POSTDOCTORAL FELLOWSHIP TRAINING PROGRAM IN CARDIOVASCULAR DISEASE

YALE UNIVERSITY SCHOOL OF MEDICINE

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Updated versions of this curriculum are available at:

http://info.med.yale.edu/intmed/cardio/training/index.html

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1. GOALS OF THE PROGRAM

1.A. Objective

The primary objective of the Fellowship Training Program in Cardiovascular Disease is to provide an academically and clinically rigorous environment for the fellows to obtain the necessary skills to become an outstanding specialist in cardiovascular diseases and to optimize each fellow's opportunities for a career in academic cardiology. These skills include a deep fund of basic and clinical knowledge, procedural skills, clinical judgment, professionalism, interpersonal skills, critical evaluation of evidence, and research skills.

1.B. Program Overview

The general cardiovascular medicine training program consists of a minimum of a three-year period of training. Core clinical training is completed in a minimum 24-month period of monthly rotations through the many aspects of clinical cardiology including consultative care, cardiac intensive care unit, congestive heart failure, cardiac imaging (echo, nuclear, CT/MRI), interventional cardiology, and electrophysiology. The third year is designed by the fellow and his or her mentor(s) as an individualized program for advanced training in one or more clinical areas and academic research training to prepare the trainee for his or her specific career. All fellows must complete a research project during the course of their fellowship. Select fellows may continue training beyond the core fellowship in many clinical and investigative areas, including the ACGME-sponsored fellowships of interventional cardiology, advanced heart failure and transplantation, and electrophysiology. Throughout three years of clinical training, fellows maintain continuity clinics within the Yale Medical Group and the VACT. Depending on the area of interest and individual fellow's performance, a fourth or fifth year of training may be offered.

The program follows the Guidelines for Training in Adult Cardiovascular Medicine Core Cardiology Training Symposium (COCATS 4) published by the AHA and ACC. These guidelines are available at www.acc.org, and copies are available in the Cardiovascular Medicine Fellowship Office.

2. CURRICULUM

2.A. Clinical Experience Overview

2.B. Patient Populations

The program is designed to provide a high level of clinical training. Each rotation provides opportunity for the fellow in management of acutely and chronically ill patients, observation of and participation in therapeutic interventions, and teaching of medical students, residents, and colleagues.

Both hospitals function as primary and tertiary care institutions. YNHH serves as a primary care hospital for the greater New Haven area and as a tertiary/quaternary care center for southern New England. VACT is a primary care hospital for veterans in the state of Connecticut, and serves as a tertiary care center for the southern New England, Rhode Island and eastern New York areas.

The patients from these institutions represent a wide variety of both common and rare cardiovascular disorders and provide excellent exposure to all areas of cardiovascular medicine in a demographically diverse population.

2.C. Introduction to Clinical Rotations

To facilitate transition into fellowship, all first year core fellows spend the first 2 months rotating through key clinical areas in order to gain exposure to all aspects of clinical cardiology at both sites.

2.D. Duty Hours

The fellowship program is dedicated to complying with ACGME guidelines for duty hours. Each fellow will not spend more than 80 hours per week, on average, caring for patients during a four-week rotation. Each fellow will average at least one weekend day (24 hours) per week free from clinical duties. Moonlighting activities at the institution will be monitored by the Program Directors for inclusion in the duty hour calculation. The *Duty Hours Policy* can be found at the back of the curriculum Appendix A, which includes the Moonlighting Policy.

3. Inpatient Care

3.A. Overview

Within the 24 months of core clinical training, nine months are dedicated to clinical (non-laboratory) responsibilities. These experiences include the YNHH (both YSC and SRC) and VACT Consult services (five to six months), the YNHH CCU service (two to three months), and the YNHH Heart Failure and Transplantation (one to two months).

These rotations comply with the ACGME requirements and ACC guidelines for the clinical core experience. Each rotation is structured in a similar fashion, with the fellow working under the direct supervision of a cardiology faculty member. In each rotation, the fellow is responsible for initially evaluating patients and formulating recommendations for treatment. This initial evaluation is then discussed with the attending, who makes the final evaluation and treatment recommendations. Medical residents and/or medical students may be present on any of these rotations as well.

The trainee is expected to provide comprehensive evaluation of the patient's cardiovascular illness in a prompt and concise manner, formulate a prioritized differential diagnosis, and outline the evaluation. The trainee should be able to enter a clear and legible document in the patient's record. The trainee should be able to communicate their evaluation in a clear and concise manner to the attending physician as well as to other members of the health care team. Interactions with

colleagues and allied personnel should be conscientious, respectful, responsible, punctual and appropriate. The trainee must exhibit humanistic qualities when interacting with patients and their families and demonstrate integrity, respect and compassion.

3.B. YNHH and VACT Consultative Services

These rotations provide exposure to a wide variety of clinical disorders in cardiology. The goal of this rotation is to expose the fellow to cardiology problems encountered in a tertiary care hospital, which includes complex cardiology problems which may arise on the medical service, as well as exposure to the cardiology problems which may arise in patients with surgical, gynecologic, and psychiatric illnesses, and in pregnancy. These rotations also provide in-depth exposure to patients undergoing cardiac surgery. Consultative services are provided for any clinical service at YNHH (both YSC and SRC), with the exception of pediatrics. The fellow has primary responsibility for all patients referred to the service, under the supervision of one faculty member dedicated to this rotation. When a medical resident or residents are assigned to this service, the resident assists the fellow and will participate in the management for a subgroup of patients on the service. The fellow will supervise the medical resident in this capacity. The attending will make rounds daily with all members of the consult team (fellow, medical residents, and students). Thus, during this rotation, the cardiology fellow is expected to acquire skills related to the clinical management of complex cardiology problems, as well as to develop supervisory and teaching skills. The Consult fellow is expected to make rounds daily on weekdays, and on one day during the weekend at their assigned hospital.

