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**Precautions and Procedures for Coronary and Structural Cardiac Interventions during
the COVID-19 Pandemic: Guidance from CAIC-ACCI**

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The world is currently in the midst of the global COVID-19 pandemic which has rapidly resulted in significant morbidity and mortality^{1,2}. Additionally, this pandemic has placed considerable strain on health care resources and providers. Acknowledging the strain on the entire health care system, this document specifically addresses the implications for the care of patients in the Cardiac Catheterization Laboratory (CCL).

Cardiovascular disease encompasses a spectrum of clinical conditions associated with significant morbidity and mortality. As long as the capacity of the Canadian health care system allows, clinicians and policy makers must attempt to maintain essential coronary and structural interventional procedures while minimizing additional burdens on hospital and system resources during the COVID-19 pandemic. The operational challenges are evolving rapidly therefore this guidance must be interpreted with flexibility and pragmatism. While some consistency across the country is desirable, provincial and regional considerations will influence how these recommendations are implemented. In collaboration with all 11 Affiliates, CCS³ and Canadian Association of Interventional Cardiology - Association Canadienne de Cardiologie d'intervention (CAIC-ACCI: <https://caic-acci.org>.) have already issued guidance for inpatient and ambulatory cardiovascular care in Canada. In this manuscript, we provide guidance on the management of coronary and structural procedures in the CCL as the COVID-19 pandemic escalates and eventually abates.

The executive, in collaboration with key subspecialty and general cardiologists from across Canada, embraced the following objectives when creating **Table 1**. The objectives reflect the core ethical principles of public health ethics: respect; the harm principle; fairness; consistency; least coercive and restrictive means; working together; reciprocity; proportionality; preservation of resources; flexibility; and procedural justice (as indicated in brackets).

1. Limit cardiac use of overall system capacity, especially in-patient/ICU beds (Working together, proportionality)
2. Minimize risk to healthcare workers (Reciprocity, care provider safety, and sustainability)
3. Maximize preservation of personal protective equipment (Preservation of resource)
4. Maximize compliance with social and healthcare distancing (The harm principle)
5. Minimize the incremental risk of patients acquiring COVID-19 related to cardiac investigations or procedures (The harm principle, proportionality)
6. Maintain essential interventional cardiology service to patients at high risk of cardiovascular events in the short term (Preservation of resources)
7. Minimize adverse outcomes for cardiovascular patients during the COVID-19 pandemic (The harm principle)
8. Ensure decisions are made in a consistent manner (Procedural justice, accountability, reasonableness)
9. Ensure decisions are communicated in a transparent and sensitive manner (Respect and transparency)

Given the unavoidable interaction of these individual recommendations, the order does not necessarily reflect priority ranking. Relative prioritization will vary over time and in various regions as the crisis evolves.

The principles above are predicated on balancing anticipated benefits and risks for individual patients while also considering societal needs during this crisis. A reduction in CCL activity is inevitable, at least over the short term and possibly longer; criteria are therefore based on identifying groups of patients most likely to benefit from a specific intervention, or conversely, most likely to suffer harm without such an intervention. In situations where the treatment effect is small, or evidence uncertain, alternate treatments that place less burden on hospital resources may be used, even if these deviate from the usual pattern of care.

The recommendations are outlined in **Table 1**. As the COVID-19 pandemic evolves, procedures will be increased or reduced based on the current level of restriction to health care services.

Recommendations also vary based on the likelihood of COVID-19 in the population in order to mitigate the risk of transmission to both Health Care Workers (HCW) and patients. CAIC-ACCI acknowledges that this document is predominantly based on consensus agreement. However, this reflects the considerable challenge of making practice recommendations in the face of a rapidly evolving global pandemic, with limited scientific evidence to guide clinical practice. The unknown duration of the crisis mandates timely review of these recommendations. Postponement rather than cancellation may be appropriate for many procedures; however, lengthy delays (several months) could have significant impact on morbidity and mortality even on patients facing relatively low short-term risk.

