



Department of Internal Medicine
Division of Cardiovascular Medicine
Interventional Cardiology
Fellowship Training Program
Goals of the Program, Curriculum

I. GOALS OF THE PROGRAM

The objective of the Fellowship Training Program in Interventional Cardiovascular Disease is to provide an academically and clinically rigorous training program to give the trainee outstanding skills in interventional cardiology. The aim of the program is to provide the trainee with the basic and clinical knowledge, procedural skills, clinical judgment, professionalism and interpersonal skills required as a specialist in interventional cardiology. This training will prepare our fellows to function not only as highly competent interventional cardiologists, but also provide a background of investigation in the field of interventional cardiovascular research.

This program includes two trainees per year for a one year interventional fellowship. The program provides the minimum training (COCATS 2) in all areas of interventional cardiology.

The goals of the program specifically include achieving high quality training (COCATS 2, Level 3) in each of the four following areas as outlined in the **American College of Cardiology Training Statement on Recommendations for the Structure of an Optimal Adult Interventional Cardiology Training Program** (JACC 1999;34:2141-7).

1. To understand the effectiveness and limitations of coronary interventional procedures in order to select patients and procedure types appropriately.
2. To achieve the appropriate cognitive knowledge and technical skills needed to perform interventional cardiac procedures at the level of quality attainable through the present state of the art.
3. To foster an attitude of life-long learning and critical thinking skills needed to gain from experience and incorporate new developments.
4. To understand and commit to quality assessment and improvement in procedure performance.

II. CURRENT OBJECTIVES OF THE PROGRAM

The fellowship program in Interventional Cardiology consists of one year of training at the University of California Davis Medical Center (UCDMC). The training program offers advanced training in interventional clinical cardiology as well as academic research training. The organization of the research portion of the training program is flexible, and may be tailored to individual fellows' goals and interests. It is the intent of the fellowship administration to individualize training within ACGME and ACC/AHA guidelines to optimize each fellow's opportunities for a career in interventional cardiology.

III. EDUCATIONAL OBJECTIVES AND CURRICULUM OF THE INTERVENTIONAL TRAINING PROGRAM

A. CLINICAL SERVICE OVERVIEW

1. **Duty Hours:** Each fellow will not spend more than 80 hours per week, averaged over 4 weeks, caring for patients. Averaged over 4 weeks, each fellow will have one day (24 hours) in 7 free from duty.
2. **Patient Population:** The fellowship program in Interventional Cardiology is designed to provide a high level of clinical training. UC Davis Medical Center serves as a primary care hospital for the greater Sacramento area and as a tertiary care center for northern California. Trainees will be exposed to the full spectrum of cardiac ischemic syndromes. These include, but are not limited to, stable angina and a variety of acute cardiac ischemic syndromes such as unstable angina, acute myocardial infarction and cardiogenic shock. The trainee's experience will include both interventions in native coronary arteries and surgically placed coronary bypass grafts. The trainee will also acquire significant experience in the management of patients who require circulatory support, particularly with intra-aortic balloon counterpulsation. The patients from this institution represent a wide variety of both common and rare cardiovascular disorders and provide excellent exposure to all areas of cardiovascular medicine.
3. **Lines of Responsibility and Supervision:** A general principle of the responsibilities of cardiology fellows is that all the care they provide is within the context of a teaching service. Other than, as is expected of all physicians, providing urgent/emergent care when others are not available to do so, interventional cardiology fellows will provide care only to patients involved in a teaching process. In general, unless extenuating circumstances require deviation, orders will be written by the most junior housestaff involved with a patient, with oversight by more senior housestaff and faculty. Thus, if more junior housestaff are immediately involved in the care of a patient, the interventional cardiology fellow will write orders only to the extent dictated by his or her expertise or involvement (example: pre- and post cath orders); the faculty will write only those orders required by level of experience (example: post angioplasty orders).

IV. CARDIOVASCULAR COMPETENCY

Faculty observe and evaluate factors which a written examination cannot test extensively. These evaluations are entered into the E*Value computer program. In addition, written testing, mini-CEX, and computer simulations are part of the cardiovascular competency review.

