

JULY 2023
VERSION 3.0

DEFINITION

Adult Interventional Cardiology is the area of enhanced competence within Adult Cardiology concerned with the integration of clinical assessment, imaging-based diagnosis, and minimally invasive therapy of cardiovascular diseases.

ELIGIBILITY REQUIREMENTS TO BEGIN TRAINING

Royal College certification in Adult Cardiology, or equivalent¹

OR

Eligibility for the Royal College examination in Adult Cardiology

OR

Registration in a Royal College-accredited residency program in Adult Cardiology
(See requirements for these qualifications.)

ELIGIBILITY REQUIREMENTS TO COMPLETE A ROYAL COLLEGE COMPETENCY PORTFOLIO

All trainees must be Royal College certified in Adult Cardiology, or equivalent, in order to be eligible to complete a Royal College competency portfolio in Adult Interventional Cardiology.

¹ Equivalency must include at least

- eight months of clinical cardiology (including at least four months of coronary care unit)
- three months of cardiac catheterization
- four months of echocardiography
- one month of electrophysiology
- one month of nuclear cardiology/exercise stress testing

Internationally trained cardiologists will require demonstration of equivalency for entrance.

© 2023 The Royal College of Physicians and Surgeons of Canada. All rights reserved.

This document may be reproduced for educational purposes only provided that the following phrase is included in all related materials: *Copyright © 2023 The Royal College of Physicians and Surgeons of Canada. Referenced and produced with permission.* Please forward a copy of the final product to the Office of Standards and Assessment, attn: manager, Specialty Standards. Written permission from the Royal College is required for all other uses. For further information regarding intellectual property, please contact: documents@royalcollege.ca. For questions regarding the use of this document, please contact: diplomas@royalcollege.ca.

MAJOR TASKS OF ADULT INTERVENTIONAL CARDIOLOGY

The discipline of Adult Interventional Cardiology includes responsibility for the following:

1. Transcatheter coronary artery and non-coronary artery diagnostic techniques
2. Interventional management of acute coronary syndrome (ACS)/stable coronary artery disease (CAD)
3. Interventional management of acute ST-elevation myocardial infarction (STEMI)
4. Interventional management of hemodynamic instability
5. Interventional approach to multi-vessel CAD
6. Catheter-based management of CAD with complex morphology
7. Identification and management of patients with complex conditions needing percutaneous coronary intervention (PCI)
8. Medical, coronary, and non-coronary vascular complications of cardiac catheterization and PCI
9. Diagnosis through invasive techniques and knowledge of interventional management of non-coronary artery disease
10. Cardiac catheterization laboratory management
11. Scholarly advancement of Adult Interventional Cardiology

At the completion of training, the diplomate will have acquired the following competencies and will function effectively as a:

Medical Expert

Definition:

As *Medical Experts*, physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills, and professional values in their provision of high-quality and safe patient-centred care. Medical Expert is the central physician Role in the CanMEDS Framework and defines the physician's clinical scope of practice.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

1. Practise medicine within their defined scope of practice and expertise

- 1.1. Demonstrate a commitment to high-quality care of their patients
- 1.2. Integrate the CanMEDS Intrinsic Roles into their practice of medicine
- 1.3. Apply knowledge of the clinical and biomedical sciences relevant to Adult Interventional Cardiology

Coronary artery disease (CAD)

- 1.3.1. Normal coronary anatomy and possible variant anatomy, and appropriate catheter selection and views for its demonstration
 - 1.3.2. Physiology of normal and abnormal coronary blood flow
 - 1.3.3. Normal and abnormal endothelial function
 - 1.3.4. Atherosclerotic lesion classification
-

