

Advanced Interventional Echocardiography (level III) Fellowship Training Program

Offered by
The McGill University Health Center

Number of Positions : 1- 2 per year
Fellowship Director: Francois Tournoux, MD
E-mail: Residency.cardiology@mcgill.ca

INTRODUCTION

The Cardiology Division of the McGill University Health Center offers a one-year Fellowship Program for cardiologists who wish to obtain expertise in Interventional Echocardiography with the American College of Cardiology / American Heart Association level 3 of clinical competency in echocardiography.

The McGill University Health Center (MUHC) includes the Royal Victoria Hospital (RVH), the Montreal General Hospital (MGH), the Lachine Hospital and the Montreal Neurological Institute (MNI), all parts of the McGill University teaching hospitals network with one of the largest Cardiology Divisions in Montreal. Its echocardiography laboratories provide basic and advanced core training to all fellows enrolled in the Cardiovascular training program, as well as to fellows from anesthesia, cardiovascular surgery, intensive care medicine, emergency medicine and general internal medicine.

Echocardiography is a non-invasive imaging modality with great diagnostic capabilities and accessibility. However, optimal diagnostic accuracy is greatly influenced by operator expertise. For that reason, a competent clinical echocardiographer must master both the cognitive skills necessary for diagnosis AND the technical abilities to obtain the best images possible. This implies a thorough understanding of the physical principles of sound transmission, as well as of fluid dynamics. With state-of-the-art echocardiography equipment, one acquires high quality 2D, 3D or 4D image static or dynamic data sets to visualize the heart's structure and function, and applies Doppler principles and Speckle tracking technology to assess heart chamber and valve function. Clinical usefulness and appropriate interpretation of such obtained echocardiography data must be done through integration of cardiovascular physiology and pathophysiology and how cardiovascular intervention interacts with disease processes. Our program at the MUHC will accept exceptional cardiologists who manifest a strong interest in attaining these goals and requirements, and specifically in developing knowledge and skills as echocardiographers involved in state-of-the-art structural heart disease and electrophysiology procedures.

In addition to transthoracic, transesophageal and stress echocardiography, the advanced interventional echocardiography trainee will be exposed to vascular imaging, including carotid, jugular, subclavian, brachial, aortic, renal, iliac, femoral, popliteal, posterior tibial and dorsalis pedal vessels and to special vascular imaging techniques such

as carotid intima-media thickness measurements, brachial artery flow-mediated vasodilatation studies and ultrasound-assisted central-line placement, pericardiocentesis and thoracentesis. The advanced interventional echocardiography trainee will also be involved with the role of echocardiography in advanced quaternary cardiology such as cardiac resynchronization therapy, ventricular assist devices and mechanical hearts, transcatheter device closure of PFO, ASD, VSD, PDA and periprosthetic leak, LA appendage occlusions, and transcatheter valvular therapies including TAVI, TMVI, TPVI and TTVI in native and prosthetic valves. For that purpose, the advanced interventional echocardiography trainee will also be exposed to cutting-edge echocardiography techniques including Real-time 3D and 4D examination and multiplanar reconstruction, 2D and 3D strain and strain rate imaging by speckle tracking and quantitative techniques using automated function imaging as well as contrast echocardiography and intracardiac echocardiography (ICE). As an advanced interventional echocardiography trainee, the candidate will be an integral member of the Structural Heart Disease Team and will serve as the imaging expert on Echo and CT-A analysis during weekly proceedings, thus assisting during highly specialized procedures with imaging guiding techniques such as fluoro-CT, rotational angiography and Fusion imaging. The McGill University Health Center Cardiology Department has unique current access to a wide array of novel technologies through its clinical and investigational programs with Structural Heart Disease, Adult Congenital Heart Disease, Electrophysiology and Heart Failure and Transplantation.

PREREQUISITES

- 1) Anticipated satisfactory completion (by the time of the fellowship beginning) of a clinical cardiology, cardiovascular surgery or anesthesiology residency program recognized by the Collège des Médecins du Québec, The Royal College of Physicians and Surgeons of Canada or foreign equivalent from The American Board of Internal Medicine and Specialties or other Royal Colleges.
- 2) Submission of complete Curriculum Vitae
- 3) Letters of recommendations from at least three active academic cardiologists
- 4) Oral interview by the Echocardiography Training Program Director and/or member(s) of the echocardiography laboratory cardiology staff.
- 5) Application process via the Minerva system with accreditation validated through the McGill Cardiology Training Program and its Program Director.

