Directives of general surgical practice during the COVID-19 pandemic: A systematic review

Ahmad AbdulAzeem Abdullah Omer

Abstract:
The coronavirus disease 2019 (COVID-19) is a serious global pandemic that has extremely affected health-care systems. This article aimed to review the perspectives of general surgical practice during the COVID-19 pandemic. A systematic review of the literature addressing modification to general surgical practice during the COVID-19 pandemic indexed in PubMed, Scopus, Google, and Google scholar was carried out on June 19–20, 2020. The literature review yielded 577 articles. The exclusion of duplication, articles not in English, and specialized ones in various surgical disciplines precluded 398 articles. Finally, following checking for relevance and publication status, 114 papers were included. Recommendations for surgical practice during the COVID-19 pandemic revolved around mitigation of the risk of virus transmission to patients and health-care workers. The emerging themes of safety precautions were related to patient prioritization and testing, mindful consideration of the operative strategy, optimum use of personal protective equipment, operative room setup, and departmental organization. However, those recommendations were often diverging and bore on a dearth of evidence and personal opinions. Multidisciplinary work and cooperation among surgical specialties are required to establish and validate the protocols for safe surgical practice during the pandemic and perhaps similar crises in future. The COVID-19 pandemic has brought several challenges to the field of medicine, including the surgical specialty. The centrality of safety precautions emerging in this crisis requires surgeons to adopt the new roles and work standards and translate them into practice during the pandemic and perhaps longer.

Keywords:
Coronavirus disease 2019, departmental organization, general surgical practice, operative room guidelines, patient prioritization, patient testing, personal protective equipment

Introduction
The first case of the acute severe respiratory syndrome, the novel coronavirus disease 2019 (COVID-19), was reported in Wuhan City, China, in December 2019. Dramatically, the disease has spread to many countries and was declared by the WHO as pandemic on March 11, 2020.[1] Inflicting more than 25 million and killing hundreds of thousands of people in a couple of months, it was one of the disasters rarely seen in the history of humanity.[2] The thrilling pandemic has imposed an unprecedented challenge to health-care systems’ integrity in the many parts of the world and tested to the extreme limits their capacity to survive amid unusual crises.[3] Hospital resources were diverted to cope with the overwhelming number of COVID-19 patients at other disease costs. Besides, health-care workers (HCWs) found themselves at the forefront of the battle line fighting an obscure enemy, sometimes barehanded, that hundreds of them lost their lives.[4,5]

Surgery was significantly impacted by the cancellation of elective procedures, exploitation of operating rooms (ORs) as additional premises, and redeployment...
of surgeons to help in the care of COVID-19 critically ill patients.\[1,4\] Besides, the staff was redistributed to preserve the workforce, while others were either isolated, quarantined, or succumbed to the disease.\[7,9\] Consequently, surgical departments suffered understaffed in risky situations where surgeons had to cope with new work circumstances and guidelines to which they were not acquainted.\[4\] Added to this is the interruption of the ongoing surgical training and education, let alone the psychological burden imposed on staff due to movement restriction, loss of leisure time, and the fear of contracting the COVID-19 infection.\[10\] General surgery was probably the most affected among other surgical specialties, given the extensive and broad range of procedures carried out by general surgeons in hospitals and ambulatory settings.\[11\]

Amid these perplexing conditions, attempts were made to modify the existing practice to limit the spread of the infection among HCWs and patients and concomitantly preserve the standards of surgical care.\[7\] This article aims to review the modifications incurred to general surgical practice during the pandemic tailored to address the risks of HCWs and optimize the use of the available resources.

### Materials and Methods

A systematic review of the published articles regarding general surgical practice during the COVID-19 pandemic, indexed in PubMed, Scopus, Google, and Google Scholar, was conducted between June 19 and 20, 2020 following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.\[12\] The search was done using the terms [Surgical practice] AND [Covid-19] or [COVID-19] limited to the document’s title. The inclusion criteria comprised articles tackling modifications to practice in general surgery, for example, departmental structure, patient prioritization and testing, choice of the surgical procedure, and operative room guidelines in addition to the publication status and language. The exclusion criteria included articles in other subspecialties, for example, orthopedics, otorhinolaryngology, and urology involving detailed disease management and those addressing general hospital financial and administrative issues. Articles that were not in English or not yet published were also excluded.

