

Trainee Section

Critical Care Cardiology: A Fellow's Guide to Training Pathways

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Mr T is a 52-year-old man admitted to your cardiac intensive care unit (CICU) after a cardiac arrest while playing squash. The initial rhythm was ventricular fibrillation. Return of spontaneous circulation was achieved in the field after 2 shocks and he was intubated. Initial electrocardiogram showed anterior ST-elevation myocardial infarction. He underwent successful emergency percutaneous intervention to the culprit left anterior descending artery. A targeted temperature management protocol was initiated. Two days later he is unresponsive without sedation, and is febrile, hypotensive, and persistently hypoxemic with a saturation of 86%, and a PaO₂ of 60 mmHg in 80% fraction of inspired oxygen and 14 cm H₂O of positive end-expiratory pressure. Chest x-ray shows bilateral patchy infiltrates. Left ventricular ejection fraction is 45%. He was initially diuresed but is now anuric.

Has your cardiology fellowship prepared you to manage this patient?

Introduction

Patients admitted to the CICU have multiple baseline comorbidities and an increasing prevalence of multiorgan failure requiring advanced therapies such as mechanical ventilation, renal replacement therapy, and mechanical circulatory support.^{1,2} In response to a growing trend in CICU acuity, cardiology leaders have identified the need for specialized CICUs to care for such patients^{3,4} and consensus statements from national professional societies have proposed staffing and education transformation for advanced CICUs.^{5,6} These positions are supported by a recent single-centre observational study that reported a transition to cardiac intensivist staffing was associated with a reduction in CICU mortality.⁷

Among cardiology graduates, critical care medicine (CCM) training can provide the skills to centralize the care of patients with a primary cardiovascular diagnosis during the most acute phases of their illness. CCM training encompasses all phases of critical illness: initial resuscitation, airway and ventilation management, hemodynamic support, antimicrobial therapy and stewardship, and establishing a multidisciplinary recovery or palliative plan. CCM specialists can also contribute to the development of protocolized care bundles, lead an interprofessional team, and function as an expert consultant leader on cardiac critical care issues at the hospital, regional, and national levels.

Critical care cardiology is a new subspecialty with several different training routes, all with their respective advantages and disadvantages (Table 1). In this article, we outline the existing training and professional development pathways for cardiology trainees interested in this field so that they might choose the route that best suits their personal and professional goals (Fig. 1).

CCM Training Pathways

Two-year training programs

Two-year programs are offered in Canada and the United States and can lead to full CCM board eligibility in both countries. In general, these programs can provide extensive clinical exposure to general CCM and critical care cardiology, as well as post cardiac surgery care in the cardiac surgical intensive care unit (CSICU). They offer a generous amount of elective time, which provides trainees with opportunities to pursue research projects or clinical electives aiming to augment their cardiology or noncardiology skills (eg, heart failure, echocardiography, continued CICU exposure, or CCM-specific procedures). Many programs offer structured research pathways, including quality improvement, which can

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Table 1. Cardiac intensive care training pathways

Duration of training after cardiology	Cardiovascular-focused critical care medicine		Critical care medicine	
	1 year		1 year	2 years
Location(s) available	Canada	US	US	US and Canada
Accreditation	Clinical fellowship certificate	ACGME (variable)	ACGME	ACGME Royal College
Critical care board eligibility	None	ABIM (if ACGME-certified)	ABIM	ABIM Royal College
Canadian clinical practice eligibility	CICU	CICU	CICU ICU (US)	CICU, ICU
Funding	Variable		Yes	Yes
Application	Contact programs directly		ERAS (US)	CaRMS (Canada) ERAS (US)
Program structure				
CICU	Y	Y	Variable	Variable
CV surgical ICU	Y	Y	Variable	Variable
Medical/surgical ICU	Y	Y	Y	Y
Airway skills	Y	Y	Y	Y (Advanced)
MCS exposure	Y	Variable	Variable	Variable
Research	Y	Y	Y	Y
Electives	Variable		1-3 Blocks	8-12 Blocks
Advantages	<ul style="list-style-type: none"> • Preparation for CICU clinical focus • MCS exposure • Flexible structure 	<ul style="list-style-type: none"> • General CCM • Board-eligible (US only) 	<ul style="list-style-type: none"> • General CCM • Board-eligible (US only) • Multiple elective blocks • Eligible for practice in CICU or ICU (US only) 	<ul style="list-style-type: none"> • General CCM • Board-eligible (Canada/US) • Multiple elective blocks • Eligible for practice in CICU or ICU
Disadvantages	<ul style="list-style-type: none"> • Not board-eligible in Canada • Condensed workload • Variable curriculum 	<ul style="list-style-type: none"> • Not board-eligible in Canada • Condensed workload • Variable CVICU/ICU/MCS exposure 	<ul style="list-style-type: none"> • Not board-eligible in Canada • Variable CSICU/MCS exposure • Condensed workload 	<ul style="list-style-type: none"> • Variable CSICU/MCS exposure

ABIM, American Board of Internal Medicine; ACGME, Accreditation Council for Graduate Medical Education; CaRMS, Canadian Resident Matching Service; CCM, critical care medicine; CICU, cardiac intensive care unit; CSICU, cardiac surgical intensive care unit; CV, cardiovascular; CVICU, cardiovascular intensive care unit; ERAS, Electronic Residency Application Service; ICU, intensive care unit; MCS, mechanical circulatory support; US, United States; Y, yes.

