor colorectal surgery waitlist<sup>25</sup> and  
41  
42 another centre (head and neck oncological surgery program) reported a 500% increase in latency  
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44 from diagnosis to surgery.<sup>26</sup> One study reported no waitlist deaths during the COVID-19  
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46 pandemic<sup>24</sup> while another saw a small decrease in the number of weekly waitlist deaths.<sup>23</sup> A  
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48 single study identified more patients leaving their renal transplantation waitlist due to mortality  
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50 or clinical deterioration.<sup>22</sup>  
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3 *Changes in Patient Pain, Anxiety, and Depression.* Two studies<sup>27 28</sup> reported pain, anxiety, and  
4 depression among more than half of waitlist patients; 42.1% experienced anxiety, and 26.3%  
5 experienced depression (Figure 3c). The leading reported cause of patient anxiety was a lack of  
6 knowledge about when their surgeries would be rescheduled. Other than a single study  
7 describing the negative financial effects of the COVID-19 pandemic,<sup>29</sup> impacts on healthcare  
8 providers and their practices were rarely discussed.  
9

### 19 **Rebuild Surgical Capacity**

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21 A total of seven studies reported the experience of rebuilding surgical capacity in their  
22 departments, hospitals, or systems; all studies referred to the COVID-19 pandemic. One study  
23 from China reported reopening non-urgent surgeries with close consideration of risk for imported  
24 transmission but did not provide further detail of triage or prioritization.<sup>30</sup> Among studies that  
25 changed their surgical triage practices, patients were prioritized for surgery based on procedure  
26 acuity or urgency (i.e., risk to patients if surgery were further delayed), resource intensity, and  
27 procedural complexity. Four studies<sup>31-34</sup> noted that prior to resuming non-urgent surgeries,  
28 availability of the staff, (Operating Room) ORs, PPE, and testing was necessary to prepare for a  
29 large and complicated surgical backlog.  
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## 44 **DISCUSSION**

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46 This review identified over 3,000 evidence sources, 132 of which were included.  
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48 Approaches to reorganizing surgical services varied between studies and centers, but the  
49 cancellation or postponement of non-urgent surgeries such as arthroplasty surgeries for chronic  
50 joint pain, coronary artery bypass graft surgery for asymptomatic individuals, and primary  
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3 gastric bypass surgery was nearly universal.<sup>2</sup> The most frequently reported change to surgical  
4 services was modified triage criteria for surgical cases, workforce, and approach to patient care.  
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6 Many studies reported a decrease in surgical volumes due to public health emergencies, while a  
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8 few reported the non-surgical impacts such as patient wellbeing or changes in healthcare  
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10 utilization beyond the surgical wards. Very few studies described their experience resuming  
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12 surgical services after a public health emergency.  
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17 The varied approaches to providing surgical services during a public health emergency  
18 identified in this review illustrate that a “one fits all” approach does not exist. Changes to  
19 surgical services likely depends on the characteristics of specific centers and their patients. While  
20 several guidelines have been published with recommendations on how to provide surgical care  
21 during COVID-19, we chose to exclude guidelines and recommendations from this review for  
22 two reasons: 1) a high quality review of surgical recommendations for the response to COVID-  
23 19 was published by one of the authors just prior to this study<sup>10</sup> and 2) because there is abundant  
24 evidence suggesting guidelines and recommendations for practice are frequently not  
25 implemented into clinical practice.<sup>35-41</sup> Some of the guideline recommendations in the review by  
26 Søreide et al.<sup>10</sup> were implemented within the included studies in the present review; such as  
27 creating areas within-hospital for ‘clean’ and ‘contaminated’ cases and workforce redeployment  
28 to critical care. However, other recommendations were infrequently noted, such as the dedicated  
29 use of isolated, negative pressure ORs for patients with COVID-19. These resource intensive  
30 practices may not have been attainable under the pressures of managing public health  
31 emergencies and may not be feasible in low-resource settings.  
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3 Changes to surgical services, such as cancelling or postponing non-urgent surgeries may  
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5 be necessary to manage public health emergencies to reduce the risk of contamination and  
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7 increase capacity within hospitals. However, the impact of these changes remains poorly  
8  
9 understood. Many studies reported decreases in surgical volumes, but few other variables were  
10  
11 explored with regards to the impact on patients, providers, and healthcare systems. Five studies  
12  
13 examined the impact of changes to surgical services among physicians and trainees, and found  
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15 that training was compromised in some specialties.<sup>18-21</sup> The finding that medical training was  
16  
17 compromised is particularly important for understanding the downstream and long-term  
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19 repercussions of the response to public health emergencies; decreases in surgical volumes and  
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21 clinical hours for trainees could have negative and unintended effects on the future quality and  
22  
23 safety of patient care.<sup>42</sup> Studies examining the effects of surgical service alterations on patients  
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25 noted negative effects on mental health outcomes,<sup>27 28</sup> pain,<sup>27</sup> and an increased incidence of death  
26  
27 among surgical patients.<sup>22 23 43</sup>

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33 Very few studies described specific actions undertaken to rebuild and resume pre-public  
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35 health emergencies surgical capacity. This may be due to the fact that most included studies  
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37 examined the ongoing COVID-19 pandemic, or because few places have implemented specific  
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39 plans to date. Included studies did describe consideration of system-level factors like availability  
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41 of PPE and ORs. However, more patient-centric considerations such as organizing child care and  
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43 requesting time away from their job during a pandemic, are needed. Interestingly, one study  
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45 reported 14% of surgical patients initiated the cancellation of their surgery,<sup>27</sup> which suggests  
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47 patient readiness for surgery during- and post-COVID-19 should be considered. For evidence to  
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49 inform policy, additional research is needed to understand the impacts of different approaches for  
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51 resuming surgical services.  
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6 This study is, to our knowledge, the first comprehensive scoping review of evidence  
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8 around reallocation of surgical services during public health emergencies. While this study has  
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10 several strengths, including a comprehensive search of academic and grey literature sources, and  
11  
12 a mix of inductive and deductive data abstraction approaches, there are some limitations that  
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14 should be considered when interpreting our findings. We modified the Joanna Briggs  
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16 methodology for scoping reviews,<sup>5</sup> according to the World Health Organization and Cochrane's  
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18 guidance on conducting rapid reviews,<sup>7 8</sup> with the intent of balancing rigor with a timely and  
19  
20 policy-responsive review of the literature. Also, given that the evidence around the COVID-19  
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22 pandemic is growing at an unprecedented rate, it is possible that additional studies have been  
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24 published since we ran our search strategy, especially around resuming surgical services. In  
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26 order to mitigate this limitation, an ongoing effort to pivot this study into a living review is  
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28 underway to ensure the data presented is up-to-date. Notably, this review did not identify  
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30 evidence from any low or middle-income countries who may face unique challenges during a  
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32 pandemic compared to high income countries described in our review. It is also likely that during  
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34 the global pandemic, many healthcare institutions have been focused on coping with COVID-19  
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36 instead of publishing their experiences; we hope more organizations will add their experience to  
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38 the literature.  
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47 In conclusion, we report early evidence of the operational changes that have occurred  
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49 internationally in response to public health emergencies which could inform the ongoing  
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51 response to COVID-19 and future public health emergencies. This study identified a gap in our  
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53 understanding of the impact of these changes on patients, providers, and the healthcare system  
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3 which should be the focus of research moving forward to provide an evidence-based approach to  
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5 managing surgical patients in future public health emergencies.  
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### 10 **Author Contributions**

11  
12 CO contributed to the design and conceptualization of the review, analysis and interpretations of  
13  
14 the data, and drafting and revising the manuscript; JSN contributed to the design of the review,  
15  
16 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
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18 version of the manuscript; AKR contributed to the design of the review, interpretation of the  
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20 data, providing feedback on the manuscript, and gave approval of the final version of the  
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22 manuscript; JCD contributed to the interpretation of the data, providing feedback on the  
23  
24 manuscript, and gave approval of the final version of the manuscript; JW contributed to the  
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26 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
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28 version of the manuscript; JR contributed to the interpretation of the data, providing feedback on  
29  
30 the manuscript, and gave approval of the final version of the manuscript; MB contributed to the  
31  
32 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
33  
34 version of the manuscript; KMS contributed to the design and conceptualization of the review,  
35  
36 analysis and interpretations of the data, providing feedback on the manuscript, and gave approval  
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38 of the final version of the manuscript.  
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## References









1. Johns Hopkins Center for Systems Science and Engineering (CSSE). COVID-19 Dashboard. [Available from: <https://coronavirus.jhu.edu/map.html>] accessed July 27, 2020.
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures. [Available from: [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedure\\_s.ashx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedure_s.ashx)] accessed July 2, 2020.
3. Shared Health Manitoba. COVID-19: The New Normal. [Available from: <https://sharedhealthmb.ca/files/covid-19-memo-the-new-normal.pdf>] accessed May 8, 2020.
4. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *British Journal of Surgery* 2020 doi: doi:10.1002/bjs.11746 [published Online First: 2020 May 12]
5. Peters MDJ, Godfrey CM, McInerney P, et al. Chapter 11: Scoping Reviews. In: E. A, Z. M, eds. Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute, 2017.
6. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018;169(7):467-73. doi: 10.7326/m18-0850 [published Online First: 2018/09/05]
7. Tricco AC, Langlois EV, Straus SE, Editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization, 2017. Licence: CC BY-NC-SA 3.0 IGO
8. Garritty C, Gartlehner G, Kamel C, et al. Cochrane Rapid Reviews. Interim Guidance from the Cochrane Rapid Review Methods Group., 2020.
9. Godin K, Stapleton J, Kirkpatrick SI, et al. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Syst Rev* 2015;4:138. doi: 10.1186/s13643-015-0125-0 [published Online First: 2015/10/27]
10. Soreide K, Hallet J, Matthews JB, et al. Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services. *Br J Surg* 2020 doi: 10.1002/bjs.11670 [published Online First: 2020/05/01]
11. Munn Z, Peters MDJ, Stern C, et al. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology* 2018;18(1):143. doi: 10.1186/s12874-018-0611-x
12. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
13. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of Experimental Ophthalmology* 2020;38(3):200-03. doi: <http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100>
14. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular diagnosis and treatment in gastrointestinal surgery department during the outbreak of coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-26.

- doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]
15. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
  16. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19 pandemic: an expert opinion from China, South Korea, Italy, United States of America, Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2 [published Online First: 2020/04/30]
  17. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi: 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]
  18. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
  19. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
  20. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First: 2020/05/10]
  21. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published Online First: 2020/05/04]
  22. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]
  23. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online First: 2020/05/03]
  24. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int* 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]
  25. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]
  26. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service disruption during COVID-19 in Hong Kong through telehealth and multi-institutional collaboration. *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]
  27. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]
  28. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a waiting list for thoracic surgery during the outbreak of Severe Acute Respiratory Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013







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- 4 29. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19
- 5 Pandemic. *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-
- 6 00379 [published Online First: 2020/04/15]
- 7 30. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences and
- 8 Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*
- 9 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First:
- 10 2020/04/29]
- 11 31. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal
- 12 Surgery and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020
- 13 doi: 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
- 14 32. Pelt CE, Campbell KL, Gililland JM, et al. The Rapid Response to the COVID-19 Pandemic
- 15 by the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020
- 16 doi: 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
- 17 33. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-
- 18 Being, 2020.
- 19 34. Health BMO. A Commitment to Surgical Renewal in BC. Canada, 2020.
- 20 35. Ben-Menachem E, French JA. Guidelines--are they useful? *Epilepsia* 2006;47 Suppl 1:62-4.
- 21 doi: 10.1111/j.1528-1167.2006.00663.x [published Online First: 2006/10/19]
- 22 36. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice
- 23 guidelines? A framework for improvement. *Jama* 1999;282(15):1458-65. [published
- 24 Online First: 1999/10/27]
- 25 37. Farquhar C, Kofa E, Slutsky J. Clinicians' attitudes to clinical practice guidelines: a
- 26 systematic review. *Med J Aust* 2002;177:502-06.
- 27 38. Grimshaw JM, Russell IT. Effect of clinical guidelines on medical practice: a systematic
- 28 review of rigorous evaluations. *Lancet* 1993;342(8883):1317-22. [published Online First:
- 29 1993/11/27]
- 30 39. Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline
- 31 dissemination and implementation strategies. *Health technology assessment (Winchester,*
- 32 *England)* 2004;8(6):iii-iv, 1-72. [published Online First: 2004/02/13]
- 33 40. Lomas J, Anderson G, Domnick-Pierre K, et al. Do practice guidelines guide practice? The
- 34 effect of a consensus statement on the practice of physicians. *N Engl J Med*
- 35 1989;321(19):1306-11.
- 36 41. Lugtenberg M, Burgers JS, Westert GP. Effects of evidence-based clinical practice
- 37 guidelines on quality of care: a systematic review. *Quality & safety in health care*
- 38 2009;18(5):385-92. doi: 10.1136/qshc.2008.028043 [published Online First: 2009/10/09]
- 39 42. Ahmed N, Devitt KS, Keshet I, et al. A systematic review of the effects of resident duty hour
- 40 restrictions in surgery: impact on resident wellness, training, and patient outcomes. *Ann*
- 41 *Surg* 2014;259(6):1041-53. doi: 10.1097/sla.0000000000000595 [published Online First:
- 42 2014/03/26]
- 43 43. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an
- 44 Orthopedic Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J*
- 45 *Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]
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**Table 1.** Description of included studies

Author	Year	Country	Public Health Emergency	Surgical Specialty	Changes to Surgical Services	Impact of Changes Examined	Resumption of Services
Alvarez-Gallego	2020	Spain	COVID-19	General			
Ammar	2020	USA	COVID-19	Neurosurgery			
Amparore	2020	Italy	COVID-19	Urology		Changes in clinical and surgical resident involvement	
Ansarin	2020	Italy	COVID-19	Oncology (Head & Neck)			
Bashir	2020	UK	COVID-19	Vascular			
Ben Abdallah	2020	France	COVID-19	Vascular			
Bernucci	2020	Italy	COVID-19	Neurosurgery		Changes in surgical volume	
Bettinelli	2020	Italy	COVID-19	Orthopedics			
Bolkan	2014	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bolkan	2018	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bourlon	2009	Mexico	H1N1	—		Number of surgical cancellations	

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Bradford	2003	China	SARS	GI		Changes in admissions and surgical volumes	
Brethauer	2020	USA	COVID-19	GI			Operative cases placed in “depot” to be rescheduled alongside new teleconsults
Brown	2020	USA	COVID-19	Orthopedics		Patient pain, anxiety and physical function	
Buckstein	2020	USA	COVID-19	Radiation Oncology			
Bundu	2016	Sierra Leone	Ebola	—		Changes in ED/ward admissions and surgical activity	
Burke	2020	USA	COVID-19	Neurosurgery			
Busin	2020	Italy	COVID-19	Ophthalmology		Changes in demand/donations for cornea bank	Set reasonable timelines for patients requiring low acuity surgery. Surgical work schedule extended into evenings and weekends
Cai	2020	USA	COVID-19	Otolaryngology		Changes in resident	

							educational programming
Cakmak	2020	Turkey	COVID-19	Oncology (Breast)			Changes in surgical volume
Carenzo	2020	Italy	COVID-19	—			Changes in surgical volume
Cenzato	2020	Italy	COVID-19	Neurosurgery			
Chan	2006	China	SARS	Ophthalmology			
Chee	2004	Singapore	SARS	—			
Chew	2020	Singapore	COVID-19	General			
Chisci	2020	Italy	COVID-19	Vascular			Changes in surgical volume
Civantos	2020	USA	COVID-19	Oncology (Head & Neck)			Number of surgical cancellations
D'Apolito	2020	Italy	COVID-19	Orthopedics			Changes in surgical volume
de Vries	2020	Netherlands	COVID-19	Transplant			Changes in transplantation volumes
Ding	2020	Singapore	COVID-19	Orthopedics			
Dominguez-Gil	2020	Spain	COVID-19	Transplant			Changes in transplantation volumes
Doussot	2020	France	COVID-19	Oncology			Changes in surgical volume
Dowdell	2020	USA	COVID-19	Orthopedics			
Ducournau	2020	France	COVID-19	Plastics			
Eichberg	2020	USA	COVID-19	Neurosurgery			
Ficarra	2020	Italy	COVID-19	Urology			Proportion of surgical cancellations

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							initiated by patients
Fontanella	2020	Italy	COVID-19	Neurosurgery			Changes in surgical volume
Fontanella	2020	Italy	COVID-19	Neurosurgery			
Giorgi	2020	Italy	COVID-19	Spinal			
Givi	2020	USA	COVID-19	Oncology (Head & Neck)			Changes in fellow educational programming
Gomez-Barrena	2020	Spain	COVID-19	Orthopedics			Changes in surgical volume
Gouveia	2020	Portugal	COVID-19	Vascular			
Guerci	2020	Italy	COVID-19	General			
Gupta	2020	India	COVID-19	Oncology (Head & Neck)			
Haines	2003	China	SARS	Obstetrics			
Hemingway	2020	USA	COVID-19	Vascular			Changes in clinical and surgical volumes
Hormati	2020	Iran	COVID-19	GI			
Hu	2020	China	COVID-19	Oncology			
Jean	2020	USA	COVID-19	Neurosurgery			Changes in surgical volume
Kempa	2020	Poland	COVID-19	Electrophysiology			Changes in surgical volume
Kessler	2020	USA	COVID-19	Neurosurgery			
Konda	2020	USA	COVID-19	Orthopedics			
Kuo	2010	Argentina	H1N1	Ophthalmology			Changes in clinical and surgical volumes
Lai	2020	China	COVID-19	Ophthalmology			
Lancaster	2020	USA	COVID-19	—			Changes in surgical volume

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3	Langer	2020	USA	COVID-19	Plastics		
4	Lauterio	2020	Italy	COVID-19	Transplant		Changes in transplantation volumes
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8	Lee	2020	China	COVID-19	Oncology (Head & Neck)		Changes in surgical wait times
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11	Leong Tan	2020	Singapore	COVID-19	Vascular		
12	Li	2020	China	COVID-19	Transplant		
13	Liebensteiner	2020	Austria	COVID-19	Orthopedics		
14	Liu	2003	Singapore	SARS	Anesthesia		
15	Mak	2020	China	COVID-19	Plastics		
16	Marti	2020	Spain	COVID-19	Oncology (Breast)		
17	Maurizi	2020	Italy	COVID-19	Thoracic		Changes in surgical volume
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20	McBride	2020	Australia	COVID-19	—		
21	McMillan	2020	Canada	COVID-19	—		Prioritization first of patients who would be at increased risk with further delay, followed by those waiting longest
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33	Meneghini	2020	USA	COVID-19	Orthopedics		
34	Meyer	2020	France	COVID-19	Neurosurgery		Changes in surgical volume
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37	Morgan	2020	UK	COVID-19	Orthopedics		
38	Nair	2020	India	COVID-19	Ophthalmology		
39	Nassar	2020	USA	COVID-19	General		
40	Park	2020	USA	COVID-19	Otolaryngology		
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








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Park	2020	South Korea	MERS	—		Changes in surgical volume	
Patel	2020	USA	COVID-19	Oncology (Head & Neck)			
Patel	2020	USA	COVID-19	Otolaryngology			
Pelt	2020	USA	COVID-19	Orthopedics		Number of surgical postponements	Surgeries prioritized based on complexity and predicted LOS, scheduling only completed if appropriate PPE and screening available.
Pittet	2020	Switzerland	COVID-19	—		Changes in surgical volume	
Prachand	2020	USA	COVID-19	—		Number of surgical cancellations	
Price	2020	USA	COVID-19	Dermatology			
Qadan	2020	USA	COVID-19	Oncology (GI/Hepatobiliary)			
Ralli	2020	Italy	COVID-19	Otolaryngology			
Rampinelli	2020	Italy	COVID-19	Oncology (Head & Neck)		Changes in surgical volume	
Randelli	2020	Italy	COVID-19	Orthopedics			
Ricciardi	2020	Italy	COVID-19	Neurosurgery			
Ross	2020	USA	COVID-19	—		Changes in clinical volumes	

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3	Rubin	2020	USA	COVID-19	Electrophysiology		Changes in lab capacity and consultation volumes
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8	Rubin	2020	USA	COVID-19	Electrophysiology		
9	Salengar	2020	USA	COVID-19	Cardiac		Changes in surgical volume
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11	Sarpong	2020	USA	COVID-19	Orthopedics		
12	Schull	2007	Canada	SARS	—		Changes in surgical volume
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14							
15	Schwarzkopf	2020	USA	COVID-19	Orthopedics		
16	Scullen	2020	USA	COVID-19	Neurosurgery		
17	Seese	2020	USA	COVID-19	Cardiac		Changes in surgical volume
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19	Sethi	2020	USA	COVID-19	GI		Changes in surgical and consultation volumes
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24	Shen	2020	China	COVID-19	—		Scheduling resumed following consideration of reduced risk of imported transmission and growing waitlist
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35	Shih	2020	China	COVID-19	Ophthalmology		Changes in surgical volume
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37	Shokri	2020	USA	COVID-19	Plastics		Changes in surgical volume
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40	Sobel	2020	USA	COVID-19	Urology		
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Sun	2020	China	COVID-19	Neurosurgery		Emergency surgeries performed	
Tan	2004	Singapore	SARS	Anesthesia			
Tan	2020	Singapore	COVID-19	Urology		Changes in surgical and consultation volumes	
Tan	2020	China	COVID-19	Neurosurgery			
Tay	2020	Singapore	COVID-19	Orthopedics		Changes in surgical volumes	
Tay	2020	Singapore	COVID-19	Orthopedics			
Thaler	2020	Austria	COVID-19	Orthopedics			
Tolone	2020	Italy	COVID-19	—			
Too	2020	Singapore	COVID-19	Interventional Radiology			
Topf	2020	USA	COVID-19	Oncology (Head & Neck)			
Tsui	2005	China	SARS	Cardiac			
Tzeng	2020	USA	COVID-19	Oncology			
Unal	2020	Turkey	COVID-19	Vascular			
Vaccaro	2020	USA	COVID-19	Orthopedics		Changes in physician remuneration and staffing	
Valenza	2020	Italy	COVID-19	Oncology		Changes in surgical volumes	
van de Haar	2020	Netherlands	COVID-19	Oncology			
Various	2020	Canada	COVID-19	—		Number of surgical postponements	Calling patients to assess their ability to reschedule,

contracting private facilities with focus on urgent surgeries, patients waiting twice their clinical benchmarks or surgeries with minimal LOS

Various	2020	Ireland	COVID-19	—			
Vicini	2020	Italy	COVID-19	Oncology (Breast)		Changes in surgical volumes	
Vlantis	2004	China	SARS	Otolaryngology		Changes in outpatient and surgical volumes	
Walker	2020	USA	COVID-19	—		Number of surgical cancellations	Assess readiness of staff to safely resume high volumes of surgery and ensured availability of rapid in-house testing
Wan	2004	China	SARS	Thoracic		Patient anxiety and depression	
Wasser	2020	Israel	COVID-19	Ophthalmology			

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Williams	2020	USA	COVID-19	Ophthalmology		Number of surgeries rescheduled
Wong	2020	Singapore	COVID-19	Anesthesia		
Wu	2020	China	COVID-19	Oncology (Head & Neck)		
Xiaolei	2020	China	COVID-19	Ophthalmology		
Zangrillo	2020	Italy	COVID-19	—		
Zarzaur	2020	USA	COVID-19	—		
Zeng	2020	China	COVID-19	Oncology (Head & Neck)		
Zizzo	2020	Italy	COVID-19	—		
Zoia	2020	Italy	COVID-19	Neurosurgery		

Domains of change to surgical services, represented numerically:

- Changes to case selection and surgical triage
- Changes to PPE protocols and practices
- Changes to the surgical workforce.
- Changes to inpatient and outpatient care
- Changes to resident and fellow education
- Changes to the environment

Abbreviations: — =data not provided, COVID-19=Coronavirus Disease 2019, ED=Emergency department, GI=Gastrointestinal; LOS=Length of stay, PPE=Personal protective equipment, SARS=Severe Acute Respiratory Syndrome

**Table 2.** Reorganization of surgical services, by domain.

<b>Change Domain</b>	<b>Number of Studies (%)</b>	<b>Examples of Change</b>
Triage or Case Selection	80 (74.7)	<ol style="list-style-type: none"> <li>1. Prioritization of patients based on pre-defined levels of acuity;</li> <li>2. Virtual multidisciplinary meetings or tumor boards;</li> <li>3. Creation of specialty-specific lists outlining surgery-eligible and ineligible ailments, often with inclusion of case-by-case category.</li> <li>4. Postponement based on high-risk patient characteristics (i.e., older age, multimorbidity) and expected need for ICU.</li> </ol>
PPE	63 (58.3)	<ol style="list-style-type: none"> <li>1. Hospital wide surgical mask mandate for staff and attendees;</li> <li>2. Standard level of PPE outlined for all patient encounters with enhanced PPE (e.g., addition of N95 or PAPR, head and shoe covering) protocol for specific procedures or care of infected patients;</li> <li>3. Refresher instruction courses provided to all hospital staff;</li> <li>4. Trained observer supervising all perioperative donning and doffing of PPE to ensure safety and compliance.</li> </ol>
Workforce	70 (64.8)	<ol style="list-style-type: none"> <li>1. Separation of clinical staff into rotating “clean” and “dirty” teams caring for exclusively for non-infected and infected patients, respectively;</li> <li>2. Temperature and symptom screening of staff with mandated quarantine periods in cases of unprotected exposure;</li> <li>3. Case discussions, handover and clinical staff meetings transitioned to virtual format;</li> <li>4. Redeployment of staff to hospital areas requiring support (e.g., ICU), often paired with virtual training to ensure comfortable transition.</li> </ol>

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3	Patient Care	95 (88.0)	
4			1. Complete cancellation or transition
5			to telemedicine for all non-urgent
6			and routine perioperative clinical
7			visits;
8			2. Patient temperature, symptom and
9			travel history screening before
10			entry to clinic (relevant for urgent
11			surgical patients);
12			3. Preference for endovascular or
13			minimally invasive surgical
14			approaches when possible, use of
15			conservative care when possible
16			(oncology);
17			4. Restrictions on number of
18			accompanying persons or visitors
19			(often zero with some allowing
20			maximum of 1).
21			
22			
23	Resident/Fellow	35 (32.4)	1. Changes to resident/fellow team
24	Education		structure and rotation schedules to
25			ensure continued coverage of
26			department and maximize
27			resident/fellow safety;
28			2. Redeployment of residents to non-
29			specialty areas requiring clinical
30			support;
31			3. Curriculum and conferences
32			shifted to online format to allow
33			continued e-learning for off-duty
34			trainees;
35			4. Trainees involvement in surgical
36			care of infected persons ceased or
37			altered (e.g., only admitted to OR
38			during low-risk/non-aerosolizing
39			procedures).
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42	Environment	70 (64.8)	1. Dedication of wards (hallways,
43			elevators), ORs, or entire hospitals
44			to treat for only those infected or
45			not infected;
46			2. Use of negative-pressure OR when
47			possible;
48			3. Transformation of surgical wards,
49			ORs and outpatient clinics into
50			patient care areas to increase surge
51			capacity;
52			4. Double occupancy patient rooms
53			reduced to single occupancy, or
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physical measures (e.g., cubicles,  
distanced waiting room chairs)  
implemented.

*Abbreviations:* ICU= Intensive care unit, PPE= Personal protective equipment, PAPR= Powered  
air purifying respirator, OR= Operating room.

For peer review only

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Figure 1. PRISMA Flow diagram.

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3 Figure 2. Summary of study characteristics.  
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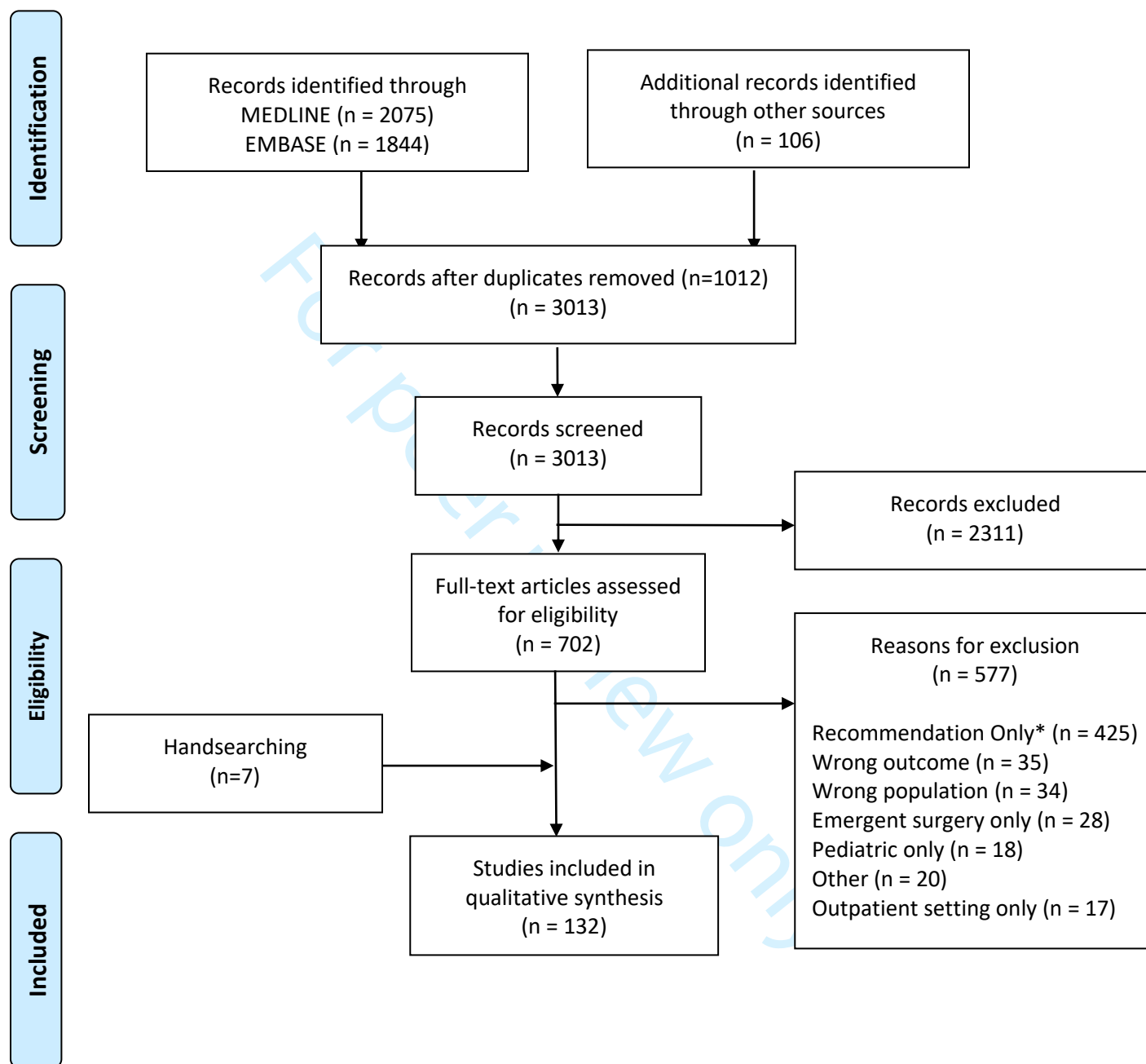
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Figure 3. Summary of leading impacts of changes to surgical programming

For peer review only

**Figure 1.** Flow of studies in the scoping review

\*Includes guidelines, recommendation-based reviews, projections or estimations without mention of true changes to surgical programming.

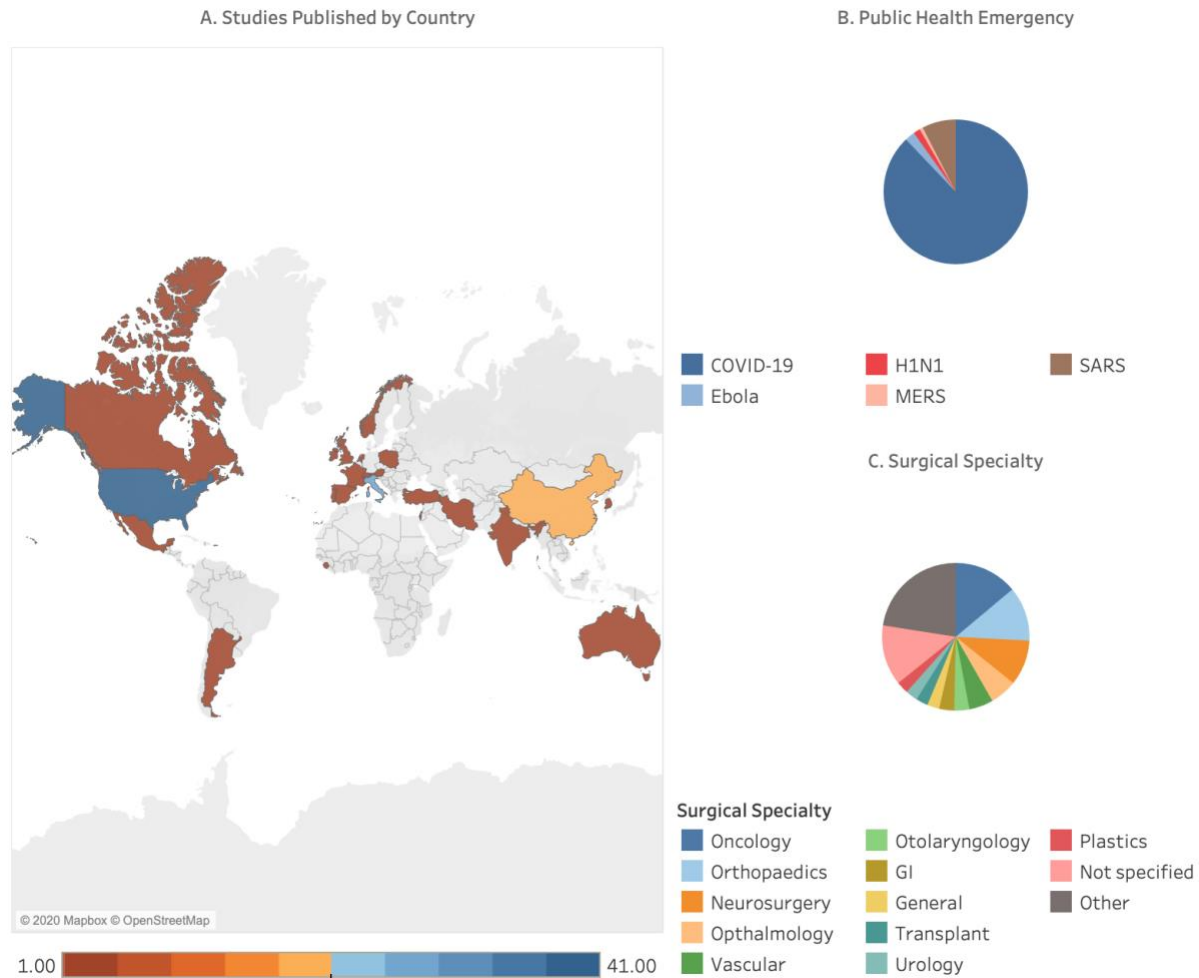
**Figure 2. Study characteristics**

Figure 2. **A.** Country of publication, **B.** Public health emergency discussed, and **C.** Surgical specialty addressed ('Other' includes Cardiac (n=3), Anesthesia (n=3), Electrophysiology (n=3), Obstetrics and Gynecology (n=3), Thoracic (n=2), Interventional Radiology (n=1), and Dermatology (n=1)).

**Figure 3.** Summary of the impacts of alterations to surgical services

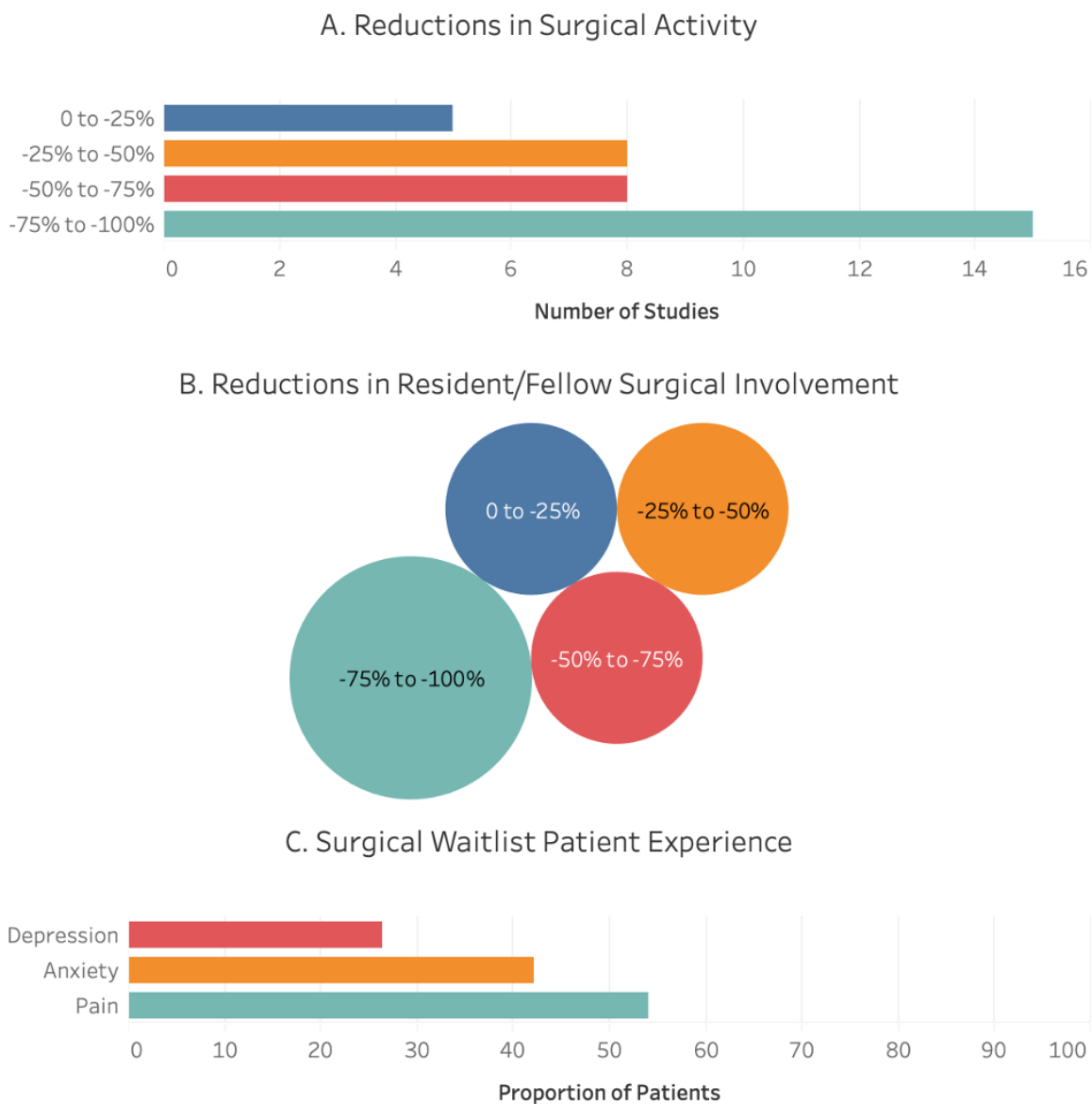


Figure 3. A summary of the impacts of alterations to surgical services during public health emergencies on **A.** Overall surgical activity (n=37 studies), **B.** Resident and fellow involvement in surgery (n=5 studies) where circle size represents the number of studies contributing to that quartile, and **C.** Patient experience (n=2 studies).

## Appendix A. Search Strategy

### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

#### Search Strategy:

- 
- 1 exp Disease Outbreaks/ (96117)
  - 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
  - 3 1 or 2 (231940)
  - 4 exp Coronavirus (13456)
  - 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
  - 6 Coronaviridae Infections/ (900)
  - 7 coronaviridae/ or coronavirus/ (3916)
  - 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
  - 9 Hemorrhagic Fever, Ebola/ (5316)
  - 10 SARS Virus/ (3038)
  - 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
  - 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
  - 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
  - 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
  - 15 (coronavir\*) adj2 (infection\*).mp. (8441)
  - 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
  - 17 General Surgery/ (38626)
  - 18 Orthopedic Procedures/ (25371)
  - 19 Traumatology/ (3474)
  - 20 Neurosurgery/ (14892)
  - 21 Obstetrics/ (22533)
  - 22 Anesthesia/ (62587)
  - 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
  - 24 exp Arthroplasty, Replacement/ (54362)
  - 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
  - 26 (surger\* or operation\* or procedure\*).mp. (3638036)
  - 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
  - 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
  - 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)
  - 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)
  - 31 3 and 16 and 30 (2075)
- .....

**Database: EMBASE <1974 to 2020 May 08>****Search Strategy:**

- 
- 1 exp epidemic/ (103292)
  - 2 exp pandemic/ (12990)
  - 3 1 or 2 (114458)
  - 4 pandemic influenza/ (4748)
  - 5 exp severe acute respiratory syndrome/ (8505)
  - 6 exp coronaviridae/ or coronaviridae infection/ (14928)
  - 7 coronavirinae/ (2093)
  - 8 Coronavirus infection/ (3397)
  - 9 avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ (7466)
  - 10 Ebola hemorrhagic fever/ (5712)
  - 11 exp SARS coronavirus/ (5823)
  - 12 Middle East respiratory syndrome/ (935)
  - 13 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (512)
  - 14 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. (92353)
  - 15 (wuhan adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV)).mp. (161)
  - 16 (coronavir\* adj2 infection\*).mp. (4793)
  - 17 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 (96712)
  - 18 general surgery/ (15070)
  - 19 orthopedic surgery/ (32672)
  - 20 traumatology/ (10653)
  - 21 neurosurgery/ (59847)
  - 22 obstetrics/ (34886)
  - 23 anesthesiological procedure/ (1785)
  - 24 elective surgery/ (34038)
  - 25 replacement arthroplasty/ or exp arthroplasty/ (73583)
  - 26 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. (966732)
  - 27 (surger\* or operation\* or procedure\*).mp. (5402047)
  - 28 ((elective or non-urgent adj2 (surg\* or procedure\*)).mp. (52808)
  - 29 (surg\* adj2 (procedure\* or planning or triag\* or operation\* or resource\* or backlog or re-organiz\* or postpon\* or cancel\* or capacit\* or wait time\*)).mp. (187480)
  - 30 ((clinic\* or hospital) adj2 (process\* or procedure\* or triag\* or planning or performance\* or capacit\*)).mp. (83715)
  - 31 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 (5948860)
  - 32 3 and 17 and 31 (1844)
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Database	Pandemic terms Pandemic, epidemic	Disease terms COVID-19, SARS, MERS, pandemic flu (h1n1, h3n2, h5n1), ebola	Surgical terms Non-urgent/elective surgery (general, orthopedic, anesthesia, trauma, neurosurgery, obstetrics)
<b>MEDLINE</b>	exp Disease Outbreaks/ OR (pandemic* or epidemic* or outbreak* or outbreak*).mp.	exp Coronavirus OR coronavirus infections/ or severe acute respiratory syndrome/ OR Coronaviridae Infections/ OR coronaviridae/ or coronavirus/ OR Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ OR Hemorrhagic Fever, Ebola/ OR SARS Virus/ OR Middle East Respiratory Syndrome Coronavirus/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola* or middle	General Surgery/ OR Orthopedic Procedures/ OR Traumatology/ OR Neurosurgery/ OR Obstetrics/ OR Anesthesia/ OR surgical procedures, operative/ or exp elective surgical procedures/ OR exp Arthroplasty, Replacement/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent) adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triage or operation* or resource* or backlog or re-organiz* or postpone* or cancel* or capacit* or wait time*)).mp.

		east respiratory syndrome or MERS).mp. OR (wuhan) adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV).mp. OR (coronavir*) adj2 (infection*).mp.	OR ((clinic* or hospital) adj2 (process* or procedure* or triage or planning or performance* or capacit*)).mp.
<b>EMBASE</b>	exp epidemic/ OR exp pandemic/	pandemic influenza/ OR exp severe acute respiratory syndrome/ OR exp coronaviridae/ or coronaviridae infection/ OR coronavirinae/ OR Coronavirus infection/ OR avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ OR Ebola hemorrhagic fever/ OR exp SARS coronavirus/ OR Middle East respiratory syndrome/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. OR	general surgery/ OR orthopedic surgery/ OR traumatology/ OR neurosurgery/ OR obstetrics/ OR anesthesiological procedure/ OR elective surgery/ OR replacement arthroplasty/ or exp arthroplasty/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triag* or operation* or resource* or backlog or re-organiz* or postpon* or cancel* or



		(wuhan adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV)).mp. OR (coronavir* adj2 infection*).mp.	capacit* or wait time*).mp. OR ((clinic* or hospital) adj2 (process* or procedure* or triag* or planning or performance* or capacit*).mp.
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## GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms “coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery” OR “guidelines”)

## NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

## GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

## GENERAL SURGICAL GROUPS/COLLEGES

1  
 2  
 3 Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)  
 4 American College of Surgeons (<https://www.facs.org>)  
 5 European Surgical Association (<https://www.europeansurgicalassociation.org>)  
 6 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
 7 French Surgical Association  
 8 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
 9 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
 10 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
 11 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
 12 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
 13 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
 14 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
 15 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
 16 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
 17 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
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21  
 22 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
 23 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
 24 OR “Surgery” OR “non-urgent” OR “guidelines”  
 25

26 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
 27 past last click for relevance.  
 28

29  
 30 STEP 4) Contact with Knowledge Experts.  
 31

Source and Site	Search Terms	Potentially Relevant Results
<b>Health Groups</b>		
World Health Organization ( <a href="https://www.who.int">https://www.who.int</a> , Advanced Search)	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	10
Center for Disease Control and Prevention ( <a href="https://www.cdc.gov">https://www.cdc.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	8
European Centre for Disease Prevention and Control ( <a href="https://www.ecdc.europa.eu/en">https://www.ecdc.europa.eu/en</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	3
<b>Governments</b>		
Government of Canada ( <a href="https://www.canada.ca/en.html">https://www.canada.ca/en.html</a> )	[contains all words] elective surgery covid	4

	[contains all words] non-urgent surgery covid	
Government of BC ( <a href="https://www2.gov.bc.ca/gov">https://www2.gov.bc.ca/gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of AB ( <a href="https://www.alberta.ca">https://www.alberta.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of SK ( <a href="https://www.saskatchewan.ca">https://www.saskatchewan.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	6
Government of MB ( <a href="https://www.gov.mb.ca">https://www.gov.mb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	4
Government of ON ( <a href="https://www.ontario.ca">https://www.ontario.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of QC ( <a href="https://www.quebec.ca/en/">https://www.quebec.ca/en/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of NB ( <a href="https://www2.gnb.ca">https://www2.gnb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NS ( <a href="https://beta.novascotia.ca">https://beta.novascotia.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NL & LB ( <a href="https://www.gov.nl.ca">https://www.gov.nl.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of PEI ( <a href="https://www.princeedwardisland.ca">https://www.princeedwardisland.ca</a> )	[contains all words] elective surgery covid	2

	[contains all words] non-urgent surgery covid	
Government of Yukon ( <a href="https://yukon.ca">https://yukon.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NWT ( <a href="https://www.gov.nt.ca">https://www.gov.nt.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Nunavut ( <a href="https://www.gov.nu.ca">https://www.gov.nu.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Australia ( <a href="https://www.australia.gov.au">https://www.australia.gov.au</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Italy ( <a href="http://www.governo.it">http://www.governo.it</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Singapore ( <a href="https://www.gov.sg">https://www.gov.sg</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of China ( <a href="https://www.gov.cn/english/">https://www.gov.cn/english/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
United States Government ( <a href="https://www.usa.gov">https://www.usa.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
<b>Surgical Colleges/Associations</b>		
Royal College of Physicians and Surgeons of Canada ( <a href="http://www.royalcollege.ca">http://www.royalcollege.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0

<p>American College of Surgeons (<a href="https://www.facs.org">https://www.facs.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>23</p>
<p>European Surgical Association (<a href="https://www.europeansurgicalassociation.org">https://www.europeansurgicalassociation.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>College of Surgeons, Singapore (<a href="https://www.ams.edu.sg">https://www.ams.edu.sg</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>3</p>
<p>German Society of Surgery (<a href="https://www.dgch.de/index.php?id=118">https://www.dgch.de/index.php?id=118</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>Philippine College of Surgeons (<a href="https://www.pcs.org.ph">https://www.pcs.org.ph</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>11</p>
<p>Royal Australasian College of Surgeons (<a href="https://www.surgeons.org">https://www.surgeons.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>12</p>
<p>Royal College of Surgeons of England (<a href="https://www.rcseng.ac.uk">https://www.rcseng.ac.uk</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>7</p>
<p>Royal College of Surgeons of Ireland (<a href="https://www.rcsi.com/dublin/">https://www.rcsi.com/dublin/</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>8</p>
<p>Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<a href="https://www.aecirujanos.es">https://www.aecirujanos.es</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>1</p>
<p>Swedish Surgical Society (<a href="http://www.svenskkirurgi.se">http://www.svenskkirurgi.se</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>

The Association of Surgeons of South Africa ( <a href="http://www.surgeon.co.za">http://www.surgeon.co.za</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
The Pan African Association of Surgeons ( <a href="http://www.africansurgeons.com">http://www.africansurgeons.com</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Total		111

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## Appendix B. Data Abstraction Form

This form has been developed by adopting and customizing the 'Data collection form- RCTs and NRS' produced by The Cochrane Collaboration. Customization includes the addition of new sections, as well as the omission of sections not relevant to the review.

### Notes on using data extraction form:

- Be consistent in the order and style you use to describe the information for each report.
- Record any missing information as unclear or not described, to make it clear that the information was not found in the study report(s), not that you forgot to extract it.
- Include any instructions and decision rules on the data collection form, or in an accompanying document. It is important to practice using the form and give training to any other authors using the form.

### 1. General Information

1. Date form completed (dd/mm/yyyy)	/ /
2. Name of person extracting data	<input type="checkbox"/> Connor M. ORielly <input type="checkbox"/> Khara M. Sauro
3. Contact details of person extracting data	
4. Title of Article/Abstract (that data are extracted from)	
5. Study ID (plus surname of author and year of study publication)	
6. Study country of origin	
7. Study funding source	
8. Possible conflicts of interest	<input type="checkbox"/> Reported <input type="checkbox"/> Not Reported
9. Notes:	

### 2. Eligibility

Study Characteristics	Inclusion Criteria	Location in text (page#/fig#/table#)
10. Type of study (design)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	

11. Population description		
12. Focused diseases/conditions		
13. Types of outcome measures		
14. Decision (with reasons for either inclusion or exclusion)	<input type="checkbox"/> Include <input type="checkbox"/> Exclude If Exclude, explain:	
15. Notes		

**IF STUDY IS EXCLUDED FROM REVIEW, DO NOT CONTINUE**

## 2. Population and setting

	Description	Location in text (page#/fig#/table#)
16. Population description		
17. Source/setting of the population (e.g., urban, rural, ethnic group)		
18. Method(s) of recruitment of participants	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random  Method:	
19. Notes:		

## 3. Methods

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
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20. Aim of study		
21. Design (e.g., cross-sectional, RCT, CCT)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	
22. Sampling technique (e.g., random or convenience)	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random	
23. Study start date (dd/mm/yyyy)	/ /	
24. Study end date/duration (dd/mm/yyyy)	/ / <b>OR</b> Duration:	
25. Notes:		

#### 4. Participants

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
26. Total number of participants/Sample size		
27. Age		
28. Sex	<input type="checkbox"/> Both Sexes <input type="checkbox"/> Males <input type="checkbox"/> Females	
29. Genders Represented		
30. Country		
31. Predominant medical complaint		
32. Co-morbidities (if any)		
33. Definition of 'Frequent use' (if any)		

34. Notes:

## 5. Outcomes

Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
35. Outcome definition		
36. Time points measured		
37. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
38. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
39. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
40. Specify Outcome		
41. Outcome definition		
42. Time points measured		
43. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
44. Unit of measurement		
45. Notes:		

Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
46. Specify Outcome		
47. Outcome definition		
48. Time points measured		
49. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
50. Unit of measurement		
51. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
52. Specify Outcome		
53. Outcome definition		
54. Time points measured		
55. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
56. Unit of measurement		
57. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
58. Outcome definition		
59. Time points measured		

60. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
61. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
62. Notes:		

## 6. Results and findings

*Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.*

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
63. Subgroup (if applicable, e.g., age/sex specific reporting)		
64. Results		
65. Response/non-response rate		
66. Unit of analysis (i.e., individual or group)		
67. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
68. Subgroup (if applicable, e.g., age/sex specific reporting)		
69. Results		
70. Response/non-response rate		
71. Unit of analysis (i.e., individual or group)		
72. Notes:		

Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
73. Subgroup (if applicable, e.g., age/sex specific reporting)		
74. Results		
75. Response/non-response rate		
76. Unit of analysis (i.e., individual or group)		
77. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
78. Subgroup (if applicable, e.g., age/sex specific reporting)		
79. Results		
80. Response/non-response rate		
81. Unit of analysis (i.e., individual or group)		
82. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
83. Subgroup (if applicable, e.g., age/sex specific reporting)		
84. Results		
85. Response/non-response rate		
86. Unit of analysis (i.e., individual or group)		
87. Notes:		

**Research Questions informed by this study (tick only boxes matching the outcome tables kept above)**

Changes to surgical programming in response to public health emergency

- Impacts of changes to surgical programming
- Actions to rebuild surgical capacity post-public health emergency

### 7. Strengths, limitations and mitigation strategy

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
88. Strengths		
89. Limitations		
90. Strategies to overcome limitations		
91. Notes:		

### 8. Conclusion and other information

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
92. Key conclusions of study authors		
93. Notes:		

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### Appendix C. Complete list of references for included studies

1. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
2. Ammar A, Stock AD, Holland R, et al. Managing a Specialty Service During the COVID-19 Crisis: Lessons From a New York City Health System. *Acad Med* 2020 doi: 10.1097/ACM.0000000000003440 [published Online First: 2020/04/19]
3. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
4. Ansarin M. Surgical management of head and neck tumours during the SARS-CoV (COVID-19) pandemic. *Acta Otorhinolaryngol Ital* 2020;40(2):87-89. doi: 10.14639/0392-100X-N0783 [published Online First: 2020/04/10]
5. Bashir M, Moughal S. Cardiovascular disease and surgery amid COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.479 [published Online First: 2020/05/04]
6. Ben Abdallah I. Early experience in Paris with the impact of the COVID-19 pandemic on vascular surgery. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.467 [published Online First: 2020/04/27]
7. Bernucci C, Brembilla C, Veiceschi P. Effects of the COVID-19 Outbreak in Northern Italy: Perspectives from the Bergamo Neurosurgery Department. *World Neurosurg* 2020;137:465-68 e1. doi: 10.1016/j.wneu.2020.03.179 [published Online First: 2020/04/06]
8. Bettinelli G, Delmastro E, Salvato D, et al. Orthopaedic patient workflow in CoViD-19 pandemic in Italy. *J Orthop* 2020;22:158-59. doi: 10.1016/j.jor.2020.04.006 [published Online First: 2020/05/07]
9. Bolkan HA, Bash-Taqi DA, Samai M, et al. Ebola and indirect effects on health service function in sierra leone. *PLoS Curr* 2014;6 doi: 10.1371/currents.outbreaks.0307d588df619f9c9447f8ead5b72b2d [published Online First: 2015/02/17]
10. Bolkan HA, van Duinen A, Samai M, et al. Admissions and surgery as indicators of hospital functions in Sierra Leone during the west-African Ebola outbreak. *BMC Health Serv Res* 2018;18(1):846. doi: 10.1186/s12913-018-3666-9 [published Online First: 2018/11/11]
11. Bourlon MT, Macias AE, de la Torre A, et al. Organization of a third-level care hospital in Mexico City during the 2009 influenza epidemic. *Arch Med Res* 2009;40(8):681-6. doi: 10.1016/j.arcmed.2009.10.009 [published Online First: 2010/03/23]
12. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]
13. Brethauer SA, Poulouse BK, Needleman BJ, et al. Redesigning a Department of Surgery during the COVID-19 Pandemic. *J Gastrointest Surg* 2020 doi: 10.1007/s11605-020-04608-4 [published Online First: 2020/04/30]
14. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]



15. Buckstein M, Skubish S, Smith K, et al. Experiencing the Surge: Report from a Large New York Radiation Oncology Department During the COVID-19 Pandemic. *Adv Radiat Oncol* 2020 doi: 10.1016/j.adro.2020.04.014 [published Online First: 2020/05/08]
16. Bundu I, Patel A, Mansaray A, et al. Surgery in the time of Ebola: how events impacted on a single surgical institution in Sierra Leone. *J R Army Med Corps* 2016;162(3):212-6. doi: 10.1136/jramc-2015-000582 [published Online First: 2016/01/21]
17. Burke JF, Chan AK, Mummaneni V, et al. Letter: The Coronavirus Disease 2019 Global Pandemic: A Neurosurgical Treatment Algorithm. *Neurosurgery* 2020;87(1):E50-E56. doi: 10.1093/neuros/nyaa116
18. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi: 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
19. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
20. Cakmak GK, Ozmen V. Sars-CoV-2 (COVID-19) Outbreak and Breast Cancer Surgery in Turkey. *Eur J Breast Health* 2020;16(2):83-85. doi: 10.5152/ejbh.2020.300320 [published Online First: 2020/04/15]
21. Carenzo L, Costantini E, Greco M, et al. Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. *Anaesthesia* 2020 doi: 10.1111/anae.15072 [published Online First: 2020/04/05]
22. Cenzato M, DiMeco F, Fontanella M, et al. Editorial. Neurosurgery in the storm of COVID-19: suggestions from the Lombardy region, Italy (ex malo bonum). *Journal of neurosurgery* 2020:1-2. doi: 10.3171/2020.3.JNS20960
23. Chan WM, Liu DTL, Chan PKS, et al. Precautions in ophthalmic practice in a hospital with a major acute SARS outbreak: an experience from Hong Kong. *Eye* 2006;20(3):283-89. doi: 10.1038/sj.eye.6701885
24. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
25. Chew MH, Koh FH, Ng KH. A call to arms: a perspective of safe general surgery in Singapore during the COVID-19 pandemic. *Singapore Med J* 2020 doi: 10.11622/smedj.2020049 [published Online First: 2020/04/04]
26. Chisci E, Masciello F, Michelagnoli S. Creation of a vascular surgical hub responding to the COVID-19 emergency: The Italian USL Toscana Centro model. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.019 [published Online First: 2020/04/20]
27. Civantos FJ, Leibowitz JM, Arnold DJ, et al. Ethical surgical triage of patients with head and neck cancer during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26229 [published Online First: 2020/05/02]
28. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]
29. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]