The literature search yielded 577 articles. Initial screening of abstracts resulted in excluding 398 articles that were not related to general surgical practice, duplicated or not in English. In the second round, 179 articles were reviewed for relevance and 65 were further excluded. Eventually, 114 articles were included in this review, including original and review articles, short reports, commentaries, and letters to editors. Figure 1 summarizes the flowchart of the literature review process.

### Results

Perspectives of general surgical practice during the COVID-19 pandemic revolved around ensuring safety and decreasing the risk of infection to patients and HCWs. The main emerging themes of safety precautions were related to patient prioritization and testing, judicious selection of the operative approach, optimum use of personal protective equipment (PPE), operative room setup, and departmental organization. Modification to the routine surgical work to minimize the risk of virus transmission during the pandemic is discussed below under the above-mentioned aspects of surgical practice.

#### Patients’ prioritization

Reduction of the surgical volume was proposed widely to reduce the risk of viral transmission and streamline the available resources toward COVID-19 patients.\[6,11\] Besides, COVID-19 patients are subjected to increased risk of postoperative morbidity and mortality, which necessitates balancing the benefit of surgery against the risk of infection.\[13,14\] Therefore, a strategy to prioritize patients for surgical care was recommended, where procedures were categorized based on their time sensitivity into essential (risk of untoward outcomes if delayed) and nonessential or discretionary, which can be deferred safely.\[7,15-17\] Detailed scales for patient prioritization were described, including the American College of Surgeons’ Elective Surgery Acuity Scale.\[18,19\] However, contextual factors should be considered, including the spread of the coronavirus, the influx of COVID-19 patients, bed occupancy, and the availability of staff and resources.\[20\]
It was argued that “elective” does not mean “optional,” and many elective procedures often require urgent intervention sometime in future. In urgent surgeries, consideration of the comorbidities, the American Association of Anesthesiologist Class, and the hemodynamic stability might imply the length of hospital stay and the demand for intensive care postoperatively and hence promote decisions of candidacy for such operations. As such, priority for surgery should be decided carefully, preferably through panels of expertise, particularly in cancer cases where the procedure’s postponement may impose risks of disease progression and decreased quality of life. However, transparency is essential, and the development of protocols to standardize patients’ prioritization on equitable and ethically based grounds is recommended.

**Patients’ testing**

Screening for COVID-19 is essential in the perioperative period to ensure the safety of patients and HCWs, particularly that up to 80% of patients may be asymptomatic. Moreover, it has implications for surgery outcomes and the rational use of PPE. However, variable recommendations for testing were noticed in different geographical locations driven by limited tests availability. A spectrum of testing practices was observed extending from no testing in areas with low prevalence to screening only symptomatic patients ending with testing all patients scheduled for surgery. Controversy existed regarding the results of the few published articles regarding the efficacy of such testing protocols. Some articles reported no cross-infection despite restricted testing regimens, while others have shown the contrary. Arguably, pending on the safety side might necessitate testing all patients scheduled for surgery. The results of asymptomatic and presumptomatic patients were observed with a high positivity rate, particularly in procedures that involve aerosol generation and ensuring HCWs and patients’ safety are of utmost priority. The virus is well known to spread through respiratory droplets, and its transmission through airborne and orofecal routes is inconclusive. Therefore, the full protection of HCWs is essential, particularly in procedures that involve aerosol generation taking laparoscopy, endoscopy, and procedures on the airway as examples.

PPE encompasses surgical masks, N95, face filtering piece (FFP2 and FFP3), and powered air-purifying respirators to guard against airborne transmission, and waterproof gowns, gloves, face shields, goggles, coverall, head, and shoe covers, and boots to protect against spillage of secretions. However, the availability and constant PPE supply were compromising, and protocols were set forth to optimize their use, particularly in resource-limited settings. For instance, three protection levels were suggested; primary and secondary ones when conducting routine ward work with low risk and confirmed or suspected cases, respectively, and a tertiary level when performing high-risk procedures that involve aerosolization as mentioned above. Training HCWs on the procedures of donning and doffing to minimize the risk of virus transmission are crucial, especially the latter, which carries a higher risk. Besides, surgical facemask should be applied to all patients who are not intubated.
PPE is also required during waste disposal, sanitization of operative rooms, and other hospital premises.\textsuperscript{[31,40]}