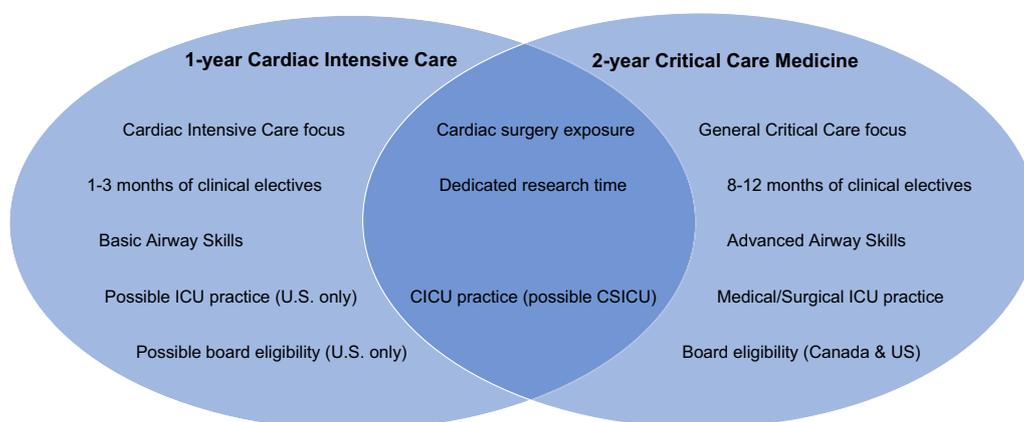


Figure 1. Currently available cardiac intensive care training pathways. ICU, intensive care unit; CICU, cardiac intensive care unit; CSICU, cardiac surgical intensive care unit.

be pursued alongside clinical time or during dedicated research time.

Royal College of Physicians of Canada-accredited programs

The 2-year Canadian CCM route provides trainees with the knowledge and skills to write the Canadian subspecialty CCM exam and become Royal College-certified specialists. This program is currently offered at most Canadian university medical faculties (Table 2). Candidates apply via the Medicine Subspecialty Match of the Canadian Residency Match Service. The Royal College mandates that a minimum of 1 year

of critical care clinical training be completed over 2 years (many programs expect trainees to complete up to 16 months), with the remaining time available for clinical electives and research. Canadian intensive care units (ICUs) are generally mixed medical/surgical units and offer trainees exposure to a wide breadth of complexity and acuity. For candidates interested in developing expertise in postoperative cardiovascular critical care or extracorporeal circulatory support, we recommend contacting program directors to inquire about their availability in detail. The Royal College of Canada does not explicitly mandate exposure to cardiac surgical patients, however, many ICUs admit these patients in their general units, and most programs encourage exposure to this

Table 2. List of programs

	Canada	United States
Cardiovascular-focused critical care medicine (1 year)		
With board eligibility	N/A	Brigham and Women's Hospital (Boston, MA) Cedars-Sinai Hospital (Los Angeles, CA) Cleveland Clinic Foundation (Cleveland, OH) Contact programs for an updated list
Without board eligibility	University of Alberta (Edmonton, AB) Toronto General Hospital (Toronto, ON)	Columbia-Presbyterian Medical Center (New York, NY) Johns Hopkins Medical Center (Baltimore, MD) Contact programs for an updated list
Critical care medicine (1-2 years)		
Critical Care Medicine (1 year) (Board-eligible in US only)	N/A	Oregon Health & Sciences University (Portland, OR) Stanford University (Stanford, CA) University of Pittsburgh Medical Center (Pittsburgh, PA) University of Washington Medical Center (Seattle, WA) See ACGME for full list
Critical care medicine (2 years) (Board-eligible in US and Canada)	Dalhousie University (Halifax, NS) Université de Laval (Québec, QC) Université de Montréal (Montréal, QC) McGill University (Montréal, QC) University of Ottawa (Ottawa, ON) Queen's University (Kingston, ON) University of Toronto (Toronto, ON) McMaster University (Hamilton, ON) Western University (London, ON) University of Manitoba (Winnipeg, MB) University of Alberta (Edmonton, AB) University of Calgary (Calgary, AB) University of British Columbia (Vancouver, BC)	Baylor College of Medicine (Houston, TX) Brown University (Providence, RI) Cleveland Clinic Foundation (Cleveland, OH) Dartmouth-Hitchcock (Lebanon, NH) Henry Ford Hospital (Detroit, MI) Mayo Clinic (Rochester, MN) Maimonides Medical Center (Brooklyn, NY) Montefiore Medical Center (Bronx, NY) National Institutes of Health (Bethesda, MD) Oregon Health & Sciences University (Portland, OR) Stanford University (Stanford, CA) University of Pittsburgh Medical Center (Pittsburgh, PA) See ACGME for full list

