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http://radiology.stanford.edu/about/annualreport/
From the Chairman

THE STANFORD DEPARTMENT OF RADIOLOGY continues to thrive in an ever-changing and challenging world. In my last message to you through the 2014–15 Annual Report, I shared examples of the department’s achievements in multiple new areas of clinical, educational, and research expansion. This growth matches our most aggressive expectations and positions the department to be an outstanding clinical and research entity at Stanford.

Implemented through our truly outstanding faculty, staff, and trainees, we continue to push the boundaries of what radiology, as a field, will offer in the years ahead. Key themes of my chairmanship have included “Science Without Borders,” which creates significant bridges to scientific and clinical activities throughout the medical school, affiliated hospitals, and across the Stanford campus. Earlier this year, we formally announced two important new initiatives: (1) The Precision Health and Integrated Diagnostics (PHIND) Center at Stanford, and (2) Project Baseline. While distinctly different initiatives, the PHIND Center and Project Baseline both introduce new concepts to healthcare and build on the long-held belief that precision health can help us move away from the position of being more reactive to being more proactive. Unlike precision medicine, precision health focuses on risk assessment, prevention, and early disease detection. We need to move the entire healthcare field towards a precision health strategy, and both the PHIND Center and Project Baseline will help us to do just that.

The new PHIND Center (page 112–113) is dedicated to longitudinal monitoring and improvement of over-200 health focuses on risk assessment, prevention, and early disease detection. We need to move the entire healthcare field towards a precision health strategy, and both the PHIND Center and Project Baseline will help us to do just that.

The second initiative, another major milestone in 2017, was the launch of Project Baseline, a collaboration between Verily, Google (Alphabet), Stanford Medicine, and Duke University School of Medicine (page 111). The project will gather comprehensive health information on 10,000 participants to better understand health and the transition to disease, including cancer and heart disease.

We have made remarkable progress in key research areas that we believe are important to healthcare in the long-term. These areas include: (1) Early disease detection as one of our strategies for moving from precision medicine towards precision health (e.g., early lung cancer screening). (2) Pharmacodynamics through the use of technologies such as MR-high intensity focused ultrasound (MRI-HIFU) and through radiochemistry with imaging agents that serve as both diagnostics and therapeutics. (3) Multimodality imaging through strategies that combine the best of what each modality has to offer (e.g., MR + PET: ultrasound + photonicacoustic). (4) Bringing together in vitro diagnostics with in vivo diagnostics for improved patient care (e.g., lung cancer detection and management through the use of CT, PET-CT, and circulating tumor cells). (5) Increased clinical trials bringing new instrumentation and new imaging agents to the clinic. (6) Breast tomosynthesis for improved breast imaging. (7) Pediatric oncologic imaging strategies with PET-MR that reduces radiation burden relative to PET-CT while still providing similar accuracy. (8) Novel strategies for improving cardiovascular imaging including 4D visualization and 3D printing for improved patient care. (9) Imaging informatics/artificial intelligence for extracting more useful information from medical data/images as well as combining information from different disciplines (e.g., genomics, pathology, and radiology). (10) Start-up companies to take academic discoveries and research to the private sector creating jobs and eventually allowing strategies pioneered at Stanford to be made available worldwide.

With the opening of many new facilities, and the expansion of existing ones, our growth in space and facilities, in particular for our clinical needs, has been remarkable. In recent years, we have experienced high growth of our clinical imaging capabilities. With the anticipated opening of the Lucile Packard Children’s Hospital Expansion in December 2017, the planned construction completion of the new Stanford Hospital in early 2019, the newly acquired outpatient sites, and a commitment to keep our imaging sites up-to-date, we have purchased more imaging equipment than ever before (pages 36–37). During the last three years alone, we have acquired 15 new clinical MRIs. Our ability to use the most cutting-edge equipment ensures that we can achieve our commitment to the highest levels of patient care.

Regarding research space: We are in the process of updating several sites, including the Lucas Center, the Clark Center, and the Porter/Canary Center facility with upgrading, or siting new equipment (that is microscopes, a microCT scanner, and magnetic particle imaging (MPI)). At the Canary Center facility, we are siting new equipment ranging from imaging to mass spectrometry to stereomicroscopy. To manage these very active research areas, we have added 13 new faculty, and ten instructors, to keep all facilities operating at the highest level and to accommodate many users’ schedules and their varied research needs.

The growth in our faculty is a reflection of the department’s commitment to excellent patient care and advancing research. Since 2016, we have welcomed 15 new faculty, ten instructors, and twenty adjunct, affiliated, courtesy, or part-time faculty. Each new faculty addition not only fills a particular gap in a specific area in the department, but also brings fresh energy and an enriched perspective to the team. Please see pages 16–27 for information about each new faculty member—and be sure to keep an eye out for them throughout your day and welcome them to our Radiology family!

With a need to increase efficiencies for a rapidly expanding department, we have restructured leadership as of August 1, 2017: (1) Dr. Garry Gold named Vice Chair of Research and Administration. (2) Dr. David Larson named Vice Chair of Education and Clinical Services. (3) Dr. Juergen Willmann named Vice Chair of Strategy, Finance and Clinical Trials. This newly formed leadership model will share department responsibilities to begin a new era of partnership with me in leading a radiology department that is rapidly expanding on all fronts. There are several other changes as well, including the naming of Dr. Heike Daldrup-Link, Associate Chair for Diversity; Dr. Wendy DeMattii, Division Chief of Breast Imaging; Dr. Payam Masaband, Associate Chair and Chief of Radiology at the VA Palo Alto Health Care System (VAPAHCS); and Dr. Christopher Beaulieu, Associate Chair of Education (taking over for Dr. Michael Federle effective January 2018). As we have further discussions on department leadership throughout this calendar year, there are likely to be additional changes announced later in 2017 and early 2018.

Ten faculty searches are currently in progress and include: (1) Three positions in Pediatric Radiology: a director of pediatric interventional radiology; a pediatric radiologist and medical director for clinical operations, and a clinical pediatric radiologist; (2) Two positions...
director of pediatric interventional radiology; a pediatric radiologist and medical director for clinical operations, and a clinical pediatric radiologist; (2) Two positions in Nuclear Medicine: a nuclear medicine/molecular imaging physician scientist and a targeted radionuclide therapy expert; (3) One position in IBIS (Integrative Biomedical Imaging Informatics at Stanford); a machine learning expert; (4) Three positions in Breast Imaging: one located in the East Bay and two at other Stanford Health Care (SHC) sites; and (5) One basic scientist for the Canary Center at Stanford for Cancer Early Detection and the Stanford Cancer Institute. We are also in the process of launching several new physician, physician-scientist, and basic scientist faculty searches in the next few months.

We are at the final stages of several faculty searches, including: a basic scientist in the Molecular Imaging Program at Stanford (MIPS), a basic scientist with the Radiological Sciences Laboratory (RSL) at VA Palo Alto, a physician-scientist to serve as director of Pediatric Neuroimaging, and a physician to serve as director of Pediatric Nuclear Medicine. We hope to successfully complete these searches in the coming months.

We have also expanded our scientific leadership staff since 2015: (1) Dr. Mark Stolowitz joined Dr. Stephanie van de Ven as Deputy Director of Operations for the Canary Center at Stanford for Cancer Early Detection; (2) Dr. Gunilla Jacobson was named Deputy Director of the Molecular Imaging Program at Stanford (MIPS); (3) Dr. Praveen Gulaka was named Deputy Director of the PET-MRI Service Center; (4) Dr. Ryan Spitler joined the department as Deputy Director of the newly established Precision Health and Integrated Diagnostics (PHIND) Center; and (5) Dr. Rajan Munshi was named Deputy Director of Scientific Program Management.