1. Patient Care

The fellow should provide patient care that is compassionate, appropriate, and effective care which encompasses the promotion of health, prevention of illness, treatment of disease, and end of life. At the cornerstone of competent patient care are the abilities to:

- gather accurate, essential information from all sources including medical interview, physical examinations, medical records, and diagnostic/therapeutic procedures;
- make informed recommendations about preventive, diagnostic, and therapeutic options and interventions that are based on clinical judgment, scientific evidence, and patient preference;
- develop, negotiate, and implement effective patient management plans and integration of patient care; and
- competently perform the diagnostic and therapeutic procedures inherent to the practice of internal medicine

2. Medical Knowledge

The fellow should demonstrate a command of established and evolving biomedical, clinical, and social sciences and the application of that knowledge to patient care and the education of others. Included in this context are:

- an open-minded and analytical approach to acquiring new knowledge;

- the ability to access and critically evaluate current medical information and scientific evidence;
- acquisition of applicable knowledge of the basic and clinical sciences that underlie the practice of internal medicine; and
- the application of this knowledge to clinical problem-solving, clinical decision-making and critical thinking.

3. Practice-Based Learning and Improvement

The fellow should use scientific evidence and methods to investigate, evaluate, and improve patient care practices. This effort encompasses the abilities to:

- identify areas for improvement and implement strategies to enhance knowledge, skills, attitudes, values, and processes of care;
- analyze areas for improvement and implement strategies to enhance knowledge, skills, attitudes, values, and processes of care;
- develop and maintain a willingness to learn from errors and use errors to improve the systems of processes of care; and
- use information technology and/or other available methodologies to access and manage information, support patient care decisions, and enhance both patient and physician education.

4. Interpersonal and Communication Skills

The fellow should establish and maintain professional relationships with patients, families, and other members of health care teams. Included are the abilities to:

- provide effective and professional consultation to other physicians and health care professionals and sustain therapeutic and ethically sound professional relationships with patients, their families, and colleagues;
- use effective listening, nonverbal questioning, and narrative skills to communicate with patients and families;
- interact with consultants in a respectful, appropriate manner; and
- maintain comprehensive, timely, and legible medical records

5. Professionalism

Fellows should demonstrate behaviors that reflect a commitment to continuous professional development, ethical practice, and understanding and sensitivity to diversity, as well as a responsible attitude towards patients, the profession, and society. Included are the abilities to:

- demonstrate respect, compassion, integrity, and altruism in relationships with patients, families, and colleagues;
- demonstrate sensitivity and responsiveness to the gender, age, culture, religion, sexual preference, socioeconomic status, beliefs, behaviors, and disabilities of patients and professional colleagues;
- adhere to principles of confidentiality, scientific/academic integrity, and informed consent; and
- recognize and identify deficiencies in peer performance.

6. Systems-Based Practice

Fellows should have an understanding of the contexts and systems in which health care is provided and the application of this knowledge to improve and optimize health care. Included are the abilities to:

- understand, access, and utilize the resources, providers, and systems necessary to provide optimal care;
- understand the limitations and opportunities inherent in various practice types and delivery systems and develop strategies to optimize care for the individual patient;
- apply evidence-based, cost-conscious strategies to prevention, diagnosis, and disease management; and
- collaborate with other members of the health care team to assist patients in dealing effectively with complex systems and improve systematic processes of care.

DOCUMENTATION

Documentation files include:

- a) bi-monthly evaluation forms
- b) documentation of procedures performed and verification of technical proficiency;
- c) brief notes substantiating critical incidents, counseling sessions, patient perspectives, and feedback on residents' skills and performance;
- d) reports of mini-CEXs or other direct observations; e) assessment of research performance, when applicable; and f) semiannual evaluation summaries.

TYPES OF FEEDBACK

Both computerized and verbal feedback are provided at the end of each rotation. Summary verbal and written feedback is given every 6 months.

The Mini-CEX: The mini-clinical evaluation exercise (mini-CEX) is available for attending evaluation on any service. The purposes of the mini-CEX are:

- a) observing residents while they conduct a focused task in any setting;
- b) rating residents on several dimensions of competence; and
- c) providing residents with educational feedback

ADDITIONAL EVALUATION METHODS

Simulations and Models: Computer-based simulations assess use of knowledge in diagnosing or treating patients or evaluating procedural skills. The Sim Suite provides comprehensive technical simulations.

