Vascular Medicine Fellowship Program at Boston Medical Center

Multidisciplinary Training Program in Vascular Medicine

To advance the care of patients with vascular diseases, it is essential to develop the next generation of vascular medicine clinician scientists. The burden of vascular diseases continues to rise in the United States and worldwide. Vascular diseases constitute one of the most common reasons for individuals to require medical care in the United States, representing a wide spectrum of conditions and syndromes involving the arteries, veins, lymphatics and circulating blood. Recent clinical trials demonstrate the benefits of multiple novel therapeutic approaches to reduce risk in patients with vascular diseases. However, multiple studies show that there is an under treatment of patients with vascular diseases emphasizing the importance of augmenting the cadre of vascular disease specialists. There have been multiple advances in the treatment of thrombotic disorders increasing the complexity of medication selection and management.

We will build on the Fellowship Directors' robust track records of training vascular medicine specialists at Boston University (BU) and Boston Medical Center (BMC). There is a long tradition of research and clinical expertise in vascular medicine at BU/BMC initiated by Dr. Jay Coffman, a founder of the Society of Vascular Medicine. Building on this tradition, over the past 2 decades, we developed fellowship training programs in vascular medicine including a 1-year clinical program and a 3-year academic program that combined clinical and research training. The 3-year program was funded by the National Institute of Health as a research career development program (K12 award) called the *Boston University Medical Center Leadership Program in Vascular Medicine*. The training programs have been led by Drs. Robert Eberhardt and Naomi Hamburg, who will serve as co-Directors of the proposed program. As a result of these programs, we successfully trained numerous clinicians and six clinician investigators pursuing careers in vascular medicine as detailed below. We also have experience training early-career clinician-scientists through blended curriculum of virtual, web-based sessions and in-person workshops as part of the American Heart Association's Tobacco Regulation and Addiction Center (A-TRAC) and two AHA-funded Strategically Funded Research Networks in Atrial Fibrillation and Cardiometabolic Diseases.

We were pleased to receive funding through the first cycle of Ansell Vascular Medicine Fellowship program to restart our vascular medicine fellowship program. We had a number of strong candidates and were pleased to recruit a fellow with a strong clinical and research record. We have a number of current trainees interested in the program for the 2021-2022 training year. In addition, with the support of the Anticoagulation Forum, we have initiated the virtual webinar approach that is facilitating integrated training across all the Ansell Fellowship programs to accelerate learning and promote collaboration.

The primary goal of the *Vascular Medicine Fellowship Program* funded through the Ansell Fellowship at BU/BMC will be to provide comprehensive training for physicians to pursue an academic career in clinical vascular medicine. The intent of the program is to promote the training of the next generation of clinical leaders in the emerging field of vascular medicine. Our Specific Aims are:

1. To provide comprehensive clinical training in general vascular medicine. We will emphasize: a) solid foundation in knowledge of vascular disease pathophysiology, epidemiology and management through structured curriculum and multidisciplinary conferences; b) skills to care for patients with vascular diseases through inpatient and outpatient rotations; c) comprehensive training in thrombosis and anticoagulation management; d) advanced training in vascular diagnostic testing through the noninvasive vascular laboratory; and e) vascular team management approaches to optimize vascular care. Upon completion of the program trainees will have satisfied the requirements set forth by the American Board of Vascular Medicine (ABVM), the National Certification Board for Anticoagulation Providers (NCBAP), and the Registered Physician in Vascular Interpretation (RPVI) exam.

2. To provide training in vascular medicine research. Through a focused mentor-guided research project, the fellow will obtain an understanding of the fundamentals of translational vascular research. The fellow will develop a research project working with one of our experienced mentors under the oversight of the program directors. In addition, curriculum will be offered to provide mentee development through: mentoring networks; career development seminars; and intensive training in oral presentations, manuscript writing, and grant development. Trainees will have the opportunity to extend the research experience through multiple available cardiovascular T32 programs at BU/BMC.

3. **To accelerate synergy across the Ansell Fellowship Vascular Medicine Programs by facilitating virtual fellowship for fellows across all the Centers.** We will continue include Ansell Fellows across the centers who commit to the cross-center program in a bimonthly video webinar to foster collaboration and share expertise. Our trainee will participate in the longitudinal seminar series.

Curriculum Outline

The clinical components including core clinical rotations, clinic experiences, and clinical electives have been developed to provide a robust exposure to the full spectrum of vascular diagnostics and therapeutics. This in-depth exposure to all aspects of vascular care allows trainees to gain a comprehensive approach in diagnosing

Core Competencies. Our overall curriculum (**Table 1**) imparts core knowledge and competencies for vascular medicine clinical scientists through training in clinical knowledge, research skills, and career and professional development skills. The didactic components will have a combined approach of a multidisciplinary vascular conference and a career development video webinar series.