*COMPETENCY TRAINING REQUIREMENTS IN ADULT INTERVENTIONAL CARDIOLOGY
(JULY 2023)*

- 1.3.5. The importance of sex and gender differences in the diagnosis and percutaneous management of CAD
- 1.3.6. Adjunctive pharmacotherapy and its indications and side effect profiles, including anti-ischemic, antiplatelet, anticoagulant, and thrombolytic agents
- 1.3.7. Revascularization procedures: PCI and coronary artery bypass graft (CABG), and their indications, contraindications, and benefits
- 1.3.8. Devices to treat CAD, including stents, thromboaspiration devices, and Rotablator and other atherectomy/plaque modification devices
- 1.3.9. Role of PCI in management of
 - 1.3.9.1. Chronic stable angina
 - 1.3.9.2. Acute coronary syndromes: unstable angina, non-ST elevation myocardial infarction (NSTEMI)
 - 1.3.9.3. Acute STEMI
 - 1.3.9.4. Post-myocardial infarction

Valvular heart disease

- 1.3.10. Invasive evaluation of aortic, mitral, pulmonic, and tricuspid valve disease, including
 - 1.3.10.1. Congenital and acquired conditions
 - 1.3.10.2. Native and prosthetic valve conditions
- 1.3.11. Techniques of percutaneous valve replacement and repair, including evolving techniques

Congenital heart disease

- 1.3.12. Intracardiac shunting: hemodynamics and pathophysiologic effects
- 1.3.13. Congenital lesions in which natural survival to adulthood is likely
- 1.3.14. Congenital lesions in which post-operative survival to adulthood is likely
- 1.3.15. Transcatheter therapeutic options to diagnose and treat congenital heart disease
- 1.3.16. Evaluation of pressure and volume overload conditions
- 1.3.17. Hemodynamic investigation of adult congenital cardiac diseases, including
 - 1.3.17.1. Intra- and extracardiac shunts
 - 1.3.17.2. Cyanotic and acyanotic conditions
 - 1.3.17.3. Palliated and corrected conditions
 - 1.3.17.4. Pulmonary hypertension caused by congenital heart disease

Congestive heart failure and cardiomyopathies

- 1.3.18. Indications for endomyocardial biopsy
- 1.3.19. Invasive diagnosis and interventional management of
 - 1.3.19.1. Hypertrophic cardiomyopathy, obstructive and non-obstructive
 - 1.3.19.2. Restrictive cardiomyopathy
 - 1.3.19.3. Other cardiomyopathies

Pulmonary vascular disease

- 1.3.20. Normal pulmonary vascular physiology
- 1.3.21. Hemodynamics of pulmonary hypertension
- 1.3.22. Pharmacology of pulmonary vasodilator agents
- 1.3.23. Etiology, natural history, and invasive diagnosis and management of
 - 1.3.23.1. Pulmonary embolism
 - 1.3.23.2. Cor pulmonale
 - 1.3.23.3. Pulmonary arterial hypertension
 - 1.3.23.4. Secondary causes of pulmonary hypertension

Pericardial disease

- 1.3.24. Pericardium, including
 - 1.3.24.1. Normal anatomy and function
 - 1.3.24.2. Effect of pericardial disease on cardiac hemodynamics and function
- 1.3.25. Invasive evaluation and treatment of
 - 1.3.25.1. Pericarditis: acute, chronic, and relapsing
 - 1.3.25.2. Post-cardiotomy syndrome
 - 1.3.25.3. Pericardial effusion and tamponade, including pericardial puncture and drainage
 - 1.3.25.4. Pericardial constriction, and its differentiation from restrictive cardiomyopathy

Mechanical support devices

- 1.3.26. Physiology and indications of mechanical support devices, including
 - 1.3.26.1. Intra-aortic balloon pump (IABP)
 - 1.3.26.2. Left ventricular assist device (LVAD)
 - 1.3.26.3. Percutaneous cardiopulmonary support (CPS)

1.3.27. Approach to cardiogenic shock, pre- and post-intervention

Cardiac catheterization and coronary angiography

1.3.28. Indications and contraindications

1.3.29. Radiation and principles of radiation protection and safety

1.3.30. Technical aspects

1.3.30.1. Equipment

1.3.30.2. Infection prevention and control

1.3.30.3. Cardiac catheterization laboratory protocol

1.3.30.4. Appropriate caseload

1.3.30.5. Contrast effects

1.3.31. Vascular access techniques

1.3.31.1. Arterial: radial, femoral, brachial

1.3.31.2. Venous: brachial, femoral

1.3.32. Measurement and interpretation of hemodynamic data, including pressure measurements and waveforms, gradients, cardiac output, assessment of valve stenosis and regurgitation, and shunt determinations