V. SPECIAL CLINICAL EXPERIENCES

A. INTERVENTIONAL CARDIOLOGY

1. Resources: UCDCMC Cardiac Catheterization Laboratories (Dr. Reginald Low, Director). The UCDCMC laboratory performs over 1600 diagnostic procedures and more than 500 interventional procedures annually. During the one year of training, a fellow will spend a minimum of nine months performing cardiac catheterization procedures. The fellow will acquire the cognitive and motor skills to perform complex percutaneous interventional procedures. All procedures are performed under the direct supervision of an attending.

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

a. *Understanding the appropriateness of procedure.* The trainee should understand the indications for percutaneous cardiac interventions, and be able to estimate the risk and benefit of procedures the performed. Knowledge of comorbid factors that increase the risk of a procedure should be demonstrated.

- b. *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.
- c. *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, brachial artery and radial artery.
- d. *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.
- e. *Pericardiocentesis.* The trainee should be able to understand the indications and potential risks of cardiac pericardiocentesis, and demonstrate adequate skills in performing the procedure.
- f. *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 (see Educational Goals below for more detail).
- g. *Evaluating and treating complications.* The trainee should have full knowledge of complications of the interventional procedures, the mechanisms for monitoring complications when suspected, and full knowledge and appropriate treatment of these complications.

2. Responsibilities: All procedures will be performed only under the direct supervision of an Attending Interventional 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 when appropriate. The fellow will also be required to participate in all scheduled catheterization conferences. The trainee will be responsible for the maintenance of detailed records in the form of a logbook that contains clinical information for each patient studied and/or treated in the laboratory. Documentation will include a patient identifier, the procedure performed, assisting physicians and procedure outcomes, including any complications encountered. Fellows will be required to review/confirm the log of all procedures performed for purposes of credentialing.

3. Teaching Conferences: A weekly catheterization conference is held each Tuesday from 7:30-9:00 am. A weekly interventional conference will be held on Friday PM. In addition Cardiology conferences are held on Monday noon and Friday 8-9am weekly. These conferences may include interventional topics.

4. Educational Objectives: The objectives of the training program for the Interventional Cardiology Fellow are to offer the teaching and experience that will allow the fellow to develop expertise in invasive percutaneous cardiac procedures. These goals are directly based on the published ACC/AHA recommendations for interventional cardiology fellowship. The formal didactic objectives are as follows.

Anatomy: Cardiac, vascular and coronary artery anatomy, including anatomic variants and congenital abnormalities.

Physiology: Basic circulatory physiology, coronary vascular physiology, myocardial blood flow regulation, myocardial physiology and metabolism.

Vascular biology and pathology: Normal vascular structure and function, response to injury, mechanisms of atherosclerosis and mechanisms of restenosis.

Hemostasis: Intrinsic and extrinsic coagulation cascade and platelet physiology.

Pathophysiology: Myocardial ischemia and infarction, myocardial reperfusion, circulatory shock, anaphylaxis and cardiac arrhythmias.

Pharmacology: Anticoagulants, antiplatelet drugs, thrombolytic drugs, X-ray contrast agents, myocardial inotropes, vasopressors, vasodilators, antiarrhythmic drugs and drugs affecting lipid metabolism.

Radiology imaging and radiation safety: Principles of X-ray imaging, quantitative coronary arteriography, operation of cinefluorographic X-ray equipment, operation of digital video imaging systems, radiation biology and radiation protection.

Intracoronary imaging and coronary physiology: Principles of intravascular ultrasound imaging and Doppler coronary flow velocity measurements.

Interventional device design and performance: Device materials and characteristics.

Clinical management strategies: Performance and limitations of interventional devices, spectrum of coronary ischemic syndromes, results of interventional cardiology clinical trials, management of acute hemodynamic alterations and mechanical and pharmacological circulatory support.