ACGME, Accreditation Council for Graduate Medical Education; CaRMS, Canadian Resident Matching Service; N/A, not available; US, United States.

patient population during mandatory or elective rotations. The Royal College CCM objectives and structure might slightly change over the next year with the introduction of competency-based training and assessment.

Accreditation Council for Graduate Medical Education 2-year programs (United States)

General CCM training in the United States is most commonly offered via a 3-year combined pulmonary and critical care pathway. There are fewer 2-year general CCM pathways (Table 2). These programs are certified by the Accreditation Council for Graduate Medical Education and comply with all requirements for board eligibility in the United States (American Board of Internal Medicine) and Canada. Applications and interview offers are communicated through the Electronic Residency Application Service, usually 1 year before the scheduled program start dates in July. However, positions are offered outside of the United States match system. The curriculum structure is similar to Canadian CCM programs, with a focus on general critical care, emphasizing medical and surgical intensive care. CICU is required with variable levels of exposure. The major advantages of this pathway are similar to those of the Canadian 2-year programs, but with the added experience of training abroad. Many sites have subspecialized ICUs, which might offer additional clinical exposure that is unique to the local training environment.

One-year programs (Canada and United States)

The 1-year clinical pathway offers the flexibility and efficiency of a focused training experience and provides CCM training in a condensed, high-intensity format. There are several options, in the United States and Canada (Table 2). There are varying curricula, and selection of a 1-year program should be guided by the personal and professional goals of the prospective trainee. Many US CCM programs offer a 1-year track to those who have completed a medical subspecialty fellowship such as cardiology. An ideal program should provide sufficient general and cardiac surgical critical care volume and expertise, as well as the flexibility to individualize their program to meet cardiology-specific objectives. These programs only exist in a few sites, however other sites might be willing to bring on cardiology trainees and program directors should be approached on an individual basis.

Currently, there are 2 Canadian 1-year cardiac intensive care programs, neither of which are presently accredited by the Royal College and offer clinical fellowship certificates only. In the United States, most (but not all) programs offer Accreditation Council for Graduate Medical Education accreditation and American Board of Internal Medicine exam eligibility for CCM. We recommend reviewing accreditation status of individual programs when applying. Trainees who completed a 1-year accredited fellowship in the United States and are interested in Royal College certification often are required to complete an extra year of training before being granted eligibility. One-year programs are best suited for trainees whose career objectives are more focused toward the CICU and potentially CSICU (in select centres and provinces), with a lower priority placed on full Canadian CCM certification.

Professional Development

Subspecialization in critical care after a cardiology fellowship can lead to a diversified, challenging, and rewarding practice. Depending on the chosen training pathways, clinical interest, and hospital organizational structure, graduates might find professional opportunities in different critical care settings (eg, CICU, CSICU, general medical/surgical ICU). Opportunities also exist to leverage this training into administrative, leadership, quality improvement, or educational roles in community or academic settings. Further applications include optimizing cardiac critical care processes, heading multidisciplinary teams of allied health care professionals, implementing evidence-based care bundles, or advancing critical care cardiology research.⁸ Tremendous potential also exists for serving as a liaison between the cardiology and intensive care services. As a novel subspecialty, critical care training can serve as a strong foundation for clinical research or career development within academic medicine. Although some critical care cardiologists might choose to practice in the ICU setting only (ie, CICU, CSICU, and medical ICU), most continue to practice general cardiology and work as consultants in the hospital or in the outpatient clinic. Although concerns have been raised regarding burnout syndromes among intensivists,⁹ the dynamic nature of a career in cardiac intensive care, which often includes clinical and nonclinical work, might promote career longevity.

Conclusion

Critical care cardiology is an exciting, yet nascent, subspecialty with a number of potential training pathways in North America. Each pathway has its own inherent advantages and trainees should select and tailor their training pathway to meet the clinical and academic needs of their desired career. The subspecialty, along with its training pathways, will continue to grow and evolve, but the knowledge and technical skills acquired during a critical care cardiology fellowship will likely remain transferable and applicable to a broad range of cardiovascular clinical and academic careers.

About the Authors

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Trainees are encouraged to reach out to these primary authors with questions regarding training in critical care cardiology. Readers are also encouraged to learn more at the CANCARE Web site (<http://www.cancareociety.com>).

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