Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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MULTISOCIETAL DOCUMENT

Safe Reintroduction of Cardiovascular Services During the COVID-19 Pandemic

From the North American Society Leadership

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CLINICAL PROBLEM

The coronavirus disease-2019 (COVID-19) pandemic has led to marked global morbidity and mortality (1-3). There have been appropriate but significant restrictions on routine medical care to comply with public health guidance on physical distancing and to help preserve or redirect limited resources. Most invasive cardiovascular (CV) procedures and diagnostic tests have been deferred with North American CV societies advocating for intensified triage and management of patients on waiting lists (4).

North American Cardiovascular Societies represented: American College of Cardiology, American Heart Association, Canadian Cardiovascular Society, Canadian Association of Interventional Cardiology, Society for Cardiovascular Angiography and Interventions, Heart Valve Society, American Society of Echocardiography, Society of Thoracic Surgeons, Heart Rhythm Society, Society of Cardiovascular Computed Tomography, American Society of Nuclear Cardiology, Society of Nuclear Medicine and Molecular Imaging, Society for Cardiovascular Magnetic Resonance, Canadian Heart Failure Society, and the Canadian Society of Cardiac Surgeons.

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ABBREVIATIONS AND ACRONYMS

COVID-19 = coronavirus disease-2019

CV = cardiovascular

HCW = health care worker

PPE = personal protective equipment

Unfortunately, patients with untreated CV disease are at increased risk of adverse outcomes (5). Delays in the treatment of patients with confirmed CV disease will be detrimental. Similarly, reduced access to diagnostic testing will lead to a high burden of undiagnosed CV disease that will further delay time to treatment. Although there will be a myriad of competing demands from multiple disciplines, this risk warrants the prioritization of CV patients as health care systems return to normal capacity (4). Although COVID-19 has had a global impact, there are regional differences in the burden of the pandemic. Some regions have not experienced a significant surge of cases variably related to social and health care adaptation measures, or the surge has passed and was less substantial than predicted. In these areas, there are available health sector resources that can be redeployed quickly. As regions move along the journey of managing the COVID-19 pandemic, there is an opportunity to reintroduce regular CV care in a progressive manner with appropriate safeguards.

The CV societies have released a number of position or guidance statements that predominantly focus on the provision of CV care during the peak of the pandemic (6–12). These documents highlight the central theme of balancing essential CV care services while reducing exposure and preserving health care resources to address the pandemic. As the COVID-19 pandemic abates, developing appropriate strategies to reintroduce routine CV care will be crucial. Unprecedented times require unprecedented collaboration. In this consensus report, we harmonize recommendations from North American CV societies and provide guidance on the safe reintroduction of invasive CV procedures and diagnostic tests after the initial peak of the COVID-19 pandemic.

STRATEGIES AND EVIDENCE

ETHICAL CONSIDERATIONS. Similar to rationing decisions made in preparation for the initial surge of COVID-19 cases, progressive and thoughtful reintroduction of CV services must be based on robust ethical analysis (13). Relevant values to be operationalized include (14): 1) *maximizing benefits* such that the most lives, or life years, are saved so that procedures or tests that are likely to benefit more people and to a greater degree are prioritized over procedures that will benefit fewer people to a lesser degree; 2) *fairness* such that like cases are treated alike, taking into consideration baseline health inequities; 3) *proportionality* such that the risk of further postponement is balanced against the risk of exacerbating COVID-19 spread; and 4) *consistency* such that reintroduction is managed across populations and among individuals regardless of ethically irrelevant factors such as ethnicity, perceived social worth, or ability to pay. Finally, the promotion of *procedural justice*, with the use of an ethical framework (15), is essential to ensure that all decisions reflect best available evidence with transparent communication.