3.C. YNHH Cardiac Intensive Care Unit (CICU)

This rotation provides exposure to critically ill cardiac patients. The goals of this rotation are to develop skills related to the care of acutely and critically ill patients, including hemodynamic monitoring, hemodynamic support, and ventilator management. The fellow is responsible for supervising the house staff team in the management of all CCU patients. The fellow is primarily responsible for those patients admitted to the CCU who are under the care of the CCU attending. The fellow assists with the management of patients under the care of full-time Yale faculty and private cardiologists in the CCU. The fellow is also responsible for coordinating care of patients who undergo primary coronary interventions for acute myocardial infarction, from the point of the emergency department, to post-procedure care (with the interventional team). A dedicated CCU attending will oversee all aspects of the fellow's duties, will make daily rounds with the fellow and housestaff team, and will be available for any questions. Teaching rounds are held at least 3 times per week with all members of the CCU team.

3.D YNHH Heart Failure and Transplantation

The goal of this rotation is for the fellow to acquire an understanding of the physiology and management of patients with heart failure and participate in the evaluation and management of patients referred for cardiac transplantation and assist devices. Training will include both the in-patient and out-patient settings, under the direct supervision of the attending on the heart failure/transplant service. The fellow will acquire the skills for proficiency in management of acute and chronic heart failure, inotropic and mechanical support, right heart catheterization (bedside and in the catheterization laboratory), cardiopulmonary stress testing, and right ventricular

endocardial biopsy.

4. Laboratory-Based Experiences

The program provides clinical training in the following areas: cardiac catheterization (four months), electrophysiology (two months), and imaging (seven to ten months). Imaging includes echocardiography, nuclear cardiology, positron-emission tomography, magnetic resonance, and computerized tomography. Other skills acquired during these rotations include exercise stress testing, ECG interpretation, cardio-pulmonary testing, tilt-table testing and ambulatory electrocardiography interpretation.

4.A Cardiac Catheterization (four months minimum)

Resources: YNHH Cardiac Catheterization Laboratories (Dr. Carlos Mena, Director), and the VACT Catheterization Laboratory (Dr. Steven Pfau, Director). The YNHH laboratory performs over 3000 diagnostic procedures and more than 1300 interventional procedures annually. The VACT lab performs more than 800 catheterizations annually and more than 200 interventional procedures. The fellow will acquire the cognitive and motor skills to perform left and right heart catheterizations. All procedures are performed under the direct supervision of an attending.

Educational Goals: The trainee will demonstrate expertise in the following aspects related to the procedure including:

1) Understanding the appropriateness of procedure. The trainee should understand the indications for right and left heart catheterization, right ventricular endocardial biopsy, and be able to estimate the risk and benefit of procedures performed for diagnostic reasons. Knowledge of comorbid factors that increase the risk of a procedure should be demonstrated.

2) Obtaining informed consent. The trainee should communicate the risk and benefits of a procedure in a manner that is understood by the patient and address questions raised by the patient. In situations where the patient cannot give informed consent, the trainee should obtain consent from appropriate sources.

3) Administering anesthesia. The trainee should demonstrate knowledge of the pharmacology of medications used for conscious sedation, contraindications for their use, side effects, and the treatment of side effects. The trainee should develop the skills to make the patient comfortable during an examination, follow the degree of sedation, and recognize and treat complications. The trainee should develop skills in obtaining vascular access to the internal jugular subclavian and femoral veins as well as the femoral artery and brachial artery.

4) Coronary angiography and ventriculography. The trainee should develop skill in the injection of contrast material for angiography and recognize the potential complications of the use of x-ray contrast material. The trainee should develop a high level of competence in the interpretation of hemodynamic data and angiographic data. Accordingly, fellows are required to participate in a minimum of 100 such procedures.

5) Pericardiocentesis. The trainee should be able to understand the indications and potential risks of cardiac pericardiocentesis. In addition, the trainee should demonstrate adequate skills in assisting during the procedure.

6) Angioplasty, interventional procedures and intra-aortic balloon counterpulsation: The trainee will acquire sufficient exposure to the indications, performance and management of complications related to these procedures.

7) Evaluating and treating complications. The trainee should have full knowledge of complications of the procedures of diagnostic catheterization, the mechanisms for monitoring complications when suspected, and full knowledge and appropriate treatment of these complications.

8) Right ventricular endocardial biopsy. The trainee should have full understanding of the indications for diagnostic endocardial biopsy, and have skill in performing this procedure both from the internal jugular and femoral venous approach. The fellow should have knowledge of the potential complications and be appropriately trained for emergent pericardiocentesis should complications arise.

Responsibilities: All procedures will be performed only under the direct supervision of an Attending Cardiologist. Fellows will be responsible for performing a pre-procedural history and physical examination and discuss the relevant noninvasive studies and indication for the procedure with the Attending. The fellow's responsibilities will also include explaining the procedures to patients, obtaining informed consent, and performing the procedure as well as all pertinent follow-up care, including documenting and reporting the findings of the procedure. The fellow will also be required to participate in all scheduled catheterization conferences. Fellows will be required to keep a log of all procedures performed.

Teaching Conferences: At YNNH, weekly didactic conference is held each Wednesday from 7:30-9:00 am. At VACT, Catheterization Conference is held every Tuesday and Thursday from 4:00-5:30 pm.

