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Ramping Up Delivery of Cardiac Surgery During the COVID-19 Pandemic: A Guidance Statement From The Society of Thoracic Surgeons COVID-19 Task Force

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The coronavirus disease 2019 (COVID-19) pandemic has had a profound global impact. Its rapid transmissibility has transformed healthcare delivery and forced countries to adopt strict measures to contain its spread. The vast majority of the United States cardiac surgical programs have deferred all but truly emergent/urgent operative procedures in an effort to reduce the burden on the healthcare system and to mobilize resources to combat the pandemic surge. While the number of COVID-19 cases continue to increase worldwide, the incidence of new cases has begun to decline in many North American cities. This "flattening of the curve" has prompted interest in reopening the economy, relaxing public health restrictions, and resuming nonurgent healthcare delivery. The following document provides a template whereby adult cardiac surgical programs may begin to ramp-up the care delivery in a deliberate and graded fashion as the COVID-19 pandemic burden begins to ease. "Resuscitating" the timely delivery of care is guided by three principles: (1) Collaborate to permit increased case volumes, balancing the clinical needs of patients awaiting surgical procedures with the local resources available within each healthcare system. (2) Prioritize patients awaiting elective procedures while proactively engaging all stakeholders, focusing on those with high-risk anatomy, changing/symptomatic clinical status, and, once these variables have been addressed, prioritizing by waiting times. (3) Reevaluate local conditions continuously to assess for any increase in admissions due to a recrudescence of cases, to assure adequate resources to care for patients, and to monitor in-hospital infectious transmissions to both patients and healthcare workers.

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REPORT

The Society of Thoracic Surgeons COVID-19 Task Force and the Workforce for Adult Cardiac and Vascular Surgery recently published guidance documents related to the practice of cardiac surgery during the acceleration phase of the coronavirus disease 2019 (COVID-19) pandemic.[1,2] These documents were aimed at providing cardiac surgeons with guidance regarding patient triage, leadership, and infection risk reduction during the pandemic surge. In many locations, however, the incidence of new cases of COVID-19 are plateauing or declining after demonstrated flattening of the epidemiologic curve. Consideration must now be made of how best

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Abbreviations and Acronyms

AS	= aortic stenosis
ASD	= atrial septal defect
CABG	= coronary artery bypass grafting
CAD	= coronary artery disease
CHF	= congestive heart failure
COVID-19	= coronavirus disease 2019
ECMO	= extracorporeal membrane oxygenation
EF	= ejection fraction
ELSO	= Extracorporeal Life Support Organization
ICU	= intensive care unit
LAD	= left anterior descending artery
LM	= left main artery
LOS	= length of stay
MR	= mitral regurgitation
NAAT	= nucleic acid amplification testing
PCR	= polymerase chain reaction
PFO	= patent foramen ovale
PPE	= personal protective equipment
TAVR	= transcatheter aortic valve replacement
VAD	= ventricular assist device

to safely modify public health restrictions and resume nonurgent and emergent healthcare delivery, specifically, elective cardiac surgical procedures.

During the early phases of the pandemic, significant efforts were made to prioritize and defer nonurgent cases to preserve mechanical ventilators and other critical care resources, personal protective equipment (PPE), blood products, hospital beds, and maintain sufficient healthcare personnel in preparation for the pandemic surge. In addition, the Centers for Disease Control and Prevention recommended[3] delaying elective inpatient and outpatient operations and procedures. This recommendation was intended to protect healthcare workers and uninfected, vulnerable patients (ie, older with cardiovascular disease) by limiting their exposure to those with known COVID-19 and asymptomatic, undiagnosed carriers of the virus. However, there is growing concern about the increased risk of further delaying cardiac surgical procedures with established survival benefits. Programs need to start planning for the resumption of care for patients awaiting postponed elective operations.