Didactic Experiences

Multidisciplinary Vascular Conference: The vascular services at BU/BMC have a longstanding 90-minute multidisciplinary vascular conference on a weekly basis. The conference includes a 30-minute faculty presentation of core vascular disease content followed by 60-minutes of case presentations by trainees to discuss management approaches. On a monthly basis the case conference focuses on the vascular laboratory to discuss contemporary issues in the performance and interpretation of non-invasive vascular laboratory modalities. The presentations will be "journal club" based and include a discussion of the essential pathophysiology of the disorders, technical aspects of performing the examination, and current diagnostic criteria. Trainees will expected to prepare several conferences annually. The conference is attended by vascular surgery, vascular medicine, interventional radiology, hematology, vascular sonographers, podiatry, neurology, and trauma services. The cores lectures cover topics as detailed in the Table 1. The purpose of the conference is to reinforce the manifestations, diagnostics, and management of common disorders requiring either inpatient or outpatient sub-specialty care. The multidisciplinary nature provides an exposure to differing perspectives on management that is an invaluable experience for the trainee. The conference provides the opportunity for clinicopathologic and imaging correlations. Fellows will also have the opportunity to attend additional teaching conferences at BU/BMC including Cardiovascular Medicine conferences (weekly grand rounds, weekly case presentations, imaging conference, quality improvement conference, monthly journal club) and the Whitaker Cardiovascular Institute weekly seminar series focused on research presentations in cardiovascular areas. All conferences have continued through the COVID19 related restrictions with video format and transition to in person as possible.

Table 1. Vascular Fellowship Didactic Curriculum--*Examples*

Vascular Medicine Clinical Expertise ***Core Knowledge Areas:*** Vascular Anatomy, Vascular Biology, Vascular Pharmacology, Vascular ultrasound principles ***Disease Specific Areas:*** Pathophysiology/Epidemiology/Clinical Presentation/Diagnostic Approach/Risk stratification/Medical Therapies/Revascularization Approaches of: Peripheral artery disease, Acute and Chronic Venous Diseases, Aortic Disease, Cerebrovascular Disease, Renal artery disease, Mesenteric Vascular Disease, Vasculitis, Vasospastic Disorders, Lymphatic Disease, Fibromuscular Dysplasia, Uncommon Vascular Disorders, Vascular ulcer management ***Non-Invasive Vascular Laboratory:*** Performance and Interpretation of duplex examinations of arterial and venous systems and physiological arterial and venous testing, administration and accreditation ***Anticoagulation Care:*** Pathophysiology of thromboembolic disease, patient education and decision making, pharmacology of antithrombotic agents, administration and accreditation ***Research Skills:*** Clinical trial design, implementation science, Risk Prediction, Shared Decision Making, Patient-centered Outcomes, Statistical Approaches, Bioinformatics
Career and Professional Development: Making the most of your IDP, Ethical Research Conduct, Scientific Presentations, Giving and Receiving Feedback, Working on multidisclinary teams, time management; grant writing, writing abstracts and manuscripts, effective presentations with lay audiences, manuscript critique
National Networking: Presentation at research meetings; attendance at AHA PVD Council Executive Committee Meetings; Internship with *Circulation Research* Editorial Board; Vascular Medicine Mentorship Program
BU: BU has a robust sponsored grant writing program, vascular biology seminar series, and translational science programming.

***Monthly Video Webinars*:** We will use a blended-learning, "flipped classroom" (pre-session readings/preparations, experiential learning during webinars) approach to accelerate career development for

trainees across the participating centers. We will participate in the development of and contribute to the twice monthly cross-institution experiential webinars that will be facilitated by clinical and research faculty as well as guest facilitators and trainees. The webinars use a 60-minute video face-to-face web technology to increase participant engagement and connectivity. We will continue a curriculum that includes both sessions with career, professional, and research development knowledge and skill-building activities as well as core clinical topics and fellow presentations of research or clinical cases. We will coordinate seminar development across the program directors of all the Ansell Vascular Medicine programs.