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2  
3 30. Ding BTK, Soh T, Tan BY, et al. Operating in a Pandemic: Lessons and Strategies from  
4 an Orthopaedic Unit at the Epicenter of COVID-19 in Singapore. *J Bone Joint Surg Am* 2020  
5 doi: 10.2106/JBJS.20.00568 [published Online First: 2020/05/08]  
6  
7 31. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation  
8 in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online  
9 First: 2020/05/03]  
10  
11 32. Doussot A, Heyd B, Lakkis Z. We Asked the Experts: How Do We Maintain Surgical  
12 Quality Standards for Enhanced Recovery Programs After Cancer Surgery During the COVID-  
13 19 Outbreak? *World J Surg* 2020 doi: 10.1007/s00268-020-05546-7 [published Online First:  
14 2020/04/27]  
15  
16 33. Dowdell JE, Louie PK, Virk S, et al. Spine fellowship training reorganizing during a  
17 pandemic: perspectives from a tertiary orthopedic specialty center in the epicenter of outbreak.  
18 *Spine J* 2020 doi: 10.1016/j.spinee.2020.04.015 [published Online First: 2020/04/29]  
19  
20 34. Ducournau F, Arianni M, Awwad S, et al. COVID-19: Initial experience of an  
21 international group of hand surgeons. *Hand Surg Rehabil* 2020;39(3):159-66. doi:  
22 10.1016/j.hansur.2020.04.001 [published Online First: 2020/04/13]  
23  
24 35. Eichberg DG, Shah AH, Luther EM, et al. Letter: Academic Neurosurgery Department  
25 Response to COVID-19 Pandemic: The University of Miami/Jackson Memorial Hospital Model.  
26 *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa118 [published Online First: 2020/04/12]  
27  
28 36. Ficarra V, Mucciardi G, Giannarini G. Re: Riccardo Campi, Daniele Amparore, Umberto  
29 Capitanio, et al. Assessing the Burden of Urgent Nondeferrable Uro-oncologic Surgery to Guide  
30 Prioritisation Strategies During the COVID-19 Pandemic: Insights from Three Italian High-  
31 volume Referral Centres. *Eur Urol*. In press. <https://doi.org/10.1016/j.eururo.2020.03.054>. *Eur*  
32 *Urol* 2020 doi: 10.1016/j.eururo.2020.04.037 [published Online First: 2020/05/04]  
33  
34 37. Fontanella MM, De Maria L, Zanin L, et al. Neurosurgical Practice During the Severe  
35 Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Pandemic: A Worldwide Survey.  
36 *World Neurosurg* 2020 doi: 10.1016/j.wneu.2020.04.204 [published Online First: 2020/05/08]  
37  
38 38. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19  
39 pandemic: an expert opinion from China, South Korea, Italy, United States of America,  
40 Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2  
41 [published Online First: 2020/04/30]  
42  
43 39. Giorgi PD, Villa F, Gallazzi E, et al. The management of emergency spinal surgery  
44 during the COVID-19 pandemic in Italy. *Bone Joint J* 2020;xxx. doi: 10.1302/0301-  
45 620X.102B6.BJJ-2020-0537 [published Online First: 2020/04/24]  
46  
47 40. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during  
48 the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First:  
49 2020/05/10]  
50  
51 41. Gomez-Barrena E, Rubio-Suarez JC, Fernandez-Baillo N, et al. Limiting spread of  
52 COVID-19 in an orthopaedic department—a perspective from Spain. *J Surg Case Rep*  
53 2020;2020(4):rjaa095. doi: 10.1093/jscr/rjaa095 [published Online First: 2020/04/30]  
54  
55 42. Gouveia EMR, Pedro LM. Vascular surgery department adjustments in the era of the  
56 COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.017 [published Online First:  
57 2020/04/20]  
58  
59 43. Guerci C, Maffioli A, Bondurri AA, et al. COVID-19: How can a department of general  
60 surgery survive in a pandemic? *Surgery* 2020;167(6):909-11. doi: 10.1016/j.surg.2020.03.012  
[published Online First: 2020/04/18]

- 1
- 2
- 3
- 4 44. Gupta A, Arora V, Nair D, et al. Status and strategies for the management of head and
- 5 neck cancer during COVID-19 pandemic: Indian scenario. *Head Neck* 2020 doi:
- 6 10.1002/hed.26227 [published Online First: 2020/05/02]
- 7 45. Haines CJ, Chu YW, Chung TK. The effect of Severe Acute Respiratory Syndrome on a
- 8 hospital obstetrics and gynaecology service. *BJOG* 2003;110(7):643-5. doi:
- 9 <http://dx.doi.org/10.1016/S1470-0328%2803%2903007-6> [published Online First: 2003/07/05]
- 10 46. British Columbia Ministry of Health. A Commitment to Surgical Renewal in BC.
- 11 Canada, 2020.
- 12 47. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery
- 13 during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published
- 14 Online First: 2020/05/04]
- 15 48. Hormati A, Ghadir MR, Zamani F, et al. Preventive strategies used by GI physicians
- 16 during the COVID-19 pandemic. *New Microbes New Infect* 2020;35:100676. doi:
- 17 10.1016/j.nmni.2020.100676 [published Online First: 2020/04/16]
- 18 49. Hu Y-J, Zhang J-M, Chen Z-P. Experiences of practicing surgical neuro-oncology during
- 19 the COVID-19 pandemic. *Journal of neuro-oncology* 2020;148(1):199-200. doi:
- 20 10.1007/s11060-020-03489-6 [published Online First: 2020/04/10]
- 21 50. Jean WC, Ironside NT, Sack KD, et al. The impact of COVID-19 on neurosurgeons and
- 22 the strategy for triaging non-emergent operations: a global neurosurgery study. *Acta Neurochir*
- 23 *(Wien)* 2020;162(6):1229-40. doi: 10.1007/s00701-020-04342-5 [published Online First:
- 24 2020/04/22]
- 25 51. Kempa M, Gulaj M, Farkowski MM, et al. Electrotherapy and electrophysiology
- 26 procedures during the coronavirus disease 2019 pandemic: an opinion of the Heart Rhythm
- 27 Section of the Polish Cardiac Society (with an update). *Kardiol Pol* 2020;78(5):488-92. doi:
- 28 10.33963/KP.15338 [published Online First: 2020/05/06]
- 29 52. Kessler RA, Zimering J, Gilligan J, et al. Neurosurgical management of brain and spine
- 30 tumors in the COVID-19 era: an institutional experience from the epicenter of the pandemic. *J*
- 31 *Neurooncol* 2020 doi: 10.1007/s11060-020-03523-7 [published Online First: 2020/05/07]
- 32 53. Konda SR, Dankert JF, Merkow D, et al. COVID-19 Response in the Global Epicenter:
- 33 Converting a New York City Level 1 Orthopedic Trauma Service into a Hybrid Orthopedic and
- 34 Medicine COVID-19 Management Team. *J Orthop Trauma* 2020 doi:
- 35 10.1097/BOT.0000000000001792 [published Online First: 2020/05/02]
- 36 54. Kuo IC, Pellegrino F, Fornero P, et al. H1N1 pandemic and ophthalmology.
- 37 *Ophthalmology* 2010;117(2):405. doi: 10.1016/j.ophtha.2009.11.035 [published Online First:
- 38 2010/02/10]
- 39 55. Lai THT, Tang EWH, Chau SKY, et al. Stepping up infection control measures in
- 40 ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. *Graefes*
- 41 *Arch Clin Exp Ophthalmol* 2020;258(5):1049-55. doi: 10.1007/s00417-020-04641-8 [published
- 42 Online First: 2020/03/04]
- 43 56. Lancaster EM, Sosa JA, Sammann A, et al. Rapid Response of an Academic Surgical
- 44 Department to the COVID-19 Pandemic: Implications for Patients, Surgeons, and the
- 45 Community. *J Am Coll Surg* 2020;230(6):1064-73. doi: 10.1016/j.jamcollsurg.2020.04.007
- 46 [published Online First: 2020/04/13]
- 47 57. Langer PD, Bernardini FP. Oculofacial Plastic Surgery and the COVID-19 Pandemic:
- 48 Current Reactions and Implications for the Future. *Ophthalmology* 2020 doi:
- 49 10.1016/j.ophtha.2020.04.035 [published Online First: 2020/04/30]
- 50
- 51
- 52
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46  
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48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
58. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int* 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]
59. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service disruption during COVID-19 in Hong Kong through telehealth and multi-institutional collaboration. *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]
60. Leong Tan GW, Chandrasekar S, Lo ZJ, et al. Early experience in the COVID-19 pandemic from a vascular surgery unit in a Singapore tertiary hospital. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.014 [published Online First: 2020/04/20]
61. Li Y, Yang N, Li X, et al. Strategies for prevention and control of the 2019 novel coronavirus disease in the department of kidney transplantation. *Transpl Int* 2020 doi: 10.1111/tri.13634 [published Online First: 2020/05/02]
62. Liebensteiner MC, Khosravi I, Hirschmann MT, et al. Massive cutback in orthopaedic healthcare services due to the COVID-19 pandemic. *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1705-11. doi: 10.1007/s00167-020-06032-2 [published Online First: 2020/05/02]
63. Liu EH, Koh KF, Chen FG. Outbreak of severe acute respiratory syndrome in Singapore and modifications in the anesthesia service. *Anesthesiology* 2004;100(6):1629-30. doi: 10.1097/00000542-200406000-00062 [published Online First: 2004/05/29]
64. Mak ST, Yuen HK. Oculoplastic surgery practice during the COVID-19 novel coronavirus pandemic: experience sharing from Hong Kong. *Orbit* 2020:1-3. doi: 10.1080/01676830.2020.1754435 [published Online First: 2020/04/17]
65. Marti C, Sanchez-Mendez JI. Neoadjuvant endocrine therapy for luminal breast cancer treatment: a first-choice alternative in times of crisis such as the COVID-19 pandemic. *Ecancermedicalscience* 2020;14:1027. doi: 10.3332/ecancer.2020.1027 [published Online First: 2020/05/06]
66. Maurizi G, Rendina EA. A High-Volume Thoracic Surgery Division into the Storm of the Covid-19 Pandemic. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.03.015 [published Online First: 2020/04/15]
67. McBride KE, Brown KGM, Fisher OM, et al. Impact of the COVID-19 pandemic on surgical services: early experiences at a nominated COVID-19 centre. *ANZ J Surg* 2020;90(5):663-65. doi: 10.1111/ans.15900 [published Online First: 2020/04/08]
68. McMillan T, Williamson K. Resuming non-urgent surgeries and allied health services, 2020.
69. Meneghini RM. Resource Reallocation during the COVID-19 Pandemic in a Suburban Hospital System: Implications for Outpatient Hip and Knee Arthroplasty. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.051 [published Online First: 2020/05/08]
70. Meyer M, Prost S, Farah K, et al. Spine Surgical Procedures during Coronavirus Disease 2019 Pandemic: Is It Still Possible to Take Care of Patients? Results of an Observational Study in the First Month of Confinement. *Asian Spine J* 2020 doi: 10.31616/asj.2020.0197 [published Online First: 2020/05/10]
71. Morgan C, Ahluwalia AK, Aframian A, et al. The impact of the novel coronavirus on trauma and orthopaedics in the UK. *Br J Hosp Med (Lond)* 2020;81(4):1-6. doi: 10.12968/hmed.2020.0137 [published Online First: 2020/04/29]
72. Nair AG, Gandhi RA, Natarajan S. Effect of COVID-19 related lockdown on ophthalmic practice and patient care in India: Results of a survey. *Indian J Ophthalmol* 2020;68(5):725-30. doi: 10.4103/ijo.IJO\_797\_20 [published Online First: 2020/04/23]

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4  
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50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
73. Nassar AH, Zern NK, McIntyre LK, et al. Emergency Restructuring of a General Surgery Residency Program During the Coronavirus Disease 2019 Pandemic: The University of Washington Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1219 [published Online First: 2020/04/07]
74. Park J, Yoo SY, Ko JH, et al. Infection Prevention Measures for Surgical Procedures during a Middle East Respiratory Syndrome Outbreak in a Tertiary Care Hospital in South Korea. *Sci Rep* 2020;10(1):325. doi: 10.1038/s41598-019-57216-x [published Online First: 2020/01/17]
75. Park JS, El-Sayed IH, Young VN, et al. Development of clinical care guidelines for faculty and residents in the era of COVID-19. *Head Neck* 2020 doi: 10.1002/hed.26225 [published Online First: 2020/04/30]
76. Patel RJ, Kejner A, McMullen C. Early institutional head and neck oncologic and microvascular surgery practice patterns across the United States during the SARS-CoV-2 (COVID19) pandemic. *Head Neck* 2020;42(6):1168-72. doi: 10.1002/hed.26189 [published Online First: 2020/04/25]
77. Patel ZM, Fernandez-Miranda J, Hwang PH, et al. Letter: Precautions for Endoscopic Transnasal Skull Base Surgery During the COVID-19 Pandemic. *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa125 [published Online First: 2020/04/16]
78. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
79. Pittet D. Hopitaux Universitaire de Genève (HUG)- A model hospital for COVID-19 patient management, 2020.
80. Prachand VN, Milner R, Angelos P, et al. Medically Necessary, Time-Sensitive Procedures: Scoring System to Ethically and Efficiently Manage Resource Scarcity and Provider Risk During the COVID-19 Pandemic. *J Am Coll Surg* 2020 doi: 10.1016/j.jamcollsurg.2020.04.011 [published Online First: 2020/04/13]
81. Price KN, Thiede R, Shi VY, et al. Strategic dermatology clinical operations during the coronavirus disease 2019 (COVID-19) pandemic. *J Am Acad Dermatol* 2020;82(6):e207-e09. doi: 10.1016/j.jaad.2020.03.089 [published Online First: 2020/04/12]
82. Qadan M, Hong TS, Tanabe KK, et al. A Multidisciplinary Team Approach for Triage of Elective Cancer Surgery at the Massachusetts General Hospital During the Novel Coronavirus COVID-19 Outbreak. *Ann Surg* 2020 doi: 10.1097/SLA.0000000000003963 [published Online First: 2020/04/18]
83. Ralli M, Greco A, de Vincentiis M. The Effects of the COVID-19/SARS-CoV-2 Pandemic Outbreak on Otolaryngology Activity in Italy. *Ear Nose Throat J* 2020;145561320923893. doi: 10.1177/0145561320923893 [published Online First: 2020/04/30]
84. Rampinelli V, Mattavelli D, Gualtieri T, et al. Reshaping head and neck reconstruction policy during the COVID-19 pandemic peak: Experience in a front-line institution. *Auris Nasus Larynx* 2020 doi: 10.1016/j.anl.2020.04.008 [published Online First: 2020/05/05]
85. Randelli PS, Compagnoni R. Management of orthopaedic and traumatology patients during the Coronavirus disease (COVID-19) pandemic in northern Italy. *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1683-89. doi: 10.1007/s00167-020-06023-3 [published Online First: 2020/04/27]

- 1  
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46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
86. Ricciardi L, Trungu S, Scerrati A, et al. Neurosurgery at the time of COVID-19: how this pandemic infectious disease is influencing neurosurgical activities and patient management. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04976-0 [published Online First: 2020/04/30]
87. 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(6):1080-91 e3. doi: 10.1016/j.jamcollsurg.2020.03.019 [published Online First: 2020/04/03]
88. Rubin GA, Biviano A, Dizon J, et al. Performance of electrophysiology procedures at an academic medical center amidst the 2020 coronavirus (COVID-19) pandemic. *J Cardiovasc Electrophysiol* 2020 doi: 10.1111/jce.14493 [published Online First: 2020/04/14]
89. Rubin GA, Wan EY, Saluja D, et al. Restructuring Electrophysiology During the COVID-19 Pandemic: A Practical Guide from a New York City Hospital Network. *Crit Pathw Cardiol* 2020 doi: 10.1097/HPC.000000000000225 [published Online First: 2020/04/24]
90. Salenger R, Etchill EW, Ad N, et al. The Surge after the Surge: Cardiac Surgery post-COVID-19. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.04.018 [published Online First: 2020/05/08]
91. Sarpong NO, Forrester LA, Levine WN. What's Important: Redeployment of the Orthopaedic Surgeon During the COVID-19 Pandemic: Perspectives from the Trenches. *J Bone Joint Surg Am* 2020 doi: 10.2106/JBJS.20.00574 [published Online First: 2020/04/15]
92. Schull MJ, Stukel TA, Vermeulen MJ, et al. Effect of widespread restrictions on the use of hospital services during an outbreak of severe acute respiratory syndrome. *Canadian Medical Association Journal* 2007;176(13):1827-32. doi: 10.1503/cmaj.061174
93. Schwarzkopf R, Maher NA, Slover JD, et al. The Response of an Orthopedic Department and Specialty Hospital at the Epicenter of a Pandemic: The NYU Langone Health Experience. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.041 [published Online First: 2020/05/08]
94. Scullen T, Mathkour M, Maulucci CM, et al. Impact of the COVID-19 Pandemic on Neurosurgical Residency Training in New Orleans. *World Neurosurg* 2020 doi: 10.1016/j.wneu.2020.04.208 [published Online First: 2020/05/08]
95. Seese L, Aranda-Michel E, Sultan I, et al. Programmatic Responses to the Coronavirus Pandemic: A Survey of 502 Cardiac Surgeons. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.04.014 [published Online First: 2020/05/04]
96. Sethi A, Swaminath A, Latorre M, et al. Donning a New Approach to the Practice of Gastroenterology: Perspectives From the COVID-19 Pandemic Epicenter. *Clin Gastroenterol Hepatol* 2020 doi: 10.1016/j.cgh.2020.04.032 [published Online First: 2020/04/25]
97. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences and Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol* 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First: 2020/04/29]
98. Shih KC, Wong JKW, Lai JSM, et al. The case for continuing elective cataract surgery during the COVID-19 pandemic. *J Cataract Refract Surg* 2020 doi: 10.1097/j.jcrs.000000000000225 [published Online First: 2020/05/06]
99. Shokri T, Lighthall JG. Telemedicine in the Era of the COVID-19 Pandemic: Implications in Facial Plastic Surgery. *Facial Plast Surg Aesthet Med* 2020;22(3):155-56. doi: 10.1089/fpsam.2020.0163 [published Online First: 2020/04/18]
100. Sobel D, Gn M, O'Rourke TK, Jr., et al. Personal Protective Equipment for Common Urologic Procedures Before and During the United States COVID-19 Pandemic: A Single Institution Study. *Urology* 2020 doi: 10.1016/j.urology.2020.04.083 [published Online First: 2020/05/08]

101. Sun Y, Mao Y. Editorial. Response to COVID-19 in Chinese neurosurgery and beyond. *Journal of neurosurgery* 2020;1-2. doi: 10.3171/2020.3.JNS20929
102. National Clinical Programme in Surgery. Surgical Patient Flow During COVID-19 Pandemic, 2020.
103. Tan TK. How severe acute respiratory syndrome (SARS) affected the department of anaesthesia at Singapore General Hospital. *Anaesth Intensive Care* 2004;32(3):394-400. doi: 10.1177/0310057x0403200316 [published Online First: 2004/07/22]
104. Tan YQ, Wu QH, Chiong E. Preserving Operational Capability While Building Capacity During the COVID-19 Pandemic: A Tertiary Urology Centre's Experience. *Urology* 2020 doi: 10.1016/j.urology.2020.04.079 [published Online First: 2020/05/04]
105. Tan YT, Wang JW, Zhao K, et al. Preliminary Recommendations for Surgical Practice of Neurosurgery Department in the Central Epidemic Area of 2019 Coronavirus Infection. *Curr Med Sci* 2020;40(2):281-84. doi: 10.1007/s11596-020-2173-5 [published Online First: 2020/03/29]
106. Tay K, Kamarul T, Lok WY, et al. COVID-19 in Singapore and Malaysia: Rising to the Challenges of Orthopaedic Practice in an Evolving Pandemic. *Malays Orthop J* 2020;14(2) doi: 10.5704/MOJ.2007.001 [published Online First: 2020/04/22]
107. Tay KJD, Lee YHD. Trauma and orthopaedics in the COVID-19 pandemic: breaking every wave. *Singapore Med J* 2020 doi: 10.11622/smedj.2020063 [published Online First: 2020/04/22]
108. Thaler M, Khosravi I, Hirschmann MT, et al. Disruption of joint arthroplasty services in Europe during the COVID-19 pandemic: an online survey within the European Hip Society (EHS) and the European Knee Associates (EKA). *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1712-19. doi: 10.1007/s00167-020-06033-1 [published Online First: 2020/05/04]
109. Tolone S, Gambardella C, Bruscianno L, et al. Telephonic triage before surgical ward admission and telemedicine during COVID-19 outbreak in Italy. Effective and easy procedures to reduce in-hospital positivity. *Int J Surg* 2020;78:123-25. doi: 10.1016/j.ijsu.2020.04.060 [published Online First: 2020/05/04]
110. Too CW, Wen DW, Patel A, et al. Interventional Radiology Procedures for COVID-19 Patients: How we Do it. *Cardiovasc Intervent Radiol* 2020;43(6):827-36. doi: 10.1007/s00270-020-02483-9 [published Online First: 2020/04/29]
111. Topf MC, Shenson JA, Holsinger FC, et al. Framework for prioritizing head and neck surgery during the COVID-19 pandemic. *Head Neck* 2020;42(6):1159-67. doi: 10.1002/hed.26184 [published Online First: 2020/04/17]
112. Tsui KL, Li SK, Li MC, et al. Preparedness of the cardiac catheterization laboratory for severe acute respiratory syndrome (SARS) and other epidemics. *J Invasive Cardiol* 2005;17(3):149-52. [published Online First: 2005/05/04]
113. Tzeng C-WD, Tran Cao HS, Roland CL, et al. Surgical decision-making and prioritization for cancer patients at the onset of the COVID-19 pandemic: A multidisciplinary approach. *Surgical Oncology* 2020;34:182-85. doi: 10.1016/j.suronc.2020.04.029
114. Unal EU, Mavioglu HL, Iscan HZ. Vascular surgery in the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.480 [published Online First: 2020/04/29]
115. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic. *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published Online First: 2020/04/15]

- 1  
2  
3 116. Valenza F, Papagni G, Marchiano A, et al. Response of a comprehensive cancer center to  
4 the COVID-19 pandemic: the experience of the Fondazione IRCCS-Istituto Nazionale dei  
5 Tumori di Milano. *Tumori* 2020;300891620923790. doi: 10.1177/0300891620923790 [published  
6 Online First: 2020/05/05]  
7  
8 117. van de Haar J, Hoes LR, Coles CE, et al. Caring for patients with cancer in the COVID-  
9 19 era. *Nat Med* 2020;26(5):665-71. doi: 10.1038/s41591-020-0874-8 [published Online First:  
10 2020/05/15]  
11 118. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of  
12 oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy  
13 region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi:  
14 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]  
15 119. Vlantis AC, Tsang RK, Wong DK, et al. The impact of severe acute respiratory syndrome  
16 on otorhinolaryngological services at the Prince of Wales Hospital in Hong Kong. *Laryngoscope*  
17 2004;114(1):171-4. doi: 10.1097/00005537-200401000-00032 [published Online First:  
18 2004/01/08]  
19 120. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-  
20 Being, 2020.  
21 121. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a  
22 waiting list for thoracic surgery during the outbreak of Severe Acute Respiratory  
23 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013  
24 122. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during  
25 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*  
26 *Experimental Ophthalmology* 2020;38(3):200-03. doi:  
27 http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100  
28 123. Wasser LM, Assayag E, Tsessler M, et al. Response of ophthalmologists in Israel to the  
29 novel coronavirus (2019-nCoV) outbreak. *Graefes Arch Clin Exp Ophthalmol* 2020 doi:  
30 10.1007/s00417-020-04694-9 [published Online First: 2020/04/30]  
31 124. Williams AM, Kalra G, Commiskey PW, et al. Ophthalmology Practice During the  
32 Coronavirus Disease 2019 Pandemic: The University of Pittsburgh Experience in Promoting  
33 Clinic Safety and Embracing Video Visits. *Ophthalmol Ther* 2020;1-9. doi: 10.1007/s40123-  
34 020-00255-9 [published Online First: 2020/05/08]  
35 125. Wong J, Goh QY, Tan Z, et al. Preparing for a COVID-19 pandemic: a review of  
36 operating room outbreak response measures in a large tertiary hospital in Singapore. *Canadian*  
37 *Journal of Anesthesia/Journal canadien d'anesthésie* 2020;67(6):732-45. doi: 10.1007/s12630-  
38 020-01620-9  
39 126. Wu V, Noel CW, Forner D, et al. Considerations for head and neck oncology practices  
40 during the coronavirus disease 2019 (COVID-19) pandemic: Wuhan and Toronto experience.  
41 *Head Neck* 2020;42(6):1202-08. doi: 10.1002/hed.26205 [published Online First: 2020/04/28]  
42 127. Zangrillo A, Beretta L, Silvani P, et al. Fast reshaping of intensive care unit facilities in a  
43 large metropolitan hospital in Milan, Italy: facing the COVID-19 pandemic emergency. *Crit*  
44 *Care Resusc* 2020 [published Online First: 2020/04/02]  
45 128. Zarzaur BL, Stahl CC, Greenberg JA, et al. Blueprint for Restructuring a Department of  
46 Surgery in Concert With the Health Care System During a Pandemic: The University of  
47 Wisconsin Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1386 [published Online  
48 First: 2020/04/15]  
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3 129. Zeng L, Su T, Huang L. Strategic plan for management in oral and maxillofacial surgery  
4 during COVID-19 epidemic. *Oral Oncol* 2020;105:104715. doi:  
5 10.1016/j.oraloncology.2020.104715 [published Online First: 2020/04/20]  
6  
7 130. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular  
8 diagnosis and treatment in gastrointestinal surgery department during the outbreak of  
9 coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-  
10 26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]  
11  
12 131. Zizzo M, Bollino R, Castro Ruiz C, et al. Surgical management of suspected or  
13 confirmed SARS-CoV-2 (COVID-19)-positive patients: a model stemming from the experience  
14 at Level III Hospital in Emilia-Romagna, Italy. *Eur J Trauma Emerg Surg* 2020 doi:  
15 10.1007/s00068-020-01377-2 [published Online First: 2020/04/30]  
16  
17 132. Zoia C, Bongetta D, Veiceschi P, et al. Neurosurgery during the COVID-19 pandemic:  
18 update from Lombardy, northern Italy. *Acta Neurochir (Wien)* 2020;162(6):1221-22. doi:  
19 10.1007/s00701-020-04305-w [published Online First: 2020/03/31]  
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## BACKGROUND

The novel coronavirus (COVID-19) has spread across the globe with unrelenting speed. At the time of writing over 4 million cases have been confirmed, among them more than 200,000 fatalities<sup>1</sup>. In addition to protecting those most vulnerable in our societies, efforts to curb further disease escalation (e.g., travel restrictions, physical distancing measures) have had a focal objective: prevent case surges that could overwhelm healthcare institutions or further aggravate existing shortages in personal protective equipment (PPE), ventilators, and hospital capacity.

Medical institutions have themselves also taken steps to maximize the availability of staff, PPE, ventilators and intensive care unit (ICU) capacity in the case that external ‘curve flattening’ practices are not sufficient. Most notably, surgical programs have suspended non-urgent (or elective) surgical procedures, often defined as procedures for which a delay of three (3) months or longer would not result in any significant adverse effect to the patient<sup>2,3</sup>. These changes span nearly all surgical specialties from oncology to orthopedics and have thrust patients, providers and programs into previously unexplored territory.

While the governing bodies of surgical practice have recommended alterations to non-urgent surgical service delivery, they have not always provided explicit instructions on how programs should approach the change. As such, different groups have likely taken different approaches to surgical triage and service delivery and it remains unclear who has done what where, and why? Further, the impacts of postponing non-urgent surgeries on the physical, psychological, emotional and professional well-being of patients and practitioners are either anecdotal or unknown<sup>4</sup>. Lastly, as COVID-19 begins to release its grip on the world and a level of post-pandemic normalcy returns, programs will be tasked with rebuilding the surgical capacity necessary to reschedule and resume postponed procedures. Evidence on the experiences of other

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3 groups doing so in the context of COVID-19 and other public health emergencies (i.e., H1N1,  
4 Ebola, SARS) will be paramount in guiding subsequent approaches.  
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8 To address the aforementioned knowledge gaps, we will conduct a rapid review of the  
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10 literature to synthesize evidence on how surgical resources were allocated in response to  
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12 COVID-19 and other public health emergencies, how these reallocations impacted patients,  
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14 practitioners and broader health systems, and what approaches have been taken to rebuild,  
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16 reorganize and resume surgical service delivery. This review will not only help explain how  
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18 international surgical programs responded to this unprecedented emergency and what the  
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20 consequences were, but will also provide the evidence-base necessary to guide responses to this  
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22 current and any future pandemic event.  
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## 28 **METHODS**

### 29 **Study Design**

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33 The planned review will answer three questions: (1) How have surgical resources been  
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35 allocated in response to COVID-19, (2) What are the patient- and system-level consequences of  
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37 reorganizing surgical resources, and (3) How have resources been reorganized to resume surgical  
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39 services? We will focus on surgeries identified as “elective” or “non-urgent”. However, to avoid  
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41 limiting study eligibility unnecessarily no set definition for this term will be used and we will  
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43 instead report the definition used by each included study.  
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### 49 **Search Strategy**

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51 An electronic search strategy was developed by the investigators (CO, KS) prior to being  
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53 reviewed and refined by collaborators with context expertise in surgery and literature review  
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3 (JNK, AKR). The search strategy includes subject headings, keywords and synonyms identifying  
4 the public health emergencies of interest as well as the surgical specialties likely affected by  
5 COVID-19 (Appendix A). Headings and keywords were adapted for use in each database. Given  
6 the diversity of the research questions related to this review no study design or publication type  
7 constraints will be applied to the search. Further, since (by definition) the impacts of a pandemic  
8 span many countries, no language restrictions will be applied. However, to deliver on the study  
9 objectives in a timely fashion, studies not easily translated by members of the research team will  
10 be subsequently excluded from the review.  
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21 We will conduct comprehensive searches of Ovid MEDLINE (including Epub Ahead of  
22 Print, In-Process & Other Non-Indexed Citations) and EMBASE from database inception  
23 onwards. Since much of the information related to the questions of this review is likely  
24 unpublished (i.e., joint statements, recommendations and guidelines from surgical colleges) we  
25 will also complete a detailed grey literature search. An *a priori* designed plan for this search has  
26 been developed (Appendix B) and will follow methodological recommendations by including  
27 targeted website searching, advanced and general Google searching and contact with knowledge  
28 experts<sup>5</sup>. Further, the reference lists from all included studies will be examined for any additional  
29 relevant studies not captured in the formal database and grey literature searches.  
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#### 44 **Study Selection**

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46 In accordance with recommendations from the Cochrane Methods Group and World  
47 Health Organization Alliance for Health Policy and Systems Research, the titles and abstracts of  
48 all retrieved items will be reviewed by one of two independent researchers (CO, KM) with a  
49 third, independent researcher (KS) serving as duplicate reviewer for a random 25% sample of all  
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3 references<sup>6,7</sup>. Eligibility criteria varies such that the relevance of studies is determined by the  
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5 research question to which they pertain. For the first question on how surgical resources have  
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7 been allocated we will include any study that examines or discusses organization of surgical  
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9 resources and patients during COVID-19 or other public health emergency (i.e., triage criteria,  
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11 allocation of hospital resources if they include surgery, PPE for the operating room staff). To  
12  
13 address the second question – consequences of reorganizing surgical resources- we will include  
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15 any studies that examine patient- and/or system-level surgical outcomes during COVID-19 or  
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17 other public health emergencies (i.e., adverse events, length of stay, ICU admissions). Lastly, to  
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19 determine how resources have been organized to resume non-urgent surgical services we will  
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21 include any study that examines resuming surgical services after COVID-19 or another public  
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23 health emergency.  
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29 Full texts of studies not excluded in the title and abstract phase will then be reviewed in  
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31 duplicate by the same researchers to ensure applicability to any of the research questions. Any  
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33 articles identified as meeting the pre-specified eligibility criteria at this stage will be included in  
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35 the final review. Interrater agreement on inclusion for the 25% sample of titles and abstracts  
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37 reviewed in duplicate as well as the full texts will be measured with a Cohen's kappa ( $\kappa$ ) statistic  
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39 and corresponding 95% confidence interval. At all stages of the review an unbiased third party  
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41 will be available to resolve any sustained disagreements between reviewers. The full study  
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43 selection process including reasons for full text exclusions will be reported using a Preferred  
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45 Reporting Items for Systematic Reviews and Meta-Analyses flow diagram<sup>8</sup>.  
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## 51 **Outcomes of Interest**

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3 Study information will be collected to answer the research questions of steps taken to  
4 respond to emergencies and rebuild capacity (see data extraction section below), but these  
5 questions are not outcome oriented and as such specific outcomes data for these questions will  
6 not be collected. However, the second research question surrounding the consequences of  
7 altering non-urgent surgical programming will require the collection of both quantitative and  
8 qualitative outcomes in order to provide the desired holistic understanding of impacts.  
9 Specifically, we will assess patient-level outcomes including the incidence of adverse events  
10 (i.e., negative event leading to patient harm and caused by management (or lack thereof) rather  
11 than the underlying condition of the patient), mortality, and quotes discussing emotional and  
12 psychological impacts of delays. We will also evaluate impacts on the healthcare system using  
13 measures of resource utilization such as number of emergency department visits, number of  
14 visits to a healthcare provider, length of hospital or ICU stay, as well as qualitative statements  
15 from practitioners and hospital administrators.  
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### 35 **Data Extraction**

36 Any relevant study and outcome data will be extracted from included studies by one  
37 researcher using a standardized data abstraction form. For all studies this form will guide the  
38 collection of information including date of publication, country where study was conducted,  
39 study design, definition of elective or non-urgent surgery, and characteristics of study sample (if  
40 applicable). The data extraction form is also designed to collect information specific to each of  
41 the three research questions such as selected surgical triage criteria, patient and health system-  
42 level outcomes, and detailed emergency response plans. A second independent researcher will  
43 review all data abstraction forms to verify their completion and accuracy.  
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### **Study Quality (Risk of Bias) Assessment**

This rapid review will aim to synthesize quantitative outcomes whenever possible but will largely involve scoping the available evidence on surgical service delivery during public health emergencies. Given this broad aim and the decision to include all study designs, quality appraisal for the included studies is not feasible and will not be performed.

### **Data Synthesis, Analysis and Reporting**

Study and sample information will be described in a narrative review and summarized in a data table. We do not anticipate being able to conduct a meta-analysis of quantitative outcomes and will instead synthesize outcomes data qualitatively with support from descriptive statistics whenever possible. Any summary tables for outcomes will be stratified by the three research questions to maximize clarity. Any within-study comparisons (e.g., incidence of adverse events in patients with delayed versus non-delayed surgery) will be considered significant at a two-tailed p-value  $<0.05$ .

### **Ethics and Dissemination**

This review will only include secondary data sources and as such there are no applicable ethical considerations. Following completion, this review will become an integral part of evidence-based guidelines to support decisions about allocating resources and organizing surgical care in the era of COVID-19 and during subsequent public health emergencies. The rapid review will also be submitted to peer-reviewed journals to reach the target audiences of patients, policy makers, practitioners and surgical program administrators.

## Limitations

The rapidly evolving nature of surgical programming during the COVID-19 situation demands an equally rapid synthesis and dissemination of key evidence. A rapid review therefore supersedes a traditional systematic review, but with this decision come methodological limitations. First, it is possible that much of the identified evidence emerges from non-traditional sources and grey literature and as a result, may be of a lower methodological quality than that from peer-reviewed sources. However, the goal of this review is not to evaluate quantitative outcomes at potential risk of bias but to instead collate the diversity of available information from surgical programs worldwide to inform decision-making. As such the potential negative impacts of lower study quality are of less concern. Secondly, the landscape of evidence specific to COVID-19 changes daily. While the selection of a set date for literature search is important for reporting and review reproducibility, it may lead to the omission of relevant information released beyond this date. We believe, however, that a current date selected for the literature search will span a period of time where some countries are in the process of recovering their surgical services while others remain in the throes of the pandemic. This will maximize the chances that sufficient evidence to answer all research questions is up to date and available.

## CONCLUSION

This paper describes the methodology for a planned rapid review that will synthesize evidence on the changes to, impacts of, and recovery of non-urgent surgical service delivery during COVID-19 and other public health emergencies. As post-pandemic normalcy begins to return and non-urgent surgeries resume, the evidence from this review will inform



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recommendations for allocating and organizing care while mitigating any potential negative impacts resulting from changes in service delivery.

For peer review only

## References

1. Johns Hopkins University Resource Center. Coronavirus COVID-19 global cases. Accessed May 6, 2020. <https://coronavirus.jhu.edu/map.html>
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures. March 13, 2020. Accessed May 13, 2020. [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.aspx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.aspx)
3. Shared Health Manitoba. COVID-19 Provincial guidance on management of elective surgery. March 25, 2020. Accessed May 13, 2020. <https://sharedhealthmb.ca/files/covid-19-elective-surgery.pdf>
4. Tam DY, Naimark D, Sander B, Barrett K, Khan YA, Mac S, et al. COVID-19: Predicting consequences of curtailing outpatient scheduled cardiac procedures in the face of COVID healthcare resource needs in Ontario. 2020.
5. Godin K, Stapleton J, Kirkpatrick SI, Hanning RH, Leatherdale ST. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Systematic Reviews*. 2015;4:138-162.
6. Garrity C, Gartlehner G, Kamel C, King VJ, Nussbaumer-Streit B, et al. Cochrane Rapid Reviews: Interim guidance from the Cochrane Rapid Reviews Methods Group. March 2020.
7. Tricco AC, Langlois EV, Strauss SE, editors. *Rapid reviews to strengthen health policy and systems: a practical guide*. Geneva: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.
8. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Review and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*. 2009;6(7):e10000097.

## Appendices

### Appendix A: Ovid MEDLINE Electronic Search Strategy

#### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

##### Search Strategy:

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- 1 exp Disease Outbreaks/ (96117)
- 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
- 3 1 or 2 (231940)
- 4 exp Coronavirus (13456)
- 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
- 6 Coronaviridae Infections/ (900)
- 7 coronaviridae/ or coronavirus/ (3916)
- 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
- 9 Hemorrhagic Fever, Ebola/ (5316)
- 10 SARS Virus/ (3038)
- 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
- 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
- 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
- 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
- 15 (coronavir\*) adj2 (infection\*).mp. (8441)
- 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
- 17 General Surgery/ (38626)
- 18 Orthopedic Procedures/ (25371)
- 19 Traumatology/ (3474)
- 20 Neurosurgery/ (14892)
- 21 Obstetrics/ (22533)
- 22 Anesthesia/ (62587)
- 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
- 24 exp Arthroplasty, Replacement/ (54362)
- 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
- 26 (surger\* or operation\* or procedure\*).mp. (3638036)
- 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
- 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
- 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)

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3 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)  
4 31 3 and 16 and 30 (2075)  
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## Appendix B: Grey Literature Search Plan

### GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms  
“coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery”  
OR “guidelines”

#### NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

#### GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

#### GENERAL SURGICAL GROUPS/COLLEGES

Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)

American College of Surgeons (<https://www.facs.org>)

European Surgical Association (<https://www.europeansurgicalassociation.org>)

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3 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
4 French Surgical Association  
5 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
6 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
7 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
8 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
9 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
10 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
11 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
12 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
13 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
14 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
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18 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
19 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
20 OR “Surgery” OR “non-urgent” OR “guidelines”  
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23 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
24 past last click for relevance.  
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26 STEP 4) Contact with Knowledge Experts.  
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## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Page 1: Title
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 3: Abstract
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Pages 5,6: Introduction
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 6: Introduction
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Not registered given rapid nature of review.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 8: Methods- Study Eligibility
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 6: Methods- Search Strategy
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix A
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Pages 7,8: Methods- Study Selection
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 9: Methods- Data Extraction
Data items	11	List and define all variables for which data	Page 9: Methods-



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		were sought and any assumptions and simplifications made.	Outcomes of Interest
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Page 10: Methods- Study Quality (ROB) Assessment
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 10: Methods- Data Synthesis, Analysis and Reporting
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Pages 10,11: Results- Search Results & Figure 1: PRISMA Flow chart
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Page 11: Results- Description of Studies & Table 1 (Individual) & Figure 2 (Summary)
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Table 1
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Pages 11-16: Results- Reorganization of Surgical Services & Impact of Reorganizing Surgical Services & Rebuild Surgical Capacity
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Pages 16 to 18: Discussion
Limitations	20	Discuss the limitations of the scoping review process.	Page 18, 19: Discussion
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Page 19: Discussion
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	NA

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.



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3 † A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g.,  
4 quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping  
5 review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).  
6 ‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the  
7 process of data extraction in a scoping review as data charting.  
8 § The process of systematically examining research evidence to assess its validity, results, and relevance before  
9 using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable  
10 to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used  
11 in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).  
12  
13

14 From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews  
15 (PRISMA ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).  
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For peer review only





# BMJ Open

## Surgery & COVID-19: A rapid scoping review of the impact of the first wave of COVID-19 on surgical services

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4 surgical services  
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3 **ABSTRACT (278/300 words)**  
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5 **Objectives:** To understand how surgical services have been reorganized during and following  
6 public health emergencies, and the consequences of these changes for patients, healthcare  
7 providers and healthcare systems.  
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14 **Design:** A rapid scoping review.  
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19 **Setting:** We searched the MEDLINE and Embase online academic, and conducted a grey  
20 literature sources for documents, memos, and press releases from governments and surgical  
21 organizations or associations.  
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28 **Participants:** Studies examining surgical service delivery during public health emergencies  
29 including COVID-19, and the impact on patients, providers and healthcare systems were  
30 included. Recommendations and guidelines were excluded.  
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37 **Primary and secondary outcome measures:** Primary outcomes were strategies implemented  
38 for the reorganization of surgical services. Secondary were the impacts of reorganization and  
39 resuming surgical services, such as; adverse events (including morbidity and mortality), primary  
40 care and emergency department visits, length of hospital and ICU stay, and changes to surgical  
41 waitlists.  
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51 **Results:** One hundred and thirty-two studies were included in this review; 111 described  
52 reorganization of surgical services, 55 described the consequences of reorganizing surgical  
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3 services and six reported actions taken to rebuild surgical capacity in public health emergencies.  
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5 Reorganizations of surgical services were grouped under six domains: case selection/triage, PPE  
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7 regulations and practice, workforce composition and deployment, outpatient and inpatient patient  
8  
9 care, resident and fellow education, and the hospital or clinical environment. Service  
10  
11 reorganizations led to large reductions in non-urgent surgical volumes, increases in surgical wait  
12  
13 times, and impacted medical training (i.e., reduced case involvement) and patient outcomes (e.g.,  
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15 increases in pain). Strategies for rebuilding surgical capacity were scarce, but focused on the  
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17 availability of staff, PPE, and patient readiness for surgery as key factors to consider before  
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19 resuming services.  
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26 **Conclusions:** Reorganization of surgical services in response to public health emergencies  
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28 appears to be context-dependent and has far-reaching consequences that must be better  
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30 understood in order to optimize future health system responses to public health emergencies.  
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## ARTICLE SUMMARY

### Strengths and limitations of the study:

- This rapid scoping review provides an exhaustive and rigorous summary of the academic and grey literature regarding modifications to surgical services in response to public health emergencies, especially the first wave of COVID-19.
- This study did not limit studies based on location or language of publication to ensure contributions from worldwide voices in the context of a worldwide pandemic.
- Both quantitative and qualitative outcomes were included, with a mix of inductive and deductive data abstraction approaches to provide a comprehensive understanding of surgical services during public health emergencies.
- Studies with potential relevance to this question are emerging at an unprecedented rate in response to the COVID-19 pandemic and as such, some may not be included in the current review.

## 1 INTRODUCTION

2 The novel SARS-CoV-2 (COVID-19) virus has spread across the globe with unrelenting  
3 speed. At the time of writing, over 88 million cases have been confirmed with 1.9M fatalities.<sup>1</sup>

4 To protect the most vulnerable in our societies, efforts to curb further escalation (e.g., travel  
5 restrictions, physical distancing) have had a focal objective: to prevent surges that could  
6 overwhelm healthcare including shortages in personal protective equipment (PPE), ventilators,  
7 and hospital capacity.

8 Medical institutions have taken steps to maximize staff, PPE, ventilators, and intensive  
9 care unit (ICU) capacity in case public health efforts to ‘flatten the curve’ are insufficient. Most  
10 notably, surgical programs have suspended non-urgent (or ‘elective’) surgical procedures. Non-  
11 urgent surgeries are often defined as procedures for which a delay of three months or longer  
12 would not result in significant adverse effects to the patient.<sup>2 3</sup> These changes have thrust  
13 patients, providers, and healthcare organizations into previously unexplored territory.

14 While governing bodies such as colleges and academies of surgery have made  
15 recommendations to alter surgical service delivery in response to COVID-19, they have not  
16 always provided explicit instructions on how programs should operationalize the  
17 recommendations. As such, approaches to surgical triage and service delivery remain unclear:  
18 who has done what where, and why? Further, the impacts of adopting these recommendations on  
19 surgical programs, and more importantly, the physical and psychological well-being of patients  
20 and healthcare providers have only been hypothesized.<sup>4</sup> Lastly, once COVID-19 begins to  
21 release its grip on the world and the post-pandemic recovery begins, programs will be tasked  
22 with rebuilding the surgical capacity necessary to reschedule and tackle the backlog of postponed  
23 procedures. Evidence distilled from the experiences of others in the context of COVID-19 and

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3 1 other public health emergencies (i.e., H1N1, Ebola, SARS) is needed to guide approaches to  
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5 2 surgical service delivery.  
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8 3 To enable evidence-informed reorganization and resumption of non-urgent surgeries  
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10 4 during COVID-19 and for future public health emergencies, we conducted a rapid scoping  
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12 5 review to identify and map the available literature. Our aim was to understand how surgical  
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14 6 services were reorganized in response to the first wave of COVID-19 and other public health  
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16 7 emergencies; how reorganization impacted patients, healthcare providers, and health systems;  
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18 8 and what approaches have been taken to resume surgical service delivery.  
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## 24 10 **METHODS**

### 25 26 11 **Study Design**

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28 12 This scoping review followed the Joanna Briggs Institute methodology and Preferred  
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30 13 Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews  
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32 14 (PRISMA-ScR) checklist.<sup>5 6</sup> The rapidly evolving situation of the current COVID-19 pandemic  
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34 15 demanded a similarly rapid evidence synthesis. Therefore, methodological concessions  
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36 16 recommended by the World Health Organization and Cochrane guidance for rapid reviews were  
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38 17 made.<sup>7 8</sup> Specifically, following a pilot exercise involving triplicate review and consensus for 50  
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40 18 abstracts only a 25% random sample of the remaining abstracts were reviewed in duplicate.  
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42 19 Further, while language limitations were not applied to the search, manuscripts not written in  
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44 20 English that could not be translated by members of the research team were not eligible for data  
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46 21 extraction, although their references were still included. This review addressed three questions:  
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48 22 1) How have surgical services been reorganized in response to public health emergencies? 2)  
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3 1 What are the patient-, healthcare provider-, and system-level consequences of reorganizing  
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5 2 surgical services? and 3) What approaches were used for resuming surgical services?  
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#### 4 **Search Strategy**

5 The search strategy was developed by two investigators (CO, KS) and refined by others  
6 with context expertise in surgery and literature review methodology (JNK, AKR). The search  
7 strategy included subject headings, keywords, and synonyms identifying public health  
8 emergencies in general and specific public health emergencies (Ebola, SARS-CoV1, H1N1,  
9 MERS), and surgery; and were tailored for each database (Appendix A). Given the exploratory  
10 nature of the review we did not filter by study design or publication type, and since the impacts  
11 of a pandemic spans many countries there were no language restrictions.

12 We used the search strategy to search MEDLINE (including Epub Ahead of Print, In-  
13 Process & Other Non-Indexed Citations) and Embase from inception until May 8, 2020.  
14 Anticipating pertinent information may not be published (i.e., joint statements,  
15 recommendations, and guidelines from surgical colleges) we supplemented the database search  
16 with a structured grey literature search including targeted website searching, advanced and  
17 general Google searching, and contact with knowledge experts (Appendix A).<sup>9</sup> The reference  
18 lists of included studies were screened for relevant studies not otherwise captured.

#### 19 20 **Study Selection**

21 Titles and abstracts were reviewed by one of two independent reviewers with a third,  
22 independent reviewer screening 25% of randomly selected references in duplicate. Full texts of  
23 studies considered potentially eligible at title/abstract screening phase by at least one reviewer

1 were reviewed in duplicate by two reviewers for eligibility. Any disagreement between  
2 reviewers at the full text screening phase was resolved through discussion and did not necessitate  
3 a third reviewer. If studies were excluded at the full text screening phase, the reason for  
4 exclusion was noted. Full text articles meeting eligibility criteria were included and data were  
5 abstracted using a standardized data abstraction form (Appendix B). At both stages of screening,  
6 a pilot sample of 50 articles were jointly reviewed by both reviewers to ensure reliable  
7 application of eligibility criteria between reviewers.

## 8

### 9 **Study Eligibility**

10 Studies were eligible for inclusion if they discussed alterations to surgical services during  
11 public health emergencies and reported: 1) reorganization of surgical services, 2) impact of  
12 reorganizing surgical services on patients, healthcare providers, or healthcare system or 3)  
13 approaches to resuming surgical capacity. Studies of any design or publication date were eligible  
14 for inclusion. Studies in any language were eligible, but consistent with rapid review methods,  
15 studies not easily translated by authors were excluded from the data synthesis, although citations  
16 are still provided. Studies were excluded if they described: only urgent interventions arising  
17 during a hospital admission (e.g., emergency tracheostomy, caesarean section), settings beyond  
18 in-patient acute care (e.g., outpatient clinics including dental clinics), changes to surgical service  
19 delivery not made in direct response to a public health emergency, and healthcare services not  
20 specifically related to surgical service.

21 Notably, our intention was to include guidelines that made recommendations regarding  
22 provision of surgical services; however, a high-quality review of guidelines was published<sup>10</sup>  
23 during the preparation of this review and as such, we chose to exclude guidelines.

1

## 2 **Data Extraction**

3 Data were abstracted by one reviewer, and verified by a second reviewer, using a  
4 standardized data abstraction form (Appendix B). Data included: date of publication, country,  
5 study design, definition of non-urgent surgery, characteristics of study sample (if applicable),  
6 outcomes of interest for the three research questions, detailed below.

## 8 **Outcomes of Interest**

9 Our primary outcomes were reorganization of surgical services, impact of reorganization  
10 and resuming surgical services. We intentionally included a broad array of outcomes and used an  
11 inductive approach to data abstraction to gain a comprehensive understanding of surgical  
12 services and the impact during public health emergencies.

13 We collected qualitative data from studies reporting on changes to surgical programming,  
14 conceptualized into five categories: changes to triage criteria or case selection, changes to PPE  
15 practices, workforce changes, changes to patient care, changes to resident and fellow education,  
16 and environmental changes. Qualitative and quantitative data on the impact of reorganization of  
17 surgical services was organized by impact on: patients, providers and healthcare system. To  
18 illustrate temporal changes, data preceding, during and after the precipitating event were  
19 collected whenever possible. Quantitative variables of interest included: adverse events  
20 (including morbidity and mortality), primary care and emergency department visits, number of  
21 hospital and ICU admissions, length of hospital and ICU stay, number of surgical procedures  
22 performed and number of procedures cancelled, care costs, and wait times for non-urgent  
23 surgery. Qualitative variables included narrative description of patient or physician experience,

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3 1 written descriptions of changes to physician remuneration, or comments surrounding surgical  
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5 2 waitlist composition. Qualitative data was also collected on details of efforts to rebuild capacity  
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8 3 to surgical services.  
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## 10 4 11 12 5 **Study Quality (Risk of Bias) Assessment** 13

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15 6 Given the aim of a rapid scoping review is not to appraise evidence but to map the  
16  
17 7 available literature,<sup>11</sup> quality appraisal of included studies was not performed.  
18

## 19 8 20 21 9 **Data Synthesis, Analysis and Reporting** 22

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24 10 Consistent with our objectives and scoping review methodology,<sup>12</sup> we did not to perform  
25  
26 11 quantitative analysis, but did use descriptive statistics to summarize quantitative outcomes. We  
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28 12 characterized and mapped the available emerging evidence using a narrative approach. We  
29  
30 13 employed inductive thematic analysis, whereby themes were allowed to develop, to aid in  
31  
32 14 characterizing the evidence. Data were synthesized and presented separately for each of the three  
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34 15 research questions.  
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## 40 17 **Patient and Public Involvement** 41

42 18 Patients and the public were not involved in study design, execution or interpretation.  
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## 46 47 20 **RESULTS** 48

### 49 21 **Search Results** 50

51 22 A total of 3 013 unique scholarly articles and 106 sources of grey literature were  
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54 23 identified, of which 702 were considered eligible for full text review. After full text review, 120  
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1 studies and five documents from the grey literature were included. Screening of the reference  
2 lists of included articles led to seven additional studies being included for a total of 132 included  
3 studies. Thirty-seven studies contributed data to more than one of the research questions  
4 resulting in the qualitative synthesis of 111 studies assessing alterations to service delivery, 55  
5 studies evaluating the consequences of these changes, and six studies enumerating their  
6 procedures for rebuilding capacity (Table 1). The flow of evidence sources within the study is  
7 detailed in Figure 1. One Spanish language study was translated for inclusion,<sup>13</sup> but two studies  
8 could not be readily translated therefore they are not included in the synthesis.<sup>14 15</sup>

## 10 **Description of Studies**

11 The majority of included studies were published in 2020 about COVID-19 (87.9%,  
12 n=116); fewer studies were related to other public health emergencies: SARS (7.58%, n=10),  
13 Ebola (2.27%, n=3), H1N1(1.52%, n=2), and MERS (0.76%, n=1). Over two thirds of the  
14 included studies (74.2%) emerged from the countries hit earliest by COVID-19; China (14.4%,  
15 n=19), Singapore (8.33%, n=11), Italy (19.7%, n=26), and the USA (31.8%, n=41). While many  
16 studies described the experiences of their surgical departments as a whole, oncology (15.9%,  
17 n=21), orthopedics (13.6%, n=18), and neurosurgery (11.4%, n=15) were the specialties most  
18 prominently represented. Summaries of descriptive study information are shown in Figure 2.

## 20 **Reorganization of Surgical Service**

21 A number of themes emerged from the 108 studies describing reorganization of surgical  
22 services. Nearly all studies reported partial, with most reporting full cessation of non-urgent  
23 surgeries at their centre, albeit with varying definitions of “non-urgent” (e.g., can be safely

1 postponed for 3 months) and “urgent” (e.g., patient would have adverse outcome if not  
2 completed within 7 days). Changes to service delivery were focused on six domains: case  
3 selection/triage, PPE regulations and practice, workforce composition and deployment,  
4 outpatient and inpatient patient care, resident and fellow education, and the hospital or clinical  
5 environment (Table 2). The three domains that were most frequently reported (case  
6 selection/triage, patient care, and workforce) are described in greater detail below.

7  
8 *1. Changes to Case Selection and Triage Procedures.* The countries and surgical specialties most  
9 effected by pandemic-related changes to service delivery are described above; however, the issue  
10 of which patients can safely undergo what surgical procedures was also discussed in the included  
11 studies. We identified cancelling or postponing “non-urgent” surgeries was almost universal.  
12 Most often hospitals cancelled surgeries via telephone or text message, but some studies  
13 identified that patients initiated their own surgical cancellations due to concerns with safety and  
14 nosocomial infection. While urgent surgeries were triaged according to routine practice, new  
15 triage decisions were made for non-urgent (including oncology) procedures. Methods for triaging  
16 non-urgent procedures varied across studies, from the use of guideline supported checklists of  
17 eligible procedures to virtual multidisciplinary meetings where the treating surgeon presented  
18 details of the case (e.g., patient characteristics, acuity, imaging) to a larger group representing  
19 many surgical specialties to reach consensus on each case.

20  
21 *2. Changes to Patient Care.* Sixty-two studies reported complete cessation or marked reduction  
22 of in-person, non-urgent outpatient clinic visits. In these studies, only urgent patients and those  
23 requiring post-operative suture or staple removal were granted in-person visits under strict

1 conditions including mask wearing, negative symptom check, history or temperature pre-  
2 screening. Studies specific to COVID-19 almost universally filled the resulting care gap for  
3 patients deemed “non-urgent” using telephone or video-based telemedicine. Interfaces used  
4 include, but were not limited to Zoom, WeChat, Facetime, telephone, and SMS text messaging.  
5 A reported advantage of telemedicine was the ability to not only follow-up with returning  
6 patients but to also continue consultations and establish contact with new patients who would  
7 require care when non-urgent surgeries resumed. While some admitted a historical reluctance to  
8 transition to video-based telemedicine and reported early concerns with their ability to establish  
9 secure connections with patients, frequently their worries faded with use and many reported  
10 telemedicine would remain integrated in their practices beyond the pandemic.

11  
12 *3. Changes to the Workforce.* Fourteen of the included studies describe changing the workforce  
13 into a minimum of two teams; a “contaminated” team providing care to infected patients and a  
14 “clean” team managing those not infected. When these teams were kept separate from one  
15 another both inside and outside of the hospital setting, surgical departments were able to  
16 continue managing the inevitable emergencies (as well as non-urgent procedures in some  
17 settings) without cross contamination during the public health emergencies. New work rotations  
18 and shift schedules were created to ensure this structure was sustainable, often with extra  
19 healthcare providers designated to replace those with exposures and to provide adequate time off  
20 to prevent burnout. This practice was only possible with wards, operating rooms, and pathways  
21 (i.e. corridors, elevators) that are separated under the same “clean” and “contaminated”  
22 designation. In the most extreme case, entire hospitals were designated for each patient group, as  
23 was done by Singapore during SARS<sup>16</sup> and Italy during COVID-19.<sup>17</sup>

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45 2 **Impact of Reorganizing Surgical Services**

6 3 Of the 55 studies with data relevant to this question, 42 were focused on changes in  
7 4 surgical volumes with six reporting changes to surgical waitlist time or composition, four  
8 5 underlining changes to resident and fellow involvement in surgery, and two showing changes in  
9 6 patient pain, anxiety, and depression. These recurring outcome measures are summarized below  
10 7 with data for all studies relevant to this question shown in Appendix C.

11 8

12 9 *Changes in Surgical Volumes.* Thirty-seven studies provided data for this outcome, with 37.8%  
13 10 (n=14) reporting a greater than 75% reduction and 70.3% (n=26) reporting a greater than 50%  
14 11 reductions in their overall or site specific non-urgent surgical volumes (Figure 3a). Not all  
15 12 studies reported reductions; as one study from an oncology “hub” hospital in Italy reported a  
16 13 20% increase in their surgical volumes, likely due to more cases being diverted to their hospital  
17 14 during the COVID-19 pandemic.<sup>18</sup>

18 15

19 16 *Changes in Resident/Fellow Involvement in Surgical Activities.* Four studies<sup>19-22</sup> reported on this  
20 17 outcome; two survey-based case series, one resident-level case study and one study containing  
21 18 both survey and case log data. The reductions in surgical involvement for residents are shown by  
22 19 quartile in Figure 3b.

23 20

24 21 *Changes to Waitlist Length and Composition.* Five studies<sup>23-27</sup> reported data for this outcome.

25 22 One centre reported a 64% increase in length of their minor colorectal surgery waitlist<sup>26</sup> and  
26 23 another centre (head and neck oncological surgery program) reported a 500% increase in latency



1 from diagnosis to surgery.<sup>27</sup> One study reported no waitlist deaths during the COVID-19  
2 pandemic<sup>25</sup> while another saw a small decrease in the number of weekly waitlist deaths.<sup>24</sup> A  
3 single study identified more patients leaving their renal transplantation waitlist due to mortality  
4 or clinical deterioration.<sup>23</sup>

5  
6 *Changes in Patient Pain, Anxiety, and Depression.* Two studies<sup>28 29</sup> reported pain, anxiety, and  
7 depression among more than half of waitlist patients; 42.1% experienced anxiety, and 26.3%  
8 experienced depression (Figure 3c). The leading reported cause of patient anxiety was a lack of  
9 knowledge about when their surgeries would be rescheduled. Other than a single study  
10 describing the negative financial effects of the COVID-19 pandemic,<sup>30</sup> impacts on healthcare  
11 providers and their practices were rarely discussed.