PROGRAM DESCRIPTION

The MUHC Advanced Interventional Echocardiography (level III) Fellowship Training Program has a duration of 12 months. During this period, the echo cardiovascular trainee will be expected to attain the level III competency described in the ACC/AHA Clinical Competence statement on Echocardiography published in the February 19, 2003 issue of the Journal of the American College of Cardiology (2003, Vol.41, no.4, pp.687-708).

More specifically, the echo cardiovascular trainee will acquire the following basic cognitive and technical skills:

1. Knowledge of physical principles underlying echocardiographic image formation, blood flow velocity measurements, tissue Doppler, speckle tracking, three-dimensional and contrast ultrasound.
2. Knowledge of transducer manipulation and technical instrument settings critical to obtain an optimal image
3. Knowledge of normal cardiac anatomy
4. Knowledge of pathological changes in cardiac anatomy due to acquired and congenital heart diseases
5. Knowledge of fluid dynamics of normal blood flow
6. Knowledge of pathological changes in blood flow due to acquired and congenital heart diseases
7. Knowledge of appropriate indications for echocardiography.
8. Knowledge of the differential diagnosis in referral requests and the echocardiographic techniques required to investigate these possibilities
9. Knowledge of cardiac auscultation and electrocardiography for correlation with results of the echocardiogram.
10. Ability to distinguish an adequate from an inadequate echocardiographic examination.
11. Knowledge of appropriate semi-quantitative and quantitative measurement techniques and ability to distinguish adequate from inadequate quantitation.
12. Ability to communicate results of the examination to the patient, medical record, and other physicians.
13. Knowledge of alternatives to echocardiography.

The ACC/AHA Clinical Competence statement on Echocardiography prescribes a training minimum requirements of 12 months and a cumulative level I to III number of 300 transthoracic two-dimensional and Doppler echocardiograms performed and 750 interpreted. In reality, this would only represent an average of 0,58 studies performed and 1,73 studies interpreted by day if one assume 52 weeks with 5 working days. However, level III competency is also meant to represent a high level of expertise that should enable an individual to serve as a director of an echocardiography laboratory and be directly responsible for quality control and for the training of sonographers and physicians in echocardiography. To that effect, the MUHC echocardiography laboratory feels that to achieve this level of competency, a more appropriate minimum volume of examination would represent 1000 additional studies and 2000 interpreted studies.

For Transesophageal echocardiography (TEE) level III training, the cardiovascular trainee the following basic cognitive and technical skills:

1. Knowledge of the appropriate indications, contraindications, and risks of TEE.
2. Understanding of the differential diagnostic considerations in each clinical case.
3. Knowledge of infection control measures and electrical safety issues related to the use of TEE.
4. Understanding of conscious sedation, including the actions, side effects and risks of sedative drugs, and cardiorespiratory monitoring.
5. Knowledge of normal cardiovascular anatomy, as visualized tomographically by

TEE.

6. Knowledge of alterations in cardiovascular anatomy that result from acquired and congenital heart diseases and of their appearance on TEE.
7. Understanding of component techniques for transthoracic echocardiography and for TEE, including when to use these methods to investigate specific clinical questions.
8. Ability to distinguish adequate from inadequate echocardiographic data, and to distinguish an adequate from an inadequate TEE examination.
9. Knowledge of other cardiovascular diagnostic methods for correlation with TEE findings.
10. Ability to communicate examination results to the patient, other health care professionals, and medical record.
11. General knowledge of appropriate alternative diagnostic modalities, especially transthoracic and epicardial echocardiography.
12. Knowledge of the normal cardiovascular anatomy as visualized by TEE.
13. Knowledge of commonly encountered blood flow velocity profiles as measured by Doppler echocardiography.
14. Detailed knowledge of the echocardiographic presentations of myocardial ischemia and infarction.
15. Detailed knowledge of the echocardiographic presentations of normal and abnormal ventricular function.
16. Detailed knowledge of the physiology and TEE presentation of air embolization.
17. Detailed knowledge of native valvular anatomy and function. Knowledge of prosthetic valvular structure and function. Detailed knowledge of the echocardiographic manifestations of valve lesions and dysfunction. Knowledge of native valvular anatomy and function, as displayed by TEE.
18. Knowledge of the major TEE manifestations of valve lesions and of the TEE techniques available for assessing lesion severity.
19. Knowledge of the principal TEE manifestations of cardiac masses, thrombi, and emboli; cardiac aneurysms, hypertrophic and other cardiomyopathies, endocarditis, aortic aneurysm and dissections, pericardial disorders and post-surgical changes.
20. Proficiency in using conscious sedation safely and effectively.
21. Knowledge of the echocardiographic manifestations of congenital heart disease
22. Proficiency in safely passing the TEE transducer into the esophagus and stomach, and in adjusting probe position to obtain the necessary tomographic images and Doppler data.
23. Ability to perform a TEE probe insertion safely in the anesthetized, intubated patient.
24. Proficiency in operating correctly the ultrasonographic instrument, including all controls affecting the quality of the data displayed.
25. Proficiency in recognizing abnormalities of cardiac structure and function as detected from the transesophageal and transgastric windows, in distinguishing normal from abnormal findings, and in recognizing artifacts.
26. Proficiency in performing qualitative and quantitative analyses of the echocardiographic data.