However, any decision to "ramp up" surgical case volume will require thoughtful and appropriate caution, with frequent reevaluation as we navigate through the uncertainties of this global pandemic. There will be a need to make collaborative decisions with precise local and regional situational awareness of disease burden, carefully balancing the risks and benefits of increasing the number of non-urgent surgical cases. Furthermore, we must maintain flexibility to readjust our escalation strategy in response to evolving conditions and rapidly changing diagnostic and therapeutic COVID-19 processes. There is the possibility of secondary surges as populations reemerge from lockdown and the potential for increased COVID-19 infections in combination with other seasonal respiratory pathogens such as influenza virus.

These guidance statements, which are based on the expert opinions of cardiac surgical and critical care leaders, provide a template whereby cardiac surgical programs may consider safely increasing case volume in a deliberate and graded fashion as the COVID-19 local disease burden begins to ease.

1. Working with public health officials, local COVID-19 prevalence in the community must be under control. Communities should have a low COVID-19 burden that can be physically isolated within the hospital or a consistent decrease in COVID-19 incidence creating the resource capacity to perform elective procedures.[4] If COVID-19 incidence resurges locally, plans should be in place for reentering the surge triage and mitigation phase.[1,2]
2. Many patients are reluctant to enter hospitals for fear of exposure to COVID-19.[5] Patients should feel comfortable they can safely undergo cardiac surgical procedures without significant risk of exposure to COVID-19 within the hospital environment. This includes enhanced attention to equipment, meals, medication administration, PPE, and interactions with other patients, visitors, and hospital personnel. Hospitals should adjust policies, protocols, and procedures to limit patient movement and exposure to potential COVID-19 fomites and personnel.[6] All attempts should be made to avoid excessive imaging, blood work, procedures, and in-hospital transport to limit these exposures.[7] Recommendations surrounding the need for repeat laboratory testing, imaging, and physical examinations should be reassessed. Video conferencing should be used for preoperative family meetings and postoperative visits, where available. In addition, the hospitals' newly formed COVID-19 infection control processes and procedures should be discussed with patients at the time of surgical consent. This necessitates shared decision-making surrounding the risk of an operation during a pandemic versus the risk of further deferring treatment of the patient's cardiovascular pathology. The surgical team should describe the special precautions being undertaken and disclose the uncertain risk of nosocomial COVID-19 infection. Patients should be advised of limited hospital visitor policies and the potential for unexpected case cancellations. Cardiac surgical patients should be limited to designated "COVID-19–secure" units (free from known COVID-19 patients), whenever possible.

   New signage and messaging should be used to educate healthcare workers and patients. Offices, clinics, hospital public areas, and waiting rooms should practice physical distancing (eg, 6-feet spacing of chairs). Hospital visitation rules need to be carefully considered to limit potential exposures. Finally, deliberate attempts should be made to preoperatively assess each patient's potential need for a

postacute care upon discharge, given the high incidence of known COVID-19 outbreaks in those facilities.[8] Expectations for discharge should be reviewed preoperatively because longer hospital stays after a cardiac surgical procedure potentially place patients at additional risk. As such, patients should plan to be safely discharged to their homes as soon as possible after an uncomplicated recovery.[9]