### 13 **Rebuild Surgical Capacity**

14 A total of seven studies reported the experience of rebuilding surgical capacity in their  
15 departments, hospitals, or systems; all studies referred to the COVID-19 pandemic. One study  
16 from China reported reopening non-urgent surgeries with close consideration of risk for imported  
17 transmission but did not provide further detail of triage or prioritization.<sup>31</sup> Among studies that  
18 changed their surgical triage practices, patients were prioritized for surgery based on procedure  
19 acuity or urgency (i.e., risk to patients if surgery were further delayed), resource intensity, and  
20 procedural complexity. Four studies<sup>32-35</sup> noted that prior to resuming non-urgent surgeries,  
21 availability of the staff, (Operating Room) ORs, PPE, and testing was necessary to prepare for a  
22 large and complicated surgical backlog.

## 1 DISCUSSION

2 This review identified over 3,000 evidence sources, 132 of which were included.

3 Approaches to reorganizing surgical services varied between studies and centers, but the  
4 cancellation or postponement of non-urgent surgeries such as arthroplasty surgeries for chronic  
5 joint pain, coronary artery bypass graft surgery for asymptomatic individuals, and primary  
6 gastric bypass surgery was nearly universal.<sup>2</sup> The most frequently reported change to surgical  
7 services was modified triage criteria for surgical cases, workforce, and approach to patient care.  
8 Many studies reported a decrease in surgical volumes due to public health emergencies, while a  
9 few reported the non-surgical impacts such as patient wellbeing or changes in healthcare  
10 utilization beyond the surgical wards. Very few studies described their experience resuming  
11 surgical services after a public health emergency.

12 The varied approaches to providing surgical services during a public health emergency  
13 identified in this review illustrate that a “one size fits all” approach does not exist. Changes to  
14 surgical services likely depends on the characteristics of specific centers and their patients. While  
15 several guidelines have been published with recommendations on how to provide surgical care  
16 during COVID-19, we chose to exclude guidelines and recommendations from this review for  
17 two reasons: 1) a high quality review of surgical recommendations for the response to COVID-  
18 19 was published by one of the authors just prior to this study<sup>10</sup> and 2) because there is abundant  
19 evidence suggesting guidelines and recommendations for practice are frequently not  
20 implemented into clinical practice.<sup>36-42</sup> Some of the guideline recommendations in the review by  
21 Søreide et al.<sup>10</sup> were implemented within the included studies in the present review; such as  
22 creating areas within-hospital for ‘clean’ and ‘contaminated’ cases and workforce redeployment  
23 to critical care. However, other recommendations were infrequently noted, such as the dedicated

1 use of isolated, negative pressure ORs for patients with COVID-19. These resource intensive  
2 practices may not have been attainable under the pressures of managing public health  
3 emergencies and may not be feasible in low-resource settings.

4  
5 Changes to surgical services, such as cancelling or postponing non-urgent surgeries may  
6 be necessary to manage public health emergencies to reduce the risk of contamination and  
7 increase capacity within hospitals. However, the impact of these changes remains poorly  
8 understood. Many studies reported decreases in surgical volumes, but few other variables were  
9 explored with regards to the impact on patients, providers, and healthcare systems. Five studies  
10 examined the impact of changes to surgical services among physicians and trainees, and found  
11 that training was compromised in some specialties.<sup>19-22</sup> The finding that medical training was  
12 compromised is particularly important for understanding the downstream and long-term  
13 repercussions of the response to public health emergencies; decreases in surgical volumes and  
14 clinical hours for trainees could have negative and unintended effects on the future quality and  
15 safety of patient care.<sup>43</sup> Notably, the impacts of public health emergencies on medical training  
16 and education were almost exclusively evaluated for residents and fellows, failing to consider the  
17 limited access that current medical undergraduate students continue to encounter when trying to  
18 explore surgical specialties. This is unlikely to affect the quality of patient care but may present  
19 later in the form of decreased career satisfaction and engagement, both of which have been  
20 associated with burnout<sup>44</sup>. Studies examining the effects of surgical service alterations on  
21 patients noted negative effects on mental health outcomes,<sup>28 29</sup> pain,<sup>28</sup> and an increased incidence  
22 of death among surgical patients.<sup>23 24 45</sup>

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3 1 Very few studies described specific actions undertaken to rebuild and resume pre-public  
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5 2 health emergencies surgical capacity. This may be due to the fact that most included studies  
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7 3 examined the ongoing COVID-19 pandemic, or because few places have implemented specific  
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9 4 plans to date. Included studies did describe consideration of system-level factors like availability  
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11 5 of PPE and ORs. However, more patient-centric considerations such as organizing childcare and  
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13 6 requesting time away from their job during a pandemic, are needed. Additionally, research  
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15 7 suggesting that surgical capacity can be rebuilt with sufficient PPE and OR space may be falling  
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17 8 victim to the lack of identified evidence exploring the wellbeing of the surgical workforce.  
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19 9 Resolving surgical backlogs by increasing available resources relies on the high functioning of a  
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21 10 workforce of surgeons and allied practitioners not overtaken by burnout and stress, something  
22  
23 11 that has not yet been borne out in the COVID-19 research. In other specialties involved with the  
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25 12 care of surgical patients, moral distress has seen a marked increase making it reasonable to  
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27 13 believe these same emotional impacts will be felt by members or surgical teams globally. Patient  
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29 14 perspectives will also play a role in the rebuild; one study reported 14% of surgical patients  
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31 15 initiated the cancellation of their surgery,<sup>28</sup> which suggests patient readiness for surgery during-  
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33 16 and post-COVID-19 should be considered. For evidence to inform policy, additional research is  
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35 17 needed to understand the impacts of different approaches for resuming surgical services.  
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44 19 This study is, to our knowledge, the first comprehensive scoping review of evidence  
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46 20 around reallocation of surgical services during public health emergencies. While this study has  
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48 21 several strengths, including a comprehensive search of academic and grey literature sources, and  
49  
50 22 a mix of inductive and deductive data abstraction approaches, there are some limitations that  
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52 23 should be considered when interpreting our findings. We modified the Joanna Briggs  
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1 methodology for scoping reviews,<sup>5</sup> according to the World Health Organization and Cochrane's  
2 guidance on conducting rapid reviews,<sup>7 8</sup> with the intent of balancing rigor with a timely and  
3 policy-responsive review of the literature. Also, given that the evidence around the COVID-19  
4 pandemic is growing at an unprecedented rate, we are aware that additional studies have been  
5 published since we ran our search strategy, especially around resuming surgical services. In  
6 order to mitigate this limitation, an ongoing effort to pivot this study into a living review is  
7 underway to ensure the data presented is up to date. This will involve re-running the MEDLINE,  
8 Embase and grey literature search strategies every 2 months in order to incorporate new evidence  
9 into the existing manuscript. Notably, this review did not identify evidence from any low- or  
10 middle-income countries who may face unique challenges during a pandemic compared to high  
11 income countries described in our review. It is also likely that during the global pandemic, many  
12 healthcare institutions have been focused on coping with COVID-19 instead of publishing their  
13 experiences; we hope more organizations will add their experience to the literature.

14  
15 In conclusion, we report early evidence of the operational changes that have occurred  
16 internationally in response to public health emergencies which could inform the ongoing  
17 response to COVID-19 and future public health emergencies. This study identified a gap in our  
18 understanding of the impact of these changes on patients, providers, and the healthcare system  
19 which should be the focus of research moving forward to provide an evidence-based approach to  
20 managing surgical patients in future public health emergencies.

21  
22 **Original protocol for the study:** The original unpublished protocol for this study is included as  
23 a supplementary file (Appendix D).

## 1 **Author Contributions**

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1 CO contributed to the design and conceptualization of the review, analysis and interpretations of  
2 the data, and drafting and revising the manuscript; JSN contributed to the design of the review,  
3 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
4 version of the manuscript; AKR contributed to the design of the review, interpretation of the  
5 data, providing feedback on the manuscript, and gave approval of the final version of the  
6 manuscript; JCD contributed to the interpretation of the data, providing feedback on the  
7 manuscript, and gave approval of the final version of the manuscript; JW contributed to the  
8 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
9 version of the manuscript; JR contributed to the interpretation of the data, providing feedback on  
10 the manuscript, and gave approval of the final version of the manuscript; MB contributed to the  
11 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
12 version of the manuscript; KMS contributed to the design and conceptualization of the review,  
13 analysis and interpretations of the data, providing feedback on the manuscript, and gave approval  
14 of the final version of the manuscript.

## 17 **Competing interest statement**

18 All authors declare that they have no competing interests in accordance with the International  
19 Committee of Medical Journal Editors uniform declaration of competing interests.

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22 This study did not receive grant from any funding agency in the public, commercial or not-for-  
23 profit sectors.

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3 **1 Data Sharing Statement**  
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- 5 2 All data presented have been previously published. Our data will be made available upon  
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8 3 reasonable request to the corresponding author.  
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## References

1. Johns Hopkins Center for Systems of Science and Engineering (CSSE). COVID-19 Dashboard. [Available from: <http://coronavirus.jhu.edu/map.html>] accessed January 8, 2020.
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures 2020 [Available from: [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.ashx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.ashx)] accessed July 2, 2020.
3. Shared Health Manitoba. COVID-19: The New Normal. [Available from: <https://sharedhealthmb.ca/files/covid-19-memo-the-new-normal.pdf>] accessed May 8, 2020.
4. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *British Journal of Surgery* 2020 doi: doi:10.1002/bjs.11746 [published Online First: 2020 May 12]
5. Peters MDJ, Godfrey CM, McInerney P, et al. Chapter 11: Scoping Reviews. In: E. A, Z. M, eds. Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute, 2017.
6. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018;169(7):467-73. doi: 10.7326/m18-0850 [published Online First: 2018/09/05]
7. Tricco AC, Langlois EV, Straus SE, Editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization, 2017. Licence: CC BY-NC-SA 3.0 IGO
8. Garritty C, Gartlehner G, Kamel C, et al. Cochrane Rapid Reviews. Interim Guidance from the Cochrane Rapid Review Methods Group., 2020.
9. Godin K, Stapleton J, Kirkpatrick SI, et al. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Syst Rev* 2015;4:138. doi: 10.1186/s13643-015-0125-0 [published Online First: 2015/10/27]
10. Soreide K, Hallet J, Matthews JB, et al. Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services. *Br J Surg* 2020 doi: 10.1002/bjs.11670 [published Online First: 2020/05/01]
11. Munn Z, Peters MDJ, Stern C, et al. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology* 2018;18(1):143. doi: 10.1186/s12874-018-0611-x
12. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 2005;8(1):19-32. doi: 10.1080/1364557032000119616
13. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
14. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*











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60
- Experimental Ophthalmology* 2020;38(3):200-03. doi:  
<http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100>
15. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular diagnosis and treatment in gastrointestinal surgery department during the outbreak of coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]
  16. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
  17. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19 pandemic: an expert opinion from China, South Korea, Italy, United States of America, Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2 [published Online First: 2020/04/30]
  18. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi: 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]
  19. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
  20. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
  21. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First: 2020/05/10]
  22. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published Online First: 2020/05/04]
  23. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]
  24. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online First: 2020/05/03]
  25. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int* 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]
  26. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]

- 1
- 2
- 3
- 4 27. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service disruption
- 5 during COVID-19 in Hong Kong through telehealth and multi-institutional collaboration.
- 6 *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]
- 7
- 8 28. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively
- 9 Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020
- 10 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]
- 11
- 12 29. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a waiting
- 13 list for thoracic surgery during the outbreak of Severe Acute Respiratory
- 14 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013
- 15
- 16 30. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic.
- 17 *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published
- 18 Online First: 2020/04/15]
- 19
- 20 31. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences and
- 21 Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*
- 22 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First:
- 23 2020/04/29]
- 24
- 25 32. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery
- 26 and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi:
- 27 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
- 28
- 29 33. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by
- 30 the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi:
- 31 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
- 32
- 33 34. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-Being,
- 34 2020.
- 35
- 36 35. BC Ministry of Health. A Commitment to Surgical Renewal in BC. Canada, 2020.
- 37
- 38 36. Ben-Menachem E, French JA. Guidelines--are they useful? *Epilepsia* 2006;47 Suppl 1:62-4.
- 39 doi: 10.1111/j.1528-1167.2006.00663.x [published Online First: 2006/10/19]
- 40
- 41 37. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice
- 42 guidelines? A framework for improvement. *Jama* 1999;282(15):1458-65. [published
- 43 Online First: 1999/10/27]
- 44
- 45 38. Farquhar C, Kofa E, Slutsky J. Clinicians' attitudes to clinical practice guidelines: a systematic
- 46 review. *Med J Aust* 2002;177:502-06.
- 47
- 48 39. Grimshaw JM, Russell IT. Effect of clinical guidelines on medical practice: a systematic
- 49 review of rigorous evaluations. *Lancet* 1993;342(8883):1317-22. [published Online First:
- 50 1993/11/27]
- 51
- 52 40. Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline
- 53 dissemination and implementation strategies. *Health technology assessment*
- 54 (*Winchester, England*) 2004;8(6):iii-iv, 1-72. [published Online First: 2004/02/13]
- 55
- 56 41. Lomas J, Anderson G, Domnick-Pierre K, et al. Do practice guidelines guide practice? The
- 57 effect of a consensus statement on the practice of physicians. *N Engl J Med*
- 58 1989;321(19):1306-11.
- 59
- 60 42. Lugtenberg M, Burgers JS, Westert GP. Effects of evidence-based clinical practice guidelines
- on quality of care: a systematic review. *Quality & safety in health care* 2009;18(5):385-
92. doi: 10.1136/qshc.2008.028043 [published Online First: 2009/10/09]





- 1  
2  
3 43. Ahmed N, Devitt KS, Keshet I, et al. A systematic review of the effects of resident duty hour  
4 restrictions in surgery: impact on resident wellness, training, and patient outcomes. *Ann*  
5 *Surg* 2014;259(6):1041-53. doi: 10.1097/sla.0000000000000595 [published Online First:  
6 2014/03/26]  
7  
8 44. Rao S, Ferris TG, Hidrue MK, et al. Physician Burnout, Engagement and Career Satisfaction in  
9 a Large Academic Medical Practice. *Clin Med Res* 2020;18(1):3-10. doi:  
10 10.3121/cmr.2019.1516 [published Online First: 2020/01/20]  
11  
12 45. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic  
13 Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty*  
14 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]  
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**Table 1.** Description of included studies

Author	Year	Country	Public Health Emergency	Surgical Specialty	Changes to Surgical Services	Impact of Changes Examined	Resumption of Services
Alvarez-Gallego	2020	Spain	COVID-19	General			
Ammar	2020	USA	COVID-19	Neurosurgery			
Amparore	2020	Italy	COVID-19	Urology		Changes in clinical and surgical resident involvement	
Ansarin	2020	Italy	COVID-19	Oncology (Head & Neck)			
Bashir	2020	UK	COVID-19	Vascular			
Ben Abdallah	2020	France	COVID-19	Vascular			
Bernucci	2020	Italy	COVID-19	Neurosurgery		Changes in surgical volume	
Bettinelli	2020	Italy	COVID-19	Orthopedics			
Bolkan	2014	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bolkan	2018	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bourlon	2009	Mexico	H1N1	—		Number of surgical cancellations	

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Bradford	2003	China	SARS	GI		Changes in admissions and surgical volumes	
Brethauer	2020	USA	COVID-19	GI			Operative cases placed in “depot” to be rescheduled alongside new teleconsults
Brown	2020	USA	COVID-19	Orthopedics		Patient pain, anxiety and physical function	
Buckstein	2020	USA	COVID-19	Radiation Oncology			
Bundu	2016	Sierra Leone	Ebola	—		Changes in ED/ward admissions and surgical activity	
Burke	2020	USA	COVID-19	Neurosurgery			
Busin	2020	Italy	COVID-19	Ophthalmology		Changes in demand/donations for cornea bank	Set reasonable timelines for patients requiring low acuity surgery. Surgical work schedule extended into evenings and weekends
Cai	2020	USA	COVID-19	Otolaryngology		Changes in resident	

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							educational programming
Cakmak	2020	Turkey	COVID-19	Oncology (Breast)			Changes in surgical volume
Carenzo	2020	Italy	COVID-19	—			Changes in surgical volume
Cenzato	2020	Italy	COVID-19	Neurosurgery			
Chan	2006	China	SARS	Ophthalmology			
Chee	2004	Singapore	SARS	—			
Chew	2020	Singapore	COVID-19	General			
Chisci	2020	Italy	COVID-19	Vascular			Changes in surgical volume
Civantos	2020	USA	COVID-19	Oncology (Head & Neck)			Number of surgical cancellations
D'Apolito	2020	Italy	COVID-19	Orthopedics			Changes in surgical volume
de Vries	2020	Netherlands	COVID-19	Transplant			Changes in transplantation volumes
Ding	2020	Singapore	COVID-19	Orthopedics			
Dominguez-Gil	2020	Spain	COVID-19	Transplant			Changes in transplantation volumes
Doussot	2020	France	COVID-19	Oncology			Changes in surgical volume
Dowdell	2020	USA	COVID-19	Orthopedics			
Ducournau	2020	France	COVID-19	Plastics			
Eichberg	2020	USA	COVID-19	Neurosurgery			
Ficarra	2020	Italy	COVID-19	Urology			Proportion of surgical cancellations

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							initiated by patients
Fontanella	2020	Italy	COVID-19	Neurosurgery			Changes in surgical volume
Fontanella	2020	Italy	COVID-19	Neurosurgery			
Giorgi	2020	Italy	COVID-19	Spinal			
Givi	2020	USA	COVID-19	Oncology (Head & Neck)			Changes in fellow educational programming
Gomez-Barrena	2020	Spain	COVID-19	Orthopedics			Changes in surgical volume
Gouveia	2020	Portugal	COVID-19	Vascular			
Guerci	2020	Italy	COVID-19	General			
Gupta	2020	India	COVID-19	Oncology (Head & Neck)			
Haines	2003	China	SARS	Obstetrics			
Hemingway	2020	USA	COVID-19	Vascular			Changes in clinical and surgical volumes
Hormati	2020	Iran	COVID-19	GI			
Hu	2020	China	COVID-19	Oncology			
Jean	2020	USA	COVID-19	Neurosurgery			Changes in surgical volume
Kempa	2020	Poland	COVID-19	Electrophysiology			Changes in surgical volume
Kessler	2020	USA	COVID-19	Neurosurgery			
Konda	2020	USA	COVID-19	Orthopedics			
Kuo	2010	Argentina	H1N1	Ophthalmology			Changes in clinical and surgical volumes
Lai	2020	China	COVID-19	Ophthalmology			
Lancaster	2020	USA	COVID-19	—			Changes in surgical volume

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Langer	2020	USA	COVID-19	Plastics		
Lauterio	2020	Italy	COVID-19	Transplant		Changes in transplantation volumes
Lee	2020	China	COVID-19	Oncology (Head & Neck)		Changes in surgical wait times
Leong Tan	2020	Singapore	COVID-19	Vascular		
Li	2020	China	COVID-19	Transplant		
Liebensteiner	2020	Austria	COVID-19	Orthopedics		
Liu	2003	Singapore	SARS	Anesthesia		
Mak	2020	China	COVID-19	Plastics		
Marti	2020	Spain	COVID-19	Oncology (Breast)		
Maurizi	2020	Italy	COVID-19	Thoracic		Changes in surgical volume
McBride	2020	Australia	COVID-19	—		
McMillan	2020	Canada	COVID-19	—		Prioritization first of patients who would be at increased risk with further delay, followed by those waiting longest
Meneghini	2020	USA	COVID-19	Orthopedics		
Meyer	2020	France	COVID-19	Neurosurgery		Changes in surgical volume
Morgan	2020	UK	COVID-19	Orthopedics		
Nair	2020	India	COVID-19	Ophthalmology		
Nassar	2020	USA	COVID-19	General		
Park	2020	USA	COVID-19	Otolaryngology		



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Park	2020	South Korea	MERS	—		Changes in surgical volume	
Patel	2020	USA	COVID-19	Oncology (Head & Neck)			
Patel	2020	USA	COVID-19	Otolaryngology			
Pelt	2020	USA	COVID-19	Orthopedics		Number of surgical postponements	Surgeries prioritized based on complexity and predicted LOS, scheduling only completed if appropriate PPE and screening available.
Pittet	2020	Switzerland	COVID-19	—		Changes in surgical volume	
Prachand	2020	USA	COVID-19	—		Number of surgical cancellations	
Price	2020	USA	COVID-19	Dermatology			
Qadan	2020	USA	COVID-19	Oncology (GI/Hepatobiliary)			
Ralli	2020	Italy	COVID-19	Otolaryngology			
Rampinelli	2020	Italy	COVID-19	Oncology (Head & Neck)		Changes in surgical volume	
Randelli	2020	Italy	COVID-19	Orthopedics			
Ricciardi	2020	Italy	COVID-19	Neurosurgery			
Ross	2020	USA	COVID-19	—		Changes in clinical volumes	

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Rubin	2020	USA	COVID-19	Electrophysiology		Changes in lab capacity and consultation volumes
Rubin	2020	USA	COVID-19	Electrophysiology		Changes in surgical volume
Salengar	2020	USA	COVID-19	Cardiac		
Sarpong	2020	USA	COVID-19	Orthopedics		Changes in surgical volume
Schull	2007	Canada	SARS	—		
Schwarzkopf	2020	USA	COVID-19	Orthopedics		Changes in surgical volume
Scullen	2020	USA	COVID-19	Neurosurgery		
Seese	2020	USA	COVID-19	Cardiac		
Sethi	2020	USA	COVID-19	GI		Changes in surgical and consultation volumes
Shen	2020	China	COVID-19	—		Scheduling resumed following consideration of reduced risk of imported transmission and growing waitlist
Shih	2020	China	COVID-19	Ophthalmology		
Shokri	2020	USA	COVID-19	Plastics		Changes in surgical volume
Sobel	2020	USA	COVID-19	Urology		









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Sun	2020	China	COVID-19	Neurosurgery		Emergency surgeries performed	
Tan	2004	Singapore	SARS	Anesthesia			
Tan	2020	Singapore	COVID-19	Urology		Changes in surgical and consultation volumes	
Tan	2020	China	COVID-19	Neurosurgery			
Tay	2020	Singapore	COVID-19	Orthopedics		Changes in surgical volumes	
Tay	2020	Singapore	COVID-19	Orthopedics			
Thaler	2020	Austria	COVID-19	Orthopedics			
Tolone	2020	Italy	COVID-19	—			
Too	2020	Singapore	COVID-19	Interventional Radiology			
Topf	2020	USA	COVID-19	Oncology (Head & Neck)			
Tsui	2005	China	SARS	Cardiac			
Tzeng	2020	USA	COVID-19	Oncology			
Unal	2020	Turkey	COVID-19	Vascular			
Vaccaro	2020	USA	COVID-19	Orthopedics		Changes in physician remuneration and staffing	
Valenza	2020	Italy	COVID-19	Oncology		Changes in surgical volumes	
van de Haar	2020	Netherlands	COVID-19	Oncology			
Various	2020	Canada	COVID-19	—		Number of surgical postponements	Calling patients to assess their ability to reschedule,







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contracting private facilities with focus on urgent surgeries, patients waiting twice their clinical benchmarks or surgeries with minimal LOS

Various	2020	Ireland	COVID-19	—			
Vicini	2020	Italy	COVID-19	Oncology (Breast)		Changes in surgical volumes	
Vlantis	2004	China	SARS	Otolaryngology		Changes in outpatient and surgical volumes	
Walker	2020	USA	COVID-19	—		Number of surgical cancellations	Assess readiness of staff to safely resume high volumes of surgery and ensured availability of rapid in-house testing
Wan	2004	China	SARS	Thoracic		Patient anxiety and depression	
Wasser	2020	Israel	COVID-19	Ophthalmology			

Williams	2020	USA	COVID-19	Ophthalmology		Number of surgeries rescheduled
Wong	2020	Singapore	COVID-19	Anesthesia		
Wu	2020	China	COVID-19	Oncology (Head & Neck)		
Xiaolei	2020	China	COVID-19	Ophthalmology		
Zangrillo	2020	Italy	COVID-19	—		
Zarzaur	2020	USA	COVID-19	—		
Zeng	2020	China	COVID-19	Oncology (Head & Neck)		
Zizzo	2020	Italy	COVID-19	—		
Zoia	2020	Italy	COVID-19	Neurosurgery		

Domains of change to surgical services, represented numerically:

-  Changes to case selection and surgical triage
-  Changes to PPE protocols and practices
-  Changes to the surgical workforce.
-  Changes to inpatient and outpatient care
-  Changes to resident and fellow education
-  Changes to the environment

*Abbreviations:* — =data not provided, COVID-19=Coronavirus Disease 2019, ED=Emergency department, GI=Gastrointestinal; LOS=Length of stay, PPE=Personal protective equipment, SARS=Severe Acute Respiratory Syndrome

**Table 2.** Reorganization of surgical services, by domain.

<b>Change Domain</b>	<b>Number of Studies (%)</b>	<b>Examples of Change</b>
Triage or Case Selection	80 (74.7)	<ol style="list-style-type: none"> <li>1. Prioritization of patients based on pre-defined levels of acuity;</li> <li>2. Virtual multidisciplinary meetings or tumor boards;</li> <li>3. Creation of specialty-specific lists outlining surgery-eligible and ineligible ailments, often with inclusion of case-by-case category.</li> <li>4. Postponement based on high-risk patient characteristics (i.e., older age, multimorbidity) and expected need for ICU.</li> </ol>
PPE	63 (58.3)	<ol style="list-style-type: none"> <li>1. Hospital wide surgical mask mandate for staff and attendees;</li> <li>2. Standard level of PPE outlined for all patient encounters with enhanced PPE (e.g., addition of N95 or PAPR, head and shoe covering) protocol for specific procedures or care of infected patients;</li> <li>3. Refresher instruction courses provided to all hospital staff;</li> <li>4. Trained observer supervising all perioperative donning and doffing of PPE to ensure safety and compliance.</li> </ol>
Workforce	70 (64.8)	<ol style="list-style-type: none"> <li>1. Separation of clinical staff into rotating “clean” and “dirty” teams caring for exclusively for non-infected and infected patients, respectively;</li> <li>2. Temperature and symptom screening of staff with mandated quarantine periods in cases of unprotected exposure;</li> <li>3. Case discussions, handover and clinical staff meetings transitioned to virtual format;</li> <li>4. Redeployment of staff to hospital areas requiring support (e.g., ICU), often paired with virtual training to ensure comfortable transition.</li> </ol>

Patient Care	95 (88.0)	<ol style="list-style-type: none"> <li>1. Complete cancellation or transition to telemedicine for all non-urgent and routine perioperative clinical visits;</li> <li>2. Patient temperature, symptom and travel history screening before entry to clinic (relevant for urgent surgical patients);</li> <li>3. Preference for endovascular or minimally invasive surgical approaches when possible, use of conservative care when possible (oncology);</li> <li>4. Restrictions on number of accompanying persons or visitors (often zero with some allowing maximum of 1).</li> </ol>
Resident/Fellow Education	35 (32.4)	<ol style="list-style-type: none"> <li>1. Changes to resident/fellow team structure and rotation schedules to ensure continued coverage of department and maximize resident/fellow safety;</li> <li>2. Redeployment of residents to non-specialty areas requiring clinical support;</li> <li>3. Curriculum and conferences shifted to online format to allow continued e-learning for off-duty trainees;</li> <li>4. Trainees involvement in surgical care of infected persons ceased or altered (e.g., only admitted to OR during low-risk/non-aerosolizing procedures).</li> </ol>
Environment	70 (64.8)	<ol style="list-style-type: none"> <li>1. Dedication of wards (hallways, elevators), ORs, or entire hospitals to treat for only those infected or not infected;</li> <li>2. Use of negative-pressure OR when possible;</li> <li>3. Transformation of surgical wards, ORs and outpatient clinics into patient care areas to increase surge capacity;</li> <li>4. Double occupancy patient rooms reduced to single occupancy, or</li> </ol>

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physical measures (e.g., cubicles, distanced waiting room chairs) implemented.

*Abbreviations:* ICU= Intensive care unit, PPE= Personal protective equipment, PAPR= Powered air purifying respirator, OR= Operating room.

For peer review only



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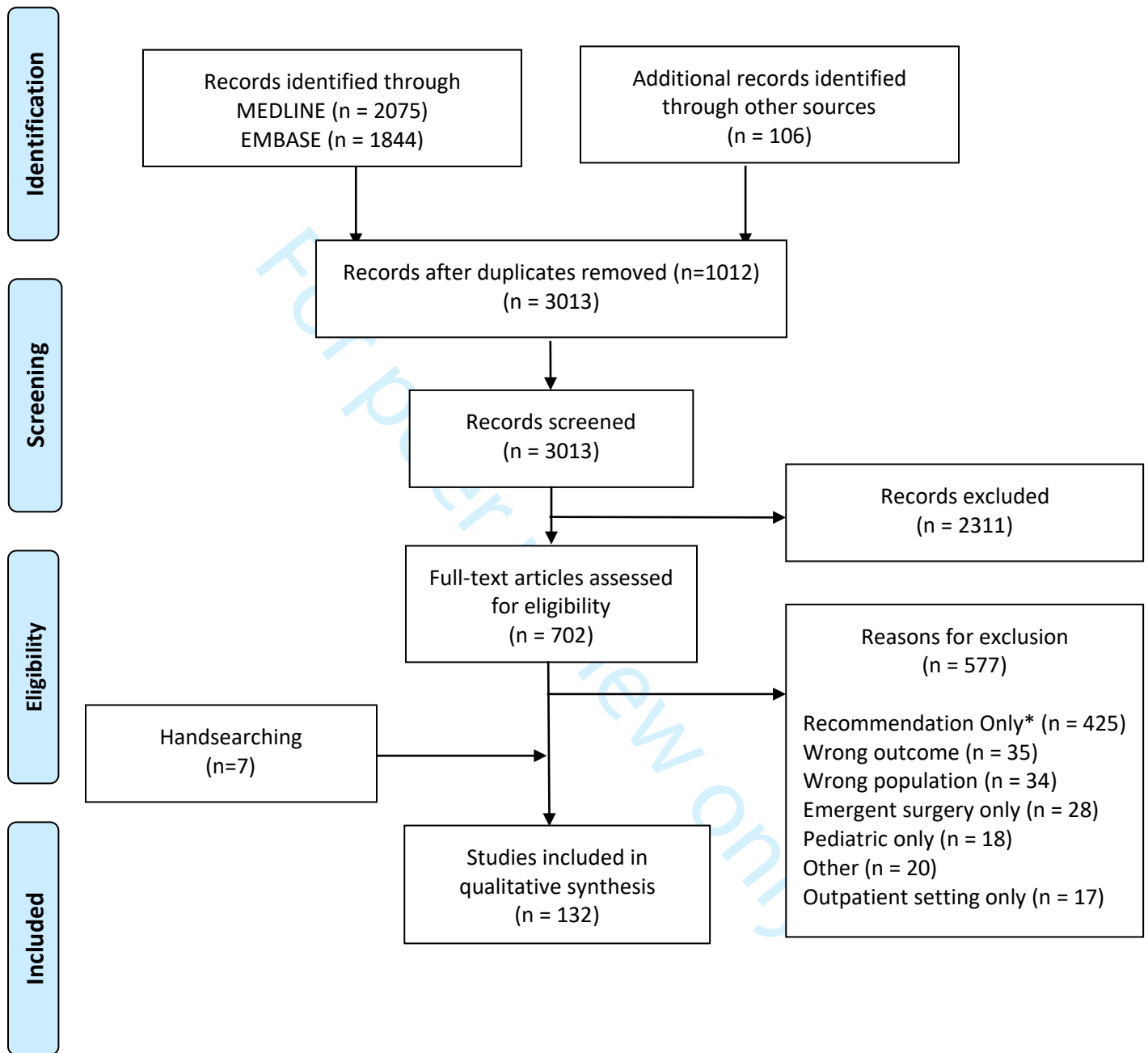
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Figure 2. Summary of study characteristics.

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**Figure 1.** Flow of studies in the scoping review

\*Includes guidelines, recommendation-based reviews, projections or estimations without mention of true changes to surgical programming.

**Figure 2. Study characteristics**

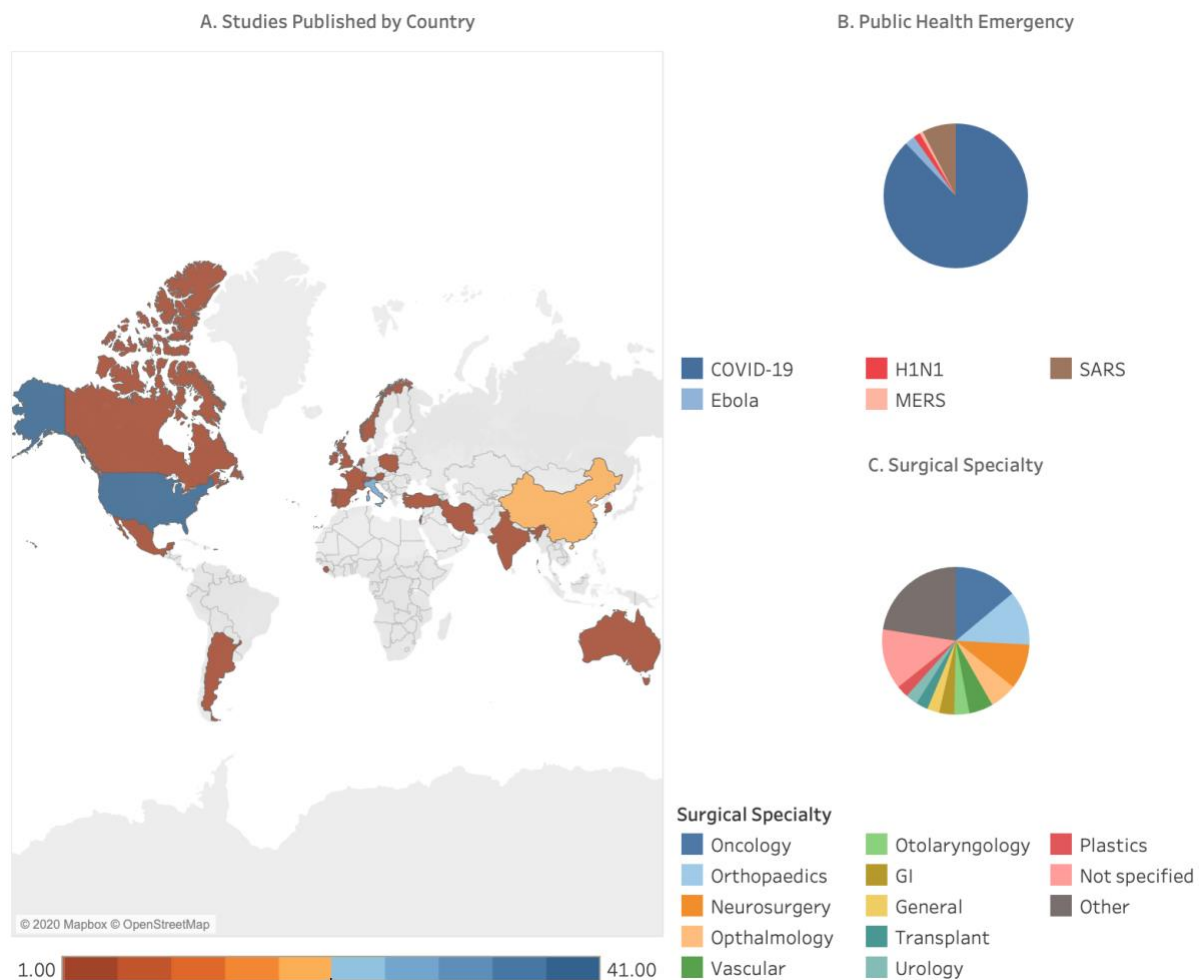


Figure 2. **A.** Country of publication, **B.** Public health emergency discussed, and **C.** Surgical specialty addressed ('Other' includes Cardiac (n=3), Anesthesia (n=3), Electrophysiology (n=3), Obstetrics and Gynecology (n=3), Thoracic (n=2), Interventional Radiology (n=1), and Dermatology (n=1)).

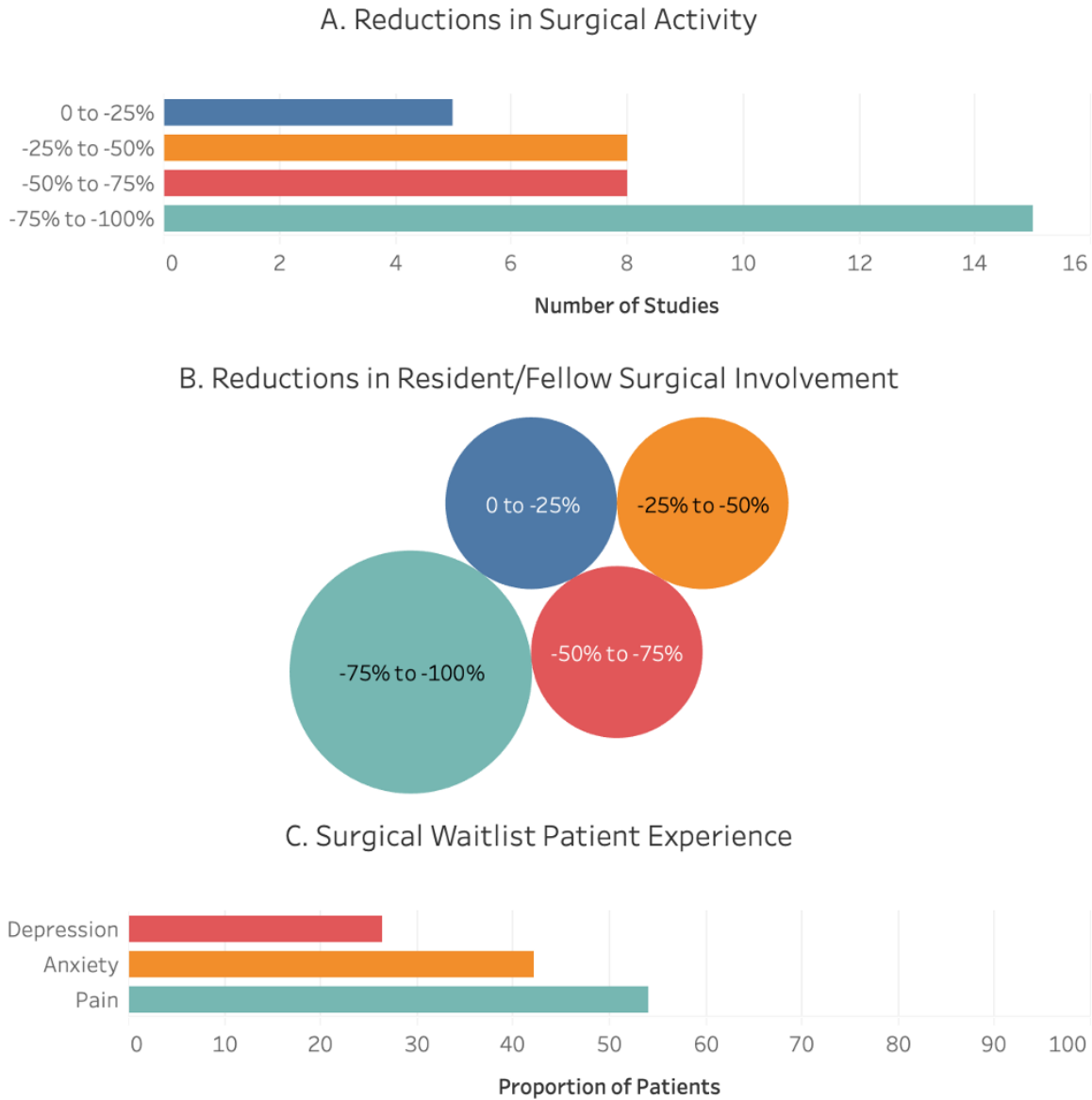
**Figure 3.** Summary of the impacts of alterations to surgical services

Figure 3. A summary of the impacts of alterations to surgical services during public health emergencies on **A.** Overall surgical activity (n=37 studies), **B.** Resident and fellow involvement in surgery (n=5 studies) where circle size represents the number of studies contributing to that quartile, and **C.** Patient experience (n=2 studies).

## Appendix A. Search Strategy

### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

#### Search Strategy:

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- 1 exp Disease Outbreaks/ (96117)
  - 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
  - 3 1 or 2 (231940)
  - 4 exp Coronavirus (13456)
  - 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
  - 6 Coronaviridae Infections/ (900)
  - 7 coronaviridae/ or coronavirus/ (3916)
  - 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
  - 9 Hemorrhagic Fever, Ebola/ (5316)
  - 10 SARS Virus/ (3038)
  - 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
  - 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
  - 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
  - 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
  - 15 (coronavir\*) adj2 (infection\*).mp. (8441)
  - 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
  - 17 General Surgery/ (38626)
  - 18 Orthopedic Procedures/ (25371)
  - 19 Traumatology/ (3474)
  - 20 Neurosurgery/ (14892)
  - 21 Obstetrics/ (22533)
  - 22 Anesthesia/ (62587)
  - 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
  - 24 exp Arthroplasty, Replacement/ (54362)
  - 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
  - 26 (surger\* or operation\* or procedure\*).mp. (3638036)
  - 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
  - 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
  - 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)
  - 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)
  - 31 3 and 16 and 30 (2075)
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**Database: EMBASE <1974 to 2020 May 08>****Search Strategy:**

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- 1 exp epidemic/ (103292)
  - 2 exp pandemic/ (12990)
  - 3 1 or 2 (114458)
  - 4 pandemic influenza/ (4748)
  - 5 exp severe acute respiratory syndrome/ (8505)
  - 6 exp coronaviridae/ or coronaviridae infection/ (14928)
  - 7 coronavirinae/ (2093)
  - 8 Coronavirus infection/ (3397)
  - 9 avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ (7466)
  - 10 Ebola hemorrhagic fever/ (5712)
  - 11 exp SARS coronavirus/ (5823)
  - 12 Middle East respiratory syndrome/ (935)
  - 13 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (512)
  - 14 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. (92353)
  - 15 (wuhan adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV)).mp. (161)
  - 16 (coronavir\* adj2 infection\*).mp. (4793)
  - 17 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 (96712)
  - 18 general surgery/ (15070)
  - 19 orthopedic surgery/ (32672)
  - 20 traumatology/ (10653)
  - 21 neurosurgery/ (59847)
  - 22 obstetrics/ (34886)
  - 23 anesthesiological procedure/ (1785)
  - 24 elective surgery/ (34038)
  - 25 replacement arthroplasty/ or exp arthroplasty/ (73583)
  - 26 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. (966732)
  - 27 (surger\* or operation\* or procedure\*).mp. (5402047)
  - 28 ((elective or non-urgent adj2 (surg\* or procedure\*)).mp. (52808)
  - 29 (surg\* adj2 (procedure\* or planning or triag\* or operation\* or resource\* or backlog or re-organiz\* or postpon\* or cancel\* or capacit\* or wait time\*)).mp. (187480)
  - 30 ((clinic\* or hospital) adj2 (process\* or procedure\* or triag\* or planning or performance\* or capacit\*)).mp. (83715)
  - 31 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 (5948860)
  - 32 3 and 17 and 31 (1844)
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Database	Pandemic terms Pandemic, epidemic	Disease terms COVID-19, SARS, MERS, pandemic flu (h1n1, h3n2, h5n1), ebola	Surgical terms Non-urgent/elective surgery (general, orthopedic, anesthesia, trauma, neurosurgery, obstetrics)
<b>MEDLINE</b>	exp Disease Outbreaks/ OR (pandemic* or epidemic* or outbreak* or outbreak*).mp.	exp Coronavirus OR coronavirus infections/ or severe acute respiratory syndrome/ OR Coronaviridae Infections/ OR coronaviridae/ or coronavirus/ OR Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ OR Hemorrhagic Fever, Ebola/ OR SARS Virus/ OR Middle East Respiratory Syndrome Coronavirus/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola* or middle	General Surgery/ OR Orthopedic Procedures/ OR Traumatology/ OR Neurosurgery/ OR Obstetrics/ OR Anesthesia/ OR surgical procedures, operative/ or exp elective surgical procedures/ OR exp Arthroplasty, Replacement/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent) adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triage or operation* or resource* or backlog or re-organiz* or postpone* or cancel* or capacit* or wait time*)).mp.

		east respiratory syndrome or MERS).mp. OR (wuhan) adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV).mp. OR (coronavir*) adj2 (infection*).mp.	OR ((clinic* or hospital) adj2 (process* or procedure* or triage or planning or performance* or capacit*)).mp.
<b>EMBASE</b>	exp epidemic/ OR exp pandemic/	pandemic influenza/ OR exp severe acute respiratory syndrome/ OR exp coronaviridae/ or coronaviridae infection/ OR coronavirinae/ OR Coronavirus infection/ OR avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ OR Ebola hemorrhagic fever/ OR exp SARS coronavirus/ OR Middle East respiratory syndrome/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. OR	general surgery/ OR orthopedic surgery/ OR traumatology/ OR neurosurgery/ OR obstetrics/ OR anesthesiological procedure/ OR elective surgery/ OR replacement arthroplasty/ or exp arthroplasty/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triag* or operation* or resource* or backlog or re-organiz* or postpon* or cancel* or

		(wuhan adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV)).mp. OR (coronavir* adj2 infection*).mp.	capacit* or wait time*).mp. OR ((clinic* or hospital) adj2 (process* or procedure* or triag* or planning or performance* or capacit*)).mp.
--	--	-----------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------

## GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms “coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery” OR “guidelines”)

## NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

## GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

## GENERAL SURGICAL GROUPS/COLLEGES

1  
 2  
 3 Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)  
 4 American College of Surgeons (<https://www.facs.org>)  
 5 European Surgical Association (<https://www.europeansurgicalassociation.org>)  
 6 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
 7 French Surgical Association  
 8 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
 9 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
 10 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
 11 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
 12 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
 13 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
 14 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
 15 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
 16 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
 17 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
 18  
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21  
 22 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
 23 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
 24 OR “Surgery” OR “non-urgent” OR “guidelines”  
 25

26  
 27 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
 28 past last click for relevance.  
 29

30  
 31 STEP 4) Contact with Knowledge Experts.  
 32

Source and Site	Search Terms	Potentially Relevant Results
<b>Health Groups</b>		
World Health Organization ( <a href="https://www.who.int">https://www.who.int</a> , Advanced Search)	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	10
Center for Disease Control and Prevention ( <a href="https://www.cdc.gov">https://www.cdc.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	8
European Centre for Disease Prevention and Control ( <a href="https://www.ecdc.europa.eu/en">https://www.ecdc.europa.eu/en</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	3
<b>Governments</b>		
Government of Canada ( <a href="https://www.canada.ca/en.html">https://www.canada.ca/en.html</a> )	[contains all words] elective surgery covid	4

	[contains all words] non-urgent surgery covid	
Government of BC ( <a href="https://www2.gov.bc.ca/gov">https://www2.gov.bc.ca/gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of AB ( <a href="https://www.alberta.ca">https://www.alberta.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of SK ( <a href="https://www.saskatchewan.ca">https://www.saskatchewan.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	6
Government of MB ( <a href="https://www.gov.mb.ca">https://www.gov.mb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	4
Government of ON ( <a href="https://www.ontario.ca">https://www.ontario.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of QC ( <a href="https://www.quebec.ca/en/">https://www.quebec.ca/en/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of NB ( <a href="https://www2.gnb.ca">https://www2.gnb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NS ( <a href="https://beta.novascotia.ca">https://beta.novascotia.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NL & LB ( <a href="https://www.gov.nl.ca">https://www.gov.nl.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of PEI ( <a href="https://www.princeedwardisland.ca">https://www.princeedwardisland.ca</a> )	[contains all words] elective surgery covid	2

	[contains all words] non-urgent surgery covid	
Government of Yukon ( <a href="https://yukon.ca">https://yukon.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NWT ( <a href="https://www.gov.nt.ca">https://www.gov.nt.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Nunavut ( <a href="https://www.gov.nu.ca">https://www.gov.nu.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Australia ( <a href="https://www.australia.gov.au">https://www.australia.gov.au</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Italy ( <a href="http://www.governo.it">http://www.governo.it</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Singapore ( <a href="https://www.gov.sg">https://www.gov.sg</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of China ( <a href="https://www.gov.cn/english/">https://www.gov.cn/english/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
United States Government ( <a href="https://www.usa.gov">https://www.usa.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
<b>Surgical Colleges/Associations</b>		
Royal College of Physicians and Surgeons of Canada ( <a href="http://www.royalcollege.ca">http://www.royalcollege.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0

<p>American College of Surgeons (<a href="https://www.facs.org">https://www.facs.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>23</p>
<p>European Surgical Association (<a href="https://www.europeansurgicalassociation.org">https://www.europeansurgicalassociation.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>College of Surgeons, Singapore (<a href="https://www.ams.edu.sg">https://www.ams.edu.sg</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>3</p>
<p>German Society of Surgery (<a href="https://www.dgch.de/index.php?id=118">https://www.dgch.de/index.php?id=118</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>Philippine College of Surgeons (<a href="https://www.pcs.org.ph">https://www.pcs.org.ph</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>11</p>
<p>Royal Australasian College of Surgeons (<a href="https://www.surgeons.org">https://www.surgeons.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>12</p>
<p>Royal College of Surgeons of England (<a href="https://www.rcseng.ac.uk">https://www.rcseng.ac.uk</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>7</p>
<p>Royal College of Surgeons of Ireland (<a href="https://www.rcsi.com/dublin/">https://www.rcsi.com/dublin/</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>8</p>
<p>Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<a href="https://www.aecirujanos.es">https://www.aecirujanos.es</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>1</p>
<p>Swedish Surgical Society (<a href="http://www.svenskkirurgi.se">http://www.svenskkirurgi.se</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>

The Association of Surgeons of South Africa ( <a href="http://www.surgeon.co.za">http://www.surgeon.co.za</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
The Pan African Association of Surgeons ( <a href="http://www.africansurgeons.com">http://www.africansurgeons.com</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Total		111



## Appendix B. Data Abstraction Form

This form has been developed by adopting and customizing the ‘Data collection form- RCTs and NRS’ produced by The Cochrane Collaboration. Customization includes the addition of new sections, as well as the omission of sections not relevant to the review.

### Notes on using data extraction form:

- Be consistent in the order and style you use to describe the information for each report.
- Record any missing information as unclear or not described, to make it clear that the information was not found in the study report(s), not that you forgot to extract it.
- Include any instructions and decision rules on the data collection form, or in an accompanying document. It is important to practice using the form and give training to any other authors using the form.

### 1. General Information

1. Date form completed (dd/mm/yyyy)	/ /
2. Name of person extracting data	<input type="checkbox"/> Connor M. ORielly <input type="checkbox"/> Khara M. Sauro
3. Contact details of person extracting data	
4. Title of Article/Abstract (that data are extracted from)	
5. Study ID (plus surname of author and year of study publication)	
6. Study country of origin	
7. Study funding source	
8. Possible conflicts of interest	<input type="checkbox"/> Reported <input type="checkbox"/> Not Reported
9. Notes:	

### 2. Eligibility

Study Characteristics	Inclusion Criteria	Location in text (page#/fig#/table#)
10. Type of study (design)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	

11. Population description		
12. Focused diseases/conditions		
13. Types of outcome measures		
14. Decision (with reasons for either inclusion or exclusion)	<input type="checkbox"/> Include <input type="checkbox"/> Exclude If Exclude, explain:	
15. Notes		

**IF STUDY IS EXCLUDED FROM REVIEW, DO NOT CONTINUE**

## 2. Population and setting

	Description	Location in text (page#/fig#/table#)
16. Population description		
17. Source/setting of the population (e.g., urban, rural, ethnic group)		
18. Method(s) of recruitment of participants	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random  Method:	
19. Notes:		

## 3. Methods

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
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20. Aim of study		
21. Design (e.g., cross-sectional, RCT, CCT)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	
22. Sampling technique (e.g., random or convenience)	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random	
23. Study start date (dd/mm/yyyy)	/ /	
24. Study end date/duration (dd/mm/yyyy)	/ / <b>OR</b> Duration:	
25. Notes:		

#### 4. Participants

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
26. Total number of participants/Sample size		
27. Age		
28. Sex	<input type="checkbox"/> Both Sexes <input type="checkbox"/> Males <input type="checkbox"/> Females	
29. Genders Represented		
30. Country		
31. Predominant medical complaint		
32. Co-morbidities (if any)		
33. Definition of 'Frequent use' (if any)		

34. Notes:

## 5. Outcomes

Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
35. Outcome definition		
36. Time points measured		
37. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
38. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
39. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
40. Specify Outcome		
41. Outcome definition		
42. Time points measured		
43. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
44. Unit of measurement		
45. Notes:		

Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
46. Specify Outcome		
47. Outcome definition		
48. Time points measured		
49. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
50. Unit of measurement		
51. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
52. Specify Outcome		
53. Outcome definition		
54. Time points measured		
55. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
56. Unit of measurement		
57. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
58. Outcome definition		
59. Time points measured		

60. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
61. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
62. Notes:		

## 6. Results and findings

*Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.*

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
63. Subgroup (if applicable, e.g., age/sex specific reporting)		
64. Results		
65. Response/non-response rate		
66. Unit of analysis (i.e., individual or group)		
67. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
68. Subgroup (if applicable, e.g., age/sex specific reporting)		
69. Results		
70. Response/non-response rate		
71. Unit of analysis (i.e., individual or group)		
72. Notes:		

Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
73. Subgroup (if applicable, e.g., age/sex specific reporting)		
74. Results		
75. Response/non-response rate		
76. Unit of analysis (i.e., individual or group)		
77. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
78. Subgroup (if applicable, e.g., age/sex specific reporting)		
79. Results		
80. Response/non-response rate		
81. Unit of analysis (i.e., individual or group)		
82. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
83. Subgroup (if applicable, e.g., age/sex specific reporting)		
84. Results		
85. Response/non-response rate		
86. Unit of analysis (i.e., individual or group)		
87. Notes:		

**Research Questions informed by this study (tick only boxes matching the outcome tables kept above)**

Changes to surgical programming in response to public health emergency

- Impacts of changes to surgical programming
- Actions to rebuild surgical capacity post-public health emergency

### 7. Strengths, limitations and mitigation strategy

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
88. Strengths		
89. Limitations		
90. Strategies to overcome limitations		
91. Notes:		

### 8. Conclusion and other information

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
92. Key conclusions of study authors		
93. Notes:		



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For peer review only

### Appendix C. Complete list of references for included studies

1. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
2. Ammar A, Stock AD, Holland R, et al. Managing a Specialty Service During the COVID-19 Crisis: Lessons From a New York City Health System. *Acad Med* 2020 doi: 10.1097/ACM.0000000000003440 [published Online First: 2020/04/19]
3. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
4. Ansarin M. Surgical management of head and neck tumours during the SARS-CoV (COVID-19) pandemic. *Acta Otorhinolaryngol Ital* 2020;40(2):87-89. doi: 10.14639/0392-100X-N0783 [published Online First: 2020/04/10]
5. Bashir M, Moughal S. Cardiovascular disease and surgery amid COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.479 [published Online First: 2020/05/04]
6. Ben Abdallah I. Early experience in Paris with the impact of the COVID-19 pandemic on vascular surgery. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.467 [published Online First: 2020/04/27]
7. Bernucci C, Brembilla C, Veiceschi P. Effects of the COVID-19 Outbreak in Northern Italy: Perspectives from the Bergamo Neurosurgery Department. *World Neurosurg* 2020;137:465-68 e1. doi: 10.1016/j.wneu.2020.03.179 [published Online First: 2020/04/06]
8. Bettinelli G, Delmastro E, Salvato D, et al. Orthopaedic patient workflow in CoViD-19 pandemic in Italy. *J Orthop* 2020;22:158-59. doi: 10.1016/j.jor.2020.04.006 [published Online First: 2020/05/07]
9. Bolkan HA, Bash-Taqi DA, Samai M, et al. Ebola and indirect effects on health service function in sierra leone. *PLoS Curr* 2014;6 doi: 10.1371/currents.outbreaks.0307d588df619f9c9447f8ead5b72b2d [published Online First: 2015/02/17]
10. Bolkan HA, van Duinen A, Samai M, et al. Admissions and surgery as indicators of hospital functions in Sierra Leone during the west-African Ebola outbreak. *BMC Health Serv Res* 2018;18(1):846. doi: 10.1186/s12913-018-3666-9 [published Online First: 2018/11/11]
11. Bourlon MT, Macias AE, de la Torre A, et al. Organization of a third-level care hospital in Mexico City during the 2009 influenza epidemic. *Arch Med Res* 2009;40(8):681-6. doi: 10.1016/j.arcmed.2009.10.009 [published Online First: 2010/03/23]
12. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]
13. Brethauer SA, Poulouse BK, Needleman BJ, et al. Redesigning a Department of Surgery during the COVID-19 Pandemic. *J Gastrointest Surg* 2020 doi: 10.1007/s11605-020-04608-4 [published Online First: 2020/04/30]
14. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]

15. Buckstein M, Skubish S, Smith K, et al. Experiencing the Surge: Report from a Large New York Radiation Oncology Department During the COVID-19 Pandemic. *Adv Radiat Oncol* 2020 doi: 10.1016/j.adro.2020.04.014 [published Online First: 2020/05/08]
16. Bundu I, Patel A, Mansaray A, et al. Surgery in the time of Ebola: how events impacted on a single surgical institution in Sierra Leone. *J R Army Med Corps* 2016;162(3):212-6. doi: 10.1136/jramc-2015-000582 [published Online First: 2016/01/21]
17. Burke JF, Chan AK, Mummaneni V, et al. Letter: The Coronavirus Disease 2019 Global Pandemic: A Neurosurgical Treatment Algorithm. *Neurosurgery* 2020;87(1):E50-E56. doi: 10.1093/neuros/nyaa116
18. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi: 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
19. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
20. Cakmak GK, Ozmen V. Sars-CoV-2 (COVID-19) Outbreak and Breast Cancer Surgery in Turkey. *Eur J Breast Health* 2020;16(2):83-85. doi: 10.5152/ejbh.2020.300320 [published Online First: 2020/04/15]
21. Carenzo L, Costantini E, Greco M, et al. Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. *Anaesthesia* 2020 doi: 10.1111/anae.15072 [published Online First: 2020/04/05]
22. Cenzato M, DiMeco F, Fontanella M, et al. Editorial. Neurosurgery in the storm of COVID-19: suggestions from the Lombardy region, Italy (ex malo bonum). *Journal of neurosurgery* 2020:1-2. doi: 10.3171/2020.3.JNS20960
23. Chan WM, Liu DTL, Chan PKS, et al. Precautions in ophthalmic practice in a hospital with a major acute SARS outbreak: an experience from Hong Kong. *Eye* 2006;20(3):283-89. doi: 10.1038/sj.eye.6701885
24. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
25. Chew MH, Koh FH, Ng KH. A call to arms: a perspective of safe general surgery in Singapore during the COVID-19 pandemic. *Singapore Med J* 2020 doi: 10.11622/smedj.2020049 [published Online First: 2020/04/04]
26. Chisci E, Masciello F, Michelagnoli S. Creation of a vascular surgical hub responding to the COVID-19 emergency: The Italian USL Toscana Centro model. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.019 [published Online First: 2020/04/20]
27. Civantos FJ, Leibowitz JM, Arnold DJ, et al. Ethical surgical triage of patients with head and neck cancer during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26229 [published Online First: 2020/05/02]
28. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]
29. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]