27. Ability to recognize subtle and major echocardiographic changes associated with myocardial ischemia and infarction.
28. Ability to detect qualitative changes and to utilize TEE to quantify ventricular function and hemodynamic status.
29. Ability to recognize echocardiographic manifestations of air embolization. Ability to visualize cardiac valves in multiple views and recognize gross valvular lesions and dysfunction. Ability to utilize TEE to evaluate and quantify the function of all cardiac valves including prosthetic valves (e.g., measurement of pressure gradients and valve areas, regurgitant jet area, effective regurgitant orifice area). Ability to assess surgical intervention on cardiac valvular function.
30. Ability to recognize large intracardiac masses and thrombi.
31. Ability to detect large pericardial effusions.
32. Ability to utilize TEE to evaluate congenital heart lesions. Ability to assess surgical intervention in congenital heart disease.
33. Ability to detect and assess the functional consequences of pathologic conditions of the heart and great vessels (such as cardiac aneurysms, hypertrophic cardiomyopathy, endocarditis, intracardiac masses, cardioembolic sources, aortic aneurysms and dissections, and pericardial disorders). Ability to evaluate surgical intervention in these conditions if applicable.
34. Ability to monitor placement and function of mechanical circulatory assistance devices
35. Ability to recognize common artifacts and pitfalls in TEE examinations.
36. Proficiency in producing a cogent written report of the echocardiographic findings and their clinical implications

The ACC/AHA Clinical Competence statement on Echocardiography prescribes a training minimum requirements of 12 months and a cumulative level I to III number of 50 transesophageal echocardiograms performed. In reality, this would only represent an average of 0,96 studies performed per week if one assume 52 weeks. However, level III competency is also meant to represent a high level of expertise that should enable an individual to serve as a director of an echocardiography laboratory and be directly responsible for quality control and for the training of sonographers and physicians in echocardiography. To that effect, the MUHC echocardiography laboratory feels that to achieve this level of competency, a more appropriate minimum volume of examination would represent 200.

For Stress echocardiography (TEE) level III training, the cardiovascular trainee the following basic cognitive and technical skills:

1. Skills for supervision of standard exercise testing, including competence in cardiopulmonary resuscitation and successful completion of an American Heart Association-sponsored course in cardiopulmonary resuscitation and renewal on a regular basis.
2. Knowledge of the indications and limitations of exercise echocardiography.
3. Knowledge of the different types of pharmacologic stress agents, including advantages and disadvantages of the different agents.
4. Knowledge of the indications for pharmacologic stress echocardiography.

5. Knowledge of limitations and contraindications of pharmacologic stress echocardiography with different types of pharmacological stress agents.
6. Knowledge of pharmacokinetics and physiologic responses of the different pharmacologic stress agents.
7. Knowledge of the side effects of different pharmacologic agents and how to manage them.
8. Knowledge of the complications of different pharmacologic stress agents and how to manage them.
9. Knowledge of cardiovascular drugs and their effects on responses to pharmacological stress.
10. Knowledge of electrocardiography and changes that may occur in response to pharmacologic stress.
11. Knowledge of the end points of pharmacologic stress echocardiography and indications for termination of a stress echocardiographic examination.
12. Knowledge of the sensitivity, specificity, and diagnostic accuracy of pharmacologic stress echocardiographic testing in different patient populations.
13. Ability to apply Doppler data to the physiologic changes that occur during pharmacologic stress.
14. Ability to identify left ventricular wall segments and recognize wall motion abnormalities at rest and during stress.
15. Knowledge of common pitfalls in the interpretation of digitally acquired images, such as arrhythmias, improper capture, and foreshortening of left ventricular cavity.
16. Knowledge of coronary anatomy and relationship to echocardiographic findings.
17. Knowledge of the relationship of imaging results to the presence or absence of myocardial viability.
18. Knowledge of specificity, sensitivity, and diagnostic accuracy of stress echocardiographic testing in different patient populations.
19. Knowledge of conditions and circumstances that can cause false- positive, indeterminate, or false-negative test results.
20. Ability to apply Doppler data to the physiologic changes that occur during exercise or pharmacologic stress.
21. Knowledge of prognostic value of stress echocardiographic testing.
22. Knowledge of alternative diagnostic procedures to stress echocardiography.

