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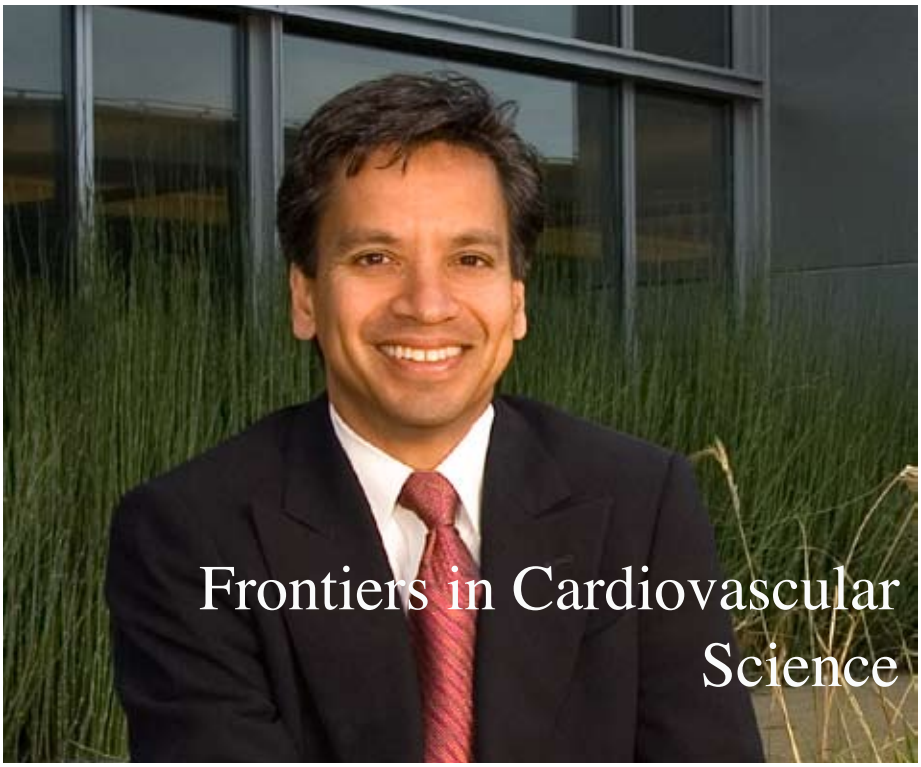

Gladstone's Deepak Srivistava opens the 2011 CVI seminar series

Deepak Srivistava of the Gladstone Institute and UC San Francisco will lead off the 2011 "Frontiers in Cardiovascular Science" seminar series sponsored by the Cardiovascular Institute. The CVI has put together an impressive lineup of speakers for the 2011 seminar series, which will generally be held on Tuesdays (with one Friday exception) at noon in the LKSC. Speakers in the series will cover a full range of topics, from molecular and cellular physiology to genomics, mathematical modeling, pathophysiology and epidemiology. Speakers will come from around the country and around the world, as well as from Stanford.

On Tuesday, January 11, Srivistava will speak about "Reprogramming approaches to cardiovascular disease." He has long focused on learning about cardiac development >>

2011 CVI Tuesday seminar series

(Continued from Page 1)

that knowledge to devise novel therapeutic approaches to treating cardiac disorders. His work in this area addresses the factors that determine the fate of cardiac stem cells and myocyte progenitor cells. One major area of Srivistava's research is the used of induced pluripotent stem cells to remodel the diseased heart. In a recent publication, Srivistava has shown that fibroblasts can be transformed directly into cardiomyocytes. The lectures will be held at noon in Paul Berg Hall, on the 2nd floor of the Li Ka Shing Center for Learning and Knowledge. Lunch will be provided.

