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# Precautions and Procedures for Coronary and Structural Cardiac Interventions During the COVID-19 Pandemic: Guidance from Canadian Association of Interventional Cardiology

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**ABSTRACT**

**The globe is currently in the midst of a COVID-19 pandemic, resulting in significant morbidity and mortality. This pandemic has placed considerable stress on health care resources and providers. This document from the Canadian Association of Interventional Cardiology- Association Canadienne de Cardiologie d'intervention, specifically addresses the implications for the care of patients in the cardiac catheterization laboratory (CCL) in Canada during the COVID-19 pandemic. The key**

**RÉSUMÉ**

**Le monde est actuellement en pleine pandémie de COVID-19 qui entraîne une morbidité et une mortalité importantes. Cette pandémie a exercé une pression considérable sur les ressources et les prestataires de soins de santé. Ce document de l'Association Canadienne de Cardiologie d'Intervention - Canadian Association of Interventional Cardiology, traite spécifiquement des implications associées aux soins des patients du laboratoire de cathétérisme cardiaque (LCC) au**

The world is currently in the midst of the global COVID-19 pandemic, which has rapidly resulted in significant morbidity and mortality.[1,2] This pandemic has placed considerable stress 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

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**principles of this document are to maintain essential interventional cardiovascular care while minimizing risks of COVID-19 to patients and staff and maintaining the overall health care resources. As the COVID-19 pandemic evolves, procedures will be increased or reduced based on the current level of restriction to health care services. Although some consistency across the country is desirable, provincial and regional considerations will influence how these recommendations are implemented. We believe the framework and recommendations in this document 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.**

**Canada pendant la pandémie de COVID-19. Les recommandations principales de ce document sont de maintenir les soins d'intervention cardiovasculaires essentiels tout en minimisant les risques de COVID-19 pour les patients et le personnel et en maintenant les ressources globales de soins de santé. À mesure que la pandémie de COVID-19 évolue, les procédures seront accrues ou réduites en fonction du niveau réactualisé de restriction des services de soins de santé. Bien qu'une certaine cohérence soit souhaitable dans l'ensemble du pays, des considérations provinciales et régionales influenceront la manière dont ces recommandations seront mises en œuvre. Nous pensons que le cadre et les recommandations de ce document fourniront des orientations cruciales aux cliniciens et aux décideurs politiques sur la gestion des procédures coronaires et structurelles dans le LCC à mesure que la pandémie de COVID-19 s'aggrave et finit par s'atténuer.**

be interpreted with flexibility and pragmatism. Although some consistency across the country is desirable, provincial and regional considerations will influence how these recommendations are implemented. In collaboration with all 11 affiliates, Canadian Cardiovascular Society (CCS),[3] 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 paper, 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 the 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 parentheses):

- Limit cardiac use of overall system capacity, especially with inpatient/intensive care unit beds (working together, proportionality).
- Minimize risk to health care workers (reciprocity, care provider safety, and sustainability).
- Maximize preservation of personal protective equipment (preservation of resources).
- Maximize compliance with social and health care distancing (the harm principle).
- Minimize the incremental risk of patients acquiring COVID-19 related to cardiac investigations or procedures (the harm principle, proportionality).
- Maintain essential interventional cardiology service to patients at high risk of cardiovascular events in the short term (preservation of resources).
- Minimize adverse outcomes for cardiovascular patients during the COVID-19 pandemic (the harm principle).
- Ensure decisions are made in a consistent manner (procedural justice, accountability, reasonableness).
- Ensure that 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 different regions, as the crisis evolves.

These principles 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 for which the treatment effect is small—or evidence uncertain—alternate approaches 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 the 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 to mitigate the risk of transmission to both health care workers and patients. CAIC-ACCI acknowledges that this document is predominantly based on consensus agreement. This approach 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 a significant negative impact on morbidity and mortality, even for patients facing relatively low short-term risk.

A few important additional considerations: (1) We encourage all Canadian research teams to track cardiovascular outcomes carefully in the coming months and focus on key research gaps recently identified.[4] If we document a large increase in potentially avoidable cardiac deaths from unavailable procedures, 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; patients with diabetes, hypertension, or pre-existing cardiovascular disease) may wish to refrain from procedures with an increased

**Table 1.** CAIC-ACCI guidance for the management of coronary and structural procedures as COVID-19 escalates and abates