- 1  
2  
3 30. Ding BTK, Soh T, Tan BY, et al. Operating in a Pandemic: Lessons and Strategies from  
4 an Orthopaedic Unit at the Epicenter of COVID-19 in Singapore. *J Bone Joint Surg Am* 2020  
5 doi: 10.2106/JBJS.20.00568 [published Online First: 2020/05/08]  
6  
7 31. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation  
8 in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online  
9 First: 2020/05/03]  
10  
11 32. Doussot A, Heyd B, Lakkis Z. We Asked the Experts: How Do We Maintain Surgical  
12 Quality Standards for Enhanced Recovery Programs After Cancer Surgery During the COVID-  
13 19 Outbreak? *World J Surg* 2020 doi: 10.1007/s00268-020-05546-7 [published Online First:  
14 2020/04/27]  
15  
16 33. Dowdell JE, Louie PK, Virk S, et al. Spine fellowship training reorganizing during a  
17 pandemic: perspectives from a tertiary orthopedic specialty center in the epicenter of outbreak.  
18 *Spine J* 2020 doi: 10.1016/j.spinee.2020.04.015 [published Online First: 2020/04/29]  
19  
20 34. Ducournau F, Arianni M, Awwad S, et al. COVID-19: Initial experience of an  
21 international group of hand surgeons. *Hand Surg Rehabil* 2020;39(3):159-66. doi:  
22 10.1016/j.hansur.2020.04.001 [published Online First: 2020/04/13]  
23  
24 35. Eichberg DG, Shah AH, Luther EM, et al. Letter: Academic Neurosurgery Department  
25 Response to COVID-19 Pandemic: The University of Miami/Jackson Memorial Hospital Model.  
26 *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa118 [published Online First: 2020/04/12]  
27  
28 36. Ficarra V, Mucciardi G, Giannarini G. Re: Riccardo Campi, Daniele Amparore, Umberto  
29 Capitanio, et al. Assessing the Burden of Urgent Nondeferrable Uro-oncologic Surgery to Guide  
30 Prioritisation Strategies During the COVID-19 Pandemic: Insights from Three Italian High-  
31 volume Referral Centres. *Eur Urol*. In press. <https://doi.org/10.1016/j.eururo.2020.03.054>. *Eur*  
32 *Urol* 2020 doi: 10.1016/j.eururo.2020.04.037 [published Online First: 2020/05/04]  
33  
34 37. Fontanella MM, De Maria L, Zanin L, et al. Neurosurgical Practice During the Severe  
35 Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Pandemic: A Worldwide Survey.  
36 *World Neurosurg* 2020 doi: 10.1016/j.wneu.2020.04.204 [published Online First: 2020/05/08]  
37  
38 38. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19  
39 pandemic: an expert opinion from China, South Korea, Italy, United States of America,  
40 Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2  
41 [published Online First: 2020/04/30]  
42  
43 39. Giorgi PD, Villa F, Gallazzi E, et al. The management of emergency spinal surgery  
44 during the COVID-19 pandemic in Italy. *Bone Joint J* 2020;xxx. doi: 10.1302/0301-  
45 620X.102B6.BJJ-2020-0537 [published Online First: 2020/04/24]  
46  
47 40. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during  
48 the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First:  
49 2020/05/10]  
50  
51 41. Gomez-Barrena E, Rubio-Suarez JC, Fernandez-Baillo N, et al. Limiting spread of  
52 COVID-19 in an orthopaedic department-a perspective from Spain. *J Surg Case Rep*  
53 2020;2020(4):rjaa095. doi: 10.1093/jscr/rjaa095 [published Online First: 2020/04/30]  
54  
55 42. Gouveia EMR, Pedro LM. Vascular surgery department adjustments in the era of the  
56 COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.017 [published Online First:  
57 2020/04/20]  
58  
59 43. Guerci C, Maffioli A, Bondurri AA, et al. COVID-19: How can a department of general  
60 surgery survive in a pandemic? *Surgery* 2020;167(6):909-11. doi: 10.1016/j.surg.2020.03.012  
[published Online First: 2020/04/18]

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
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46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
44. Gupta A, Arora V, Nair D, et al. Status and strategies for the management of head and neck cancer during COVID-19 pandemic: Indian scenario. *Head Neck* 2020 doi: 10.1002/hed.26227 [published Online First: 2020/05/02]
  45. Haines CJ, Chu YW, Chung TK. The effect of Severe Acute Respiratory Syndrome on a hospital obstetrics and gynaecology service. *BJOG* 2003;110(7):643-5. doi: <http://dx.doi.org/10.1016/S1470-0328%2803%2903007-6> [published Online First: 2003/07/05]
  46. British Columbia Ministry of Health. A Commitment to Surgical Renewal in BC. Canada, 2020.
  47. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published Online First: 2020/05/04]
  48. Hormati A, Ghadir MR, Zamani F, et al. Preventive strategies used by GI physicians during the COVID-19 pandemic. *New Microbes New Infect* 2020;35:100676. doi: 10.1016/j.nmni.2020.100676 [published Online First: 2020/04/16]
  49. Hu Y-J, Zhang J-M, Chen Z-P. Experiences of practicing surgical neuro-oncology during the COVID-19 pandemic. *Journal of neuro-oncology* 2020;148(1):199-200. doi: 10.1007/s11060-020-03489-6 [published Online First: 2020/04/10]
  50. Jean WC, Ironside NT, Sack KD, et al. The impact of COVID-19 on neurosurgeons and the strategy for triaging non-emergent operations: a global neurosurgery study. *Acta Neurochir (Wien)* 2020;162(6):1229-40. doi: 10.1007/s00701-020-04342-5 [published Online First: 2020/04/22]
  51. Kempa M, Gulaj M, Farkowski MM, et al. Electrotherapy and electrophysiology procedures during the coronavirus disease 2019 pandemic: an opinion of the Heart Rhythm Section of the Polish Cardiac Society (with an update). *Kardiol Pol* 2020;78(5):488-92. doi: 10.33963/KP.15338 [published Online First: 2020/05/06]
  52. Kessler RA, Zimering J, Gilligan J, et al. Neurosurgical management of brain and spine tumors in the COVID-19 era: an institutional experience from the epicenter of the pandemic. *J Neurooncol* 2020 doi: 10.1007/s11060-020-03523-7 [published Online First: 2020/05/07]
  53. 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 doi: 10.1097/BOT.0000000000001792 [published Online First: 2020/05/02]
  54. Kuo IC, Pellegrino F, Fornero P, et al. H1N1 pandemic and ophthalmology. *Ophthalmology* 2010;117(2):405. doi: 10.1016/j.ophtha.2009.11.035 [published Online First: 2010/02/10]
  55. Lai THT, Tang EWH, Chau SKY, et al. Stepping up infection control measures in ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. *Graefes Arch Clin Exp Ophthalmol* 2020;258(5):1049-55. doi: 10.1007/s00417-020-04641-8 [published Online First: 2020/03/04]
  56. Lancaster EM, Sosa JA, Sammann A, et al. Rapid Response of an Academic Surgical Department to the COVID-19 Pandemic: Implications for Patients, Surgeons, and the Community. *J Am Coll Surg* 2020;230(6):1064-73. doi: 10.1016/j.jamcollsurg.2020.04.007 [published Online First: 2020/04/13]
  57. Langer PD, Bernardini FP. Oculofacial Plastic Surgery and the COVID-19 Pandemic: Current Reactions and Implications for the Future. *Ophthalmology* 2020 doi: 10.1016/j.ophtha.2020.04.035 [published Online First: 2020/04/30]

- 1  
2  
3 58. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north  
4 of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int*  
5 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]  
6  
7 59. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service  
8 disruption during COVID-19 in Hong Kong through telehealth and multi-institutional  
9 collaboration. *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]  
10  
11 60. Leong Tan GW, Chandrasekar S, Lo ZJ, et al. Early experience in the COVID-19  
12 pandemic from a vascular surgery unit in a Singapore tertiary hospital. *J Vasc Surg* 2020 doi:  
13 10.1016/j.jvs.2020.04.014 [published Online First: 2020/04/20]  
14  
15 61. Li Y, Yang N, Li X, et al. Strategies for prevention and control of the 2019 novel  
16 coronavirus disease in the department of kidney transplantation. *Transpl Int* 2020 doi:  
17 10.1111/tri.13634 [published Online First: 2020/05/02]  
18  
19 62. Liebensteiner MC, Khosravi I, Hirschmann MT, et al. Massive cutback in orthopaedic  
20 healthcare services due to the COVID-19 pandemic. *Knee Surg Sports Traumatol Arthrosc*  
21 2020;28(6):1705-11. doi: 10.1007/s00167-020-06032-2 [published Online First: 2020/05/02]  
22  
23 63. Liu EH, Koh KF, Chen FG. Outbreak of severe acute respiratory syndrome in Singapore  
24 and modifications in the anesthesia service. *Anesthesiology* 2004;100(6):1629-30. doi:  
25 10.1097/00000542-200406000-00062 [published Online First: 2004/05/29]  
26  
27 64. Mak ST, Yuen HK. Oculoplastic surgery practice during the COVID-19 novel  
28 coronavirus pandemic: experience sharing from Hong Kong. *Orbit* 2020:1-3. doi:  
29 10.1080/01676830.2020.1754435 [published Online First: 2020/04/17]  
30  
31 65. Marti C, Sanchez-Mendez JI. Neoadjuvant endocrine therapy for luminal breast cancer  
32 treatment: a first-choice alternative in times of crisis such as the COVID-19 pandemic.  
33 *Ecancermedicalscience* 2020;14:1027. doi: 10.3332/ecancer.2020.1027 [published Online First:  
34 2020/05/06]  
35  
36 66. Maurizi G, Rendina EA. A High-Volume Thoracic Surgery Division into the Storm of  
37 the Covid-19 Pandemic. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.03.015  
38 [published Online First: 2020/04/15]  
39  
40 67. McBride KE, Brown KGM, Fisher OM, et al. Impact of the COVID-19 pandemic on  
41 surgical services: early experiences at a nominated COVID-19 centre. *ANZ J Surg*  
42 2020;90(5):663-65. doi: 10.1111/ans.15900 [published Online First: 2020/04/08]  
43  
44 68. McMillan T, Williamson K. Resuming non-urgent surgeries and allied health services,  
45 2020.  
46  
47 69. Meneghini RM. Resource Reallocation during the COVID-19 Pandemic in a Suburban  
48 Hospital System: Implications for Outpatient Hip and Knee Arthroplasty. *J Arthroplasty* 2020  
49 doi: 10.1016/j.arth.2020.04.051 [published Online First: 2020/05/08]  
50  
51 70. Meyer M, Prost S, Farah K, et al. Spine Surgical Procedures during Coronavirus Disease  
52 2019 Pandemic: Is It Still Possible to Take Care of Patients? Results of an Observational Study  
53 in the First Month of Confinement. *Asian Spine J* 2020 doi: 10.31616/asj.2020.0197 [published  
54 Online First: 2020/05/10]  
55  
56 71. Morgan C, Ahluwalia AK, Aframian A, et al. The impact of the novel coronavirus on  
57 trauma and orthopaedics in the UK. *Br J Hosp Med (Lond)* 2020;81(4):1-6. doi:  
58 10.12968/hmed.2020.0137 [published Online First: 2020/04/29]  
59  
60 72. Nair AG, Gandhi RA, Natarajan S. Effect of COVID-19 related lockdown on ophthalmic  
practice and patient care in India: Results of a survey. *Indian J Ophthalmol* 2020;68(5):725-30.  
doi: 10.4103/ijo.IJO\_797\_20 [published Online First: 2020/04/23]

- 1  
2  
3  
4  
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9  
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46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
73. Nassar AH, Zern NK, McIntyre LK, et al. Emergency Restructuring of a General Surgery Residency Program During the Coronavirus Disease 2019 Pandemic: The University of Washington Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1219 [published Online First: 2020/04/07]
74. Park J, Yoo SY, Ko JH, et al. Infection Prevention Measures for Surgical Procedures during a Middle East Respiratory Syndrome Outbreak in a Tertiary Care Hospital in South Korea. *Sci Rep* 2020;10(1):325. doi: 10.1038/s41598-019-57216-x [published Online First: 2020/01/17]
75. Park JS, El-Sayed IH, Young VN, et al. Development of clinical care guidelines for faculty and residents in the era of COVID-19. *Head Neck* 2020 doi: 10.1002/hed.26225 [published Online First: 2020/04/30]
76. Patel RJ, Kejner A, McMullen C. Early institutional head and neck oncologic and microvascular surgery practice patterns across the United States during the SARS-CoV-2 (COVID19) pandemic. *Head Neck* 2020;42(6):1168-72. doi: 10.1002/hed.26189 [published Online First: 2020/04/25]
77. Patel ZM, Fernandez-Miranda J, Hwang PH, et al. Letter: Precautions for Endoscopic Transnasal Skull Base Surgery During the COVID-19 Pandemic. *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa125 [published Online First: 2020/04/16]
78. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
79. Pittet D. Hopitaux Universitaire de Genève (HUG)- A model hospital for COVID-19 patient management, 2020.
80. Prachand VN, Milner R, Angelos P, et al. Medically Necessary, Time-Sensitive Procedures: Scoring System to Ethically and Efficiently Manage Resource Scarcity and Provider Risk During the COVID-19 Pandemic. *J Am Coll Surg* 2020 doi: 10.1016/j.jamcollsurg.2020.04.011 [published Online First: 2020/04/13]
81. Price KN, Thiede R, Shi VY, et al. Strategic dermatology clinical operations during the coronavirus disease 2019 (COVID-19) pandemic. *J Am Acad Dermatol* 2020;82(6):e207-e09. doi: 10.1016/j.jaad.2020.03.089 [published Online First: 2020/04/12]
82. Qadan M, Hong TS, Tanabe KK, et al. A Multidisciplinary Team Approach for Triage of Elective Cancer Surgery at the Massachusetts General Hospital During the Novel Coronavirus COVID-19 Outbreak. *Ann Surg* 2020 doi: 10.1097/SLA.0000000000003963 [published Online First: 2020/04/18]
83. Ralli M, Greco A, de Vincentiis M. The Effects of the COVID-19/SARS-CoV-2 Pandemic Outbreak on Otolaryngology Activity in Italy. *Ear Nose Throat J* 2020;145561320923893. doi: 10.1177/0145561320923893 [published Online First: 2020/04/30]
84. Rampinelli V, Mattavelli D, Gualtieri T, et al. Reshaping head and neck reconstruction policy during the COVID-19 pandemic peak: Experience in a front-line institution. *Auris Nasus Larynx* 2020 doi: 10.1016/j.anl.2020.04.008 [published Online First: 2020/05/05]
85. Randelli PS, Compagnoni R. Management of orthopaedic and traumatology patients during the Coronavirus disease (COVID-19) pandemic in northern Italy. *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1683-89. doi: 10.1007/s00167-020-06023-3 [published Online First: 2020/04/27]

- 1  
2  
3 86. Ricciardi L, Trungu S, Scerrati A, et al. Neurosurgery at the time of COVID-19: how this  
4 pandemic infectious disease is influencing neurosurgical activities and patient management. *J*  
5 *Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04976-0 [published Online First: 2020/04/30]  
6  
7 87. Ross SW, Lauer CW, Miles WS, et al. Maximizing the Calm before the Storm: Tiered  
8 Surgical Response Plan for Novel Coronavirus (COVID-19). *J Am Coll Surg* 2020;230(6):1080-  
9 91 e3. doi: 10.1016/j.jamcollsurg.2020.03.019 [published Online First: 2020/04/03]  
10  
11 88. Rubin GA, Biviano A, Dizon J, et al. Performance of electrophysiology procedures at an  
12 academic medical center amidst the 2020 coronavirus (COVID-19) pandemic. *J Cardiovasc*  
13 *Electrophysiol* 2020 doi: 10.1111/jce.14493 [published Online First: 2020/04/14]  
14  
15 89. Rubin GA, Wan EY, Saluja D, et al. Restructuring Electrophysiology During the  
16 COVID-19 Pandemic: A Practical Guide from a New York City Hospital Network. *Crit Pathw*  
17 *Cardiol* 2020 doi: 10.1097/HPC.000000000000225 [published Online First: 2020/04/24]  
18  
19 90. Salenger R, Etchill EW, Ad N, et al. The Surge after the Surge: Cardiac Surgery post-  
20 COVID-19. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.04.018 [published Online  
21 First: 2020/05/08]  
22  
23 91. Sarpong NO, Forrester LA, Levine WN. What's Important: Redeployment of the  
24 Orthopaedic Surgeon During the COVID-19 Pandemic: Perspectives from the Trenches. *J Bone*  
25 *Joint Surg Am* 2020 doi: 10.2106/JBJS.20.00574 [published Online First: 2020/04/15]  
26  
27 92. Schull MJ, Stukel TA, Vermeulen MJ, et al. Effect of widespread restrictions on the use  
28 of hospital services during an outbreak of severe acute respiratory syndrome. *Canadian Medical*  
29 *Association Journal* 2007;176(13):1827-32. doi: 10.1503/cmaj.061174  
30  
31 93. Schwarzkopf R, Maher NA, Slover JD, et al. The Response of an Orthopedic Department  
32 and Specialty Hospital at the Epicenter of a Pandemic: The NYU Langone Health Experience. *J*  
33 *Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.041 [published Online First: 2020/05/08]  
34  
35 94. Scullen T, Mathkour M, Maulucci CM, et al. Impact of the COVID-19 Pandemic on  
36 Neurosurgical Residency Training in New Orleans. *World Neurosurg* 2020 doi:  
37 10.1016/j.wneu.2020.04.208 [published Online First: 2020/05/08]  
38  
39 95. Seese L, Aranda-Michel E, Sultan I, et al. Programmatic Responses to the Coronavirus  
40 Pandemic: A Survey of 502 Cardiac Surgeons. *Ann Thorac Surg* 2020 doi:  
41 10.1016/j.athoracsur.2020.04.014 [published Online First: 2020/05/04]  
42  
43 96. Sethi A, Swaminath A, Latorre M, et al. Donning a New Approach to the Practice of  
44 Gastroenterology: Perspectives From the COVID-19 Pandemic Epicenter. *Clin Gastroenterol*  
45 *Hepatol* 2020 doi: 10.1016/j.cgh.2020.04.032 [published Online First: 2020/04/25]  
46  
47 97. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences  
48 and Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*  
49 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First: 2020/04/29]  
50  
51 98. Shih KC, Wong JKW, Lai JSM, et al. The case for continuing elective cataract surgery  
52 during the COVID-19 pandemic. *J Cataract Refract Surg* 2020 doi:  
53 10.1097/j.jcrs.000000000000225 [published Online First: 2020/05/06]  
54  
55 99. Shokri T, Lighthall JG. Telemedicine in the Era of the COVID-19 Pandemic:  
56 Implications in Facial Plastic Surgery. *Facial Plast Surg Aesthet Med* 2020;22(3):155-56. doi:  
57 10.1089/fpsam.2020.0163 [published Online First: 2020/04/18]  
58  
59 100. Sobel D, Gn M, O'Rourke TK, Jr., et al. Personal Protective Equipment for Common  
60 Urologic Procedures Before and During the United States COVID-19 Pandemic: A Single  
Institution Study. *Urology* 2020 doi: 10.1016/j.urology.2020.04.083 [published Online First:  
2020/05/08]



101. Sun Y, Mao Y. Editorial. Response to COVID-19 in Chinese neurosurgery and beyond. *Journal of neurosurgery* 2020;1-2. doi: 10.3171/2020.3.JNS20929
102. National Clinical Programme in Surgery. Surgical Patient Flow During COVID-19 Pandemic, 2020.
103. Tan TK. How severe acute respiratory syndrome (SARS) affected the department of anaesthesia at Singapore General Hospital. *Anaesth Intensive Care* 2004;32(3):394-400. doi: 10.1177/0310057x0403200316 [published Online First: 2004/07/22]
104. Tan YQ, Wu QH, Chiong E. Preserving Operational Capability While Building Capacity During the COVID-19 Pandemic: A Tertiary Urology Centre's Experience. *Urology* 2020 doi: 10.1016/j.urology.2020.04.079 [published Online First: 2020/05/04]
105. Tan YT, Wang JW, Zhao K, et al. Preliminary Recommendations for Surgical Practice of Neurosurgery Department in the Central Epidemic Area of 2019 Coronavirus Infection. *Curr Med Sci* 2020;40(2):281-84. doi: 10.1007/s11596-020-2173-5 [published Online First: 2020/03/29]
106. Tay K, Kamarul T, Lok WY, et al. COVID-19 in Singapore and Malaysia: Rising to the Challenges of Orthopaedic Practice in an Evolving Pandemic. *Malays Orthop J* 2020;14(2) doi: 10.5704/MOJ.2007.001 [published Online First: 2020/04/22]
107. Tay KJD, Lee YHD. Trauma and orthopaedics in the COVID-19 pandemic: breaking every wave. *Singapore Med J* 2020 doi: 10.11622/smedj.2020063 [published Online First: 2020/04/22]
108. Thaler M, Khosravi I, Hirschmann MT, et al. Disruption of joint arthroplasty services in Europe during the COVID-19 pandemic: an online survey within the European Hip Society (EHS) and the European Knee Associates (EKA). *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1712-19. doi: 10.1007/s00167-020-06033-1 [published Online First: 2020/05/04]
109. Tolone S, Gambardella C, Bruscianno L, et al. Telephonic triage before surgical ward admission and telemedicine during COVID-19 outbreak in Italy. Effective and easy procedures to reduce in-hospital positivity. *Int J Surg* 2020;78:123-25. doi: 10.1016/j.ijsu.2020.04.060 [published Online First: 2020/05/04]
110. Too CW, Wen DW, Patel A, et al. Interventional Radiology Procedures for COVID-19 Patients: How we Do it. *Cardiovasc Intervent Radiol* 2020;43(6):827-36. doi: 10.1007/s00270-020-02483-9 [published Online First: 2020/04/29]
111. Topf MC, Shenson JA, Holsinger FC, et al. Framework for prioritizing head and neck surgery during the COVID-19 pandemic. *Head Neck* 2020;42(6):1159-67. doi: 10.1002/hed.26184 [published Online First: 2020/04/17]
112. Tsui KL, Li SK, Li MC, et al. Preparedness of the cardiac catheterization laboratory for severe acute respiratory syndrome (SARS) and other epidemics. *J Invasive Cardiol* 2005;17(3):149-52. [published Online First: 2005/05/04]
113. Tzeng C-WD, Tran Cao HS, Roland CL, et al. Surgical decision-making and prioritization for cancer patients at the onset of the COVID-19 pandemic: A multidisciplinary approach. *Surgical Oncology* 2020;34:182-85. doi: 10.1016/j.suronc.2020.04.029
114. Unal EU, Mavioglu HL, Iscan HZ. Vascular surgery in the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.480 [published Online First: 2020/04/29]
115. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic. *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published Online First: 2020/04/15]

- 1  
2  
3 116. Valenza F, Papagni G, Marchiano A, et al. Response of a comprehensive cancer center to  
4 the COVID-19 pandemic: the experience of the Fondazione IRCCS-Istituto Nazionale dei  
5 Tumori di Milano. *Tumori* 2020;300891620923790. doi: 10.1177/0300891620923790 [published  
6 Online First: 2020/05/05]  
7  
8 117. van de Haar J, Hoes LR, Coles CE, et al. Caring for patients with cancer in the COVID-  
9 19 era. *Nat Med* 2020;26(5):665-71. doi: 10.1038/s41591-020-0874-8 [published Online First:  
10 2020/05/15]  
11 118. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of  
12 oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy  
13 region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi:  
14 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]  
15 119. Vlantis AC, Tsang RK, Wong DK, et al. The impact of severe acute respiratory syndrome  
16 on otorhinolaryngological services at the Prince of Wales Hospital in Hong Kong. *Laryngoscope*  
17 2004;114(1):171-4. doi: 10.1097/00005537-200401000-00032 [published Online First:  
18 2004/01/08]  
19 120. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-  
20 Being, 2020.  
21 121. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a  
22 waiting list for thoracic surgery during the outbreak of Severe Acute Respiratory  
23 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013  
24 122. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during  
25 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*  
26 *Experimental Ophthalmology* 2020;38(3):200-03. doi:  
27 http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100  
28 123. Wasser LM, Assayag E, Tessler M, et al. Response of ophthalmologists in Israel to the  
29 novel coronavirus (2019-nCoV) outbreak. *Graefes Arch Clin Exp Ophthalmol* 2020 doi:  
30 10.1007/s00417-020-04694-9 [published Online First: 2020/04/30]  
31 124. Williams AM, Kalra G, Commiskey PW, et al. Ophthalmology Practice During the  
32 Coronavirus Disease 2019 Pandemic: The University of Pittsburgh Experience in Promoting  
33 Clinic Safety and Embracing Video Visits. *Ophthalmol Ther* 2020;1-9. doi: 10.1007/s40123-  
34 020-00255-9 [published Online First: 2020/05/08]  
35 125. Wong J, Goh QY, Tan Z, et al. Preparing for a COVID-19 pandemic: a review of  
36 operating room outbreak response measures in a large tertiary hospital in Singapore. *Canadian*  
37 *Journal of Anesthesia/Journal canadien d'anesthésie* 2020;67(6):732-45. doi: 10.1007/s12630-  
38 020-01620-9  
39 126. Wu V, Noel CW, Forner D, et al. Considerations for head and neck oncology practices  
40 during the coronavirus disease 2019 (COVID-19) pandemic: Wuhan and Toronto experience.  
41 *Head Neck* 2020;42(6):1202-08. doi: 10.1002/hed.26205 [published Online First: 2020/04/28]  
42 127. Zangrillo A, Beretta L, Silvani P, et al. Fast reshaping of intensive care unit facilities in a  
43 large metropolitan hospital in Milan, Italy: facing the COVID-19 pandemic emergency. *Crit*  
44 *Care Resusc* 2020 [published Online First: 2020/04/02]  
45 128. Zarzaur BL, Stahl CC, Greenberg JA, et al. Blueprint for Restructuring a Department of  
46 Surgery in Concert With the Health Care System During a Pandemic: The University of  
47 Wisconsin Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1386 [published Online  
48 First: 2020/04/15]  
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3 129. Zeng L, Su T, Huang L. Strategic plan for management in oral and maxillofacial surgery  
4 during COVID-19 epidemic. *Oral Oncol* 2020;105:104715. doi:  
5 10.1016/j.oraloncology.2020.104715 [published Online First: 2020/04/20]  
6  
7 130. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular  
8 diagnosis and treatment in gastrointestinal surgery department during the outbreak of  
9 coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-  
10 26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]  
11  
12 131. Zizzo M, Bollino R, Castro Ruiz C, et al. Surgical management of suspected or  
13 confirmed SARS-CoV-2 (COVID-19)-positive patients: a model stemming from the experience  
14 at Level III Hospital in Emilia-Romagna, Italy. *Eur J Trauma Emerg Surg* 2020 doi:  
15 10.1007/s00068-020-01377-2 [published Online First: 2020/04/30]  
16  
17 132. Zoia C, Bongetta D, Veiceschi P, et al. Neurosurgery during the COVID-19 pandemic:  
18 update from Lombardy, northern Italy. *Acta Neurochir (Wien)* 2020;162(6):1221-22. doi:  
19 10.1007/s00701-020-04305-w [published Online First: 2020/03/31]  
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## BACKGROUND

The novel coronavirus (COVID-19) has spread across the globe with unrelenting speed. At the time of writing over 4 million cases have been confirmed, among them more than 200,000 fatalities<sup>1</sup>. In addition to protecting those most vulnerable in our societies, efforts to curb further disease escalation (e.g., travel restrictions, physical distancing measures) have had a focal objective: prevent case surges that could overwhelm healthcare institutions or further aggravate existing shortages in personal protective equipment (PPE), ventilators, and hospital capacity.

Medical institutions have themselves also taken steps to maximize the availability of staff, PPE, ventilators and intensive care unit (ICU) capacity in the case that external ‘curve flattening’ practices are not sufficient. Most notably, surgical programs have suspended non-urgent (or elective) surgical procedures, often defined as procedures for which a delay of three (3) months or longer would not result in any significant adverse effect to the patient<sup>2,3</sup>. These changes span nearly all surgical specialties from oncology to orthopedics and have thrust patients, providers and programs into previously unexplored territory.

While the governing bodies of surgical practice have recommended alterations to non-urgent surgical service delivery, they have not always provided explicit instructions on how programs should approach the change. As such, different groups have likely taken different approaches to surgical triage and service delivery and it remains unclear who has done what where, and why? Further, the impacts of postponing non-urgent surgeries on the physical, psychological, emotional and professional well-being of patients and practitioners are either anecdotal or unknown<sup>4</sup>. Lastly, as COVID-19 begins to release its grip on the world and a level of post-pandemic normalcy returns, programs will be tasked with rebuilding the surgical capacity necessary to reschedule and resume postponed procedures. Evidence on the experiences of other

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3 groups doing so in the context of COVID-19 and other public health emergencies (i.e., H1N1,  
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5 Ebola, SARS) will be paramount in guiding subsequent approaches.  
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8 To address the aforementioned knowledge gaps, we will conduct a rapid review of the  
9  
10 literature to synthesize evidence on how surgical resources were allocated in response to  
11  
12 COVID-19 and other public health emergencies, how these reallocations impacted patients,  
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14 practitioners and broader health systems, and what approaches have been taken to rebuild,  
15  
16 reorganize and resume surgical service delivery. This review will not only help explain how  
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18 international surgical programs responded to this unprecedented emergency and what the  
19  
20 consequences were, but will also provide the evidence-base necessary to guide responses to this  
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22 current and any future pandemic event.  
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## 28 **METHODS**

### 29 **Study Design**

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33 The planned review will answer three questions: (1) How have surgical resources been  
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35 allocated in response to COVID-19, (2) What are the patient- and system-level consequences of  
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37 reorganizing surgical resources, and (3) How have resources been reorganized to resume surgical  
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39 services? We will focus on surgeries identified as “elective” or “non-urgent”. However, to avoid  
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41 limiting study eligibility unnecessarily no set definition for this term will be used and we will  
42  
43 instead report the definition used by each included study.  
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### 49 **Search Strategy**

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51 An electronic search strategy was developed by the investigators (CO, KS) prior to being  
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53 reviewed and refined by collaborators with context expertise in surgery and literature review  
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3 (JNK, AKR). The search strategy includes subject headings, keywords and synonyms identifying  
4 the public health emergencies of interest as well as the surgical specialties likely affected by  
5 COVID-19 (Appendix A). Headings and keywords were adapted for use in each database. Given  
6 the diversity of the research questions related to this review no study design or publication type  
7 constraints will be applied to the search. Further, since (by definition) the impacts of a pandemic  
8 span many countries, no language restrictions will be applied. However, to deliver on the study  
9 objectives in a timely fashion, studies not easily translated by members of the research team will  
10 be subsequently excluded from the review.  
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22 We will conduct comprehensive searches of Ovid MEDLINE (including Epub Ahead of  
23 Print, In-Process & Other Non-Indexed Citations) and EMBASE from database inception  
24 onwards. Since much of the information related to the questions of this review is likely  
25 unpublished (i.e., joint statements, recommendations and guidelines from surgical colleges) we  
26 will also complete a detailed grey literature search. An *a priori* designed plan for this search has  
27 been developed (Appendix B) and will follow methodological recommendations by including  
28 targeted website searching, advanced and general Google searching and contact with knowledge  
29 experts<sup>5</sup>. Further, the reference lists from all included studies will be examined for any additional  
30 relevant studies not captured in the formal database and grey literature searches.  
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#### 44 **Study Selection**

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46 In accordance with recommendations from the Cochrane Methods Group and World  
47 Health Organization Alliance for Health Policy and Systems Research, the titles and abstracts of  
48 all retrieved items will be reviewed by one of two independent researchers (CO, KM) with a  
49 third, independent researcher (KS) serving as duplicate reviewer for a random 25% sample of all  
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3 references<sup>6,7</sup>. Eligibility criteria varies such that the relevance of studies is determined by the  
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5 research question to which they pertain. For the first question on how surgical resources have  
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7 been allocated we will include any study that examines or discusses organization of surgical  
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9 resources and patients during COVID-19 or other public health emergency (i.e., triage criteria,  
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11 allocation of hospital resources if they include surgery, PPE for the operating room staff). To  
12  
13 address the second question – consequences of reorganizing surgical resources- we will include  
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15 any studies that examine patient- and/or system-level surgical outcomes during COVID-19 or  
16  
17 other public health emergencies (i.e., adverse events, length of stay, ICU admissions). Lastly, to  
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19 determine how resources have been organized to resume non-urgent surgical services we will  
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21 include any study that examines resuming surgical services after COVID-19 or another public  
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23 health emergency.  
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29 Full texts of studies not excluded in the title and abstract phase will then be reviewed in  
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31 duplicate by the same researchers to ensure applicability to any of the research questions. Any  
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33 articles identified as meeting the pre-specified eligibility criteria at this stage will be included in  
34  
35 the final review. Interrater agreement on inclusion for the 25% sample of titles and abstracts  
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37 reviewed in duplicate as well as the full texts will be measured with a Cohen's kappa ( $\kappa$ ) statistic  
38  
39 and corresponding 95% confidence interval. At all stages of the review an unbiased third party  
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41 will be available to resolve any sustained disagreements between reviewers. The full study  
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43 selection process including reasons for full text exclusions will be reported using a Preferred  
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45 Reporting Items for Systematic Reviews and Meta-Analyses flow diagram<sup>8</sup>.  
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## 51 **Outcomes of Interest**

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3 Study information will be collected to answer the research questions of steps taken to  
4 respond to emergencies and rebuild capacity (see data extraction section below), but these  
5 questions are not outcome oriented and as such specific outcomes data for these questions will  
6 not be collected. However, the second research question surrounding the consequences of  
7 altering non-urgent surgical programming will require the collection of both quantitative and  
8 qualitative outcomes in order to provide the desired holistic understanding of impacts.  
9 Specifically, we will assess patient-level outcomes including the incidence of adverse events  
10 (i.e., negative event leading to patient harm and caused by management (or lack thereof) rather  
11 than the underlying condition of the patient), mortality, and quotes discussing emotional and  
12 psychological impacts of delays. We will also evaluate impacts on the healthcare system using  
13 measures of resource utilization such as number of emergency department visits, number of  
14 visits to a healthcare provider, length of hospital or ICU stay, as well as qualitative statements  
15 from practitioners and hospital administrators.  
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### 35 **Data Extraction**

36 Any relevant study and outcome data will be extracted from included studies by one  
37 researcher using a standardized data abstraction form. For all studies this form will guide the  
38 collection of information including date of publication, country where study was conducted,  
39 study design, definition of elective or non-urgent surgery, and characteristics of study sample (if  
40 applicable). The data extraction form is also designed to collect information specific to each of  
41 the three research questions such as selected surgical triage criteria, patient and health system-  
42 level outcomes, and detailed emergency response plans. A second independent researcher will  
43 review all data abstraction forms to verify their completion and accuracy.  
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### **Study Quality (Risk of Bias) Assessment**

This rapid review will aim to synthesize quantitative outcomes whenever possible but will largely involve scoping the available evidence on surgical service delivery during public health emergencies. Given this broad aim and the decision to include all study designs, quality appraisal for the included studies is not feasible and will not be performed.

### **Data Synthesis, Analysis and Reporting**

Study and sample information will be described in a narrative review and summarized in a data table. We do not anticipate being able to conduct a meta-analysis of quantitative outcomes and will instead synthesize outcomes data qualitatively with support from descriptive statistics whenever possible. Any summary tables for outcomes will be stratified by the three research questions to maximize clarity. Any within-study comparisons (e.g., incidence of adverse events in patients with delayed versus non-delayed surgery) will be considered significant at a two-tailed p-value <0.05.

### **Ethics and Dissemination**

This review will only include secondary data sources and as such there are no applicable ethical considerations. Following completion, this review will become an integral part of evidence-based guidelines to support decisions about allocating resources and organizing surgical care in the era of COVID-19 and during subsequent public health emergencies. The rapid review will also be submitted to peer-reviewed journals to reach the target audiences of patients, policy makers, practitioners and surgical program administrators.

## Limitations

The rapidly evolving nature of surgical programming during the COVID-19 situation demands an equally rapid synthesis and dissemination of key evidence. A rapid review therefore supersedes a traditional systematic review, but with this decision come methodological limitations. First, it is possible that much of the identified evidence emerges from non-traditional sources and grey literature and as a result, may be of a lower methodological quality than that from peer-reviewed sources. However, the goal of this review is not to evaluate quantitative outcomes at potential risk of bias but to instead collate the diversity of available information from surgical programs worldwide to inform decision-making. As such the potential negative impacts of lower study quality are of less concern. Secondly, the landscape of evidence specific to COVID-19 changes daily. While the selection of a set date for literature search is important for reporting and review reproducibility, it may lead to the omission of relevant information released beyond this date. We believe, however, that a current date selected for the literature search will span a period of time where some countries are in the process of recovering their surgical services while others remain in the throes of the pandemic. This will maximize the chances that sufficient evidence to answer all research questions is up to date and available.

## CONCLUSION

This paper describes the methodology for a planned rapid review that will synthesize evidence on the changes to, impacts of, and recovery of non-urgent surgical service delivery during COVID-19 and other public health emergencies. As post-pandemic normalcy begins to return and non-urgent surgeries resume, the evidence from this review will inform

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3 recommendations for allocating and organizing care while mitigating any potential negative  
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5 impacts resulting from changes in service delivery.  
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For peer review only

## References

1. Johns Hopkins University Resource Center. Coronavirus COVID-19 global cases. Accessed May 6, 2020. <https://coronavirus.jhu.edu/map.html>
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures. March 13, 2020. Accessed May 13, 2020. [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.aspx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.aspx)
3. Shared Health Manitoba. COVID-19 Provincial guidance on management of elective surgery. March 25, 2020. Accessed May 13, 2020. <https://sharedhealthmb.ca/files/covid-19-elective-surgery.pdf>
4. Tam DY, Naimark D, Sander B, Barrett K, Khan YA, Mac S, et al. COVID-19: Predicting consequences of curtailing outpatient scheduled cardiac procedures in the face of COVID healthcare resource needs in Ontario. 2020.
5. Godin K, Stapleton J, Kirkpatrick SI, Hanning RH, Leatherdale ST. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Systematic Reviews*. 2015;4:138-162.
6. Garrity C, Gartlehner G, Kamel C, King VJ, Nussbaumer-Streit B, et al. Cochrane Rapid Reviews: Interim guidance from the Cochrane Rapid Reviews Methods Group. March 2020.
7. Tricco AC, Langlois EV, Strauss SE, editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.
8. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Review and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*. 2009;6(7):e10000097.

## Appendices

### Appendix A: Ovid MEDLINE Electronic Search Strategy

#### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

##### Search Strategy:

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- 1 exp Disease Outbreaks/ (96117)
- 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
- 3 1 or 2 (231940)
- 4 exp Coronavirus (13456)
- 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
- 6 Coronaviridae Infections/ (900)
- 7 coronaviridae/ or coronavirus/ (3916)
- 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
- 9 Hemorrhagic Fever, Ebola/ (5316)
- 10 SARS Virus/ (3038)
- 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
- 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
- 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
- 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
- 15 (coronavir\*) adj2 (infection\*).mp. (8441)
- 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
- 17 General Surgery/ (38626)
- 18 Orthopedic Procedures/ (25371)
- 19 Traumatology/ (3474)
- 20 Neurosurgery/ (14892)
- 21 Obstetrics/ (22533)
- 22 Anesthesia/ (62587)
- 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
- 24 exp Arthroplasty, Replacement/ (54362)
- 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
- 26 (surger\* or operation\* or procedure\*).mp. (3638036)
- 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
- 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
- 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)

30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)  
31 3 and 16 and 30 (2075)

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## Appendix B: Grey Literature Search Plan

### GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms  
“coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery”  
OR “guidelines”)

#### NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

#### GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

#### GENERAL SURGICAL GROUPS/COLLEGES

Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)

American College of Surgeons (<https://www.facs.org>)

European Surgical Association (<https://www.europeansurgicalassociation.org>)

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2  
3 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
4 French Surgical Association  
5 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
6 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
7 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
8 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
9 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
10 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
11 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
12 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
13 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
14 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
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18 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
19 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
20 OR “Surgery” OR “non-urgent” OR “guidelines”  
21

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23 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
24 past last click for relevance.  
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26 STEP 4) Contact with Knowledge Experts.  
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## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Page 1: Title
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 3: Abstract
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Pages 5,6: Introduction
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 6: Introduction
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Not registered given rapid nature of review.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 8: Methods- Study Eligibility
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 6: Methods- Search Strategy
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix A
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Pages 7.8: Methods- Study Selection
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 9: Methods- Data Extraction
Data items	11	List and define all variables for which data	Page 9: Methods-





SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		were sought and any assumptions and simplifications made.	Outcomes of Interest
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Page 10: Methods- Study Quality (ROB) Assessment
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 10: Methods- Data Synthesis, Analysis and Reporting
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Pages 10,11: Results- Search Results & Figure 1: PRISMA Flow chart
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Page 11: Results- Description of Studies & Table 1 (Individual) & Figure 2 (Summary)
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Table 1
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Pages 11-16: Results- Reorganization of Surgical Services & Impact of Reorganizing Surgical Services & Rebuild Surgical Capacity
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Pages 16 to 18: Discussion
Limitations	20	Discuss the limitations of the scoping review process.	Page 18, 19: Discussion
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Page 19: Discussion
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	NA

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.



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3 † A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g.,  
4 quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping  
5 review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).  
6 ‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the  
7 process of data extraction in a scoping review as data charting.  
8 § The process of systematically examining research evidence to assess its validity, results, and relevance before  
9 using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable  
10 to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used  
11 in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).  
12

13  
14 From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews  
15 (PRISMA ScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.  
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For peer review only



# BMJ Open

## Surgery & COVID-19: A rapid scoping review of the impact of the first wave of COVID-19 on surgical services

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043966.R2
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Date Submitted by the Author:	17-Feb-2021
Complete List of Authors:	O'Rielly, Connor; University of Calgary, Community Health Sciences Ng-Kamstra, Joshua; University of Calgary Cumming School of Medicine, Department of Critical Care Medicine Kania-Richmond, Ania; Alberta Health Services Dort, Joseph; University of Calgary, White, Jonathan; University of Alberta, Surgery Robert, Jill; Alberta Health Services Brindle, Mary; University of Calgary Cumming School of Medicine, Department of Pediatrics Sauro, Khara; University of Calgary Cumming School of Medicine,
<b>Primary Subject Heading</b>:	Surgery
Secondary Subject Heading:	Health services research
Keywords:	SURGERY, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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Manuscripts



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3 Surgery & COVID-19: A rapid scoping review of the impact of the first wave of COVID-19 on  
4 surgical services  
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38 Word Count: 4049 words  
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41 Keywords: public health emergency, surgical services, healthcare resource utilization, health  
42 services  
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3 **ABSTRACT (278/300 words)**  
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5 **Objectives:** To understand how surgical services have been reorganized during and following  
6 public health emergencies, particularly the first wave of the COVID-19 pandemic, and the  
7 consequences for patients, healthcare providers and healthcare systems.  
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14 **Design:** A rapid scoping review.  
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19 **Setting:** We searched the MEDLINE, Embase and grey literature sources for documents,  
20 memos, and press releases from governments and surgical organizations or associations.  
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26 **Participants:** Studies examining surgical service delivery during public health emergencies  
27 including COVID-19, and the impact on patients, providers and healthcare systems were  
28 included. Recommendations and guidelines were excluded.  
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35 **Primary and secondary outcome measures:** Primary outcomes were strategies implemented  
36 for the reorganization of surgical services. Secondary were the impacts of reorganization and  
37 resuming surgical services, such as; adverse events (including morbidity and mortality), primary  
38 care and emergency department visits, length of hospital and ICU stay, and changes to surgical  
39 waitlists.  
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49 **Results:** One hundred and thirty-two studies were included in this review; 111 described  
50 reorganization of surgical services, 55 described the consequences of reorganizing surgical  
51 services and six reported actions taken to rebuild surgical capacity in public health emergencies.  
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3 Reorganizations of surgical services were grouped under six domains: case selection/triage, PPE  
4 regulations and practice, workforce composition and deployment, outpatient and inpatient patient  
5 care, resident and fellow education, and the hospital or clinical environment. Service  
6 reorganizations led to large reductions in non-urgent surgical volumes, increases in surgical wait  
7 times, and impacted medical training (i.e., reduced case involvement) and patient outcomes (e.g.,  
8 increases in pain). Strategies for rebuilding surgical capacity were scarce, but focused on the  
9 availability of staff, PPE, and patient readiness for surgery as key factors to consider before  
10 resuming services.  
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24 **Conclusions:** Reorganization of surgical services in response to public health emergencies  
25 appears to be context-dependent and has far-reaching consequences that must be better  
26 understood in order to optimize future health system responses to public health emergencies.  
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## ARTICLE SUMMARY

### Strengths and limitations of the study:

- This rapid scoping review provides an exhaustive and rigorous summary of the academic and grey literature regarding modifications to surgical services in response to public health emergencies, especially the first wave of COVID-19.
- This study did not limit studies based on location or language of publication to ensure contributions from worldwide voices in the context of a worldwide pandemic.
- Both quantitative and qualitative outcomes were included, with a mix of inductive and deductive data abstraction approaches to provide a comprehensive understanding of surgical services during public health emergencies.
- Studies with potential relevance to this question are emerging at an unprecedented rate in response to the COVID-19 pandemic and as such, some may not be included in the current review.



## 1 INTRODUCTION

2 The novel SARS-CoV-2 (COVID-19) virus has spread across the globe with unrelenting  
3 speed. At the time of writing, over 88 million cases have been confirmed with 1.9M fatalities.<sup>1</sup>

4 To protect the most vulnerable in our societies, efforts to curb further escalation (e.g., travel  
5 restrictions, physical distancing) have had a focal objective: to prevent surges that could  
6 overwhelm healthcare including shortages in personal protective equipment (PPE), ventilators,  
7 and hospital capacity.

8 Medical institutions have taken steps to maximize staff, PPE, ventilators, and intensive  
9 care unit (ICU) capacity in case public health efforts to ‘flatten the curve’ are insufficient. Most  
10 notably, surgical programs have suspended non-urgent (or ‘elective’) surgical procedures. Non-  
11 urgent surgeries are often defined as procedures for which a delay of three months or longer  
12 would not result in significant adverse effects to the patient.<sup>2 3</sup> These changes have thrust  
13 patients, providers, and healthcare organizations into previously unexplored territory.

14 While governing bodies such as colleges and academies of surgery have made  
15 recommendations to alter surgical service delivery in response to COVID-19, they have not  
16 always provided explicit instructions on how programs should operationalize the  
17 recommendations. As such, approaches to surgical triage and service delivery remain unclear:  
18 who has done what where, and why? Further, the impacts of adopting these recommendations on  
19 surgical programs, and more importantly, the physical and psychological well-being of patients  
20 and healthcare providers have only been hypothesized.<sup>4</sup> Lastly, once COVID-19 begins to  
21 release its grip on the world and the post-pandemic recovery begins, programs will be tasked  
22 with rebuilding the surgical capacity necessary to reschedule and tackle the backlog of postponed  
23 procedures. Evidence distilled from the experiences of others in the context of COVID-19 and

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3 1 other public health emergencies (i.e., H1N1, Ebola, SARS) is needed to guide approaches to  
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5 2 surgical service delivery.  
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7  
8 3 To enable evidence-informed reorganization and resumption of non-urgent surgeries  
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10 4 during COVID-19 and for future public health emergencies, we conducted a rapid scoping  
11  
12 5 review to identify and map the available literature. Our objective was to understand how surgical  
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14 6 services have been reorganized during and following public health emergencies, particularly the  
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16 7 first wave of the COVID-19 pandemic, and the consequences of these changes for patients,  
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18 8 healthcare providers and healthcare systems.  
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## 24 10 **METHODS**

### 25 26 11 **Study Design**

27  
28 12 This scoping review followed the Joanna Briggs Institute methodology and Preferred  
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30 13 Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews  
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32 14 (PRISMA-ScR) checklist.<sup>5 6</sup> The rapidly evolving situation of the current COVID-19 pandemic  
33  
34 15 demanded a similarly rapid evidence synthesis. Therefore, methodological concessions  
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36 16 recommended by the World Health Organization and Cochrane guidance for rapid reviews were  
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38 17 made.<sup>7 8</sup> Specifically, following a pilot exercise involving triplicate review and consensus for 50  
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40 18 abstracts only a 25% random sample of the remaining abstracts were reviewed in duplicate.  
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42 19 Further, while language limitations were not applied to the search, manuscripts not written in  
43  
44 20 English that could not be translated by members of the research team were not eligible for data  
45  
46 21 extraction, although their references were still included. This review addressed three research  
47  
48 22 questions to achieve our objective: 1) How have surgical services been reorganized in response  
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50 23 to public health emergencies, especially the first wave of the COVID-19 pandemic? 2) What are  
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1 the patient-, healthcare provider-, and system-level consequences of reorganizing surgical  
2 services? and 3) What approaches have been used for resuming surgical services?

#### 4 **Search Strategy**

5 The search strategy was developed by two investigators (CO, KS) and refined by others  
6 with context expertise in surgery and literature review methodology (JNK, AKR). The search  
7 strategy included subject headings, keywords, and synonyms identifying public health  
8 emergencies in general and specific public health emergencies (Ebola, SARS-CoV1, H1N1,  
9 MERS), and surgery; and were tailored for each database (Appendix A). Given the exploratory  
10 nature of the review we did not filter by study design or publication type, and since the impacts  
11 of a pandemic spans many countries there were no language restrictions.

12 We used the search strategy to search MEDLINE (including Epub Ahead of Print, In-  
13 Process & Other Non-Indexed Citations) and Embase from inception until May 8, 2020.  
14 Anticipating pertinent information may not be published (i.e., joint statements,  
15 recommendations, and guidelines from surgical colleges) we supplemented the database search  
16 with a structured grey literature search including targeted website searching, advanced and  
17 general Google searching, and contact with knowledge experts (Appendix A).<sup>9</sup> The reference  
18 lists of included studies were screened for relevant studies not otherwise captured.

#### 19 **Study Selection**

20 Titles and abstracts were reviewed by one of two independent reviewers with a third,  
21 independent reviewer screening 25% of randomly selected references in duplicate. Full texts of  
22 studies considered potentially eligible at title/abstract screening phase by at least one reviewer

1 were reviewed in duplicate by two reviewers for eligibility. Any disagreement between  
2 reviewers at the full text screening phase was resolved through discussion and did not necessitate  
3 a third reviewer. If studies were excluded at the full text screening phase, the reason for  
4 exclusion was noted. Full text articles meeting eligibility criteria were included and data were  
5 abstracted using a standardized data abstraction form (Appendix B). At both stages of screening,  
6 a pilot sample of 50 articles were jointly reviewed by both reviewers to ensure reliable  
7 application of eligibility criteria between reviewers.

## 8

### 9 **Study Eligibility**

10 Studies were eligible for inclusion if they discussed alterations to surgical services during  
11 public health emergencies and reported: 1) reorganization of surgical services, 2) impact of  
12 reorganizing surgical services on patients, healthcare providers, or healthcare system or 3)  
13 approaches to resuming surgical capacity. Studies of any design or publication date were eligible  
14 for inclusion. Studies in any language were eligible, but consistent with rapid review methods,  
15 studies not easily translated by authors were excluded from the data synthesis, although citations  
16 are still provided. Studies were excluded if they described: only urgent interventions arising  
17 during a hospital admission (e.g., emergency tracheostomy, caesarean section), settings beyond  
18 in-patient acute care (e.g., outpatient clinics including dental clinics), changes to surgical service  
19 delivery not made in direct response to a public health emergency, and healthcare services not  
20 specifically related to surgical service.

21 Notably, our intention was to include guidelines that made recommendations regarding  
22 provision of surgical services; however, a high-quality review of guidelines was published<sup>10</sup>  
23 during the preparation of this review and as such, we chose to exclude guidelines.

1

## 2 **Data Extraction**

3 Data were abstracted by one reviewer, and verified by a second reviewer, using a  
4 standardized data abstraction form (Appendix B). Data included: date of publication, country,  
5 study design, definition of non-urgent surgery, characteristics of study sample (if applicable),  
6 outcomes of interest for the three research questions, detailed below.

## 8 **Outcomes of Interest**

9 Our primary outcomes were reorganization of surgical services, impact of reorganization  
10 and resuming surgical services. We intentionally included a broad array of outcomes and used an  
11 inductive approach to data abstraction to gain a comprehensive understanding of surgical  
12 services and the impact during public health emergencies.

13 We collected qualitative data from studies reporting on changes to surgical programming,  
14 conceptualized into five categories: changes to triage criteria or case selection, changes to PPE  
15 practices, workforce changes, changes to patient care, changes to resident and fellow education,  
16 and environmental changes. Qualitative and quantitative data on the impact of reorganization of  
17 surgical services was organized by impact on: patients, providers and healthcare system. To  
18 illustrate temporal changes, data preceding, during and after the precipitating event were  
19 collected whenever possible. Quantitative variables of interest included: adverse events  
20 (including morbidity and mortality), primary care and emergency department visits, number of  
21 hospital and ICU admissions, length of hospital and ICU stay, number of surgical procedures  
22 performed and number of procedures cancelled, care costs, and wait times for non-urgent  
23 surgery. Qualitative variables included narrative description of patient or physician experience,

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3 1 written descriptions of changes to physician remuneration, or comments surrounding surgical  
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5 2 waitlist composition. Qualitative data was also collected on details of efforts to rebuild capacity  
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8 3 to surgical services.  
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## 10 4 11 12 5 **Study Quality (Risk of Bias) Assessment** 13

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15 6 Given the aim of a rapid scoping review is not to appraise evidence but to map the  
16  
17 7 available literature,<sup>11</sup> quality appraisal of included studies was not performed.  
18

## 19 8 20 21 9 **Data Synthesis, Analysis and Reporting** 22

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24 10 Consistent with our objectives and scoping review methodology,<sup>12</sup> we did not to perform  
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26 11 quantitative analysis, but did use descriptive statistics to summarize quantitative outcomes. We  
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28 12 characterized and mapped the available emerging evidence using inductive thematic analysis.  
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31 13 Specifically, two authors (CO, KS) familiarized themselves with the included studies and,  
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33 14 throughout the data extraction process, continuously identified and specified recurrent themes  
34  
35 15 emerging from the data. This was a non-linear process that continued until both authors were  
36  
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38 16 satisfied that the selected themes represented all important aspects of the evidence. The  
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40 17 penultimate themes are presented. Data were synthesized and presented separately for each of the  
41  
42 18 three research questions.  
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## 44 19 45 46 47 20 **Patient and Public Involvement** 48

49 21 Patients and the public were not involved in study design, execution or interpretation.  
50  
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## 52 53 54 23 **RESULTS** 55 56 57 58 59 60

## 1 **Search Results**

2 A total of 3 013 unique scholarly articles and 106 sources of grey literature were  
3 identified, of which 702 were considered eligible for full text review. After full text review, 120  
4 studies and five documents from the grey literature were included. Screening of the reference  
5 lists of included articles led to seven additional studies being included for a total of 132 included  
6 studies. Thirty-seven studies contributed data to more than one of the research questions  
7 resulting in the qualitative synthesis of 111 studies assessing alterations to service delivery, 55  
8 studies evaluating the consequences of these changes, and six studies enumerating their  
9 procedures for rebuilding capacity (Table 1). The flow of evidence sources within the study is  
10 detailed in Figure 1. One Spanish language study was translated for inclusion,<sup>13</sup> but two studies  
11 could not be readily translated therefore they are not included in the synthesis.<sup>14 15</sup>

## 13 **Description of Studies**

14 The majority of included studies were published in 2020 about COVID-19 (87.9%,  
15 n=116); fewer studies were related to other public health emergencies: SARS (7.58%, n=10),  
16 Ebola (2.27%, n=3), H1N1(1.52%, n=2), and MERS (0.76%, n=1). Over two thirds of the  
17 included studies (74.2%) emerged from the countries hit earliest by COVID-19; China (14.4%,  
18 n=19), Singapore (8.33%, n=11), Italy (19.7%, n=26), and the USA (31.8%, n=41). While many  
19 studies described the experiences of their surgical departments as a whole, oncology (15.9%,  
20 n=21), orthopedics (13.6%, n=18), and neurosurgery (11.4%, n=15) were the specialties most  
21 prominently represented. Summaries of descriptive study information are shown in Figure 2.

## 23 **Reorganization of Surgical Service**

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3 1 A number of themes emerged from the 108 studies describing reorganization of surgical  
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5 2 services. Nearly all studies reported partial, with most reporting full cessation of non-urgent  
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7 3 surgeries at their centre, albeit with varying definitions of “non-urgent” (e.g., can be safely  
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9 4 postponed for 3 months) and “urgent” (e.g., patient would have adverse outcome if not  
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11 5 completed within 7 days). Changes to service delivery were focused on six domains: case  
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13 6 selection/triage, PPE regulations and practice, workforce composition and deployment,  
14  
15 7 outpatient and inpatient patient care, resident and fellow education, and the hospital or clinical  
16  
17 8 environment (Table 2). The three domains that were most frequently reported (case  
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19 9 selection/triage, patient care, and workforce) are described in greater detail below.  
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26 11 *1. Changes to Case Selection and Triage Procedures.* The countries and surgical specialties most  
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28 12 effected by pandemic-related changes to service delivery are described above; however, the issue  
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30 13 of which patients can safely undergo what surgical procedures was also discussed in the included  
31  
32 14 studies. We identified cancelling or postponing “non-urgent” surgeries was almost universal.  
33  
34 15 Most often hospitals cancelled surgeries via telephone or text message, but some studies  
35  
36 16 identified that patients initiated their own surgical cancellations due to concerns with safety and  
37  
38 17 nosocomial infection. While urgent surgeries were triaged according to routine practice, new  
39  
40 18 triage decisions were made for non-urgent (including oncology) procedures. Methods for triaging  
41  
42 19 non-urgent procedures varied across studies, from the use of guideline supported checklists of  
43  
44 20 eligible procedures to virtual multidisciplinary meetings where the treating surgeon presented  
45  
46 21 details of the case (e.g., patient characteristics, acuity, imaging) to a larger group representing  
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48 22 many surgical specialties to reach consensus on each case.  
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3 1 2. *Changes to Patient Care*. Sixty-two studies reported complete cessation or marked reduction  
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5 2 of in-person, non-urgent outpatient clinic visits. In these studies, only urgent patients and those  
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7 3 requiring post-operative suture or staple removal were granted in-person visits under strict  
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9 4 conditions including mask wearing, negative symptom check, history or temperature pre-  
10  
11 5 screening. Studies specific to COVID-19 almost universally filled the resulting care gap for  
12  
13 6 patients deemed “non-urgent” using telephone or video-based telemedicine. Interfaces used  
14  
15 7 include, but were not limited to Zoom, WeChat, Facetime, telephone, and SMS text messaging.  
16  
17 8 A reported advantage of telemedicine was the ability to not only follow-up with returning  
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19 9 patients but to also continue consultations and establish contact with new patients who would  
20  
21 10 require care when non-urgent surgeries resumed. While some admitted a historical reluctance to  
22  
23 11 transition to video-based telemedicine and reported early concerns with their ability to establish  
24  
25 12 secure connections with patients, frequently their worries faded with use and many reported  
26  
27 13 telemedicine would remain integrated in their practices beyond the pandemic.  
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35 15 3. *Changes to the Workforce*. Fourteen of the included studies describe changing the workforce  
36  
37 16 into a minimum of two teams; a “contaminated” team providing care to infected patients and a  
38  
39 17 “clean” team managing those not infected. When these teams were kept separate from one  
40  
41 18 another both inside and outside of the hospital setting, surgical departments were able to  
42  
43 19 continue managing the inevitable emergencies (as well as non-urgent procedures in some  
44  
45 20 settings) without cross contamination during the public health emergencies. New work rotations  
46  
47 21 and shift schedules were created to ensure this structure was sustainable, often with extra  
48  
49 22 healthcare providers designated to replace those with exposures and to provide adequate time off  
50  
51 23 to prevent burnout. This practice was only possible with wards, operating rooms, and pathways  
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1 (i.e. corridors, elevators) that are separated under the same “clean” and “contaminated”  
2 designation. In the most extreme case, entire hospitals were designated for each patient group, as  
3 was done by Singapore during SARS<sup>16</sup> and Italy during COVID-19.<sup>17</sup>

## 5 **Impact of Reorganizing Surgical Services**

6 Of the 55 studies with data relevant to this question, 42 were focused on changes in  
7 surgical volumes with six reporting changes to surgical waitlist time or composition, four  
8 underlining changes to resident and fellow involvement in surgery, and two showing changes in  
9 patient pain, anxiety, and depression. These recurring outcome measures are summarized below  
10 with data for all studies relevant to this question shown in Appendix C.