The formal objectives in percutaneous interventional procedural skills are:

1. Conventional balloon and cutting balloon coronary angioplasty
2. Intracoronary stents, including drug eluting and self-expanding stents
3. Primary angioplasty and stent deployment for acute myocardial infarction
4. Atherectomy techniques (other than laser) such as rotational atherectomy
5. Intravascular ultrasound
6. Intra-aortic balloon counterpulsation and other techniques of mechanical circulatory support
7. Cardiac valvuloplasty
8. Coronary flow measurement (including fractional flow reserve)
9. Transcatheter closure of congenital defects such as atrial septal defect and patent foramen ovale
10. Distal Embolic Protection Devices
11. Full range of arterial vascular access techniques, including transfemoral, brachial and radial approaches
12. Experience treating the full range of coronary lesion morphologic subsets. This includes ACC/AHA Type A, B and C lesions; total occlusions; heavily calcified lesions; saphenous vein graft lesions; and lesions accessed via arterial bypass grafts
13. Exposure to transcatheter aortic valve replacement patient selection, workup, and procedural steps
14. Use of cardiac support devices for cardiogenic shock and high risk PCI such as intra-aortic balloon pump counterpulsation and Impella
15. Interventional approach to the management of paravalvular leaks
16. Exposure to the workup and procedural steps for left atrial appendage occlusion

5. Educational Purpose: The skills and techniques of cardiac catheterization remain an essential component of any cardiology practice, and the ability to perform interventional cardiac procedures can be an invaluable skill in the management of patients. The skills required demand both diagnostic acumen and manual dexterity. The educational purpose of the interventional fellowship program is to train the fellows to integrate the history, physical, and non-invasive data, and through the catheterization procedure ultimately formulate a final diagnostic and therapeutic plan.

6. Participation in Research: Participation in clinical research by trainees is an integral component of achieving competence in this rapidly evolving field. The interventional cardiology training program at UC Davis Medical Center has an active clinical research program, and its trainees will be directly involved in the conduct of research. This may range from participation as a multicenter clinical trial-contributing site to locally initiated research in various facets of interventional cardiology. Trainees will be actively involved in the conduct of and enrollment of patients in clinical trials. Ideally, trainees will also be active collaborators in locally initiated research protocols and will participate in data analysis and presentation.

7. Teaching Methods: Developing proficiency in interventional cardiology requires close supervision of the interventional cardiology fellow. An attending interventional cardiologist who is experienced closely supervises each procedure. The fellows are exposed to the styles and techniques from 5 -7 interventional cardiologists which is valuable in terms of learning a variety of approaches. There is no procedure in the cardiac cath lab that is unsupervised. The supervision begins from the initial evaluation of the patient, writing of history and physical, reviewing laboratory data, reviewing physical exam, and the performance of the procedure. At the end of the procedure, as important as the procedure itself, is the post-catheterization/intervention care which is again closely supervised and evaluated. Each fellow is required to see the patient post-procedure to discuss the results of the cath and the future plans with the patient and/or their family. This again is done in conjunction with the attending cardiologist. In addition, all films are reviewed in a timely fashion and all cardiac-catheterization reports are dictated by a cardiology fellow. Close communication with the referring physicians, referring fellows, and residents is essential and is also closely monitored. Our cardiac catheterization conferences review specific details of cardiac catheterization, diagnosis, technique, and involve reviews of the literature. We also offer didactic lectures in specific areas of the cardiac catheterization laboratory such as radiation safety, evaluation of valvular heart disease, coronary anomalies, and assorted other pertinent topics as outlined above under "Educational Objectives."

8. Mix of diseases, patient characteristics, and types of clinical encounters, procedures, and services: As mentioned above, the interventional cardiology fellow learns to perform complex invasive cardiac techniques. The fellows will perform **over 250** interventional procedures as mandated by the ACC/AHA guidelines. A log is maintained in the cardiac catheterization laboratory of every cardiology procedure and of each fellow's involvement. As mentioned above, the fellow dictates each cardiology report that is thoroughly reviewed both before dictation and after dictation with a cardiology attending. There is a wide variety of cardiologic diseases including adult congenital heart disease, pulmonary disease, coronary artery disease, and cardiomyopathy. In the cardiomyopathy patient, myocardial biopsies will also be performed. Again an attending cardiologist closely supervises these procedures. There is a wide range of both gender and ethnic diversities seen in the cardiac catheterization laboratory. The fellows will frequently see patients in cardiology clinic, refer them for cardiac catheterization, and then perform the procedures themselves or refer the procedure to one of their colleagues. A large proportion of patients come from the inpatient service, or from the consultation service. These patients may be seen in the intensive care unit and telemetry units before referral to the cardiac cath lab. The fellows obtain consent on all of the patients and know the patients well before arrival in the cardiac catheterization laboratory. They will also meet patients in an outpatient, same day surgery area and perform the same consultation and consent as is done in the intensive care unit.