Furthermore, Dr. Gary Glover has stepped down as Division Chief of the Radiological Sciences Laboratory (RSL) after twenty-four years of extraordinary service (1990–2014) and Co-Division Chief of RSL (since 2014). He continues to serve as the head of the Lucas MRI Service Center, and to run an active laboratory where he helps to mentor faculty and trainees. We thank Dr. Glover for his outstanding and dedicated service. Dr. Kim Butts Pauly, Co-Division Chief of RSL since 2014, is now the sole Division Chief of RSL.

Research has remained on a tremendous trajectory as well. According to the most recent data published by the Academy of Radiology Research for 2016, we continue to be among the top two or three NIH-funded Radiology Departments in the country and the highest NIH-funded per capita of all Radiology Departments in the USA. During fiscal year 2017 (September 1, 2016 through August 31, 2017), we experienced an overall increase of 22% in total funding and secured funding for 76 new sponsored research projects. New awards include: 20 new NIH awards (10 R01, 3 F32, 2 K99, 1 R21, 1 R25, 1 T32, 1 U01, 1 X01); 32 new industry-funded projects (12 with new collaborators); 10 non-profit awards (foundations and professional organizations); and 14 awards from other funding sources (Department of Defense (DOD), Stanford University, and other university sub-contracts).

The Stanford Department of Radiology proudly reflects new and broader interests that are underscored by our successes and collaborations in multiple areas that include physics, chemistry, molecular biology, mathematics, materials science, engineering, genetics, bioinformatics, epide-
In Memoriam

Herbert Abrams, MD (1920–2016)

Dr. Abrams was an internationally renowned pioneer in radiology. He was Professor and Director of Diagnostic Radiology at Stanford from 1960 to 1967, and was then appointed and served as the Philip H. Cook Professor and Chairman of Radiology at Harvard University from 1967 to 1985. He returned to Stanford in 1985 as Professor of Radiology to focus most of his time on research. He retired in 1990 as Professor of Radiology, Emeritus, but was recalled part-time from 1992 to 2008.

A recognized expert on cardiovascular radiology, Dr. Abrams authored nearly 200 papers and seven books on cardiovascular disease and health policy, and was founding Editor-in-Chief of the journal Cardiovascular and Interventional Radiology. His 1961 textbook Angiography, the first comprehensive volume on the subject, is in its 4th edition (edited by Dr. Stanley Baum) under the title Abrams’ Angiography: Vascular and Interventional Radiology.

Dr. Abrams also served as the Editor-in-Chief of the journal Postgraduate Radiology (1980–1999). He was an Honorary Fellow of the Royal College of Radiology of Great Britain and the Royal College of Surgeons of Ireland. Dr. Abrams was awarded the 1984 Gold Medal of the Association of University Radiologists, the 1995 Gold Medal from the Radiological Society of North America (RSNA), and the 2000 Gold Medal from the Society of Cardiovascular and Interventional Radiology in recognition of his lifetime achievements in cardiovascular radiology.

A member of the Institute of Medicine of the National Academy of Sciences, Dr. Abrams was also founding vice-president of International Physicians for the Prevention of Nuclear War (IPPNW) in 1980. The group’s primary goal was to educate and publicize the health risks and consequences of nuclear war, and to counter theories that physicians might be able to save enough people to continue civilized life. Dr. Abrams later called nuclear weapons and nuclear war “the central health issue of the 20th century.” This group received the UNESCO Prize for Peace Education in 1984, followed by the Nobel Peace Prize in 1985. He also served for 20 years on the National Board of Directors for Physicians for Social Responsibility (PSR), and was also National Co-Chairman during the 1980’s.

According to Scott Sagan, Professor of Political Science at Stanford, “his contributions were huge,” including his “work to try to educate both the public and world leaders about the consequences of nuclear weapons use.” Further, in the 1990s, Dr. Abrams began to also focus on the occurrence of Presidential/World Leader disability and its potential impact on decision-making. He lectured every year at Stanford on how the physical and psychological health of leaders influenced their decision-making about war and peace.

Dr. Herb Abrams passed away on January 20, 2016. His colleagues across the nation and in unison can only describe him as “a class act—a gentleman and a scholar for all time.”
Gerald Friedland, MD (1933–2016)

Gerald Friedland, MD, a professor emeritus of Stanford Department of Radiology passed away on April 2, 2016 in Los Gatos, California. He was 82.

Dr. Friedland received his medical degree from the University of Pretoria, South Africa, and completed his medical training in Scotland, Cambridge, and London before moving on to London’s Great Ormond Street Hospital for Sick Children. He led a career as a clinical radiologist, researcher, and administrator. He authored or co-authored more than 100 medical articles and 35 book chapters and contributed to four books.

Dr. Friedland joined Stanford as an Instructor in 1966, became an Assistant Professor in 1968, and was promoted to Associate Professor in 1972. He left Stanford in 1975 to become the Director of Diagnostic Radiology and Professor of Radiology at Wake Forest University’s Bowman Gray School of Medicine in North Carolina. In 1978, he returned to Stanford as Professor of Radiology and in the early 1980’s became Chief of what is now the VA Palo Alto Health Care System until his retirement as Professor of Radiology, Emeritus, in 1992. He received a Lifetime Achievement Award from Stanford and organized the first Pioneering Efforts of Women in Medicine and the Medical Sciences conference in 2000.

In Dr. Friedland’s early years, his clinical focus was on pediatric radiology and radiologic gastroenterology, but later he became interested in uroradiology and research. He developed a way to use ultrasound to image the urethra and prostates of patients with spinal cord injuries, and provided definitive information on the structure of the esophagus. His research at VA Palo Alto resulted in significantly reducing radiation exposure to abdominal and reproductive organs.

Dr. Gerald Friedland was truly an extraordinary individual. His passing is a great loss to the department and to the Stanford community as a whole. Dr. Friedland will be profoundly missed by everyone whose lives he touched; he was a kind soul, an excellent physician, an ethical researcher, and a true scholar.

F. Graham Sommer, MD (1946–2016)

Graham Sommer, MD, Professor of Radiology, Emeritus, at Stanford University School of Medicine, passed away on October 2, 2016, at the age of 70 of amyotrophic lateral sclerosis (ALS). With Mozart playing in the background, he died peacefully at his home on the Stanford campus, surrounded by family, friends, and his beloved cats.

A dedicated clinician and researcher, an avid bicyclist, golfer, skier, hiker, wine connoisseur, world traveler, and musician, Dr. Sommer was, above all, a friend to many here at Stanford and elsewhere. Dr. Michael Federle, a colleague, friend, and golfing partner, commented, “He lived life to the fullest.”

Dr. Sommer grew up in British Columbia, Canada, received his BS degree from the University of Victoria in 1968 and his MD degree from McGill University in 1972. He did research training in Biomedical Engineering at Stanford from 1972 to 1973 before going to UCSF for his residency training in radiology from 1974–1977. He remained at UCSF to complete his fellowship in ultrasound, CT, body imaging, and genitourinary radiology in 1978. Dr. Sommer was then appointed Assistant Professor at Yale University, where he stayed for one year before returning to Stanford in 1979 as Assistant Professor of Radiology.