Unfortunately, some articles pointed to poor PPE applications by HCWs due to either unavailability or that their appropriate use is not strictly followed.\textsuperscript{[7]} Geographical variation in the rate of COVID-19 infection among HCWs was observed and attributed to compliance with the appropriate use of PPE.\textsuperscript{[41]}

**Choice of the procedure**

The increased postoperative morbidity and mortality associated with COVID-19 have embarked reconsideration of surgical care standards, including the operative strategy.\textsuperscript{[13,20,42]} High mortality and intensive care unit (ICU) admission rates were reported in association with aggressive and lengthy surgical procedures in COVID-19 patients, given its adverse effect on the immune system.\textsuperscript{[20,43,44]} Besides, lengthy procedures increase surgeons’ exposure time, and consequently, their susceptibility to the infection, given that isolation in the OR is impossible.\textsuperscript{[14]} Therefore, a wise operative approach to mitigate the risk of infection revolves around decreasing the operative time and the length of hospital stay.\textsuperscript{[44‑46]} This entails commending the least possible operative intervention and considering surgical therapy alternatives if they are equally effective.\textsuperscript{[5,11,13,23]} However, local factors, including the status of the virus spread, bed occupancy, and availability of ICUs and PPE, should also be considered.\textsuperscript{[44,47]}

As such, acute appendicitis could be treated conservatively with antibiotics accepting the risk of relatively higher recurrence rate. In addition, Cholecystostomy and interval rather than early cholecystectomy may be planned for acute cholecystitis to delay surgical intervention and avoid a more aggressive approach.\textsuperscript{[6,14]} Similarly, loop colostomy as a staged procedure for colonic obstruction is preferred to a more radical approach of colectomy and primary anastomosis, and stenting might be safer than palliative resection.\textsuperscript{[6,27]} Besides, taxis and neoadjuvant therapy can be useful strategies to defer surgery in incarcerated hernia and oncologic operations, respectively.\textsuperscript{[23,33]} Intuitively, the standard procedure to which the surgeon is acquainted should be done by the most expert to decrease the exposure time and the need for undue re-intervention.\textsuperscript{[45,48]}

Controversy existed regarding the choice of minimal access versus open procedures during the pandemic.\textsuperscript{[7,25,33]} Although the former has numerous advantages, including minimum physical impact on the body and shorter hospital stay, an increased risk of virus transmission through aerosol generation in surgical plume and pneumoperitoneum was alluded.\textsuperscript{[4,15,20,22]} Such risk is contemplated based on the assertion of aerosolization of human papilloma virus, Hepatitis B, and human immunodeficiency viruses in surgical smoke and pneumoperitoneum in previous observations.\textsuperscript{[40,50]} Laparoscopy might be avoided in COVID-19 patients or where surgeons are not well trained on it; open surgery might be safer in such circumstances. However, smoke evacuation is still necessary.\textsuperscript{[27,40,50]} Nevertheless, laparoscopic interventions should be decided prudently on individual bases and underwent when the benefits outweigh the risks, and the necessary precautions to decrease the likelihood of infection were enacted.\textsuperscript{[6,7,41,51,52]} These include applying the minimum pneumoperitoneum pressure, creating appropriately sized trocar incisions, and using bipolar electrocautery. Besides, setting laser and ultrasonic dissection devices at the minimum energy and using filters for pneumoperitoneum deflation and smoke evacuation at the nearest generation.\textsuperscript{[10,45,53,54]}

The selected operative intervention should not compromise the standards of care but be modified to decrease the risk of infection.\textsuperscript{[13,42]} However, it was argued that an operative approach with inferior results might still be ethically acceptable if the risk of COVID-19 and its associated morbidity and mortality can be significantly lowered.\textsuperscript{[42]} In consonance, although autonomy is an undisputed patient’s right, it can be overridden by society’s benefit, given the high pressure of the pandemic on the health-care systems.\textsuperscript{[55]} The increased morbidity and mortality, considering the risk of surgery and COVID-19, should be discussed clearly with the patient and be subsumed in the consent form to avoid medicolegal dilemmas.\textsuperscript{[3,42,47]}