Clinical Rotations

Inpatient Vascular Medicine Consult Rotation:

There is a longstanding Vascular Medicine Inpatient Consultation Service that is staffed by non-invasive and interventional vascular medicine faculty members. General cardiovascular medicine fellows, vascular surgery fellows, internal medicine residents and medical students all rotate on the service. The service includes the evaluation of patients with vascular emergencies including acute aortic syndromes, acute limb ischemia, pulmonary embolism, acute venous thrombosis, atheroembolism, vascular wounds, and acute stroke. A major component of the consult service is the Pulmonary Embolism Response Team (PERT) that is involved in the management of all patients with acute pulmonary embolism. The PERT participation assures that trainees have a robust exposure to both routine and complex venous thromboembolism and its management including anticoagulation and advanced therapies. Another element of the rotation is to assist in the perioperative evaluation and management for vascular surgery. Trainees develop expertise in the perioperative management for vascular surgery including its attendant complications. Emphasis is placed on the utility of the perioperative assessment as an entry point to establishing long-term risk modification and routine vascular disease care. During this experience the trainee serve as a liaison to the other inpatient services in an educational capacity. It is expected that trainee will develop skills and interest in educating others about vascular disorders. Fellows will spend 3 months on the inpatient service.

Outpatient Clinic Longitudinal Experience:

The importance of the outpatient exposure is to ensure that trainees become proficient in the management of vascular disorders encountered in an ambulatory setting. Fellows will participate in the ambulatory vascular medicine practice within the Cardiovascular Center at Boston Medical Center. This includes the longitudinal evaluation and management of patients with conditions such as intermittent claudication, entrapment syndromes, chronic venous insufficiency, deep vein thrombosis and thrombophilias, carotid and subclavian arterial disease, lymphedema, vasospastic disorders (such as Raynaud's phenomenon), and atherosclerosis risk factors, such as hypertension and dyslipidemias. This experience includes a multi-disciplinary approach to allow our trainees to encounter the full breath of vascular disorders and their management. Trainees will perform evaluations and assist in the management of patients with vascular related problems under the supervision of one of the vascular medicine staff physicians. Trainees will participate in the vascular medicine clinic for one half day per week for the entire 12 month fellowship experience.

Supervised Exercise Training (SET) Program:

The cardiovascular rehabilitation program has been an integral part of the outpatient cardiovascular services at BMC for decades. With the recent approval of payment for SET for patients with claudication, the program is actively offering services to patients with PAD. All patients are seen for evaluation by a vascular medicine physician and then engage in a 12-week, 3-times weekly program. The participation in the vascular rehabilitation program will allow for the acquisition of knowledge and ability to implement supervised exercise therapy for claudication, as well as the management of atherosclerotic risk factors. Fellows will spent one month working with the SET program seeing patients at all stages of the program.

Anticoagulation Services Experience:

An experience with the Anticoagulation Services will provide trainees with a dedicated exposure to anticoagulation management. Trainees will participate in the Anticoagulation Clinic at Boston Medical Center working closely with our clinical anticoagulation pharmacists. This experience will provide an opportunity of assist in the anticoagulation management including initiation and follow up care for both coumadin and direct oral anticoagulants (DOACs). Fellows will be exposure to complex decision making including management of patients during pregnancy, with obesity, with cancer, with bleeding complications, during the perioperative period. Fellows will understand complex social factors that may be barriers to optimal management. Fellows will be exposed to decision-making algorithms and patient education approaches. Fellows will attend monthly meetings of the hospital Antithrombotic Committee (led by Dr. Eberhardt) to review safety protocols and

antithrombotic complications. Trainees will gain insight into issues related to factors affecting the effectiveness of anticoagulants and required adjustments to maintain therapeutic actions and to safely perform procedures. Fellows will gain the experience needed to direct independently an anticoagulation service. Fellows will spend one half day per week for the entire 12 month fellowship.

Non-Invasive Vascular Laboratory Rotation:

The goal is to insure that trainees are competent in the interpretation of non-invasive vascular laboratory studies. The BMC Vascular Laboratory is accredited by the Intersocietal Accreditation Commission for Vascular Testing and co-led by vascular surgery and vascular medicine (Drs. Farber and Eberhardt). During the rotation trainees are exposed to the full range of techniques including physiologic arterial and venous studies, arterial duplex, carotid duplex, and venous duplex studies. Arterial physiologic studies will include pulse volume recording, segmental limb pressures, Doppler waveform analysis, and provocative maneuvers such as exercise studies, and thoracic maneuvers. Venous physiologic studies include use of provocative maneuvers such as Valsalva or rapid cuff deflation. Venous duplex examinations to evaluate for thrombosis, assess for reflux, and map veins. Arterial duplex of the extremities to assess for stenosis, graft patency, arteriovenous fistulas, hemodialysis access, and pseudoaneurysm including thrombin injections. Arterial duplex of the intra-abdominal vessels to evaluate for renal artery stenosis, mesenteric stenosis, and abdominal aortic aneurysm, including following endograft placement. Carotid duplex to assess for stenosis, occlusion, dissection, aneurysm, and intimal medial thickness.