Widely known as an expert in ultrasound and magnetic resonance imaging (MRI), much of Dr. Sommer’s research focused on blood flow to vital organs as well as imaging and treatment of the prostate. His interests in radiology were diverse, as were his interests outside of the field. In fact, by his own admission and with his own unique brand of humor, he characterized himself as a “Renaissance radiologist.”

His wife, Denise Leclair, described him as “... a driven man. He had such a hungry mind; it drove him.” His inquisitive nature surrounding medicine was balanced by his love for music. Dr. Sommer was an accomplished classical pianist and composer who played events frequently, including the local Filoli Mansion, a country estate in Woodside, California. His legacy is closely linked to that love of music as exemplified by his 2016 pledge of $1 million to McGill University.

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Office of the Chair

Sanjiv Sam Gambhir, MD, PhD
Chair, Department of Radiology
Division Chief, Molecular Imaging Program at Stanford
Division Chief, Canary Center at Stanford for Cancer Early Detection
Director, Precision Health and Integrated Diagnostics Center at Stanford

Yun-Ting Yeh
Director, Finance and Administration

Garry Gold, MD
Vice Chair, Research and Administration
September 1, 2017 to Present
Associate Chair, Research
2012 to 2017

David Larson, MD, MBA
Vice Chair, Education and Clinical Operations
September 1, 2017 to Present
Associate Chair, Performance Improvement

Juergen Willmann, MD
Vice Chair, Strategy, Finance, and Clinical Trials
September 1, 2017 to Present
Division Chief, Body Imaging

Associate Chairs

Richard Barth, MD
Associate Chair, Pediatric Imaging
Radiologist-In-Chief, LPCH
Division Chief, Pediatric Imaging

Christopher Beaulieu, MD, PhD
Associate Chair, Clinical Education
January 1, 2018 to Present
Division Chief, Musculoskeletal Imaging

Heike Daldrup-Link, MD
Associate Chair, Diversity

Michael Federle, MD
Associate Chair, Education

Robert Herfkens, MD
Associate Chair, Clinical Technology

R. Brooke Jeffrey, MD
Associate Chair, Academic Affairs
Vice Chair
2010 to 2017

Curtis Langlotz, MD, PhD
Associate Chair, Information Systems

Volney Van Dalen, MD
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Division Chiefs

Ann Leung, MD
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Payam Massaband, MD
Associate Chair and Division Chief, Radiology
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Bruce Parker, MD
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Hans Ringertz, MD, PhD
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Wendy DeMartini, MD
Division Chief, Breast Imaging

Dominik Fleischmann, MD
Division Chief, Cardiovascular Imaging

Lawrence “Rusty” Hofmann, MD
Division Chief, Interventional Radiology

Andrei Iagaru, MD
Division Chief, Nuclear Medicine and Molecular Imaging

Sandy Napel, PhD
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John Chang, MD, PhD
Adjunct Clinical Instructor
Lawrence Chow, MD
Clinical Associate Professor
Bruce Daniel, MD
Professor
Terry Desser, MD
Professor
Ahmed El Kaffas, PhD
Instructor
Michael Federle, MD
Professor

Stuart Stein, MD
Adjunct Clinical Assistant Professor
Russell Stewart, MD, MBA
Clinical Assistant Professor
Vadney Van Dusen, MD
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Scott Williams, MD
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Juergen Willmann, MD
Professor
Michael Yang, MD
Adjunct Clinical Instructor

Body MRI
Pejman Ghanouni, MD, PhD
Assistant Professor
Robert Herfkens, MD
Professor
Douglas Lake, MD
Adjunct Clinical Assistant Professor
Andreas Loening, MD, PhD
Assistant Professor
Michael Muelly, MD
Clinical Instructor
Sheyasi Vasanawala, MD, PhD
Associate Professor

Breast Imaging
Audra Brunelle, MD
Clinical Assistant Professor
Wendy DeMartini, MD
Professor
Debra Reda, MD
Professor
Kris Lipson, MD
Clinical Instructor
Sunita Pal, MD
Clinical Associate Professor
Lisa Schmelzel, MD
Clinical Assistant Professor
Xin Ye, MD
Clinical Instructor

Canary Center at Stanford for Cancer Early Detection
Utkan Demirci, PhD
Professor
Sanjiv Sam Gambhir, MD, PhD
Professor

Integrative Biomedical Imaging Informatics (IBIIS)
Benedict Anchang, PhD
Instructor
Curtis Langlotz, MD, PhD
Professor
Sandy Naepl, PhD
Professor
David Park, PhD
Adjunct Lecturer
Sylvia Plevritis, PhD
Professor
Daniel Rubin, MD, MS
Associate Professor

Cardiovascular Imaging
Christoph Becker, MD
Professor
Francis Chan, MD, PhD
Associate Professor
Domink Fleischmann, MD
Professor
Sanjay Gupta, MD
Adjunct Clinical Instructor
Richard Hallert, MD
Clinical Instructor
Horacio Murrillo, MD, PhD
Adjunct Clinical Instructor
Koen Nieman, MD, PhD
Associate Professor
Humberto Wong, MD
Adjunct Clinical Instructor

Interventional Radiology
Richard Baxter, MD
Adjunct Clinical Associate Professor
Lawrence [Rusty] Hofmann MD
Professor
Richard Hong, MD
Adjunct Clinical Instructor
David Hoveyepan, MD
Clinical Professor
Gloria Hwang, MD
Clinical Associate Professor
Ibrahim Idakoji, MD
Clinical Instructor
Andrew Kesselman, MD
Clinical Instructor
Nichita Kothary, MBBS
Associate Professor
William Kuo, MD
Associate Professor
John Loule, MD
Clinical Associate Professor
Charles P. Semba, MD
Adjunct Professor
Taylo Shimizu, MD
Clinical Assistant Professor
Daniel Sze, MD, PhD
Professor
Taiyo Shimizu, MD
Adjunct Professor
Charles P. Semba, MD
Clinical Associate Professor

Molecular Imaging Program (MIPS)
Vikram Bajaj, PhD
Adjunct Professor
Carolyne Bertazi, PhD*
Professor
Joshua Cates, MD
Instructor
Zhen Cheng, PhD
Associate Professor
Frederick Chin, PhD
Assistant Professor
Sanjiv Sam Gambhir, MD, PhD
Professor

* Courtesy Appointment

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Radiology Department Report 2015–2017
Radiology Faculty
Neuroimaging and Neurointervention

Christopher Neal, MD
Adjunct Clinical Assistant Professor

Rajiv Pandit, MBBS
Assistant Professor

Rajiv Pandit, MBBS
Clinical Assistant Professor (Affiliated)

Mudula Penta, MD
Associate Professor

Max Wintermark, MD, MBA
Clinical Instructor

Kristen Yeom, MD
Associate Professor

Hisham Dahmoush, MBCh
Clinical Instructor

Neural Medicine and Molecular Imaging

Guido Davidzon, MD
Clinical Assistant Professor

Andrei Logaru, MD
Associate Professor

Erik Kithna, MD, PhD
Clinical Assistant Professor

Shyam Srinivas, MD, PhD
Clinical Assistant Professor

Jeffrey Tseng, MD
Clinical Assistant Professor (Affiliated)