**Departmental organization**

**Outpatient clinics**

Strategies to decrease exposure are essentially required to retain HCWs in the workforce during the pandemic.\textsuperscript{[56]} As such, the number of outpatient clinics should be reduced, and telemedicine used instead to initially assess patients and evaluate their need to come to the hospital.\textsuperscript{[58]} Videoconferences, email, phone calls, and social media applications were attempted to facilitate perioperative assessment and follow-up.\textsuperscript{[4,23,57]} Virtual clinics allow for sorting out patients and interpreting the results of their investigations and may, therefore, speed up treatment and spot those who need to attend in person for further assessment.\textsuperscript{[7,52]} Photos of diseased body parts could also be supplemented online to provide a visual clue to the diagnosis.\textsuperscript{[58]} However, triage by general practitioners and surgeons is occasionally mandatory.\textsuperscript{[59]}

Where the patient has to attend for further evaluation, a time-specific appointment should be booked in advance, prioritizing patients based on their health circumstances, for instance, cancer patients owing to their increased
A detailed history of suggestive COVID-19 symptoms should be sought and temperature checked to triage patients outside.\[33\] The number of HCWs should be kept to the minimum considering presence of the most senior staff to minimize the need for re-consultation.\[8,37,56\] As such, and where possible, residents, medical officers, interns, and other junior staff should be exempted.\[56,60\] Patients should apply facemasks and employ social distancing, and measures should be taken to prevent them from moving across each other.\[21,33\] Surgeons should bypass most but the essential parts of the physical examination and ensure PPE’s appropriate use.\[33\] Besides, rooms must be well ventilated, and surfaces disinfected in intervals between patients.

**Staff**

Many surgeons were lost from the workforce due to redeployment or COVID-19 contact or infection.\[7\] Besides, many of them were subjected to mental stress, the so-called “the hidden or parallel pandemic” due to unfamiliar work and life circumstances, and the fear of contracting the infection.\[9,10,22,56,57\] As such, strategies were proposed to retain HCWs in the workforce to maintain service and meet any surge in the number of COVID-19 cases.\[23,56\] Such recommendations included designating hospitals for COVID-19 patients and restructuring staff into small groups to work on a shift basis (e.g., every two weeks coinciding with the virus’s incubation period).\[8,56,60\] Unnecessary HCWs and nonmedical staff should stay at home\[58\] but be encouraged to stay connected to maintain teamwork and minimize the psychological burden as well.\[23,60\]

HCWs should work in only one hospital, and teams might be assigned to COVID and non-COVID-19 patients. Furthermore, those who serve COVID-19 patients may work for extended shifts to optimize resources.\[8,40\] Similarly, surgical departments might be set as “standard sections” for COVID free patients and “observational areas” for suspected cases.\[8,33\] However, the legitimacy of such segregation measures is criticized given the questionable ability of HCWs to withstand long shifts with COVID-19 patients and the efficacy with which virus transmission could be prevented.\[40\] HCWs should maintain a duty of self-evaluation and testing should they developed symptoms of COVID-19 and self-isolation if they harbored the infection.\[36,52\] Training HCWs on prevention strategies, including reducing paperwork and documentation, are essential to alleviate fear and anxiety and reduce infection risk.\[8,53\]

**Operative room guidelines**

**Operating room building**

A designate OR complex for COVID-19 patients is recommended.\[6,15,23,35,56\] If in the same building, the OR for COVID-19 patients should be next to the main entrance and is zone-colored.\[8,29,40,50\] Special areas for donning and doffing should be provided.\[51\] Doors and windows should be kept closed during surgery, and telecommunication devices used to decrease traffic.\[15,20,52\] The OR suite should be equipped with negative pressure and air renewal systems and, if not available, the use of filters is advocated (e.g., high efficiency and ultralow particulate filters).\[36,54\] Positive pressure systems should be stopped during surgery and turned on at least 20 min after the patient has left the OR.\[51\] Turnover time should be increased to allow for proper sterilization and disinfection as emphasis is mainly on safety rather than productivity.\[10,23,52\]

**Patients**

COVID-19 patients should have wrist tags and be operated on at the end of the list if there is no separate OR complex.\[36\] Patients should be transferred to the OR with dedicated porters through the shortest route that is clear and labeled, avoiding traffic and right away to the OR.\[20,33,37,40\] Designated routes and elevators should be used and adequately disinfected.\[20,35\] Examination, induction, intubation, extubation, and recovery procedures are preferably conducted in the OR to reduce the contamination of other areas.\[6,28\] Specimens should be carefully labeled as originating from COVID or non-COVID-19 patients.\[36\]