3. Healthcare providers should be aware that their safety also remains a priority. Cardiac surgical programs should follow precautions and guidelines that have been put in place by their respective institutions, adhering to the recommendations of local, regional, and national public health authorities to manage and contain COVID-19 transmission.[10] The risk of nosocomial infection may be significantly reduced by vigilant attention to frequent hand hygiene, environmental cleaning, appropriate use of PPE, the creation of "COVID-19–secure" units, social distancing in the hospital,[11] and self-isolation of COVID-19–positive healthcare workers. It is imperative that healthcare workers continue to follow institutional policies about reporting symptoms, undergoing testing, and implementing self-quarantine when appropriate. They must abstain from work if they become sick, no matter how mild their symptoms. Contingency planning for staffing must be in place for healthcare workers who require self-isolation. This is particularly relevant for the small and highly specialized cardiac teams. In addition, support and treatment services should be available for providers who experience mental health concerns, physical and/or emotional exhaustion as a result of professional or personal experiences during the pandemic.[12,13] Finally, there will likely be evolution and institutional variation in COVID-19 nasopharyngeal and serologic screening for asymptomatic healthcare workers. Healthcare leaders must be aware of this dynamic process.
4. Hospitals should develop and implement comprehensive screening procedures to identify patients at increased risk for COVID-19 as cardiac surgical programs begin to ramp up. These include the following:
   a. Standardized clinical screening telephone questionnaires within 48 hours before hospital admission, focusing on the clinical history of patients and their cohabitants (including viral-like symptoms, anosmia,[14] and ageusia, all of which are frequently associated with COVID-19).
   b. Unless recent outpatient testing suggests the patient is infection free, if possible, the initial admission should be to a single room within the hospital where additional rapid same-day preoperative screening or testing, or both, may be performed as needed.
   c. Once admitted to the ward, each patient must be clinically screened for the signs and symptoms of viral illness, with COVID-19 testing administered as needed.
5. Nucleic acid amplification testing (NAAT) for COVID-19 (eg, by polymerase chain reaction [PCR]) should be strongly considered for patients in areas of high disease burden, those who have recently been exposed to infected individuals, and those who exhibit even mild symptoms. If there has been a recent exposure, a 2-week quarantine is recommended. Finally, when possible, all preoperative patients should be tested before admission. Unfortunately, there is no test currently available that can reliably rule out COVID-19. Despite this, tests using nasopharyngeal swabs for COVID-19 NAAT, including rapid PCR tests, are being increasingly performed across the country, often with the ability to return results within minutes or hours. In light of this, we propose the following guidance regarding COVID-19 test interpretation in the ramp-up phase based on the best available evidence at this time.
   a. Nasopharyngeal swab NAAT (or its equivalent) for COVID-19 should be considered before all elective cardiac surgical procedures. The timing of sampling should be as close to the surgical procedure as possible (preferably within 24-48 hours), allowing sufficient time for the results to be processed.
   b. When NAAT testing is positive, these results can be very helpful because delaying the operation should strongly be considered.
   c. When NAAT testing is negative, results must be interpreted with caution because false-negative rates in asymptomatic patients can be as high as 30% to 50%.[15,16] Clinical sensitivity can be reduced due to poor quality specimen collection[17] or specimen collection early in the disease process (higher false-negative rates have been noted in the asymptomatic or preclinical period).[15] For patients in areas of high COVID-19 disease activity who require urgent or emergent procedures, if the NAAT testing and initial symptom screen are negative, consider repeat NAAT testing by nasopharyngeal swabs separated by more than 24 hours apart and consulting with local infection control practitioners.
   d. Elective surgical patients with negative NAAT testing in whom the clinical suspicion of COVID-19 infection remains high should self-quarantine for a 2-week period of observation. Before the surgical procedure, patients should be rescreened for symptoms and exposures and retested in conjunction with local infectious disease consultation.
   e. If a suspicious clinical syndrome concerning for COVID-19 develops in a patient postoperatively, additional investigative tools may include repeat nasopharyngeal specimen collection, endotracheal aspirates for NAAT testing, computed tomographic imaging, or a combination of these.[18]
   f. Clearly, as improved testing methods become available, they should be used, all the while