The ACC/AHA Clinical Competence statement on Echocardiography prescribes a training minimum requirements of 12 months and a cumulative level I to III number of 100 stress echocardiograms performed. Although these guidelines reflect the minimum number of stress echocardiograms, it should be emphasized that this numbers reflect the minimum examinations considered for clinical competence and that this advanced echocardiography (level III) fellowship training program will offer a greater experience in interpretation of stress echocardiograms over the time period.

The Advanced Interventional Echocardiography (level III) Fellowship Training Program will permit the Fellow to sit for the National Board of Echocardiography examination, should he/she choose. The technical imaging skills of the cardiovascular

trainee in TTE, TEE and Stress Echo will be periodically evaluated during the Fellowship to determine if additional dedicated scanning time in respective studies should be implemented. The complexity of the cases studied will also be monitored by diagnosis, which the cardiovascular trainee will be expected to interpret accurately and completely under concomitant expert reading and supervision by a level III echocardiography staff and structural heart disease team members as well as gradual independence will be increased as their experience increases.

The technical aspects of echocardiographic image acquisition and measurements will be taught by experienced sonographers in the lab and the interpretation of studies will be supervised by level III echocardiologists. The Fellow will be encouraged to use supplementary educational resources, including instructional tapes and extensive teaching files, and will be assigned reading from standardized texts. Teaching will incorporate both technical as well as cognitive skills required to perform and interpret echocardiograms. Fellows will participate in regular Echo Rounds, which are held 2-3 times per month and will regularly present on both basic as well as cutting edge topics in echocardiography.

Once assured of adequate technical skills, the Fellow will be phased into the interpreter's role. This entails reading and interpreting echocardiograms performed by sonographers, formulating a report, and reviewing the study and the report with the attending echocardiologist. In addition, the trainee will then commence taking on-call duty (home call) in transthoracic echocardiography, covering one weekend, and 6 week-night calls for echocardiography ONLY, supervised by an attending echocardiologist.

The MUHC serves as one of the primary teaching sites in echocardiography for the McGill University Cardiology Program, and frequently has PGY 4-6 Residents rotating through the Laboratory. The Echocardiography Fellow will interact with these Cardiology Residents and will assume a role as an educator by reviewing their studies and teaching them basic and eventually advanced concepts. Recent Fellows in Echocardiography have contributed tremendously through their daily interactions and specific lectures to the clinical cardiology Residents and the Cardiology Division staff, and have taught as well at the Medical School during the small group physiology sessions.

Echocardiography Laboratory Faculty:

Jean Buithieu MD, Director, Echocardiography and non-invasive cardiac imaging

Matthias Freidrich MD, Director of Cardiac Imaging

Natalie Bottega MD

Richard Haichin MD

Roupen Hatzakorzian MD (Anesthesiology and Intensive Care Unit)*

Thao Huynh MD

Murray Kornbluth MD

Ian Malcolm MD

Ariane Marelli MD
Negareh Moussavi MD (Echo and Cardiac MR-A)
Nilay Ozen MD[§]
Deric Rahal MD
Renée Schiff MD[§]
Gordan Samoukovic MD (Cardiovascular Surgery and Intensive Care Unit)*
James Stewart MD
Georges Thanassoulis
Judith Therrien MD[§]

*Joint Appointment

[§] Associate Staff from McGill University Teaching Hospitals

Structural Heart Disease Team Faculty:

Nicolo Piazza MD (Interventional Cardiology and Cardiac CT-A)
Giuseppe Martucci MD (Interventional Cardiology and Cardiac CT-A)
Benoît de Varennes MD (Cardiovascular Surgery)
Kevin Lachapelle MD (Cardiovascular Surgery)
Emmanuel Moss MD (Cardiovascular Surgery)
Gordan Samoukovic MD (Cardiovascular Surgery & Intensive Care)
Christo Tchevenkov MD (Cardiovascular Surgery & Congenital Heart Disease)
David Bracco MD (Anesthesiology, Trauma & Intensive Care)

Facilities:

The MUHC Echocardiography Laboratory is staffed by 16 full-time GFT Level 3 Echocardiographers and 7 cardiac sonographers. Overall, the laboratory has an integrated imaging system over the four sites with 2 GE Healthcare Vivid E95 machines, 10 GE Healthcare Vivid E9 and one Philips Healthcare IE33, all equipped with real-time 4-Dimensional TTE and TEE probes) and 2 GE Healthcare Vivid I machines, all linked to a central Siemens Syngo Dynamic Image server and a Intelrad-Image long-time deeper archiving system. All studies are stored in a RAW image data format which enables full off-line analysis on workstations using post-processing capabilities once only possible on-line on imaging machines. There are 9 dedicated Syngo imaging workstations (all with GE Healthcare EchoPACs). Furthermore, the 2 GE Healthcare Vivid E9 machines and the 1 dedicated Syngo imaging workstations from the Anesthesiology department are also linked to the Syngo Dynamics Image server, enabling full access to all echocardiograms performed by the two departments. Reporting is done electronically through the Siemens Syngo Dynamics which is interfaced with the hospital OACIS information services, which allows generating final signed reports within a few minutes of the examination.

At the MGH, the laboratory has three imaging rooms, a central reviewing room and a secretarial area located on the 17th floor D wing while the exercise echo facility is located on the 5th floor E wing near the electrophysiology laboratory, where intracardiac and transesophageal echocardiography is performed.

At the RVH, the main laboratory on the Building C RC floor has six imaging bays, and two more adjacent to the exercise treadmill area for exercise treadmill and supine ergometer echocardiograms. The review area is located centrally to these imaging bays. An additional imaging bay with a small adjacent review area is located within the specialized cardiology clinics where Structural heart disease patients, Adult Congenital Heart Disease and heart failure patients are followed. There are additional echocardiographic examination areas located in the Center for Innovative Medicine (CIM) where state-of-the-art equipment including a GE Healthcare E95, two Phillips Healthcare EpiQ 7 and one Siemens SC 2000 are dedicated to cardiac and vascular multimodality imaging. The CIM research Echocardiography Laboratory has dedicated PACS workstation with advanced GE Healthcare EchoPACS and Phillips Healthcare Qlab advanced analysis software. Intraoperative transesophageal echocardiograms performed by anesthesiology are performed in the C3 cardiac operating theaters rooms. Finally, transesophageal monitoring studies during structural heart disease interventional procedures are performed in the catheterization biplane angiography suite and fusion imaging suites located in the B3 interventional area and also in the Hybrid room in the C3 area.

A comprehensive library of Echo reference books, landmark articles and multimedia CDs and DVDs as well as on-line computer PCs are in the review area of the RVH Echocardiography Laboratory.

Clinical Research:

The echo lab at the MUHC maintains an active research program. The MUHC is an officially recognized Advanced Heart Failure, Ventricular Assist Device (VAD) and Cardiac Transplantation Center. The MUHC has also a nationally recognized adult Congenital Heart Disease Center for the Montreal regional Area and a large part of the Quebec Province Territory. The MUHC has also an internationally known comprehensive advanced structural heart disease team performing PFO, ASD, VSD, PDA and periprosthetic leak device closure, LA appendage occlusions and transcatheter aortic, mitral, pulmonic and tricuspid prosthetic valve implantations and repairs in native and prosthetic valves.

As an integral member of the Structural Heart Disease Team, the Advanced Structural Heart Disease Echocardiography Fellow is heavily involved in clinical evaluation of patients with Echo and Cardiac CT-A advanced analysis. The team is very active in High-profile International Meetings - Transcatheter Valve Therapies (TVT), Transcatheter Cardiovascular Therapeutics (TCT), London Valves and EuroPCR, where it has been asked to perform numerous Live Cases. The Team is also very active in proctoring developing Structural Heart Disease Interventional Laboratories in North America, Europe, the Middle East and Asia. As the cardiovascular imaging expert, the advanced echo fellow is also be heavily exposed to cardiac CTA and MRA 3D multiplanar reconstruction and analysis. Fellows are expected and strongly encouraged to participate in a project in their area of interest, and if feasible to initiate a project that can be completed within their Fellowship. The Fellow will be encouraged to submit original research for presentation at scientific congresses and to attend these meetings. Planned

Echocardiography, CV Imaging and Interventional cardiology meetings will provide Fellows with ample opportunity to present to a wide audience and develop speaker and teaching skills.