January 11, 2011
Reprogramming Approaches to Cardiovascular Disease
Deepak Srivastava, MD
University of California, San Francisco

January 18, 2011
What is in Common between Myocardial Infarction, Nitroglycerin, Asian Alcohol Flushing Syndrome and Diabetic Cardiomyopathy?
Daria Mochly-Rosen, PhD
Stanford University

January 25, 2011
The Paradox of the Right Ventricle
Anton Vonk-Noordegraaf
VU University Medical Center, Amsterdam, Holland

February 1, 2011
Chromatin Remodeling in Heart Development and Pathophysiology
Ching-Pin Chang, MD, PhD
Stanford University

February 8, 2011
Personal and NonPersonal Genomics
Mike Snyder, MD
Stanford University

Special Friday Event
February 4, 2011
Cardiovascular Institute
Mini-Symposium

Systems Pathobiology and Personalized Cardiovascular Medicine: A Complex Systems Approach to the Redefinition of Human Cardiovascular Diseases
Joseph Loscalzo, MD, PhD
Brigham and Women's Hospital, Boston

More presentation titles and speakers list to follow

February 15, 2011
Population Genetic Inference in the Personal Genome Era
Carlos Bustamante, PhD
Stanford University

February 22, 2011
Moving Cell Culture into the Third Dimension
Sarah Heilshorn, PhD
Stanford University

March 1, 2011
Pathways to Hypertrophy and Failure
Dan Bernstein, MD
Stanford University

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2011 CVI Tuesday seminar series

(Cont. from Page 2)

March 8, 2011
Translational Research: Replication, Credibility, and Efficiency
John Ioannidis, MD, DSc
Stanford University

March 15, 2011
Developmental Mechanisms of Cardiac Disease
Jonathan Epstein, MD
University of Pennsylvania, Philadelphia

March 22, 2011
The Virtual Heart: Modeling Heart Failure Across the Scales
Ellen Kuhl, PhD
Stanford University

March 29, 2011
Finding Molecular Pathways that Reverse Pulmonary Hypertension
Marlene Rabinovitch, MD
Stanford University

April 12, 2011
Title forthcoming
Eric Topol, MD
Scripps Research Institute

April 19, 2011
Circadian Clock Regulation of Metabolism and Obesity
Brian Feldman, MD
Stanford University

April 26, 2011
Insulin Resistance; the Link between Obesity and Cardiovascular Disease
Gerald Reaven, MD
Stanford University

May 17, 2011
Epidemiology of Heart Failure and LV Remodeling: Insights from Community-Based Studies
Vasan Ramachandran, MD, DM, FACC, FAHA
Boston University, MA

May 31, 2011
Agnostic Approaches to Cardiovascular Genetics and Genomics
Nicholas Leeper, MD
Stanford University

September 27, 2011
Arrhythmogenic Right Ventricular Dysplasia: Where DO We Stand in 2011?
Hugh Calkins, MD
Johns Hopkins University, Baltimore

October 25, 2011
Inherited and Arrhythmogenic Diseases: from Bench to Bedside
Silvia Priori, MD, PhD
NYU, Pavia, Italy

December 6, 2011
Systems Biology and Systems Medicine—Catalyzing the Revolution from Reactive to Proactive (P4) Medicine
Leroy Hood, MD, PhD
University of Washington, Seattle

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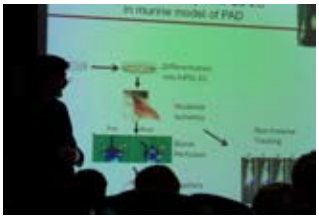
CVI NEWS

CIRCULATION
Goings on about the Institute

Fridays at Falk 4-5:30 PM - A postdoc-centric afternoon series



In the new year the Fridays at Falk series continues to be a forum for informal talks, discussion, and happy hour. They are intended to provide a venue for postdocs, graduate students, and interested faculty to learn more about who's doing what, where, and when in the CVI. The planning committee includes Arwen Hunter, PhD, from the Cooke lab, Ildi Toma, PhD, and Elaine Wang, PhD from the Yang lab.

Joseph Wu wins presidential award

CVI researcher Joseph Wu and three other Stanford scientists have each won a Presidential Early Career Award for Scientists and Engineers. The award is the highest honor bestowed by the U.S. government on outstanding scientists and engineers in the early stages of their research careers. The winners will receive research grants to pursue their research for up to five more years.
Wu, associate professor of medicine and radiology, received one of the awards. The other winners are Dominique Bergmann, assistant professor of biology; Gianluca Iaccarino, assistant professor of mechanical engineering; and Jacob Wacker, theoretical physicist at SLAC.
Wu studies how embryonic and adult stem cells survive, proliferate and transform into other cell types. Wu approaches his research with an eye toward clinical treatment and is investigating the potential of stem cells to form tumors or be rejected by the immune system. He also works on techniques that can turn developed cells, like skin cells, into induced pluripotent stem cells without depending on possibly dangerous viruses, a risky feature of early methods.