Thomas Yohanann, MD
Clinical Instructor

Pediatric Imaging

Patrick Barnes, MD
Professor

Richard Barth, MD
Professor

Francis Blankenberg, MD
Associate Professor

Jana Chalouhi, MD
Adjunct Lecturer

Francis Chan, MD, PhD
Associate Professor

Joseph Cheng, PhD
Instructor

Jeremy Dahl, PhD
Assistant Professor

Hisham Dahmoush, MBCh
Clinical Instructor

Heike Daldrup-Link, MD
Professor

Satwan Halabi, MD
Clinical Assistant Professor

Diana Jeromin, MD
Adjunct Clinical Assistant Professor

Robert Jones, MD
Adjunct Clinical Instructor

Ralph Lachman, MD
Clinical Professor

Fred Lurgham, MD
Clinical Assistant Professor

David L. Larson, MD
Associate Professor

Edward Lewbowitz, MD
Clinical Professor

Matthew Lungren, MD
Assistant Professor

Beverley Newman, MBCh
Clinical Instructor

Alex Ostynskaya, MD, PhD
Adjunct Lecturer

Erika Rubesova, MD
Clinical Assistant Professor

Matthew Schmitz, MD
Adjunct Clinical Instructor

Jayne Seelknin, DO
Clinical Assistant Professor

Glen Seidel, MD
Clinical Professor

Avnish Thakor, MD, PhD
Assistant Professor

Shreyas Vasanawala, MD, PhD
Associate Professor

Kristen Yeom, MD
Associate Professor

Emily Tosi, MD
Clinical Instructor

VA Radiology

Stephanie Chang, MD
Clinical Instructor (Affiliated)

Boo Do, MD
Clinical Assistant Professor (Affiliated)

Christine Ghdalan, MD
Clinical Instructor (Affiliated)

Charles Lau, MD, MBA
Clinical Associate Professor (Affiliated)

Patrick Lee, MD
Adjunct Clinical Assistant Professor

Sachin Malik, MD
Clinical Instructor (Affiliated)

Payam Massaband, MD
Clinical Assistant Professor

Michelle Nguyen, MD
Clinical Assistant Professor (Affiliated)

Eric Olcott, MD
Professor

Christopher Posham, MD, PhD
Clinical Instructor (Affiliated)

Amanda Riga, MD
Clinical Instructor (Affiliated)

Rajesh Shah, MD
Clinical Assistant Professor (Affiliated)

Lewis Shin, MD
Clinical Associate Professor (Affiliated)

Ali Tahvidari, MD
Clinical Assistant Professor (Affiliated)

Katherine To’a, MD
Clinical Assistant Professor (Affiliated)

Eric Travinh, MD
Clinical Instructor

VA Nuclear Medicine

Christine Kaeling, MBBS
Clinical Associate Professor (Affiliated)

George Segall, MD
Professor

Mirza Vasanawala, MBBS
Clinical Assistant Professor (Affiliated)

Thoracic Imaging

Henry Guo, MD, PhD
Clinical Assistant Professor

Ann Leung, MD
Professor

Margaret Lin, MD
Adjunct Clinical Assistant Professor

Emily Tosi, MD
Clinical Instructor

Radiology Department Report 2015–2017

Radiology Faculty

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Radiology Department Report 2015–2017

Radiology Faculty

18
New Faculty Appointments (2016–2017)

Raag Airan, MD, PhD

Dr. Raag Airan received his BS in physics and mathematics from MIT (2003), from Stanford, he received an MS (2006), and a PhD in bioengineering (2010). Dr. Airan completed an internship at Washington Hospital Center in Washington, DC (2011), followed by a radiology residency (2011–2015) and neuroradiology fellowship (2016) at Johns Hopkins. He joined Stanford Radiology as an Assistant Professor (2016). Dr. Airan’s primary research interests focus primarily on the development and use of MR-guided focused ultrasound (MRgFUS) for interventions in the nervous system.

Benedict Anchang, PhD

Dr. Anchang received his BS in mathematics from the University of Buea, Cameroon (2002). He then earned two MS degrees in statistics and in applied statistics, both from the University of Hasselt, Belgium (2005–2006). He next completed his PhD in bioinformatics, magna cum laude, from the University of Regensburg, Germany (2011). He joined the Integrative Biomedical Imaging Informatics at Stanford (IBIIS) Division as a postdoctoral fellow (2012). Dr. Anchang continues his research with IBIIS in mathematical modeling, disease progression, and prediction. He was appointed as a Radiology Instructor in 2017.

Stephanie Chang, MD

Dr. Stephanie Chang received her MD from UCSF in 2010, and completed her Internal Medicine internship at Kaiser Permanente in Oakland from 2010 to 2011. She began her diagnostic radiology residency at Washington University in St. Louis in 2011 and transferred to our residency program the following year. She completed a fellowship in our Body MRI division in 2016 and joined VA Palo Alto as a Staff Radiologist.

Joshua Cates, PhD

Dr. Cates received his PhD in Nuclear Engineering from the University of Tennessee in 2013. He has been a postdoctoral fellow in our Department since 2013 in Dr. Craig Levin’s lab. He has been involved in several molecular imaging instrumentation research projects, including the research, development and testing of a prototype PET system. He has also helped direct the Basic Sciences Lecture series for Nuclear Medicine and Radiology residents. He was the recipient of the IEEE Trainee Award in 2008, 2014, 2015, and the Valentin T. Jordonov Radiation Instrumentation Award in 2014, 2015, and 2016.

Joseph Cheng, PhD

Dr. Cheng received his BS degree at MIT (2004) and also his Masters in Engineering (2007). He then completed his PhD in electrical engineering, at Stanford (2013). He continued as a postdoctoral scholar in radiology (2013–2016), where he is well-known as an expert in free-breathing MRI and other techniques that benefit clinical pediatric patients. Dr. Cheng was named a WS Moore Young Investigator, ISMRM (2015). Continuing his work on the development of novel translational pediatric MRI techniques, Dr. Cheng was appointed as a Radiology Instructor in 2016.

Hisham Dahmoush, MBBCch

Dr. Dahmoush received his MBBCch degree from Cairo University (1996) and completed his internship and radiology residency at Cairo University Hospitals (2001). He was faculty at the latter and at Wadi El Neel Hospital (2002–2010). He then completed a pediatric neuroradiology fellowship at Children’s Hospital of Philadelphia (CHOP) (2012), a pediatric radiology fellowship at CHOP (2013), and an adult neuroradiology fellowship at the Hospital of the University of Pennsylvania (2014). He returned to CHOP for a child neuroradiology fellowship (2015) and a one-year international medicine residency at the Brigham and Women’s Hospital in Boston before joining our department in 2016.

Lawrence Chow, MD

Dr. Chow earned his MD from the University of Michigan (1993) and completed an internship at the University of Vermont (1994). He completed his radiology residency (2000) and a body imaging fellowship (2001), both at Stanford Radiology. He was an Assistant Professor in our department (2002–2005). He then became Associate Professor of Radiology at the Oregon Health and Science University (OHSU) (2005–2011). He has worked as a consulting radiologist for Vision Radiology Professional Services since 2005 and as a radiologist for OHSU since 2011. Dr. Chow recently returned to Stanford as Clinical Associate Professor in Body Imaging in 2017.