1.3.32.1. Physiological and pharmacological maneuvers

1.3.33. Transseptal catheterization

Complications of cardiac catheterization and angiography

1.3.34. Risk factors for and diagnosis and treatment of

1.3.34.1. Contrast reactions

1.3.34.2. Drug reactions

1.3.34.3. Local and systemic bleeding, hematoma, retroperitoneal hemorrhage, and forearm compartment syndrome

1.3.34.4. Pseudoaneurysm and AV fistula

1.3.34.5. Thrombotic occlusion, arterial perforation and dissection, and atheroembolism

1.3.34.6. Neurologic complications

1.3.34.7. Acute kidney injury

1.3.34.8. Access site infections

1.3.35. Appropriate use of vascular closure devices and their complications

Adjunctive diagnostic techniques

- 1.3.36. Indications and contra-indications for intracoronary imaging
- 1.3.37. Techniques used to evaluate coronary physiology

Interventional cardiology procedures

- 1.3.38. Techniques for PCI in the management of
 - 1.3.38.1. Chronic stable angina
 - 1.3.38.2. Acute coronary syndromes: unstable angina, NSTEMI
 - 1.3.38.3. Acute STEMI
 - 1.3.38.4. Post-myocardial infarction management

1.3.39. Transbrachial and transradial intervention

1.3.40. Intervention in left ventricle (LV) dysfunction

1.3.41. Intervention for

- 1.3.41.1. Chronic total occlusion
- 1.3.41.2. Thrombotic lesions
- 1.3.41.3. Bifurcation lesions
- 1.3.41.4. Calcified and tortuous coronary artery anatomy
- 1.3.41.5. Ostial lesions
- 1.3.41.6. Long lesions and small vessels
- 1.3.41.7. Coronary bypass grafts
- 1.3.41.8. Left main lesions

Complications of interventional cardiology procedures

- 1.3.42. Complications of PCIs and technologies
- 1.3.43. Properties of adjunctive antiplatelet, antithrombotic, and fibrinolytic therapies
- 1.3.44. Diagnosis and management of
 - 1.3.44.1. Cardiac arrest
 - 1.3.44.2. Severe arrhythmias
 - 1.3.44.3. Coronary dissection and perforation
 - 1.3.44.4. Sub-acute closure and stent thrombosis
 - 1.3.44.5. Acute coronary vasospasm
 - 1.3.44.6. No-reflow
 - 1.3.44.7. Coronary air embolism

*COMPETENCY TRAINING REQUIREMENTS IN ADULT INTERVENTIONAL CARDIOLOGY
(JULY 2023)*

- 1.3.45. Diagnosis and management of embolized stents or other entrapped equipment, using snares and other retrieval devices

Cardiac catheterization laboratory management

- 1.3.46. Infection prevention and control, including cleaning, disinfection, and sterilization
 - 1.3.47. Equipment costs, including maintenance and replacement
 - 1.3.48. Radiation protection and safety for patients and laboratory personnel
 - 1.3.49. Occupational health, safety, and wellness
 - 1.3.50. Quality assurance and control procedures
- 1.4. Perform appropriately timed clinical assessments with recommendations that are presented in an organized manner
 - 1.5. Carry out professional duties in the face of multiple competing demands
 - 1.6. Recognize and respond to the complexity, uncertainty, and ambiguity inherent in medical practice