**Operating room staff**

The number of attendants should be kept to the minimum, and a detailed list of all participants is needed for contact tracing.\[6,15,40\] Surgeons and their assisting staff should enter the OR only after intubation and leave before extubating the patient.\[11,37,49,52\] Intraoperative documentation should be discouraged, and all paper-based records are kept outside the OR.\[20,40\] First and second “timeouts,” checklists, designated roles, and adequate preoperative planning and communication are advocated to avoid mistakes and ensure safety.\[6,37,41,52\] A runner should be available outside the OR to help bring anything required from the outside.\[15,20\] A dedicated OR team was recommended to minimize cross-infection risk with other staff members.\[20,27,37\] Considering the modern ventilation systems that pump air from the ceiling and absorb it near the floor, it might be safer for staff to remain in the room center and avoid leaning or sitting on the ground.\[40\] Staff should shower and change uniforms before resuming their routine work.\[6\]

**Instruments**

Single-use instruments were recommended; otherwise, proper sterilization and disinfection are indicated.\[4,33,36\] Essential items should be brought to the OR in advance, and once the operation started, attempts should be made to use the instruments already available.\[6,15,37\]
Unnecessary devices should be kept outside the OR or otherwise left inside, wrapped with plastic shields. [6,20,35] Well-identifiable containers should be preserved for hazardous waste disposal, while Linen should be immediately sealed and appropriately cleaned and sterilized. [40]

**Discussion**

Recommendations for surgical practice during the COVID-19 pandemic revolved around mitigation of the risk of virus transmission to patients and HCWs. Therefore, deferment of elective surgeries, appropriate use of PPE, and mindful consideration of the operative strategy were prospected. Besides, modification to the routines of departmental work and operative room guidelines were inevitable. However, those recommendations were often diverging and bore on a dearth of evidence and personal opinions. Multidisciplinary work and cooperation are required to establish and validate protocols for safe surgical practice during the pandemic and perhaps similar crises in the future.

Concomitantly, resumption of surgical service is expected to face some challenges that would require careful anticipation and management. [22,52] The large number of cases queued due to elective surgery’s cancellation created a backlog that would necessitate extra efforts and time to clear up. [1,24,57] Therefore, the patient prioritization strategy adopted during the pandemic may supervene for a while and may prolong the time-lapse for surgery, which is already lengthy. [39,61] Disease progression, particularly in cancer surgery, may alter the presentation and impose additional diagnostic and therapeutic challenges in the postpandemic period. [62] The adverse effects of loss of work on the psychological well-being and hand-skills of surgeons were speculated and require vigilance given the uncertainty of when the pandemic will end. [22,46,57] It has been highlighted that flattening the curve does not decrease the absolute number of cases; instead, it spreads them over a more extended period so that health-care systems could sustain it. [63] Figure 2 summarizes the current perspectives of surgical practice to combat the Covid-19 disease and may require further study and modification.

**Limitations and recommendation**

There is a dearth of evidence to support most of the recommendations mentioned earlier, which mainly hinges on personal opinions and limited evidence trials and may inevitably change in due time. Besides, a follow-up search of the literature was not done, which may render part of the information written in this article outdated. However, such a labile medium is expected, given our limited knowledge regarding the novel coronavirus, which is still evolving. The articulation of protocols through multidisciplinary and collaborative approaches to resume surgical practice safely is an anticipated initiative. [21,34] Fortunately, surgeons showed good will and worked assiduously to maintain service and help other departments sustain their work during the pandemic’s challenging times, which was quite reassuring. [1,55]