People with atrial fibrillation needed for study

The Stanford University Medical Center is recruiting patients for a clinical trial designed to determine whether medications or catheter ablation is a more effective treatment for atrial fibrillation.
Stanford is one of 140 medical centers to participate in the study called the "Catheter ablation versus anti-arrhythmic drug therapy for atrial fibrillation" trial, also known as CABANA. It is the first large-scale study of its kind and will include more than 3,000 patients.
Patients over the age of 18 with diagnosed atrial fibrillation who meet certain criteria are eligible for the study. Stanford plans to enroll 21 patients. For more information, contact Linda Norton RN, MSN, at (650) 725-5597.
The lead Stanford investigator is Amin Al-Ahmad, MD, assistant professor of cardiovascular medicine.

NHBLI-sponsored K12 vascular medicine fellowship and the NIH T32 vascular medicine fellowship

Applications are now being accepted for two vascular medicine fellowships. For more information, see page seven of this newsletter.

About this newsletter: please direct comments, suggestions and news to: mhaddad@stanford.edu

2011 CVI Seed Grants Awarded

The Cardiovascular Institute has announced the awardees of the latest round of seed grants. The CVI seed grants are intended to provide resources for promising research at an early stage of development.

Comprehensive and real time assessment of a genetic risk score for cardiovascular disease in the Women's Health Initiative

Themistocles (Tim) Assimes,MD, PhD Assistant Professor of Medicine; Manisha Desai, PhD, Clinical Associate Professor of Medicine; John Ioannidis, MD, CF Rehnborg Professor in Disease Prevention, Professor of Medicine; Joshua Knowles, MD, PhD, Clinical Instructor, Cardiovascular Medicine; Jessica Kubo, Biostatistician; Marco Perez, MD, Fellow, Cardiovascular Medicine; Thomas Quertermous, MD, Professor of Medicine; Marcia Stefanick, PhD, Professor of Medicine, Professor of Obstetrics & Gynecology

Recent advances in genetics have facilitated the identification of susceptibility loci for coronary atherosclerosis and its risk factors. Here, we propose to use the rich bio-resource formed by the Women's Health Initiative to develop an infrastructure that will comprehensively and in real time assess the utility of a multi-locus genetic risk score (GRS) for CAD in women ≥50 years of age. Importantly, the make-up of this bio-resource will provide us with enough power to test the modifying effect of age on GRS. The results of this study will provide the scientific community with valuable insights into the pathophysiology of early vs. late onset atherosclerosis disease in women as well as differences in the pathophysiology between men and women. The results will also allow the scientific community to gauge the appropriate time to conduct key large-scale clinical trials to prove the utility of GRS in women.

A novel imaging approach to early detection of cardiovascular disease

Helen M. Blau, PhD, Professor, Department of Microbiology and Immunology Director, Baxter Laboratory for Stem Cell Biology; Francis Blankenberg, MD, Associate Professor, Department of Radiology Lucile Packard Children's Hospital; Foteini Mourkioti, PhD, Research Associate Baxter Laboratory for Stem Cell Biology; Srihari C. Sampath, MD, PhD, MPhil, Senior Resident, Department of Radiology; Srinath C. Sampath, MD, PhD, MPhil, Senior Resident, Department of Radiology