2. Perform a patient-centred clinical assessment and establish a management plan

- 2.1. Prioritize issues to be addressed in a patient encounter
- 2.2. Elicit a history, perform a physical exam, select appropriate investigations, and interpret the results for the purpose of diagnosis and management, disease prevention, and health promotion
 - 2.2.1. Formulate a problem list
 - 2.2.2. Assess the patient's suitability for an interventional cardiology procedure
 - 2.2.2.1. Incorporate the patient's age, sex and gender, concurrent conditions, and health status into decision-making
 - 2.2.2.2. Consider the risks and benefits of proposed and alternate diagnostic and therapeutic strategies
- 2.3. Establish goals of care in collaboration with patients and their families,² which may include slowing disease progression, treating symptoms, achieving cure, improving function, and palliation
- 2.4. Establish a patient-centred management plan
 - 2.4.1. Correlate, evaluate, and prioritize information acquired by clinical, hemodynamic, and angiographic assessment

² Throughout this document, references to the patient's family are intended to include all those who are personally significant to the patient and are concerned with their care, including, according to the patient's circumstances, family members, partners, caregivers, legal guardians, and substitute decision-makers

- 2.4.2. Integrate evidence-based medicine to properly assess physiology and apply intravascular imaging to guide intervention
- 2.4.3. Develop and implement a diagnostic, therapeutic, and secondary prevention plan, applying the evidence base of Adult Interventional Cardiology

3. Plan and perform procedures and therapies for the purpose of assessment and/or management

- 3.1. Determine the most appropriate procedures or therapies
- 3.2. Obtain and document informed consent, explaining the risks and benefits of, and the rationale for, a proposed procedure or therapy
- 3.3. Prioritize a procedure or therapy, taking into account clinical urgency and available resources
- 3.4. Perform a procedure in a skilful and safe manner, adapting to unanticipated findings or changing clinical circumstances
 - 3.4.1. Coronary artery angiography
 - 3.4.2. Ventriculography
 - 3.4.3. Right-left heart pressure measurements
 - 3.4.4. Vascular access
 - 3.4.5. Invasive coronary physiology assessment
 - 3.4.6. Intravascular imaging
 - 3.4.7. Pericardiocentesis
 - 3.4.8. Temporary transvenous pacing
 - 3.4.9. Intra-aortic counterpulsation
 - 3.4.10. Coronary interventional device application
 - 3.4.10.1. Balloon and stent implantation
 - 3.4.10.2. Protection devices
 - 3.4.10.3. Microcatheters, and guide extension and aspiration devices
 - 3.4.10.4. Calcium modifying devices

4. Establish plans for ongoing care and, when appropriate, timely consultation

- 4.1. Implement a patient-centred care plan that supports ongoing care, follow-up on investigations, response to treatment, and further consultation
 - 4.1.1. Determine the need for and urgency of referral to another physician or surgeon for consideration of an alternate diagnostic or therapeutic option
 - 4.1.2. Recognize and manage complications of coronary angiography and interventional cardiology procedures

5. Actively contribute, as an individual and as a member of a team providing care, to the continuous improvement of health care quality and patient safety

- 5.1. Recognize and respond to harm from health care delivery, including patient safety incidents
- 5.2. Adopt strategies that promote patient safety and address human and system factors
 - 5.2.1. Demonstrate an understanding of and apply the ALARA (as low as reasonably achievable) principle

Communicator

Definition:

As *Communicators*, physicians form relationships with patients and their families that facilitate the gathering and sharing of essential information for effective health care.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

- 1. Establish professional therapeutic relationships with patients and their families**
- 2. Elicit and synthesize accurate and relevant information, incorporating the perspectives of patients and their families**
- 3. Share health care information and plans with patients and their families**
 - 3.1. Share information and explanations that are clear, accurate, and timely, while checking for patient and family understanding
 - 3.1.1. Use plain language to provide information about an interventional procedure to the patient and family, including risks, appropriateness, and rationale
 - 3.1.2. Provide the patient and family with appropriate post-procedure teaching and information about the management plan
 - 3.2. Disclose harmful patient safety incidents to patients and their families accurately and appropriately
- 4. Engage patients and their families in developing plans that reflect the patient's health care needs and goals**
- 5. Document and share written and electronic information about the medical encounter to optimize clinical decision-making, patient safety, confidentiality, and privacy**
 - 5.1. Document clinical encounters in an accurate, complete, timely, and accessible manner, in compliance with regulatory and legal requirements
 - 5.1.1. Provide comprehensive written reports of diagnostic and therapeutic procedures and the ongoing management plan in a timely manner

