A) GENERAL OVERVIEW

The goal of our interventional cardiovascular program is to prepare trainees to function at a high level of clinical performance in interventional cardiology. This includes the development of appropriate clinical judgment in selecting patients for cardiovascular interventional procedures and a high level of technical skill in performing them. This overall goal has four components:

1) To understand the effectiveness and limitations of coronary and peripheral vascular interventions in order to select patients and procedure types appropriately.
2) To achieve the appropriate cognitive knowledge and technical skills needed to perform interventional cardiac and vascular 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.

Our training program does not operate in isolation. Cardiac and endovascular interventions are only some of the therapeutic techniques applicable to the management of patients with coronary artery, valvular and peripheral arterial disease. Thus their application must be selected within the context of all potential cardiovascular therapeutic strategies and must utilize information from all available cardiovascular diagnostic techniques. Furthermore, our program is integrally affiliated with, and a component of our comprehensive ACGME accredited cardiology training program.

B) PROGRAM STRUCTURE

Faculty

Our faculty comprises four interventional cardiologists and one full time invasive non-interventional cardiologist. All faculty are full-time and are committed to the teaching program.

Program Director

The Program Director (Dr. Giorgio Gimelli) is Board Certified in Cardiovascular Medicine and Interventional Cardiology, has completed his training seven years ago, and has been a fully affiliated faculty member of the overall cardiovascular training program at our institution for the last six years. He is responsible for the administration of the cardiac catheterization laboratory, the overall teaching program, quality control, and trainee evaluation.

Other Key Faculty
Dr. Matthew Wolff, Dr. Amish Raval, Dr. Mark Sasse, Dr. Jon Keevil are the other key faculty members and are board certified in cardiovascular medicine by the ABIM. They are cardiologists with expertise in all aspects of diagnostic procedures, including the evaluation of coronary, valvular, congenital and cardiomyopathic disease, and are familiar with complex hemodynamics in patients with all types of heart disease. Drs. Wolff, Raval and Sasse are board certified interventional cardiologists and are responsible, along with Dr. Gimelli, for training the interventional cardiology fellows. The interventional cardiology faculty routinely practice and are highly experienced in peripheral arterial interventions, and perform at least 300 percutaneous coronary interventions and 25 peripheral interventions each per year.

**Associated Faculty**

Drs. Maryl Johnson and Walter Kao are heart failure specialists and perform a large number of endomyocardial biopsies in our laboratory. Drs. Girma Tefera, Matthew Mell, Margaret Schwarze and John Hoch are vascular surgeons with expertise in endovascular procedures who provide our trainees with additional exposure to diagnostic and interventional peripheral vascular procedures.

**Facility and Environment**

Our four cardiac catheterization laboratories are fully equipped and staffed in accordance with the “American College of Cardiology/Society for Cardiovascular Angiography and Interventions Clinical Expert Document on Cardiac Catheterization Laboratory Standards”. Digital radiographic image acquisition, as well as digital-image road mapping capability are available in all four laboratories, and image quality and radiation exposure are regularly monitored by appropriate support personnel. High quality physiologic monitoring and recording equipments are present in all laboratories, as well as equipment for the assessment of fractional flow reserve and intravascular ultrasound. The cardiac catheterization laboratory has on-site access to all core cardiology services, cardiac surgery, anesthesia, vascular and interventional radiology and vascular surgery.

**Patient Mix**

Our trainees are exposed to a full spectrum of cardiac ischemic syndromes, including but not limited to stable and unstable angina, acute myocardial infarction and cardiogenic shock, as well as to a wide range of valvular and peripheral arterial disease. The trainee’s experience includes interventions in native coronary arteries and surgically placed coronary bypass grafts. Experience is gained in the placement and management of intra-aortic balloon pumps and percutaneous left ventricular assist devices (TandemHeart), as well as in complex endovascular procedures in limb, renal and carotid arteries.

**Program Procedure Volume**

In our program we perform a minimum of 800 coronary interventions per year, including a large number of primary angioplasties for acute myocardial infarctions, as well as at least 200 peripheral interventions per year. Trainees are also exposed to mitral and aortic valvuloplasty.

**Conduct of training**
The interventional cardiology fellow operates under the supervision of and reports directly to the interventional faculty member attending any given procedure. All procedures are performed under this faculty member’s direct supervision, and the nature of the trainee’s participation in a given procedure varies depending on the procedure complexity and the trainee’s experience level.