REPORT

RAMP UP PHASE 1

< 25%
Increase in capacity

1. Focus on in-patient urgent/emergent services with gradual introduction of appropriately prioritized out-of-hospital patients
2. Careful consideration of patients who may require prolonged ICU and hospital length of stay
   a. *Avoid frail, older adult patients (Clinical Frailty Score > 4, Edmonton Frailty Score >6 or equivalent)*
   b. *Avoid other vulnerable patients including those with renal insufficiency, depressed EF, advanced CHF*
   c. *Avoid complex procedures, including re-operative surgery, that not only carry risk of prolonged ICU/ hospital length of stay but also may require excessive blood product transfusion*
3. Prioritize isolated CABG, isolated valve procedures and less complex procedures to maximize patient flow
   a. *Emphasis on patients with aortic stenosis (AS) and coronary artery disease (CAD) with prognostic benefit (e.g. critical aortic stenosis, left main disease, proximal LAD stenosis)*

- Perform TAVR procedures in patients who are most symptomatic

RAMP UP PHASE 2

25%-50%
Increase in capacity

1. Maintain in-patient urgent/emergent services while broadening inclusion of appropriately prioritized out-of-hospital patients
2. Consider expanding essential procedures to include all types of interventions based on the ICU capacity at your institution
3. Continue to prioritize those patients with greatest survival benefit
   a. *Severe symptomatic valvular heart disease*
   b. *CABG in patients left main (LM), proximal left anterior descending (LAD) or 3-vessel disease / depressed EF*
   c. *Aortic aneurysm disease with high-risk features (>6.0 cm, rapid growth) and/or symptoms*
   d. *Cardiac tumors with high-risk features for obstruction or embolism*

RAMP UP PHASE 3

50%-100%
Increase in capacity

1. Maintain in-patient urgent/emergent services
2. Return to normal outpatient services while continuing to prioritize those at greatest risk on the wait list
3. Consider ongoing deferral of truly elective interventions
   a. *Asymptomatic severe MR*
   b. *ASD and/or PFO surgery*
   c. *Asymptomatic aneurysm with demonstrated stable size*

ALL PHASES

1. Contact patients on the waitlist for surgery to prioritize their symptoms
2. Adopt a mechanism by which waitlisted patients who are having increased symptoms or who are not doing well can contact the program to receive additional screening
3. Utilize guidance regarding ventricular assist device (VAD), cardiac transplantation and mechanical circulatory support, including extracorporeal membrane oxygenation (ECMO) provided by the Extracorporeal Life Support Organization (ELSO)

recognizing that these are elective surgical procedures, and a 2-week quarantine with retesting may be the safest approach for any patient, regardless of pretest probabilities.

6. Nonurgent patients waiting for prolonged periods before an operation are at risk for clinical deterioration or adverse events. Cardiac surgery programs should proactively reassess each patient on their waiting list while pursuing a graded increase in elective case volume. Aspects of this management may include, but are not limited to, the following:
   a. All waiting list patients should be contacted by telephone or video conference for reassessment at least every 2 to 4 weeks to assess their clinical status and should be instructed to call if their symptoms worsen.
   b. Hospitals should have a clear plan in place to formally escalate the care of patients with deteriorating symptoms or unstable clinical characteristics, particularly in the face of high-risk anatomy.
   c. Peer review among the interdisciplinary heart team is highly encouraged for complex patients.
   d. Continued reevaluation of local pandemic conditions should occur regularly as part of the cardiac surgical ramp-up strategy. Programs should be prepared to immediately stop ramping up or to even deescalate cardiac surgical volumes should there be a resurgence in the number of local COVID-19 cases, admissions, and deaths.
7. A phased approach is recommended to resuming elective procedures based on each hospital's reexpansion capacity (Figure 1). We have defined an increase in hospital capacity as the percentage of resources previously allocated to the COVID-19 pandemic that have now been reallocated to the management of non COVID-19 patients. Phase 1 reflects up to a 25% increase in capacity, phase 2 a 25% to 50% increase, and phase 3 a 50% to 100% increase or a return to normal institutional activity. Depending on which phase of reexpansion your institution is currently in, your cardiac surgical program should have a defined approach about which elective cases will be given priority during the ramp-up. The number of elective cases by which each program may ramp-up depends on the urgent case demands at the institution and the overall institutional capacity in the context of COVID-19 prevalence and the impact on the healthcare workforce.
8. Hospitals should create and put into operation sustainable plans to ensure that they continue to care for patients with COVID-19 infections while concurrently addressing all the other healthcare needs of their noninfected local populations. Increased surgical volume will consume PPE and other resources, which should be modeled to ensure capacity. Policies regarding the use of PPE during operations for patients deemed to be non–COVID-19 should be established. Those institutions with a high incidence of persistent COVID-19 disease burden will likely need to designate separate "COVID-19–care" and "COVID-19–secure" units for the foreseeable future. We must continue to assume we will have hospitalized symptomatic COVID-19 patients until we have a vaccine or sufficient herd immunity.
9. Efforts to escalate cardiac surgical volumes require regular communication between members of the cardiac surgical team, intensive care units, hospital administration, and public health officials. Ideally, a regional dashboard that provides real-time trending of resource use (eg, hospital admissions, intensive care unit admissions, ventilator use, and PPE availability) should be created to facilitate communication and well-informed forecasting to allow for thoughtful decision making.
10. Real-time quality assurance teams should be focused on monitoring COVID-19 transmission within cardiac surgical units, postoperative complications related or unrelated to COVID-19, deficiencies in hospital workflow, or other related quality issues. Potential sources of concern may include noncardiac-specific personnel staffing our operating rooms and the cardiac intensive care unit, expedited workups, inadequate preoperative testing, and "pandemic"- level of care.