A few important additional considerations:

- 1) We encourage all Canadian research teams to carefully track cardiovascular outcomes in the coming months, and focus on key research gaps recently identified⁴. If we document a large increase in potentially avoidable cardiac deaths from unavailable procedures, then difficult but necessary discussions about

allocation of resources to infection vs. emergent cardiovascular procedures will be crucial;

- 2) Certain cardiac catheterization staff with comorbidities associated with adverse events in the setting of contracting COVID-19 (age >60 years, diabetes, hypertension, or pre-existing cardiovascular disease) may wish to refrain from procedures with an increased risk of aerosolization if adequate PPE cannot be provided. Depending on their level of competency and in accordance with their training programs, trainees may also wish to refrain from all cardiac catheterization procedures;
- 3) PPE use, including correct donning and doffing, changing scrubs and showering between cases with a high likelihood of COVID-19, and changing civilian clothes and footwear upon entering and leaving the hospital will remain our best defence during the pandemic⁵;
- 4) The threshold for performing percutaneous vs surgical coronary and valvular interventions may vary as the pandemic escalates and abates. After review by the Heart Team, multivessel PCI, TAVI or MitralClip may be appropriate to facilitate hospital discharge and reduce length of stay (LOS);
- 5) In the setting of STEMI (or other situations requiring emergent cardiac catheterization), pre-hospital screening for symptoms of influenza like illnesses (ILI), pre-existing knowledge of COVID-19 positivity, and if available in the future, rapid COVID-19 testing should be strongly encouraged so that patients can receive appropriate care and by-pass the emergency department;
- 6) Goal of rapid but safe discharge with teleconference or telephone follow-up should be promoted to facilitate bed capacity and avoid hospital exposure.

*In summary, we believe the above framework and the recommendations in **Table 1** will provide crucial guidance for clinicians and policy makers on the management of coronary and structural procedures in the CCL as the COVID-19 pandemic escalates and eventually abates.*

Table 1: CAIC-ACCI Guidance for the Management of Coronary and Structural Procedures as COVID-19 Escalates and Abates

Response Levels


Minor restriction in regular services

Major restriction in regular services

Complete inability to provide services due to staff/resource limitations
STEMI

- Patients with low probability of COVID-19 – PPCI OR pharmacoinvasive as per current regional practice.
- Patients with **Moderate/High** probability or **COVID-19 +ve** - PPCI with Aerosol Level PPE and N95 mask OR pharmacoinvasive at discretion of the treating team. If pharmacoinvasive with successful fibrinolysis, consider emergent COVID-19 testing with planned PCI within 24hrs.

- Most patients now considered **Moderate/High** probability or **COVID-19 +ve** - pharmacoinvasive OR PPCI with Aerosol Level PPE and N95 mask at discretion of the treating team. If pharmacoinvasive with successful fibrinolysis, consider emergent COVID-19 testing with scheduled PCI within 24 hours.

- Complete inability to provide PPCI. All patients will be treated with Thrombolysis as per regional protocols.

Cardiogenic Shock

- Patients with **low** probability of COVID-19 – Continue as per usual regional practice.
- Patients with **Moderate/High** probability or **COVID-19 +ve** - Consider an invasive approach with Aerosol Level PPE and N95 mask if age OR comorbidities do not preclude a reasonable likelihood of meaningful survival.

- Most patients now considered **Moderate/High** probability or **COVID-19 +ve** - Consider an invasive approach with Aerosol Level PPE and N95 mask if age OR comorbidities do not preclude a reasonable likelihood of meaningful survival.

- Medical management of all cardiogenic shock cases.

Out of Hospital Cardiac Arrest (OHCA)

- Patients with **low** probability of COVID-19 – Continue as per usual regional practice.
- Patients with **Moderate/High** probability or **COVID-19 +ve** - Consider an invasive approach with Aerosol Level PPE and N95 mask if age OR comorbidities do not preclude a reasonable likelihood of meaningful survival.