For general concerns regarding cath lab operations, the fellowship training program, or any personal concerns or difficulties that might affect the fellow’s performance or educational experience, the fellow communicates directly with the program director (Dr. Gimelli).

Requisite participation in a procedure includes the following elements:

**Pre-procedural evaluation**
For patients referred for diagnostic or interventional procedures from the ward cardiology service or the cardiology consult service, or for patients admitted electively through the procedure service, a complete preoperative assessment including a history and physical examination is obtained and recorded by the diagnostic cardiology fellow assigned to the case, and reviewed with the attending cardiologist prior to the procedure. Particular attention should be placed on details in the history and/or physical which may place the patient at increased risk for the procedure (for example, peripheral vascular disease, renal insufficiency, history of heart failure). The attending cardiologist performs a limited history and physical examination, and discusses discrepancies with the fellow. Pertinent laboratory values (chemistry and hematology values) are checked, and abnormal values are communicated to the attending cardiologist. The fellow is responsible for obtaining informed consent for the procedure. Procedure service nurses will often assist with obtaining consent from elective outpatients. This is a courtesy designed to enhance workflow, not an obligation on their part. Ultimate responsibility for consent resides with the fellow and attending faculty.

The indications for the procedure and the anticipated technical details are discussed with the attending cardiologist prior to the case being initiated. One rare occasions, scheduling conflicts may result in an interventional fellow assisting with a procedure on a patient previously evaluated and consented by another fellow. In this situation, the new fellow is responsible for familiarizing him/herself with the patient’s history and physical exam as previously recorded, and repeating the key positives of the physical exam as well as reviewing laboratory studies. Again, the indications for the procedure and the anticipated technical details are to be discussed with the attending cardiologist prior to the case being initiated.

Emergency cases referred for diagnostic or interventional catheterization procedures may be evaluated and consented for the procedure by the ward or consult fellow or faculty. Consent for interventional procedures cannot be obtained by housestaff or medical students. In this situation, the interventional cardiology fellow is responsible for familiarizing him/herself with the patient’s history and physical exam as previously recorded.
Performance of the procedure by the trainee.
Interventional cardiovascular fellows have already achieved Level 2 training during the core cardiovascular fellowship. They will assume greater participation in interventional procedures as experience is gained and eventually perform as primary operators, although it has to be stressed that all procedures will be performed under the direct supervision of the attending cardiologist.

Vascular access alone may be obtained independently by the interventional cardiology fellow at the discretion of the catheterization laboratory director and the attending cardiologist. Difficulties with access (i.e. lack of success obtaining access after 3 attempts or difficulty advancing a guidewire) will require the presence of the attending cardiologist under any circumstance, and further attempts at access should be abandoned until the attending is in the room.

Hemostasis (by direct compression or vascular closure devices) is often done by a catheterization laboratory or procedure service nurse, but the interventional fellow involved in the case remain, along with the attending cardiologist, ultimately responsible for hemostasis. Hemostasis-related complications should be reported immediately to the responsible cath lab faculty.

Post-procedure care
The trainee is actively involved in post-procedural management both in and out of the cardiac catheterization laboratory.

After the procedure, a preliminary catheterization report should be included in the patient’s chart. The electronic catheterization report should be completed immediately after the case (ideally before the patient leaves the laboratory), and the key findings of the diagnostic or therapeutic procedure should be discussed with the attending cardiologist. The trainee should monitor the patient’s status and be available to respond to any adverse reactions or complications that may arise, including hemodynamic instability, vascular complications, heart failure, renal failure, bleeding, myocardial ischemia or change in mental status.

Complications should be immediately reported to the appropriate cath lab faculty member (regardless of the service of origin of the patient, or the temporal relationship between the complication and the procedure). A complication form (available from the procedure service nurses) should be completed. Following resolution of the complication (or hospital discharge), a complication note may be required. The cath lab director reviews the complication form, and if a dictated complication note is required the fellow will be notified. This one or two paragraph note should include the following elements:
1) a succinct description of the patient’s presentation
2) a list of the procedures performed, with relevant procedural details (i.e., access site)
3) a description of the complication
4) any patient or procedural risk factors predisposing towards the complication
5) any preventative measures taken before, during or after the procedure designed to mitigate this risk
6) a description of the management of the complication
7) the outcome, including any long-term sequelae (or the absence of sequelae)
Complications are entered into the cath lab database and discussed at the monthly Quality Improvement Conference.