Trainees interpret vascular studies with the vascular laboratory medical director (or another physician reading staff) during the dedicated rotation. This dedicated exposure will include “hands-on” training in performing studies with our technologists. Trainees will gain an appreciation of the technical issues that affect the quality of the examination and image optimization and learn the principle governing the technique. During this experience trainees meet the recommendation for interpreting vascular studies to be eligible for the APCA credential of Registered Physician in Vascular Interpretation. This includes interpretation of 100 venous, 100 extracranial carotid, 100 limb arterial, 75 visceral vascular duplex ultrasound, and 100 physiologic arterial studies. Fellows will spent 4 months in the non-invasive vascular laboratory (some of this time can overlap with the inpatient consult service).

Vascular Surgery and Endovascular Rotation:

Invasive angiography and interventions (open and endovascular) are integral components of the care of patients with many vascular diseases. Exposure to procedural specialties will allow trainees to gain an appreciation of the indications, technical considerations, and potential complications of catheter-based interventions for both arterial and venous diseases. Working with vascular surgery will promote a greater understanding of the indications, technical issues, benefits and risks of surgical vascular revascularization and reconstruction. Fellows will evaluate patients prior to, during, and following diagnostic studies and interventions performed in the interventional laboratory. The endovascular practice and suite is shared by interventional cardiology, interventional radiology and vascular surgery. During the rotation trainees will directly observe endovascular and operative procedures and participate in the peri-procedural care of patients undergoing surgical revascularization. Fellows will also have the opportunity to participate in vascular surgery outpatient clinic to gain further knowledge and skills in evaluating patients with vascular diseases as well as wound care principles. The outpatient experience will also ensures an exposure to techniques in the management of chronic venous insufficiency including sclerotherapy and venous ablation. Fellows will spend 1-2 months on the interventional and vascular surgery services.

Advanced Vascular Imaging Rotation:

A rotation in advance vascular imaging will allow trainees an exposure to vascular techniques in magnetic resonance and computed tomographic imaging. This is designed to allow trainees to understand the role of these imaging techniques in the evaluation of common arterial and venous disorders such as atherosclerosis, aneurysm, dissection, thrombosis and vasculitis. Trainees will learn the physical principles underlying these modalities and gain an understanding of their role in the management of diseases in the carotid, aortic, renal, mesenteric, peripheral and pulmonary circulations. Interpretation of imaging techniques and appropriate use of contrast with these modalities will be learned during the experience. This will include magnetic resonance techniques (such as spin-echo, time-of-flight, contrast-enhanced and phase-contrast imaging, and imaging reformatting) and computed tomographic image display issues (such as projections, reformatting, and three-dimensional reconstruction). This rotation is an extension for an ongoing joint program in cardiovascular magnetic resonance and computed tomographic imaging between Cardiovascular Medicine and Radiology at Boston Medical Center. Fellows will spend 1 month in the imaging rotation.

Elective Rotations:
To help trainees fully appreciate the role of various specialists and the role for collaborative care, electives in related area will be available. This includes fields such a pulmonary, rheumatology, dermatology, and podiatry. During elective time trainees will have the opportunity to work closely with one (or more) of these specialists in both the inpatient and/or outpatient settings.

- ***Pulmonary***: An elective in pulmonary medicine can be arranged focusing in on pulmonary thromboembolic disease, pulmonary hypertension, and sickle cell disease. Working with Drs. Klings and Martinez in the evaluation and management of pulmonary hypertension would include diagnostic testing and therapeutic "trails" to therapies such as pulmonary vasodilators.
- ***Rheumatology***: An elective in rheumatology can be arranged to focus on the evaluation and management of vasculitis. A more detailed exposure to large vessel vasculitis and its complications would be gained during a rotation.
- ***Dermatology***: An elective in dermatology can be arranged to allow for a more detailed experience in wound care and venous ulcer management. There is a significant clinical interest in the evaluation and management of chronic venous disease within dermatology.
- ***Podiatry***. An elective in podiatry can be arranged with a focus on limb salvage and wound management.

Quality Improvement:
The trainees will be encourage to participate in several forums that focus on quality activities within the vascular arena. This will include participation on the anti-thrombotic taskforce committee, PERT oversight committee and vascular lab reaccreditation working group. These will provided trainees with an understanding of and hand on participation with the processes involving in both local and national anticoagulation safety activities, PERT optimization, and vascular lab accreditation.