Duchenne muscular dystrophy (DMD), the most common lethal genetic disorder of children, is characterized by continuous injury and progressive degeneration of skeletal and cardiac muscle, and uniformly leads to death from cardiomyopathy and/or diaphragmatic failure. While the molecular mechanism linking dystrophin mutation to cardiac failure remains unclear, altered redox homeostasis has been suggested to play a critical role. In a new cross-departmental collaboration, we have preliminary data describing a novel method for metabolic imaging of the heart, which allows direct readout of the age-related perturbation of redox homeostasis known to occur in Duchenne muscular dystrophy. Using a new and clinically relevant mouse model of DMD developed in the Blau lab (Sacco et al 2010, Cell, in press), we have strongly validated this strategy, demonstrating profound cardiac redox abnormalities in aging dystrophic animals, as revealed using non-invasive molecular imaging. Critically, these imaging findings are apparent before symptoms become evident clinically or by echocardiography, providing new insight into and mechanisms for the study of age-related dysfunction in the heart. Seed funding will allow us to develop this imaging reagent in our preclinical model, advance it towards clinical use in DMD patients, and allow us to establish its utility in other forms of cardiomyopathy, including in ischemic disease.

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2011 CVI Seed Grants

(Continued from Page 5)

Nanoscale, in situ force measurements to uncover the roles of mechanical force in age-associated ventricular hypertrophy

Alexander Dunn, PhD, Asst. Professor, Chemical Engineering

Recent observations suggest that molecule-level mechanical forces between cells are critical in governing age-related cardiac tissue remodeling. Current techniques for measuring the forces experienced by cells are ill suited for use with three-dimensional cellular assemblies, and are wholly incompatible with in vivo measurements. We will develop a new fluorescence microscopy technique, termed molecular force microscopy (MFM), that directly visualizes the mechanical forces experienced cells in culture, and eventually in whole organisms. We will use MFM to measure, with millisecond and micrometer accuracy, the fluctuating mechanical forces experienced by cardiomyocytes working against externally applied strain. These measurements will test the working hypothesis that pathological ventricular hypertrophy is the direct result of chronic mechanical stress experienced by cardiomyocytes

Telomere Biology and Cardiovascular Aging

Francois Haddad, MD, Clinical Assist. Prof. of Medicine; Ingela Schnittger, MD, Professor of Medicine; David Liang, MD, PhD, Associate Professor of Medicine; Armaghan Fatemeh-Gomari-Grisar (research fellow); Mark Davis, PhD, Professor Microbiology & Immunmology; Cornelia Weyand, MD, Professor of Medicine; Jose Montoya, MD, Associate Professor of Medicine; Shai Shen-Orr, PhD, Engineering Research Associare; Atul Butte, MD, PhD, Assistant Professor of Pediatrics, Medicine (medical informatics)

Cardiovascular aging is often associated with progressive atherosclerosis, increased arterial stiffness,impaired ventricular filling and decreased maximal cardiac output with exercise. Studies have shown that several differences in cardiovascular aging exist between men and women and vary according to fitness level. Recent data also suggests that cellular aging reflected by leukocyte telomere length is associated with atherosclerosis and cardiovascular disease risk. Telomere length serves as a marker of replicative immunosenescence. At this time, the relationship between cardiovascular aging and immune aging (also known as immunosenescence) has not been explored in depth. Here, we propose to analyze the relationship between cardiovascular aging, telomere biology and immunosenescence using novel integrative analysis methods. As part of the project, we will also determine cardiovascular aging profiles according to sex and level of activity in a cohort of 300 healthy volunteers.

Effects of Aging and Gender on Abdominal Aortic Aneurysm Development, and the Role of MicroRNAs

Joshua M. Spin, MD, PhD, Instructor Cardiovascular Medicine; Junya Azuma, MD, PhD, Postdoctoral Fellow Cardiovascular Medicine; Alicia Deng, LSRA; Lars Maegdefessel, MD, Postdoctoral Fellow Cardiovascular Medicine; Philip S. Tsao, MD, Associate Professor Cardiovascular Medicine; Atul Butte, MD, PhD Assistant Professor Pediatrics, Medicine (Medical Informatics); Alex A. Morgan, Biomedical Informatics

Aging leads to both dilatation and substantial stiffening of the aorta, and constitutes one of the primary risk factors for the development of abdominal aortic aneurysm (AAA), a major source of morbidity and mortality. Using a mouse model of AAA, we propose to study gene expression changes associated with aging and gender, consisting of both mRNA and miRNA profiling of aortic segments. We will develop analysis methods to identify age- and gender-related regulatory gene modules and key miRNA master regulators, which will be tested for disease-modifying therapeutic potential in future studies.

