## 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[1]. 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[2,3]. These changes span nearly all surgical specialties from oncology to orthopedics and have thrusted 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[4]. 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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groups doing so in the context of COVID-19 and other public health emergencies (i.e., H1N1, Ebola, SARS) will be paramount in guiding subsequent approaches.

To address the aforementioned knowledge gaps, we will conduct a rapid review of the literature to synthesize evidence on how surgical resources were allocated in response to COVID-19 and other public health emergencies, how these reallocations impacted patients, practitioners and broader health systems, and what approaches have been taken to rebuild, reorganize and resume surgical service delivery. This review will not only help explain how international surgical programs responded to this unprecedented emergency and what the consequences were, but will also provide the evidence-base necessary to guide responses to this current and any future pandemic event.

## METHODS

### Study Design

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

### Search Strategy

An electronic search strategy was developed by the investigators (CO, KS) prior to being reviewed and refined by collaborators with context expertise in surgery and literature review



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(JNK, AKR). The search strategy includes subject headings, keywords and synonyms identifying the public health emergencies of interest as well as the surgical specialties likely affected by COVID-19 (Appendix A). Headings and keywords were adapted for use in each database. Given the diversity of the research questions related to this review no study design or publication type constraints will be applied to the search. Further, since (by definition) the impacts of a pandemic span many countries, no language restrictions will be applied. However, to deliver on the study objectives in a timely fashion, studies not easily translated by members of the research team will be subsequently excluded from the review.

We will conduct comprehensive searches of Ovid MEDLINE (including Epub Ahead of Print, In-Process & Other Non-Indexed Citations) and EMBASE from database inception onwards. Since much of the information related to the questions of this review is likely unpublished (i.e., joint statements, recommendations and guidelines from surgical colleges) we will also complete a detailed grey literature search. An *a priori* designed plan for this search has been developed (Appendix B) and will follow methodological recommendations by including targeted website searching, advanced and general Google searching and contact with knowledge experts[5]. Further, the reference lists from all included studies will be examined for any additional relevant studies not captured in the formal database and grey literature searches.

**Study Selection**

In accordance with recommendations from the Cochrane Methods Group and World Health Organization Alliance for Health Policy and Systems Research, the titles and abstracts of all retrieved items will be reviewed by one of two independent researchers (CO, KM) with a third, independent researcher (KS) serving as duplicate reviewer for a random 25% sample of all



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references[6,7]. Eligibility criteria varies such that the relevance of studies is determined by the research question to which they pertain. For the first question on how surgical resources have been allocated we will include any study that examines or discusses organization of surgical resources and patients during COVID-19 or other public health emergency (i.e., triage criteria, allocation of hospital resources if they include surgery, PPE for the operating room staff). To address the second question – consequences of reorganizing surgical resources- we will include any studies that examine patient- and/or system-level surgical outcomes during COVID-19 or other public health emergencies (i.e., adverse events, length of stay, ICU admissions). Lastly, to determine how resources have been organized to resume non-urgent surgical services we will include any study that examines resuming surgical services after COVID-19 or another public health emergency.

Full texts of studies not excluded in the title and abstract phase will then be reviewed in duplicate by the same researchers to ensure applicability to any of the research questions. Any articles identified as meeting the pre-specified eligibility criteria at this stage will be included in the final review. Interrater agreement on inclusion for the 25% sample of titles and abstracts reviewed in duplicate as well as the full texts will be measured with a Cohen's kappa (κ) statistic and corresponding 95% confidence interval. At all stages of the review an unbiased third party will be available to resolve any sustained disagreements between reviewers. The full study selection process including reasons for full text exclusions will be reported using a Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram[8].

**Outcomes of Interest**



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

**Data Extraction**

Any relevant study and outcome data will be extracted from included studies by one researcher using a standardized data abstraction form. For all studies this form will guide the collection of information including date of publication, country where study was conducted, study design, definition of elective or non-urgent surgery, and characteristics of study sample (if applicable). The data extraction form is also designed to collect information specific to each of the three research questions such as selected surgical triage criteria, patient and health system-level outcomes, and detailed emergency response plans. A second independent researcher will 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 heath 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 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.



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**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.



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# 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:

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 Hemorrahagic 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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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)

**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)

College of Surgeons, Singapore (https://www.ams.edu.sg/colleges/CSS/home)
French Surgical Association
German Society of Surgery (https://www.dgch.de/index.php?id=118)
Italian Society of Surgery (SIC) and Italian Association of Hospital Surgeons (ACOI)
Philippine College of Surgeons (https://www.pcs.org.ph)
Royal Australasian College of Surgeons (https://www.surgeons.org)
Royal College of Surgeons of England (https://www.rcseng.ac.uk)
Royal College of Surgeons of Ireland (https://www.rcsi.com/dublin/)
Spanish Society of Surgery (Associacion Espanola de Cirujanos) (https://www.aecirujanos.es)
Swedish Surgical Society (http://www.svenskkirurgi.se)
The Association of Surgeons of South Africa (http://www.surgeon.co.za)
The Pan African Association of Surgeons (http://www.africansurgeons.com)

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

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

STEP 4) Contact with Knowledge Experts.



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