Fellowship Faculty

The Vascular Medicine fellowship faculty represent a broad-range of expertise in clinical and research aspects of vascular diseases as shown in Table 2. The Program Leadership Committee will be responsible for recruitment, selection, and oversight of the fellows. A brief description of each faculty member is provided here.

Table 2. Vascular Medicine Fellowship Faculty, Clinical Expertise, Research Domains

Program Leadership Committee	
Robert Eberhardt, MD (Program Co-Director)	Clinical Vascular Medicine and Non-Invasive Vascular Imaging
Naomi Hamburg, MD, MS (Program Co-Director)	Vascular Medicine and Translational Vascular Research
Omar Siddiqi, MD (Cardiovascular Fellowship Director)	Graduate Medical Education, Cardio-oncology Expertise
Frederick Ruberg, MD (Cardiovascular Fellowship Co-Director)	Graduate Medical Education, Cardiovascular Imaging research
Clinical and Research Faculty	
Ashvin Pande, MD	Cardiology and Vascular Intervention and Vascular Medicine
Gene Kwan, MD, MPH	Vascular Medicine and International Vascular Health
Emelia Benjamin, MD, MS	Atrial Fibrillation and Thrombosis, Genetic Epidemiology, Professional Development
Alik Farber, MD	Vascular Surgery, Clinical Trials in Vascular Surgery
Jeff Siracuse, MD	Vascular Registry Studies, Implementation Science
Mikhail Higgins, MD	Interventional Radiology, Venous thromboembolism interventions
Jorge Soto, MD	Vascular Radiology and Imaging
Elaine Hylek, MD	Anticoagulation management and clinical trials
Kieran Fennell, PharmD	Anticoagulation management
Katya Ravid, DSc	Platelet biology, interdisciplinary research program development
Vipul Chitalia, MD, PhD	Thrombosis in renal disease and peripheral artery disease

Program Leadership Committee

Robert T. Eberhardt, MD. (Co-Director) Dr. Eberhardt is the Director of Vascular Medicine Services, Co-Director of the Vascular Non-invasive Laboratory, Director of the Supervised Exercise Training Program and Associate Professor of Medicine. He has extensive experience training fellows in vascular medicine in

dedicated fellowship and as elements of the general cardiovascular medicine fellowship and vascular surgery fellowship programs. He directed the clinical training program for the NHLBI-funded K12 vascular medicine fellowship. He has held important leadership positions in vascular medicine including on the Board of Directors of the Intersocietal Accreditation Commission for Vascular Testing, Board of Directors of the Society of Vascular Medicine, the Board of Directors of the American Board of Vascular Medicine, and the Vice-Chair of the RPVI Council of the Alliance of Physician Certification and Advancement. He has lectured nationally and published key clinical treatment articles about both venous and arterial diseases. He will oversee all aspects of the clinical training program.

Naomi M. Hamburg, MD, MS. (Co-Director) Dr. Hamburg is the Chief of the Vascular Biology Section, Director of the Whitaker Cardiovascular Institute, and the Joseph A. Vita Associate Professor of Cardiovascular Medicine. She trained at BU/BMC in Cardiovascular Medicine and completed the K12 program in Vascular Medicine. She leads a clinical translational research program focused on understanding the development of vascular dysfunction in patients with vascular disease and risk factors. She has been continuously funded by the NIH for over 10 years and has active research programs studying the mechanisms of vascular dysfunction in users of electronic cigarettes, patients with diabetes mellitus, and patients with peripheral artery disease. She has more than 130 papers in the peer-reviewed literature and extensive experience with national and international presentations. She has trained more than 18 post-doctoral fellows many of whom have gone on to independent research careers. She was the Associate Director of the K12 program and is the co-director of the T32 Postdoctoral Fellowship Program in Cardiovascular Diseases. She has been actively involved in leadership positions in Vascular Medicine including currently the Council Chair of the American Heart Association's PVD Council, Board of Directors of the Intersocietal Accreditation Commission for Vascular Testing, Board of Directors of the Society of Vascular Medicine, Vascular Medicine Program Chair for the American College of Cardiology, and serves as an Associate Editor for *Circulation Research*. She is co-chair of the ACCF Advanced Training Statement in Vascular Medicine that will be published in 2020. She will direct the research training aspects of the fellowship program.