- Most patients now considered **Moderate/High** probability or **COVID-19 +ve** - Consider an invasive approach with Aerosol Level PPE and N95 mask if age OR comorbidities do not preclude a reasonable likelihood of meaningful survival.

- Medical management of all OHCA

<p>NSTEMI (High Risk) (Refractory symptoms, hemodynamic instability, significant LV dysfunction, suspected LM or significant proximal epicardial disease, GRACE risk score >140)</p>	<ul style="list-style-type: none"> • Patients with low probability of COVID-19 – Invasive approach as per current regional practice. • Patients with Moderate/High probability of COVID-19 - Invasive approach with <u>Aerosol Level PPE and N95 mask</u>. • COVID-19 +ve – consider invasive strategy with <u>Aerosol Level PPE and N95 mask</u> 	<ul style="list-style-type: none"> • Most patients now considered Moderate/High probability or COVID-19 +ve - Consider an invasive approach with <u>Aerosol Level PPE and N95 mask</u>. 	<ul style="list-style-type: none"> • Medical management of all ACS
<p>Low/Medium Risk NSTEMI and UA</p>	<ul style="list-style-type: none"> • Invasive approach OR medical management for most patients. If medical management selected and failed, screen (symptom questionnaire AND swab) all patients for COVID-19 prior to invasive approach. If COVID-19 +ve, <u>Aerosol Level PPE and N95 mask</u>. 	<ul style="list-style-type: none"> • Medical management favored over an invasive approach for most patients. If medical management selected and failed, screen (symptom questionnaire AND swab) all patients for COVID-19 prior to invasive approach. If COVID-19 +ve, <u>Aerosol Level PPE and N95 mask</u>. 	<ul style="list-style-type: none"> • Medical management of all ACS
<p>Type 2 MI (Consider COVID-19 myocarditis)</p>	<ul style="list-style-type: none"> • Investigations and treatment as per clinical judgement. Consider CT coronary angiography with Droplet Level PPE instead of an invasive approach. 	<ul style="list-style-type: none"> • Investigations and treatment as per clinical judgement. Consider CT coronary angiography with Droplet Level PPE instead of an invasive approach. 	<ul style="list-style-type: none"> • Medical management of all Type 2 MI
<p>Outpatients</p>	<ul style="list-style-type: none"> • Consider cardiac catheterization for outpatients who are clinically considered to be moderate to higher risk. • Screen (symptom questionnaire AND/OR swab) all patients for COVID-19. • All non-urgent/elective cases should be deferred for > 30 days. 	<ul style="list-style-type: none"> • Consider cardiac catheterization for “urgent” outpatients only including those with symptoms AND non-invasive testing suggesting high risk for CV events in the short term. • Screen (symptom questionnaire AND/OR swab) all patients for COVID-19. • Others should be considered lower-risk and deferred for >30 days 	<ul style="list-style-type: none"> • Medical management for all Outpatients
<p>CHIP</p>	<ul style="list-style-type: none"> • Limited cases that would facilitate hospital discharge. • Screen (symptoms questionnaire AND swab) all patients for COVID-19. 	<ul style="list-style-type: none"> • Complete cessation of cases 	<ul style="list-style-type: none"> • Complete cessation of cases
<p>CTO</p>	<ul style="list-style-type: none"> • Complete cessation of cases 	<ul style="list-style-type: none"> • Complete cessation of cases 	<ul style="list-style-type: none"> • Complete cessation of cases