4.B Echocardiography (three months minimum, although 6 months is preferred per COCATS 4 guidelines)

Resources: The primary experience for echocardiography is the YNHH Echocardiography Service (Dr. Lissa Sugeng, Director) which performs more than 20000 transthoracic and more than 1000 transesophageal examinations per year. The population includes a wide spectrum of acquired and congenital heart disease in patients of varying age and gender. Stress echocardiography is performed at YNHH, as well as in the Branford cardiology office, and fellows are encouraged to become familiar with this technique. A searchable repository of digital echocardiography cases is available on the computer in the YNHH Echocardiography reading area.

Educational Goals: The goal of the echocardiography rotation is to train fellows in the essentials of clinical echocardiography and to provide additional training for those fellows who wish to pursue an academic career in echocardiography. For all fellows, training will include instruction in the basic aspects of ultrasound, instrumentation, the ability to perform routine transthoracic studies, including Doppler examinations, use of contrast, 2D and 3D echocardiography, and to

relate the findings to the patient's medical management. All fellows in the first two years will attain basic expertise (COCATS Level 1, level II preferred), during a minimum of three months of training (6 months preferred) and performance of at least 75 echocardiographic procedures and interpretation of at least 150 transthoracic studies. Advanced training beyond these two general clinical years (COCATS Level 2 or 3) is available for fellows who wish to pursue careers in echocardiography and will incorporate more comprehensive training in transesophageal, stress (exercise and pharmacologic), intraoperative, and interventional (performed during biopsy, pericardiocentesis) ultrasound techniques.

Responsibilities: The fellow is responsible for the acquisition and interpretation of echocardiograms during this rotation, and is supervised by both technical staff and attending specialists in echocardiography. The fellow ultimately is responsible directly to the attending in echocardiography.

Teaching Conferences: Echocardiography conducts biweekly, one hour organized teaching meetings for all levels of individuals connected with the echocardiographic services or interested in cardiac imaging. This includes the ultrasonographers, echocardiography fellows andechocardiography attendings. Fellows will also be expected to present relevant echocardiographic studies at other conferences such as the Cardiology Case Conferences and Cardiac Imaging Conference.

4.C. Nuclear Cardiology (four months minimum)

Resources: The primary experience for this rotation is the YNHH Nuclear Cardiology and Exercise Laboratory (Dr. Edward Miller, Director) and the VACT Nuclear Cardiology Laboratory (Dr. Judith Meadows, Director). The YNHH laboratory is one of the largest clinical nuclear cardiology laboratories in the world, performing more than 8,000 clinically requested tests each year; including SPECT, SPECT/CT, and PET/CT. All laboratories cooperatively engage in 2 areas of activity: 1) clinical evaluation and diagnosis, and 2) clinical research.

Educational Goals: The goals of this rotation are to instruct the fellow in the indications, performance, and interpretation of stress testing and diagnostic nuclear cardiology procedures. Fellows will also perform and interpret cardiopulmonary stress tests. Fellows completing a minimum of level 1 training (2 months) will be conversant with the field of nuclear cardiology for application in general clinical management of cardiovascular patients.

Organized lectures and reading sessions will provide the fellow with an understanding of the clinical applications of nuclear cardiology, including imaging with positron-emitting radionuclides and computed tomography (CT) hybrid systems including single-photon emission computed tomography (SPECT/CT) and positron emission tomography (PET/CT). The material covered will include radiopharmaceuticals, radiation physics instrumentation, nuclear cardiology diagnostic tests, and procedures/protocols, general cardiology as it relates to image interpretation, risk stratification, myocardial perfusion imaging, ventricular function imaging, and assessment of myocardial viability. Specificity, sensitivity, diagnostic accuracy, utility in assessing prognoses and interventions, costs, indications, and pitfalls in interpretation and clinical application will be reviewed for each patient subset.

Fellows will have hands-on supervised experience over a two-year period with a minimum of 100 exercise studies and 50 standard nuclear exams (e.g., myocardial perfusion imaging and radionuclide angiography) and as many of the less commonly performed procedures as possible.. For exercise testing, the fellow should become proficient with performing and interpreting maximal and submaximal exercise tests, become familiar with exercise physiology, know the essentials of preparation for exercise testing, and know the clinical importance of the findings. The fellow will be instructed to perform all types of pharmacologic testing (dipyridamole, adenosine, dobutamine), and learn the indications for these methods. The fellow will be given primary responsibility to perform stress tests, under direct supervision of an attending and/or a specially-trained exercise physiologist.

Responsibilities: The fellow is responsible for the performance and interpretation of standard exercise tests, exercise and pharmacologic stress radionuclide perfusion imaging (SPECT and PET), gated blood pool imaging, and cardiopulmonary stress testing, all under the direct supervision of the attending cardiologist. The fellow will work directly with exercise lab personnel, and will participate in daily readout sessions with the attending. The fellow is directly responsible to the attending of the exercise/nuclear lab for all components of this rotation.

Teaching Conferences: Teaching meetings for all levels of individuals connected with the nuclear cardiology service or interested in cardiac imaging are held weekly. These conferences will include; journal article review, and topic presentations. At least twice per month, the focus of this conference is ongoing research in the laboratory. Daily readout sessions with the attending are held at in the clinical laboratory. In addition, the weekly Cardiology Catheterization Conference or Cardiology Grand Rounds often features a discussion of nuclear cardiology during case presentations. The laboratory also maintains a large collection of teaching cases available for review.