**Conclusion**

The COVID-19 pandemic has imposed an unprecedented challenge to the integrity of health-care systems in many parts of the world and tested to the extreme limits their capacity to survive amid unusual crises. Surgery was not an exception and suffered due to the diversion of resources to care for the escalating numbers of COVID-19 patients. Such pressures implied modification of the current practice to limit virus transmission yet maintaining the standards of surgical care and training. Multidisciplinary initiatives and cooperation are required to establish evidence-based protocols for safe practice and resumption of surgical service. As the whole world is learning from this tragic experience, surgeons might need to adopt new roles and work standards and translate these into their practice during the COVID-19 pandemic and perhaps longer.
Acknowledgment
This publication was supported by the Deanship of Scientific Research at Prince Sattam bin Abdul-Aziz University, Al-Kharj, Saudi Arabia.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Lombardi C, Gordini L, D’Amore A, Marzi F, Tedesco S, Grani G, et al. Endocrine surgery during COVID-19 pandemic: Do we need an update of indications in Italy? Endocrine 2020;4:1-4.
2. World Health Organization; Accessed on 22, September 2020 from: https://covid19.who.int/.
3. Deo SV, Kumar S, Kumar N, Saikia J, Bhorival S, Bhatnagar S, et al. Guiding Principles for Cancer Surgery during the COVID-19 Pandemic. Indian J Surg Oncol 2020;11 Suppl 1:3-10.
4. Correia M, Ramos R, Bahten L. The surgeons and the COVID-19 pandemic. Rev Col Bras Cir 2012;47:e536.
5. Gok AF, Eryılmaz M, Ozmen MN, Alimoglu O, Ertekin C, Kuroglu MH. Recommendations for trauma and emergency general surgery practice during COVID-19 pandemic. Ulus Travma Acil Cerrahi Derg 2020;26:335-42.
6. De Simone B, Chouillard E, Di Saverio S, Pagani L, Sartelli M, et al. Emergency surgery during the COVID-19 pandemic: What you need to know for practice. Ann R Coll Surg Engl 2020;102:325-32.
7. Patriti A, Baicocchi GL, Catena F, Marini P, Catarci M; FACS on behalf of the Associazione Chirurghi Ospedalieri Italiani (ACOI). Emergency general surgery in Italy during the COVID-19 outbreak: First survey from the real life. World J Emerg Surg 2020;15:36.
8. Mitura K, Myśliwiec P, Rogula W, Soleccki M, Furcal J, Kazanowski M, et al. Guidelines for the management of surgical departments in non-hospitals hospitals during the COVID-19 pandemic. Guidelines 2020;92:42-53.
9. Stahel PF. How to risk-stratify elective surgery during the COVID-19 pandemic? Patient Saf Surg 2020;14:8.
10. Balasubramanian A, Paleri V, Bennett R, Paleri V. Impact of COVID-19 on the mental health of surgeons and coping strategies. Head Neck 2020;42:1-7.
11. Diaz A, Sarac B, Schoenbrunner A, Jians J, Pawlik T. Elective surgery in the time of COVID-19. Am J Surg 2020;219:900-2.
12. The Equator Network. Enhancing the Quality and Transparency of Health Research. Available from: https://www.equator-network.org. [Last accessed on 2021 Feb 03].
13. Campanile FC, Podda M, Arezzo A, Botteri E, Sartori A, Guerrieri M, et al. Acute cholecystitis during COVID-19 pandemic: A multisocietary position statement. World J Emerg Surg 2015;10:38.
14. Al-Jabir A, Kerwan A, Nicola M, Alsaifi Z, Khan M, Sohrabi C, et al. Impact of the Coronavirus (COVID-19) pandemic on surgical practice – Part 2 (surgical prioritisation). Int J Surg 2020;79:233-48.
15. Flemming S, Hankir M, Ernestus RI, Seyfried F, Germer CT, Meybohm P, et al. Surgery in times of COVID-19 – Recommendations for hospital and patient management. Langenbecks Arch Surg 2020;405:359-64.
16. Al-Omar K, Bakkar S, Khasawneh L, Donatini G, Miccoli P. Resuming elective surgery in the time of COVID-19: A safe and comprehensive strategy. Updates Surg 2020;3:1-5.
17. Guerci C, Maffioli A, Bondurri AA, Ferrario L, Lazzarin F, Danelli P. COVID-19: How can a department of general surgery survive in a pandemic? Surgery 2020;167:909-11.