New fellowships in vascular medicine available under NIH-funded programs

NHBLI-sponsored K12 vascular medicine fellowship - deadline Feb 28th, 2011
The National Heart, Lung and Blood Institute has named Stanford University as one of seven NIH-funded K12 training programs in Vascular Medicine. We intend to train leaders in academic vascular medicine. Individuals that complete this program will have proficiency in the care of patients with vascular disease. They will be leaders in translational vascular research, bringing new insights, therapies, devices and diagnostics to vascular care.

Trainees will achieve proficiency in the inpatient and outpatient vascular practice, and non-invasive vascular diagnostic laboratory. They will become familiar with catheter-based endovascular intervention, vascular surgery, vascular pathology and other related disciplines. During their training, they will participate in mentored clinical research, and have formal didactics in clinical protocol design, biostatistics, data management, as well as legal, ethical and regulatory issues that attend clinical research.

The application deadline is Feb 28th, 2011 for the NHBLI Sponsored K12 Vascular Medicine Fellowship. For more information, see the website at: http://vascularmed.stanford.edu/

NIH T32 training grant makes postdoctoral vascular medicine fellowships available
The Cardiovascular Institute can fund up to six postdoctoral fellows for a period of two years each through the NIH T32 training grant "Mechanisms & Innovation in Vascular Disease" co-directed by Dr. Ronald Dalman and Dr. John Cooke.

The program will train 6 postdoctoral fellows annually using (1) a structured curriculum, (2) a well-defined mentorship, and (3) an internal and external evaluation process. The program includes regular monitoring of the trainee, mentor, and program, with clearly articulated expectations for each. Trainees accepted into this program will have identified a mentor. By their acceptance of the award, the trainee and the mentor will agree to participate in the mandatory educational activities of the training program and its evaluation processes. All fellows will undergo a minimum two-year training period, with strong encouragement to submit individual research proposals (NRSA and AHA) for the following year(s). Support for a second year will be conditional on evidence of research progress and submission of individual grants for a third year. Typically, a third year (or more) is necessary for the transition to independence. It is anticipated that in Year 1 the trainee and mentor will outline a career plan for transition to independence, which may include grant preparations for funding through a K08 mechanism or application to the existing K12.

The application deadline for the program is March 1, 2011. More information and a link to the application is available at: http://vascularmed.stanford.edu/

Researchers give school kids a taste of CVI science

When Dr. John Cooke (Professor and Associate Director of the CVI) received an email from the Lego Cells Science Team from Almaden Country School, he was intrigued. The letter read, "We are the Lego Cells, a robotics team in San Jose. We are seven fourth graders, and we need information for the research part of our Lego robotics competition. We are doing research on heart disease and its connection with smoking. We would like to know more about progenitor cells. We think it is interesting that progenitor cells can repair things, and we were thinking of a solution that has to do with repairing the endothelium..."

Of course, Dr. Cooke has been thinking about ways to repair the endothelium for the past 25 years, so he was interested to meet these budding young scientists. He invited the team to the CV Institute on Dec 3, 2010, to visit with him and Dr. Robert Robbins (Professor and Director of CVI). The kids heard a lecture on vascular disease, endothelial regeneration and progenitor cells. They asked some perceptive questions. (" What does it take to grow progenitor cells? How do we get them out of the bone marrow? Are there bad side effects to the endothelium from adding progenitor cells? How many progenitor cells do we need? How can you give them to people? Could nanorobots be used to repair the endothelium?"). Drs. Robbins and Cooke were very impressed by the precocious knowledge and insight of these budding young investigators.

Then the team went on a tour of the CVRB and its laboratories, and got to hear from some of the junior scientists at Stanford, including Dr. Ngan Huang who let them view endothelial progenitor cells through the microscope.

Informed by their trip to Stanford, the following day the Lego Cells took 2nd place in their scientific performance among 36 teams of 4th-8th graders and earned an invitation to the NorCal Championship tournament in January 2011.