11  
12 *Changes in Surgical Volumes.* Thirty-seven studies provided data for this outcome, with 37.8%  
13 (n=14) reporting a greater than 75% reduction and 70.3% (n=26) reporting a greater than 50%  
14 reductions in their overall or site specific non-urgent surgical volumes (Figure 3a). Not all  
15 studies reported reductions; as one study from an oncology “hub” hospital in Italy reported a  
16 20% increase in their surgical volumes, likely due to more cases being diverted to their hospital  
17 during the COVID-19 pandemic.<sup>18</sup>

18  
19 *Changes in Resident/Fellow Involvement in Surgical Activities.* Four studies<sup>19-22</sup> reported on this  
20 outcome; two survey-based case series, one resident-level case study and one study containing  
21 both survey and case log data. The reductions in surgical involvement for residents are shown by  
22 quartile in Figure 3b.

1 *Changes to Waitlist Length and Composition.* Five studies<sup>23-27</sup> reported data for this outcome.  
2 One centre reported a 64% increase in length of their minor colorectal surgery waitlist<sup>26</sup> and  
3 another centre (head and neck oncological surgery program) reported a 500% increase in latency  
4 from diagnosis to surgery.<sup>27</sup> One study reported no waitlist deaths during the COVID-19  
5 pandemic<sup>25</sup> while another saw a small decrease in the number of weekly waitlist deaths.<sup>24</sup> A  
6 single study identified more patients leaving their renal transplantation waitlist due to mortality  
7 or clinical deterioration.<sup>23</sup>

8  
9 *Changes in Patient Pain, Anxiety, and Depression.* Two studies<sup>28 29</sup> reported pain, anxiety, and  
10 depression among more than half of waitlist patients; 42.1% experienced anxiety, and 26.3%  
11 experienced depression (Figure 3c). The leading reported cause of patient anxiety was a lack of  
12 knowledge about when their surgeries would be rescheduled. Other than a single study  
13 describing the negative financial effects of the COVID-19 pandemic,<sup>30</sup> impacts on healthcare  
14 providers and their practices were rarely discussed.

## 16 **Rebuild Surgical Capacity**

17 A total of seven studies reported the experience of rebuilding surgical capacity in their  
18 departments, hospitals, or systems; all studies referred to the COVID-19 pandemic. One study  
19 from China reported reopening non-urgent surgeries with close consideration of risk for imported  
20 transmission but did not provide further detail of triage or prioritization.<sup>31</sup> Among studies that  
21 changed their surgical triage practices, patients were prioritized for surgery based on procedure  
22 acuity or urgency (i.e., risk to patients if surgery were further delayed), resource intensity, and  
23 procedural complexity. Four studies<sup>32-35</sup> noted that prior to resuming non-urgent surgeries,

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3 1 availability of the staff, (Operating Room) ORs, PPE, and testing was necessary to prepare for a  
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5 2 large and complicated surgical backlog.  
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#### 4 **DISCUSSION**

5 This review identified over 3,000 evidence sources, 132 of which were included.

6 Approaches to reorganizing surgical services varied between studies and centers, but the  
7  
8 cancellation or postponement of non-urgent surgeries such as arthroplasty surgeries for chronic  
9  
10 joint pain, coronary artery bypass graft surgery for asymptomatic individuals, and primary  
11  
12 gastric bypass surgery was nearly universal.<sup>2</sup> The most frequently reported change to surgical  
13  
14 services was modified triage criteria for surgical cases, workforce, and approach to patient care.  
15  
16 Many studies reported a decrease in surgical volumes due to public health emergencies, while a  
17  
18 few reported the non-surgical impacts such as patient wellbeing or changes in healthcare  
19  
20 utilization beyond the surgical wards. Very few studies described their experience resuming  
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22 surgical services after a public health emergency.  
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35 The varied approaches to providing surgical services during a public health emergency  
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37 identified in this review illustrate that a “one size fits all” approach does not exist. Changes to  
38  
39 surgical services likely depends on the characteristics of specific centers and their patients. While  
40  
41 several guidelines have been published with recommendations on how to provide surgical care  
42  
43 during COVID-19, we chose to exclude guidelines and recommendations from this review for  
44  
45 two reasons: 1) a high quality review of surgical recommendations for the response to COVID-  
46  
47 19 was published by one of the authors just prior to this study<sup>10</sup> and 2) because there is abundant  
48  
49 evidence suggesting guidelines and recommendations for practice are frequently not  
50  
51 implemented into clinical practice.<sup>36-42</sup> Some of the guideline recommendations in the review by  
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3 1 Søreide et al.<sup>10</sup> were implemented within the included studies in the present review; such as  
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5 2 creating areas within-hospital for ‘clean’ and ‘contaminated’ cases and workforce redeployment  
6  
7 3 to critical care. However, other recommendations were infrequently noted, such as the dedicated  
8  
9 4 use of isolated, negative pressure ORs for patients with COVID-19. These resource intensive  
10  
11 5 practices may not have been attainable under the pressures of managing public health  
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13 6 emergencies and may not be feasible in low-resource settings.  
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19 8 Changes to surgical services, such as cancelling or postponing non-urgent surgeries may  
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21 9 be necessary to manage public health emergencies to reduce the risk of contamination and  
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23 10 increase capacity within hospitals. However, the impact of these changes remains poorly  
24  
25 11 understood. Many studies reported decreases in surgical volumes, but few other variables were  
26  
27 12 explored with regards to the impact on patients, providers, and healthcare systems. Five studies  
28  
29 13 examined the impact of changes to surgical services among physicians and trainees, and found  
30  
31 14 that training was compromised in some specialties.<sup>19-22</sup> The finding that medical training was  
32  
33 15 compromised is particularly important for understanding the downstream and long-term  
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35 16 repercussions of the response to public health emergencies; decreases in surgical volumes and  
36  
37 17 clinical hours for trainees could have negative and unintended effects on the future quality and  
38  
39 18 safety of patient care.<sup>43</sup> Notably, the impacts of public health emergencies on medical training  
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41 19 and education were almost exclusively evaluated for residents and fellows, failing to consider the  
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43 20 limited access that current medical undergraduate students continue to encounter when trying to  
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45 21 explore surgical specialties. This is unlikely to affect the quality of patient care but may present  
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47 22 later in the form of decreased career satisfaction and engagement, both of which have been  
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49 23 associated with burnout<sup>44</sup>. Studies examining the effects of surgical service alterations on  
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1 patients noted negative effects on mental health outcomes,<sup>28 29</sup> pain,<sup>28</sup> and an increased incidence  
2 of death among surgical patients.<sup>23 24 45</sup>

3       Very few studies described specific actions undertaken to rebuild and resume pre-public  
4 health emergencies surgical capacity. This may be due to the fact that most included studies  
5 examined the ongoing COVID-19 pandemic, or because few places have implemented specific  
6 plans to date. Included studies did describe consideration of system-level factors like availability  
7 of PPE and ORs. However, more patient-centric considerations such as organizing childcare and  
8 requesting time away from their job during a pandemic, are needed. Additionally, research  
9 suggesting that surgical capacity can be rebuilt with sufficient PPE and OR space may be falling  
10 victim to the lack of identified evidence exploring the wellbeing of the surgical workforce.  
11 Resolving surgical backlogs by increasing available resources relies on the high functioning of a  
12 workforce of surgeons and allied practitioners not overtaken by burnout and stress, something  
13 that has not yet been borne out in the COVID-19 research. In other specialties involved with the  
14 care of surgical patients, moral distress has seen a marked increase making it reasonable to  
15 believe these same emotional impacts will be felt by members or surgical teams globally. Patient  
16 perspectives will also play a role in the rebuild; one study reported 14% of surgical patients  
17 initiated the cancellation of their surgery,<sup>28</sup> which suggests patient readiness for surgery during-  
18 and post-COVID-19 should be considered. For evidence to inform policy, additional research is  
19 needed to understand the impacts of different approaches for resuming surgical services.

20  
21       This study is, to our knowledge, the first comprehensive scoping review of evidence  
22 around reallocation of surgical services during public health emergencies. While this study has  
23 several strengths, including a comprehensive search of academic and grey literature sources, and

1 a mix of inductive and deductive data abstraction approaches, there are some limitations that  
2 should be considered when interpreting our findings. We modified the Joanna Briggs  
3 methodology for scoping reviews,<sup>5</sup> according to the World Health Organization and Cochrane's  
4 guidance on conducting rapid reviews,<sup>7 8</sup> with the intent of balancing rigor with a timely and  
5 policy-responsive review of the literature. Also, given that the evidence around the COVID-19  
6 pandemic is growing at an unprecedented rate, we are aware that additional studies have been  
7 published since we ran our search strategy, especially around resuming surgical services. In  
8 order to mitigate this limitation, an ongoing effort to pivot this study into a living review is  
9 underway to ensure the data presented is up to date. This will involve re-running the MEDLINE,  
10 Embase and grey literature search strategies every 2 months in order to incorporate new evidence  
11 into the existing manuscript. Notably, this review did not identify evidence from any low- or  
12 middle-income countries who may face unique challenges during a pandemic compared to high  
13 income countries described in our review. It is also likely that during the global pandemic, many  
14 healthcare institutions have been focused on coping with COVID-19 instead of publishing their  
15 experiences; we hope more organizations will add their experience to the literature.

16  
17 In conclusion, we report early evidence of the operational changes that have occurred  
18 internationally in response to public health emergencies which could inform the ongoing  
19 response to COVID-19 and future public health emergencies. This study identified a gap in our  
20 understanding of the impact of these changes on patients, providers, and the healthcare system  
21 which should be the focus of research moving forward to provide an evidence-based approach to  
22 managing surgical patients in future public health emergencies.

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3 1 **Original protocol for the study:** The original unpublished protocol for this study is included as  
4  
5 2 a supplementary file (Appendix D).  
6

### 7 3 **Author Contributions**

8  
9  
10 4 CO contributed to the design and conceptualization of the review, analysis and interpretations of  
11  
12 5 the data, and drafting and revising the manuscript; JSN contributed to the design of the review,  
13  
14 6 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
15  
16 7 version of the manuscript; AKR contributed to the design of the review, interpretation of the  
17  
18 8 data, providing feedback on the manuscript, and gave approval of the final version of the  
19  
20 9 manuscript; JCD contributed to the interpretation of the data, providing feedback on the  
21  
22 10 manuscript, and gave approval of the final version of the manuscript; JW contributed to the  
23  
24 11 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
25  
26 12 version of the manuscript; JR contributed to the interpretation of the data, providing feedback on  
27  
28 13 the manuscript, and gave approval of the final version of the manuscript; MB contributed to the  
29  
30 14 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
31  
32 15 version of the manuscript; KMS contributed to the design and conceptualization of the review,  
33  
34 16 analysis and interpretations of the data, providing feedback on the manuscript, and gave approval  
35  
36 17 of the final version of the manuscript.  
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### 45 19 **Competing interest statement**

46  
47 20 All authors declare that they have no competing interests in accordance with the International  
48  
49 21 Committee of Medical Journal Editors uniform declaration of competing interests.  
50  
51  
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### 53 23 **Funding statement**

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1  
2  
3 1 This study did not receive grant from any funding agency in the public, commercial or not-for-  
4  
5 2 profit sectors.  
6

7  
8 3 **Data Sharing Statement**  
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10 4 All data presented have been previously published. Our data will be made available upon  
11  
12 5 reasonable request to the corresponding author.  
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50  
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60

## References

1. Johns Hopkins Center for Systems of Science and Engineering (CSSE). COVID-19 Dashboard. [Available from: <http://coronavirus.jhu.edu/map.html>] accessed January 8, 2020.
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures 2020 [Available from: [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.ashx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.ashx)] accessed July 2, 2020.
3. Shared Health Manitoba. COVID-19: The New Normal. [Available from: <https://sharedhealthmb.ca/files/covid-19-memo-the-new-normal.pdf>] accessed May 8, 2020.
4. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *British Journal of Surgery* 2020 doi: doi:10.1002/bjs.11746 [published Online First: 2020 May 12]
5. Peters MDJ, Godfrey CM, McInerney P, et al. Chapter 11: Scoping Reviews. In: E. A, Z. M, eds. Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute, 2017.
6. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018;169(7):467-73. doi: 10.7326/m18-0850 [published Online First: 2018/09/05]
7. Tricco AC, Langlois EV, Straus SE, Editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization, 2017. Licence: CC BY-NC-SA 3.0 IGO
8. Garritty C, Gartlehner G, Kamel C, et al. Cochrane Rapid Reviews. Interim Guidance from the Cochrane Rapid Review Methods Group., 2020.
9. Godin K, Stapleton J, Kirkpatrick SI, et al. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Syst Rev* 2015;4:138. doi: 10.1186/s13643-015-0125-0 [published Online First: 2015/10/27]
10. Soreide K, Hallet J, Matthews JB, et al. Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services. *Br J Surg* 2020 doi: 10.1002/bjs.11670 [published Online First: 2020/05/01]
11. Munn Z, Peters MDJ, Stern C, et al. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology* 2018;18(1):143. doi: 10.1186/s12874-018-0611-x
12. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 2005;8(1):19-32. doi: 10.1080/1364557032000119616
13. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
14. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*









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- Experimental Ophthalmology* 2020;38(3):200-03. doi:  
<http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100>
15. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular diagnosis and treatment in gastrointestinal surgery department during the outbreak of coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]
  16. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
  17. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19 pandemic: an expert opinion from China, South Korea, Italy, United States of America, Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2 [published Online First: 2020/04/30]
  18. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi: 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]
  19. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
  20. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
  21. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First: 2020/05/10]
  22. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published Online First: 2020/05/04]
  23. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]
  24. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online First: 2020/05/03]
  25. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int* 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]
  26. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]

- 1
- 2
- 3
- 4 27. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service disruption
- 5 during COVID-19 in Hong Kong through telehealth and multi-institutional collaboration.
- 6 *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]
- 7
- 8 28. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively
- 9 Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020
- 10 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]
- 11
- 12 29. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a waiting
- 13 list for thoracic surgery during the outbreak of Severe Acute Respiratory
- 14 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013
- 15
- 16 30. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic.
- 17 *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published
- 18 Online First: 2020/04/15]
- 19
- 20 31. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences and
- 21 Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*
- 22 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First:
- 23 2020/04/29]
- 24
- 25 32. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery
- 26 and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi:
- 27 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
- 28
- 29 33. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by
- 30 the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi:
- 31 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
- 32
- 33 34. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-Being,
- 34 2020.
- 35
- 36 35. BC Ministry of Health. A Commitment to Surgical Renewal in BC. Canada, 2020.
- 37
- 38 36. Ben-Menachem E, French JA. Guidelines--are they useful? *Epilepsia* 2006;47 Suppl 1:62-4.
- 39 doi: 10.1111/j.1528-1167.2006.00663.x [published Online First: 2006/10/19]
- 40
- 41 37. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice
- 42 guidelines? A framework for improvement. *Jama* 1999;282(15):1458-65. [published
- 43 Online First: 1999/10/27]
- 44
- 45 38. Farquhar C, Kofa E, Slutsky J. Clinicians' attitudes to clinical practice guidelines: a systematic
- 46 review. *Med J Aust* 2002;177:502-06.
- 47
- 48 39. Grimshaw JM, Russell IT. Effect of clinical guidelines on medical practice: a systematic
- 49 review of rigorous evaluations. *Lancet* 1993;342(8883):1317-22. [published Online First:
- 50 1993/11/27]
- 51
- 52 40. Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline
- 53 dissemination and implementation strategies. *Health technology assessment*
- 54 (*Winchester, England*) 2004;8(6):iii-iv, 1-72. [published Online First: 2004/02/13]
- 55
- 56 41. Lomas J, Anderson G, Domnick-Pierre K, et al. Do practice guidelines guide practice? The
- 57 effect of a consensus statement on the practice of physicians. *N Engl J Med*
- 58 1989;321(19):1306-11.
- 59
- 60 42. Lugtenberg M, Burgers JS, Westert GP. Effects of evidence-based clinical practice guidelines
- on quality of care: a systematic review. *Quality & safety in health care* 2009;18(5):385-
92. doi: 10.1136/qshc.2008.028043 [published Online First: 2009/10/09]





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3 43. Ahmed N, Devitt KS, Keshet I, et al. A systematic review of the effects of resident duty hour  
4 restrictions in surgery: impact on resident wellness, training, and patient outcomes. *Ann*  
5 *Surg* 2014;259(6):1041-53. doi: 10.1097/sla.0000000000000595 [published Online First:  
6 2014/03/26]  
7  
8 44. Rao S, Ferris TG, Hidrue MK, et al. Physician Burnout, Engagement and Career Satisfaction in  
9 a Large Academic Medical Practice. *Clin Med Res* 2020;18(1):3-10. doi:  
10 10.3121/cmr.2019.1516 [published Online First: 2020/01/20]  
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12 45. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic  
13 Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty*  
14 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]  
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**Table 1.** Description of included studies

Author	Year	Country	Public Health Emergency	Surgical Specialty	Changes to Surgical Services	Impact of Changes Examined	Resumption of Services
Alvarez-Gallego	2020	Spain	COVID-19	General			
Ammar	2020	USA	COVID-19	Neurosurgery			
Amparore	2020	Italy	COVID-19	Urology		Changes in clinical and surgical resident involvement	
Ansarin	2020	Italy	COVID-19	Oncology (Head & Neck)			
Bashir	2020	UK	COVID-19	Vascular			
Ben Abdallah	2020	France	COVID-19	Vascular			
Bernucci	2020	Italy	COVID-19	Neurosurgery		Changes in surgical volume	
Bettinelli	2020	Italy	COVID-19	Orthopedics			
Bolkan	2014	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bolkan	2018	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bourlon	2009	Mexico	H1N1	—		Number of surgical cancellations	

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Bradford	2003	China	SARS	GI		Changes in admissions and surgical volumes	
Brethauer	2020	USA	COVID-19	GI			Operative cases placed in “depot” to be rescheduled alongside new teleconsults
Brown	2020	USA	COVID-19	Orthopedics		Patient pain, anxiety and physical function	
Buckstein	2020	USA	COVID-19	Radiation Oncology			
Bundu	2016	Sierra Leone	Ebola	—		Changes in ED/ward admissions and surgical activity	
Burke	2020	USA	COVID-19	Neurosurgery			
Busin	2020	Italy	COVID-19	Ophthalmology		Changes in demand/donations for cornea bank	Set reasonable timelines for patients requiring low acuity surgery. Surgical work schedule extended into evenings and weekends
Cai	2020	USA	COVID-19	Otolaryngology		Changes in resident	

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							educational programming
Cakmak	2020	Turkey	COVID-19	Oncology (Breast)			Changes in surgical volume
Carenzo	2020	Italy	COVID-19	—			Changes in surgical volume
Cenzato	2020	Italy	COVID-19	Neurosurgery			
Chan	2006	China	SARS	Ophthalmology			
Chee	2004	Singapore	SARS	—			
Chew	2020	Singapore	COVID-19	General			
Chisci	2020	Italy	COVID-19	Vascular			Changes in surgical volume
Civantos	2020	USA	COVID-19	Oncology (Head & Neck)			Number of surgical cancellations
D'Apolito	2020	Italy	COVID-19	Orthopedics			Changes in surgical volume
de Vries	2020	Netherlands	COVID-19	Transplant			Changes in transplantation volumes
Ding	2020	Singapore	COVID-19	Orthopedics			
Dominguez-Gil	2020	Spain	COVID-19	Transplant			Changes in transplantation volumes
Doussot	2020	France	COVID-19	Oncology			Changes in surgical volume
Dowdell	2020	USA	COVID-19	Orthopedics			
Ducournau	2020	France	COVID-19	Plastics			
Eichberg	2020	USA	COVID-19	Neurosurgery			
Ficarra	2020	Italy	COVID-19	Urology			Proportion of surgical cancellations
















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							initiated by patients
Fontanella	2020	Italy	COVID-19	Neurosurgery			Changes in surgical volume
Fontanella	2020	Italy	COVID-19	Neurosurgery			
Giorgi	2020	Italy	COVID-19	Spinal			
Givi	2020	USA	COVID-19	Oncology (Head & Neck)			Changes in fellow educational programming
Gomez-Barrena	2020	Spain	COVID-19	Orthopedics			Changes in surgical volume
Gouveia	2020	Portugal	COVID-19	Vascular			
Guerci	2020	Italy	COVID-19	General			
Gupta	2020	India	COVID-19	Oncology (Head & Neck)			
Haines	2003	China	SARS	Obstetrics			
Hemingway	2020	USA	COVID-19	Vascular			Changes in clinical and surgical volumes
Hormati	2020	Iran	COVID-19	GI			
Hu	2020	China	COVID-19	Oncology			
Jean	2020	USA	COVID-19	Neurosurgery			Changes in surgical volume
Kempa	2020	Poland	COVID-19	Electrophysiology			Changes in surgical volume
Kessler	2020	USA	COVID-19	Neurosurgery			
Konda	2020	USA	COVID-19	Orthopedics			
Kuo	2010	Argentina	H1N1	Ophthalmology			Changes in clinical and surgical volumes
Lai	2020	China	COVID-19	Ophthalmology			
Lancaster	2020	USA	COVID-19	—			Changes in surgical volume

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Langer	2020	USA	COVID-19	Plastics		
Lauterio	2020	Italy	COVID-19	Transplant		Changes in transplantation volumes
Lee	2020	China	COVID-19	Oncology (Head & Neck)		Changes in surgical wait times
Leong Tan	2020	Singapore	COVID-19	Vascular		
Li	2020	China	COVID-19	Transplant		
Liebensteiner	2020	Austria	COVID-19	Orthopedics		
Liu	2003	Singapore	SARS	Anesthesia		
Mak	2020	China	COVID-19	Plastics		
Marti	2020	Spain	COVID-19	Oncology (Breast)		
Maurizi	2020	Italy	COVID-19	Thoracic		Changes in surgical volume
McBride	2020	Australia	COVID-19	—		
McMillan	2020	Canada	COVID-19	—		Prioritization first of patients who would be at increased risk with further delay, followed by those waiting longest
Meneghini	2020	USA	COVID-19	Orthopedics		
Meyer	2020	France	COVID-19	Neurosurgery		Changes in surgical volume
Morgan	2020	UK	COVID-19	Orthopedics		
Nair	2020	India	COVID-19	Ophthalmology		
Nassar	2020	USA	COVID-19	General		
Park	2020	USA	COVID-19	Otolaryngology		

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Park	2020	South Korea	MERS	—		Changes in surgical volume	
Patel	2020	USA	COVID-19	Oncology (Head & Neck)			
Patel	2020	USA	COVID-19	Otolaryngology			
Pelt	2020	USA	COVID-19	Orthopedics		Number of surgical postponements	Surgeries prioritized based on complexity and predicted LOS, scheduling only completed if appropriate PPE and screening available.
Pittet	2020	Switzerland	COVID-19	—		Changes in surgical volume	
Prachand	2020	USA	COVID-19	—		Number of surgical cancellations	
Price	2020	USA	COVID-19	Dermatology			
Qadan	2020	USA	COVID-19	Oncology (GI/Hepatobiliary)			
Ralli	2020	Italy	COVID-19	Otolaryngology			
Rampinelli	2020	Italy	COVID-19	Oncology (Head & Neck)		Changes in surgical volume	
Randelli	2020	Italy	COVID-19	Orthopedics			
Ricciardi	2020	Italy	COVID-19	Neurosurgery			
Ross	2020	USA	COVID-19	—		Changes in clinical volumes	

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Rubin	2020	USA	COVID-19	Electrophysiology		Changes in lab capacity and consultation volumes
Rubin	2020	USA	COVID-19	Electrophysiology		Changes in surgical volume
Salengar	2020	USA	COVID-19	Cardiac		
Sarpong	2020	USA	COVID-19	Orthopedics		Changes in surgical volume
Schull	2007	Canada	SARS	—		
Schwarzkopf	2020	USA	COVID-19	Orthopedics		Changes in surgical volume
Scullen	2020	USA	COVID-19	Neurosurgery		
Seese	2020	USA	COVID-19	Cardiac		
Sethi	2020	USA	COVID-19	GI		Changes in surgical and consultation volumes
Shen	2020	China	COVID-19	—		Scheduling resumed following consideration of reduced risk of imported transmission and growing waitlist
Shih	2020	China	COVID-19	Ophthalmology		
Shokri	2020	USA	COVID-19	Plastics		Changes in surgical volume
Sobel	2020	USA	COVID-19	Urology		









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Sun	2020	China	COVID-19	Neurosurgery		Emergency surgeries performed	
Tan	2004	Singapore	SARS	Anesthesia			
Tan	2020	Singapore	COVID-19	Urology		Changes in surgical and consultation volumes	
Tan	2020	China	COVID-19	Neurosurgery			
Tay	2020	Singapore	COVID-19	Orthopedics		Changes in surgical volumes	
Tay	2020	Singapore	COVID-19	Orthopedics			
Thaler	2020	Austria	COVID-19	Orthopedics			
Tolone	2020	Italy	COVID-19	—			
Too	2020	Singapore	COVID-19	Interventional Radiology			
Topf	2020	USA	COVID-19	Oncology (Head & Neck)			
Tsui	2005	China	SARS	Cardiac			
Tzeng	2020	USA	COVID-19	Oncology			
Unal	2020	Turkey	COVID-19	Vascular			
Vaccaro	2020	USA	COVID-19	Orthopedics		Changes in physician remuneration and staffing	
Valenza	2020	Italy	COVID-19	Oncology		Changes in surgical volumes	
van de Haar	2020	Netherlands	COVID-19	Oncology			
Various	2020	Canada	COVID-19	—		Number of surgical postponements	Calling patients to assess their ability to reschedule,







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contracting private facilities with focus on urgent surgeries, patients waiting twice their clinical benchmarks or surgeries with minimal LOS

Various	2020	Ireland	COVID-19	—			
Vicini	2020	Italy	COVID-19	Oncology (Breast)		Changes in surgical volumes	
Vlantis	2004	China	SARS	Otolaryngology		Changes in outpatient and surgical volumes	
Walker	2020	USA	COVID-19	—		Number of surgical cancellations	Assess readiness of staff to safely resume high volumes of surgery and ensured availability of rapid in-house testing
Wan	2004	China	SARS	Thoracic		Patient anxiety and depression	
Wasser	2020	Israel	COVID-19	Ophthalmology			

Williams	2020	USA	COVID-19	Ophthalmology		Number of surgeries rescheduled
Wong	2020	Singapore	COVID-19	Anesthesia		
Wu	2020	China	COVID-19	Oncology (Head & Neck)		
Xiaolei	2020	China	COVID-19	Ophthalmology		
Zangrillo	2020	Italy	COVID-19	—		
Zarzaur	2020	USA	COVID-19	—		
Zeng	2020	China	COVID-19	Oncology (Head & Neck)		
Zizzo	2020	Italy	COVID-19	—		
Zoia	2020	Italy	COVID-19	Neurosurgery		

Domains of change to surgical services, represented numerically:

-  Changes to case selection and surgical triage
-  Changes to PPE protocols and practices
-  Changes to the surgical workforce.
-  Changes to inpatient and outpatient care
-  Changes to resident and fellow education
-  Changes to the environment

*Abbreviations:* — =data not provided, COVID-19=Coronavirus Disease 2019, ED=Emergency department, GI=Gastrointestinal; LOS=Length of stay, PPE=Personal protective equipment, SARS=Severe Acute Respiratory Syndrome

**Table 2.** Reorganization of surgical services, by domain.

<b>Change Domain</b>	<b>Number of Studies (%)</b>	<b>Examples of Change</b>
Triage or Case Selection	80 (74.7)	<ol style="list-style-type: none"> <li>1. Prioritization of patients based on pre-defined levels of acuity;</li> <li>2. Virtual multidisciplinary meetings or tumor boards;</li> <li>3. Creation of specialty-specific lists outlining surgery-eligible and ineligible ailments, often with inclusion of case-by-case category.</li> <li>4. Postponement based on high-risk patient characteristics (i.e., older age, multimorbidity) and expected need for ICU.</li> </ol>
PPE	63 (58.3)	<ol style="list-style-type: none"> <li>1. Hospital wide surgical mask mandate for staff and attendees;</li> <li>2. Standard level of PPE outlined for all patient encounters with enhanced PPE (e.g., addition of N95 or PAPR, head and shoe covering) protocol for specific procedures or care of infected patients;</li> <li>3. Refresher instruction courses provided to all hospital staff;</li> <li>4. Trained observer supervising all perioperative donning and doffing of PPE to ensure safety and compliance.</li> </ol>
Workforce	70 (64.8)	<ol style="list-style-type: none"> <li>1. Separation of clinical staff into rotating “clean” and “dirty” teams caring for exclusively for non-infected and infected patients, respectively;</li> <li>2. Temperature and symptom screening of staff with mandated quarantine periods in cases of unprotected exposure;</li> <li>3. Case discussions, handover and clinical staff meetings transitioned to virtual format;</li> <li>4. Redeployment of staff to hospital areas requiring support (e.g., ICU), often paired with virtual training to ensure comfortable transition.</li> </ol>



Patient Care	95 (88.0)	<ol style="list-style-type: none"> <li>1. Complete cancellation or transition to telemedicine for all non-urgent and routine perioperative clinical visits;</li> <li>2. Patient temperature, symptom and travel history screening before entry to clinic (relevant for urgent surgical patients);</li> <li>3. Preference for endovascular or minimally invasive surgical approaches when possible, use of conservative care when possible (oncology);</li> <li>4. Restrictions on number of accompanying persons or visitors (often zero with some allowing maximum of 1).</li> </ol>
Resident/Fellow Education	35 (32.4)	<ol style="list-style-type: none"> <li>1. Changes to resident/fellow team structure and rotation schedules to ensure continued coverage of department and maximize resident/fellow safety;</li> <li>2. Redeployment of residents to non-specialty areas requiring clinical support;</li> <li>3. Curriculum and conferences shifted to online format to allow continued e-learning for off-duty trainees;</li> <li>4. Trainees involvement in surgical care of infected persons ceased or altered (e.g., only admitted to OR during low-risk/non-aerosolizing procedures).</li> </ol>
Environment	70 (64.8)	<ol style="list-style-type: none"> <li>1. Dedication of wards (hallways, elevators), ORs, or entire hospitals to treat for only those infected or not infected;</li> <li>2. Use of negative-pressure OR when possible;</li> <li>3. Transformation of surgical wards, ORs and outpatient clinics into patient care areas to increase surge capacity;</li> <li>4. Double occupancy patient rooms reduced to single occupancy, or</li> </ol>

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physical measures (e.g., cubicles, distanced waiting room chairs) implemented.

*Abbreviations:* ICU= Intensive care unit, PPE= Personal protective equipment, PAPR= Powered air purifying respirator, OR= Operating room.

For peer review only

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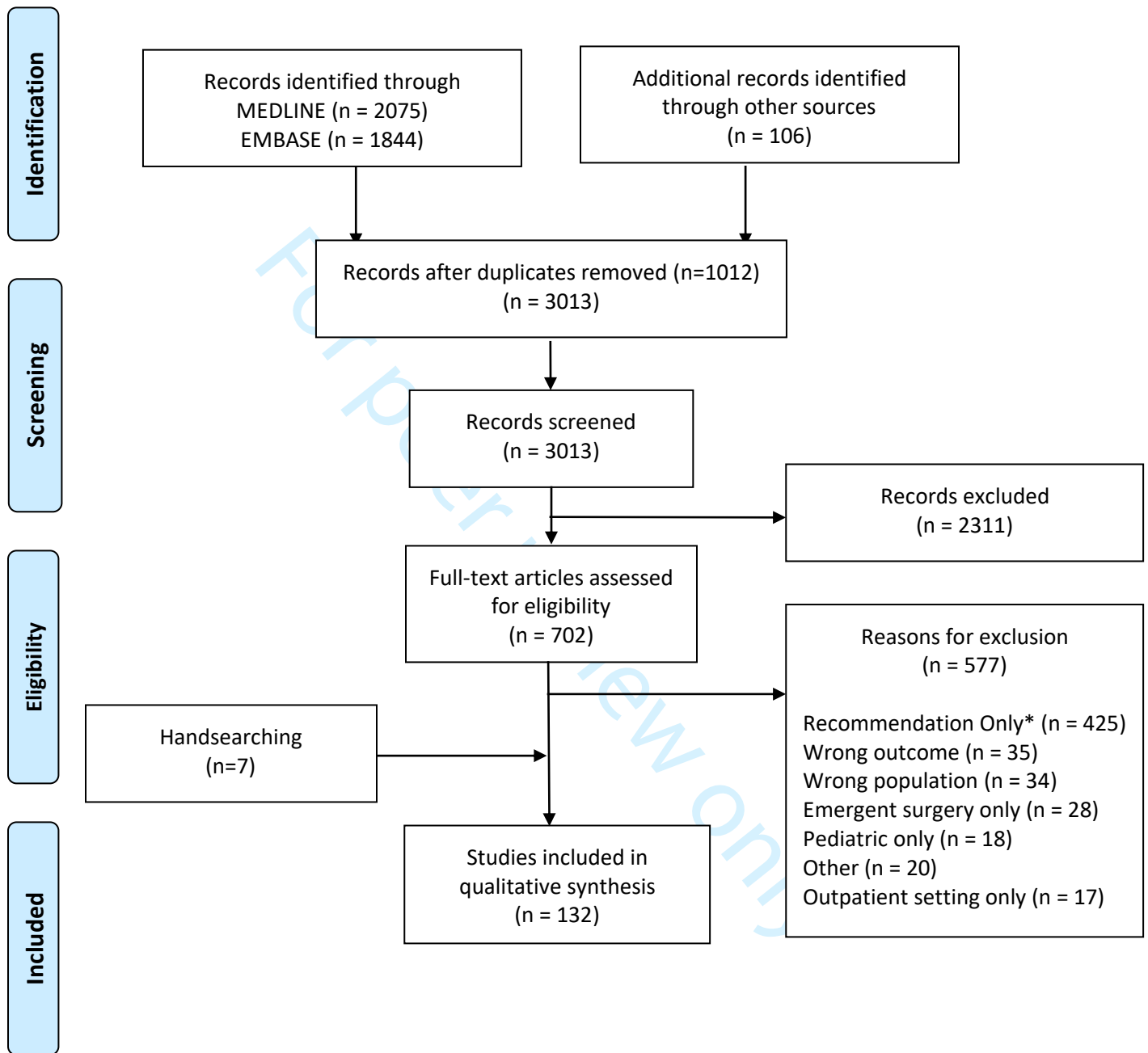
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Figure 2. Summary of study characteristics.

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**Figure 1.** Flow of studies in the scoping review

\*Includes guidelines, recommendation-based reviews, projections or estimations without mention of true changes to surgical programming.

**Figure 2. Study characteristics**

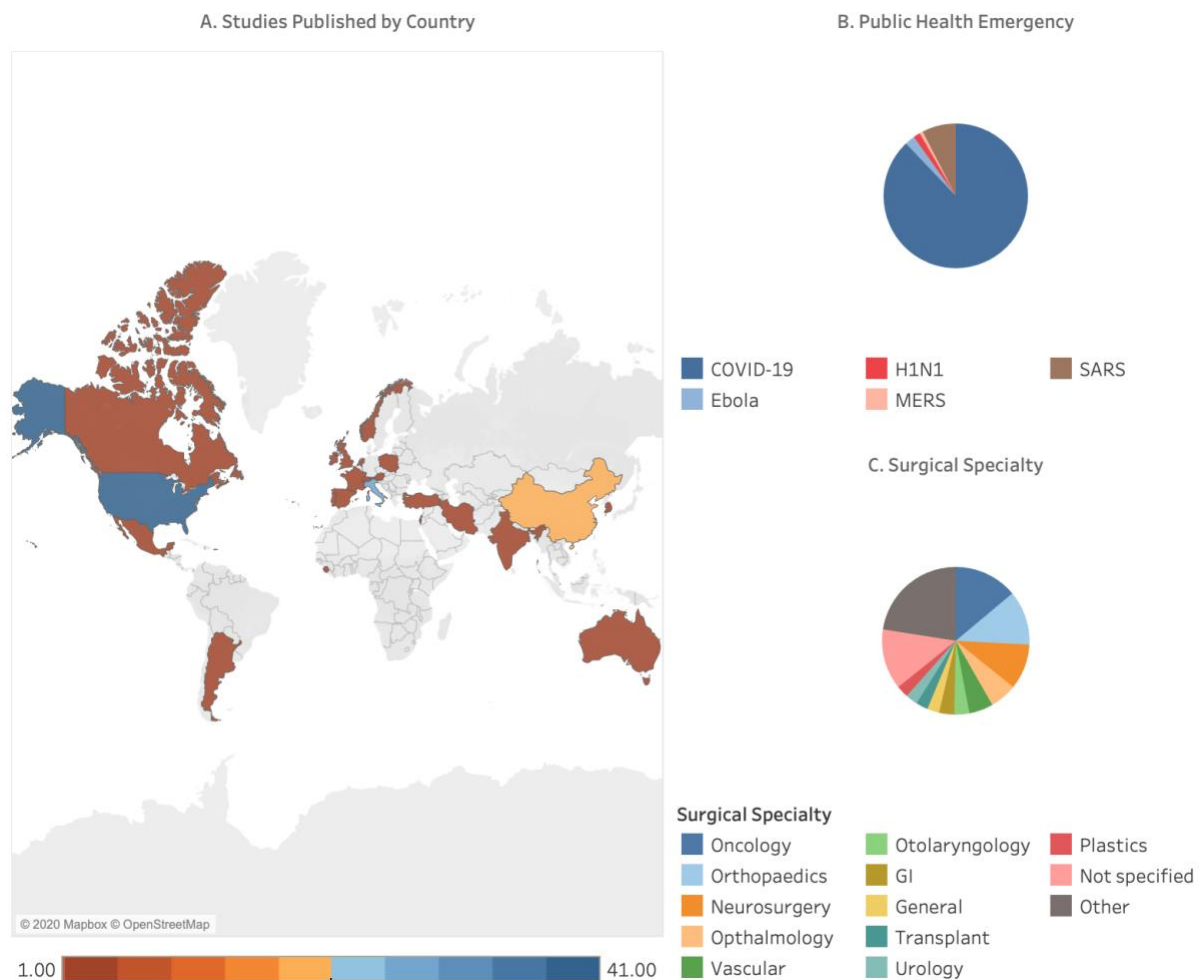


Figure 2. **A.** Country of publication, **B.** Public health emergency discussed, and **C.** Surgical specialty addressed ('Other' includes Cardiac (n=3), Anesthesia (n=3), Electrophysiology (n=3), Obstetrics and Gynecology (n=3), Thoracic (n=2), Interventional Radiology (n=1), and Dermatology (n=1)).

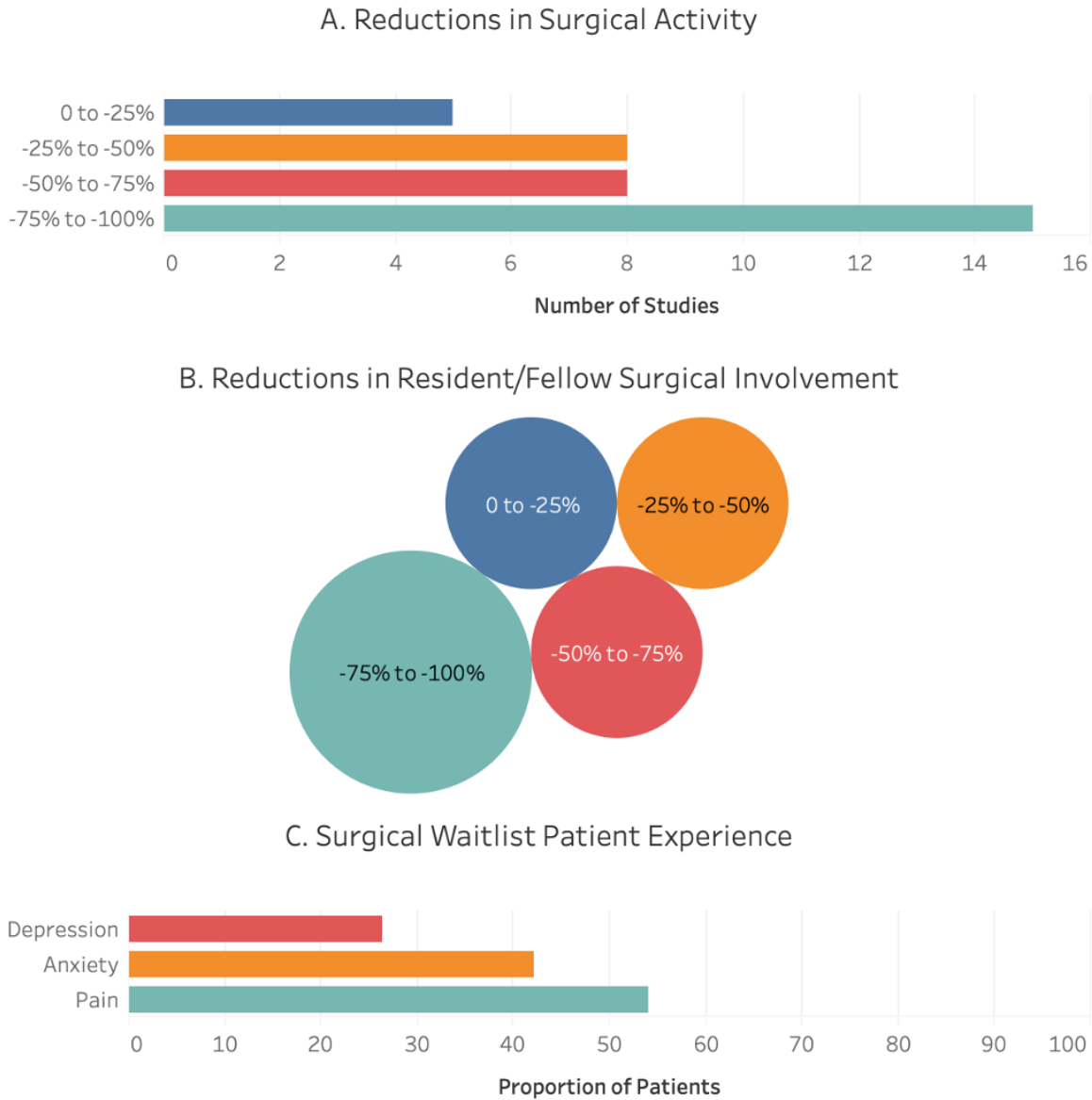
**Figure 3.** Summary of the impacts of alterations to surgical services

Figure 3. A summary of the impacts of alterations to surgical services during public health emergencies on **A.** Overall surgical activity (n=37 studies), **B.** Resident and fellow involvement in surgery (n=5 studies) where circle size represents the number of studies contributing to that quartile, and **C.** Patient experience (n=2 studies).



## Appendix A. Search Strategy

### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

#### Search Strategy:

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- 1 exp Disease Outbreaks/ (96117)
  - 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
  - 3 1 or 2 (231940)
  - 4 exp Coronavirus (13456)
  - 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
  - 6 Coronaviridae Infections/ (900)
  - 7 coronaviridae/ or coronavirus/ (3916)
  - 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
  - 9 Hemorrhagic Fever, Ebola/ (5316)
  - 10 SARS Virus/ (3038)
  - 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
  - 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
  - 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
  - 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
  - 15 (coronavir\*) adj2 (infection\*).mp. (8441)
  - 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
  - 17 General Surgery/ (38626)
  - 18 Orthopedic Procedures/ (25371)
  - 19 Traumatology/ (3474)
  - 20 Neurosurgery/ (14892)
  - 21 Obstetrics/ (22533)
  - 22 Anesthesia/ (62587)
  - 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
  - 24 exp Arthroplasty, Replacement/ (54362)
  - 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
  - 26 (surger\* or operation\* or procedure\*).mp. (3638036)
  - 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
  - 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
  - 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)
  - 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)
  - 31 3 and 16 and 30 (2075)
- .....

**Database: EMBASE <1974 to 2020 May 08>****Search Strategy:**

- 
- 1 exp epidemic/ (103292)
  - 2 exp pandemic/ (12990)
  - 3 1 or 2 (114458)
  - 4 pandemic influenza/ (4748)
  - 5 exp severe acute respiratory syndrome/ (8505)
  - 6 exp coronaviridae/ or coronaviridae infection/ (14928)
  - 7 coronavirinae/ (2093)
  - 8 Coronavirus infection/ (3397)
  - 9 avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ (7466)
  - 10 Ebola hemorrhagic fever/ (5712)
  - 11 exp SARS coronavirus/ (5823)
  - 12 Middle East respiratory syndrome/ (935)
  - 13 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (512)
  - 14 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. (92353)
  - 15 (wuhan adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV)).mp. (161)
  - 16 (coronavir\* adj2 infection\*).mp. (4793)
  - 17 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 (96712)
  - 18 general surgery/ (15070)
  - 19 orthopedic surgery/ (32672)
  - 20 traumatology/ (10653)
  - 21 neurosurgery/ (59847)
  - 22 obstetrics/ (34886)
  - 23 anesthesiological procedure/ (1785)
  - 24 elective surgery/ (34038)
  - 25 replacement arthroplasty/ or exp arthroplasty/ (73583)
  - 26 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. (966732)
  - 27 (surger\* or operation\* or procedure\*).mp. (5402047)
  - 28 ((elective or non-urgent adj2 (surg\* or procedure\*)).mp. (52808)
  - 29 (surg\* adj2 (procedure\* or planning or triag\* or operation\* or resource\* or backlog or re-organiz\* or postpon\* or cancel\* or capacit\* or wait time\*)).mp. (187480)
  - 30 ((clinic\* or hospital) adj2 (process\* or procedure\* or triag\* or planning or performance\* or capacit\*)).mp. (83715)
  - 31 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 (5948860)
  - 32 3 and 17 and 31 (1844)
- .....

Database	Pandemic terms Pandemic, epidemic	Disease terms COVID-19, SARS, MERS, pandemic flu (h1n1, h3n2, h5n1), ebola	Surgical terms Non-urgent/elective surgery (general, orthopedic, anesthesia, trauma, neurosurgery, obstetrics)
MEDLINE	exp Disease Outbreaks/ OR (pandemic* or epidemic* or outbreak* or outbreak*).mp.	exp Coronavirus OR coronavirus infections/ or severe acute respiratory syndrome/ OR Coronaviridae Infections/ OR coronaviridae/ or coronavirus/ OR Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ OR Hemorrhagic Fever, Ebola/ OR SARS Virus/ OR Middle East Respiratory Syndrome Coronavirus/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola* or middle	General Surgery/ OR Orthopedic Procedures/ OR Traumatology/ OR Neurosurgery/ OR Obstetrics/ OR Anesthesia/ OR surgical procedures, operative/ or exp elective surgical procedures/ OR exp Arthroplasty, Replacement/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent) adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triage or operation* or resource* or backlog or re-organiz* or postpone* or cancel* or capacit* or wait time*)).mp.

		east respiratory syndrome or MERS).mp. OR (wuhan) adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV).mp. OR (coronavir*) adj2 (infection*).mp.	OR ((clinic* or hospital) adj2 (process* or procedure* or triage or planning or performance* or capacit*)).mp.
<b>EMBASE</b>	exp epidemic/ OR exp pandemic/	pandemic influenza/ OR exp severe acute respiratory syndrome/ OR exp coronaviridae/ or coronaviridae infection/ OR coronavirinae/ OR Coronavirus infection/ OR avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ OR Ebola hemorrhagic fever/ OR exp SARS coronavirus/ OR Middle East respiratory syndrome/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. OR	general surgery/ OR orthopedic surgery/ OR traumatology/ OR neurosurgery/ OR obstetrics/ OR anesthesiological procedure/ OR elective surgery/ OR replacement arthroplasty/ or exp arthroplasty/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triag* or operation* or resource* or backlog or re-organiz* or postpon* or cancel* or

		(wuhan adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV)).mp. OR (coronavir* adj2 infection*).mp.	capacit* or wait time*).mp. OR ((clinic* or hospital) adj2 (process* or procedure* or triag* or planning or performance* or capacit*).mp.
--	--	-----------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------

## GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms “coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery” OR “guidelines”)

## NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

## GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

## GENERAL SURGICAL GROUPS/COLLEGES

1  
 2  
 3 Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)  
 4 American College of Surgeons (<https://www.facs.org>)  
 5 European Surgical Association (<https://www.europeansurgicalassociation.org>)  
 6 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
 7 French Surgical Association  
 8 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
 9 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
 10 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
 11 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
 12 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
 13 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
 14 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
 15 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
 16 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
 17 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
 18  
 19  
 20

21  
 22 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
 23 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
 24 OR “Surgery” OR “non-urgent” OR “guidelines”  
 25

26  
 27 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
 28 past last click for relevance.  
 29

30  
 31 STEP 4) Contact with Knowledge Experts.  
 32

Source and Site	Search Terms	Potentially Relevant Results
<b>Health Groups</b>		
World Health Organization ( <a href="https://www.who.int">https://www.who.int</a> , Advanced Search)	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	10
Center for Disease Control and Prevention ( <a href="https://www.cdc.gov">https://www.cdc.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	8
European Centre for Disease Prevention and Control ( <a href="https://www.ecdc.europa.eu/en">https://www.ecdc.europa.eu/en</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	3
<b>Governments</b>		
Government of Canada ( <a href="https://www.canada.ca/en.html">https://www.canada.ca/en.html</a> )	[contains all words] elective surgery covid	4

	[contains all words] non-urgent surgery covid	
Government of BC ( <a href="https://www2.gov.bc.ca/gov">https://www2.gov.bc.ca/gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of AB ( <a href="https://www.alberta.ca">https://www.alberta.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of SK ( <a href="https://www.saskatchewan.ca">https://www.saskatchewan.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	6
Government of MB ( <a href="https://www.gov.mb.ca">https://www.gov.mb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	4
Government of ON ( <a href="https://www.ontario.ca">https://www.ontario.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of QC ( <a href="https://www.quebec.ca/en/">https://www.quebec.ca/en/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of NB ( <a href="https://www2.gnb.ca">https://www2.gnb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NS ( <a href="https://beta.novascotia.ca">https://beta.novascotia.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NL & LB ( <a href="https://www.gov.nl.ca">https://www.gov.nl.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of PEI ( <a href="https://www.princeedwardisland.ca">https://www.princeedwardisland.ca</a> )	[contains all words] elective surgery covid	2

	[contains all words] non-urgent surgery covid	
Government of Yukon ( <a href="https://yukon.ca">https://yukon.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NWT ( <a href="https://www.gov.nt.ca">https://www.gov.nt.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Nunavut ( <a href="https://www.gov.nu.ca">https://www.gov.nu.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Australia ( <a href="https://www.australia.gov.au">https://www.australia.gov.au</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Italy ( <a href="http://www.governo.it">http://www.governo.it</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Singapore ( <a href="https://www.gov.sg">https://www.gov.sg</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of China ( <a href="https://www.gov.cn/english/">https://www.gov.cn/english/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
United States Government ( <a href="https://www.usa.gov">https://www.usa.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
<b>Surgical Colleges/Associations</b>		
Royal College of Physicians and Surgeons of Canada ( <a href="http://www.royalcollege.ca">http://www.royalcollege.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0



<p>American College of Surgeons (<a href="https://www.facs.org">https://www.facs.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>23</p>
<p>European Surgical Association (<a href="https://www.europeansurgicalassociation.org">https://www.europeansurgicalassociation.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>College of Surgeons, Singapore (<a href="https://www.ams.edu.sg">https://www.ams.edu.sg</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>3</p>
<p>German Society of Surgery (<a href="https://www.dgch.de/index.php?id=118">https://www.dgch.de/index.php?id=118</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>Philippine College of Surgeons (<a href="https://www.pcs.org.ph">https://www.pcs.org.ph</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>11</p>
<p>Royal Australasian College of Surgeons (<a href="https://www.surgeons.org">https://www.surgeons.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>12</p>
<p>Royal College of Surgeons of England (<a href="https://www.rcseng.ac.uk">https://www.rcseng.ac.uk</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>7</p>
<p>Royal College of Surgeons of Ireland (<a href="https://www.rcsi.com/dublin/">https://www.rcsi.com/dublin/</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>8</p>
<p>Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<a href="https://www.aecirujanos.es">https://www.aecirujanos.es</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>1</p>
<p>Swedish Surgical Society (<a href="http://www.svenskkirurgi.se">http://www.svenskkirurgi.se</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>

The Association of Surgeons of South Africa ( <a href="http://www.surgeon.co.za">http://www.surgeon.co.za</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
The Pan African Association of Surgeons ( <a href="http://www.africansurgeons.com">http://www.africansurgeons.com</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Total		111

## Appendix B. Data Abstraction Form

This form has been developed by adopting and customizing the 'Data collection form- RCTs and NRS' produced by The Cochrane Collaboration. Customization includes the addition of new sections, as well as the omission of sections not relevant to the review.

### Notes on using data extraction form:

- Be consistent in the order and style you use to describe the information for each report.
- Record any missing information as unclear or not described, to make it clear that the information was not found in the study report(s), not that you forgot to extract it.
- Include any instructions and decision rules on the data collection form, or in an accompanying document. It is important to practice using the form and give training to any other authors using the form.