Role of the Echocardiography Fellow:

During the twelve months of training, the trainee should acquire the following skill sets:

- understand cardiovascular anatomy, hemodynamics and the physical principles and instrumentation of ultrasound
- understand indications for transthoracic echocardiography (TTE) as per published guidelines.
- understand the limitations of TTE
- understand the echocardiographic appearance of cardiac structures including cardiac chambers, valves, pericardium, and major blood vessels
- learn to correlate echocardiographic features with findings from other investigations, e.g. cardiac catheterization, cardiac tomographic techniques (CT-A, MR-A), surgical and autopsy observations, as well as how to utilize the information provided by the echo study in clinical decision-making, including surgical indications, prognostic information, and guidance of medical therapy.
- learn the indications, contraindications, strengths and weaknesses for transesophageal and intracardiac echocardiography.
learn about the safe use of conscious sedation agents including their complications and treatment of complications.
learn to perform esophageal intubation of the TEE probe and to perform a comprehensive transesophageal and intracardiac echocardiographic examination to address the conditions listed below.
- learn the indications for different stress echo modalities as well as strengths/weaknesses vis a vis other imaging modalities.
learn how to perform exercise, dobutamine and dipyridamole stress echo, including recognition of complications, and their management.
learn to interpret the hemodynamic effects on the heart of exercise in the setting of valvular heart diseases including mitral and aortic regurgitation and mitral stenosis.
- learn to perform and interpret transthoracic M-mode, two-dimensional, pulsed Doppler, Continuous Wave Doppler, tissue Doppler, and Colour Flow studies in adult patients referred to an echocardiographic lab. Advanced tissue Doppler for the purposes of dyssynchrony analysis and cardiac resynchronization, as well as strain and strain rate imaging by speckle tracking techniques will also be taught.
- learn to interpret neonatal echos using an segmental approach and recognize and quantify structural abnormalities, including congenital cardiac conditions and neonatal conditions such as PDA.
- learn the indications, contraindications and precautions regarding the performance of contrast studies, using both agitated saline, as well as echo contrast agents.

This should include the following cardiac conditions:

- I Left and right ventricular dysfunction – segmental and global, including systolic and diastolic dysfunction, including the assessment of dyssynchrony
- II Valvular heart disease including the assessment and quantitation of stenosis and regurgitation of all four cardiac valves
- III Pericardial disease including pericardial effusion, assessment of constrictive pericarditis (and its distinction from restrictive cardiomyopathy), cardiac tamponade, and the use of echocardiography to guide pericardiocentesis
- VI Congenital heart disease such as atrial septal defect, ventricular septal defect, Tetralogy of Fallot, Ebstein’s Anomaly and complex congenital heart disease
- V Assessment of the aorta and its major branches to diagnose and evaluate dissection, intramural hematoma, aneurysm and atheromata
- VI Pulmonary hypertension – including Doppler estimation of right ventricular and pulmonary artery pressures and systemic and vascular resistance
- VIII Assistance in evaluation and implantation, operation and troubleshooting of Mechanical Ventricular Assist Devices (Impella, ECMO, Heartmate, Heartware and other ventricular assist devices)
- IX Assistance in evaluation and implantation of PFO, ASD, VSD, PDA and periprosthetic leak Amplatzer device closure, LA appendage occlusions with St.Jude ACP and Amulet device and Boston Scientific Watchman devices. TAVI (Edwards LifeSciences Sapien, Medtronic CoreValve and CreValve Evolut R, Boston Scientific Lotus and Microport), TMVI (HighLife, Abbott MitraClip, Valtech CardioBand and others), pulmonic (Andrastents and Medtronic Melody valves) and tricuspid transcatheter repair and bioprosthesis implantations in native and prosthetic valves.

In addition, the Fellow will learn management skills necessary to participate in and direct a modern university echo lab. These include equipment evaluation and troubleshooting, screening of echocardiographic studies to prioritize for urgency, time management, interactions with para-professionals including sonographers, receptionists, clerical workers etc. Data management and reporting skills are also essential attributes that will be taught.

Evaluation:

The Fellows will be evaluated on a regular basis by all echocardiologists in the echo lab as well as the sonographer staff. Their case logs will be reviewed for volume and type of cases. In addition to this, the Fellows will initially be given weekly or bi-weekly written tests commensurate with their level of training in order to evaluate their evolving knowledge base. They will be given echocardiographic cases to interpret. As well, more

theoretical exams focusing on physical principles, echocardiographic definitions and criteria for a variety of normal and pathological findings will be given. Verbal feedback will be given initially biweekly, with written feedback a minimum of twice per year. Written evaluations using the standard McGill evaluation format as well as CanMeds format as applicable will be made.

Fellows will be encouraged to feedback to the program director about all issues that concern him/her and that impact on learning. A McGill Resident Feedback form will be given to the Fellow to submit to the Fellowship Director, who will consider the comments and make changes to the Fellowship program as needed to best suit the needs of the Fellow. In addition, the Fellow will complete a report at the end of the Fellowship, to be submitted to the Cardiology Program Director for McGill University.