| Response level | Level 1<br>Minor restriction in regular services | Level 2<br>Major restriction in regular services | Level 3<br>Complete inability to provide services due to staff/resource limitations |
|---|---|---|---|
| Coronary | | | |
| STEMI | • Patients with **low** probability of COVID-19 PPCI OR pharmacoinvasive as per current regional practice<br>• 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 24 hours. | • 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.<br>• 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.<br>• 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 |
| NSTEMI (high risk)<br>(Refractory symptoms, hemodynamic instability, significant LV dysfunction, suspected LM or significant proximal epicardial disease, GRACE risk score >140) | • Patients with **low** probability of COVID-19: invasive approach as per current regional practice.<br>• Patients with **moderate/high** probability of COVID-19: invasive approach with aerosol level PPE and N95 mask.<br>• **COVID-19 +ve:** consider invasive strategy with aerosol level PPE and N95 mask | • Most patients now considered **moderate/high** probability or **COVID-19 +ve**: Consider an invasive approach with aerosol level PPE and N95 mask. | Medical management of all ACS |
| Low/medium risk NSTEMI and UA | Invasive approach OR medical management for most patients.<br>If medical management selected and failed, screen (symptom questionnaire AND swab) all patients for COVID-19 prior to invasive approach. If **COVID-19 +ve,** aerosol level PPE and N95 mask. | Medical management favoured over an invasive approach for most patients.<br>If medical management selected and failed, screen (symptom questionnaire AND swab) all patients for COVID-19 before invasive approach. If **COVID-19 +ve,** aerosol level PPE and N95 mask. | Medical management of all ACS |
| Type 2 MI (Consider COVID-19 myocarditis) | Investigations and treatment as per clinical judgement. Consider CT coronary angiography with droplet level PPE instead of an invasive approach. | Investigations and treatment as per clinical judgement. Consider CT coronary angiography with droplet level PPE instead of an invasive approach. | Medical management of all type 2 MI |
| Outpatients | • Consider cardiac catheterization for outpatients who are clinically considered to be moderate to higher risk.<br>• Screen (symptom questionnaire AND/OR swab) all patients for COVID-19.<br>• All nonurgent/elective cases should be deferred for >30 days. | • Consider cardiac catheterization for "urgent" outpatients only including those with symptoms AND noninvasive testing suggesting high risk for CV events in the short term.<br>• Screen (symptom questionnaire AND/OR swab) all patients for COVID-19.<br>• Others should be considered lower-risk and deferred for >30 days | Medical management for all outpatients |
| CHIP | • Limited cases that would facilitate hospital discharge.<br>• Screen (symptoms questionnaire AND swab) all patients for COVID-19. | Complete cessation of cases | Complete cessation of cases |
| CTO | Complete cessation of cases | Complete cessation of cases | Complete cessation of cases |

| | | | |
|---|---|---|---|
| Structural heart | | | |
| TAVI | High-risk TAVI cases only with short expected LOS (low EF, valve-in-valve with severe AR, or recent hospitalization). | Limited inpatient cases that would facilitate hospital discharge | Complete cessation of cases |
| MitraClip (Abbott Laboratories) | High-risk cases with history of repeated HF hospitalizations or ED visits | Limited inpatient cases that would facilitate hospital discharge | Complete cessation of cases |
| Myocardial biopsies | Limited cases in collaboration with transplant team | Limited cases in collaboration with transplant team | Complete cessation of cases |
| ASD/PFO | Complete cessation of cases | Complete cessation of cases | Complete cessation of cases |
| LAAC | Complete cessation of cases | Complete cessation of cases | Complete cessation of cases |
| Adult congenital | Limited cases in collaboration with adult congenital team | Complete cessation of cases | Complete cessation of cases |
| Pre-solid organ transplant | Complete cessation of cases | Complete cessation of cases | Complete cessation of cases |
| Pulmonary HTN | Limited cases in collaboration with pulmonary hypertension team | Complete cessation of cases | Complete cessation of cases |

ACS, acute coronary syndrome; AR, aortic regurgitation; ASD, atrial-septal defect; CHIP, complex and high-risk interventional procedures; CT, computed tomography; CTO, chronic total occlusions; CV, cardiovascular; EF, ejection fraction; GRACE, global registry of acute coronary events; HF, heart failure; HTN, hypertension; LAAC, left-atrial appendage closure; LM, left main; LOS, length of stay; LV, left ventricular; MI, myocardial infarction; NSTEMI, non-ST elevation myocardial infraction; PFO, patent foramen ovale; PPCI, primary percutaneous coronary intervention; PPE, personal protective equipment; STEMI, ST-elevation myocardial infarction; TAVI, transcatheter aortic valve implantation; UA, unstable angina.

risk of aerosolization if adequate personal protective equipment cannot be provided. Depending on their level of competency, and in accordance with their training programs, trainees may also wish to refrain from cardiac catheterization procedures. (3) Use of personal protective equipment, 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 defense during the pandemic.[5] (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 percutaneous coronary intervention, transcatheter aortic valve intervention, or MitralClip (Abbott Laboratories, Lake Bluff, IL) may be appropriate to facilitate hospital discharge and reduce length of stay. (5) In the setting of ST-elevation myocardial infarction or other situations requiring emergent cardiac catheterization, prehospital screening for symptoms of influenza-like illnesses, 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 bypass the emergency department. (6) The goal of rapid but safe discharge with teleconference or telephone follow-up should be promoted to facilitate maximizing the use of bed capacity and avoid hospital exposure.

In summary, we believe this framework, and the recommendations in the 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.

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## Disclosures

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## References

1. Munster VJ, Koopmans M, van Doremalen N, van Riel D, de Wit E. A novel coronavirus emerging in China: key questions for impact assessment. N Engl J Med 2020;382:692-4.

2. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.

3. Guidance from the CCS COVID-19 Rapid Response Team: Canadian Cardiovascular Society, https://www.ccs.ca/en/. Published 2020. Accessed March 15, 2020.

4. Bedford J, Enria D, Giesecke J, et al. COVID-19: towards controlling of a pandemic. Lancet 2020;395:P1015-8.

5. Driggin E, Madhavan M, Bikdeli B, et al. Cardiovascular considerations for patients, health care workers, and health systems during the coronavirus disease 2019 (COVID-19) pandemic [e-pub ahead of print]. J Am Coll Cardiol 2020. https://doi.org/10.1016/j.jacc.2020.03.031. Accessed March 15, 2020.