### 1. General Information

1. Date form completed (dd/mm/yyyy)	/ /
2. Name of person extracting data	<input type="checkbox"/> Connor M. ORielly <input type="checkbox"/> Khara M. Sauro
3. Contact details of person extracting data	
4. Title of Article/Abstract (that data are extracted from)	
5. Study ID (plus surname of author and year of study publication)	
6. Study country of origin	
7. Study funding source	
8. Possible conflicts of interest	<input type="checkbox"/> Reported <input type="checkbox"/> Not Reported
9. Notes:	

### 2. Eligibility

Study Characteristics	Inclusion Criteria	Location in text (page#/fig#/table#)
10. Type of study (design)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	

11. Population description		
12. Focused diseases/conditions		
13. Types of outcome measures		
14. Decision (with reasons for either inclusion or exclusion)	<input type="checkbox"/> Include <input type="checkbox"/> Exclude If Exclude, explain:	
15. Notes		

**IF STUDY IS EXCLUDED FROM REVIEW, DO NOT CONTINUE**

## 2. Population and setting

	Description	Location in text (page#/fig#/table#)
16. Population description		
17. Source/setting of the population (e.g., urban, rural, ethnic group)		
18. Method(s) of recruitment of participants	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random  Method:	
19. Notes:		

## 3. Methods

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
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20. Aim of study		
21. Design (e.g., cross-sectional, RCT, CCT)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	
22. Sampling technique (e.g., random or convenience)	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random	
23. Study start date (dd/mm/yyyy)	/ /	
24. Study end date/duration (dd/mm/yyyy)	/ / <b>OR</b> Duration:	
25. Notes:		

#### 4. Participants

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
26. Total number of participants/Sample size		
27. Age		
28. Sex	<input type="checkbox"/> Both Sexes <input type="checkbox"/> Males <input type="checkbox"/> Females	
29. Genders Represented		
30. Country		
31. Predominant medical complaint		
32. Co-morbidities (if any)		
33. Definition of 'Frequent use' (if any)		

34. Notes:

## 5. Outcomes

Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
35. Outcome definition		
36. Time points measured		
37. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
38. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
39. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
40. Specify Outcome		
41. Outcome definition		
42. Time points measured		
43. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
44. Unit of measurement		
45. Notes:		

Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
46. Specify Outcome		
47. Outcome definition		
48. Time points measured		
49. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
50. Unit of measurement		
51. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
52. Specify Outcome		
53. Outcome definition		
54. Time points measured		
55. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
56. Unit of measurement		
57. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
58. Outcome definition		
59. Time points measured		

60. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
61. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
62. Notes:		

## 6. Results and findings

*Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.*

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
63. Subgroup (if applicable, e.g., age/sex specific reporting)		
64. Results		
65. Response/non-response rate		
66. Unit of analysis (i.e., individual or group)		
67. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
68. Subgroup (if applicable, e.g., age/sex specific reporting)		
69. Results		
70. Response/non-response rate		
71. Unit of analysis (i.e., individual or group)		
72. Notes:		



Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
73. Subgroup (if applicable, e.g., age/sex specific reporting)		
74. Results		
75. Response/non-response rate		
76. Unit of analysis (i.e., individual or group)		
77. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
78. Subgroup (if applicable, e.g., age/sex specific reporting)		
79. Results		
80. Response/non-response rate		
81. Unit of analysis (i.e., individual or group)		
82. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
83. Subgroup (if applicable, e.g., age/sex specific reporting)		
84. Results		
85. Response/non-response rate		
86. Unit of analysis (i.e., individual or group)		
87. Notes:		

**Research Questions informed by this study (tick only boxes matching the outcome tables kept above)**

Changes to surgical programming in response to public health emergency

- Impacts of changes to surgical programming
- Actions to rebuild surgical capacity post-public health emergency

### 7. Strengths, limitations and mitigation strategy

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
88. Strengths		
89. Limitations		
90. Strategies to overcome limitations		
91. Notes:		

### 8. Conclusion and other information

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
92. Key conclusions of study authors		
93. Notes:		

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For peer review only

### Appendix C. Complete list of references for included studies

1. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
2. Ammar A, Stock AD, Holland R, et al. Managing a Specialty Service During the COVID-19 Crisis: Lessons From a New York City Health System. *Acad Med* 2020 doi: 10.1097/ACM.0000000000003440 [published Online First: 2020/04/19]
3. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
4. Ansarin M. Surgical management of head and neck tumours during the SARS-CoV (COVID-19) pandemic. *Acta Otorhinolaryngol Ital* 2020;40(2):87-89. doi: 10.14639/0392-100X-N0783 [published Online First: 2020/04/10]
5. Bashir M, Moughal S. Cardiovascular disease and surgery amid COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.479 [published Online First: 2020/05/04]
6. Ben Abdallah I. Early experience in Paris with the impact of the COVID-19 pandemic on vascular surgery. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.467 [published Online First: 2020/04/27]
7. Bernucci C, Brembilla C, Veiceschi P. Effects of the COVID-19 Outbreak in Northern Italy: Perspectives from the Bergamo Neurosurgery Department. *World Neurosurg* 2020;137:465-68 e1. doi: 10.1016/j.wneu.2020.03.179 [published Online First: 2020/04/06]
8. Bettinelli G, Delmastro E, Salvato D, et al. Orthopaedic patient workflow in CoViD-19 pandemic in Italy. *J Orthop* 2020;22:158-59. doi: 10.1016/j.jor.2020.04.006 [published Online First: 2020/05/07]
9. Bolkan HA, Bash-Taqi DA, Samai M, et al. Ebola and indirect effects on health service function in sierra leone. *PLoS Curr* 2014;6 doi: 10.1371/currents.outbreaks.0307d588df619f9c9447f8ead5b72b2d [published Online First: 2015/02/17]
10. Bolkan HA, van Duinen A, Samai M, et al. Admissions and surgery as indicators of hospital functions in Sierra Leone during the west-African Ebola outbreak. *BMC Health Serv Res* 2018;18(1):846. doi: 10.1186/s12913-018-3666-9 [published Online First: 2018/11/11]
11. Bourlon MT, Macias AE, de la Torre A, et al. Organization of a third-level care hospital in Mexico City during the 2009 influenza epidemic. *Arch Med Res* 2009;40(8):681-6. doi: 10.1016/j.arcmed.2009.10.009 [published Online First: 2010/03/23]
12. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]
13. Brethauer SA, Poulouse BK, Needleman BJ, et al. Redesigning a Department of Surgery during the COVID-19 Pandemic. *J Gastrointest Surg* 2020 doi: 10.1007/s11605-020-04608-4 [published Online First: 2020/04/30]
14. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]

15. Buckstein M, Skubish S, Smith K, et al. Experiencing the Surge: Report from a Large New York Radiation Oncology Department During the COVID-19 Pandemic. *Adv Radiat Oncol* 2020 doi: 10.1016/j.adro.2020.04.014 [published Online First: 2020/05/08]
16. Bundu I, Patel A, Mansaray A, et al. Surgery in the time of Ebola: how events impacted on a single surgical institution in Sierra Leone. *J R Army Med Corps* 2016;162(3):212-6. doi: 10.1136/jramc-2015-000582 [published Online First: 2016/01/21]
17. Burke JF, Chan AK, Mummaneni V, et al. Letter: The Coronavirus Disease 2019 Global Pandemic: A Neurosurgical Treatment Algorithm. *Neurosurgery* 2020;87(1):E50-E56. doi: 10.1093/neuros/nyaa116
18. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi: 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
19. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
20. Cakmak GK, Ozmen V. Sars-CoV-2 (COVID-19) Outbreak and Breast Cancer Surgery in Turkey. *Eur J Breast Health* 2020;16(2):83-85. doi: 10.5152/ejbh.2020.300320 [published Online First: 2020/04/15]
21. Carenzo L, Costantini E, Greco M, et al. Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. *Anaesthesia* 2020 doi: 10.1111/anae.15072 [published Online First: 2020/04/05]
22. Cenzato M, DiMeco F, Fontanella M, et al. Editorial. Neurosurgery in the storm of COVID-19: suggestions from the Lombardy region, Italy (ex malo bonum). *Journal of neurosurgery* 2020:1-2. doi: 10.3171/2020.3.JNS20960
23. Chan WM, Liu DTL, Chan PKS, et al. Precautions in ophthalmic practice in a hospital with a major acute SARS outbreak: an experience from Hong Kong. *Eye* 2006;20(3):283-89. doi: 10.1038/sj.eye.6701885
24. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
25. Chew MH, Koh FH, Ng KH. A call to arms: a perspective of safe general surgery in Singapore during the COVID-19 pandemic. *Singapore Med J* 2020 doi: 10.11622/smedj.2020049 [published Online First: 2020/04/04]
26. Chisci E, Masciello F, Michelagnoli S. Creation of a vascular surgical hub responding to the COVID-19 emergency: The Italian USL Toscana Centro model. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.019 [published Online First: 2020/04/20]
27. Civantos FJ, Leibowitz JM, Arnold DJ, et al. Ethical surgical triage of patients with head and neck cancer during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26229 [published Online First: 2020/05/02]
28. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]
29. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]

- 1  
2  
3 30. Ding BTK, Soh T, Tan BY, et al. Operating in a Pandemic: Lessons and Strategies from  
4 an Orthopaedic Unit at the Epicenter of COVID-19 in Singapore. *J Bone Joint Surg Am* 2020  
5 doi: 10.2106/JBJS.20.00568 [published Online First: 2020/05/08]  
6  
7 31. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation  
8 in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online  
9 First: 2020/05/03]  
10  
11 32. Doussot A, Heyd B, Lakkis Z. We Asked the Experts: How Do We Maintain Surgical  
12 Quality Standards for Enhanced Recovery Programs After Cancer Surgery During the COVID-  
13 19 Outbreak? *World J Surg* 2020 doi: 10.1007/s00268-020-05546-7 [published Online First:  
14 2020/04/27]  
15  
16 33. Dowdell JE, Louie PK, Virk S, et al. Spine fellowship training reorganizing during a  
17 pandemic: perspectives from a tertiary orthopedic specialty center in the epicenter of outbreak.  
18 *Spine J* 2020 doi: 10.1016/j.spinee.2020.04.015 [published Online First: 2020/04/29]  
19  
20 34. Ducournau F, Arianni M, Awwad S, et al. COVID-19: Initial experience of an  
21 international group of hand surgeons. *Hand Surg Rehabil* 2020;39(3):159-66. doi:  
22 10.1016/j.hansur.2020.04.001 [published Online First: 2020/04/13]  
23  
24 35. Eichberg DG, Shah AH, Luther EM, et al. Letter: Academic Neurosurgery Department  
25 Response to COVID-19 Pandemic: The University of Miami/Jackson Memorial Hospital Model.  
26 *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa118 [published Online First: 2020/04/12]  
27  
28 36. Ficarra V, Mucciardi G, Giannarini G. Re: Riccardo Campi, Daniele Amparore, Umberto  
29 Capitanio, et al. Assessing the Burden of Urgent Nondeferrable Uro-oncologic Surgery to Guide  
30 Prioritisation Strategies During the COVID-19 Pandemic: Insights from Three Italian High-  
31 volume Referral Centres. *Eur Urol*. In press. <https://doi.org/10.1016/j.eururo.2020.03.054>. *Eur*  
32 *Urol* 2020 doi: 10.1016/j.eururo.2020.04.037 [published Online First: 2020/05/04]  
33  
34 37. Fontanella MM, De Maria L, Zanin L, et al. Neurosurgical Practice During the Severe  
35 Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Pandemic: A Worldwide Survey.  
36 *World Neurosurg* 2020 doi: 10.1016/j.wneu.2020.04.204 [published Online First: 2020/05/08]  
37  
38 38. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19  
39 pandemic: an expert opinion from China, South Korea, Italy, United States of America,  
40 Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2  
41 [published Online First: 2020/04/30]  
42  
43 39. Giorgi PD, Villa F, Gallazzi E, et al. The management of emergency spinal surgery  
44 during the COVID-19 pandemic in Italy. *Bone Joint J* 2020;xxx. doi: 10.1302/0301-  
45 620X.102B6.BJJ-2020-0537 [published Online First: 2020/04/24]  
46  
47 40. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during  
48 the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First:  
49 2020/05/10]  
50  
51 41. Gomez-Barrena E, Rubio-Suarez JC, Fernandez-Baillo N, et al. Limiting spread of  
52 COVID-19 in an orthopaedic department-a perspective from Spain. *J Surg Case Rep*  
53 2020;2020(4):rjaa095. doi: 10.1093/jscr/rjaa095 [published Online First: 2020/04/30]  
54  
55 42. Gouveia EMR, Pedro LM. Vascular surgery department adjustments in the era of the  
56 COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.017 [published Online First:  
57 2020/04/20]  
58  
59 43. Guerci C, Maffioli A, Bondurri AA, et al. COVID-19: How can a department of general  
60 surgery survive in a pandemic? *Surgery* 2020;167(6):909-11. doi: 10.1016/j.surg.2020.03.012  
[published Online First: 2020/04/18]

- 1  
2  
3 44. Gupta A, Arora V, Nair D, et al. Status and strategies for the management of head and  
4 neck cancer during COVID-19 pandemic: Indian scenario. *Head Neck* 2020 doi:  
5 10.1002/hed.26227 [published Online First: 2020/05/02]
- 6 45. Haines CJ, Chu YW, Chung TK. The effect of Severe Acute Respiratory Syndrome on a  
7 hospital obstetrics and gynaecology service. *BJOG* 2003;110(7):643-5. doi:  
8 <http://dx.doi.org/10.1016/S1470-0328%2803%2903007-6> [published Online First: 2003/07/05]
- 9 46. British Columbia Ministry of Health. A Commitment to Surgical Renewal in BC.  
10 Canada, 2020.
- 11 47. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery  
12 during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published  
13 Online First: 2020/05/04]
- 14 48. Hormati A, Ghadir MR, Zamani F, et al. Preventive strategies used by GI physicians  
15 during the COVID-19 pandemic. *New Microbes New Infect* 2020;35:100676. doi:  
16 10.1016/j.nmni.2020.100676 [published Online First: 2020/04/16]
- 17 49. Hu Y-J, Zhang J-M, Chen Z-P. Experiences of practicing surgical neuro-oncology during  
18 the COVID-19 pandemic. *Journal of neuro-oncology* 2020;148(1):199-200. doi:  
19 10.1007/s11060-020-03489-6 [published Online First: 2020/04/10]
- 20 50. Jean WC, Ironside NT, Sack KD, et al. The impact of COVID-19 on neurosurgeons and  
21 the strategy for triaging non-emergent operations: a global neurosurgery study. *Acta Neurochir*  
22 (*Wien*) 2020;162(6):1229-40. doi: 10.1007/s00701-020-04342-5 [published Online First:  
23 2020/04/22]
- 24 51. Kempa M, Gulaj M, Farkowski MM, et al. Electrotherapy and electrophysiology  
25 procedures during the coronavirus disease 2019 pandemic: an opinion of the Heart Rhythm  
26 Section of the Polish Cardiac Society (with an update). *Kardiol Pol* 2020;78(5):488-92. doi:  
27 10.33963/KP.15338 [published Online First: 2020/05/06]
- 28 52. Kessler RA, Zimering J, Gilligan J, et al. Neurosurgical management of brain and spine  
29 tumors in the COVID-19 era: an institutional experience from the epicenter of the pandemic. *J*  
30 *Neurooncol* 2020 doi: 10.1007/s11060-020-03523-7 [published Online First: 2020/05/07]
- 31 53. Konda SR, Dankert JF, Merkow D, et al. COVID-19 Response in the Global Epicenter:  
32 Converting a New York City Level 1 Orthopedic Trauma Service into a Hybrid Orthopedic and  
33 Medicine COVID-19 Management Team. *J Orthop Trauma* 2020 doi:  
34 10.1097/BOT.0000000000001792 [published Online First: 2020/05/02]
- 35 54. Kuo IC, Pellegrino F, Fornero P, et al. H1N1 pandemic and ophthalmology.  
36 *Ophthalmology* 2010;117(2):405. doi: 10.1016/j.ophtha.2009.11.035 [published Online First:  
37 2010/02/10]
- 38 55. Lai THT, Tang EWH, Chau SKY, et al. Stepping up infection control measures in  
39 ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. *Graefes*  
40 *Arch Clin Exp Ophthalmol* 2020;258(5):1049-55. doi: 10.1007/s00417-020-04641-8 [published  
41 Online First: 2020/03/04]
- 42 56. Lancaster EM, Sosa JA, Sammann A, et al. Rapid Response of an Academic Surgical  
43 Department to the COVID-19 Pandemic: Implications for Patients, Surgeons, and the  
44 Community. *J Am Coll Surg* 2020;230(6):1064-73. doi: 10.1016/j.jamcollsurg.2020.04.007  
45 [published Online First: 2020/04/13]
- 46 57. Langer PD, Bernardini FP. Oculofacial Plastic Surgery and the COVID-19 Pandemic:  
47 Current Reactions and Implications for the Future. *Ophthalmology* 2020 doi:  
48 10.1016/j.ophtha.2020.04.035 [published Online First: 2020/04/30]

- 1  
2  
3 58. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north  
4 of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int*  
5 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]  
6  
7 59. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service  
8 disruption during COVID-19 in Hong Kong through telehealth and multi-institutional  
9 collaboration. *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]  
10  
11 60. Leong Tan GW, Chandrasekar S, Lo ZJ, et al. Early experience in the COVID-19  
12 pandemic from a vascular surgery unit in a Singapore tertiary hospital. *J Vasc Surg* 2020 doi:  
13 10.1016/j.jvs.2020.04.014 [published Online First: 2020/04/20]  
14  
15 61. Li Y, Yang N, Li X, et al. Strategies for prevention and control of the 2019 novel  
16 coronavirus disease in the department of kidney transplantation. *Transpl Int* 2020 doi:  
17 10.1111/tri.13634 [published Online First: 2020/05/02]  
18  
19 62. Liebensteiner MC, Khosravi I, Hirschmann MT, et al. Massive cutback in orthopaedic  
20 healthcare services due to the COVID-19 pandemic. *Knee Surg Sports Traumatol Arthrosc*  
21 2020;28(6):1705-11. doi: 10.1007/s00167-020-06032-2 [published Online First: 2020/05/02]  
22  
23 63. Liu EH, Koh KF, Chen FG. Outbreak of severe acute respiratory syndrome in Singapore  
24 and modifications in the anesthesia service. *Anesthesiology* 2004;100(6):1629-30. doi:  
25 10.1097/00000542-200406000-00062 [published Online First: 2004/05/29]  
26  
27 64. Mak ST, Yuen HK. Oculoplastic surgery practice during the COVID-19 novel  
28 coronavirus pandemic: experience sharing from Hong Kong. *Orbit* 2020:1-3. doi:  
29 10.1080/01676830.2020.1754435 [published Online First: 2020/04/17]  
30  
31 65. Marti C, Sanchez-Mendez JI. Neoadjuvant endocrine therapy for luminal breast cancer  
32 treatment: a first-choice alternative in times of crisis such as the COVID-19 pandemic.  
33 *Ecancermedicalscience* 2020;14:1027. doi: 10.3332/ecancer.2020.1027 [published Online First:  
34 2020/05/06]  
35  
36 66. Maurizi G, Rendina EA. A High-Volume Thoracic Surgery Division into the Storm of  
37 the Covid-19 Pandemic. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.03.015  
38 [published Online First: 2020/04/15]  
39  
40 67. McBride KE, Brown KGM, Fisher OM, et al. Impact of the COVID-19 pandemic on  
41 surgical services: early experiences at a nominated COVID-19 centre. *ANZ J Surg*  
42 2020;90(5):663-65. doi: 10.1111/ans.15900 [published Online First: 2020/04/08]  
43  
44 68. McMillan T, Williamson K. Resuming non-urgent surgeries and allied health services,  
45 2020.  
46  
47 69. Meneghini RM. Resource Reallocation during the COVID-19 Pandemic in a Suburban  
48 Hospital System: Implications for Outpatient Hip and Knee Arthroplasty. *J Arthroplasty* 2020  
49 doi: 10.1016/j.arth.2020.04.051 [published Online First: 2020/05/08]  
50  
51 70. Meyer M, Prost S, Farah K, et al. Spine Surgical Procedures during Coronavirus Disease  
52 2019 Pandemic: Is It Still Possible to Take Care of Patients? Results of an Observational Study  
53 in the First Month of Confinement. *Asian Spine J* 2020 doi: 10.31616/asj.2020.0197 [published  
54 Online First: 2020/05/10]  
55  
56 71. Morgan C, Ahluwalia AK, Aframian A, et al. The impact of the novel coronavirus on  
57 trauma and orthopaedics in the UK. *Br J Hosp Med (Lond)* 2020;81(4):1-6. doi:  
58 10.12968/hmed.2020.0137 [published Online First: 2020/04/29]  
59  
60 72. Nair AG, Gandhi RA, Natarajan S. Effect of COVID-19 related lockdown on ophthalmic  
practice and patient care in India: Results of a survey. *Indian J Ophthalmol* 2020;68(5):725-30.  
doi: 10.4103/ijo.IJO\_797\_20 [published Online First: 2020/04/23]



- 1  
2  
3  
4  
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46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
73. Nassar AH, Zern NK, McIntyre LK, et al. Emergency Restructuring of a General Surgery Residency Program During the Coronavirus Disease 2019 Pandemic: The University of Washington Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1219 [published Online First: 2020/04/07]
74. Park J, Yoo SY, Ko JH, et al. Infection Prevention Measures for Surgical Procedures during a Middle East Respiratory Syndrome Outbreak in a Tertiary Care Hospital in South Korea. *Sci Rep* 2020;10(1):325. doi: 10.1038/s41598-019-57216-x [published Online First: 2020/01/17]
75. Park JS, El-Sayed IH, Young VN, et al. Development of clinical care guidelines for faculty and residents in the era of COVID-19. *Head Neck* 2020 doi: 10.1002/hed.26225 [published Online First: 2020/04/30]
76. Patel RJ, Kejner A, McMullen C. Early institutional head and neck oncologic and microvascular surgery practice patterns across the United States during the SARS-CoV-2 (COVID19) pandemic. *Head Neck* 2020;42(6):1168-72. doi: 10.1002/hed.26189 [published Online First: 2020/04/25]
77. Patel ZM, Fernandez-Miranda J, Hwang PH, et al. Letter: Precautions for Endoscopic Transnasal Skull Base Surgery During the COVID-19 Pandemic. *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa125 [published Online First: 2020/04/16]
78. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
79. Pittet D. Hopitaux Universitaire de Genève (HUG)- A model hospital for COVID-19 patient management, 2020.
80. Prachand VN, Milner R, Angelos P, et al. Medically Necessary, Time-Sensitive Procedures: Scoring System to Ethically and Efficiently Manage Resource Scarcity and Provider Risk During the COVID-19 Pandemic. *J Am Coll Surg* 2020 doi: 10.1016/j.jamcollsurg.2020.04.011 [published Online First: 2020/04/13]
81. Price KN, Thiede R, Shi VY, et al. Strategic dermatology clinical operations during the coronavirus disease 2019 (COVID-19) pandemic. *J Am Acad Dermatol* 2020;82(6):e207-e09. doi: 10.1016/j.jaad.2020.03.089 [published Online First: 2020/04/12]
82. Qadan M, Hong TS, Tanabe KK, et al. A Multidisciplinary Team Approach for Triage of Elective Cancer Surgery at the Massachusetts General Hospital During the Novel Coronavirus COVID-19 Outbreak. *Ann Surg* 2020 doi: 10.1097/SLA.0000000000003963 [published Online First: 2020/04/18]
83. Ralli M, Greco A, de Vincentiis M. The Effects of the COVID-19/SARS-CoV-2 Pandemic Outbreak on Otolaryngology Activity in Italy. *Ear Nose Throat J* 2020;145561320923893. doi: 10.1177/0145561320923893 [published Online First: 2020/04/30]
84. Rampinelli V, Mattavelli D, Gualtieri T, et al. Reshaping head and neck reconstruction policy during the COVID-19 pandemic peak: Experience in a front-line institution. *Auris Nasus Larynx* 2020 doi: 10.1016/j.anl.2020.04.008 [published Online First: 2020/05/05]
85. Randelli PS, Compagnoni R. Management of orthopaedic and traumatology patients during the Coronavirus disease (COVID-19) pandemic in northern Italy. *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1683-89. doi: 10.1007/s00167-020-06023-3 [published Online First: 2020/04/27]

- 1  
2  
3 86. Ricciardi L, Trungu S, Scerrati A, et al. Neurosurgery at the time of COVID-19: how this  
4 pandemic infectious disease is influencing neurosurgical activities and patient management. *J*  
5 *Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04976-0 [published Online First: 2020/04/30]  
6  
7 87. Ross SW, Lauer CW, Miles WS, et al. Maximizing the Calm before the Storm: Tiered  
8 Surgical Response Plan for Novel Coronavirus (COVID-19). *J Am Coll Surg* 2020;230(6):1080-  
9 91 e3. doi: 10.1016/j.jamcollsurg.2020.03.019 [published Online First: 2020/04/03]  
10  
11 88. Rubin GA, Biviano A, Dizon J, et al. Performance of electrophysiology procedures at an  
12 academic medical center amidst the 2020 coronavirus (COVID-19) pandemic. *J Cardiovasc*  
13 *Electrophysiol* 2020 doi: 10.1111/jce.14493 [published Online First: 2020/04/14]  
14  
15 89. Rubin GA, Wan EY, Saluja D, et al. Restructuring Electrophysiology During the  
16 COVID-19 Pandemic: A Practical Guide from a New York City Hospital Network. *Crit Pathw*  
17 *Cardiol* 2020 doi: 10.1097/HPC.000000000000225 [published Online First: 2020/04/24]  
18  
19 90. Salenger R, Etchill EW, Ad N, et al. The Surge after the Surge: Cardiac Surgery post-  
20 COVID-19. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.04.018 [published Online  
21 First: 2020/05/08]  
22  
23 91. Sarpong NO, Forrester LA, Levine WN. What's Important: Redeployment of the  
24 Orthopaedic Surgeon During the COVID-19 Pandemic: Perspectives from the Trenches. *J Bone*  
25 *Joint Surg Am* 2020 doi: 10.2106/JBJS.20.00574 [published Online First: 2020/04/15]  
26  
27 92. Schull MJ, Stukel TA, Vermeulen MJ, et al. Effect of widespread restrictions on the use  
28 of hospital services during an outbreak of severe acute respiratory syndrome. *Canadian Medical*  
29 *Association Journal* 2007;176(13):1827-32. doi: 10.1503/cmaj.061174  
30  
31 93. Schwarzkopf R, Maher NA, Slover JD, et al. The Response of an Orthopedic Department  
32 and Specialty Hospital at the Epicenter of a Pandemic: The NYU Langone Health Experience. *J*  
33 *Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.041 [published Online First: 2020/05/08]  
34  
35 94. Scullen T, Mathkour M, Maulucci CM, et al. Impact of the COVID-19 Pandemic on  
36 Neurosurgical Residency Training in New Orleans. *World Neurosurg* 2020 doi:  
37 10.1016/j.wneu.2020.04.208 [published Online First: 2020/05/08]  
38  
39 95. Seese L, Aranda-Michel E, Sultan I, et al. Programmatic Responses to the Coronavirus  
40 Pandemic: A Survey of 502 Cardiac Surgeons. *Ann Thorac Surg* 2020 doi:  
41 10.1016/j.athoracsur.2020.04.014 [published Online First: 2020/05/04]  
42  
43 96. Sethi A, Swaminath A, Latorre M, et al. Donning a New Approach to the Practice of  
44 Gastroenterology: Perspectives From the COVID-19 Pandemic Epicenter. *Clin Gastroenterol*  
45 *Hepatol* 2020 doi: 10.1016/j.cgh.2020.04.032 [published Online First: 2020/04/25]  
46  
47 97. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences  
48 and Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*  
49 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First: 2020/04/29]  
50  
51 98. Shih KC, Wong JKW, Lai JSM, et al. The case for continuing elective cataract surgery  
52 during the COVID-19 pandemic. *J Cataract Refract Surg* 2020 doi:  
53 10.1097/j.jcrs.000000000000225 [published Online First: 2020/05/06]  
54  
55 99. Shokri T, Lighthall JG. Telemedicine in the Era of the COVID-19 Pandemic:  
56 Implications in Facial Plastic Surgery. *Facial Plast Surg Aesthet Med* 2020;22(3):155-56. doi:  
57 10.1089/fpsam.2020.0163 [published Online First: 2020/04/18]  
58  
59 100. Sobel D, Gn M, O'Rourke TK, Jr., et al. Personal Protective Equipment for Common  
60 Urologic Procedures Before and During the United States COVID-19 Pandemic: A Single  
Institution Study. *Urology* 2020 doi: 10.1016/j.urology.2020.04.083 [published Online First:  
2020/05/08]

101. Sun Y, Mao Y. Editorial. Response to COVID-19 in Chinese neurosurgery and beyond. *Journal of neurosurgery* 2020;1-2. doi: 10.3171/2020.3.JNS20929
102. National Clinical Programme in Surgery. Surgical Patient Flow During COVID-19 Pandemic, 2020.
103. Tan TK. How severe acute respiratory syndrome (SARS) affected the department of anaesthesia at Singapore General Hospital. *Anaesth Intensive Care* 2004;32(3):394-400. doi: 10.1177/0310057x0403200316 [published Online First: 2004/07/22]
104. Tan YQ, Wu QH, Chiong E. Preserving Operational Capability While Building Capacity During the COVID-19 Pandemic: A Tertiary Urology Centre's Experience. *Urology* 2020 doi: 10.1016/j.urology.2020.04.079 [published Online First: 2020/05/04]
105. Tan YT, Wang JW, Zhao K, et al. Preliminary Recommendations for Surgical Practice of Neurosurgery Department in the Central Epidemic Area of 2019 Coronavirus Infection. *Curr Med Sci* 2020;40(2):281-84. doi: 10.1007/s11596-020-2173-5 [published Online First: 2020/03/29]
106. Tay K, Kamarul T, Lok WY, et al. COVID-19 in Singapore and Malaysia: Rising to the Challenges of Orthopaedic Practice in an Evolving Pandemic. *Malays Orthop J* 2020;14(2) doi: 10.5704/MOJ.2007.001 [published Online First: 2020/04/22]
107. Tay KJD, Lee YHD. Trauma and orthopaedics in the COVID-19 pandemic: breaking every wave. *Singapore Med J* 2020 doi: 10.11622/smedj.2020063 [published Online First: 2020/04/22]
108. Thaler M, Khosravi I, Hirschmann MT, et al. Disruption of joint arthroplasty services in Europe during the COVID-19 pandemic: an online survey within the European Hip Society (EHS) and the European Knee Associates (EKA). *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1712-19. doi: 10.1007/s00167-020-06033-1 [published Online First: 2020/05/04]
109. Tolone S, Gambardella C, Bruscianno L, et al. Telephonic triage before surgical ward admission and telemedicine during COVID-19 outbreak in Italy. Effective and easy procedures to reduce in-hospital positivity. *Int J Surg* 2020;78:123-25. doi: 10.1016/j.ijsu.2020.04.060 [published Online First: 2020/05/04]
110. Too CW, Wen DW, Patel A, et al. Interventional Radiology Procedures for COVID-19 Patients: How we Do it. *Cardiovasc Intervent Radiol* 2020;43(6):827-36. doi: 10.1007/s00270-020-02483-9 [published Online First: 2020/04/29]
111. Topf MC, Shenson JA, Holsinger FC, et al. Framework for prioritizing head and neck surgery during the COVID-19 pandemic. *Head Neck* 2020;42(6):1159-67. doi: 10.1002/hed.26184 [published Online First: 2020/04/17]
112. Tsui KL, Li SK, Li MC, et al. Preparedness of the cardiac catheterization laboratory for severe acute respiratory syndrome (SARS) and other epidemics. *J Invasive Cardiol* 2005;17(3):149-52. [published Online First: 2005/05/04]
113. Tzeng C-WD, Tran Cao HS, Roland CL, et al. Surgical decision-making and prioritization for cancer patients at the onset of the COVID-19 pandemic: A multidisciplinary approach. *Surgical Oncology* 2020;34:182-85. doi: 10.1016/j.suronc.2020.04.029
114. Unal EU, Mavioglu HL, Iscan HZ. Vascular surgery in the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.480 [published Online First: 2020/04/29]
115. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic. *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published Online First: 2020/04/15]

- 1  
2  
3 116. Valenza F, Papagni G, Marchiano A, et al. Response of a comprehensive cancer center to  
4 the COVID-19 pandemic: the experience of the Fondazione IRCCS-Istituto Nazionale dei  
5 Tumori di Milano. *Tumori* 2020;300891620923790. doi: 10.1177/0300891620923790 [published  
6 Online First: 2020/05/05]  
7  
8 117. van de Haar J, Hoes LR, Coles CE, et al. Caring for patients with cancer in the COVID-  
9 19 era. *Nat Med* 2020;26(5):665-71. doi: 10.1038/s41591-020-0874-8 [published Online First:  
10 2020/05/15]  
11 118. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of  
12 oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy  
13 region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi:  
14 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]  
15 119. Vlantis AC, Tsang RK, Wong DK, et al. The impact of severe acute respiratory syndrome  
16 on otorhinolaryngological services at the Prince of Wales Hospital in Hong Kong. *Laryngoscope*  
17 2004;114(1):171-4. doi: 10.1097/00005537-200401000-00032 [published Online First:  
18 2004/01/08]  
19 120. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-  
20 Being, 2020.  
21 121. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a  
22 waiting list for thoracic surgery during the outbreak of Severe Acute Respiratory  
23 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013  
24 122. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during  
25 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*  
26 *Experimental Ophthalmology* 2020;38(3):200-03. doi:  
27 http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100  
28 123. Wasser LM, Assayag E, Tessler M, et al. Response of ophthalmologists in Israel to the  
29 novel coronavirus (2019-nCoV) outbreak. *Graefes Arch Clin Exp Ophthalmol* 2020 doi:  
30 10.1007/s00417-020-04694-9 [published Online First: 2020/04/30]  
31 124. Williams AM, Kalra G, Commiskey PW, et al. Ophthalmology Practice During the  
32 Coronavirus Disease 2019 Pandemic: The University of Pittsburgh Experience in Promoting  
33 Clinic Safety and Embracing Video Visits. *Ophthalmol Ther* 2020;1-9. doi: 10.1007/s40123-  
34 020-00255-9 [published Online First: 2020/05/08]  
35 125. Wong J, Goh QY, Tan Z, et al. Preparing for a COVID-19 pandemic: a review of  
36 operating room outbreak response measures in a large tertiary hospital in Singapore. *Canadian*  
37 *Journal of Anesthesia/Journal canadien d'anesthésie* 2020;67(6):732-45. doi: 10.1007/s12630-  
38 020-01620-9  
39 126. Wu V, Noel CW, Forner D, et al. Considerations for head and neck oncology practices  
40 during the coronavirus disease 2019 (COVID-19) pandemic: Wuhan and Toronto experience.  
41 *Head Neck* 2020;42(6):1202-08. doi: 10.1002/hed.26205 [published Online First: 2020/04/28]  
42 127. Zangrillo A, Beretta L, Silvani P, et al. Fast reshaping of intensive care unit facilities in a  
43 large metropolitan hospital in Milan, Italy: facing the COVID-19 pandemic emergency. *Crit*  
44 *Care Resusc* 2020 [published Online First: 2020/04/02]  
45 128. Zarzaur BL, Stahl CC, Greenberg JA, et al. Blueprint for Restructuring a Department of  
46 Surgery in Concert With the Health Care System During a Pandemic: The University of  
47 Wisconsin Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1386 [published Online  
48 First: 2020/04/15]  
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3 129. Zeng L, Su T, Huang L. Strategic plan for management in oral and maxillofacial surgery  
4 during COVID-19 epidemic. *Oral Oncol* 2020;105:104715. doi:  
5 10.1016/j.oraloncology.2020.104715 [published Online First: 2020/04/20]  
6  
7 130. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular  
8 diagnosis and treatment in gastrointestinal surgery department during the outbreak of  
9 coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-  
10 26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]  
11  
12 131. Zizzo M, Bollino R, Castro Ruiz C, et al. Surgical management of suspected or  
13 confirmed SARS-CoV-2 (COVID-19)-positive patients: a model stemming from the experience  
14 at Level III Hospital in Emilia-Romagna, Italy. *Eur J Trauma Emerg Surg* 2020 doi:  
15 10.1007/s00068-020-01377-2 [published Online First: 2020/04/30]  
16  
17 132. Zoia C, Bongetta D, Veiceschi P, et al. Neurosurgery during the COVID-19 pandemic:  
18 update from Lombardy, northern Italy. *Acta Neurochir (Wien)* 2020;162(6):1221-22. doi:  
19 10.1007/s00701-020-04305-w [published Online First: 2020/03/31]  
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## BACKGROUND

The novel coronavirus (COVID-19) has spread across the globe with unrelenting speed. At the time of writing over 4 million cases have been confirmed, among them more than 200,000 fatalities<sup>1</sup>. In addition to protecting those most vulnerable in our societies, efforts to curb further disease escalation (e.g., travel restrictions, physical distancing measures) have had a focal objective: prevent case surges that could overwhelm healthcare institutions or further aggravate existing shortages in personal protective equipment (PPE), ventilators, and hospital capacity.

Medical institutions have themselves also taken steps to maximize the availability of staff, PPE, ventilators and intensive care unit (ICU) capacity in the case that external ‘curve flattening’ practices are not sufficient. Most notably, surgical programs have suspended non-urgent (or elective) surgical procedures, often defined as procedures for which a delay of three (3) months or longer would not result in any significant adverse effect to the patient<sup>2,3</sup>. These changes span nearly all surgical specialties from oncology to orthopedics and have thrust patients, providers and programs into previously unexplored territory.

While the governing bodies of surgical practice have recommended alterations to non-urgent surgical service delivery, they have not always provided explicit instructions on how programs should approach the change. As such, different groups have likely taken different approaches to surgical triage and service delivery and it remains unclear who has done what where, and why? Further, the impacts of postponing non-urgent surgeries on the physical, psychological, emotional and professional well-being of patients and practitioners are either anecdotal or unknown<sup>4</sup>. Lastly, as COVID-19 begins to release its grip on the world and a level of post-pandemic normalcy returns, programs will be tasked with rebuilding the surgical capacity necessary to reschedule and resume postponed procedures. Evidence on the experiences of other

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3 groups doing so in the context of COVID-19 and other public health emergencies (i.e., H1N1,  
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5 Ebola, SARS) will be paramount in guiding subsequent approaches.  
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8 To address the aforementioned knowledge gaps, we will conduct a rapid review of the  
9  
10 literature to synthesize evidence on how surgical resources were allocated in response to  
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12 COVID-19 and other public health emergencies, how these reallocations impacted patients,  
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14 practitioners and broader health systems, and what approaches have been taken to rebuild,  
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16 reorganize and resume surgical service delivery. This review will not only help explain how  
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18 international surgical programs responded to this unprecedented emergency and what the  
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20 consequences were, but will also provide the evidence-base necessary to guide responses to this  
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22 current and any future pandemic event.  
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## 28 **METHODS**

### 29 **Study Design**

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33 The planned review will answer three questions: (1) How have surgical resources been  
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35 allocated in response to COVID-19, (2) What are the patient- and system-level consequences of  
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37 reorganizing surgical resources, and (3) How have resources been reorganized to resume surgical  
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39 services? We will focus on surgeries identified as “elective” or “non-urgent”. However, to avoid  
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41 limiting study eligibility unnecessarily no set definition for this term will be used and we will  
42  
43 instead report the definition used by each included study.  
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### 49 **Search Strategy**

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51 An electronic search strategy was developed by the investigators (CO, KS) prior to being  
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53 reviewed and refined by collaborators with context expertise in surgery and literature review  
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3 (JNK, AKR). The search strategy includes subject headings, keywords and synonyms identifying  
4 the public health emergencies of interest as well as the surgical specialties likely affected by  
5 COVID-19 (Appendix A). Headings and keywords were adapted for use in each database. Given  
6 the diversity of the research questions related to this review no study design or publication type  
7 constraints will be applied to the search. Further, since (by definition) the impacts of a pandemic  
8 span many countries, no language restrictions will be applied. However, to deliver on the study  
9 objectives in a timely fashion, studies not easily translated by members of the research team will  
10 be subsequently excluded from the review.  
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22 We will conduct comprehensive searches of Ovid MEDLINE (including Epub Ahead of  
23 Print, In-Process & Other Non-Indexed Citations) and EMBASE from database inception  
24 onwards. Since much of the information related to the questions of this review is likely  
25 unpublished (i.e., joint statements, recommendations and guidelines from surgical colleges) we  
26 will also complete a detailed grey literature search. An *a priori* designed plan for this search has  
27 been developed (Appendix B) and will follow methodological recommendations by including  
28 targeted website searching, advanced and general Google searching and contact with knowledge  
29 experts<sup>5</sup>. Further, the reference lists from all included studies will be examined for any additional  
30 relevant studies not captured in the formal database and grey literature searches.  
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#### 44 **Study Selection**

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46 In accordance with recommendations from the Cochrane Methods Group and World  
47 Health Organization Alliance for Health Policy and Systems Research, the titles and abstracts of  
48 all retrieved items will be reviewed by one of two independent researchers (CO, KM) with a  
49 third, independent researcher (KS) serving as duplicate reviewer for a random 25% sample of all  
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3 references<sup>6,7</sup>. Eligibility criteria varies such that the relevance of studies is determined by the  
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5 research question to which they pertain. For the first question on how surgical resources have  
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7 been allocated we will include any study that examines or discusses organization of surgical  
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9 resources and patients during COVID-19 or other public health emergency (i.e., triage criteria,  
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11 allocation of hospital resources if they include surgery, PPE for the operating room staff). To  
12  
13 address the second question – consequences of reorganizing surgical resources- we will include  
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15 any studies that examine patient- and/or system-level surgical outcomes during COVID-19 or  
16  
17 other public health emergencies (i.e., adverse events, length of stay, ICU admissions). Lastly, to  
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19 determine how resources have been organized to resume non-urgent surgical services we will  
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21 include any study that examines resuming surgical services after COVID-19 or another public  
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23 health emergency.  
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29 Full texts of studies not excluded in the title and abstract phase will then be reviewed in  
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31 duplicate by the same researchers to ensure applicability to any of the research questions. Any  
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33 articles identified as meeting the pre-specified eligibility criteria at this stage will be included in  
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35 the final review. Interrater agreement on inclusion for the 25% sample of titles and abstracts  
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37 reviewed in duplicate as well as the full texts will be measured with a Cohen's kappa ( $\kappa$ ) statistic  
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39 and corresponding 95% confidence interval. At all stages of the review an unbiased third party  
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41 will be available to resolve any sustained disagreements between reviewers. The full study  
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43 selection process including reasons for full text exclusions will be reported using a Preferred  
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45 Reporting Items for Systematic Reviews and Meta-Analyses flow diagram<sup>8</sup>.  
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## 51 **Outcomes of Interest**

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3 Study information will be collected to answer the research questions of steps taken to  
4 respond to emergencies and rebuild capacity (see data extraction section below), but these  
5 questions are not outcome oriented and as such specific outcomes data for these questions will  
6 not be collected. However, the second research question surrounding the consequences of  
7 altering non-urgent surgical programming will require the collection of both quantitative and  
8 qualitative outcomes in order to provide the desired holistic understanding of impacts.  
9 Specifically, we will assess patient-level outcomes including the incidence of adverse events  
10 (i.e., negative event leading to patient harm and caused by management (or lack thereof) rather  
11 than the underlying condition of the patient), mortality, and quotes discussing emotional and  
12 psychological impacts of delays. We will also evaluate impacts on the healthcare system using  
13 measures of resource utilization such as number of emergency department visits, number of  
14 visits to a healthcare provider, length of hospital or ICU stay, as well as qualitative statements  
15 from practitioners and hospital administrators.  
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### 35 **Data Extraction**

36 Any relevant study and outcome data will be extracted from included studies by one  
37 researcher using a standardized data abstraction form. For all studies this form will guide the  
38 collection of information including date of publication, country where study was conducted,  
39 study design, definition of elective or non-urgent surgery, and characteristics of study sample (if  
40 applicable). The data extraction form is also designed to collect information specific to each of  
41 the three research questions such as selected surgical triage criteria, patient and health system-  
42 level outcomes, and detailed emergency response plans. A second independent researcher will  
43 review all data abstraction forms to verify their completion and accuracy.  
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### **Study Quality (Risk of Bias) Assessment**

This rapid review will aim to synthesize quantitative outcomes whenever possible but will largely involve scoping the available evidence on surgical service delivery during public health emergencies. Given this broad aim and the decision to include all study designs, quality appraisal for the included studies is not feasible and will not be performed.

### **Data Synthesis, Analysis and Reporting**

Study and sample information will be described in a narrative review and summarized in a data table. We do not anticipate being able to conduct a meta-analysis of quantitative outcomes and will instead synthesize outcomes data qualitatively with support from descriptive statistics whenever possible. Any summary tables for outcomes will be stratified by the three research questions to maximize clarity. Any within-study comparisons (e.g., incidence of adverse events in patients with delayed versus non-delayed surgery) will be considered significant at a two-tailed p-value <0.05.

### **Ethics and Dissemination**

This review will only include secondary data sources and as such there are no applicable ethical considerations. Following completion, this review will become an integral part of evidence-based guidelines to support decisions about allocating resources and organizing surgical care in the era of COVID-19 and during subsequent public health emergencies. The rapid review will also be submitted to peer-reviewed journals to reach the target audiences of patients, policy makers, practitioners and surgical program administrators.

## Limitations

The rapidly evolving nature of surgical programming during the COVID-19 situation demands an equally rapid synthesis and dissemination of key evidence. A rapid review therefore supersedes a traditional systematic review, but with this decision come methodological limitations. First, it is possible that much of the identified evidence emerges from non-traditional sources and grey literature and as a result, may be of a lower methodological quality than that from peer-reviewed sources. However, the goal of this review is not to evaluate quantitative outcomes at potential risk of bias but to instead collate the diversity of available information from surgical programs worldwide to inform decision-making. As such the potential negative impacts of lower study quality are of less concern. Secondly, the landscape of evidence specific to COVID-19 changes daily. While the selection of a set date for literature search is important for reporting and review reproducibility, it may lead to the omission of relevant information released beyond this date. We believe, however, that a current date selected for the literature search will span a period of time where some countries are in the process of recovering their surgical services while others remain in the throes of the pandemic. This will maximize the chances that sufficient evidence to answer all research questions is up to date and available.

## CONCLUSION

This paper describes the methodology for a planned rapid review that will synthesize evidence on the changes to, impacts of, and recovery of non-urgent surgical service delivery during COVID-19 and other public health emergencies. As post-pandemic normalcy begins to return and non-urgent surgeries resume, the evidence from this review will inform

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3 recommendations for allocating and organizing care while mitigating any potential negative  
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5 impacts resulting from changes in service delivery.  
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For peer review only

## References

1. Johns Hopkins University Resource Center. Coronavirus COVID-19 global cases. Accessed May 6, 2020. <https://coronavirus.jhu.edu/map.html>
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures. March 13, 2020. Accessed May 13, 2020. [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.aspx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.aspx)
3. Shared Health Manitoba. COVID-19 Provincial guidance on management of elective surgery. March 25, 2020. Accessed May 13, 2020. <https://sharedhealthmb.ca/files/covid-19-elective-surgery.pdf>
4. Tam DY, Naimark D, Sander B, Barrett K, Khan YA, Mac S, et al. COVID-19: Predicting consequences of curtailing outpatient scheduled cardiac procedures in the face of COVID healthcare resource needs in Ontario. 2020.
5. Godin K, Stapleton J, Kirkpatrick SI, Hanning RH, Leatherdale ST. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Systematic Reviews*. 2015;4:138-162.
6. Garrity C, Gartlehner G, Kamel C, King VJ, Nussbaumer-Streit B, et al. Cochrane Rapid Reviews: Interim guidance from the Cochrane Rapid Reviews Methods Group. March 2020.
7. Tricco AC, Langlois EV, Strauss SE, editors. *Rapid reviews to strengthen health policy and systems: a practical guide*. Geneva: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.
8. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Review and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*. 2009;6(7):e10000097.

## Appendices

### Appendix A: Ovid MEDLINE Electronic Search Strategy

#### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

##### Search Strategy:

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- 1 exp Disease Outbreaks/ (96117)
  - 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
  - 3 1 or 2 (231940)
  - 4 exp Coronavirus (13456)
  - 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
  - 6 Coronaviridae Infections/ (900)
  - 7 coronaviridae/ or coronavirus/ (3916)
  - 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
  - 9 Hemorrhagic Fever, Ebola/ (5316)
  - 10 SARS Virus/ (3038)
  - 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
  - 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
  - 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
  - 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
  - 15 (coronavir\*) adj2 (infection\*).mp. (8441)
  - 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
  - 17 General Surgery/ (38626)
  - 18 Orthopedic Procedures/ (25371)
  - 19 Traumatology/ (3474)
  - 20 Neurosurgery/ (14892)
  - 21 Obstetrics/ (22533)
  - 22 Anesthesia/ (62587)
  - 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
  - 24 exp Arthroplasty, Replacement/ (54362)
  - 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
  - 26 (surger\* or operation\* or procedure\*).mp. (3638036)
  - 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
  - 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
  - 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)

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3 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)  
4 31 3 and 16 and 30 (2075)  
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## Appendix B: Grey Literature Search Plan

### GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms  
“coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery”  
OR “guidelines”

#### NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

#### GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

#### GENERAL SURGICAL GROUPS/COLLEGES

Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)

American College of Surgeons (<https://www.facs.org>)

European Surgical Association (<https://www.europeansurgicalassociation.org>)



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2  
3 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
4 French Surgical Association  
5 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
6 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
7 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
8 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
9 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
10 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
11 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
12 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
13 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
14 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
15  
16  
17

18 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
19 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
20 OR “Surgery” OR “non-urgent” OR “guidelines”  
21

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23 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
24 past last click for relevance.  
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26 STEP 4) Contact with Knowledge Experts.  
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## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Page 1: Title
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 3: Abstract
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Pages 5,6: Introduction
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 6: Introduction
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Not registered given rapid nature of review.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 8: Methods- Study Eligibility
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 6: Methods- Search Strategy
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix A
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Pages 7,8: Methods- Study Selection
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 9: Methods- Data Extraction
Data items	11	List and define all variables for which data	Page 9: Methods-



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		were sought and any assumptions and simplifications made.	Outcomes of Interest
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Page 10: Methods- Study Quality (ROB) Assessment
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 10: Methods- Data Synthesis, Analysis and Reporting
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Pages 10,11: Results- Search Results & Figure 1: PRISMA Flow chart
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Page 11: Results- Description of Studies & Table 1 (Individual) & Figure 2 (Summary)
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Table 1
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Pages 11-16: Results- Reorganization of Surgical Services & Impact of Reorganizing Surgical Services & Rebuild Surgical Capacity
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Pages 16 to 18: Discussion
Limitations	20	Discuss the limitations of the scoping review process.	Page 18, 19: Discussion
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Page 19: Discussion
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	NA

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.



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3 † A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g.,  
4 quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping  
5 review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).  
6 ‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the  
7 process of data extraction in a scoping review as data charting.  
8 § The process of systematically examining research evidence to assess its validity, results, and relevance before  
9 using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable  
10 to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used  
11 in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).  
12

13  
14 From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews  
15 (PRISMA ScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.  
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For peer review only



# BMJ Open

## Surgery & COVID-19: A rapid scoping review of the impact of the first wave of COVID-19 on surgical services

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043966.R3
Article Type:	Original research
Date Submitted by the Author:	12-May-2021
Complete List of Authors:	O'Rielly, Connor; University of Calgary, Community Health Sciences Ng-Kamstra, Joshua; University of Calgary Cumming School of Medicine, Department of Critical Care Medicine Kania-Richmond, Ania; Alberta Health Services Dort, Joseph; University of Calgary, White, Jonathan; University of Alberta, Surgery Robert, Jill; Alberta Health Services Brindle, Mary; University of Calgary Cumming School of Medicine, Department of Pediatrics Sauro, Khara; University of Calgary Cumming School of Medicine,
<b>Primary Subject Heading</b>:	Surgery
Secondary Subject Heading:	Health services research
Keywords:	SURGERY, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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Manuscripts



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3 Surgery & COVID-19: A rapid scoping review of the impact of the first wave of COVID-19 on  
4 surgical services  
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38 Word Count: 3894 words  
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41 Keywords: public health emergency, surgical services, healthcare resource utilization, health  
42 services  
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3 **ABSTRACT (278/300 words)**  
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5 **Objectives:** To understand how surgical services have been reorganized during and following  
6 public health emergencies, particularly the first wave of the COVID-19 pandemic, and the  
7 consequences for patients, healthcare providers and healthcare systems.  
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14 **Design:** A rapid scoping review.  
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19 **Setting:** We searched the MEDLINE, Embase and grey literature sources for documents, and  
20 press releases from governments and surgical organizations or associations.  
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26 **Participants:** Studies examining surgical service delivery during public health emergencies  
27 including COVID-19, and the impact on patients, providers and healthcare systems were  
28 included.  
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35 **Primary and secondary outcome measures:** Primary outcomes were strategies implemented  
36 for the reorganization of surgical services. Secondary were the impacts of reorganization and  
37 resuming surgical services, such as; adverse events (including morbidity and mortality), primary  
38 care and emergency department visits, length of hospital and ICU stay, and changes to surgical  
39 waitlists.  
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49 **Results:** One hundred and thirty-two studies were included in this review; 111 described  
50 reorganization of surgical services, 55 described the consequences of reorganizing surgical  
51 services and six reported actions taken to rebuild surgical capacity in public health emergencies.  
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3 Reorganizations of surgical services were grouped under six domains: case selection/triage, PPE  
4 regulations and practice, workforce composition and deployment, outpatient and inpatient patient  
5 care, resident and fellow education, and the hospital or clinical environment. Service  
6 reorganizations led to large reductions in non-urgent surgical volumes, increases in surgical wait  
7 times, and impacted medical training (i.e., reduced case involvement) and patient outcomes (e.g.,  
8 increases in pain). Strategies for rebuilding surgical capacity were scarce, but focused on the  
9 availability of staff, PPE, and patient readiness for surgery as key factors to consider before  
10 resuming services.  
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24 **Conclusions:** Reorganization of surgical services in response to public health emergencies  
25 appears to be context-dependent and has far-reaching consequences that must be better  
26 understood in order to optimize future health system responses to public health emergencies.  
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## ARTICLE SUMMARY

### Strengths and limitations of the study:

- This rapid scoping review provides an exhaustive and rigorous summary of the academic and grey literature regarding modifications to surgical services in response to public health emergencies, especially the first wave of COVID-19.
- This study did not limit studies based on location or language of publication to ensure contributions from worldwide voices in the context of a worldwide pandemic.
- Both quantitative and qualitative outcomes were included, with a mix of inductive and deductive data abstraction approaches to provide a comprehensive understanding of surgical services during public health emergencies.
- Studies with potential relevance to this question are emerging at an unprecedented rate in response to the COVID-19 pandemic and as such, some may not be included in the current review.

## 1 INTRODUCTION

2 The novel SARS-CoV-2 (COVID-19) virus has spread across the globe with unrelenting  
3 speed. At the time of writing, over 88 million cases have been confirmed with 1.9M fatalities.<sup>1</sup>

4 To protect the most vulnerable in our societies, efforts to curb further escalation (e.g., travel  
5 restrictions, physical distancing) have had a focal objective: to prevent surges that could  
6 overwhelm healthcare including shortages in personal protective equipment (PPE), ventilators,  
7 and hospital capacity.

8 Medical institutions have taken steps to maximize staff, PPE, ventilators, and intensive  
9 care unit (ICU) capacity in case public health efforts to ‘flatten the curve’ are insufficient. Most  
10 notably, surgical programs have suspended non-urgent (or ‘elective’) surgical procedures. Non-  
11 urgent surgeries are often defined as procedures for which a delay of three months or longer  
12 would not result in significant adverse effects to the patient.<sup>2 3</sup> These changes have thrust  
13 patients, providers, and healthcare organizations into previously unexplored territory.

14 While governing bodies such as colleges and academies of surgery have made  
15 recommendations to alter surgical service delivery in response to COVID-19, they have not  
16 always provided explicit instructions on how programs should operationalize the  
17 recommendations. As such, approaches to surgical triage and service delivery remain unclear:  
18 who has done what where, and why? Further, the impacts of adopting these recommendations on  
19 surgical programs, and more importantly, the physical and psychological well-being of patients  
20 and healthcare providers have only been hypothesized.<sup>4</sup> Lastly, once COVID-19 begins to  
21 release its grip on the world and the post-pandemic recovery begins, programs will be tasked  
22 with rebuilding the surgical capacity necessary to reschedule and tackle the backlog of postponed  
23 procedures. Evidence distilled from the experiences of others in the context of COVID-19 and

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3 1 other public health emergencies (i.e., H1N1, Ebola, SARS) is needed to guide approaches to  
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5 2 surgical service delivery.  
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8 3 To enable evidence-informed reorganization and resumption of non-urgent surgeries  
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10 4 during COVID-19 and for future public health emergencies, we conducted a rapid scoping  
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12 5 review to identify and map the available literature. Our objective was to understand how surgical  
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14 6 services have been reorganized during and following public health emergencies, particularly the  
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16 7 first wave of the COVID-19 pandemic, and the consequences of these changes for patients,  
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18 8 healthcare providers and healthcare systems.  
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## 24 10 **METHODS**

### 25 26 11 **Study Design**

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28 12 This scoping review followed the Joanna Briggs Institute methodology and Preferred  
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30 13 Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews  
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32 14 (PRISMA-ScR) checklist.<sup>5 6</sup> The rapidly evolving situation of the current COVID-19 pandemic  
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34 15 demanded a similarly rapid evidence synthesis. Therefore, methodological concessions  
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36 16 recommended by the World Health Organization and Cochrane guidance for rapid reviews were  
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38 17 made.<sup>7 8</sup> Specifically, following a pilot exercise involving triplicate review and consensus for 50  
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40 18 abstracts only a 25% random sample of the remaining abstracts were reviewed in duplicate.  
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42 19 Further, while language limitations were not applied to the search, manuscripts not written in  
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44 20 English that could not be translated by members of the research team were not eligible for data  
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46 21 extraction, although their references were still included. This review addressed three research  
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48 22 questions to achieve our objective: 1) How have surgical services been reorganized in response  
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50 23 to public health emergencies, especially the first wave of the COVID-19 pandemic? 2) What are  
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1 the patient-, healthcare provider-, and system-level consequences of reorganizing surgical  
2 services? and 3) What approaches have been used for resuming surgical services?

#### 4 **Search Strategy**

5 The search strategy was developed by two investigators (CO, KS) and refined by others  
6 with context expertise in surgery and literature review methodology (JNK, AKR). The search  
7 strategy included subject headings, keywords, and synonyms identifying public health  
8 emergencies in general and specific public health emergencies (Ebola, SARS-CoV1, H1N1,  
9 MERS), and surgery; and were tailored for each database (Appendix A). Given the exploratory  
10 nature of the review we did not filter by study design or publication type, and since the impacts  
11 of a pandemic spans many countries there were no language restrictions.

12 We used the search strategy to search MEDLINE (including Epub Ahead of Print, In-  
13 Process & Other Non-Indexed Citations) and Embase from inception until May 8, 2020.  
14 Anticipating pertinent information may not be published (i.e., joint statements,  
15 recommendations, and guidelines from surgical colleges) we supplemented the database search  
16 with a structured grey literature search including targeted website searching, advanced and  
17 general Google searching, and contact with knowledge experts (Appendix A).<sup>9</sup> The reference  
18 lists of included studies were screened for relevant studies not otherwise captured.

#### 20 **Study Selection**

21 Titles and abstracts were reviewed by one of two independent reviewers with a third,  
22 independent reviewer screening 25% of randomly selected references in duplicate. Full texts of  
23 studies considered potentially eligible at title/abstract screening phase by at least one reviewer

1 were reviewed in duplicate by two reviewers for eligibility. Any disagreement between  
2 reviewers at the full text screening phase was resolved through discussion and did not necessitate  
3 a third reviewer. If studies were excluded at the full text screening phase, the reason for  
4 exclusion was noted. Full text articles meeting eligibility criteria were included and data were  
5 abstracted using a standardized data abstraction form (Appendix B). At both stages of screening,  
6 a pilot sample of 50 articles were jointly reviewed by both reviewers to ensure reliable  
7 application of eligibility criteria between reviewers.

## 8

### 9 **Study Eligibility**

10 Studies were eligible for inclusion if they discussed alterations to surgical services during  
11 public health emergencies and reported: 1) reorganization of surgical services, 2) impact of  
12 reorganizing surgical services on patients, healthcare providers, or healthcare system or 3)  
13 approaches to resuming surgical capacity. Studies of any design or publication date were eligible  
14 for inclusion. Studies in any language were eligible, but consistent with rapid review methods,  
15 studies not easily translated by authors were excluded from the data synthesis, although citations  
16 are still provided. Studies were excluded if they described: only urgent interventions arising  
17 during a hospital admission (e.g., emergency tracheostomy, caesarean section), settings beyond  
18 in-patient acute care (e.g., outpatient clinics including dental clinics), changes to surgical service  
19 delivery not made in direct response to a public health emergency, and healthcare services not  
20 specifically related to surgical service.

21 Notably, our intention was to include guidelines that made recommendations regarding  
22 provision of surgical services; however, a high-quality review of guidelines was published<sup>10</sup>  
23 during the preparation of this review and as such, we chose to exclude guidelines.

1

## 2 **Data Extraction**

3 Data were abstracted by one reviewer, and verified by a second reviewer, using a  
4 standardized data abstraction form (Appendix B). Data included: date of publication, country,  
5 study design, definition of non-urgent surgery, characteristics of study sample (if applicable),  
6 outcomes of interest for the three research questions, detailed below.

## 8 **Outcomes of Interest**

9 Our primary outcomes were reorganization of surgical services, impact of reorganization  
10 and resuming surgical services. We intentionally included a broad array of outcomes and used an  
11 inductive approach to data abstraction to gain a comprehensive understanding of surgical  
12 services and the impact during public health emergencies.

13 We collected qualitative data from studies reporting on changes to surgical programming,  
14 conceptualized into five categories: changes to triage criteria or case selection, changes to PPE  
15 practices, workforce changes, changes to patient care, changes to resident and fellow education,  
16 and environmental changes. Qualitative and quantitative data on the impact of reorganization of  
17 surgical services was organized by impact on: patients, providers and healthcare system. To  
18 illustrate temporal changes, data preceding, during and after the precipitating event were  
19 collected whenever possible. Quantitative variables of interest included: adverse events  
20 (including morbidity and mortality), primary care and emergency department visits, number of  
21 hospital and ICU admissions, length of hospital and ICU stay, number of surgical procedures  
22 performed and number of procedures cancelled, care costs, and wait times for non-urgent  
23 surgery. Qualitative variables included narrative description of patient or physician experience,

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3 1 written descriptions of changes to physician remuneration, or comments surrounding surgical  
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5 2 waitlist composition. Qualitative data was also collected on details of efforts to rebuild capacity  
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8 3 to surgical services.  
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## 10 4 11 12 5 **Study Quality (Risk of Bias) Assessment** 13

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15 6 Given the aim of a rapid scoping review is not to appraise evidence but to map the  
16  
17 7 available literature,<sup>11</sup> quality appraisal of included studies was not performed.  
18

## 19 8 20 21 9 **Data Synthesis, Analysis and Reporting** 22

23  
24 10 Consistent with our objectives and scoping review methodology,<sup>12</sup> we did not to perform  
25  
26 11 quantitative analysis, but did use descriptive statistics to summarize quantitative outcomes. We  
27  
28 12 characterized and mapped the available emerging evidence using an inductive qualitative  
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30  
31 13 approach. Specifically, two authors (CO, KS) familiarized themselves with the included studies  
32  
33 14 and, throughout the data extraction process, continuously identified and specified recurrent  
34  
35 15 categories emerging from the data. This was a non-linear process that continued until both  
36  
37  
38 16 authors were satisfied that the selected categories represented all important aspects of the  
39  
40 17 evidence. The penultimate categories are presented. Data were synthesized and presented  
41  
42 18 separately for each of the three research questions.  
43  
44

## 45 19 46 47 20 **Patient and Public Involvement** 48

49 21 Patients and the public were not involved in study design, execution or interpretation.  
50  
51 22

## 52 53 54 23 **Statement of Ethics Approval** 55 56 57 58 59 60



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3 1 Ethics approval was not required because this study did not involve humans or animals,  
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5 2 but rather only included published data.  
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## 10 4 **RESULTS**

### 11 5 **Search Results**

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14 6 A total of 3 013 unique scholarly articles and 106 sources of grey literature were  
15  
16 7 identified, of which 702 were considered eligible for full text review. After full text review, 120  
17  
18 8 studies and five documents from the grey literature were included. Screening of the reference  
19  
20 9 lists of included articles led to seven additional studies being included for a total of 132 included  
21  
22 10 studies. Thirty-seven studies contributed data to more than one of the research questions  
23  
24 11 resulting in the qualitative synthesis of 111 studies assessing alterations to service delivery, 55  
25  
26 12 studies evaluating the consequences of these changes, and six studies enumerating their  
27  
28 13 procedures for rebuilding capacity (Table 1). The flow of evidence sources within the study is  
29  
30 14 detailed in Figure 1. One Spanish language study was translated for inclusion,<sup>13</sup> but two studies  
31  
32 15 could not be readily translated therefore they are not included in the synthesis.<sup>14 15</sup>  
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### 40 17 **Description of Studies**

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42 18 The majority of included studies were published in 2020 about COVID-19 (87.9%,  
43  
44 19 n=116); fewer studies were related to other public health emergencies: SARS (7.58%, n=10),  
45  
46 20 Ebola (2.27%, n=3), H1N1(1.52%, n=2), and MERS (0.76%, n=1). Over two thirds of the  
47  
48 21 included studies (74.2%) emerged from the countries hit earliest by COVID-19; China (14.4%,  
49  
50 22 n=19), Singapore (8.33%, n=11), Italy (19.7%, n=26), and the USA (31.8%, n=41). While many  
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52 23 studies described the experiences of their surgical departments as a whole, oncology (15.9%,  
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1 n=21), orthopedics (13.6%, n=18), and neurosurgery (11.4%, n=15) were the specialties most  
2 prominently represented. Summaries of descriptive study information are shown in Figure 2.