Guido Davidzon, MD

Dr. Davidzon earned his MD degree from Universidad Maimónides in Buenos Aires, Argentina (2003) and completed a two-year neurology research fellowship at Columbia University (2005–2006), and a surgical internship at Yale New Haven Hospital (2007). He also completed an NIM Fellowship in biomedical informatics at Harvard-MGH (2010). He completed Stanford Radiology’s three-year residency program in nuclear medicine and molecular imaging (2013) and was Chief Resident during his third year. He practiced as a nuclear medicine physician at Kaiser Permanente, Santa Clara, and was Clinical Assistant Professor at Stanford University before joining our department in 2017.
New Faculty Appointments (2016–2017)

Joseph DeMartini, MD
Clinical Associate Professor Musculoskeletal Imaging

Dr. Joseph DeMartini received his BS, with honors, from UC Davis (1980). After completing his Master’s degree in civil engineering from California State University, Sacramento (1984), he completed his MD at the Medical College of Virginia (1997). Following completion of a radiology residency at the University of Washington (2002), he completed a fellowship in musculoskeletal radiology at the Mayo Clinic (2003). Dr. DeMartini was an Associate Professor at the University of Wisconsin-Madison (2013–2016) prior to joining our department as a Clinical Associate Professor in 2016.

Wendy DeMartini, MD
Professor Breast Imaging

Dr. DeMartini received her BS from Saint Mary’s College of California (1993) and an MD from Medical College of Virginia (1997). She completed her residency at the University of Washington (UW) (2002), a fellowship at Barrow Neurological Institute (2003), and a breast imaging fellowship at UW (2004). From 2004–2011, she was faculty at UW and was recruited to the University of Wisconsin as Professor of Radiology and Section Chief of Breast Imaging (2013). Dr. DeMartini was elected President of SBIR (2017). She joined our department as Professor of Radiology and Division Chief of Breast Imaging in 2016.

Ahmed El Kaffas, PhD
Instructor Body Imaging

Dr. El Kaffas received his BS (2005) and his MS degrees both from Ryerson University in Toronto, Canada (2008). He received his PhD in medical biophysics from the University of Toronto (2013) and was a postdoctoral fellow at the Sunnybrook Research Institute and the University of Toronto (2014). Continuing his research in ultrasound, Dr. El Kaffas joined the Stanford Radiology as a postdoctoral scholar (2015). As a member of the Body Imaging Division and participant in its ultrasound-related research activities, Dr. El Kaffas was recently appointed Instructor in 2017.

Christine Ghatan, MD
Clinical Instructor (Affiliated) Interventional Radiology

Dr. Christina Ghatan received her MD from USC (2009). She completed her residency in Diagnostic Radiology at Cedars-Sinai Medical Center (2014), followed by an Interventional Radiology fellowship at Icahn School of Medicine at Mount Sinai (2015). Prior to joining VA Palo Alto as a staff radiologist, she was an Assistant Professor at the University of Colorado Denver. She joined our department as a clinical instructor in 2017.

Sharon Hori, PhD
Instructor Molecular Imaging Program at Stanford (MIPS)

Dr. Hori received her BS in applied mathematics and a second BS in cybernetics, both from UCLA (2003). Continuing at UCLA, Dr. Hori also earned an MS in biomedical engineering (2007). She was a postdoctoral fellow in our Department from 2008–2014 and then moved into a Research Associate role. Her research on developing cancer animal models to study early-stage disease overlaps with research efforts of the Molecular Imaging Program at Stanford (MIPS) and the Canary Center for Cancer Early Detection (Canary). Dr. Hori was appointed Instructor of Radiology in 2016.

Ibrahim Idakoji, MD
Clinical Instructor Interventional Radiology

Dr. Idakoji received an MD from the University of Illinois College of Medicine at Urbana-Champaign (2011). Following his medical training, he completed a one-year internship at the University of Texas Health Science Center at Houston (UTHealth) (2012). He continued on at UTHealth to complete his radiology residency training (2013). Following his residency, Dr. Idakoji also completed a fellowship at Barrow Neurological Institute in Phoenix, Arizona before joining our department as a Clinical Instructor in 2017.

Stefan Harmsen, PhD
Instructor Molecular Imaging Program at Stanford (MIPS)

Dr. Harmsen completed his MS in chemistry at Free University, Amsterdam (2005), and his PhD in toxicology (2009) and postdoctoral research fellowship (2010) at Utrecht University, Netherlands. He worked as a Research Fellow and then was a Research Associate at the Memorial Sloan Kettering Cancer Center, New York (2014–2016). His research involves the design, synthesis, and characterization of nanoparticles and dyes for early detection of cancer, immune cell monitoring, and guided resection. Most recently, Dr. Harmsen joined Stanford’s Department of Pediatrics, Division of Neonatology, and then transitioned to our department as an Instructor in 2017.

Syed Hashmi, MD
Clinical Instructor Neuroimaging

Dr. Hashmi received his MD from the University Of Illinois College Of Medicine at Urbana-Champaign (2011). Following his medical training, he completed a one-year internship at the University of Texas Health Science Center at Houston (UTHealth) (2012). He continued on at UTHealth to complete his radiology residency training (2013). Following his residency, Dr. Hashmi also completed a fellowship at Barrow Neurological Institute in Phoenix, Arizona before joining our department as a Clinical Instructor in 2017.
New Faculty Appointments (2016–2017)

Andrew Kesselman, MD

Dr. Kesselman received his MD from New York Medical College (2011) followed by a one-year internship at Mount Sinai Beth Israel Medical Center, New York. He then completed a diagnostic radiology residency program at the State University of New York (2014). Following his residency, he completed a vascular and interventional radiology fellowship in our department (2017). Dr. Kesselman specializes in minimally invasive image-guided procedures and comprehensive management of vascular and oncologic disease. He was appointed as a Clinical Instructor for the Interventional Radiology Division in 2017.

Feliks Kogan, PhD

Dr. Kogan received his BS in optics and applied mathematics from the University of Rochester (2007), following with his PhD in bioengineering from the University of Pennsylvania (2013). He completed an MRI post-doctoral fellowship in the Radiological Sciences Lab (RSL) (2015), and continued on as a Research Associate (2015–2017). He was named an ESRRM Junior Fellow (2018), honored with an ESRRM Young Investigator Cum Laude Award (2017), and received an NIH/NIBIB K99 award (2017). Dr. Kogan was appointed Instructor in 2017.

Shivaani Kummar, MD

Dr. Kummar is Professor of Medicine [Oncology] and of Radiology Molecular Imaging Program at Stanford (MIPS)(Secondary Appointment in Radiology). She completed her MD at the Lady Hardinge Medical College [New Delhi, India] (1992). Her training in clinical trials at the National Institutes of Health (NIH) introduces valuable collaboration potential with faculty in the design of new cancer clinical trials, with consideration for the best imaging modalities to optimize the trial. She works closely with our faculty to understand how specific cancer clinical trials may benefit patients. Dr. Kummar was appointed Professor of Medicine and Radiology in 2016.

Bryan Lanzman, MD

Dr. Lanzman received his MD from Columbia University (2010) College of Physicians and Surgeons. He then completed his residency in diagnostic radiology at New York Presbyterian Hospital, Columbia University Medical Center (2015). Dr. Lanzman was a fellow in the Neuroradiology and Neurointervention division and was appointed Clinical Instructor in 2017.

Edward Lo, MD

Dr. Lo received his MD from the University of Illinois at Chicago (2010), followed by a one-year internship at Weiss Memorial Hospital, Illinois (2011). He then completed his diagnostic radiology residency at the University of Illinois at Chicago (2015). Dr. Lo then came to the Stanford Department of Radiology as a concurrent fellow and Clinical Instructor (2015–2016). He was appointed as a Clinical Instructor in our Body Imaging Division in 2016.