4.D. Cardiac CT/MRI (one month minimum)

The Yale Cardiac CT/MRI rotation introduces the fellow to the background, basics and applications of advanced cardiovascular imaging techniques including cardiovascular computed tomography (CT) and magnetic resonance (CMR). This rotation is led by Dr. Lauren Baldassarre, Cardiology Director of Cardiac CT/MRI

The rotation will comprise of 4 weeks during core fellowship Cardiology Training. The fellow will be expected to be available daily for assistance with imaging consultation with referring physicians, assistance in study scheduling, live image acquisition and study reporting. The Yale Advanced Cardiovascular Imaging service is staffed by a collaborative effort from faculty in both the Departments of Radiology and Cardiology. Cardiology fellows are expected to interact and work with trainees from other Departments such as Radiology residents or Nuclear Medicine residents.

Attending and Fellow attendance at all study acquisitions is expected. In addition, it is expected that the Fellow will log in to IDX Radiology scheduling system and look ahead for the following week's scheduled studies. The Fellow is to obtain clinical history by online medical record search, chart review or telephonic contact with the referring physician. All details such as patient history, prior studies (results to be faxed or emailed prior to the study being completed), contraindications

and any other relevant questions should be obtained. Any questions should be directed to the Cardiac Imaging attending on call.

Cardiac CT & CMR studies are performed predominantly daily.

Journal papers of interest in CCT and CMR will be available in the Cardiac CT/MR reading room on the main computer workstation. All fellows are encouraged to read introductory papers at the beginning of the rotation to familiarize themselves with the basics of CT/MR.

All fellows are expected to present a topic for discussion in either CT or MR that includes a clinically relevant topic. This is to be presented during the Friday CV imaging slot at noon during the fellow's rotation. In addition, there are multiple research opportunities within the section and the fellow is encouraged to partake in these activities.

4.E. VA Cardiac Imaging

Resources: The West Haven VA provides a full range of cardiac imaging, including echocardiography, nuclear cardiology, PET, CT, and CMR. Through the direction of Dr. Farid Jadbabaie (Echo) and Dr. Judith Meadows (Nuclear), fellows experience both hands-on experience with image acquisition and image interpretation of all modalities. The fellows are under the direct supervison of the attendings of the day.

Educational Goals: The WHVA cardiac imaging rotation complements the goals of each the YNHH echocardiography and nuclear goals as outlined above.

Teaching Conferences: Fellows are expected to actively participate in the Tuesday and Thursday afternoon VA case conferences as well as any core cardiology and cardiac imaging conferences at Yale.

4.F. Electrophysiology and Pacemaker/ICD follow-up (two months)

Resources: The primary Electrophysiology experience occurs at YNHH (Dr. Joseph Akar, Director) during a minimum of two dedicated months. The YNHH EP Laboratory provides comprehensive clinical services including arrhythmia consultation, cardiac pacing, defibrillator and resynchronization therapy. During this rotation, the fellow will work under the supervision of electrophysiology attendings and advanced fellows.

Educational Goals: The goal of core training in electrophysiology is for fellows to acquire knowledge and experience in the diagnosis and management of arrhythmias, the indications and limitations of electrophysiologic studies, the appropriate use of antiarrhythmic agents, and to be exposed to noninvasive (ambulatory ECG, event monitoring, tilt-table testing, signal-averaged ECG) and invasive (electrophysiologic testing, implantation of cardiac arrhythmia control devices) techniques used to assess and treat patients with arrhythmias. The fellow will be expected to gain familiarity with the basic components of device assessment and interrogation. The fellow will demonstrate knowledge of measuring pacing and sensing thresholds in patients with temporary pacemakers, as well as the appropriate indications for these procedures. Insertion of at least 10 temporary pacemakers and performance of at least 10 cardioversions is required, during the two-year clinical fellowship. Advanced training is available for fellows to pursue careers in

electrophysiology. In general, this advanced training requires 2 additional years after the third year of general fellowship, and leads to eligibility for certification.

Responsibilities: The rotating fellow will see, evaluate, and participate in the management of new consults/admission to the service in conjunction with the EP fellow and attending. The fellow will also perform invasive EP studies and elective cardioversions under the direct supervision of the attending. During the month, the fellow is expected to observe at least one pacemaker and one ICD implantation in the Operating Room, and observe and participate in at least one EP ablation procedure each week. Fellows will also participate in daily interpretation of ECG and Holter monitor recordings.

Teaching Conferences: The Electrophysiology team conducts a clinical conference each Monday at 7:30- 8:15 am and a didactic conference each Thursday at 7:30 am. Additionally, the ECG Teaching Conference is held each Friday at 7:30 am for much of the year.

5. Ambulatory Experience

The goals of the ambulatory experience are to provide exposure to outpatient cardiology practice, including both consultative and continuity experiences, to provide a means for clinical follow-up of patients recently discharged from the hospital. The out-patient experience is comprised of the VACT Cardiology Clinic, YPB Cardiology Fellows Clinic, and the SRC Cardiology Fellows Clinic.

These longitudinal clinics provide the fellow the opportunity to follow and manage patients in continuity for three years in an out-patient setting. Fellows participate in dedicated continuity clinics and alternate clinic weeks between two sites (usually VACT and either YPB or SR) one-half day every week during their core clinical training. Fellows see on average one new patient and 6-8 return patients on their clinic day, and are directly responsible for care of the patients to which they have been assigned. Fellows then see these patients in follow-up throughout their core years. On each day, attendings are available solely to supervise the fellows in this capacity.

The patient populations in these two clinics provide a diverse experience in terms of gender, socioeconomic status and reason for referral. Routine management of common cardiology problems, pre-operative evaluations prior to noncardiac surgery, evaluations for potential revascularization procedures (surgical and interventional), post-revascularization follow-up, follow-up of recently discharged patients, and referrals for complex cardiology problems are similar in both venues.