Summary

The COVID-19 pandemic has introduced unique challenges for cardiac surgical programs. Elective cases have been cancelled and urgent cases delayed to reallocate resources for patients with COVID-19. Waiting lists have grown, and patients being asked to postpone their operation have been forced to experience necessary but prolonged delays. Patients who were once deemed surgical candidates have increasingly been referred for medical management or alternative percutaneous therapies, with potential adverse long-term impacts.

The effect of the COVID-19 pandemic on individual hospitals varies widely. It is important for institutions to continuously reassess their capabilities and potential

Figure 1. (see previous page) Phased implementation approach to cardiac surgery ramp-up based on the increase in hospital capacity. (AS, aortic stenosis; ASD, atrial septal defect; CABG, coronary artery bypass grafting; CAD, coronary artery disease; CHF, congestive heart failure; ECMO, extracorporeal membrane oxygenation; ELSO, Extracorporeal Life Support Organization; EF, ejection fraction; ICU, intensive care unit; LM, left main artery; LAD, left anterior descending artery; LOS, length of stay; MR, mitral regurgitation; PFO, patent foramen ovale; TAVR, transcatheter aortic valve replacement; VAD, ventricular assist device.) (Reprinted with permission from Hassan A, Arora RC, Adams C, et al. Cardiac surgery in Canada during the COVID-19 pandemic: a guidance statement from the Canadian Society of Cardiac Surgeons. Can J Cardiol. 2020;36:952-955.)

limitations, while simultaneously surveying for potential subsequent waves of COVID-19. As new data emerge, these statements may change over time given the fluidity and scope of the current pandemic. Geographic differences in epidemiology and practice patterns across the country must be acknowledged and do not substitute for individualized expertise when putting into operation a deliberate and graded increase in cardiac surgical volume as the incidence of COVID-19 begins to ease.

Clearly, economic factors remain highly relevant in United States healthcare. Some surgeons are compensated on a model that correlates with production of relative value units. Nonmilitary hospitals are also heavily reimbursed based on procedural volume. The financial impacts to medical centers has also been well described and are substantial, with hospitals under major financial crises.[19,20] Nevertheless, it is imperative that cardiac surgeons advocate in the best interest of their patients and function as good citizens for their institutions by supporting the principles stated in The Society of Thoracic Surgeons Adult Cardiac Triage Guidance Document[1]: (1) protect our patients, (2) protect the healthcare team, and (3) protect society.

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