Sanjay Malhotra, PhD

Dr. Malhotra is Associate Professor of Radiation Oncology (Radiation and Cancer Biology) and Radiology (Molecular Imaging Program at Stanford (MIPS)) (Secondary Appointment in Radiology). Dr. Malhotra, who received his PhD in Chemistry in 1993, provides scientific guidance to our MIPS faculty with respect to medicinal chemistry. He helps design and optimize small molecules for use in imaging for translational medicine. He will also work with new molecular targets to identify new leads against those specific targets.

Ying Lu, PhD

Professor (Courtesy) Molecular Imaging Program at Stanford (MIPS)

Dr. Lu is Professor of Biomedical Data Science and, by courtesy, of Radiology (Molecular Imaging Program at Stanford (MIPS)) and of Health Research and Policy (Epidemiology). He collaborates with our faculty and provides statistical expertise on study design and analysis. He is also involved in statistical methodology research in radiology, in particular on topics of imaging clinical trial design, quality control and validation of imaging markers, and statistical decision-making for choosing imaging modalities. Dr. Lu was appointed Professor of Radiology (courtesy) in 2017.

Sachin Malik, MD

Dr. Sachin Malik received his MD degree from Case Western Reserve University School of Medicine (2010). He completed his internship in Medicine (2011) and his residency in Diagnostic Radiology (2015), both at Kaiser Permanente Los Angeles Medical Center, completing a 12-month MRI Mini-Fellowship as part of his training. Prior to joining VA Palo Alto as a staff radiologist, he was a Cardiothoracic Imaging fellow at Duke University. At VA Palo Alto, he covers both Thoracic and Cardiovascular Imaging. Dr. Malik was appointed Clinical Instructor in 2016.

Feliks Kogan, PhD

Clinical Instructor Interventional Radiology

Instructor Radiological Sciences Laboratory (RSL)

Dr. Kogan received his BS in optics and applied mathematics from the University of Rochester (2007), following with his PhD in bioengineering from the University of Pennsylvania (2013). He completed an MRI post-doctoral fellowship in the Radiological Sciences Lab (RSL) (2015), and continued on as a Research Associate (2015–2017). He was named an ESRRM Junior Fellow (2018), honored with an ESRRM Young Investigator Cum Laude Award (2017), and received an NIH/NIBIB K99 award (2017). Dr. Kogan was appointed Instructor in 2017.

Feliks Kogan, PhD

Clinical Instructor Interventional Radiology

Instructor Radiological Sciences Laboratory (RSL)

Clinical Instructor Body Imaging

Dr. Kogan received his BS in optics and applied mathematics from the University of Rochester (2007), following with his PhD in bioengineering from the University of Pennsylvania (2013). He completed an MRI post-doctoral fellowship in the Radiological Sciences Lab (RSL) (2015), and continued on as a Research Associate (2015–2017). He was named an ESRRM Junior Fellow (2018), honored with an ESRRM Young Investigator Cum Laude Award (2017), and received an NIH/NIBIB K99 award (2017). Dr. Kogan was appointed Instructor in 2017.
New Faculty Appointments (2016–2017)

Michael Muelly, MD
Dr. Michael Muelly received his MD from Penn State University (2013). He completed one year of Preliminary Surgery residency at Penn State Hershey Medical Center (2014), and then transferred to Stanford as a Diagnostic Radiology resident in our Department (2015–2018). Dr. Muelly completed an NCI Body MRI fellowship in our department in 2018. His primary position is at Google where he will be a Brain Resident, working on research application of Google’s deep learning techniques to healthcare.

Koen Nieman, MD, PhD
Dr. Nieman is Associate Professor of Medicine (Cardiovascular Medicine) and of Radiology (Cardiovascular Imaging) at Stanford. He received his MD from Erasmus University in Rotterdam (1998) and his PhD in coronary CT angiography from Erasmus University Medical Center (EMMC), Rotterdam (2003). He completed his cardiology training in Rotterdam (2008). Dr. Nieman is an internationally recognized expert in cardiac CT and coronary CT angiography. Dr. Nieman was Associate Professor and Director of the Cardiac CT and MR Research Program at EMMC before joining our department in 2016.

Christopher Parham, MD, PhD
Dr. Christopher Parham received his MD and PhD from the University of North Carolina (UNC) Chapel Hill (2006). He did his postdoctoral fellowship in Biomedical Engineering (2006–2007) at UNC. He began his residency at UCSF in the Department of Radiology and Biomedical Imaging in 2008 and transferred to the Radiology residency program at UNC Chapel Hill (2009–2012). Dr. Parham completed an NCI Body Imaging fellowship in our Department in 2013. He has been working as a radiologist at VA Palo Alto since 2012. Dr. Parham was appointed Clinical Instructor in 2017.

Bhavik Patel, MD, MBA
Dr. Patel received his BS (2003) and MD (2007) from the University of Alabama (UAB). He also completed his diagnostic radiology residency training at UAB, where he served as Chief Resident (2011–2012). He completed a Body Imaging fellowship at Stanford (2012), after which, he joined Duke as faculty (2013). He additionally received his MBA from the Duke University’s Fuqua School of Business (2015). In 2016, he joined Stanford as an Assistant Professor in the Body Imaging Division.

Mudula Penta, MD
Dr. Penta received her BA, magna cum laude, from Rice University (2002) and her MD from Stanford School of Medicine (2006). She completed an otolaryngology-head and neck surgery residency at Washington University in St. Louis (2010), followed by a diagnostic radiology residency at the University of Texas Southwestern Medical Center (2014). She joined Stanford Radiology as a neuroradiology fellow (2014–2016) and concurrently was appointed Clinical Instructor in 2016.

Sheena Prakash, MD
Dr. Prakash received her MD (2010) from Louisiana State University (LSU) and her MD from Stanford School of Medicine (2010). She completed an otolaryngology-head and neck surgery residency at Wake Forest Baptist Medical Center (2015). She completed an abdominal imaging fellowship at Stanford Radiology (2016) before being appointed to our department as a Clinical Instructor in 2017.

Johannes Reiter, PhD
Dr. Reiter received his PhD (2010) from the Institute of Science and Technology Austria (IST Austria). Shortly after, he worked at the Broad Institute and the Dana-Farber Cancer Institute in Cambridge, MA. He was a postdoctoral researcher at Harvard University, prior to joining our Department (2017). His new approach to reconstruct the evolutionary history of metastases has been shown to significantly outperform existing methods and is already used in multiple research institutions. He was appointed Instructor in 2017.

Stephan Rogalla, MD
Dr. Rogalla received his MD (2006) from Humboldt University of Berlin, in Germany. He completed his residency in gastroenterology, oncology, and surgery from Charité Medical University of Berlin, in Germany (2012). He completed a postdoctoral fellowship in our department (2015). He will continue his research to improve the diagnostics and treatment of medulloblastoma. Dr. Rogalla transitioned from the Department of Pediatrics to Radiology as an Instructor in 2017.
New Faculty Appointments (2016–2017)

Emily Tsai, MD
Dr. Tsai received her MD from Stanford University (2011). She completed her radiology residency at UCLA (2016), followed by a thoracic imaging fellowship at NYU as Chief Fellow (2014). Dr. Tsai worked as an interventional radiologist at Sutter Health in Modesto (2014–2017). With significant experience building an IR service, Dr. Tsai will lead IR and Breast Imaging faculty as Director of ValleyCare and Emeryville Radiology Services. He will be responsible for scheduling, strategy, practice growth, and community outreach. He was appointed Clinical Assistant Professor in 2017.