Omar K. Siddiqi, MD. Dr. Siddiqi is an Assistant Professor in the section of cardiovascular medicine, and the Program Director of the cardiovascular medicine fellowship program at Boston Medical Center. He is also the co-director of the cardiovascular pathophysiology module for second year medical students at the Boston University School of Medicine. A graduate of the Harvard Macy Program for Educators in Health Professions, Dr. Siddiqi's academic interests are in the area of curriculum development and the application of interactive and simulation-based learning to medical education. He has led the introduction of team-based learning (TBL) to the medical school pathophysiology curriculum. At the fellowship level, Dr. Siddiqi is interested in studying the use of simulation and interactive learning in developing an echocardiography curriculum. This curriculum includes hands-on twice monthly sessions on the CAE echo simulator, an interactive echocardiogram practice lab and monthly interactive Imaging Show and Tell sessions.

Frederick L. Ruberg, MD is an Associate Professor of Medicine and Radiology at Boston University (BU) School of Medicine and clinical cardiologist at Boston Medical Center (BMC), specializing in cardiac imaging and infiltrative heart disease. He is Associate Chief of Cardiovascular Medicine for Academic Affairs, Co-Director of the Cardiovascular Medicine Fellowship program (prior Program Director), director of the cardiac MRI program at BMC as well as the Integrated Pilot Grants Program of the Boston University Clinical and Translational Science Institute. Dr. Ruberg is also an Associate Editor of *Circulation: Cardiovascular Imaging* His NIH and industry-funded research program focuses on the application of non-invasive cardiac imaging for amyloidosis identification and clinical care optimization. Current projects involve the application of pyrophosphate imaging for detection of ATTR amyloidosis, application of echocardiographic strain imaging as a disease marker, and validation of point of care diagnostic tools for cardiac amyloidosis identification in the outpatient clinic. Dr. Ruberg is an active mentor of MD-trained physicians at BMC, having received the excellence in mentoring award from the BMC internal medicine residency in 2017. He is a former member of the advisory committee of the NHLBI-funded K12 Vascular Medicine Program.

Clinical and Research Faculty

Ashvin Pande, MD is a Clinical Associate Professor Director of Invasive Cardiology and of the Cardiac Catheterization laboratory and staff member of the Cardiovascular Medicine section at Boston Medical Center. He is board certified in internal medicine, cardiovascular disease, interventional cardiology, and endovascular medicine. He is a member of the American College of Cardiology and a Fellow of the Society for Cardiovascular Angiography and Interventions. His areas of clinical interest include complex coronary artery angioplasty and stenting, medical and interventional management of peripheral vascular disease, structural

heart disease including closure of patent foramen ovale and atrial septal defects, and minimally-invasive treatments for valvular heart disease. He has served as site PI of national trials in carotid stenting and peripheral arterial disease and revascularization. He is a key faculty member in the Interventional Cardiology Training Program at Boston Medical Center and has previously served as a faculty member on the Vascular Medicine Training Grant.

Gene F. Kwan, MD, MPH. Dr. Kwan is an Assistant Professor of Medicine and a member of the Vascular Medicine Faculty. He is also the Associate Director of Cardiovascular Research and Training at Partners in Health. He is a graduate of the K12 Program in Vascular Medicine. His research focus is on equitable delivery and utilization of health services for cardiovascular diseases in low-income countries. He has an ongoing NIH-funded K23 grant focused on community-based interventions for heart failure care in Haiti. He has lectured globally about non-communicable diseases and health policy. He is recognized for his clinical teaching excellence through multiple resident and fellow awards.

Emelia J. Benjamin, MD, MS. Dr. Benjamin is Professor of Medicine and Assistant Provost for Faculty Development. She is a world-renowned expert in atrial fibrillation, thrombosis, and genetic epidemiology. She has been continuously funded by the NIH for more than 20 years. In addition to her research and mentoring excellence, she has developed a rigorous program of faculty development and training. She leads longitudinal faculty development seminars, training cores, and has published extensively on educational scholarship. She is the Chair of the Association of University Cardiologists, received the AHA Women in Cardiology Mentoring Award, and the Paul Dudley White Award.

Alik Farber, MD. Dr. Farber is Professor of Surgery and Radiology, Chief of the Division of Vascular and Endovascular Surgery and Associate Chair for Clinical Operations. He has leadership experience in clinical operations and research experience with a focus on clinical trials in vascular diseases. He is national co-PI of the **B**est **E**ndovascular versus **S**urgical **T**herapy for Patients with **C**ritical **L**imb **I**schemia (BEST-CLI) Trial. He has published extensively in the field of vascular surgery and served as the co-investigator for the multicenter, NIDDK sponsored Hemodialysis Fistula Maturation (HFM) Study.