COLLABORATION AMONG REGIONAL PUBLIC HEALTH OFFICIALS, HEALTH AUTHORITIES, AND CV CARE PROVIDERS. Some regions have seen an escalation in COVID-19 cases when social restrictions and physical distancing have been eased. Hospital-based CV teams must establish active partnerships with regional public health policymakers to exchange up-to-date information on both the local status of the pandemic and the growing morbidity and mortality on CV waiting lists. This is essential for the safe reintroduction of regular CV services. There should be a sustained reduction in the rate of new COVID-19 admissions and deaths in the relevant geographic area for a pre-specified time interval as determined by local public health officials before changes can be implemented. Importantly, if COVID-19 admissions and deaths start to increase, there must be immediate and transparent cessation of most elective invasive procedures and tests. Resumption of these services would occur in collaboration with regional public health policymakers. As discussed in the following text, COVID-19 testing of potential patients and health care workers (HCWs), as well as personal protective equipment (PPE), must also be carefully monitored to minimize the risk of shortages as the pandemic escalates and abates. A cohesive partnership with regional public health officials will facilitate management of the dynamic balance between

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provision of essential CV care and responding to ongoing fluctuations in COVID-19 admissions and deaths.

PROTECTION OF PATIENTS AND HCWs. The protection of patients and HCWs must be addressed before any reintroduction of CV procedures and tests. Regions must have the necessary critical care capacity, PPE, and trained staff available before the recommendations summarized in Table 1 can be implemented. Importantly, a transparent plan for testing and retesting potential patients and HCWs for COVID-19 must be operationalized before elective procedures and tests are resumed. Additional considerations include:

1. *Physical distancing.* Consider strategies to minimize patient contact with HCWs performing invasive CV procedures and diagnostic tests. These may include virtual pre-procedural clinics, virtual consenting for procedures and diagnostic tests, and minimizing the number of HCWs in physical contact with any given patient. Restrictions should be implemented on the number of people that can accompany a patient or visit a patient after a procedure or test. Whenever possible, multiple tests or procedures should be consolidated into a single comprehensive visit.
2. *COVID-19 screening.* Encourage routine screening of all patients prior to any C procedure or test to ensure the safety of HCWs. This testing may include nasopharyngeal swabs and saliva or rapid antibody tests, and should be guided by local institutional infectious disease experts and closely coordinated with regional public health officials. Key considerations include the availability and accuracy of the previously mentioned tests as well as the frequency and timing of COVID-19 testing and retesting. Appropriate PPE is required to protect HCWs even if patients are asymptomatic, as the sensitivity of available tests is low in this setting. A significant benefit of testing is the opportunity to defer COVID-19-positive patients if they remain clinically stable.
3. *PPE.* The use of PPE for HCWs during routine CV procedures and diagnostic tests will be an important consideration. The need to ensure staff safety must be balanced against the need to conserve PPE supplies in the event that the pandemic escalates. Emergent cases, such as ST-segment elevation myocardial infarction patients and urgent surgeries, or aerosol-generating medical procedures will likely continue to require the highest level of PPE for the foreseeable future; thus, available supplies must be carefully monitored.

AREAS OF UNCERTAINTY

Leaders from the North American CV societies acknowledge that the recommendations in this guidance document are based predominantly on expert opinion. This reflects the global challenge of managing a new and rapidly evolving pandemic where evidence is limited.

GUIDANCE FROM PROFESSIONAL SOCIETIES

Table 1 harmonizes recommendations from major North American CV societies and provides guidance on the safe reintroduction of invasive CV procedures and diagnostic tests during the COVID-19 pandemic. Important considerations when implementing Table 1 include:

1. Decisions regarding transitioning between response levels requires close collaboration with public health officials and health systems. It is expected that this process will be dynamic and continue to evolve as new information becomes available.
2. A transparent collaborative plan for COVID-19 testing and PPE use must be in place before a safe reintroduction of procedures and tests can occur.
3. It is expected that different regions will be at different response levels as the pandemic escalates and abates.
4. Within a given region, different invasive procedures and diagnostic tests may be at different response levels depending on local COVID-19 penetrance and infrastructure requirements.
5. In general, a minimally invasive procedure with a shorter length of stay is preferable if both strategies have similar efficacy and safety.
6. A less invasive test or alternative imaging modality should be considered if both tests have similar efficacy.
7. The language in Table 1 was chosen to give clinicians, health systems, and policy makers the maximum flexibility when moving between response levels in their region. COVID-19 prevalence, admission, and death rates as well as appropriate time intervals for safe reintroduction will change, and thus, we utilized “selective” cases and “some” or “most” CV procedures in Table 1.
8. Maintaining reserve capacity to ensure the ability to manage a possible second surge in COVID-19 cases is a key competing priority. This balance should be actively managed as regions pass