Andrew Shon, MD
Dr. Shon received his MD from the University of Illinois at Chicago (2011). He completed a diagnostic radiology residency at the University of Illinois at Chicago (2014), followed by his residency. Dr. Shon completed a body imaging fellowship at Stanford Radiology (2017). Following his postdoctoral training, he became a full-time Clinical Instructor in our Department in 2017.

Katheryne Wilson, PhD
Dr. Wilson received her PhD from the University of Texas in 2012. She has been a Postdoctoral Fellow in our Department since 2012 and is currently working closely with Dr. Juergen Willmann. In her new role as Instructor, she will be expanding the research program on photoacoustic imaging and machine learning in the Translational Molecular Imaging Laboratory and teaching graduate students, medical students, residents and fellows. She is the recipient of several awards, including an NIH K99, a Molecular Imaging Young Investigator Award from Stanford, and a Helena Anna Henzl-Gabor Young Women in Science Travel Fellowship.

Xin Ye, MD
Dr. Ye received his MD from UCLA (2011). He completed a preliminary medicine internship at the White Memorial Medical Center (WMAC) in Los Angeles (2012). He then completed radiology residencies at Emory University (2013) and Loma Linda University (2016) respectively, both prior to the completion of a breast imaging fellowship (2017). Dr. Ye provides all aspects of clinical breast imaging and general radiology services. He joined the department as a Clinical Instructor in 2017.

Thomas Yohannan, MD
Dr. Yohannan received his MD from the University of Illinois (2011). He completed a diagnostic radiology internship at the Aurora St. Luke’s Medical Center in Milwaukee, WI (2014). Following his residency, Dr. Yohannan became a Clinical Fellow at UCSF’s Department of Nuclear Medicine, where he participates in clinical care and teaching. His interests as a new faculty member at Stanford include clinical care and teaching. He was appointed Clinical Instructor in 2017.

Taiyo Shimizu, MD
Dr. Shimizu earned his MD from UCLA (2008), followed by an internship (2009). He completed his radiology residency at Mount Sinai Medical Center, Miami, where he was Chief Resident (2013). He also completed a vascular and interventional radiology (IR) fellowship at NYU as Chief Fellow (2014). Dr. Shimizu worked as an interventional radiologist at Sutter Health in Modesto (2014–2017). With significant experience building an IR service, Dr. Shimizu will lead IR and Breast Imaging faculty as Director of ValleyCare and Emeryville Radiology Services. He will be responsible for scheduling, strategy, practice growth, and community outreach. He was appointed Clinical Assistant Professor in 2017.

Andrew Shon, MD
Clinical Instructor
Interventional Radiology

Emily Tsai, MD
Clinical Instructor
Thoracic Imaging

Katheryne Wilson, PhD
Instructor
Molecular Imaging Program at Stanford (MIPS)

Xin Ye, MD
Clinical Instructor
Breast Imaging

Thomas Yohannan, MD
Clinical Instructor
Nuclear Medicine

Taiyo Shimizu, MD
Clinical Assistant Professor
Interventional Radiology

Evan Zucker, MD
Clinical Assistant Professor
Pediatric Radiology

Dr. Zucker received his MD from Harvard Medical School (2008) after which he completed a one-year internship at Newton-Wellesley Hospital in Newton, MA (2009). He completed his residency in diagnostic radiology at Tufts Medical Center, Boston (2013) and a fellowship in pediatric radiology at the Stanford Lucile Packard Children’s Hospital (2014). He joined our faculty as a Clinical Instructor (2014) but soon thereafter left for a cardiovascular imaging fellowship at MGH. Dr. Zucker then returned to Stanford in a new role as Clinical Assistant Faculty in 2016.

Quazi Al-Tariq, MD
Adjunct Clinical Instructor
Body Imaging

Jana Chalouhi, MD
Adjunct Lecturer
Pediatric Radiology

Wilson Chwang, MD, PhD
Adjunct Clinical Instructor
Neuroimaging

Robert Jones, MD
Adjunct Clinical Instructor
Pediatric Radiology

Jeff Kleck, PhD
Adjunct Professor
Molecular Imaging Program at Stanford

Patrick Lee, MD
Adjunct Clinical Assistant Professor
Musculoskeletal Imaging
VA Palo Alto Health Care System

David Douglas, MD
Adjunct Clinical Instructor
Neuroimaging

Sanjay Gupta, MD
Adjunct Clinical Instructor
Cardiovascular Imaging

Diego Jaramillo, MD
Adjunct Clinical Professor
Pediatric Radiology

Connie Montgomery, MD
Adjunct Clinical Instructor
Musculoskeletal Imaging

Alex Olshansky, MD, PhD
Adjunct Lecturer
Pediatric Radiology

Neil Thakur, MD
Adjunct Clinical Instructor
Neuroimaging
Faculty Retirements (2016–2017)

Peter Kane, MD

*Years of Service 1999–2016*

Dr. Peter Kane received his BS from Santa Clara University and his MD from Saint Louis University. He completed his residency training at St. Mary’s Hospital in San Francisco (1965) and was the resident supervisor at Los Angeles County General Hospital (1965–1966).

Following his medical school and residency training, Dr. Kane launched his career as a pediatric radiologist at Oakland Children’s Hospital, where he served in this role from 1967 to 2002. Intermittently, Dr. Kane set aside time for reservist military service during 1960–1962 and as a radiologist at US Army Hospitals during 1990 and 1991. During these years, he also held appointments at UCSF and UC Davis and served as President of the Pacific Coast Pediatric Radiologists Association. Following his military service and work at Oakland Children’s Hospital, Dr. Kane joined the Stanford Lucile Packard Children’s Hospital as a Clinical Professor in October 1999, where he became an active member of the faculty and a friend and colleague to many. Dr. Kane tried to retire in 2013, but Dr. Rich Barth gently coaxed him to stay on as faculty “just a bit longer.” In December 2016, after a career filled with compassion for his patients and generous service to his country, Dr. Kane officially retired with fond memories and true friendships made during his 17 years of service to Stanford and the Lucille Packard Children’s Hospital.

Peter Moskowitz, MD

*Years of Service 1975–1982 and 2001–2016*

Dr. Peter Moskowitz completed medical school training at UCSF in 1970, an internship in medicine/pediatrics at the University of Wisconsin in 1971, radiology residency training at UCSF in 1974, and a senior residency in pediatric radiology at the Children’s Hospital in Boston in 1975. Dr. Moskowitz spent much of his radiology career in the Bay Area including UCSF, Stanford, and LPCH. He has been a member of the Stanford Radiology family for 22 years as Clinical Professor of Pediatric Radiology.

Dr. Moskowitz received Emeritus status in 2013, and worked part-time until July 2016. He remains dedicated to his other passion, guiding doctors through career transitions and burnout, as a certified career transition and life coach since 1997. He is a member of the American Counseling Association and the New Edges Learning Community. He recently co-authored a book on physician career management titled, The Three Stages of a Physician’s Career: Navigating from Training to Beyond Retirement. More information about Dr. Moskowitz and his work as a physician coach is available at http://cppr.com. We thank Dr. Moskowitz for his many years of service, his passion and support of his colleagues, and his dedication to further the field of radiology and the empowerment of its physicians.