Response Levels



Minor restriction in regular services



Major restriction in regular services



Complete inability to provide services due to staff/resource limitations

	Response Level 1: Minor restriction in regular services	Response Level 2: Major restriction in regular services	Response Level 3: Complete inability to provide services due to staff/resource limitations
TAVI	<ul style="list-style-type: none"> High risk TAVI cases only with short expected LOS (low EF, valve-in-valve with severe AR, or recent hospitalization). 	<ul style="list-style-type: none"> Limited inpatient cases that would facilitate hospital discharge 	<ul style="list-style-type: none"> Complete cessation of cases
MitraClip	<ul style="list-style-type: none"> High risk cases with history of repeated HF hospitalizations or ER visits 	<ul style="list-style-type: none"> Limited inpatient cases that would facilitate hospital discharge 	<ul style="list-style-type: none"> Complete cessation of cases
Myocardial Biopsies	<ul style="list-style-type: none"> Limited cases in collaboration with Transplant Team 	<ul style="list-style-type: none"> Limited cases in collaboration with Transplant Team 	<ul style="list-style-type: none"> Complete cessation of cases
ASD/PFO	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases
LAAC	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases
Adult Congenital	<ul style="list-style-type: none"> Limited cases in collaboration with Adult Congenital Team 	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases
Pre-Solid Organ Transplant	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases
Pulmonary HTN	<ul style="list-style-type: none"> Limited cases in collaboration with Pulmonary Hypertension Team 	<ul style="list-style-type: none"> Complete cessation of cases 	<ul style="list-style-type: none"> Complete cessation of cases

Abbreviations and Acronyms:

- ASD: atrial septal defect
- CAIC-ACCI: Canadian Association of Interventional Cardiology - Association Canadienne de Cardiologie d'intervention
- CCS: Canadian Cardiovascular Society
- ICU: Intensive Care Unit
- ILI: influenza like illnesses
- LOS: length of stay
- OHCA: out of hospital cardiac arrest
- PFO: patent foramen ovale
- PPCI: primary percutaneous cardiovascular intervention
- PPE: personal protective equipment
- STEMI: ST segment elevation myocardial infarction
- TAVI: transcatheter aortic valve implantation

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Contributing Authors:

David A Wood MD¹
Janarthanan Sathananthan MBChB, MPH¹
Ken Gin MD¹
Samer Mansour MD²
Hung Q Ly MD SM³
Ata-ur-Rehman Quraishi MD⁴
Andrea Lavoie MD⁵
Sohrab Lutchmedial MD⁶
Mohamed Nosair MD³
Akshay Bagai MD⁷
Kevin R Bainey MD⁸
Robert H Boone MD¹
Shuangbo Liu MD⁷

Andrew Krahn MD¹
Sean Virani MD¹
Shamir R Mehta MD⁹
Madhu K Natarajan MD⁹
James L Velianou MD⁹
Payam Dehghani MD⁵
Harindra C Wijesundera MD¹⁰
Anita W Asgar MD,MSc³
Alice Virani MA, MS, MPH, PhD¹¹
Robert C Welsh MD⁸
John G Webb MD¹
Eric A Cohen MD¹⁰

List of Institutions:

1. Centre for Cardiovascular Innovation, UBC Division of Cardiology, St Paul's and Vancouver General Hospital, Vancouver, Canada
2. Centre Hospitalier de l'Université de Montréal (CHUM) Research Center and Cardiovascular Center, Montreal, Canada
3. Montréal Heart Institute, Université de Montréal, Montréal, Québec, Canada
4. Dalhousie University and QE II Health Sciences Centre, Halifax, Nova Scotia, Canada
5. University of Saskatchewan & Prairie Vascular, Regina, Saskatchewan, Canada
6. New Brunswick Heart Centre, Saint John Regional Hospital / Dalhousie University, Saint John, Canada
7. St Michael's Hospital, University of Toronto, Toronto, Ontario, Canada.
8. Mazankowski Alberta Heart Institute, University of Alberta, Edmonton, Alberta, Canada
9. Population Health Research Institute, McMaster University and Hamilton Health Sciences, Hamilton, Ontario, Canada
10. Schulich Heart Centre, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada
11. Department of Medical Genetics, University of British Columbia, Vancouver, Canada