Dr. Ole Jorgenson (Head of Almaden Country School) later wrote: "Please accept my thanks for ... the warm and gracious welcome you provided the children, and at the level of personal attention and access you afforded them on very short notice. Clearly you appreciate the life-shaping influence you have in helping us make learning relevant for our future scientists (and poets, and teachers, and . . .) -- I admire the work you do on behalf of the scientific community and your willingness to take precious time to inspire seven eager, curious, and impressionable young people. Who can predict what you made possible today! We need more of this in our world.With much gratitude, Ole!"

Report contradicts FDA warning against use of anti-clotting drug with proton-pump inhibitors

It's appropriate for heart patients who need to take the anti-clotting drug clopidogrel and who also have a high risk of gastrointestinal bleeding to receive a prescription for acid-reducing medications called proton-pump inhibitors such as pantoprazole, according to a new consensus document issued Nov. 8 by three medical groups. The benefits outweigh the potential risks, according to the document, which contradicts last year's warning to patients by the U.S. Food and Drug Administration that the two therapies should not be combined because the proton-pump inhibitors could reduce the efficacy of clopidogrel by 50 percent.

Clopidogrel is marketed as Plavix; pantoprazole, which is sold under the brand name Protonix, is one of a half dozen or so proton-pump inhibitors.

"In patients at high risk of GI bleeding who require antiplatelet therapy for heart disease, the balance of risk and benefit favor use of proton-pump inhibitors," said Mark Hlatky, MD, professor of cardiovascular medicine and vice chair of the writing committee that produced the document on the combined therapy. "In patients at low risk of GI bleeding, however, the balance of risk and benefit tips away from using proton-pump inhibitors together with antiplatelet drugs."

Clopidogrel is widely used to prevent blood clotting in patients who have undergone bypass surgery, angioplasty, stenting and other procedures. Because it can increase susceptibility to bleeding, physicians often prescribe acid-reducing drugs to lower this risk. The FDA recommended replacement of proton-pump inhibitors by another class of drugs that is not as effective.

The three medical groups involved were the American College of Cardiology Foundation, the American College of Gastroenterology and the American Heart Association. The committee's work was funded by the American College of Cardiology Foundation with no contributions from industry.

Supplementing angiograms with other probe saves money as well as lives, study shows

A new interventional heart technology that can help patients avoid needless stenting operations by providing in-depth measurements of blood flow in the vessels to the heart has now been found to also save money as well as lives, according to a study published Dec. 14 in Circulation: Journal of the American Heart Association.

"This is one of those rare situations in which a new technology not only improves outcomes but also saves resources," said William Fearon, MD, first author of the study and associate professor of cardiovascular medicine.

The technology is known as "fractional flow reserve," or FFR. It involves inserting a coronary pressure guidewire into the artery instead of relying solely on the traditional coronary angiogram to determine which arteries should be stented for patients with coronary artery disease.

Over the course of a year, FFR saved an average of $2,000 per patient, according to the study. The overall cost was reduced from approximatley $14,000 to $12,000.

"What we found was a combination of savings first at the initial procedure as a result of fewer stents and then further savings due to fewer events during follow-up — fewer heart attacks, fewer blood clots, fewer repeat surgeries," Fearon said.

The cost of an average stent, which doctors use to prop open clogged arteries, is $2,000. The pressure wire costs about $650.

The cost comparison study of the two treatment methods for coronary artery disease was an outgrowth of a 2009 study published in the New England Journal of Medicine called "FAME." Fearon was co-principal investigator and senior author of that multicenter international study. Researchers in the Circulation trial performed an economic evaluation of the results from the FAME trial.

The FAME trial included about 1,000 patients in the United States and Europe. Patients either suffered from chest pains or were recovering from mild heart attacks. All patients had multiple coronary arteries with narrowing.

About half were treated with the traditional method of using an angiogram to decide which narrowings to stent.

The other half of the patients underwent the angiogram with the additional pressure wire technique. To measure blood flow beyond the areas in the arteries that appear narrowed, the pressure wire was threaded through the same catheter used for the angiogram.