6. Technical and Other Skills

6.A. Technical and Procedural Skill Requirements

The program provides sufficient experience for the fellows to acquire skill and proficiency in the performance and interpretation of:

a. *History and physical examination*. This is supervised by faculty members while on the clinical services. The fellows have the opportunity to correlate their physical findings with results

of cardiac diagnostic procedures.

b. Basic and advanced cardiac life support. Fellows entering their training have documented certification in ACLS. Their ability to supervise complex resuscitative procedures and treat complex acute life threatening arrhythmias takes place in the CCU rotation.

c. Elective cardioversion. Both in-patient and out-patient cardioversions of atrial arrhythmias are performed by the fellows and supervised by the faculty members.

d. Bedside right heart catheterization pacemakers (transvenous and transcutaneous). In the CCU, cardiology fellows will perform bedside right heart catheterization under the supervision of faculty members for the first several months. The insertion and management of temporary pacemakers is performed routinely in the electrophysiology and catheterization laboratories, as well as in emergencies in the CCU.

e. Right and left heart catheterization including coronary arteriography. Fellows perform and participate in at least 100 diagnostic catheterizations in the Yale and VA cath labs.

f. Exercise stress testing. Fellows perform a minimum of 50 tests.

g. Echocardiography. Fellows perform at least 75 studies, including transthoracic and transesophageal, and interpret 150 studies.

h. Pericardiocentesis. Performed during the cardiac catheterization rotations at YNHH and the VA, as well as a structure simulation laboratory during first year orientation

i. Programming and follow-up surveillance of permanent pacemakers. Performed on an out-patient basis during the electrophysiology rotation.

j. Nuclear cardiology studies. Fellows will learn the basic aspects of image acquisition and interpretation in at least 100 cases.

6.B Procedure Logs

Fellows are expected to keep complete and accurate logs of their procedures during their core training. They are expected to log their procedures into the MedHub. The following procedures should be included in procedure logs at minimum. Fellows seeking advanced training in subspecialty areas (e.g. echocardiography) should consult the ACC website (guidelines for training) as well as professional societies (e.g. American Society of Echocardiography, American Society of Nuclear Cardiology, etc) for specific requirements, and add to this list as appropriate to meet professional goals:

Catheterization (min. 100)
Echo (min. 75)
Pericardiocentesis
Temporary pacers
ACLS training documentation

6.C Additional Procedural Opportunities

The program provides opportunities for fellows to acquire experience with the performance and interpretation of:

a. *Intracardiac electrophysiologic studies*. As part of the electrophysiology rotation, fellows assist in performing and interpreting at least 15 such studies in two years.

b. *Intra-aortic balloon counterpulsation*. As part of the catheterization laboratory rotation and in the CCU.

c. *Percutaneous transluminal coronary angioplasty and other interventional procedures*. Fellows assist in these procedures on a limited basis during their core training for exposure to the technique. All fellows are versed in the indications for, management of and complications of patients with regard to interventional procedures.

6.D. Additional Interpretive Opportunities

The program provides sufficient experience for fellows to acquire skill in the interpretation of:

a. *Chest x-rays*. On an individual basis with the attending radiologist as well as didactic training.

b. *Electrocardiograms*. As part of the weekly conference schedule, ECGs are reviewed. All clinical services require ECG review. A minimum of 3500 ECGs must be interpreted over the course of the two-year core fellowship.

c. *Ambulatory ECG recording*. Supervised at the VACT and the YNHH EP lab, a minimum of 150 recordings will be interpreted by each fellow.

d. *Radionuclide studies of myocardial function and perfusion*. Intensive rotation with didactic and practical interpretation during the Nuclear Cardiology rotations.

e. *Cardiovascular literature*. A monthly Journal Club is held to review a recent manuscript, and formal training in clinical epidemiology is provided during the core didactic sessions each month. Attendance is mandatory and is recorded at each session.

7. Formal Instruction

The educational goals are achieved through the Cardiology Core Curriculum which includes an introductory summer series of didactic lectures during the first two months of each year and subsequent didactic lecture series throughout the year covering a variety of topics in Cardiovascular Disease. A matrix of Cardiology Fellowship Didactic Conferences is attached as an Appendix.

The training program provides didactic instruction in the following ACGME specified topics:

7.A. Basic science

a. Cardiovascular anatomy
b. Cardiovascular physiology
c. Cardiovascular metabolism
d. Molecular biology of the cardiovascular system
e. Cardiovascular pharmacology
f. Cardiovascular pathology

7.B. Prevention of cardiovascular disease

a. Epidemiology and biostatistics
b. Risk factors
c. Lipid disorders

7.C. Evaluation and management of patients (with the following)

a. Coronary artery disease and its manifestations and complications
b. Arrhythmias
c. Hypertension
d. Cardiomyopathy
e. Valvular heart disease
f. Pericardial disease
g. Pulmonary heart disease
h. Peripheral vascular disease
i. Cerebrovascular disease
j. Heart disease in pregnancy
k. Congenital heart disease in adults
l. Cardiovascular trauma

7.D. Management of:

a. Acute and chronic congestive heart failure
b. Acute myocardial infarction and other acute ischemic syndromes
c. Acute and chronic arrhythmias
d. Preoperative and postoperative patients
e. Cardiac transplant patients
f. Geriatric patients with cardiovascular disease

7.E. Diagnostic techniques, including:

a. Magnetic resonance imaging
b. CT angiography
c. Positron emission tomography

8. Clinical Case Conferences and Specialty Lectures

The monthly conference schedules are maintained and distributed by the Fellowship Office, posted on MedHub and sent electronically to all fellows and faculty. Attendance is tracked via a bar code reader. The attendance policy for fellows is a minimum of 75% of conference attendance is expected. If a fellow is < 50% attendance, this can be noted on summary evaluation and revocation of moonlighting privileges can occur. See Conference Matrix in Appendix for schedule and below:

Advanced Hemodynamics/ Angiography Review--monthly
Basic Science Series--monthly
Congenital Heart Disease 4 Lectures/year
Cardiac Pathology—quarterly (Hearts with Henry)
Cardiology Grand Rounds--biweekly
Cardiology Case Conference YNHH--biweekly
Multidisciplinary Cardiac Conference- VACT--twice weekly
Clinical Epidemiology Series--Monthly
ECG Conference--weekly (July-January)
Electrophysiology Conference--weekly
Echocardiography Cardiac Imaging Conference--weekly
Clinical Reasoning--monthly
Journal Club--monthly
Interventional Cardiology Conference—weekly
Morbidity and Mortality--quarterly
7:30 a.m. or Noon conferences, daily. Topics vary
Nuclear Cardiology conference--weekly
Cardiac Imaging conference--weekly
Humanities in Cardiology conference--monthly
Board Review—monthly

9. Research Experience Requirement

Cardiology trainees take an active role in both the clinical and basic science research within the Section of Cardiovascular Medicine. All fellows are assigned a research mentor during matriculation into the program. Research mentorship is continued throughout the first two years of clinical training to help guide the trainee towards a clinical research experience related to a field of clinical subspecialization, or to a basic science laboratory in anticipation of an investigative career in cardiovascular diseases.

The program makes scholarship a high priority and requires completion of either original research (published in a peer reviewed journal) or substantial scholarly work related to cardiology, as a requirement for completing the training program. Guidance in planning research directions with the trainee is provided by Dr. Miller. Research is supervised directly by the individual faculty mentor.

While it is not expected that every fellow's project will result in publishable work, it is expected that every fellow conduct an original research project with the guidance of appropriate faculty members.

Research activity is initiated during the first two years during formal scheduled research blocks. Fellows present papers at national meetings including those of the American Heart Association and the American College of Cardiology. Fellows receive instruction in research at a number of levels. First, through Journal Club they are exposed to critical assessment of the medical and scientific literature. Second, they are lectured on basic methods in clinical research within the Department of Medicine summer lecture series. Third, there is a Core Curriculum and series of lectures in Basic Science Cardiovascular Research directed by Dr. Bender during the year. Finally, the individual instruction and mentorship which the faculty member provides to the trainee is ongoing during the fellowship and the essential part of the trainee's research experience.

In addition, the trainees are involved in several scholarly activities including teaching the medical housestaff and students, presenting lectures at Cardiology Grand Rounds, presenting articles at Journal Club (both general cardiology and within the individual laboratories), presenting their research at the annual Cardiology Trainee Research Symposium and national meetings.

10. Advanced Fellowship Training

Advanced fellowship training refers to the one or more years of focused training in a specific area of cardiology, in addition to the core two-year required foundation in general cardiology. Training is available in a variety of clinical and research areas and is tailored to the goals and skills of each fellow. The tracks listed below represent common sequences of training, but modifications can be made if approved by the Program Director.

10.A. Advanced Cardiac Imaging (Dr. Meadows)

The goal for this track is for individuals to attain expertise in at least one imaging modality (Level III), advanced exposure in the other modalities and to gain appropriate investigative skills for a career in academic cardiology. Training will take place at both clinical sites (Yale New Haven Hospital and the VA Connecticut Healthcare System). In general, two years of training is recommended. The fellow will identify a research mentor and project, to be conducted over a one to two-year period. The particular structure of the training sequence will vary, depending on the goals of the trainee.

For those interested in truly advanced training in cardiovascular imaging, funding is available for 2 to 3 years of research training in imaging technology, and molecular and translational imaging, through an NIH funded T32 training grant as part of the Yale Translational Research Imaging Center (Y-TRIC). This training can involve: hands-on research experience on clinical 1.5T and 3T MR magnets for pre-clinical or clinical research, pre-clinical experience with microCT, microSPECT/CT, and high-resolution mouse echocardiography, pre-clinical or clinical experience with PET/CT, SPECT/CT, or 3D ultrasound, or pre-clinical training in the ranostic multi-modality probe development.

10.B. Heart Failure/Transplantation (Dr. Daniel Jacoby, Director)

This ACGME-accredited fellowship program is appropriate for individuals who wish to pursue academic careers in heart failure and transplantation. In addition to level 3 training in heart failure, fellows will identify a research mentor and project.

10.C. *Clinical Electrophysiology (Dr. Lynda Rosenfeld, Director)*

This ACGME certified program is a two-year program and requires completion of a three-year fellowship in Cardiovascular Medicine. At the completion of this program, individuals will achieve level 3 training in electrophysiology and will be eligible for ABIM board certification in Clinical Cardiac Electrophysiology.

10.D. Interventional Cardiology (Dr. Joseph Brennan, Director)

This is a one-year ACGME-accredited program that is performed upon completion of a three-year fellowship in Cardiovascular Disease. Individuals will achieve level 3 training in interventional cardiology, and be eligible for ABIM board certification in both Cardiovascular Disease and Interventional Cardiology.

Clinical Track: This track is appropriate for individuals who will pursue careers in clinical cardiology and interventional cardiology. Fellows in this track must have completed a three-year training program in Cardiovascular Disease, often with advanced clinical training in another area (e.g. noninvasive imaging, heart failure, etc).