Jeffrey J. Siracuse, MD, MBA. Dr. Jeffrey Siracuse is a Vascular Surgeon at Boston Medical Center and an Associate Professor of Surgery and Radiology at Boston University. Clinically his interests include treatment of peripheral arterial disease, aortic aneurysms, carotid artery disease, vascular trauma, thoracic outlet syndrome, venous disease, and creation of dialysis access. He is the medical director of the Pre-Procedure Clinic and is the Vascular Surgery Fellowship Program Director. He has received funding from the National Institutes of Health as well as Surgical Specialty Societies. He has published over 130 papers focusing on peripheral vascular disease. He is an Associate Editor of Annals of Vascular Surgery and on the editorial board of the Journal of Vascular Surgery. He is the chair of the Society for Vascular Surgery's Appropriateness Committee as well as the Vascular Study Group of New England Research Advisory Council.

Mikhail Higgins, MD, MPH. Dr. Higgins is an Assistant Professor of Radiology in Vascular and Interventional Radiology. He is the Program Director for the Endovascular Intervention Fellowship and Director of the Medical Student Clerkship in Radiology. He is an integral member of the PERT team and his research interests include patient safety, health care provider wellness, and diversity and inclusion.

Jorge A. Soto, MD. Dr. Soto is Professor of Radiology and Chief of Radiology. His research interests include CT and MR imaging of vascular diseases. He was the President of the New England Roentgen Ray Society and Executive Committee of the American Society of Emergency Radiology. In addition he currently serves or has served on multiple committees for national and international scientific societies including the Radiological Society of North America, American Roentgen Ray Society, Society of Abdominal Radiology and American College of Radiology.

Elaine M. Hylek, MD, MPH. Dr. Hylek is a Professor of Medicine and Director of the Thrombosis and Anticoagulation Service. Her research areas include arterial (stroke) and venous thrombosis, anticoagulant therapies, and atrial fibrillation. She has served as PI on several NIH R01 grants, served on the Executive Steering Committees for international clinical trials and national registries, Event Adjudication Committees, and Data Safety Monitoring Boards. She has also served as the Late Breaking Clinical Trial Discussant for multiple international trials in the field of thrombosis. Dr. Hylek is a Section Editor for Thrombosis and Haemostasis, a member of the International Society of Thrombosis and Haemostasis Executive Committee for World Thrombosis Day.

Kieran Fennell, PharmD. Dr. Fennell is an anticoagulation clinical pharmacy specialist. He has worked in the Anticoagulation Clinic Service (ACS) for over 15 years and has managed the clinic for the past 3. He has been an active member of the BMC Anticoagulation Task Force for 6 years and provided mentorship and preceptorship to countless pharmacy students and residents. He started the patient DOAC teaching and monitoring program at BMC 4 years ago expanding the services the ACS can provide to accommodate the ever changing landscape of anticoagulation management. Kieran has a passion for patient care, especially the unique and challenging patient population we are privileged to care for here at BMC.

Katya Ravid, DSc. Dr. Ravid is Professor of Biochemistry and Director of the Evans Center for Interdisciplinary Biomedical Research. Her major research interests include platelet production and function. She has extensive experience mentoring graduate and postgraduate students in research development. She is President of the Massachusetts Academy of Sciences was Chair of the Thrombosis and Vascular Biology Scientific Committee of the American Society of Hematology and has received mentoring awards from the Department of Medicine.

Vipul Chitalia, MD, PhD. Dr. Chitalia is Associate Professor and a member of the Nephrology Faculty. He has an active research program studying vascular diseases in patients with chronic kidney disease. He has discovered novel mediators of thrombosis in the setting of kidney failure. He was co-Director of a Thrombosis and Hemostasis Affinity Research Collaboration. He has collaborated with both Drs. Farber and Dr. Hamburg on research regarding the predictors of PAD in patients with chronic kidney disease.

Research Opportunities

Our faculty team has expertise in multiple components of vascular disease research as well as career development. In addition to the didactic programming, fellows will be expected to carry out a research project with a selected research mentor from the overall fellowship faculty. Trainees with select one of the cadre of potential mentors who will help provide a focused or guided research project. This is a limited time exposure; however during time available, this research project will provide potential exposure to many of the key aspects of clinical investigations (including study design, data collection, data analysis and interpretation, and data presentation including manuscript preparation). This will also encourage trainees to seek additional resources to allow for additional time commitment to conduct a more extended project. Each fellow will develop an Individual Development Plan that will be reviewed with the Program Directors and with the research mentor. Multiple strategies will promote participant productivity including: 1. Clear expectations in mentee/mentor agreements; 2) Opportunities during webinars to focus on research timelines and productivity; 3) Submission of quarterly progress reports; and 4) Check-ins with Program Directors including career coaching.