Additional responsibilities of the interventional fellow include rounding on the patient at the conclusion of the working day. This requirement applies to inpatients on both the procedure and ward services, as well as patients on non-cardiology services. An exception is outpatients discharged from the APC. Post-operative rounding and documentation on these patients is provided by the procedure service nurses and attendings. However, the involvement of the fellow in the post-operative care of these patients may be requested in the event of complications.

Conferences
All trainees must attend a weekly cardiac catheterization conference and a monthly joint cardiology/cardiovascular surgery conference. The weekly conferences will include a core curriculum, as well as case presentations. The core curriculum will reflect the recommendations of the Society for Cardiovascular Angiography and Interventions (www.scai.org). During case presentations, hemodynamic and angiographic data are discussed in context with history, physical exam and non invasive findings. Indications, complications and management strategies are discussed. A regular morbidity and mortality conference is held separately on a monthly basis. Trainees also attend weekly Cardiology Grand Rounds, other core hospital conferences, weekly General Cardiology Journal Club, and a weekly joint peripheral vascular conference.

Research
Participation in clinical research is an integral component of achieving competence in the rapidly evolving field of interventional cardiology. Our interventional cardiovascular program has an active clinical research program, and our trainees are directly involved in the conduct of research, including participation in multiple multi-center clinical trials. Trainees are involved in the conduct of and enrollment of patients in clinical trials, and participate in data analysis and presentation.

SIX CORE COMPETENCIES DURING CARDIAC CATHETERIZATION TRAINING

The six core competencies of the ACGME are patient care, medical knowledge, practice-based learning and improvement, interpersonal communication skills, professionalism, and system-based practice knowledge. In the context of interventional cardiology training, the core competencies are applied in the cardiac catheterization laboratory as the training progresses. Evaluation of fellows is the mechanism by which we evaluate the successful acquisition of the skills needed to achieve Level 3 training. Regular and timely formal performance feedback is given to the trainees at the end of each monthly rotation. Additional informal feedback is given on a per-need basis.
Listed below are the goals of the interventional cardiovascular fellowship, keeping in mind the six core competencies of the fellowship education.

1) COGNITIVE KNOWLEDGE

- **Anatomy:** Cardiac, vascular and coronary anatomy, including anatomic variants and congenital abnormalities
- **Physiology:** Basic circulatory physiology, coronary and peripheral 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. Occlusive peripheral arterial disease, aortic dissection, penetrating aortic ulcers and intramural hematoma. Arteritis, vasospastic disorders, leg and foot ulcers. Carotid and renal artery stenosis.
- **Pharmacology:** Anticoagulants, antiplatelet drugs, thrombolytic drugs, X-ray contrast agents, myocardial inotropes, vaspressors, vasodilators, antiarrhythmic drugs and drugs affecting lipid metabolism. Peripheral arterial thrombolysis.
- **Intravascular imaging and vascular physiology:** Principles of intravascular ultrasound imaging and Doppler coronary flow velocity measurements.
- **Non-invasive imaging:** Interpretation and selection of appropriate non-invasive vascular imaging.
- **Interventional device design and performance:** Device material and characteristics.
- **Clinical management strategies:** Performance and limitations of interventional devices, spectrum of coronary ischemic syndromes and peripheral arterial disease, results of interventional cardiology trials, management of acute hemodynamic alterations and mechanical pharmacological circulatory support.
- **Complications of the procedure and their management:** Hypotension, acute myocardial ischemia, congestive heart failure, renal failure, vascular complications, contrast reactions, retroperitoneal bleeding, and cardiac tamponade. Complications of peripheral vascular interventions.

2-3) PATIENT CARE AND PRACTICE BASED LEARNING AND IMPROVEMENT
Patient care and direct practice-based learning will occur in the context of the initial evaluation of patients undergoing endovascular interventional procedures, in the cardiac catheterization laboratory suite, as well as post-procedurally. The nature of a trainee’s participation in a given case will vary depending on the procedure’s complexity and the trainee’s experience.