TABLE 1 Safe Reintroduction of Cardiovascular Procedures and Diagnostic Tests During the COVID-19 Pandemic: Guidance From North American Society Leadership

Response Level (in Collaboration With Public Health Officials)	Level 2 Reintroduction of Some Services	Level 1 Reintroduction of Most Services	Level 0 Regular Services (Ongoing COVID-19 Testing/Surveillance and Monitoring of PPE Availability)
Interventional and Structural Cardiology			
STEMI	• COVID-19 status may be unavailable at time of STEMI. Use of PPE will be dictated by regional health authority and COVID-19 penetrance. • Primary PCI for most patients. Selective pharmacoinvasive therapy as per regional practice. • If moderate/high probability or COVID-19 +ve consider alternative investigations (TTE and/or CCT) prior to catheterization laboratory activation or pharmacoinvasive therapy.	• COVID-19 status may be unavailable at time of STEMI. Use of PPE will be dictated by regional health authority and COVID-19 penetrance. • Primary PCI for most patients. Selective pharmacoinvasive therapy as per regional practice. • If moderate/high probability or COVID-19 +ve consider alternative investigations (TTE and/or CCT) prior to catheterization laboratory activation or pharmacoinvasive therapy.	• COVID-19 status may be unavailable at time of STEMI. Use of PPE will be dictated by regional health authority and COVID-19 penetrance. • Primary PCI for most patients. Selective pharmacoinvasive therapy as per regional practice. • If moderate/high probability or COVID-19 +ve consider alternative investigations (TTE and/or CCT) prior to catheterization laboratory activation or pharmacoinvasive therapy.
ACS (NSTEMI/UA)	• NSTEMI (high risk)—invasive strategy (refractory symptoms, hemodynamic instability, significant LV dysfunction, suspected LM or significant proximal epicardial disease, GRACE risk score >140) • Medium-risk NSTEMI—selective invasive strategy • Low-Risk NSTEMI and UA—medical therapy	• NSTEMI (high risk)—invasive strategy (refractory symptoms, hemodynamic instability, significant LV dysfunction, suspected LM or significant proximal epicardial disease, GRACE risk score >140) • Medium-risk NSTEMI—invasive strategy • Low-risk NSTEMI and UA—selective invasive strategy	Routine service for all cases
Elective catheterization laboratory cases	• Outpatients with symptoms AND noninvasive testing suggesting high risk for CV events in the short term	• All outpatients who are clinically considered to be moderate and high risk • Stable cases may still be deferred	Routine service for all cases
TAVR	• Inpatients and outpatients with severe symptomatic aortic stenosis	• Most patients accepted by the heart team • Stable cases may still be deferred	Routine service for all cases
MitraClip	• Inpatients and outpatients with severe symptomatic mitral regurgitation	• Most patients accepted by the heart team • Stable cases may still be deferred	Routine service for all cases
ASD/PFO	• Selective cases	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
LAAC	• Selective cases	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Other	Selective cases • Pulmonary hypertension • Adult congenital	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Cardiovascular Surgery			
Coronary	• Inpatients waiting for surgery • Outpatients with progressive symptoms or LV impairment	• All inpatients waiting for surgery • Majority of outpatients • Stable cases may still be deferred	Routine service for all cases
Valve surgery	• Inpatients waiting for surgery • Outpatients with severe symptomatic valvular disease or LV impairment	• All inpatients waiting for surgery • Majority of outpatients • Stable cases may still be deferred	Routine service for all cases
Other	• Acute aortic dissection • Valvular endocarditis • Heart transplant/VAD • High risk cardiac tumors • Severe symptomatic congenital heart disease	• Majority of cases • Stable cases may still be deferred	Routine service for all cases