Fellows will be able to select from vascular epidemiology (Hamburg, Benjamin, Farber, Kwan), vascular biology (Ravid, Chitalia), translational vascular clinical research (Hamburg, Chitalia), vascular clinical trials (Farber, Siracuse, Hylek). Projects will be tailored to fit trainees career aspirations with mentors expertise.

In addition to the vast experience in research mentoring across the program faculty members, BU/BMC has demonstrated success in training academic leaders in vascular medicine through the NIH-funded K12 program. The 6 K12 fellows and highlights of the career successes are listed below:

Naomi M. Hamburg, MD, MS. As noted above, Dr. Hamburg was the first fellow in the K12 program as a junior faculty member at BU. Her research mentor was Dr. Joseph Vita and her projects focused on the impact of metabolic diseases on vascular health. She has gone on to receive independent funding through the NIH, AHA, and industry programs. She has more than 130 original peer-reviewed publications, has served in numerous leadership roles, and has lectured widely on vascular diseases.

Rene Quiroz, MD, MPH. Dr. Quiroz completed research in vascular epidemiology and venous thrombosis during his fellowship experiences. He is currently a well-respected vascular medicine and cardiology practitioner in San Antonio Texas and has served on the board of the vascular council of the American Society of Echocardiography as well as lectured at multiple cardiovascular meetings about vascular imaging and vascular patient care.

Corey E Tabit, MD, MPH, PhD, MBA. Dr. Tabit is Assistant Professor of Medicine at The University of Chicago Medical Center. He has an active research program investigating the vascular biology of patients with left ventricular assist devices. He received an AHA Scientist Development Grant and has 16 publications as well as 12 national speaking engagements. He practices clinical vascular medicine and cardiology.

Rebecca LeLeiko, MD, MS. Dr. LeLeiko is an Assistant Professor at Emory School of Medicine. She in a vascular medicine specialist, part of the Fibromuscular Dysplasia Program. Previously she was a vascular medicine clinician at the Boston VA Healthcare System.

Christina Fanola, MD, MS. Dr. Fanola is Assistant Professor of Medicine at the University of Minnesota Medical School. After the K12 program, she completed a fellowship in clinical trials with the TIMI Study Group at Harvard Medical School. She practices vascular medicine and cardiovascular medicine. She has 16 publications in the medical literature, multiple presentations and served on the vascular council leadership of the American Society of Echocardiography.

Gene F Kwan, MD, MPH. As noted above, Dr. Kwan is an Associate Professor at BUSM and has been funded by the NIH with a K23 grant. He has 32 publications in the medical literature and more than 10 national and international lectures.

There are multiple training resources available through the Whitaker Cardiovascular Institute, the Framingham Heart Study, and across the Department of Medicine that will be available for trainees including core facilities, grant writing workshops, career development programming, biostatistical support, and other training programs that will allow for synergistic project development.

Our active ongoing research programs and research mentoring experience along with our demonstrated success in producing leaders in the field of vascular medicine will ensure the success of our revitalized vascular medicine fellowship program. We are also committed to promoting the success of all the Ansell Fellowship Programs through the shared webinar based educational programming.

Our current fellow, **Leili Behrooz, MD**, has prior research experience studying the impact of novel tobacco product use on cardiovascular health metrics. She is working with Dr. Hamburg on a clinical trial of novel diabetes medications on vascular endothelial phenotype.

Each trainee will be paired with a primary research mentor who will be responsible for overseeing the trainee's research program and will sign a mentoring agreement with the trainee. All fellows are required to develop and maintain an Individual Development Plan (IDP) with the training directors and the primary research mentor. Within two months, the fellow will develop a one page research plan along with the primary research mentor that includes a specific timeline and milestones that will be reviewed regularly with the program directors. The fellow will have the opportunity to present a Work in Progress research talk at the Whitaker Cardiovascular Institute seminar series similar to the T32 post-doctoral fellows. All eligible fellows will be offered the opportunity to continue research training through the T32 Multidisciplinary Training Grant in Cardiovascular Sciences.

All trainees will be expected to attend the Anticoagulation Forum's National Conference in October 2021.

Program Outcomes and Evaluation

At the completion of the fellowship program, all fellows will be independent practitioners of vascular medicine who will have experience in all areas of venous thromboembolism, peripheral vascular disease and anticoagulation management. All fellows will be expected to complete certification through the ABVM, RPVI, and NCBAP. We will collect information regarding success at completing board certifications. We will collect information regarding metrics of research success including abstracts, publications, invited talks, and grants. We will engage in a continuous program evaluation with collection of information regarding attainment of program aims as well as feedback from the program trainees and mentors. We will make program modifications as indicated by evaluation of feedback to foster a culture of transparency and responsiveness.