Academic Track: This track is appropriate for individuals who will pursue academic careers in interventional cardiology. In this track, the fellows 3rd year of general cardiology training is coordinated with his/her 4th year of interventional cardiology training, with a particular emphasis on research. Research projects are identified and approved by the Director, in consultation with the Program Director of the core fellowship and faculty mentors. Additional years of research are encouraged, depending on goals of training.

10.E. Structural Interventions (Dr. John Forrest, Director)

This is a one-year fellowship program designed to provide advanced training in interventions in structural heart disease (e.g. TAVR, etc). This program includes intensive laboratory procedural experience, as well as inpatient and outpatient patient care exposure. Individuals will obtain advanced training in these structural interventions, following completion of a previous coronary interventional cardiology fellowship.

10.F. Peripheral Vascular Interventions (Dr. Carlos Mena, Director)

This is a one-year fellowship is designed to provide expertise in peripheral vascular interventions and medical therapy. This is usually completed following a three-year core cardiology fellowship, but can be completed as part of an intensive third-year core fellowship training experience. Fellows will be involved in all aspects of peripheral vascular disease care, including intensive procedural exposure, outpatient evaluation, inpatient management and non-invasive imaging.

10.G. Research

Research training may take a variety of different forms, depending on a trainee's experience, goals, and subspecialty interests. Training in clinical research often is incorporated into the advanced

clinical training tracks as noted above. As noted in Section 9, the program places a high priority to exposing all trainees to research, through a series of didactic lectures, conferences, and focused projects with faculty mentors. This section describes opportunities for those individuals who seek in-depth research training.

Basic Science Research. Training can be arranged in basic science research for fellows and is coordinated by the Program Director. The length of training, sequence relative to clinical training, and identification of specific laboratory/mentor will depend on a number of variables, including previous training, current goals, and available lab resources. In general, such training involves a multi-year commitment on the part of both fellow and faculty mentor. Fellows potentially interested in basic research are encouraged to discuss options with faculty early in their training, and to speak to a broad range of faculty so as to be fully aware of the scope of the options.

Basic science research training can be accomplished within the scope of the general cardiology fellowship but may also be performed as part of a number of specific programs that are available at Yale. Information is available on the section's website. These include:

1. NIH T-32 training grant in vascular biology (Dr. Jeffrey Bender, Director)

2. NIH T-32 training grant in translational cardiac imaging (Y-TRIC, Dr. Albert Sinusas, Director)

3. Investigative Medicine (Ph.D.) Program. (https://medicine.yale.edu/investigativemedicine)

4. Yale Masters of Health Sciences (MHS) program (https://medicine.yale.edu/education/osr/mhs/)

5. ABIM Research Pathway (coordinated with the residency program in Internal Medicine)

6. The National Clinician Scholars Program (http://medicine.yale.edu/intmed/nationalcsp/; NCSP; formerly Robert Wood Johnson Clinical Scholars Program) is directed by Dr. Cary Gross and is designed to train physicians to be leaders in health care delivery, policy, design and implementation of clinical research, and outcomes research. The program is one of only four in the country, and is comprised of rigorous course work and practical experiences, with formal training in critical thinking and quantitative research methods. The program is competitive, and applicants who wish to pursue such training during fellowship must apply in the 2nd year of training. If accepted, the 2-year program will include the 3rd year of general cardiology training, as well as a 4th additional year.

7. Clinical and Translational Research. Focused, in-depth training can be arranged in clinical and translational research for fellows, and is coordinated by the Program Director. The length of training, sequence relative to core clinical training, and identification of specific laboratory/mentor will depend on a number of variables, including previous training, current goals, and available lab resources. In general, such training involves a multi-year commitment on the part of both fellow and faculty mentor. Opportunities vary widely, and include areas such as noninvasive imaging, outcomes research, interventional cardiology, and heart failure.

11. EVALUATION PROCESS

11.A. Trainee evaluations

The Cardiology trainee's clinical and technical competence is observed on a daily basis by the cardiology faculty, assessed in detail and documented in the trainee's record. Specifically, the trainee's knowledge base in cardiovascular diseases, skills in history taking and physical examination, clinical judgment, clinical management and consultation are assessed. In addition, the technical proficiency with respect to specialized cardiac procedures is documented. Finally, communication skills, humanistic qualities, professional attitudes and behavior, and commitment to scholarship are evaluated. A standardized trainee evaluation form issued by the American Board of Internal Medicine is completed by the supervising faculty member each month through the MedHub system.

11.B. Feedback

The trainees receive feedback at the end of each rotation. In addition, twice a year, the Program Director or Associate Program Director meet with each trainee to provide feedback on their performance with counseling and, when necessary, remedial assignments. Prior to meeting the the PD/APD, fellows perform self-evaluations in MedHub for self-directed improvement. Fellows document their cardiovascular procedures in log books through MedHub on a twice yearly basis which are submitted to the Program Director for evaluation and future credentialing.

11.C. Advancement

Yearly advancement in the fellowship program is dependent upon successful completion of each year of training. The Clinical Competency Committee is responsible for assessing each fellow's performance, and ultimately recommending to the PD whether advancement is appropriate. Decisions are based on evaluations, direct observation, and feedback from faculty, peers, students, and other staff.

11.D. Training Summary

The Program Director provides a detailed written evaluation of the clinical performance and academic accomplishments of each subspecialty trainee at the completion of the program in compliance with YNHH GME policies. Evaluations document the degree to which the fellow has acquired clinical competence and technical skills. This can be used to substantiate recommendations and judgments provided to hospital credentialing committees, certifying boards, licensing agencies, and other appropriate bodies. Fellows receive certification on the basis of satisfactory completion of their 3 years. In the event of adverse evaluation, trainees are offered the opportunity to address the judgment on their academic deficiencies or misconduct before an independent clinical competence committee outside the Section of Cardiovascular Medicine within the Department of Medicine.