Conclusion:

The MUHC Advanced Interventional Echocardiography Fellowship is striving to offer a wide and deep exposure to a wide array of cardiovascular pathologies while offering the candidate the opportunity to further customize their training to suit eventual career paths

Table 1, Echocardiography Training Objectives and Strategies

Roles	Objectives	Strategies
Medical Expert	<ul style="list-style-type: none"> • Understand cardiovascular anatomy, hemodynamics and the physical principles and instrumentation of ultrasound including 2D, Doppler, harmonics, and mechanisms and identification of artifacts • Learn to perform and interpret (in the clinical context) transthoracic M Mode, two-dimensional, pulse Doppler, continuous wave, and tissue Doppler and Colour Flow studies on patients with common cardiovascular illnesses • Understands the indications, contraindications, strengths and weaknesses of transthoracic, transesophageal and intracardiac echocardiography • learn about the safe use of conscious sedation agents 	<ul style="list-style-type: none"> • Understand the basic principles and instrumentation of ultra sound and Doppler • Become familiar with both normal and abnormal echocardiographic appearance of cardiac structures on transthoracic and transesophageal echo • Acquire the knowledge base for the basic Doppler equations used in echocardiography • Know the two-dimensional and Doppler features of left ventricular systolic and diastolic dysfunction, right ventricular dysfunction, cardiomyopathies, pulmonary hypertension, valvular regurgitations, stenosis, prosthetic heart valves, pericardial disease, intracardiac mass and thrombus and simple congenital heart disease in adults and neonates.

	<p>including their complications and treatment of complications.</p> <ul style="list-style-type: none"> • learn to perform esophageal intubation of the TEE probe and to perform a comprehensive transesophageal examination to address the conditions listed below. • learn how to perform exercise, dobutamine and dipyridamole stress echo, including recognition of complications, and their management. • learn to interpret the hemodynamic effects on the heart of exercise and pharmacological stimulation in the setting of valvular heart diseases including mitral and aortic regurgitation and mitral stenosis. • Know the echocardiographic appearance of cardiac structures including cardiac chambers, valves and major blood vessels • Learn to correlate echocardiographic features with findings from other investigations including hemodynamic studies, CTA, MRA and surgical/pathological correlation • learn to interpret neonatal echos using an segmental approach and recognize and quantify structural abnormalities, including congenital cardiac conditions and neonatal conditions such as PDA. 	<ul style="list-style-type: none"> • Know the appropriate response on the left and right ventricles to stress, as well as the hemodynamic effects of stress on valvular heart disease • The above will be accomplished by direct supervision with a senior sonographer and staff cardiologist using heart models, ultrasound simulator as well as standard echocardiographic texts and educational audio-visual resources
Communicator	<ul style="list-style-type: none"> • Develop a good patient relationship during the examination with appropriate attention to comfort and personal privacy • Interpret from the requisition the relevant questions to be answered by the echocardiographic examination 	<ul style="list-style-type: none"> • Work closely with echocardiographic technologists in order to acquire appropriate skills to perform the examination in an effective and compassionate fashion • Read examination with staff cardiologists to learn how to interpret and report effectively

	<ul style="list-style-type: none"> •Develop a report of all salient echocardiographic features •Communicate the results of the examination to the patient when appropriate, as well as to the referring physician and members of the Structural Heart Diseases Team 	<ul style="list-style-type: none"> •Prepare sample/practice reports of echocardiographic studies
Collaborator	<ul style="list-style-type: none"> •Work closely with the staff in the echocardiographic department including technologists, assisting in the preparation, performance of the study, and discharge from the echo Lab •Work with the staff cardiologists in an effective and professional manner •Work with other physicians and allied health care professionals when performing echocardiographic examinations as a member of the Structural Heart Disease Team 	<ul style="list-style-type: none"> •Spend adequate amount of time with staff cardiologists as well as sonographers •Perform echocardiographic studies in the Intensive Care Unit, Coronary Care Unit, the Operating room, The Hybrid OR and the Catheterization and Electrophysiology Laboratories