"The pressure wire is a thin wire with a sensor near the tip that can measure the pressure of blood flow," Fearon explained. "If the narrowing is truly significant it will cause a drop in blood pressure beyond the narrowing. If the pressure was 80 percent or less than the pressure in front of the narrowing, a stent was implanted."

Researchers found that patients who received the additional blood flow test received one-third fewer stents than the group examined only with an angiogram. Those patients received 2.7 stents on average. The other half who had their blood flow measured in each artery received only 1.9 stents on average.

But an additional study was needed to provide evidence that the new technique also saved money.

New drug may provide more cost-effective stroke prevention than warfarin, study shows

A newly approved drug may be a cost-effective way to prevent stroke in patients with an irregular heart rhythm — and may also offer patients better health outcomes than the commonly prescribed, but potentially risky, blood thinner warfarin. That's according to a new analysis from researchers at the Stanford University School of Medicine and the Veterans Affairs Palo Alto Health Care System.

"Dabigatran is the first new drug in 20 years to be approved for stroke prevention in atrial fibrillation, and we wanted to see if it could be cost-effective even before it made its debut in the United States," said cardiac electrophysiologist Mintu Turakhia, MD, MAS, a VA investigator and an instructor of medicine at Stanford. Turakhia is senior author of the research that appears Nov. 2 in the Annals of Internal Medicine.

"We found that for the average patient — 65 years and older with a risk of stroke — this drug has the potential to be a cost-effective alternative to warfarin, depending on how it is priced," said first author James Freeman, MD, MPH, a cardiology fellow at Stanford.

The researchers hope their findings will help guide decisions by physicians, insurance payers and policy-makers about the drug, dabigatran, which the U.S. Food and Drug Administration approved on Oct. 19 for the prevention of stroke in patients with atrial fibrillation. "We now have sufficient efficacy and cost-effectiveness data to help inform policy on this drug in the United States," Turakhia said.

Atrial fibrillation is responsible for about 15 percent of the 700,000 strokes per year in the United States. Many patients are prescribed the anticoagulant warfarin as a preventive measure. Although warfarin is effective at reducing a patient's stroke risk, it is a less-than-perfect therapy: The dosage has to be just right (too little and it could fail to prevent stroke, too much and it could lead to serious or fatal hemorrhage), and patients on the drug face constant blood testing and dose adjustment.

"Among my patients, I get asked about alternatives to warfarin a dozen times a week," said Turakhia, who specializes in the treatment and research of atrial fibrillation. "Many of them are just unhappy with the need for regular, often lifelong blood testing."

Much research has focused on developing a suitable replacement for warfarin, which has been in clinical use for 65 years. Although warfarin is effective at reducing a patient's stroke risk, it is a less-than-perfect therapy: The dosage has to be just right (too little and it could fail to prevent stroke, too much and it could lead to serious or fatal hemorrhage), and patients on the drug face constant blood testing and dose adjustment.

Dabigatran, an oral anti-clotting drug that requires no blood testing, emerged as one promising alternative. In a large, multicenter study published in the New England Journal of Medicine last year, the drug was about as effective as warfarin in preventing strokes but less likely to cause intracranial hemorrhages. Patients on the new drug, though, did have a slightly increased risk of heart attack.

For this study, the researchers developed a mathematical model to compare outcomes and costs of warfarin, low-dose (110 mg twice daily) dabigatran and high-dose (150 mg twice daily) dabigatran. The team's model simulated 10,000 patients aged 65 and older with atrial fibrillation and risk factors for stroke. They determined that high-dose dabigatran prevented 1,000 more intracranial hemorrhages and 600 more strokes than warfarin was calculated to prevent, though dabigatran resulted in 400 additional heart attacks. They also determined that total lifetime costs were $143,193 for warfarin, and $168,398 for high-dose dabigatran. (Though warfarin is much less expensive than dabigatran, the costs of lifelong monitoring and adverse effects boosted its total costs.)

Other Stanford authors on the study were medical student Ruo Zhu; Douglas K. Owens, MD, an investigator at the VA and professor of medicine and of health research and policy at the medical school; Alan Garber, MD, PhD, professor of medicine; and Paul Wang, MD, professor of medicine.