Collaborator

Definition:

As *Collaborators*, physicians work effectively with other health care professionals to provide safe, high-quality, patient-centred care.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

- 1. Work effectively with physicians and other colleagues in the health care professions**
 - 1.1. Establish and maintain positive relationships with physicians and other colleagues in the health care professions to support relationship-centred collaborative care
 - 1.2. Negotiate overlapping and shared responsibilities with physicians and other colleagues in the health care professions in episodic and ongoing care
 - 1.2.1. Work effectively within the cardiac catheterization laboratory team
 - 1.2.2. Apply knowledge of the role of cardiac surgeons in the optimal choice of revascularization
 - 1.3. Engage in respectful shared decision-making with physicians and other colleagues in the health care professions
 - 1.3.1. Work with the treating cardiologist to assess, plan, provide, and integrate care for individual patients or groups of patients
 - 1.3.2. Engage in respectful collaborative shared decision-making with cardiac surgeons
- 2. Work with physicians and other colleagues in the health care professions to promote understanding, manage differences, and resolve conflicts**
- 3. Hand over the care of a patient to another health care professional to facilitate continuity of safe patient care**

Leader

Definition:

As *Leaders*, physicians engage with others to contribute to a vision of a high-quality health care system and take responsibility for the delivery of excellent patient care through their activities as clinicians, administrators, scholars, or teachers.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

1. Contribute to the improvement of health care delivery in teams, organizations, and systems

1.1. Apply the science of quality improvement to contribute to improving systems of patient care

1.1.1. Contribute to quality assurance activities aimed at improving delivery of interventional cardiology patient care

1.2. Contribute to a culture that promotes patient safety

1.3. Analyze patient safety incidents to enhance systems of care

1.4. Use health informatics to improve the quality of patient care and optimize patient safety

2. Engage in the stewardship of health care resources

2.1. Allocate health care resources for optimal patient care

2.2. Apply evidence and management processes to achieve cost-appropriate care

3. Demonstrate leadership in health care systems

3.1. Demonstrate leadership skills to enhance health care

3.1.1. Contribute to the management of the interventional cardiac catheterization laboratory

4. Manage career planning, finances, and health human resources in personal practice(s)

Health Advocate

Definition:

As *Health Advocates*, physicians contribute their expertise and influence as they work with communities or patient populations to improve health. They work with those they serve to determine and understand needs, speak on behalf of others when required, and support the mobilization of resources to effect change.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

- 1. Respond to an individual patient's health needs by advocating with the patient within and beyond the clinical environment**
- 2. Respond to the needs of the communities or populations they serve by advocating with them for system-level change in a socially accountable manner**
 - 2.1. Contribute to a process to improve health in the community or population
 - 2.1.1. Engage in opportunities to advance interventional cardiac care

Scholar

Definition:

As *Scholars*, physicians demonstrate a lifelong commitment to excellence in practice through continuous learning and by teaching others, evaluating evidence, and contributing to scholarship.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

- 1. Engage in the continuous enhancement of their professional activities through ongoing learning**
 - 1.1. Identify opportunities for learning and improvement by regularly reflecting on and assessing their performance using various internal and external data sources
 - 1.1.1. Prepare and reflect on audits of personal procedural and medical complication rates
- 2. Teach students, residents, the public, and other health care professionals**
- 3. Integrate best available evidence into practice**
- 4. Contribute to the creation and dissemination of knowledge and practices applicable to health**
 - 4.1. Contribute to the work of a research program

Professional

Definition:

As *Professionals*, physicians are committed to the health and well-being of individual patients and society through ethical practice, high personal standards of behaviour, accountability to the profession and society, physician-led regulation, and maintenance of personal health.

Key and Enabling Competencies: Adult Interventional Cardiology diplomates are able to...