Manager	<ul style="list-style-type: none"> •Utilizes the echocardiographic equipment and time in an efficient manner •Respects and adheres to both the laboratory schedule and the patients needs for a timely examination •Understands the indications and contraindications for cardiac echo 	<ul style="list-style-type: none"> •Works closely with the sonographer to screen the booking schedule and triage/select appropriate cases •Works closely with the Laboratory Technical and Medical Directors to understand proper management and planning of technical resources and equipment
Health Advocate	<ul style="list-style-type: none"> •Understand the role of echocardiography in diagnosing cardiovascular disease •Use the information from echocardiography to help patients modify cardiac risk factors •Use echocardiography to help patients understand their cardiovascular illness 	<ul style="list-style-type: none"> •Utilize the information from echocardiographic studies in combination with the information obtained from the patients to promote cardiovascular health
Scholar	<ul style="list-style-type: none"> •Understand knowledge gaps in technical and interpret skills in echocardiography •Critically evaluates the literature on topics related to echocardiography •Assist in the teaching of more junior housestaff in the technical and interpretive skills of echocardiography •Participate in rounds and presentations of echocardiographic topics 	<ul style="list-style-type: none"> •Read the appropriate literature provided •Refer to the standard textbooks of cardiology and electrocardiography •Attend Cardiology Grand Rounds •Attend city wide echocardiography rounds • Prepare/present in-depth echo presentation/journal clubs dealing with appropriate topic for level of training • Review/utilize multimedia resources including teaching case banks and electronic textbooks to supplement printed materials
Professional	<ul style="list-style-type: none"> •Interact with patients coming to the Echocardiography Laboratory with integrity, honesty and compassion •Work with other physicians and allied healthcare professionals in a appropriate and professional manner 	<ul style="list-style-type: none"> •Use senior staff cardiologists as mentors •Spend an appropriate amount of time in the echocardiography laboratory in order to develop the appropriate professional skills

**Table 2, Echocardiography Trainee Objective Specific Evaluation
Echocardiography Laboratory**

Fellow _____

Date of Rotation _____ Supervisor _____

Roles	Objectives	Not Met	Met	Met with Distinction	Comments
Medical Expert	<ul style="list-style-type: none"> • Understand cardiovascular anatomy, hemodynamics and the physical principles and instrumentation of ultra sound • Understands the indications, contraindications, strengths and weaknesses of both transthoracic and transesophageal echocardiography • Performs esophageal intubation of TEE probe in appropriate manner • Performs complete TEE examination • Know the echocardiographic appearance of cardiac structures including cardiac chambers, valves and major blood vessels • Learn to correlate echocardiographic features with findings from other investigations including hemodynamics and surgical specimens • Learn to perform and interpret transthoracic M Mode, two-dimensional, pulse Doppler, continuous wave Doppler and Colour Flow studies on patients with common 				

	<p>cardiovascular illnesses</p> <ul style="list-style-type: none"> • knows the indications for different stress echo modalities as well as strengths/weaknesses vis a vis other imaging modalities. • knows how to perform exercise, dobutamine and dipyridamole stress echo, including recognition of complications, and their management. • knows how to interpret the hemodynamic effects on the heart of exercise in the setting of valvular heart diseases including mitral and aortic regurgitation and mitral stenosis. 				
--	---	--	--	--	--

Communicator	<ul style="list-style-type: none"> • Develop a good patient relationship during the examination with appropriate attention to comfort • Interpret from the requisition the relevant questions to be answered by the echocardiographic examination • Develop a report of all salient echocardiographic features • Communicate the results of the examination to the patient and the referring physician 	Not Met	Met	Met with Distinction	Comments
Collaborator	<ul style="list-style-type: none"> • Work closely with the staff in the echocardiographic 				

	department including technologists •Work with the staff cardiologists in an effective and professional manner •Work with other physicians and allied health care professionals when performing echocardiographic examinations				
Manager	•Utilizes the echocardiographic equipment and time in an efficient manner •Respects and adheres to both the laboratory schedule and the patients needs for a timely examination •Understands the indications and contraindications for cardiac echo				

Health Advocate	•Understand the role of echocardiography in diagnosing cardiovascular disease •Use the information from echocardiography to help patients modify cardiac risk factors •Use echocardiography to help patients understand their cardiovascular illness	Not Met	Met	Met with Distinction	Comments
Scholar	•Understand knowledge gaps in technical and interpret skills in echocardiography •Critically the literature on topics related to echocardiography				

	<ul style="list-style-type: none"> •Assist in the teaching of more junior housestaff in the technical and interpretive skills of echocardiography •Participate in rounds and presentations of echocardiographic topics 				
Professional	<ul style="list-style-type: none"> •Interact with patients coming to the Echocardiography Laboratory with integrity, honesty and compassion •Work with other physicians and allied healthcare professionals in an appropriate and professional manner 				

Were the objectives discussed at the beginning of the rotation? Yes No
 At the midpoint of the rotation? Yes No
 Were the objectives successfully completed? Yes No

Comments: _____

Strengths: _____

Areas for Improvement: _____

SIGNATURES: _____

_____ Date _____
 Trainee/Resident

_____ Date _____
 Evaluator