The trainee’s goals will be:

- Pre-procedural evaluation to assess appropriateness and to plan procedure strategy
- Personal performance of the case’s critical manipulations under the direct supervision of a program faculty member. The faculty member who takes overall responsibility for the case must be immediately available to supervise the trainee’s actions and to take over the performance of the case any time it is in the best patient’s interest.
- Active involvement in post-procedural management both in the catheterization laboratory at the conclusion of the case and in the inpatient unit or holding area afterward. This includes assessing for possible adverse outcomes, managing access sites and managing anticolagulation issues.
- Active involvement in procedure reporting and the process of ensuring quality
- Maintenance of a portfolio of novel and advanced interventional procedural techniques integrated with current available literature, to be used for presentation and review.

Core Procedure capability and technical skill acquired by the trainee

- Conventional balloon coronary angioplasty
- Coronary artery stents
- Primary angioplasty for acute myocardial infarction
- Atherectomy techniques (laser, rotablator)
- Intravascular ultrasound
- Intra-aortic balloon counterpulsation and other techniques of circulatory support
- Cardiac valvuloplasty
- Endomyocardial biopsy
- Transcathether closure of congenital defects
- Peripheral angiography
- Peripheral artery thrombolysis
- Percutaneous mechanical thrombectomy for arterial thrombus
- Subclavian, brachiocephalic and upper extremity endovascular interventions.
- Renal artery interventions
- Aortic, iliac and common femoral artery interventions.
- Endovascular treatment of superficial femoral artery disease
- Infrapopliteal interventions

Trainees Evaluation
The competence of all interventional cardiovascular trainees is documented by the interventional cardiology program director, who is responsible for assessment of the success of the trainee’s progress in collaboration with the other program faculty. The overall evaluation includes rigorous compilation of trainee experience and assessment of the trainee’s cognitive knowledge, technical skill, and clinical and procedural judgment. Evaluative feedback, verbal and written, to the trainee during the training period is vital to direct the trainee’s progress. All procedures performed by the trainee are documented electronically.

In addition to assessment of the cognitive skills listed above, trainee evaluation involves three components: cognitive, technical, and documentary.

- Case selection and preprocedural, intraprocedural, and postprocedural care and judgment are evaluated in every trainee, both in the inpatient and outpatient setting.
- Interpretive skills that relate to assessment of complex hemodynamics, coronary and vascular angiographic images, and physiologic studies are evaluated.
- Quality of clinical follow-up, reliability, interaction with other physicians, patients, and laboratory support staff, and the initiative and ability to make independent, appropriate decisions are considered. Trainees must have knowledge of the specific equipment to be used in each procedure, both in the coronary and peripheral arterial circulation.
- Assessment of technical performance is done on a continuous basis. This is best done by direct oversight during procedures of actual handling of equipment and devices, by assessment of the interaction of the trainee with the device and specific anatomy being treated, and by procedural complication rate.

4) INTERPERSONAL AND COMMUNICATION SKILLS

Interpersonal communication skills which have been acquired during level 1 and level 2 training will continue to develop during the interventional fellowship year. The trainee will become an integral part of the cardiac catheterization laboratory team. Level 3 trainees will assume progressive responsibilities for the conduct of the interventional procedure, as well as of the interactions with patients and their families across a broad range of socioeconomic and cultural backgrounds. They will become more involved in the discussion of the results of the study with other medical providers becoming capable of acting in a consultative role to referring primary care physicians and cardiologists, as well as to cardiothoracic and vascular surgeons.

5) PROFESSIONALISM

The fellow will further develop the concepts of professional behavior acquired during the core cardiology training, and will continue to interact with the multiple different types of
providers in a large cardiac catheterization laboratory that include clerical staff, technicians, nurses, faculty, and other senior fellows. Formal conferences on professionalism are held regularly.

The trainee will
- Demonstrate empathy, sensitivity and compassion as a physician
- Demonstrate high standards of ethical behavior
- Understand the ethical aspects of the relationship with industry
- Refine her/his understanding of the elements of patients rights and confidentiality

6) SYSTEM-BASED PRACTICE

The trainee will further develop her/his appreciation of the role of the cardiac catheterization laboratory in a system of health care delivery, eventually understanding the role of the laboratory in the context of the needs of a large inpatient hospital system. They will continue to gain deeper appreciation of procedural indications as well as of their cost effectiveness, as well as of diagnostic and procedural coding.

During their training the fellows will attend formal practice improvement conferences and will also be engaged in specific practice improvement projects. These include a cardiac catheterization laboratory quality improvement initiative with reporting to the ACC National Cardiovascular Data Registry (ACC-NCDR™), participation in the University of Wisconsin Level 1 Heart Attack Program, and the development of a chest pain center in our emergency medicine department.