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TABLE 1 Continued

Response Level (in Collaboration With Public Health Officials)	Level 2 Reintroduction of Some Services	Level 1 Reintroduction of Most Services	Level 0 Regular Services (Ongoing COVID-19 Testing/Surveillance and Monitoring of PPE Availability)
Electrophysiology			
Ablation	• Pre-excited AF • AF with recurrent admissions +/− CHF • Drug refractory VT	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Devices	• PPM for all inpatients and selective high-risk outpatients • Secondary prevention ICD and selective primary prevention ICD. • Device generator elective replacement indicator activated	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Other	Selective cases • Lead replacement, revision and extraction with infection, or inappropriate shocks • Implantable loop recorder for syncope • Ambulatory monitoring • Cardioversion	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Echocardiography			
TTE	• All inpatients • Selective outpatients in which TTE will alter short-term management	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
TEE	• All patients where TEE will alter short-term management. Given potential for false −ve COVID-19 testing, consider aerosol level PPE for possible AGMP.	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Exercise testing with imaging	• Selective cases where exercise testing will alter short-term management • Pharmacological testing preferred over exercise testing	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Cardiac CT			
CT coronary angiography	• All inpatients and selective symptomatic outpatients	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Structural heart disease	• Pre-procedural structural heart disease planning for all inpatients and selective outpatients	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Other	Selective cases • Pulmonary vein assessment for AF ablation planning • Cardiac masses • Congenital heart disease	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Cardiovascular Magnetic Resonance Imaging			
LV/RV assessment	• All inpatients and selective outpatients • Consider alternate imaging modality	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Infiltrative/inflammatory disease	• All inpatients and selective outpatients	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Myocardial viability	• All inpatients and selective outpatients	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Stress cardiac imaging	• All inpatients and selective outpatients • Consider alternate imaging modality	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Other	Selective cases • Congenital heart disease • Cardiac masses • Vascular: thoracic aortic disease and pulmonary vein mapping	• Majority of cases • Stable cases may still be deferred	Routine service for all cases

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TABLE 1 Continued

Response Level (in Collaboration With Public Health Officials)	Level 2 Reintroduction of Some Services	Level 1 Reintroduction of Most Services	Level 0 Regular Services (Ongoing COVID-19 Testing/Surveillance and Monitoring of PPE Availability)
Nuclear Cardiac Imaging			
Exercise testing with imaging	• All inpatients and selective outpatients • Preference for vasodilator testing over exercise testing	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Myocardial viability	• All inpatients and selective outpatients	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Other	Selective cases • LV assessment • Preoperative organ transplant assessment • Infiltrative diseases	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Heart Failure/Transplant			
Cardiopulmonary testing	• All inpatients and selective outpatients	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Endomyocardial biopsy	Selective cases • Transplant surveillance in patients deemed to be at high risk for rejection • Guide treatment in patients with presumed myocarditis	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Right heart catheterization	Selective cases • Facilitate transplant listing or candidacy for mechanical circulatory support • Tailored hemodynamic therapy in cardiogenic shock	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Vascular			
Critical limb ischemia	• All inpatients and selective outpatient cases	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
TEVAR/EVAR	• All inpatients and selective outpatient cases	• Majority of cases • Stable cases may still be deferred	Routine service for all cases
Other	Selective cases • Mesenteric ischemia • Symptomatic DVT	• Majority of cases • Stable cases may still be deferred	Routine service for all cases

ACS = acute coronary syndromes; AF = atrial fibrillation; AGMP = aerosol-generating medical procedure; ASD = atrial septal defect; CCT = cardiac computed tomography; CHF = congestive heart failure; COVID-19 = coronavirus disease-2019; EVAR = endovascular repair of aortic aneurysm; GRACE = Global Registry of Acute Coronary Events; ICD = implantable cardioverter-defibrillator; LAAC = left atrial appendage closure; LV = left ventricular; LM = left main; MI = myocardial infarction; NSTEMI = non–ST-segment elevation myocardial infarction; PFO = patent foramen ovale; PCI = percutaneous coronary intervention; PPE = personal protective equipment; PPM = permanent pacemaker; STEMI = ST-segment elevation myocardial infarction; TAVR = transcatheter aortic valve replacement; TEE = transesophageal echocardiography; TEVAR = thoracic endovascular aortic repair; TTE = transthoracic echocardiography; UA = unstable angina; VAD = ventricular assist device; VT = ventricular tachycardia; +ve = positive; -ve = negative.

through different levels of restriction to ensure the capability of supporting both elements of care delivery focused on net population health.

CONCLUSIONS

This consensus report provides harmonized guidance from North American CV societies. It provides an ethical framework with appropriate safeguards for the gradual reintroduction of invasive CV procedures and diagnostic tests after the initial peak of the COVID-19 pandemic. A collaborative approach will be essential to mitigate the ongoing morbidity and mortality associated with untreated CV disease.

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