9. Reading lists, pathological material, and other educational resources to be used: As mentioned above, we have weekly conferences that involve issues related to cardiac catheterization and monthly conferences related to specific, more defined, less care oriented discussions. There are a variety of textbooks available to the fellows in the cardiac catheterization laboratory and in the cardiology office areas. Fellows also have access to the internet, both in the main hospital and in the cardiology academic offices.

10. Method of evaluation of fellows' performance: At the end of each rotation, a fellow is counseled regarding their performance and during the period of time in the laboratory they are frequently counseled regarding their overall performance. The attending cardiologist who has had contact with the fellow directly submits the evaluations that are reviewed by the fellowship director. During training, the program director will meet with the trainee periodically to provide structured evaluative feedback on his/her progress. This will include identification of deficiencies and shortcomings and formulation of a plan for remediation.

11. Clinical experience description: The clinical experience is essentially as described above. It involves evaluation and management of a wide variety of cardiac diseases that require invasive cardiology evaluation.

12. Definition of the fellows' supervision by the faculty: Again, as stated above there is no procedure in the cardiac catheterization laboratory that is not closely supervised by an attending cardiologist. Any patient who has a procedure in the cardiac catheterization laboratory is seen by both the fellow and the faculty before the start of the procedure. Careful review is mandated and essential for the safety of the patient and for the broadest educational experience for the fellow.

13. Integration of medical problems, health promotion, and cultural, socioeconomic, ethical, occupational, environmental, and behavioral issues: Understanding the patients' perception of their medical problem, their understanding of the procedure to be performed, their reaction to the disease, their ability to cope with the disease is an essential component of the fellow's ability to perform ultimately in their own capacity as attending cardiologist. Each patient who is non-English speaking has an interpreter that is involved with consent as well as a discussion of the procedure and post catheterization care. Socioeconomic issues profoundly contribute to the ability of our patients to conform to our recommendations; therefore, close occupational histories and social histories are required during the evaluation of the cardiac catheterization experience. With respect to occupational and environmental issues, a preoccupation with radiation safety is continually emphasized. Promotion of good health practices such as low cholesterol diets and smoking cessation and frequent referrals to our cardiac risk reduction clinic and cardiac rehab as well as coronary reversal program are emphasized as essential components of the overall cardiology care.

14. Teaching rounds and conferences: The cardiac fellows are required to present cases at our cardiology conferences and to present didactic teaching experiences. They review a topic and integrate the literature related to a specific case. In addition, as mentioned above, formal cardiology seminars are held in which more specific topics are addressed by an attending cardiologist. At the weekly catheterization conference, interventional fellows will review and critique both diagnostic and interventional cases with respect to case selection, procedure conduct and outcome. This conference should review and discuss all adverse outcomes that occur within the training program (CQI is in place at UC Davis Medical Center). A special interventional conference held on Friday morning will review the interesting interventional cases done each week. Interventional fellows will be expected to present short didactic presentations in addition to case presentations.

15. Range of clinical problems and stages of illness: Again as discussed above, the fellow in the cardiac catheterization laboratories sees every patient, from the patient with chronic stable angina to ST elevation myocardial infarction with cardiogenic shock. There is no aspect of adult cardiology that they are not exposed to in the cardiac catheterization laboratory.

16. Humanistic qualities: As much through example as in practice, the humanistic qualities, which include respect for all patients are mandated during the fellows' experience. It is emphasized that anyone can be trained to do diagnostic, invasive cardiology work, but the excellent cardiologist is respected by their patients and their peers for their humanistic as well as their intellectual abilities.

17. Lines of Responsibility and Supervision: The fellow assigned to this service works directly under the supervision of the faculty assigned to perform cardiac catheterizations and interventional procedures. The fellow is

responsible for initial evaluation of patients referred for cardiac catheterization, preparing them for the procedure, working along side of the faculty in the performance of the procedure, and performing indicated post-procedure assessment. The faculty working with the fellow in performing this procedure on a patient is responsible for assuring that the fellow's care of the patient is appropriate and that the fellow receives teaching and appropriate experience in learning the skills and judgment of performing cardiac catheterization.