1. Demonstrate a commitment to patients by applying best practices and adhering to high ethical standards

- 1.1. Exhibit appropriate professional behaviours and relationships in all aspects of practice, demonstrating honesty, integrity, humility, commitment, compassion, respect, altruism, respect for diversity, and maintenance of confidentiality
- 1.2. Demonstrate a commitment to excellence in all aspects of practice
- 1.3. Recognize and respond to ethical issues encountered in practice
- 1.4. Recognize and manage conflicts of interest
 - 1.4.1. Maintain appropriate boundaries with industry

2. Demonstrate a commitment to society by recognizing and responding to societal expectations in health care

3. Demonstrate a commitment to the profession by adhering to standards and participating in physician-led regulation

- 3.1. Fulfil and adhere to professional and ethical codes, standards of practice, and laws governing practice
 - 3.1.1. Adhere to regulations governing radiation protection and safety

4. Demonstrate a commitment to physician health and well-being to foster optimal patient care

- 4.1. Exhibit self-awareness and manage influences on personal well-being and professional performance
 - 4.1.1. Demonstrate safe use of cardiac catheterization laboratory equipment as it relates to radiation safety
 - 4.1.2. Monitor personal radiation exposure
- 4.2. Manage personal and professional demands for a sustainable practice throughout the physician life cycle

REQUIRED TRAINING EXPERIENCES

Clinical training experiences

1. Assess patients who have been referred for diagnostic or interventional procedures
2. Perform and interpret diagnostic cardiac catheterization and coronary arteriography for patients with a wide range of cardiovascular diseases
3. Perform interventional cardiology procedures, with skills progressing as a primary operator
4. Manage the care of patients who have experienced a complication of a diagnostic or interventional cardiology procedure
5. Provide recommendations for the ongoing care and follow-up of patients who have undergone an interventional cardiology procedure
6. Participate in the after-hours coverage of the adult interventional cardiology service

Other training experiences

7. Participate in case conferences with cardiac surgeons and other cardiologists
8. Participate in critical appraisal activities, such as journal club
9. Participate in the management and administration of the adult interventional cardiology service
10. Prepare an audit of personal procedural and medical complication rates
11. Participate in a local, provincial/territorial, or national project aimed at advancing the scope or quality of care provided in the cardiac catheterization laboratory at the base institution
12. Educate one or more of the following groups about Adult Interventional Cardiology: other physicians, other health professionals, members of the public, or government officials
13. Conduct a scholarly project, basic science or clinical, related to Adult Interventional Cardiology

RECOMMENDED TRAINING EXPERIENCES

1. Participate in training courses and continuing professional development activities specific to Adult Interventional Cardiology
2. Develop continuing medical education modules relevant to Adult Interventional Cardiology
3. Participate in formal training in research methodology or medical education

OPTIONAL TRAINING EXPERIENCES

1. Participate in pediatric interventional cardiology, which may include interventional cardiology for adults with congenital heart disease
2. Participate in adult interventional cardiology for structural heart disease
3. Participate in chronic total occlusion procedures
4. Participate in complex higher-risk and indicated percutaneous coronary intervention (CHIP)
5. Undertake advanced training in coronary artery physiology or intracoronary imaging
6. Participate in computed tomography angiography (CTA)

The AFC Committee for Adult Interventional Cardiology recommends a training time of 104 weeks to achieve the Adult Interventional Cardiology competencies.

The recommended minimum experiences include

- 500 diagnostic procedures as primary operator,
- 250 interventional procedures as primary operator, and
- 50 cases of primary percutaneous coronary intervention as primary operator (which may be included in the 250 procedures listed in the second bullet above).

The document is to be reviewed by the AFC Subcommittee in Adult Interventional Cardiology by 31 December 2024.

Provisional approval – Office of Education – June 2012

Editorial revisions – Office of Education – September 2012

Approved – Specialty Standards Review Committee – October 2012

Revised – Area of Focused Competence Working Group – April 2013

Revised – AFC Subcommittee in Adult Interventional Cardiology and Office of Specialty Education – June-November 2022

Approved – Specialty Standards Review Committee – February 2023