#### 3 4 **Reorganization of Surgical Service**

5 A number of categories emerged from the 108 studies describing reorganization of  
6 surgical services. Nearly all studies reported partial, with most reporting full cessation of non-  
7 urgent surgeries at their centre, albeit with varying definitions of “non-urgent” (e.g., can be  
8 safely postponed for 3 months) and “urgent” (e.g., patient would have adverse outcome if not  
9 completed within 7 days). Changes to service delivery were focused on six domains: case  
10 selection/triage, PPE regulations and practice, workforce composition and deployment,  
11 outpatient and inpatient patient care, resident and fellow education, and the hospital or clinical  
12 environment (Table 2). The three domains that were most frequently reported (case  
13 selection/triage, patient care, and workforce) are described in greater detail below.

14  
15 *1. Changes to Case Selection and Triage Procedures.* The countries and surgical specialties most  
16 effected by pandemic-related changes to service delivery are described above; however, the issue  
17 of which patients can safely undergo what surgical procedures was also discussed in the included  
18 studies. We identified cancelling or postponing “non-urgent” surgeries was almost universal.  
19 Most often hospitals cancelled surgeries via telephone or text message, but some studies  
20 identified that patients initiated their own surgical cancellations due to concerns with safety and  
21 nosocomial infection. While urgent surgeries were triaged according to routine practice, new  
22 triage decisions were made for non-urgent (including oncology) procedures. Methods for triaging  
23 non-urgent procedures varied across studies, from the use of guideline supported checklists of

1  
2  
3 1 eligible procedures to virtual multidisciplinary meetings where the treating surgeon presented  
4  
5 2 details of the case (e.g., patient characteristics, acuity, imaging) to a larger group representing  
6  
7  
8 3 many surgical specialties to reach consensus on each case.  
9  
10 4

11  
12 5 *2. Changes to Patient Care.* Sixty-two studies reported complete cessation or marked reduction  
13  
14 6 of in-person, non-urgent outpatient clinic visits. In these studies, only urgent patients and those  
15  
16 7 requiring post-operative suture or staple removal were granted in-person visits under strict  
17  
18 8 conditions including mask wearing, negative symptom check, history or temperature pre-  
19  
20 9 screening. Studies specific to COVID-19 almost universally filled the resulting care gap for  
21  
22 10 patients deemed “non-urgent” using telephone or video-based telemedicine. Interfaces used  
23  
24 11 include, but were not limited to Zoom, WeChat, Facetime, telephone, and SMS text messaging.  
25  
26 12 A reported advantage of telemedicine was the ability to not only follow-up with returning  
27  
28 13 patients but to also continue consultations and establish contact with new patients who would  
29  
30 14 require care when non-urgent surgeries resumed. While some admitted a historical reluctance to  
31  
32 15 transition to video-based telemedicine and reported early concerns with their ability to establish  
33  
34 16 secure connections with patients, frequently their worries faded with use and many reported  
35  
36 17 telemedicine would remain integrated in their practices beyond the pandemic.  
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45 19 *3. Changes to the Workforce.* Fourteen of the included studies describe changing the workforce  
46  
47 20 into a minimum of two teams; a “contaminated” team providing care to infected patients and a  
48  
49 21 “clean” team managing those not infected. When these teams were kept separate from one  
50  
51 22 another both inside and outside of the hospital setting, surgical departments were able to  
52  
53 23 continue managing the inevitable emergencies (as well as non-urgent procedures in some  
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1 settings) without cross contamination during the public health emergencies. New work rotations  
2 and shift schedules were created to ensure this structure was sustainable, often with extra  
3 healthcare providers designated to replace those with exposures and to provide adequate time off  
4 to prevent burnout. This practice was only possible with wards, operating rooms, and pathways  
5 (i.e. corridors, elevators) that are separated under the same “clean” and “contaminated”  
6 designation. In the most extreme case, entire hospitals were designated for each patient group, as  
7 was done by Singapore during SARS<sup>16</sup> and Italy during COVID-19.<sup>17</sup>

8

### 9 **Impact of Reorganizing Surgical Services**

10 Of the 55 studies with data relevant to this question, 42 were focused on changes in  
11 surgical volumes with six reporting changes to surgical waitlist time or composition, four  
12 underlining changes to resident and fellow involvement in surgery, and two showing changes in  
13 patient pain, anxiety, and depression. These recurring outcome measures are summarized below  
14 with data for all studies relevant to this question shown in Appendix C.

15

16 *Changes in Surgical Volumes.* Thirty-seven studies provided data for this outcome, with 37.8%  
17 (n=14) reporting a greater than 75% reduction and 70.3% (n=26) reporting a greater than 50%  
18 reductions in their overall or site specific non-urgent surgical volumes (Figure 3a). Not all  
19 studies reported reductions; as one study from an oncology “hub” hospital in Italy reported a  
20 20% increase in their surgical volumes, likely due to more cases being diverted to their hospital  
21 during the COVID-19 pandemic.<sup>18</sup>

22

1 *Changes in Resident/Fellow Involvement in Surgical Activities.* Four studies<sup>19-22</sup> reported on this  
2 outcome; two survey-based case series, one resident-level case study and one study containing  
3 both survey and case log data. The reductions in surgical involvement for residents are shown by  
4 quartile in Figure 3b.

5  
6 *Changes to Waitlist Length and Composition.* Five studies<sup>23-27</sup> reported data for this outcome.  
7 One centre reported a 64% increase in length of their minor colorectal surgery waitlist<sup>26</sup> and  
8 another centre (head and neck oncological surgery program) reported a 500% increase in latency  
9 from diagnosis to surgery.<sup>27</sup> One study reported no waitlist deaths during the COVID-19  
10 pandemic<sup>25</sup> while another saw a small decrease in the number of weekly waitlist deaths.<sup>24</sup> A  
11 single study identified more patients leaving their renal transplantation waitlist due to mortality  
12 or clinical deterioration.<sup>23</sup>

13  
14 *Changes in Patient Pain, Anxiety, and Depression.* Two studies<sup>28 29</sup> reported pain, anxiety, and  
15 depression among more than half of waitlist patients; 42.1% experienced anxiety, and 26.3%  
16 experienced depression (Figure 3c). The leading reported cause of patient anxiety was a lack of  
17 knowledge about when their surgeries would be rescheduled. Other than a single study  
18 describing the negative financial effects of the COVID-19 pandemic,<sup>30</sup> impacts on healthcare  
19 providers and their practices were rarely discussed.

## 20 21 **Rebuild Surgical Capacity**

22 A total of seven studies reported the experience of rebuilding surgical capacity in their  
23 departments, hospitals, or systems; all studies referred to the COVID-19 pandemic. One study

1 from China reported reopening non-urgent surgeries with close consideration of risk for imported  
2 transmission but did not provide further detail of triage or prioritization.<sup>31</sup> Among studies that  
3 changed their surgical triage practices, patients were prioritized for surgery based on procedure  
4 acuity or urgency (i.e., risk to patients if surgery were further delayed), resource intensity, and  
5 procedural complexity. Four studies<sup>32-35</sup> noted that prior to resuming non-urgent surgeries,  
6 availability of the staff, (Operating Room) ORs, PPE, and testing was necessary to prepare for a  
7 large and complicated surgical backlog.

8

## 9 **DISCUSSION**

10 This review identified over 3,000 evidence sources, 132 of which were included.  
11 Approaches to reorganizing surgical services varied between studies and centers, but the  
12 cancellation or postponement of non-urgent surgeries such as arthroplasty surgeries for chronic  
13 joint pain, coronary artery bypass graft surgery for asymptomatic individuals, and primary  
14 gastric bypass surgery was nearly universal.<sup>2</sup> The most frequently reported change to surgical  
15 services was modified triage criteria for surgical cases, workforce, and approach to patient care.  
16 Many studies reported a decrease in surgical volumes due to public health emergencies, while a  
17 few reported the non-surgical impacts such as patient wellbeing or changes in healthcare  
18 utilization beyond the surgical wards. Very few studies described their experience resuming  
19 surgical services after a public health emergency.

20 The varied approaches to providing surgical services during a public health emergency  
21 identified in this review illustrate that a “one size fits all” approach does not exist. Changes to  
22 surgical services likely depends on the characteristics of specific centers and their patients. While  
23 several guidelines have been published with recommendations on how to provide surgical care

1 during COVID-19, we chose to exclude guidelines and recommendations from this review for  
2 two reasons: 1) a high quality review of surgical recommendations for the response to COVID-  
3 19 was published by one of the authors just prior to this study<sup>10</sup> and 2) because there is abundant  
4 evidence suggesting guidelines and recommendations for practice are frequently not  
5 implemented into clinical practice.<sup>36-42</sup> Some of the guideline recommendations in the review by  
6 Søreide et al.<sup>10</sup> were implemented within the included studies in the present review; such as  
7 creating areas within-hospital for ‘clean’ and ‘contaminated’ cases and workforce redeployment  
8 to critical care. However, other recommendations were infrequently noted, such as the dedicated  
9 use of isolated, negative pressure ORs for patients with COVID-19. These resource intensive  
10 practices may not have been attainable under the pressures of managing public health  
11 emergencies and may not be feasible in low-resource settings.

12  
13 Changes to surgical services, such as cancelling or postponing non-urgent surgeries may  
14 be necessary to manage public health emergencies to reduce the risk of contamination and  
15 increase capacity within hospitals. However, the impact of these changes remains poorly  
16 understood. Many studies reported decreases in surgical volumes, but few other variables were  
17 explored with regards to the impact on patients, providers, and healthcare systems. Five studies  
18 examined the impact of changes to surgical services among physicians and trainees, and found  
19 that training was compromised in some specialties.<sup>19-22</sup> The finding that medical training was  
20 compromised is particularly important for understanding the downstream and long-term  
21 repercussions of the response to public health emergencies; decreases in surgical volumes and  
22 clinical hours for trainees could have negative and unintended effects on the future quality and  
23 safety of patient care.<sup>43</sup> Notably, the impacts of public health emergencies on medical training

1 and education were almost exclusively evaluated for residents and fellows, failing to consider the  
2 limited access that current medical undergraduate students continue to encounter when trying to  
3 explore surgical specialties. This is unlikely to affect the quality of patient care but may present  
4 later in the form of decreased career satisfaction and engagement, both of which have been  
5 associated with burnout<sup>44</sup>. Studies examining the effects of surgical service alterations on  
6 patients noted negative effects on mental health outcomes,<sup>28 29</sup> pain,<sup>28</sup> and an increased incidence  
7 of death among surgical patients.<sup>23 24 45</sup>

8       Very few studies described specific actions undertaken to rebuild and resume pre-public  
9 health emergencies surgical capacity. This may be due to the fact that most included studies  
10 examined the ongoing COVID-19 pandemic, or because few places have implemented specific  
11 plans to date. Included studies did describe consideration of system-level factors like availability  
12 of PPE and ORs. However, more patient-centric considerations such as organizing childcare and  
13 requesting time away from their job during a pandemic, are needed. Additionally, research  
14 suggesting that surgical capacity can be rebuilt with sufficient PPE and OR space may be falling  
15 victim to the lack of identified evidence exploring the wellbeing of the surgical workforce.  
16 Resolving surgical backlogs by increasing available resources relies on the high functioning of a  
17 workforce of surgeons and allied practitioners not overtaken by burnout and stress, something  
18 that has not yet been borne out in the COVID-19 research. In other specialties involved with the  
19 care of surgical patients, moral distress has seen a marked increase making it reasonable to  
20 believe these same emotional impacts will be felt by members or surgical teams globally. Patient  
21 perspectives will also play a role in the rebuild; one study reported 14% of surgical patients  
22 initiated the cancellation of their surgery,<sup>28</sup> which suggests patient readiness for surgery during-



1 and post-COVID-19 should be considered. For evidence to inform policy, additional research is  
2 needed to understand the impacts of different approaches for resuming surgical services.

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10 This study is, to our knowledge, the first comprehensive scoping review of evidence  
11 around reallocation of surgical services during public health emergencies. While this study has  
12 several strengths, including a comprehensive search of academic and grey literature sources, and  
13 a mix of inductive and deductive data abstraction approaches, there are some limitations that  
14 should be considered when interpreting our findings. We modified the Joanna Briggs  
15 methodology for scoping reviews,<sup>5</sup> according to the World Health Organization and Cochrane's  
16 guidance on conducting rapid reviews,<sup>7,8</sup> with the intent of balancing rigor with a timely and  
17 policy-responsive review of the literature. Also, given that the evidence around the COVID-19  
18 pandemic is growing at an unprecedented rate, we are aware that additional studies have been  
19 published since we ran our search strategy, especially around resuming surgical services. In  
20 order to mitigate this limitation, an ongoing effort to pivot this study into a living review is  
21 underway to ensure the data presented is up to date. This will involve re-running the MEDLINE,  
22 Embase and grey literature search strategies every 2 months in order to incorporate new evidence  
23 into the existing manuscript. Notably, this review did not identify evidence from any low- or  
24 middle-income countries who may face unique challenges during a pandemic compared to high  
25 income countries described in our review. It is also likely that during the global pandemic, many  
26 healthcare institutions have been focused on coping with COVID-19 instead of publishing their  
27 experiences; we hope more organizations will add their experience to the literature.

1  
2  
3 1 In conclusion, we report early evidence of the operational changes that have occurred  
4  
5 2 internationally in response to public health emergencies which could inform the ongoing  
6  
7 3 response to COVID-19 and future public health emergencies. This study identified a gap in our  
8  
9 4 understanding of the impact of these changes on patients, providers, and the healthcare system  
10  
11 5 which should be the focus of research moving forward to provide an evidence-based approach to  
12  
13 6 managing surgical patients in future public health emergencies.  
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19 8 **Original protocol for the study:** The original unpublished protocol for this study is included as  
20  
21 9 a supplementary file (Appendix D).  
22  
23

#### 24 10 **Author Contributions**

25  
26 11 CO contributed to the design and conceptualization of the review, analysis and interpretations of  
27  
28 12 the data, and drafting and revising the manuscript; JSN contributed to the design of the review,  
29  
30 13 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
31  
32 14 version of the manuscript; AKR contributed to the design of the review, interpretation of the  
33  
34 15 data, providing feedback on the manuscript, and gave approval of the final version of the  
35  
36 16 manuscript; JCD contributed to the interpretation of the data, providing feedback on the  
37  
38 17 manuscript, and gave approval of the final version of the manuscript; JW contributed to the  
39  
40 18 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
41  
42 19 version of the manuscript; JR contributed to the interpretation of the data, providing feedback on  
43  
44 20 the manuscript, and gave approval of the final version of the manuscript; MB contributed to the  
45  
46 21 interpretation of the data, providing feedback on the manuscript, and gave approval of the final  
47  
48 22 version of the manuscript; KMS contributed to the design and conceptualization of the review,  
49  
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1 analysis and interpretations of the data, providing feedback on the manuscript, and gave approval  
2 of the final version of the manuscript.

#### 3 4 **Competing interest statement**

5 All authors declare that they have no competing interests in accordance with the International  
6 Committee of Medical Journal Editors uniform declaration of competing interests.

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9 This study did not receive grant from any funding agency in the public, commercial or not-for-  
10 profit sectors.

#### 11 **Data Sharing Statement**

12 All data presented have been previously published. Our data will be made available upon  
13 reasonable request to the corresponding author.

## References

1. Johns Hopkins Center for Systems of Science and Engineering (CSSE). COVID-19 Dashboard. [Available from: <http://coronavirus.jhu.edu/map.html>] accessed January 8, 2020.
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures 2020 [Available from: [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.ashx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.ashx)] accessed July 2, 2020.
3. Shared Health Manitoba. COVID-19: The New Normal. [Available from: <https://sharedhealthmb.ca/files/covid-19-memo-the-new-normal.pdf>] accessed May 8, 2020.
4. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *British Journal of Surgery* 2020 doi: doi:10.1002/bjs.11746 [published Online First: 2020 May 12]
5. Peters MDJ, Godfrey CM, McInerney P, et al. Chapter 11: Scoping Reviews. In: E. A, Z. M, eds. Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute, 2017.
6. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018;169(7):467-73. doi: 10.7326/m18-0850 [published Online First: 2018/09/05]
7. Tricco AC, Langlois EV, Straus SE, Editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization, 2017. Licence: CC BY-NC-SA 3.0 IGO
8. Garritty C, Gartlehner G, Kamel C, et al. Cochrane Rapid Reviews. Interim Guidance from the Cochrane Rapid Review Methods Group., 2020.
9. Godin K, Stapleton J, Kirkpatrick SI, et al. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Syst Rev* 2015;4:138. doi: 10.1186/s13643-015-0125-0 [published Online First: 2015/10/27]
10. Soreide K, Hallet J, Matthews JB, et al. Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services. *Br J Surg* 2020 doi: 10.1002/bjs.11670 [published Online First: 2020/05/01]
11. Munn Z, Peters MDJ, Stern C, et al. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology* 2018;18(1):143. doi: 10.1186/s12874-018-0611-x
12. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 2005;8(1):19-32. doi: 10.1080/1364557032000119616
13. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
14. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*









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60
- Experimental Ophthalmology* 2020;38(3):200-03. doi:  
<http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100>
15. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular diagnosis and treatment in gastrointestinal surgery department during the outbreak of coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]
  16. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
  17. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19 pandemic: an expert opinion from China, South Korea, Italy, United States of America, Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2 [published Online First: 2020/04/30]
  18. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi: 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]
  19. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
  20. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
  21. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First: 2020/05/10]
  22. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published Online First: 2020/05/04]
  23. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]
  24. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online First: 2020/05/03]
  25. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int* 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]
  26. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]

- 1
- 2
- 3
- 4 27. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service disruption
- 5 during COVID-19 in Hong Kong through telehealth and multi-institutional collaboration.
- 6 *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]
- 7
- 8 28. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively
- 9 Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020
- 10 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]
- 11
- 12 29. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a waiting
- 13 list for thoracic surgery during the outbreak of Severe Acute Respiratory
- 14 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013
- 15
- 16 30. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic.
- 17 *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published
- 18 Online First: 2020/04/15]
- 19
- 20 31. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences and
- 21 Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*
- 22 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First:
- 23 2020/04/29]
- 24
- 25 32. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery
- 26 and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi:
- 27 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
- 28
- 29 33. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by
- 30 the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi:
- 31 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
- 32
- 33 34. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-Being,
- 34 2020.
- 35
- 36 35. BC Ministry of Health. A Commitment to Surgical Renewal in BC. Canada, 2020.
- 37
- 38 36. Ben-Menachem E, French JA. Guidelines--are they useful? *Epilepsia* 2006;47 Suppl 1:62-4.
- 39 doi: 10.1111/j.1528-1167.2006.00663.x [published Online First: 2006/10/19]
- 40
- 41 37. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice
- 42 guidelines? A framework for improvement. *Jama* 1999;282(15):1458-65. [published
- 43 Online First: 1999/10/27]
- 44
- 45 38. Farquhar C, Kofa E, Slutsky J. Clinicians' attitudes to clinical practice guidelines: a systematic
- 46 review. *Med J Aust* 2002;177:502-06.
- 47
- 48 39. Grimshaw JM, Russell IT. Effect of clinical guidelines on medical practice: a systematic
- 49 review of rigorous evaluations. *Lancet* 1993;342(8883):1317-22. [published Online First:
- 50 1993/11/27]
- 51
- 52 40. Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline
- 53 dissemination and implementation strategies. *Health technology assessment*
- 54 (*Winchester, England*) 2004;8(6):iii-iv, 1-72. [published Online First: 2004/02/13]
- 55
- 56 41. Lomas J, Anderson G, Domnick-Pierre K, et al. Do practice guidelines guide practice? The
- 57 effect of a consensus statement on the practice of physicians. *N Engl J Med*
- 58 1989;321(19):1306-11.
- 59
- 60 42. Lugtenberg M, Burgers JS, Westert GP. Effects of evidence-based clinical practice guidelines
- on quality of care: a systematic review. *Quality & safety in health care* 2009;18(5):385-
92. doi: 10.1136/qshc.2008.028043 [published Online First: 2009/10/09]

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3 43. Ahmed N, Devitt KS, Keshet I, et al. A systematic review of the effects of resident duty hour  
4 restrictions in surgery: impact on resident wellness, training, and patient outcomes. *Ann*  
5 *Surg* 2014;259(6):1041-53. doi: 10.1097/sla.0000000000000595 [published Online First:  
6 2014/03/26]  
7  
8 44. Rao S, Ferris TG, Hidrue MK, et al. Physician Burnout, Engagement and Career Satisfaction in  
9 a Large Academic Medical Practice. *Clin Med Res* 2020;18(1):3-10. doi:  
10 10.3121/cmr.2019.1516 [published Online First: 2020/01/20]  
11  
12 45. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic  
13 Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty*  
14 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]  
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**Table 1.** Description of included studies

Author	Year	Country	Public Health Emergency	Surgical Specialty	Changes to Surgical Services	Impact of Changes Examined	Resumption of Services
Alvarez-Gallego	2020	Spain	COVID-19	General			
Ammar	2020	USA	COVID-19	Neurosurgery			
Amparore	2020	Italy	COVID-19	Urology		Changes in clinical and surgical resident involvement	
Ansarin	2020	Italy	COVID-19	Oncology (Head & Neck)			
Bashir	2020	UK	COVID-19	Vascular			
Ben Abdallah	2020	France	COVID-19	Vascular			
Bernucci	2020	Italy	COVID-19	Neurosurgery		Changes in surgical volume	
Bettinelli	2020	Italy	COVID-19	Orthopedics			
Bolkan	2014	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bolkan	2018	Norway	Ebola	Obstetrics		Changes in non-Ebola admissions and surgical volumes	
Bourlon	2009	Mexico	H1N1	—		Number of surgical cancellations	



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Bradford	2003	China	SARS	GI		Changes in admissions and surgical volumes	
Brethauer	2020	USA	COVID-19	GI			Operative cases placed in “depot” to be rescheduled alongside new teleconsults
Brown	2020	USA	COVID-19	Orthopedics		Patient pain, anxiety and physical function	
Buckstein	2020	USA	COVID-19	Radiation Oncology			
Bundu	2016	Sierra Leone	Ebola	—		Changes in ED/ward admissions and surgical activity	
Burke	2020	USA	COVID-19	Neurosurgery			
Busin	2020	Italy	COVID-19	Ophthalmology		Changes in demand/donations for cornea bank	Set reasonable timelines for patients requiring low acuity surgery. Surgical work schedule extended into evenings and weekends
Cai	2020	USA	COVID-19	Otolaryngology		Changes in resident	

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							educational programming
Cakmak	2020	Turkey	COVID-19	Oncology (Breast)			Changes in surgical volume
Carenzo	2020	Italy	COVID-19	—			Changes in surgical volume
Cenzato	2020	Italy	COVID-19	Neurosurgery			
Chan	2006	China	SARS	Ophthalmology			
Chee	2004	Singapore	SARS	—			
Chew	2020	Singapore	COVID-19	General			
Chisci	2020	Italy	COVID-19	Vascular			Changes in surgical volume
Civantos	2020	USA	COVID-19	Oncology (Head & Neck)			Number of surgical cancellations
D'Apolito	2020	Italy	COVID-19	Orthopedics			Changes in surgical volume
de Vries	2020	Netherlands	COVID-19	Transplant			Changes in transplantation volumes
Ding	2020	Singapore	COVID-19	Orthopedics			
Dominguez-Gil	2020	Spain	COVID-19	Transplant			Changes in transplantation volumes
Doussot	2020	France	COVID-19	Oncology			Changes in surgical volume
Dowdell	2020	USA	COVID-19	Orthopedics			
Ducournau	2020	France	COVID-19	Plastics			
Eichberg	2020	USA	COVID-19	Neurosurgery			
Ficarra	2020	Italy	COVID-19	Urology			Proportion of surgical cancellations














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							initiated by patients
Fontanella	2020	Italy	COVID-19	Neurosurgery			Changes in surgical volume
Fontanella	2020	Italy	COVID-19	Neurosurgery			
Giorgi	2020	Italy	COVID-19	Spinal			
Givi	2020	USA	COVID-19	Oncology (Head & Neck)			Changes in fellow educational programming
Gomez-Barrena	2020	Spain	COVID-19	Orthopedics			Changes in surgical volume
Gouveia	2020	Portugal	COVID-19	Vascular			
Guerci	2020	Italy	COVID-19	General			
Gupta	2020	India	COVID-19	Oncology (Head & Neck)			
Haines	2003	China	SARS	Obstetrics			
Hemingway	2020	USA	COVID-19	Vascular			Changes in clinical and surgical volumes
Hormati	2020	Iran	COVID-19	GI			
Hu	2020	China	COVID-19	Oncology			
Jean	2020	USA	COVID-19	Neurosurgery			Changes in surgical volume
Kempa	2020	Poland	COVID-19	Electrophysiology			Changes in surgical volume
Kessler	2020	USA	COVID-19	Neurosurgery			
Konda	2020	USA	COVID-19	Orthopedics			
Kuo	2010	Argentina	H1N1	Ophthalmology			Changes in clinical and surgical volumes
Lai	2020	China	COVID-19	Ophthalmology			
Lancaster	2020	USA	COVID-19	—			Changes in surgical volume

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Langer	2020	USA	COVID-19	Plastics		
Lauterio	2020	Italy	COVID-19	Transplant		Changes in transplantation volumes
Lee	2020	China	COVID-19	Oncology (Head & Neck)		Changes in surgical wait times
Leong Tan	2020	Singapore	COVID-19	Vascular		
Li	2020	China	COVID-19	Transplant		
Liebensteiner	2020	Austria	COVID-19	Orthopedics		
Liu	2003	Singapore	SARS	Anesthesia		
Mak	2020	China	COVID-19	Plastics		
Marti	2020	Spain	COVID-19	Oncology (Breast)		
Maurizi	2020	Italy	COVID-19	Thoracic		Changes in surgical volume
McBride	2020	Australia	COVID-19	—		
McMillan	2020	Canada	COVID-19	—		Prioritization first of patients who would be at increased risk with further delay, followed by those waiting longest
Meneghini	2020	USA	COVID-19	Orthopedics		
Meyer	2020	France	COVID-19	Neurosurgery		Changes in surgical volume
Morgan	2020	UK	COVID-19	Orthopedics		
Nair	2020	India	COVID-19	Ophthalmology		
Nassar	2020	USA	COVID-19	General		
Park	2020	USA	COVID-19	Otolaryngology		

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Park	2020	South Korea	MERS	—		Changes in surgical volume	
Patel	2020	USA	COVID-19	Oncology (Head & Neck)			
Patel	2020	USA	COVID-19	Otolaryngology			
Pelt	2020	USA	COVID-19	Orthopedics		Number of surgical postponements	Surgeries prioritized based on complexity and predicted LOS, scheduling only completed if appropriate PPE and screening available.
Pittet	2020	Switzerland	COVID-19	—		Changes in surgical volume	
Prachand	2020	USA	COVID-19	—		Number of surgical cancellations	
Price	2020	USA	COVID-19	Dermatology			
Qadan	2020	USA	COVID-19	Oncology (GI/Hepatobiliary)			
Ralli	2020	Italy	COVID-19	Otolaryngology			
Rampinelli	2020	Italy	COVID-19	Oncology (Head & Neck)		Changes in surgical volume	
Randelli	2020	Italy	COVID-19	Orthopedics			
Ricciardi	2020	Italy	COVID-19	Neurosurgery			
Ross	2020	USA	COVID-19	—		Changes in clinical volumes	

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Rubin	2020	USA	COVID-19	Electrophysiology		Changes in lab capacity and consultation volumes
Rubin	2020	USA	COVID-19	Electrophysiology		Changes in surgical volume
Salengar	2020	USA	COVID-19	Cardiac		
Sarpong	2020	USA	COVID-19	Orthopedics		Changes in surgical volume
Schull	2007	Canada	SARS	—		
Schwarzkopf	2020	USA	COVID-19	Orthopedics		Changes in surgical volume
Scullen	2020	USA	COVID-19	Neurosurgery		
Seese	2020	USA	COVID-19	Cardiac		
Sethi	2020	USA	COVID-19	GI		Changes in surgical and consultation volumes
Shen	2020	China	COVID-19	—		Scheduling resumed following consideration of reduced risk of imported transmission and growing waitlist
Shih	2020	China	COVID-19	Ophthalmology		
Shokri	2020	USA	COVID-19	Plastics		Changes in surgical volume
Sobel	2020	USA	COVID-19	Urology		

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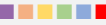





Sun	2020	China	COVID-19	Neurosurgery		Emergency surgeries performed	
Tan	2004	Singapore	SARS	Anesthesia			
Tan	2020	Singapore	COVID-19	Urology		Changes in surgical and consultation volumes	
Tan	2020	China	COVID-19	Neurosurgery			
Tay	2020	Singapore	COVID-19	Orthopedics		Changes in surgical volumes	
Tay	2020	Singapore	COVID-19	Orthopedics			
Thaler	2020	Austria	COVID-19	Orthopedics			
Tolone	2020	Italy	COVID-19	—			
Too	2020	Singapore	COVID-19	Interventional Radiology			
Topf	2020	USA	COVID-19	Oncology (Head & Neck)			
Tsui	2005	China	SARS	Cardiac			
Tzeng	2020	USA	COVID-19	Oncology			
Unal	2020	Turkey	COVID-19	Vascular			
Vaccaro	2020	USA	COVID-19	Orthopedics		Changes in physician remuneration and staffing	
Valenza	2020	Italy	COVID-19	Oncology		Changes in surgical volumes	
van de Haar	2020	Netherlands	COVID-19	Oncology			
Various	2020	Canada	COVID-19	—		Number of surgical postponements	Calling patients to assess their ability to reschedule,

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contracting private facilities with focus on urgent surgeries, patients waiting twice their clinical benchmarks or surgeries with minimal LOS

Various	2020	Ireland	COVID-19	—			
Vicini	2020	Italy	COVID-19	Oncology (Breast)		Changes in surgical volumes	
Vlantis	2004	China	SARS	Otolaryngology		Changes in outpatient and surgical volumes	
Walker	2020	USA	COVID-19	—		Number of surgical cancellations	Assess readiness of staff to safely resume high volumes of surgery and ensured availability of rapid in-house testing
Wan	2004	China	SARS	Thoracic		Patient anxiety and depression	
Wasser	2020	Israel	COVID-19	Ophthalmology			



Williams	2020	USA	COVID-19	Ophthalmology		Number of surgeries rescheduled
Wong	2020	Singapore	COVID-19	Anesthesia		
Wu	2020	China	COVID-19	Oncology (Head & Neck)		
Xiaolei	2020	China	COVID-19	Ophthalmology		
Zangrillo	2020	Italy	COVID-19	—		
Zarzaur	2020	USA	COVID-19	—		
Zeng	2020	China	COVID-19	Oncology (Head & Neck)		
Zizzo	2020	Italy	COVID-19	—		
Zoia	2020	Italy	COVID-19	Neurosurgery		

Domains of change to surgical services, represented numerically:

-  Changes to case selection and surgical triage
-  Changes to PPE protocols and practices
-  Changes to the surgical workforce.
-  Changes to inpatient and outpatient care
-  Changes to resident and fellow education
-  Changes to the environment

*Abbreviations:* — =data not provided, COVID-19=Coronavirus Disease 2019, ED=Emergency department, GI=Gastrointestinal; LOS=Length of stay, PPE=Personal protective equipment, SARS=Severe Acute Respiratory Syndrome

**Table 2.** Reorganization of surgical services, by domain.

<b>Change Domain</b>	<b>Number of Studies (%)</b>	<b>Examples of Change</b>
Triage or Case Selection	80 (74.7)	<ol style="list-style-type: none"> <li>1. Prioritization of patients based on pre-defined levels of acuity;</li> <li>2. Virtual multidisciplinary meetings or tumor boards;</li> <li>3. Creation of specialty-specific lists outlining surgery-eligible and ineligible ailments, often with inclusion of case-by-case category.</li> <li>4. Postponement based on high-risk patient characteristics (i.e., older age, multimorbidity) and expected need for ICU.</li> </ol>
PPE	63 (58.3)	<ol style="list-style-type: none"> <li>1. Hospital wide surgical mask mandate for staff and attendees;</li> <li>2. Standard level of PPE outlined for all patient encounters with enhanced PPE (e.g., addition of N95 or PAPR, head and shoe covering) protocol for specific procedures or care of infected patients;</li> <li>3. Refresher instruction courses provided to all hospital staff;</li> <li>4. Trained observer supervising all perioperative donning and doffing of PPE to ensure safety and compliance.</li> </ol>
Workforce	70 (64.8)	<ol style="list-style-type: none"> <li>1. Separation of clinical staff into rotating “clean” and “dirty” teams caring for exclusively for non-infected and infected patients, respectively;</li> <li>2. Temperature and symptom screening of staff with mandated quarantine periods in cases of unprotected exposure;</li> <li>3. Case discussions, handover and clinical staff meetings transitioned to virtual format;</li> <li>4. Redeployment of staff to hospital areas requiring support (e.g., ICU), often paired with virtual training to ensure comfortable transition.</li> </ol>

Patient Care	95 (88.0)	<ol style="list-style-type: none"> <li>1. Complete cancellation or transition to telemedicine for all non-urgent and routine perioperative clinical visits;</li> <li>2. Patient temperature, symptom and travel history screening before entry to clinic (relevant for urgent surgical patients);</li> <li>3. Preference for endovascular or minimally invasive surgical approaches when possible, use of conservative care when possible (oncology);</li> <li>4. Restrictions on number of accompanying persons or visitors (often zero with some allowing maximum of 1).</li> </ol>
Resident/Fellow Education	35 (32.4)	<ol style="list-style-type: none"> <li>1. Changes to resident/fellow team structure and rotation schedules to ensure continued coverage of department and maximize resident/fellow safety;</li> <li>2. Redeployment of residents to non-specialty areas requiring clinical support;</li> <li>3. Curriculum and conferences shifted to online format to allow continued e-learning for off-duty trainees;</li> <li>4. Trainees involvement in surgical care of infected persons ceased or altered (e.g., only admitted to OR during low-risk/non-aerosolizing procedures).</li> </ol>
Environment	70 (64.8)	<ol style="list-style-type: none"> <li>1. Dedication of wards (hallways, elevators), ORs, or entire hospitals to treat for only those infected or not infected;</li> <li>2. Use of negative-pressure OR when possible;</li> <li>3. Transformation of surgical wards, ORs and outpatient clinics into patient care areas to increase surge capacity;</li> <li>4. Double occupancy patient rooms reduced to single occupancy, or</li> </ol>

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physical measures (e.g., cubicles, distanced waiting room chairs) implemented.

*Abbreviations:* ICU= Intensive care unit, PPE= Personal protective equipment, PAPR= Powered air purifying respirator, OR= Operating room.

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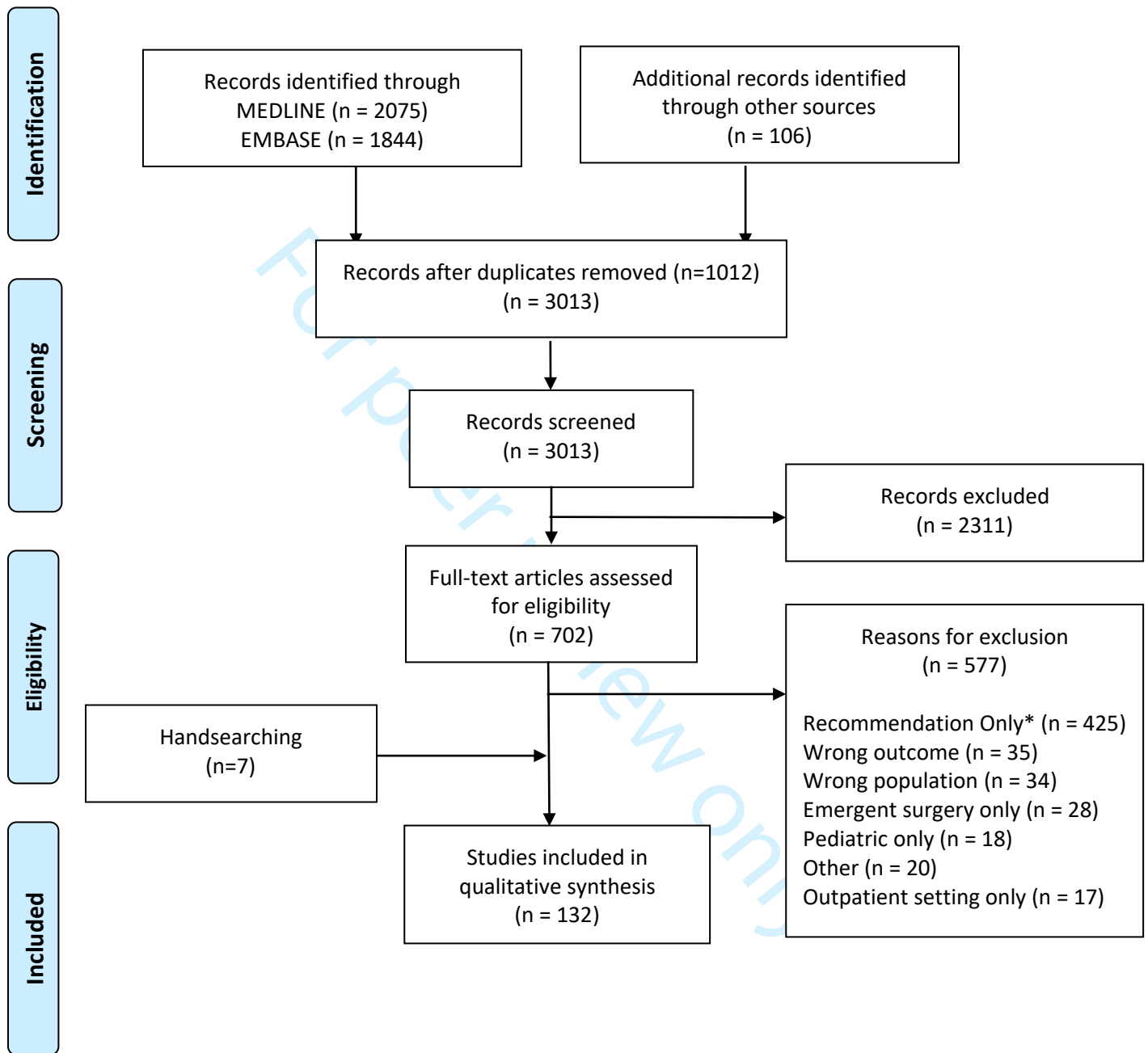
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Figure 2. Summary of study characteristics.

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For peer review only

**Figure 1.** Flow of studies in the scoping review

\*Includes guidelines, recommendation-based reviews, projections or estimations without mention of true changes to surgical programming.



**Figure 2. Study characteristics**

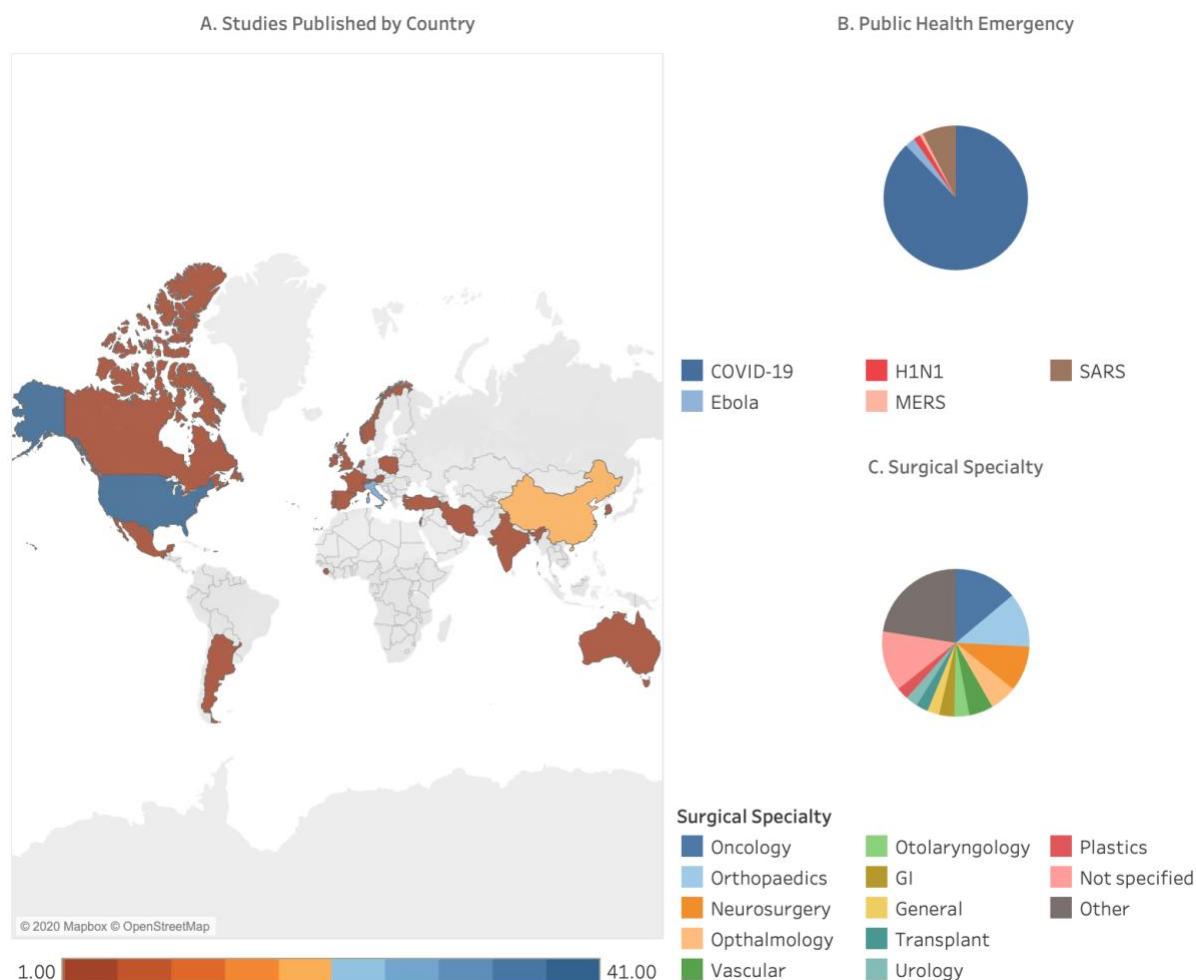


Figure 2. **A.** Country of publication, **B.** Public health emergency discussed, and **C.** Surgical specialty addressed ('Other' includes Cardiac (n=3), Anesthesia (n=3), Electrophysiology (n=3), Obstetrics and Gynecology (n=3), Thoracic (n=2), Interventional Radiology (n=1), and Dermatology (n=1)).

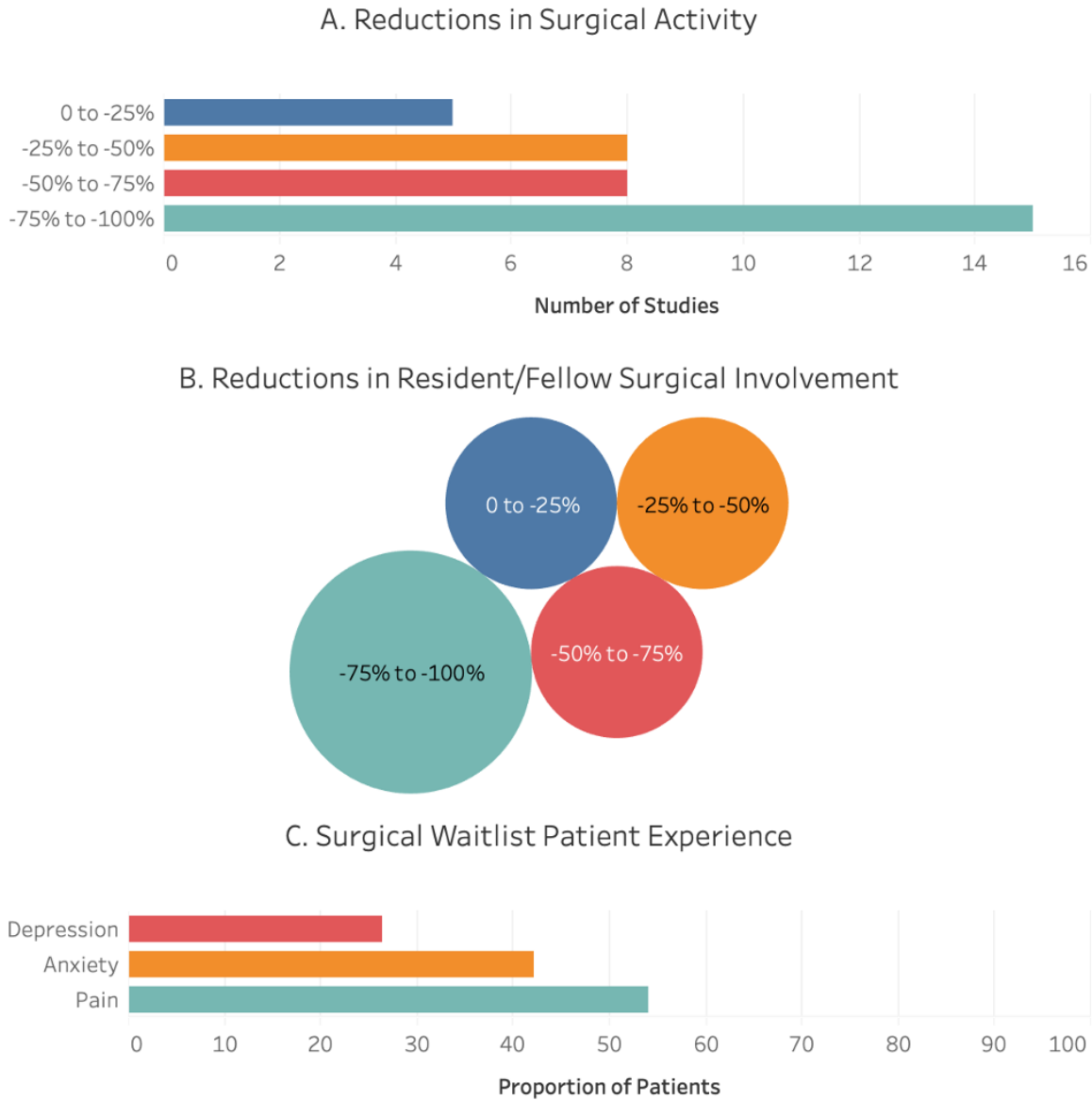
**Figure 3.** Summary of the impacts of alterations to surgical services

Figure 3. A summary of the impacts of alterations to surgical services during public health emergencies on **A.** Overall surgical activity (n=37 studies), **B.** Resident and fellow involvement in surgery (n=5 studies) where circle size represents the number of studies contributing to that quartile, and **C.** Patient experience (n=2 studies).

## Appendix A. Search Strategy

### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

#### Search Strategy:

- 
- 1 exp Disease Outbreaks/ (96117)
  - 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
  - 3 1 or 2 (231940)
  - 4 exp Coronavirus (13456)
  - 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
  - 6 Coronaviridae Infections/ (900)
  - 7 coronaviridae/ or coronavirus/ (3916)
  - 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
  - 9 Hemorrhagic Fever, Ebola/ (5316)
  - 10 SARS Virus/ (3038)
  - 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
  - 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
  - 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
  - 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
  - 15 (coronavir\*) adj2 (infection\*).mp. (8441)
  - 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
  - 17 General Surgery/ (38626)
  - 18 Orthopedic Procedures/ (25371)
  - 19 Traumatology/ (3474)
  - 20 Neurosurgery/ (14892)
  - 21 Obstetrics/ (22533)
  - 22 Anesthesia/ (62587)
  - 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
  - 24 exp Arthroplasty, Replacement/ (54362)
  - 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
  - 26 (surger\* or operation\* or procedure\*).mp. (3638036)
  - 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
  - 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
  - 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)
  - 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)
  - 31 3 and 16 and 30 (2075)
- .....

**Database: EMBASE <1974 to 2020 May 08>****Search Strategy:**

- 
- 1 exp epidemic/ (103292)
  - 2 exp pandemic/ (12990)
  - 3 1 or 2 (114458)
  - 4 pandemic influenza/ (4748)
  - 5 exp severe acute respiratory syndrome/ (8505)
  - 6 exp coronaviridae/ or coronaviridae infection/ (14928)
  - 7 coronavirinae/ (2093)
  - 8 Coronavirus infection/ (3397)
  - 9 avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ (7466)
  - 10 Ebola hemorrhagic fever/ (5712)
  - 11 exp SARS coronavirus/ (5823)
  - 12 Middle East respiratory syndrome/ (935)
  - 13 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (512)
  - 14 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. (92353)
  - 15 (wuhan adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV)).mp. (161)
  - 16 (coronavir\* adj2 infection\*).mp. (4793)
  - 17 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 (96712)
  - 18 general surgery/ (15070)
  - 19 orthopedic surgery/ (32672)
  - 20 traumatology/ (10653)
  - 21 neurosurgery/ (59847)
  - 22 obstetrics/ (34886)
  - 23 anesthesiological procedure/ (1785)
  - 24 elective surgery/ (34038)
  - 25 replacement arthroplasty/ or exp arthroplasty/ (73583)
  - 26 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. (966732)
  - 27 (surger\* or operation\* or procedure\*).mp. (5402047)
  - 28 ((elective or non-urgent adj2 (surg\* or procedure\*)).mp. (52808)
  - 29 (surg\* adj2 (procedure\* or planning or triag\* or operation\* or resource\* or backlog or re-organiz\* or postpon\* or cancel\* or capacit\* or wait time\*)).mp. (187480)
  - 30 ((clinic\* or hospital) adj2 (process\* or procedure\* or triag\* or planning or performance\* or capacit\*)).mp. (83715)
  - 31 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 (5948860)
  - 32 3 and 17 and 31 (1844)
- .....

Database	Pandemic terms Pandemic, epidemic	Disease terms COVID-19, SARS, MERS, pandemic flu (h1n1, h3n2, h5n1), ebola	Surgical terms Non-urgent/elective surgery (general, orthopedic, anesthesia, trauma, neurosurgery, obstetrics)
<b>MEDLINE</b>	exp Disease Outbreaks/ OR (pandemic* or epidemic* or outbreak* or outbreak*).mp.	exp Coronavirus OR coronavirus infections/ or severe acute respiratory syndrome/ OR Coronaviridae Infections/ OR coronaviridae/ or coronavirus/ OR Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ OR Hemorrhagic Fever, Ebola/ OR SARS Virus/ OR Middle East Respiratory Syndrome Coronavirus/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola* or middle	General Surgery/ OR Orthopedic Procedures/ OR Traumatology/ OR Neurosurgery/ OR Obstetrics/ OR Anesthesia/ OR surgical procedures, operative/ or exp elective surgical procedures/ OR exp Arthroplasty, Replacement/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent) adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triage or operation* or resource* or backlog or re-organiz* or postpone* or cancel* or capacit* or wait time*)).mp.

		east respiratory syndrome or MERS).mp. OR (wuhan) adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV).mp. OR (coronavir*) adj2 (infection*).mp.	OR ((clinic* or hospital) adj2 (process* or procedure* or triage or planning or performance* or capacit*)).mp.
<b>EMBASE</b>	exp epidemic/ OR exp pandemic/	pandemic influenza/ OR exp severe acute respiratory syndrome/ OR exp coronaviridae/ or coronaviridae infection/ OR coronavirinae/ OR Coronavirus infection/ OR avian influenza virus/ or “influenza a virus (h1n1)”/ or “influenza a virus (h3n2)”/, “influenza a virus (h5n1)”/ OR Ebola hemorrhagic fever/ OR exp SARS coronavirus/ OR Middle East respiratory syndrome/ OR (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. OR (coronavir* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV).mp. OR	general surgery/ OR orthopedic surgery/ OR traumatology/ OR neurosurgery/ OR obstetrics/ OR anesthesiological procedure/ OR elective surgery/ OR replacement arthroplasty/ or exp arthroplasty/ OR (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anaesthesia or anesthesia).mp. OR (surger* or operation* or procedure*).mp. OR ((elective or non-urgent adj2 (surg* or procedure*)).mp. OR (surg* adj2 (procedure* or planning or triag* or operation* or resource* or backlog or re-organiz* or postpon* or cancel* or

		(wuhan adj2 (coronavir* or flu or pneumonia* or COVID-19 or 2019-nCoV)).mp. OR (coronavir* adj2 infection*).mp.	capacit* or wait time*).mp. OR ((clinic* or hospital) adj2 (process* or procedure* or triag* or planning or performance* or capacit*).mp.
--	--	-----------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------

## GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms “coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery” OR “guidelines”)

## NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

## GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

## GENERAL SURGICAL GROUPS/COLLEGES

1  
 2  
 3 Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)  
 4 American College of Surgeons (<https://www.facs.org>)  
 5 European Surgical Association (<https://www.europeansurgicalassociation.org>)  
 6 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
 7 French Surgical Association  
 8 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
 9 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
 10 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
 11 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
 12 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
 13 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
 14 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
 15 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
 16 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
 17 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
 18  
 19  
 20

21  
 22 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
 23 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
 24 OR “Surgery” OR “non-urgent” OR “guidelines”  
 25

26  
 27 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
 28 past last click for relevance.  
 29

30  
 31 STEP 4) Contact with Knowledge Experts.  
 32

Source and Site	Search Terms	Potentially Relevant Results
<b>Health Groups</b>		
World Health Organization ( <a href="https://www.who.int">https://www.who.int</a> , Advanced Search)	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	10
Center for Disease Control and Prevention ( <a href="https://www.cdc.gov">https://www.cdc.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	8
European Centre for Disease Prevention and Control ( <a href="https://www.ecdc.europa.eu/en">https://www.ecdc.europa.eu/en</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	3
<b>Governments</b>		
Government of Canada ( <a href="https://www.canada.ca/en.html">https://www.canada.ca/en.html</a> )	[contains all words] elective surgery covid	4



	[contains all words] non-urgent surgery covid	
Government of BC ( <a href="https://www2.gov.bc.ca/gov">https://www2.gov.bc.ca/gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of AB ( <a href="https://www.alberta.ca">https://www.alberta.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	2
Government of SK ( <a href="https://www.saskatchewan.ca">https://www.saskatchewan.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	6
Government of MB ( <a href="https://www.gov.mb.ca">https://www.gov.mb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	4
Government of ON ( <a href="https://www.ontario.ca">https://www.ontario.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of QC ( <a href="https://www.quebec.ca/en/">https://www.quebec.ca/en/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of NB ( <a href="https://www2.gnb.ca">https://www2.gnb.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NS ( <a href="https://beta.novascotia.ca">https://beta.novascotia.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NL & LB ( <a href="https://www.gov.nl.ca">https://www.gov.nl.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of PEI ( <a href="https://www.princeedwardisland.ca">https://www.princeedwardisland.ca</a> )	[contains all words] elective surgery covid	2

	[contains all words] non-urgent surgery covid	
Government of Yukon ( <a href="https://yukon.ca">https://yukon.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	1
Government of NWT ( <a href="https://www.gov.nt.ca">https://www.gov.nt.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Nunavut ( <a href="https://www.gov.nu.ca">https://www.gov.nu.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Australia ( <a href="https://www.australia.gov.au">https://www.australia.gov.au</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Italy ( <a href="http://www.governo.it">http://www.governo.it</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of Singapore ( <a href="https://www.gov.sg">https://www.gov.sg</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Government of China ( <a href="https://www.gov.cn/english/">https://www.gov.cn/english/</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
United States Government ( <a href="https://www.usa.gov">https://www.usa.gov</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
<b>Surgical Colleges/Associations</b>		
Royal College of Physicians and Surgeons of Canada ( <a href="http://www.royalcollege.ca">http://www.royalcollege.ca</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0

<p>American College of Surgeons (<a href="https://www.facs.org">https://www.facs.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>23</p>
<p>European Surgical Association (<a href="https://www.europeansurgicalassociation.org">https://www.europeansurgicalassociation.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>College of Surgeons, Singapore (<a href="https://www.ams.edu.sg">https://www.ams.edu.sg</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>3</p>
<p>German Society of Surgery (<a href="https://www.dgch.de/index.php?id=118">https://www.dgch.de/index.php?id=118</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>
<p>Philippine College of Surgeons (<a href="https://www.pcs.org.ph">https://www.pcs.org.ph</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>11</p>
<p>Royal Australasian College of Surgeons (<a href="https://www.surgeons.org">https://www.surgeons.org</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>12</p>
<p>Royal College of Surgeons of England (<a href="https://www.rcseng.ac.uk">https://www.rcseng.ac.uk</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>7</p>
<p>Royal College of Surgeons of Ireland (<a href="https://www.rcsi.com/dublin/">https://www.rcsi.com/dublin/</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>8</p>
<p>Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<a href="https://www.aecirujanos.es">https://www.aecirujanos.es</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>1</p>
<p>Swedish Surgical Society (<a href="http://www.svenskkirurgi.se">http://www.svenskkirurgi.se</a>)</p>	<p>[contains all words] elective surgery covid [contains all words] non-urgent surgery covid</p>	<p>0</p>

The Association of Surgeons of South Africa ( <a href="http://www.surgeon.co.za">http://www.surgeon.co.za</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
The Pan African Association of Surgeons ( <a href="http://www.africansurgeons.com">http://www.africansurgeons.com</a> )	[contains all words] elective surgery covid [contains all words] non-urgent surgery covid	0
Total		111

## Appendix B. Data Abstraction Form

This form has been developed by adopting and customizing the 'Data collection form- RCTs and NRS' produced by The Cochrane Collaboration. Customization includes the addition of new sections, as well as the omission of sections not relevant to the review.

### Notes on using data extraction form:

- Be consistent in the order and style you use to describe the information for each report.
- Record any missing information as unclear or not described, to make it clear that the information was not found in the study report(s), not that you forgot to extract it.
- Include any instructions and decision rules on the data collection form, or in an accompanying document. It is important to practice using the form and give training to any other authors using the form.