18. Olson MT, Triantafyllou T, Singhal S. Resumption of elective surgery during the COVID-19 pandemic: What lessons can we apply? Eur Surg 2020;5:1-3.
19. Tan WJ, Foo FJ, Sivarajah SS, Li LH, Koh FH, Chew MH. Safe colorectal surgery in the COVID-19 Era – A Singapore experience. Ann Coloproctol 2020;36:65-9.
20. Moletta L, Pierobon ES, Capovilla G, Costantini M, Salvador R, Merigliano S, et al. International guidelines and recommendations for surgery during Covid-19 pandemic: A Systematic Review. Int J Surg 2020;79:180-8.
21. Mouton C, Hirschmann MT, Ollivier M, Seil R, Menetrey J. COVID-19-ESSKA guidelines and recommendations for resuming elective surgery. J Exp Orthop 2020;7:28.
22. Sharma D, Agrawal V, Agrawal P. Roadmap for restarting elective surgery during/after COVID-19 pandemic. Indian J Surg 2020;11:1-5.
23. Pelosi A, Moeckli B, Oldani G, Triponez F, Tosco C. Response of a European surgical department to the COVID-19 crisis. Swiss Med Wkly 2020;150:w20241.
24. Finley C, Prashad A, Camuso N, Daly C, Aprikian A, Ball CG, et al. Guidance for management of cancer surgery during the COVID-19 pandemic. Can J Surg 2020;63:52-4.
25. Vourtzoumis P, Alkhamesi N, Elnahas A, Hawel JE, Schlachtew. Operating during COVID-19: Is there a risk of viral transmission from surgical smoke during surgery? Can J Surg 2020;63:E299-301.
26. Levi S, Jiang F, Su W, Chen C, Chen J, Mei W, et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. EClinicalMedicine 2020;21:100331.
27. Sorrentino L, Guaglio M, Cosimelli M. Elective colorectal cancer surgery at the oncologic hub of Lombardy inside a pandemic COVID-19 area. J Surg Oncol 2020;122:1-3.
28. Kumar J, Raina R. Recommendations for surgery during the COVID-19 pandemic. Indian J Surg 2020;11:1-2.
29. Wong D, Tang E, Njo A, Chu C, Chau S, Chow TL, et al. Risk stratification protocol to reduce consumption of personal protective equipment for emergency surgeries during COVID-19 pandemic. Hong Kong Med J 2020;26:252-4.
30. Al-Muhammad MA. Testing recommendation for COVID-19 (SARS-CoV-2) in patients planned for surgery – Continuing the service and ‘suppressing’ the pandemic. Br J Oral Maxillofac Surg 2020;58:503-5.
31. Alimoglu O, Erol C, Kilic F, Baysal H. Cancer surgery during the Covid-19 pandemic in Turkey. Int J Surg 2020;22:54-5.
32. Tomulescu V, Surlin V, Scripcariu V, Bintintan V, Duta C, Calu V, et al. Colorectal surgery in romania during the COVID-19 pandemic. Chirurgia 2020;115:129-37.
33. Liu Z, Zhang Y, Wang X, Zhang D, Dias D, Chandramohan K, et al. Recommendations for surgery during the novel coronavirus (COVID-19) epidemic. Indian J Surg 2020;11:1-5.
34. Zarrintan S. Surgical operations during the COVID-19 outbreak: Should elective surgeries be suspended? Int J Surg 2020;78:5-6.
35. Welsh Surgical Research Initiative (WSRI) Collaborative. Impact of the Coronavirus (COVID‑19) pandemic on surgical practice – Part 2 (surgical prioritisation). Int J Surg 2020;19:900-2.
36. Welsh Surgical Research Initiative (WSRI) Collaborative. Impact of the Coronavirus (COVID‑19) pandemic on surgical practice – Part 2 (surgical prioritisation). Int J Surg 2020;19:900-2.
37. Welsh Surgical Research Initiative (WSRI) Collaborative. Impact of the Coronavirus (COVID‑19) pandemic on surgical practice – Part 2 (surgical prioritisation). Int J Surg 2020;19:900-2.
38. Welsh Surgical Research Initiative (WSRI) Collaborative. Impact of the Coronavirus (COVID‑19) pandemic on surgical practice – Part 2 (surgical prioritisation). Int J Surg 2020;19:900-2.
39. Welsh Surgical Research Initiative (WSRI) Collaborative. Impact of the Coronavirus (COVID‑19) pandemic on surgical practice – Part 2 (surgical prioritisation). Int J Surg 2020;19:900-2.
39. Dexter F, Elhakim M, Loftus RW, Seering MS, Epstein RH. Strategies for daily operating room management of ambulatory surgery centers following resolution of the acute phase of the COVID-19 pandemic. J Clin Anesth 2020;64:109854.