11.E. Faculty Participation

The Faculty of the Section of Cardiovascular Medicine is involved in every aspect of the fellowship training. The full time faculty includes over 40 members with expertise covering all of

the subspecialty areas of cardiology. Clinical evaluation, procedural skills, research and academic work is overseen by full time faculty members. The faculty provides not only didactic teaching and clinical supervision but also professional mentoring for trainees aspiring to careers in cardiovascular disease.

11.F. Procedure for Faculty Evaluations

The trainees complete written evaluations of each faculty member supervising his/her activity during each rotation through the MedHub system. In addition, the Program Directors meet quarterly with the fellows to discuss their clinical experiences and to acquire feedback on their faculty supervision. The ABIM approved form for Faculty Evaluations is used (Appendix C).

12. FACILITIES AND EQUIPMENT

The cardiology trainees participate in a night-float system during their first year, where they are excused from daytime clinical responsibilities and have dedicated call rooms. They have desk space within the Section of Cardiovascular Disease with a place for storage of their personal belongings, books and work space for written work. In addition, the trainees are provided with a library of current journals and textbooks as well as computer resources.

Appendix A. **Section Policies**

A. Supervision of Fellows

a. In all rotations, fellows are supervised by attending physician faculty. Lines of responsibility are delineated in the curriculum.

b. Faculty schedules assign responsibility for supervision to specific faculty members, as well as on-call responsibilities, so as to provide fellows with appropriate supervision and consultation.

c. Issues related to monitor resident fatigue and workload are addressed routinely at monthly faculty meetings and in more depth during periodic faculty educational retreats.

B. Duty Hours

a. Duty hours for fellows in cardiovascular medicine include all clinical and academic activities, including time spent in-hospital during on-call periods.

b. The program adheres to the limitations of an average 80-hour work week and 1 day in 7 free of educational and clinical responsibilities (averaged over a 4-week period).

c. Fellows will document actual hours spent in-hospital during on-call periods, and submit a monthly report to the fellowship administration. Hours spent in-hospital apply towards the 80-hour work week standard, but not to the 24-hour continuous duty limit.

C. On-call Activities

a. Call is taken from home for fellows in cardiovascular medicine, exclusive of night-float rotations. Nine fellows share primary call responsibilities over a year period. One fellow is on-call per night, resulting in an average on-call frequency of 1 day in 10.

b. The program directors monitor frequency of call, actual time spent in hospital, and overall service demands of the on-call schedule. Program directors review this with each fellow every 6 months, and make adjustments to schedules when warranted.

D. Moonlighting Policy

a. Cardiovascular fellows will not be permitted to moonlight within the institution（i.e. Yale-New Haven Hospital or VACT) unless approved by the Program Director.

b. If program directors believe that external moonlighting is interfering with the ability of a resident to perform his/her duties (including conference attendance and/or work hours), or affects the overall performance in a negative fashion, the resident will be advised to stop moonlighting, and that failure to take corrective action will jeopardize their ability to successfully complete the program.

c. Fellows on J-1 visas are NOT permitted to do any moonlighting.

d. Moonlighting hours (both internal and external) are to be reported for duty hours submissions in MedHub

E. Oversight

a. Oversight of the duty hours for cardiovascular fellows is provided by the program directors, in accordance with institutional policies.

b. Attending faculty are responsible for providing back-up support for all fellows during normal duty and on-call hours.

F. University Policies

a. The section adheres to all applicable university-wide policies that pertain to fellows. These include but are not restricted to policies on grievance procedures, maternity/family leave, behavior in the workplace, and professional credentialing.

b. University policies are available through the Office of Graduate Medical Education (688-1449; Room TMP 236)

G. Didactic Conference Matrix

	Monday	Tuesday	Wednesday	Thursday	Friday
7:00am		PV Conference			
7:30am	**Core Curriculum*** (Quarterly fellow meetings, humanities)	**Cardiology Grand Rounds** (8:00, Fitkin Auditorium) Begins September	Interventional Conference (7:30-8: didactic; 8-9: practical) LVAD meeting 8-9 (SDU conf room)	ECG, Clinical Reasoning/ Hemodynamics (alternating)	EP
11:00am-12:00pm					Cardio-Oncology Conference
Noon	Board Review* (1st and 2nd Monday) Begins October	Echo Lab Conference***	Clinical/ Translational Research Conference		Imaging Conference
2:00pm	Nuclear Didactic/Journal Club**				
3:00pm					CHF didactics/journal club (SDU conf room)
4pm		VA Cath Conference (VA) Transplant meeting (Dana 309)		VA Cath Conference (VA)	

All conferences in Dana 309 unless noted, Attendance tracked at conferences in **bold**

***Core Curriculum will be held every Monday, Tuesday, and Thursday in **July** at 7:30am for our "Boot camp" series. Starting **8/12/19**, the Core Curriculum lecture will be held from **12-1 pm on Mondays in Dana 309**. Board review will be moved to a different day/time and will start in October.

Monthly general cardiology journal club to start in August- time TBD

**Nuclear Reading Room (EP-2), ***Echo Reading Room (EP-2)
Research Conferences:

1. Y-TRIC Imaging: Weekly, Friday, 9am, LSOG 103
2. Myocardial Biology Conference: Weekly, Monday, 1pm, 300 George Street, Room 781
3. CM Medicine Research-In-Progress: Last Friday of Month, 3 pm, 300 George Street, 1st floor conference room (followed by happy hour)

Attendance tracked at conferences in Bold