### 1. General Information

1. Date form completed (dd/mm/yyyy)	/ /
2. Name of person extracting data	<input type="checkbox"/> Connor M. ORielly <input type="checkbox"/> Khara M. Sauro
3. Contact details of person extracting data	
4. Title of Article/Abstract (that data are extracted from)	
5. Study ID (plus surname of author and year of study publication)	
6. Study country of origin	
7. Study funding source	
8. Possible conflicts of interest	<input type="checkbox"/> Reported <input type="checkbox"/> Not Reported
9. Notes:	

### 2. Eligibility

Study Characteristics	Inclusion Criteria	Location in text (page#/fig#/table#)
10. Type of study (design)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	

11. Population description		
12. Focused diseases/conditions		
13. Types of outcome measures		
14. Decision (with reasons for either inclusion or exclusion)	<input type="checkbox"/> Include <input type="checkbox"/> Exclude If Exclude, explain:	
15. Notes		

**IF STUDY IS EXCLUDED FROM REVIEW, DO NOT CONTINUE**

## 2. Population and setting

	Description	Location in text (page#/fig#/table#)
16. Population description		
17. Source/setting of the population (e.g., urban, rural, ethnic group)		
18. Method(s) of recruitment of participants	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random  Method:	
19. Notes:		

## 3. Methods

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
--	------------------------------------------------	-----------------------------------------

20. Aim of study		
21. Design (e.g., cross-sectional, RCT, CCT)	<input type="checkbox"/> Case Study <input type="checkbox"/> Case Series <input type="checkbox"/> Observational	
22. Sampling technique (e.g., random or convenience)	<input type="checkbox"/> Random <input type="checkbox"/> Non-Random	
23. Study start date (dd/mm/yyyy)	/ /	
24. Study end date/duration (dd/mm/yyyy)	/ / <b>OR</b> Duration:	
25. Notes:		

#### 4. Participants

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
26. Total number of participants/Sample size		
27. Age		
28. Sex	<input type="checkbox"/> Both Sexes <input type="checkbox"/> Males <input type="checkbox"/> Females	
29. Genders Represented		
30. Country		
31. Predominant medical complaint		
32. Co-morbidities (if any)		
33. Definition of 'Frequent use' (if any)		

34. Notes:

## 5. Outcomes

Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
35. Outcome definition		
36. Time points measured		
37. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
38. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
39. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
40. Specify Outcome		
41. Outcome definition		
42. Time points measured		
43. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
44. Unit of measurement		
45. Notes:		



Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
46. Specify Outcome		
47. Outcome definition		
48. Time points measured		
49. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
50. Unit of measurement		
51. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
52. Specify Outcome		
53. Outcome definition		
54. Time points measured		
55. Unit of Measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
56. Unit of measurement		
57. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
58. Outcome definition		
59. Time points measured		

60. Domains of change	<input type="checkbox"/> Surgical triage <input type="checkbox"/> PPE <input type="checkbox"/> Workforce <input type="checkbox"/> Patient care <input type="checkbox"/> Environmental	
61. Unit of measurement	<input type="checkbox"/> Group <input type="checkbox"/> Individual	
62. Notes:		

## 6. Results and findings

*Keep only the tables for outcomes relevant to this particular study, duplicate tables as necessary.*

Outcome 1: Alterations to surgical programming (RQ1)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
63. Subgroup (if applicable, e.g., age/sex specific reporting)		
64. Results		
65. Response/non-response rate		
66. Unit of analysis (i.e., individual or group)		
67. Notes:		

Outcome 2: Patient-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
68. Subgroup (if applicable, e.g., age/sex specific reporting)		
69. Results		
70. Response/non-response rate		
71. Unit of analysis (i.e., individual or group)		
72. Notes:		

Outcome 3: System-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
73. Subgroup (if applicable, e.g., age/sex specific reporting)		
74. Results		
75. Response/non-response rate		
76. Unit of analysis (i.e., individual or group)		
77. Notes:		

Outcome 4: Practitioner-level outcomes (RQ2)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
78. Subgroup (if applicable, e.g., age/sex specific reporting)		
79. Results		
80. Response/non-response rate		
81. Unit of analysis (i.e., individual or group)		
82. Notes:		

Outcome 5: Alterations to rebuild capacity (RQ3)	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
83. Subgroup (if applicable, e.g., age/sex specific reporting)		
84. Results		
85. Response/non-response rate		
86. Unit of analysis (i.e., individual or group)		
87. Notes:		

**Research Questions informed by this study (tick only boxes matching the outcome tables kept above)**

Changes to surgical programming in response to public health emergency

- Impacts of changes to surgical programming
- Actions to rebuild surgical capacity post-public health emergency

### 7. Strengths, limitations and mitigation strategy

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
88. Strengths		
89. Limitations		
90. Strategies to overcome limitations		
91. Notes:		

### 8. Conclusion and other information

	Descriptions as stated in the article/abstract	Location in text (page#/fig#/table#)
92. Key conclusions of study authors		
93. Notes:		

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58  
59  
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For peer review only

### Appendix C. Complete list of references for included studies

1. Alvarez Gallego M, Gortazar de Las Casas S, Pascual Miguelanez I, et al. SARS-CoV-2 pandemic on the activity and professionals of a General Surgery and Digestive Surgery Service in a tertiary hospital. *Cir Esp* 2020 doi: 10.1016/j.ciresp.2020.04.001 [published Online First: 2020/04/28]
2. Ammar A, Stock AD, Holland R, et al. Managing a Specialty Service During the COVID-19 Crisis: Lessons From a New York City Health System. *Acad Med* 2020 doi: 10.1097/ACM.0000000000003440 [published Online First: 2020/04/19]
3. Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020 doi: 10.23736/S0393-2249.20.03868-0 [published Online First: 2020/04/08]
4. Ansarin M. Surgical management of head and neck tumours during the SARS-CoV (COVID-19) pandemic. *Acta Otorhinolaryngol Ital* 2020;40(2):87-89. doi: 10.14639/0392-100X-N0783 [published Online First: 2020/04/10]
5. Bashir M, Moughal S. Cardiovascular disease and surgery amid COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.479 [published Online First: 2020/05/04]
6. Ben Abdallah I. Early experience in Paris with the impact of the COVID-19 pandemic on vascular surgery. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.467 [published Online First: 2020/04/27]
7. Bernucci C, Brembilla C, Veiceschi P. Effects of the COVID-19 Outbreak in Northern Italy: Perspectives from the Bergamo Neurosurgery Department. *World Neurosurg* 2020;137:465-68 e1. doi: 10.1016/j.wneu.2020.03.179 [published Online First: 2020/04/06]
8. Bettinelli G, Delmastro E, Salvato D, et al. Orthopaedic patient workflow in CoViD-19 pandemic in Italy. *J Orthop* 2020;22:158-59. doi: 10.1016/j.jor.2020.04.006 [published Online First: 2020/05/07]
9. Bolkan HA, Bash-Taqi DA, Samai M, et al. Ebola and indirect effects on health service function in sierra leone. *PLoS Curr* 2014;6 doi: 10.1371/currents.outbreaks.0307d588df619f9c9447f8ead5b72b2d [published Online First: 2015/02/17]
10. Bolkan HA, van Duinen A, Samai M, et al. Admissions and surgery as indicators of hospital functions in Sierra Leone during the west-African Ebola outbreak. *BMC Health Serv Res* 2018;18(1):846. doi: 10.1186/s12913-018-3666-9 [published Online First: 2018/11/11]
11. Bourlon MT, Macias AE, de la Torre A, et al. Organization of a third-level care hospital in Mexico City during the 2009 influenza epidemic. *Arch Med Res* 2009;40(8):681-6. doi: 10.1016/j.arcmed.2009.10.009 [published Online First: 2010/03/23]
12. Bradford IM. Tales from the frontline: the colorectal battle against SARS. *Colorectal Dis* 2004;6(2):121-3. doi: 10.1111/j.1462-8910.2004.00600.x [published Online First: 2004/03/11]
13. Brethauer SA, Poulouse BK, Needleman BJ, et al. Redesigning a Department of Surgery during the COVID-19 Pandemic. *J Gastrointest Surg* 2020 doi: 10.1007/s11605-020-04608-4 [published Online First: 2020/04/30]
14. Brown TS, Bedard NA, Rojas EO, et al. The Effect of the COVID-19 Pandemic on Electively Scheduled Hip and Knee Arthroplasty Patients in the United States. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.052 [published Online First: 2020/05/08]

15. Buckstein M, Skubish S, Smith K, et al. Experiencing the Surge: Report from a Large New York Radiation Oncology Department During the COVID-19 Pandemic. *Adv Radiat Oncol* 2020 doi: 10.1016/j.adro.2020.04.014 [published Online First: 2020/05/08]
16. Bundu I, Patel A, Mansaray A, et al. Surgery in the time of Ebola: how events impacted on a single surgical institution in Sierra Leone. *J R Army Med Corps* 2016;162(3):212-6. doi: 10.1136/jramc-2015-000582 [published Online First: 2016/01/21]
17. Burke JF, Chan AK, Mummaneni V, et al. Letter: The Coronavirus Disease 2019 Global Pandemic: A Neurosurgical Treatment Algorithm. *Neurosurgery* 2020;87(1):E50-E56. doi: 10.1093/neuros/nyaa116
18. Busin M, Yu AC, Ponzin D. Coping with COVID-19: An Italian Perspective on Corneal Surgery and Eye Banking in the Time of a Pandemic and Beyond. *Ophthalmology* 2020 doi: 10.1016/j.ophtha.2020.04.031 [published Online First: 2020/05/08]
19. Cai Y, Jiam NT, Wai KC, et al. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. *Laryngoscope* 2020 doi: 10.1002/lary.28733 [published Online First: 2020/05/06]
20. Cakmak GK, Ozmen V. Sars-CoV-2 (COVID-19) Outbreak and Breast Cancer Surgery in Turkey. *Eur J Breast Health* 2020;16(2):83-85. doi: 10.5152/ejbh.2020.300320 [published Online First: 2020/04/15]
21. Carenzo L, Costantini E, Greco M, et al. Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. *Anaesthesia* 2020 doi: 10.1111/anae.15072 [published Online First: 2020/04/05]
22. Cenzato M, DiMeco F, Fontanella M, et al. Editorial. Neurosurgery in the storm of COVID-19: suggestions from the Lombardy region, Italy (ex malo bonum). *Journal of neurosurgery* 2020:1-2. doi: 10.3171/2020.3.JNS20960
23. Chan WM, Liu DTL, Chan PKS, et al. Precautions in ophthalmic practice in a hospital with a major acute SARS outbreak: an experience from Hong Kong. *Eye* 2006;20(3):283-89. doi: 10.1038/sj.eye.6701885
24. Chee VW, Khoo ML, Lee SF, et al. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004;100(6):1394-8. doi: 10.1097/00000542-200406000-00010 [published Online First: 2004/05/29]
25. Chew MH, Koh FH, Ng KH. A call to arms: a perspective of safe general surgery in Singapore during the COVID-19 pandemic. *Singapore Med J* 2020 doi: 10.11622/smedj.2020049 [published Online First: 2020/04/04]
26. Chisci E, Masciello F, Michelagnoli S. Creation of a vascular surgical hub responding to the COVID-19 emergency: The Italian USL Toscana Centro model. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.019 [published Online First: 2020/04/20]
27. Civantos FJ, Leibowitz JM, Arnold DJ, et al. Ethical surgical triage of patients with head and neck cancer during the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26229 [published Online First: 2020/05/02]
28. D'Apolito R, Faraldi M, Ottaiano I, et al. Disruption of Arthroplasty Practice in an Orthopedic Center in Northern Italy During the Coronavirus Disease 2019 Pandemic. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.057 [published Online First: 2020/05/07]
29. de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol* 2020:101304. doi: 10.1016/j.trim.2020.101304 [published Online First: 2020/05/07]

- 1  
2  
3 30. Ding BTK, Soh T, Tan BY, et al. Operating in a Pandemic: Lessons and Strategies from  
4 an Orthopaedic Unit at the Epicenter of COVID-19 in Singapore. *J Bone Joint Surg Am* 2020  
5 doi: 10.2106/JBJS.20.00568 [published Online First: 2020/05/08]  
6  
7 31. Dominguez-Gil B, Coll E, Fernandez-Ruiz M, et al. COVID-19 in Spain: Transplantation  
8 in the midst of the pandemic. *Am J Transplant* 2020 doi: 10.1111/ajt.15983 [published Online  
9 First: 2020/05/03]  
10  
11 32. Doussot A, Heyd B, Lakkis Z. We Asked the Experts: How Do We Maintain Surgical  
12 Quality Standards for Enhanced Recovery Programs After Cancer Surgery During the COVID-  
13 19 Outbreak? *World J Surg* 2020 doi: 10.1007/s00268-020-05546-7 [published Online First:  
14 2020/04/27]  
15  
16 33. Dowdell JE, Louie PK, Virk S, et al. Spine fellowship training reorganizing during a  
17 pandemic: perspectives from a tertiary orthopedic specialty center in the epicenter of outbreak.  
18 *Spine J* 2020 doi: 10.1016/j.spinee.2020.04.015 [published Online First: 2020/04/29]  
19  
20 34. Ducournau F, Arianni M, Awwad S, et al. COVID-19: Initial experience of an  
21 international group of hand surgeons. *Hand Surg Rehabil* 2020;39(3):159-66. doi:  
22 10.1016/j.hansur.2020.04.001 [published Online First: 2020/04/13]  
23  
24 35. Eichberg DG, Shah AH, Luther EM, et al. Letter: Academic Neurosurgery Department  
25 Response to COVID-19 Pandemic: The University of Miami/Jackson Memorial Hospital Model.  
26 *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa118 [published Online First: 2020/04/12]  
27  
28 36. Ficarra V, Mucciardi G, Giannarini G. Re: Riccardo Campi, Daniele Amparore, Umberto  
29 Capitanio, et al. Assessing the Burden of Urgent Nondeferrable Uro-oncologic Surgery to Guide  
30 Prioritisation Strategies During the COVID-19 Pandemic: Insights from Three Italian High-  
31 volume Referral Centres. *Eur Urol*. In press. <https://doi.org/10.1016/j.eururo.2020.03.054>. *Eur*  
32 *Urol* 2020 doi: 10.1016/j.eururo.2020.04.037 [published Online First: 2020/05/04]  
33  
34 37. Fontanella MM, De Maria L, Zanin L, et al. Neurosurgical Practice During the Severe  
35 Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Pandemic: A Worldwide Survey.  
36 *World Neurosurg* 2020 doi: 10.1016/j.wneu.2020.04.204 [published Online First: 2020/05/08]  
37  
38 38. Fontanella MM, Saraceno G, Lei T, et al. Neurosurgical activity during COVID-19  
39 pandemic: an expert opinion from China, South Korea, Italy, United States of America,  
40 Colombia and United Kingdom. *J Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04994-2  
41 [published Online First: 2020/04/30]  
42  
43 39. Giorgi PD, Villa F, Gallazzi E, et al. The management of emergency spinal surgery  
44 during the COVID-19 pandemic in Italy. *Bone Joint J* 2020;xxx. doi: 10.1302/0301-  
45 620X.102B6.BJJ-2020-0537 [published Online First: 2020/04/24]  
46  
47 40. Givi B, Moore MG, Bewley AF, et al. Advanced head and neck surgery training during  
48 the COVID-19 pandemic. *Head Neck* 2020 doi: 10.1002/hed.26252 [published Online First:  
49 2020/05/10]  
50  
51 41. Gomez-Barrena E, Rubio-Suarez JC, Fernandez-Baillo N, et al. Limiting spread of  
52 COVID-19 in an orthopaedic department-a perspective from Spain. *J Surg Case Rep*  
53 2020;2020(4):rjaa095. doi: 10.1093/jscr/rjaa095 [published Online First: 2020/04/30]  
54  
55 42. Gouveia EMR, Pedro LM. Vascular surgery department adjustments in the era of the  
56 COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.017 [published Online First:  
57 2020/04/20]  
58  
59 43. Guerci C, Maffioli A, Bondurri AA, et al. COVID-19: How can a department of general  
60 surgery survive in a pandemic? *Surgery* 2020;167(6):909-11. doi: 10.1016/j.surg.2020.03.012  
[published Online First: 2020/04/18]



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2  
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4  
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46  
47  
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50  
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52  
53  
54  
55  
56  
57  
58  
59  
60
44. Gupta A, Arora V, Nair D, et al. Status and strategies for the management of head and neck cancer during COVID-19 pandemic: Indian scenario. *Head Neck* 2020 doi: 10.1002/hed.26227 [published Online First: 2020/05/02]
  45. Haines CJ, Chu YW, Chung TK. The effect of Severe Acute Respiratory Syndrome on a hospital obstetrics and gynaecology service. *BJOG* 2003;110(7):643-5. doi: <http://dx.doi.org/10.1016/S1470-0328%2803%2903007-6> [published Online First: 2003/07/05]
  46. British Columbia Ministry of Health. A Commitment to Surgical Renewal in BC. Canada, 2020.
  47. Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.492 [published Online First: 2020/05/04]
  48. Hormati A, Ghadir MR, Zamani F, et al. Preventive strategies used by GI physicians during the COVID-19 pandemic. *New Microbes New Infect* 2020;35:100676. doi: 10.1016/j.nmni.2020.100676 [published Online First: 2020/04/16]
  49. Hu Y-J, Zhang J-M, Chen Z-P. Experiences of practicing surgical neuro-oncology during the COVID-19 pandemic. *Journal of neuro-oncology* 2020;148(1):199-200. doi: 10.1007/s11060-020-03489-6 [published Online First: 2020/04/10]
  50. Jean WC, Ironside NT, Sack KD, et al. The impact of COVID-19 on neurosurgeons and the strategy for triaging non-emergent operations: a global neurosurgery study. *Acta Neurochir (Wien)* 2020;162(6):1229-40. doi: 10.1007/s00701-020-04342-5 [published Online First: 2020/04/22]
  51. Kempa M, Gulaj M, Farkowski MM, et al. Electrotherapy and electrophysiology procedures during the coronavirus disease 2019 pandemic: an opinion of the Heart Rhythm Section of the Polish Cardiac Society (with an update). *Kardiol Pol* 2020;78(5):488-92. doi: 10.33963/KP.15338 [published Online First: 2020/05/06]
  52. Kessler RA, Zimering J, Gilligan J, et al. Neurosurgical management of brain and spine tumors in the COVID-19 era: an institutional experience from the epicenter of the pandemic. *J Neurooncol* 2020 doi: 10.1007/s11060-020-03523-7 [published Online First: 2020/05/07]
  53. 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 doi: 10.1097/BOT.0000000000001792 [published Online First: 2020/05/02]
  54. Kuo IC, Pellegrino F, Fornero P, et al. H1N1 pandemic and ophthalmology. *Ophthalmology* 2010;117(2):405. doi: 10.1016/j.ophtha.2009.11.035 [published Online First: 2010/02/10]
  55. Lai THT, Tang EWH, Chau SKY, et al. Stepping up infection control measures in ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. *Graefes Arch Clin Exp Ophthalmol* 2020;258(5):1049-55. doi: 10.1007/s00417-020-04641-8 [published Online First: 2020/03/04]
  56. Lancaster EM, Sosa JA, Sammann A, et al. Rapid Response of an Academic Surgical Department to the COVID-19 Pandemic: Implications for Patients, Surgeons, and the Community. *J Am Coll Surg* 2020;230(6):1064-73. doi: 10.1016/j.jamcollsurg.2020.04.007 [published Online First: 2020/04/13]
  57. Langer PD, Bernardini FP. Oculofacial Plastic Surgery and the COVID-19 Pandemic: Current Reactions and Implications for the Future. *Ophthalmology* 2020 doi: 10.1016/j.ophtha.2020.04.035 [published Online First: 2020/04/30]

- 1  
2  
3 58. Lauterio A, De Carlis R, Belli L, et al. How to guarantee liver transplantation in the north  
4 of Italy during the COVID-19 pandemic: A sound transplant protection strategy. *Transpl Int*  
5 2020 doi: 10.1111/tri.13633 [published Online First: 2020/04/30]  
6  
7 59. Lee AKF, Cho RHW, Lau EHL, et al. Mitigation of head and neck cancer service  
8 disruption during COVID-19 in Hong Kong through telehealth and multi-institutional  
9 collaboration. *Head Neck* 2020 doi: 10.1002/hed.26226 [published Online First: 2020/05/02]  
10  
11 60. Leong Tan GW, Chandrasekar S, Lo ZJ, et al. Early experience in the COVID-19  
12 pandemic from a vascular surgery unit in a Singapore tertiary hospital. *J Vasc Surg* 2020 doi:  
13 10.1016/j.jvs.2020.04.014 [published Online First: 2020/04/20]  
14  
15 61. Li Y, Yang N, Li X, et al. Strategies for prevention and control of the 2019 novel  
16 coronavirus disease in the department of kidney transplantation. *Transpl Int* 2020 doi:  
17 10.1111/tri.13634 [published Online First: 2020/05/02]  
18  
19 62. Liebensteiner MC, Khosravi I, Hirschmann MT, et al. Massive cutback in orthopaedic  
20 healthcare services due to the COVID-19 pandemic. *Knee Surg Sports Traumatol Arthrosc*  
21 2020;28(6):1705-11. doi: 10.1007/s00167-020-06032-2 [published Online First: 2020/05/02]  
22  
23 63. Liu EH, Koh KF, Chen FG. Outbreak of severe acute respiratory syndrome in Singapore  
24 and modifications in the anesthesia service. *Anesthesiology* 2004;100(6):1629-30. doi:  
25 10.1097/00000542-200406000-00062 [published Online First: 2004/05/29]  
26  
27 64. Mak ST, Yuen HK. Oculoplastic surgery practice during the COVID-19 novel  
28 coronavirus pandemic: experience sharing from Hong Kong. *Orbit* 2020:1-3. doi:  
29 10.1080/01676830.2020.1754435 [published Online First: 2020/04/17]  
30  
31 65. Marti C, Sanchez-Mendez JI. Neoadjuvant endocrine therapy for luminal breast cancer  
32 treatment: a first-choice alternative in times of crisis such as the COVID-19 pandemic.  
33 *Ecancermedicalscience* 2020;14:1027. doi: 10.3332/ecancer.2020.1027 [published Online First:  
34 2020/05/06]  
35  
36 66. Maurizi G, Rendina EA. A High-Volume Thoracic Surgery Division into the Storm of  
37 the Covid-19 Pandemic. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.03.015  
38 [published Online First: 2020/04/15]  
39  
40 67. McBride KE, Brown KGM, Fisher OM, et al. Impact of the COVID-19 pandemic on  
41 surgical services: early experiences at a nominated COVID-19 centre. *ANZ J Surg*  
42 2020;90(5):663-65. doi: 10.1111/ans.15900 [published Online First: 2020/04/08]  
43  
44 68. McMillan T, Williamson K. Resuming non-urgent surgeries and allied health services,  
45 2020.  
46  
47 69. Meneghini RM. Resource Reallocation during the COVID-19 Pandemic in a Suburban  
48 Hospital System: Implications for Outpatient Hip and Knee Arthroplasty. *J Arthroplasty* 2020  
49 doi: 10.1016/j.arth.2020.04.051 [published Online First: 2020/05/08]  
50  
51 70. Meyer M, Prost S, Farah K, et al. Spine Surgical Procedures during Coronavirus Disease  
52 2019 Pandemic: Is It Still Possible to Take Care of Patients? Results of an Observational Study  
53 in the First Month of Confinement. *Asian Spine J* 2020 doi: 10.31616/asj.2020.0197 [published  
54 Online First: 2020/05/10]  
55  
56 71. Morgan C, Ahluwalia AK, Aframian A, et al. The impact of the novel coronavirus on  
57 trauma and orthopaedics in the UK. *Br J Hosp Med (Lond)* 2020;81(4):1-6. doi:  
58 10.12968/hmed.2020.0137 [published Online First: 2020/04/29]  
59  
60 72. Nair AG, Gandhi RA, Natarajan S. Effect of COVID-19 related lockdown on ophthalmic  
practice and patient care in India: Results of a survey. *Indian J Ophthalmol* 2020;68(5):725-30.  
doi: 10.4103/ijo.IJO\_797\_20 [published Online First: 2020/04/23]

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2  
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46  
47  
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49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
73. Nassar AH, Zern NK, McIntyre LK, et al. Emergency Restructuring of a General Surgery Residency Program During the Coronavirus Disease 2019 Pandemic: The University of Washington Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1219 [published Online First: 2020/04/07]
74. Park J, Yoo SY, Ko JH, et al. Infection Prevention Measures for Surgical Procedures during a Middle East Respiratory Syndrome Outbreak in a Tertiary Care Hospital in South Korea. *Sci Rep* 2020;10(1):325. doi: 10.1038/s41598-019-57216-x [published Online First: 2020/01/17]
75. Park JS, El-Sayed IH, Young VN, et al. Development of clinical care guidelines for faculty and residents in the era of COVID-19. *Head Neck* 2020 doi: 10.1002/hed.26225 [published Online First: 2020/04/30]
76. Patel RJ, Kejner A, McMullen C. Early institutional head and neck oncologic and microvascular surgery practice patterns across the United States during the SARS-CoV-2 (COVID19) pandemic. *Head Neck* 2020;42(6):1168-72. doi: 10.1002/hed.26189 [published Online First: 2020/04/25]
77. Patel ZM, Fernandez-Miranda J, Hwang PH, et al. Letter: Precautions for Endoscopic Transnasal Skull Base Surgery During the COVID-19 Pandemic. *Neurosurgery* 2020 doi: 10.1093/neuros/nyaa125 [published Online First: 2020/04/16]
78. Pelt CE, Campbell KL, Gililand JM, et al. The Rapid Response to the COVID-19 Pandemic by the Arthroplasty Divisions at Two Academic Referral Centers. *J Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.030 [published Online First: 2020/05/02]
79. Pittet D. Hopitaux Universitaire de Genève (HUG)- A model hospital for COVID-19 patient management, 2020.
80. Prachand VN, Milner R, Angelos P, et al. Medically Necessary, Time-Sensitive Procedures: Scoring System to Ethically and Efficiently Manage Resource Scarcity and Provider Risk During the COVID-19 Pandemic. *J Am Coll Surg* 2020 doi: 10.1016/j.jamcollsurg.2020.04.011 [published Online First: 2020/04/13]
81. Price KN, Thiede R, Shi VY, et al. Strategic dermatology clinical operations during the coronavirus disease 2019 (COVID-19) pandemic. *J Am Acad Dermatol* 2020;82(6):e207-e09. doi: 10.1016/j.jaad.2020.03.089 [published Online First: 2020/04/12]
82. Qadan M, Hong TS, Tanabe KK, et al. A Multidisciplinary Team Approach for Triage of Elective Cancer Surgery at the Massachusetts General Hospital During the Novel Coronavirus COVID-19 Outbreak. *Ann Surg* 2020 doi: 10.1097/SLA.0000000000003963 [published Online First: 2020/04/18]
83. Ralli M, Greco A, de Vincentiis M. The Effects of the COVID-19/SARS-CoV-2 Pandemic Outbreak on Otolaryngology Activity in Italy. *Ear Nose Throat J* 2020;145561320923893. doi: 10.1177/0145561320923893 [published Online First: 2020/04/30]
84. Rampinelli V, Mattavelli D, Gualtieri T, et al. Reshaping head and neck reconstruction policy during the COVID-19 pandemic peak: Experience in a front-line institution. *Auris Nasus Larynx* 2020 doi: 10.1016/j.anl.2020.04.008 [published Online First: 2020/05/05]
85. Randelli PS, Compagnoni R. Management of orthopaedic and traumatology patients during the Coronavirus disease (COVID-19) pandemic in northern Italy. *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1683-89. doi: 10.1007/s00167-020-06023-3 [published Online First: 2020/04/27]

- 1  
2  
3 86. Ricciardi L, Trungu S, Scerrati A, et al. Neurosurgery at the time of COVID-19: how this  
4 pandemic infectious disease is influencing neurosurgical activities and patient management. *J*  
5 *Neurosurg Sci* 2020 doi: 10.23736/S0390-5616.20.04976-0 [published Online First: 2020/04/30]  
6  
7 87. Ross SW, Lauer CW, Miles WS, et al. Maximizing the Calm before the Storm: Tiered  
8 Surgical Response Plan for Novel Coronavirus (COVID-19). *J Am Coll Surg* 2020;230(6):1080-  
9 91 e3. doi: 10.1016/j.jamcollsurg.2020.03.019 [published Online First: 2020/04/03]  
10  
11 88. Rubin GA, Biviano A, Dizon J, et al. Performance of electrophysiology procedures at an  
12 academic medical center amidst the 2020 coronavirus (COVID-19) pandemic. *J Cardiovasc*  
13 *Electrophysiol* 2020 doi: 10.1111/jce.14493 [published Online First: 2020/04/14]  
14  
15 89. Rubin GA, Wan EY, Saluja D, et al. Restructuring Electrophysiology During the  
16 COVID-19 Pandemic: A Practical Guide from a New York City Hospital Network. *Crit Pathw*  
17 *Cardiol* 2020 doi: 10.1097/HPC.000000000000225 [published Online First: 2020/04/24]  
18  
19 90. Salenger R, Etchill EW, Ad N, et al. The Surge after the Surge: Cardiac Surgery post-  
20 COVID-19. *Ann Thorac Surg* 2020 doi: 10.1016/j.athoracsur.2020.04.018 [published Online  
21 First: 2020/05/08]  
22  
23 91. Sarpong NO, Forrester LA, Levine WN. What's Important: Redeployment of the  
24 Orthopaedic Surgeon During the COVID-19 Pandemic: Perspectives from the Trenches. *J Bone*  
25 *Joint Surg Am* 2020 doi: 10.2106/JBJS.20.00574 [published Online First: 2020/04/15]  
26  
27 92. Schull MJ, Stukel TA, Vermeulen MJ, et al. Effect of widespread restrictions on the use  
28 of hospital services during an outbreak of severe acute respiratory syndrome. *Canadian Medical*  
29 *Association Journal* 2007;176(13):1827-32. doi: 10.1503/cmaj.061174  
30  
31 93. Schwarzkopf R, Maher NA, Slover JD, et al. The Response of an Orthopedic Department  
32 and Specialty Hospital at the Epicenter of a Pandemic: The NYU Langone Health Experience. *J*  
33 *Arthroplasty* 2020 doi: 10.1016/j.arth.2020.04.041 [published Online First: 2020/05/08]  
34  
35 94. Scullen T, Mathkour M, Maulucci CM, et al. Impact of the COVID-19 Pandemic on  
36 Neurosurgical Residency Training in New Orleans. *World Neurosurg* 2020 doi:  
37 10.1016/j.wneu.2020.04.208 [published Online First: 2020/05/08]  
38  
39 95. Seese L, Aranda-Michel E, Sultan I, et al. Programmatic Responses to the Coronavirus  
40 Pandemic: A Survey of 502 Cardiac Surgeons. *Ann Thorac Surg* 2020 doi:  
41 10.1016/j.athoracsur.2020.04.014 [published Online First: 2020/05/04]  
42  
43 96. Sethi A, Swaminath A, Latorre M, et al. Donning a New Approach to the Practice of  
44 Gastroenterology: Perspectives From the COVID-19 Pandemic Epicenter. *Clin Gastroenterol*  
45 *Hepatol* 2020 doi: 10.1016/j.cgh.2020.04.032 [published Online First: 2020/04/25]  
46  
47 97. Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences  
48 and Lessons from a General Hospital in Nanjing, China. *Cardiovasc Intervent Radiol*  
49 2020;43(6):810-19. doi: 10.1007/s00270-020-02474-w [published Online First: 2020/04/29]  
50  
51 98. Shih KC, Wong JKW, Lai JSM, et al. The case for continuing elective cataract surgery  
52 during the COVID-19 pandemic. *J Cataract Refract Surg* 2020 doi:  
53 10.1097/j.jcrs.000000000000225 [published Online First: 2020/05/06]  
54  
55 99. Shokri T, Lighthall JG. Telemedicine in the Era of the COVID-19 Pandemic:  
56 Implications in Facial Plastic Surgery. *Facial Plast Surg Aesthet Med* 2020;22(3):155-56. doi:  
57 10.1089/fpsam.2020.0163 [published Online First: 2020/04/18]  
58  
59 100. Sobel D, Gn M, O'Rourke TK, Jr., et al. Personal Protective Equipment for Common  
60 Urologic Procedures Before and During the United States COVID-19 Pandemic: A Single  
Institution Study. *Urology* 2020 doi: 10.1016/j.urology.2020.04.083 [published Online First:  
2020/05/08]

101. Sun Y, Mao Y. Editorial. Response to COVID-19 in Chinese neurosurgery and beyond. *Journal of neurosurgery* 2020;1-2. doi: 10.3171/2020.3.JNS20929
102. National Clinical Programme in Surgery. Surgical Patient Flow During COVID-19 Pandemic, 2020.
103. Tan TK. How severe acute respiratory syndrome (SARS) affected the department of anaesthesia at Singapore General Hospital. *Anaesth Intensive Care* 2004;32(3):394-400. doi: 10.1177/0310057x0403200316 [published Online First: 2004/07/22]
104. Tan YQ, Wu QH, Chiong E. Preserving Operational Capability While Building Capacity During the COVID-19 Pandemic: A Tertiary Urology Centre's Experience. *Urology* 2020 doi: 10.1016/j.urology.2020.04.079 [published Online First: 2020/05/04]
105. Tan YT, Wang JW, Zhao K, et al. Preliminary Recommendations for Surgical Practice of Neurosurgery Department in the Central Epidemic Area of 2019 Coronavirus Infection. *Curr Med Sci* 2020;40(2):281-84. doi: 10.1007/s11596-020-2173-5 [published Online First: 2020/03/29]
106. Tay K, Kamarul T, Lok WY, et al. COVID-19 in Singapore and Malaysia: Rising to the Challenges of Orthopaedic Practice in an Evolving Pandemic. *Malays Orthop J* 2020;14(2) doi: 10.5704/MOJ.2007.001 [published Online First: 2020/04/22]
107. Tay KJD, Lee YHD. Trauma and orthopaedics in the COVID-19 pandemic: breaking every wave. *Singapore Med J* 2020 doi: 10.11622/smedj.2020063 [published Online First: 2020/04/22]
108. Thaler M, Khosravi I, Hirschmann MT, et al. Disruption of joint arthroplasty services in Europe during the COVID-19 pandemic: an online survey within the European Hip Society (EHS) and the European Knee Associates (EKA). *Knee Surg Sports Traumatol Arthrosc* 2020;28(6):1712-19. doi: 10.1007/s00167-020-06033-1 [published Online First: 2020/05/04]
109. Tolone S, Gambardella C, Bruscianno L, et al. Telephonic triage before surgical ward admission and telemedicine during COVID-19 outbreak in Italy. Effective and easy procedures to reduce in-hospital positivity. *Int J Surg* 2020;78:123-25. doi: 10.1016/j.ijsu.2020.04.060 [published Online First: 2020/05/04]
110. Too CW, Wen DW, Patel A, et al. Interventional Radiology Procedures for COVID-19 Patients: How we Do it. *Cardiovasc Intervent Radiol* 2020;43(6):827-36. doi: 10.1007/s00270-020-02483-9 [published Online First: 2020/04/29]
111. Topf MC, Shenson JA, Holsinger FC, et al. Framework for prioritizing head and neck surgery during the COVID-19 pandemic. *Head Neck* 2020;42(6):1159-67. doi: 10.1002/hed.26184 [published Online First: 2020/04/17]
112. Tsui KL, Li SK, Li MC, et al. Preparedness of the cardiac catheterization laboratory for severe acute respiratory syndrome (SARS) and other epidemics. *J Invasive Cardiol* 2005;17(3):149-52. [published Online First: 2005/05/04]
113. Tzeng C-WD, Tran Cao HS, Roland CL, et al. Surgical decision-making and prioritization for cancer patients at the onset of the COVID-19 pandemic: A multidisciplinary approach. *Surgical Oncology* 2020;34:182-85. doi: 10.1016/j.suronc.2020.04.029
114. Unal EU, Mavioglu HL, Iscan HZ. Vascular surgery in the COVID-19 pandemic. *J Vasc Surg* 2020 doi: 10.1016/j.jvs.2020.04.480 [published Online First: 2020/04/29]
115. Vaccaro AR, Getz CL, Cohen BE, et al. Practice Management During the COVID-19 Pandemic. *J Am Acad Orthop Surg* 2020;28(11):464-70. doi: 10.5435/JAAOS-D-20-00379 [published Online First: 2020/04/15]

- 1  
2  
3 116. Valenza F, Papagni G, Marchiano A, et al. Response of a comprehensive cancer center to  
4 the COVID-19 pandemic: the experience of the Fondazione IRCCS-Istituto Nazionale dei  
5 Tumori di Milano. *Tumori* 2020;300891620923790. doi: 10.1177/0300891620923790 [published  
6 Online First: 2020/05/05]  
7  
8 117. van de Haar J, Hoes LR, Coles CE, et al. Caring for patients with cancer in the COVID-  
9 19 era. *Nat Med* 2020;26(5):665-71. doi: 10.1038/s41591-020-0874-8 [published Online First:  
10 2020/05/15]  
11 118. Vicini E, Galimberti V, Naninato P, et al. COVID-19: The European institute of  
12 oncology as a "hub" centre for breast cancer surgery during the pandemic in Milan (Lombardy  
13 region, northern Italy) - A screenshot of the first month. *Eur J Surg Oncol* 2020 doi:  
14 10.1016/j.ejso.2020.04.026 [published Online First: 2020/05/04]  
15 119. Vlantis AC, Tsang RK, Wong DK, et al. The impact of severe acute respiratory syndrome  
16 on otorhinolaryngological services at the Prince of Wales Hospital in Hong Kong. *Laryngoscope*  
17 2004;114(1):171-4. doi: 10.1097/00005537-200401000-00032 [published Online First:  
18 2004/01/08]  
19 120. Walker JP. Resuming Elective Surgery at UTMB Predicated on Patient and Staff Well-  
20 Being, 2020.  
21 121. Wan IYP, Wat KHY, Ng CSH, et al. Evaluation of the emotional status of patients on a  
22 waiting list for thoracic surgery during the outbreak of Severe Acute Respiratory  
23 Syndrome(SARS). *Stress and Health* 2004;20(4):209-12. doi: 10.1002/smi.1013  
24 122. Wang X, Wang Z, Yao C, et al. Management of ophthalmic perioperative period during  
25 2019 novel coronavirus disease outbreak. *Zhonghua Shiyan Yanke Zazhi/Chinese Journal of*  
26 *Experimental Ophthalmology* 2020;38(3):200-03. doi:  
27 http://dx.doi.org/10.3760/cma.j.issn115989-20200224-00100  
28 123. Wasser LM, Assayag E, Tessler M, et al. Response of ophthalmologists in Israel to the  
29 novel coronavirus (2019-nCoV) outbreak. *Graefes Arch Clin Exp Ophthalmol* 2020 doi:  
30 10.1007/s00417-020-04694-9 [published Online First: 2020/04/30]  
31 124. Williams AM, Kalra G, Commiskey PW, et al. Ophthalmology Practice During the  
32 Coronavirus Disease 2019 Pandemic: The University of Pittsburgh Experience in Promoting  
33 Clinic Safety and Embracing Video Visits. *Ophthalmol Ther* 2020;1-9. doi: 10.1007/s40123-  
34 020-00255-9 [published Online First: 2020/05/08]  
35 125. Wong J, Goh QY, Tan Z, et al. Preparing for a COVID-19 pandemic: a review of  
36 operating room outbreak response measures in a large tertiary hospital in Singapore. *Canadian*  
37 *Journal of Anesthesia/Journal canadien d'anesthésie* 2020;67(6):732-45. doi: 10.1007/s12630-  
38 020-01620-9  
39 126. Wu V, Noel CW, Forner D, et al. Considerations for head and neck oncology practices  
40 during the coronavirus disease 2019 (COVID-19) pandemic: Wuhan and Toronto experience.  
41 *Head Neck* 2020;42(6):1202-08. doi: 10.1002/hed.26205 [published Online First: 2020/04/28]  
42 127. Zangrillo A, Beretta L, Silvani P, et al. Fast reshaping of intensive care unit facilities in a  
43 large metropolitan hospital in Milan, Italy: facing the COVID-19 pandemic emergency. *Crit*  
44 *Care Resusc* 2020 [published Online First: 2020/04/02]  
45 128. Zarzaur BL, Stahl CC, Greenberg JA, et al. Blueprint for Restructuring a Department of  
46 Surgery in Concert With the Health Care System During a Pandemic: The University of  
47 Wisconsin Experience. *JAMA Surg* 2020 doi: 10.1001/jamasurg.2020.1386 [published Online  
48 First: 2020/04/15]  
49  
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52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 129. Zeng L, Su T, Huang L. Strategic plan for management in oral and maxillofacial surgery  
4 during COVID-19 epidemic. *Oral Oncol* 2020;105:104715. doi:  
5 10.1016/j.oraloncology.2020.104715 [published Online First: 2020/04/20]  
6  
7 130. Zhen L, Lin T, Zhao ML, et al. [Management strategy for the resumption of regular  
8 diagnosis and treatment in gastrointestinal surgery department during the outbreak of  
9 coronavirus disease 2019 (COVID-19)]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2020;23(4):321-  
10 26. doi: 10.3760/cma.j.issn.1671-0274.2020-0316-00146 [published Online First: 2020/04/21]  
11  
12 131. Zizzo M, Bollino R, Castro Ruiz C, et al. Surgical management of suspected or  
13 confirmed SARS-CoV-2 (COVID-19)-positive patients: a model stemming from the experience  
14 at Level III Hospital in Emilia-Romagna, Italy. *Eur J Trauma Emerg Surg* 2020 doi:  
15 10.1007/s00068-020-01377-2 [published Online First: 2020/04/30]  
16  
17 132. Zoia C, Bongetta D, Veiceschi P, et al. Neurosurgery during the COVID-19 pandemic:  
18 update from Lombardy, northern Italy. *Acta Neurochir (Wien)* 2020;162(6):1221-22. doi:  
19 10.1007/s00701-020-04305-w [published Online First: 2020/03/31]  
20  
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## BACKGROUND

The novel coronavirus (COVID-19) has spread across the globe with unrelenting speed. At the time of writing over 4 million cases have been confirmed, among them more than 200,000 fatalities<sup>1</sup>. In addition to protecting those most vulnerable in our societies, efforts to curb further disease escalation (e.g., travel restrictions, physical distancing measures) have had a focal objective: prevent case surges that could overwhelm healthcare institutions or further aggravate existing shortages in personal protective equipment (PPE), ventilators, and hospital capacity.

Medical institutions have themselves also taken steps to maximize the availability of staff, PPE, ventilators and intensive care unit (ICU) capacity in the case that external ‘curve flattening’ practices are not sufficient. Most notably, surgical programs have suspended non-urgent (or elective) surgical procedures, often defined as procedures for which a delay of three (3) months or longer would not result in any significant adverse effect to the patient<sup>2,3</sup>. These changes span nearly all surgical specialties from oncology to orthopedics and have thrust patients, providers and programs into previously unexplored territory.

While the governing bodies of surgical practice have recommended alterations to non-urgent surgical service delivery, they have not always provided explicit instructions on how programs should approach the change. As such, different groups have likely taken different approaches to surgical triage and service delivery and it remains unclear who has done what where, and why? Further, the impacts of postponing non-urgent surgeries on the physical, psychological, emotional and professional well-being of patients and practitioners are either anecdotal or unknown<sup>4</sup>. Lastly, as COVID-19 begins to release its grip on the world and a level of post-pandemic normalcy returns, programs will be tasked with rebuilding the surgical capacity necessary to reschedule and resume postponed procedures. Evidence on the experiences of other



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3 groups doing so in the context of COVID-19 and other public health emergencies (i.e., H1N1,  
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5 Ebola, SARS) will be paramount in guiding subsequent approaches.  
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8 To address the aforementioned knowledge gaps, we will conduct a rapid review of the  
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10 literature to synthesize evidence on how surgical resources were allocated in response to  
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12 COVID-19 and other public health emergencies, how these reallocations impacted patients,  
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14 practitioners and broader health systems, and what approaches have been taken to rebuild,  
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16 reorganize and resume surgical service delivery. This review will not only help explain how  
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18 international surgical programs responded to this unprecedented emergency and what the  
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20 consequences were, but will also provide the evidence-base necessary to guide responses to this  
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22 current and any future pandemic event.  
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## 28 **METHODS**

### 29 **Study Design**

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33 The planned review will answer three questions: (1) How have surgical resources been  
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35 allocated in response to COVID-19, (2) What are the patient- and system-level consequences of  
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37 reorganizing surgical resources, and (3) How have resources been reorganized to resume surgical  
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39 services? We will focus on surgeries identified as “elective” or “non-urgent”. However, to avoid  
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41 limiting study eligibility unnecessarily no set definition for this term will be used and we will  
42  
43 instead report the definition used by each included study.  
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### 49 **Search Strategy**

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52 An electronic search strategy was developed by the investigators (CO, KS) prior to being  
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54 reviewed and refined by collaborators with context expertise in surgery and literature review  
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3 (JNK, AKR). The search strategy includes subject headings, keywords and synonyms identifying  
4 the public health emergencies of interest as well as the surgical specialties likely affected by  
5 COVID-19 (Appendix A). Headings and keywords were adapted for use in each database. Given  
6 the diversity of the research questions related to this review no study design or publication type  
7 constraints will be applied to the search. Further, since (by definition) the impacts of a pandemic  
8 span many countries, no language restrictions will be applied. However, to deliver on the study  
9 objectives in a timely fashion, studies not easily translated by members of the research team will  
10 be subsequently excluded from the review.  
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22 We will conduct comprehensive searches of Ovid MEDLINE (including Epub Ahead of  
23 Print, In-Process & Other Non-Indexed Citations) and EMBASE from database inception  
24 onwards. Since much of the information related to the questions of this review is likely  
25 unpublished (i.e., joint statements, recommendations and guidelines from surgical colleges) we  
26 will also complete a detailed grey literature search. An *a priori* designed plan for this search has  
27 been developed (Appendix B) and will follow methodological recommendations by including  
28 targeted website searching, advanced and general Google searching and contact with knowledge  
29 experts<sup>5</sup>. Further, the reference lists from all included studies will be examined for any additional  
30 relevant studies not captured in the formal database and grey literature searches.  
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## 44 **Study Selection**

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46 In accordance with recommendations from the Cochrane Methods Group and World  
47 Health Organization Alliance for Health Policy and Systems Research, the titles and abstracts of  
48 all retrieved items will be reviewed by one of two independent researchers (CO, KM) with a  
49 third, independent researcher (KS) serving as duplicate reviewer for a random 25% sample of all  
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3 references<sup>6,7</sup>. Eligibility criteria varies such that the relevance of studies is determined by the  
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5 research question to which they pertain. For the first question on how surgical resources have  
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7 been allocated we will include any study that examines or discusses organization of surgical  
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9 resources and patients during COVID-19 or other public health emergency (i.e., triage criteria,  
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11 allocation of hospital resources if they include surgery, PPE for the operating room staff). To  
12  
13 address the second question – consequences of reorganizing surgical resources- we will include  
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15 any studies that examine patient- and/or system-level surgical outcomes during COVID-19 or  
16  
17 other public health emergencies (i.e., adverse events, length of stay, ICU admissions). Lastly, to  
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19 determine how resources have been organized to resume non-urgent surgical services we will  
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21 include any study that examines resuming surgical services after COVID-19 or another public  
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23 health emergency.  
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29 Full texts of studies not excluded in the title and abstract phase will then be reviewed in  
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31 duplicate by the same researchers to ensure applicability to any of the research questions. Any  
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33 articles identified as meeting the pre-specified eligibility criteria at this stage will be included in  
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35 the final review. Interrater agreement on inclusion for the 25% sample of titles and abstracts  
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37 reviewed in duplicate as well as the full texts will be measured with a Cohen's kappa ( $\kappa$ ) statistic  
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39 and corresponding 95% confidence interval. At all stages of the review an unbiased third party  
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41 will be available to resolve any sustained disagreements between reviewers. The full study  
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43 selection process including reasons for full text exclusions will be reported using a Preferred  
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45 Reporting Items for Systematic Reviews and Meta-Analyses flow diagram<sup>8</sup>.  
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## 51 **Outcomes of Interest**

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3 Study information will be collected to answer the research questions of steps taken to  
4 respond to emergencies and rebuild capacity (see data extraction section below), but these  
5 questions are not outcome oriented and as such specific outcomes data for these questions will  
6 not be collected. However, the second research question surrounding the consequences of  
7 altering non-urgent surgical programming will require the collection of both quantitative and  
8 qualitative outcomes in order to provide the desired holistic understanding of impacts.  
9 Specifically, we will assess patient-level outcomes including the incidence of adverse events  
10 (i.e., negative event leading to patient harm and caused by management (or lack thereof) rather  
11 than the underlying condition of the patient), mortality, and quotes discussing emotional and  
12 psychological impacts of delays. We will also evaluate impacts on the healthcare system using  
13 measures of resource utilization such as number of emergency department visits, number of  
14 visits to a healthcare provider, length of hospital or ICU stay, as well as qualitative statements  
15 from practitioners and hospital administrators.  
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### 35 **Data Extraction**

36 Any relevant study and outcome data will be extracted from included studies by one  
37 researcher using a standardized data abstraction form. For all studies this form will guide the  
38 collection of information including date of publication, country where study was conducted,  
39 study design, definition of elective or non-urgent surgery, and characteristics of study sample (if  
40 applicable). The data extraction form is also designed to collect information specific to each of  
41 the three research questions such as selected surgical triage criteria, patient and health system-  
42 level outcomes, and detailed emergency response plans. A second independent researcher will  
43 review all data abstraction forms to verify their completion and accuracy.  
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### **Study Quality (Risk of Bias) Assessment**

This rapid review will aim to synthesize quantitative outcomes whenever possible but will largely involve scoping the available evidence on surgical service delivery during public health emergencies. Given this broad aim and the decision to include all study designs, quality appraisal for the included studies is not feasible and will not be performed.

### **Data Synthesis, Analysis and Reporting**

Study and sample information will be described in a narrative review and summarized in a data table. We do not anticipate being able to conduct a meta-analysis of quantitative outcomes and will instead synthesize outcomes data qualitatively with support from descriptive statistics whenever possible. Any summary tables for outcomes will be stratified by the three research questions to maximize clarity. Any within-study comparisons (e.g., incidence of adverse events in patients with delayed versus non-delayed surgery) will be considered significant at a two-tailed p-value  $<0.05$ .

### **Ethics and Dissemination**

This review will only include secondary data sources and as such there are no applicable ethical considerations. Following completion, this review will become an integral part of evidence-based guidelines to support decisions about allocating resources and organizing surgical care in the era of COVID-19 and during subsequent public health emergencies. The rapid review will also be submitted to peer-reviewed journals to reach the target audiences of patients, policy makers, practitioners and surgical program administrators.

## Limitations

The rapidly evolving nature of surgical programming during the COVID-19 situation demands an equally rapid synthesis and dissemination of key evidence. A rapid review therefore supersedes a traditional systematic review, but with this decision come methodological limitations. First, it is possible that much of the identified evidence emerges from non-traditional sources and grey literature and as a result, may be of a lower methodological quality than that from peer-reviewed sources. However, the goal of this review is not to evaluate quantitative outcomes at potential risk of bias but to instead collate the diversity of available information from surgical programs worldwide to inform decision-making. As such the potential negative impacts of lower study quality are of less concern. Secondly, the landscape of evidence specific to COVID-19 changes daily. While the selection of a set date for literature search is important for reporting and review reproducibility, it may lead to the omission of relevant information released beyond this date. We believe, however, that a current date selected for the literature search will span a period of time where some countries are in the process of recovering their surgical services while others remain in the throes of the pandemic. This will maximize the chances that sufficient evidence to answer all research questions is up to date and available.

## CONCLUSION

This paper describes the methodology for a planned rapid review that will synthesize evidence on the changes to, impacts of, and recovery of non-urgent surgical service delivery during COVID-19 and other public health emergencies. As post-pandemic normalcy begins to return and non-urgent surgeries resume, the evidence from this review will inform

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3 recommendations for allocating and organizing care while mitigating any potential negative  
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5 impacts resulting from changes in service delivery.  
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For peer review only

## References

1. Johns Hopkins University Resource Center. Coronavirus COVID-19 global cases. Accessed May 6, 2020. <https://coronavirus.jhu.edu/map.html>
2. American College of Surgeons. COVID-19: Recommendations for management of elective surgical procedures. March 13, 2020. Accessed May 13, 2020. [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.aspx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.aspx)
3. Shared Health Manitoba. COVID-19 Provincial guidance on management of elective surgery. March 25, 2020. Accessed May 13, 2020. <https://sharedhealthmb.ca/files/covid-19-elective-surgery.pdf>
4. Tam DY, Naimark D, Sander B, Barrett K, Khan YA, Mac S, et al. COVID-19: Predicting consequences of curtailing outpatient scheduled cardiac procedures in the face of COVID healthcare resource needs in Ontario. 2020.
5. Godin K, Stapleton J, Kirkpatrick SI, Hanning RH, Leatherdale ST. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Systematic Reviews*. 2015;4:138-162.
6. Garrity C, Gartlehner G, Kamel C, King VJ, Nussbaumer-Streit B, et al. Cochrane Rapid Reviews: Interim guidance from the Cochrane Rapid Reviews Methods Group. March 2020.
7. Tricco AC, Langlois EV, Strauss SE, editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.
8. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Review and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*. 2009;6(7):e10000097.



## Appendices

### Appendix A: Ovid MEDLINE Electronic Search Strategy

#### Database: Ovid MEDLINE (R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to May 08, 2020>

##### Search Strategy:

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- 1 exp Disease Outbreaks/ (96117)
- 2 (pandemic\* or epidemic\* or outbreak\* or out break\*).mp. (230774)
- 3 1 or 2 (231940)
- 4 exp Coronavirus (13456)
- 5 coronavirus infections/ or severe acute respiratory syndrome/ (11068)
- 6 Coronaviridae Infections/ (900)
- 7 coronaviridae/ or coronavirus/ (3916)
- 8 Influenza a virus, h1n1 subtype/ or Influenza a virus, h3n2 subtype/ or influenza a virus, h5n1 subtype/ (22141)
- 9 Hemorrhagic Fever, Ebola/ (5316)
- 10 SARS Virus/ (3038)
- 11 Middle East Respiratory Syndrome Coronavirus/ (1034)
- 12 (pneumonia.mp. or exp pneumonia/) and Wuhan.mp. (661)
- 13 (coronavir\* or COVID-19 or SARS-related coronavirus or SARS-CoV-2 or 2019 novel coronavirus or 2019-nCoV or nCoV or h1n1 or h3n2 or h5n1 or avian influenza or avian flu or swine influenza or swine flu or SARS or ebola\* or middle east respiratory syndrome or MERS).mp. (77950)
- 14 (wuhan) adj2 (coronavir\* or flu or pneumonia\* or COVID-19 or 2019-nCoV).mp. (190)
- 15 (coronavir\*) adj2 (infection\*).mp. (8441)
- 16 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (79915)
- 17 General Surgery/ (38626)
- 18 Orthopedic Procedures/ (25371)
- 19 Traumatology/ (3474)
- 20 Neurosurgery/ (14892)
- 21 Obstetrics/ (22533)
- 22 Anesthesia/ (62587)
- 23 surgical procedures, operative/ or exp elective surgical procedures/ (68085)
- 24 exp Arthroplasty, Replacement/ (54362)
- 25 (general surgery or orthopaedic or orthopedic or trauma or neurosurgery or obstetrics or anesthesia or anaesthesia).mp. (748651)
- 26 (surger\* or operation\* or procedure\*).mp. (3638036)
- 27 ((elective or non-urgent) adj2 (surg\* or procedure\*)).mp. (31794)
- 28 (surg\* adj2 (procedure\* or planning or triage or operation\* or resource\* or backlog or re-organiz\* or postpone\* or cancel\* or capacit\* or wait time\*)).mp. (444474)
- 29 ((clinic\* or hospital) adj2 (process\* or procedure\* or triage or planning or performance\* or capacit\*)).mp. (69185)

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3 30 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (4101483)  
4 31 3 and 16 and 30 (2075)  
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## Appendix B: Grey Literature Search Plan

### GREY LITERATURE SEARCH PLAN

Developed in reference to Guide from the University of Toronto (Stapleton, Fuller & Lenton)

STEP 1) Targeted Website Browsing. Will be using any combination of standard terms  
“coronavirus” OR “Covid-19” OR “Surgery” OR “non-urgent surgery” OR “elective surgery”  
OR “guidelines”

#### NON-GOVERNMENT GROUPS

World Health Organization (<https://www.who.int>)

Center for Disease Control and Prevention (<https://www.cdc.gov>)

European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>)

#### GOVERNMENTS/HEALTH SYSTEMS

Canada (<https://www.canada.ca/en.html>)

- BC (<https://www2.gov.bc.ca/gov/content/home>)
- AB (<https://www.alberta.ca/index.aspx>)
- SK (<https://www.saskatchewan.ca>)
- MB (<https://www.gov.mb.ca>)
- ON (<https://www.ontario.ca/page/government>)
- QC (<https://www.quebec.ca/en/>)
- NB (<https://www2.gnb.ca>)
- NS (<https://beta.novascotia.ca>)
- NL & LB (<https://www.gov.nl.ca>)
- PEI (<https://www.princeedwardisland.ca/en>)
- Yukon (<https://yukon.ca>)
- NWT (<https://www.gov.nt.ca>)
- Nunavut (<https://www.gov.nu.ca>)

Australia (<https://www.australia.gov.au>)

Italy (<http://www.governo.it>)

Singapore (<https://www.gov.sg>)

China (<https://www.gov.cn/english/>)

USA (<https://www.usa.gov>)

#### GENERAL SURGICAL GROUPS/COLLEGES

Royal College of Physicians and Surgeons of Canada (<http://www.royalcollege.ca>)

American College of Surgeons (<https://www.facs.org>)

European Surgical Association (<https://www.europeansurgicalassociation.org>)

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3 College of Surgeons, Singapore (<https://www.ams.edu.sg/colleges/CSS/home>)  
4 French Surgical Association  
5 German Society of Surgery (<https://www.dgch.de/index.php?id=118>)  
6 Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)  
7 Philippine College of Surgeons (<https://www.pcs.org.ph>)  
8 Royal Australasian College of Surgeons (<https://www.surgeons.org>)  
9 Royal College of Surgeons of England (<https://www.rcseng.ac.uk>)  
10 Royal College of Surgeons of Ireland (<https://www.rcsi.com/dublin/>)  
11 Spanish Society of Surgery (Asociacion Espanola de Cirujanos) (<https://www.aecirujanos.es>)  
12 Swedish Surgical Society (<http://www.svenskkirurgi.se>)  
13 The Association of Surgeons of South Africa (<http://www.surgeon.co.za>)  
14 The Pan African Association of Surgeons (<http://www.africansurgeons.com>)  
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18 STEP 2) Advanced Google Searching. Targeting above sites will assess 5 pages of Google  
19 Search past last click. Will be using standard and consistent terms “coronavirus” OR “Covid-19”  
20 OR “Surgery” OR “non-urgent” OR “guidelines”  
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23 STEP 3) General Search Engine (Google) Search with same terms as above, assessing 5 pages  
24 past last click for relevance.  
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26 STEP 4) Contact with Knowledge Experts.  
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## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Page 1: Title
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 3: Abstract
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Pages 5,6: Introduction
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 6: Introduction
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Not registered given rapid nature of review.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 8: Methods- Study Eligibility
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 6: Methods- Search Strategy
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix A
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Pages 7,8: Methods- Study Selection
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 9: Methods- Data Extraction
Data items	11	List and define all variables for which data	Page 9: Methods-



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		were sought and any assumptions and simplifications made.	Outcomes of Interest
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Page 10: Methods- Study Quality (ROB) Assessment
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 10: Methods- Data Synthesis, Analysis and Reporting
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Pages 10,11: Results- Search Results & Figure 1: PRISMA Flow chart
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Page 11: Results- Description of Studies & Table 1 (Individual) & Figure 2 (Summary)
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Table 1
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Pages 11-16: Results- Reorganization of Surgical Services & Impact of Reorganizing Surgical Services & Rebuild Surgical Capacity
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Pages 16 to 18: Discussion
Limitations	20	Discuss the limitations of the scoping review process.	Page 18, 19: Discussion
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Page 19: Discussion
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	NA

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.



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† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).

For peer review only