40. Coccolini F, Perrone G, Chiarugi M, Di Marzo F, Ansaloni L, Scandroglio I, et al. Surgery in COVID-19 patients: Operational directives. World J Emerg Surg 2020;15:25.

41. Yib H, Chiu P, Hassan C, Antonelli G, Sharma P. ISDE guidance statement: Management of upper gastrointestinal endoscopy and surgery in COVID-19 outbreak. Dis Esophagus 2020;33:1-4.

42. Macleod J, Mezher S, Hasan R. Surgery during COVID-19 crisis conditions: Can we protect our ethical integrity against the odds? J Med Ethics 2020;46:1-3.

43. Myles P, Maswime S. Mitigating the risks of surgery during the COVID-19 pandemic. Lancet 2020;396: 2-3.

44. Besnier E, Tuech JJ, Schwarz L. We asked the experts: COVID-19 outbreak: Is there still a place for scheduled surgery? “Reflection from pathophysiological data”. World J Surg 2020;44:1695-8.

45. Joseph J, Joseph A, Oomman S, Jayanthi N. Laparoscopic versus open surgery: Aerosols and their implications for surgery during the COVID-19 pandemic. Eur Surg 2020;10:1-2.

46. Scaravonati R, Díaz E, Roche S, Bertone S, Brandi C. Strategies for follow up after hernia surgery during COVID 19 Pandemia. Int J Surg 2020;79:103-4.

47. Krishnamurthy A, Gopinath KS. The need for prioritizing cancer surgeries amidst the COVID-19 pandemic. Indian J Surg Oncol 2020;11:169-70.

48. Hojaij FC, Chinelatto LA, Boog GH, Kasmirski JA, Lopes JV, Sacramento FM. Surgical practice in the current COVID-19 pandemic: A rapid systematic review. Clinics (Sao Paulo) 2020;75:e1923.

49. Wexner SD, Cortés-Guiral D, Gilshtein H, Kent I, Reymond MA. COVID-19: Impact on colorectal surgery. Colorectal Dis 2020;22:635-40.

50. Vigneswaran Y, Prachand VN, Posner MC, Matthews JB, Hussain M. What is the appropriate use of laparoscopy over open procedures in the current COVID-19 Climate? J Gastrointest Surg 2020;24:1686-91.

51. Mowbray NG, Ansell J, Horwood J, Cornish J, Rizkallah P, Parker A, et al. Safe management of surgical smoke in the age of COVID-19. Br J Surg 2020;107:1406-13.

52. Heffernan DS, Evans HL, Huston JM, Claridge JA, Blake DP, May AK, et al. Surgical infection society guidance for operative and peri-operative care of adult patients infected by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). Surg Infect (Larchmt) 2020;21:301-8.

53. Williams M, Blake S, Matthews H. Mitigating the risk of aerosol generation from power tools during the COVID-19 pandemic. Ann R Coll Surg Engl 2020;102:393-4.

54. Al-Niaimi F, Ali F. COVID-19 and dermatologic surgery: Hazards of surgical plume. Dermatol Ther 2020;33:e13593.

55. Harkin DW. Ethics for surgeons during the COVID-19 pandemic, review article. Ann Med Surg (Lond) 2020;55:316-9.

56. Rana RE, Ather MH, Enam SA. Change in surgical practice amidst COVID 19; example from a tertiary care centre in Pakistan. Ann Med Surg (Lond) 2020;54:79-81.

57. Karim J, Hachach-Haram N, Dasgupta P. Bolstering the surgical response to COVID-19: How virtual technology will save lives and safeguard surgical practice. BJU Int 2020;125:E18-9.

58. Hamza M, Khan HS, Sattar ZA, Hanif M. Doctor-patient communication in surgical practice during the coronavirus (COVID-19) pandemic. Br J Surg 2020;107:e193.

59. La Torre M, Pata F, Gallo G. Delayed benign surgery during the COVID-19 pandemic: The other side of the coin. Br J Surg 2020;107:e258.

60. Brethauer SA, Poulose BK, Needleman BJ, Sims C, Arnold M, Washburn K, et al. Redesigning a department of surgery during the COVID-19 pandemic. J Gastrointest Surg 2020;24:1852-9.

61. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: Global predictive modelling to inform surgical recovery plans. Br J Surg 2020;107:1440-9.

62. Berardi G, Levi Sandri GB, Colasanti M, Ettorre GM. Readaptation of surgical practice during COVID-19 outbreak: What has been done, what is missing and what to expect. Br J Surg 2020;107:e251.

63. Cook T, Harrop-Griffiths W. Kicking on while it’s still kicking off – Getting surgery and anaesthesia restarted after COVID-19. Anaesthesia 2020;75:1273-7.