Iain Ross McDougall, MD, PhD

*Years of Service 1976–2008 and 2009–2016*

Dr. Ross McDougall retired in January 2016 after 40 years of service. He has been associated with Stanford University Hospitals and the School of Medicine since 1972, first as a fellow for two years, and from 1976 to 2008 as full-time faculty. He was born, raised, and educated in Glasgow, Scotland where he attended the University of Glasgow to study medicine. Dr. McDougall trained in medicine and passed the Membership Examination of the Royal College of Physicians and Surgeons in Glasgow in 1971, and subsequently became a Fellow of that College and the Royal College of Physicians in London. He was awarded a PhD in 1972 for clinical and radiobiological studies of iodine-125 for the treatment of thyrotoxicosis. In 1972, he received a Harkness Fellowship to spend 21 months conducting thyroid research in Stanford under the supervision of the late Dr. Joseph Kriss from 1972–1974. He then returned to Glasgow in 1974.

Following a brief stay in his home country, Dr. McDougall was lured back to Stanford in 1976 as an Associate Professor in Nuclear Medicine but also attended on the Internal Medicine and Endocrinology wards. Due to his work and earlier training, in 1989 he was appointed director of the Kriss Thyroid Clinic, which he led for 20 years. He also became director of the Nuclear Medicine Residency Program, which he led for 25 years. In recognition of his clinical and teaching abilities, he was awarded the Arthur Bloomfield Award for excellence in teaching of clinical medicine in 1985, the Alvin C. Rambar Award for clinical excellence in 1988, and the Albion Walter Hewlett Award in 2010. For his work in thyroid cancer, Dr. McDougall received the Distinguished Scientist Award from the Western Regional Chapter of the Society of Nuclear Medicine and Molecular Imaging in 2006.

Dr. Ross McDougall served Stanford on multiple fronts as Chairman of the Medical School Senate and President of the Medical Center. He was appointed to the American Board of Nuclear Medicine where he served as Chairman (2 years) and Governor of the American Board of Internal Medicine (3 years). Dr. McDougall has inspired generations of physicians, technologists, and trainees to be the very best they can be. We have enjoyed working with and alongside this most amazing, and dedicated clinician.
METHOD
52in52 included staff from all service modalities and all inpatient and outpatient locations. Each project was led by a self-identified individual and assisted by a coach trained in quality improvement principles. The owner was held accountable to report on project progress, results, waste eliminated, and sustain plans. A simple problem-solving guide was provided to facilitate improvement by empowering projects in 52 weeks. The program supported daily problem-solving and completing 52 front-line driven projects in 52 weeks. The program was created to drive continuous improvement by empowering front-line staff to identify and solve problems while providing them with the necessary resources, tools, and management support.

52in52 is directed by Dr. David Larson (Associate Professor and Associate Chair of Performance Improvement) with a management team of Jake Mickelsen (Quality Improvement Manager), Dot Cordova (Safety and Compliance Project Manager), Sandhya Kumar (Operations Project Manager), and Allison Faust (Project Coordinator).

RESULTS
In a total of 52 weeks, 54 improvement projects were completed with an average start to completion time of 6–7 weeks. Annualized results are summarized below:

- Wasted labor time eliminated: 3,200 hours
- Labor cost savings: $280,000
- Incremental revenues: $11,400,000
- Supply cost savings: $315,000
- Patient experience top box score: +8 points at one clinic
- Near-miss safety events reduction: 60 near-miss events

Overall, employee engagement results show that 52in52 helped project leads develop in their personal growth and learning, increased their ability to contribute meaningful work to the department, and improved their knowledge and confidence to solve problems. Last, although seemingly insurmountable, completion of 52 improvement projects in 52 weeks is feasible.
### Faculty Honors and Awards

<table>
<thead>
<tr>
<th>Name</th>
<th>Award/Institution</th>
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<tbody>
<tr>
<td>Raag Airan, MD, PhD</td>
<td>2017 Finalist for the Science-PINS Prize for Neuromodulation</td>
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<tr>
<td>Joseph Cheng, PhD</td>
<td>2017 ISMRM Magna Cum Laude Merit Award</td>
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<tr>
<td>Bruce Daniel, MD</td>
<td>2016 Elected to AIMBE College of Fellows</td>
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<tr>
<td>Guido Davidzon, MD</td>
<td>2017 SNMMI Emerging Leaders Award</td>
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<tr>
<td>Wendy DelMarthi, MD</td>
<td>2017 Elected President of the Society of Breast Imaging</td>
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<tr>
<td>Ulkan Demirci, PhD</td>
<td>2017 Elected to AIMBE College of Fellows</td>
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<td></td>
<td>2017 Academy for Radiology &amp; Biomedical Imaging Research Distinguished Investigator Award</td>
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<tr>
<td>David Douglas, MD</td>
<td>2017 Ursula Mary Kocemba-Slosky, PhD, Professional Relations Fellowship</td>
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<tr>
<td>Rebecca Fahrig, PhD</td>
<td>2016 Elected to AIMBE College of Fellows</td>
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<tr>
<td>Michael Federle, MD</td>
<td>2017 Society of Computed Body Tomography and Magnetic Resonance (SCBT-MR) Gold Medal Winner</td>
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<tr>
<td>Sanjiv Sam Gambhir, MD, PhD</td>
<td>2016 Elected to the National Academy of Inventors; 2017 Appointed President of the International Society for Strategic Studies in Radiology (ISSR)</td>
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<tr>
<td>Pejman Ghanouni, MD, PhD</td>
<td>2017 Honorary President of the 6th International Symposium on Focused Ultrasound</td>
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<tr>
<td>Gary Gold, MD</td>
<td>2016 Elected to AIMBE College of Fellows</td>
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<tr>
<td>Michelle James, PhD</td>
<td>2016 Suffrage Science Award, MRC Imperial College of London</td>
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<tr>
<td>Brooke Jeffrey, MD</td>
<td>2016 Society for Radiologists in Ultrasound Lifetime Achievement Award</td>
</tr>
<tr>
<td>Aya Kamaya, MD</td>
<td>2016 American Roentgen Ray Society Bronze Award</td>
</tr>
<tr>
<td>Feliks Kogan, PhD</td>
<td>2017 ISMRM Young Investigator Award</td>
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<tr>
<td>Curtis Langlotz, MD, PhD</td>
<td>2016 Named to RSNA Board of Directors</td>
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<tr>
<td>Ann Leung, MD</td>
<td>2016 Elected President of the Society of Thoracic Radiology (STR)</td>
</tr>
<tr>
<td>Craig Levin, PhD</td>
<td>2017 Elected to AIMBE College of Fellows</td>
</tr>
<tr>
<td>Matthew Lungen, MD, MPH</td>
<td>2017 Best Poster of The Coalition for Imaging and Bioengineering Research (CIBR) Medical Imaging Technology Showcase</td>
</tr>
<tr>
<td>I. Ross McDougall, MD, PhD</td>
<td>2016 SNMMI-Georg Charles de Hevesy Nuclear Pioneer Award</td>
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<tr>
<td>William Northway, MD</td>
<td>2016 Distinguished Medical Staff Award, Lucile Packard Children’s Hospital</td>
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<tr>
<td>Tomomi NotsuFosaki, MD</td>
<td>2017–2019 Wagner-Tortula Fellowship</td>
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<tr>
<td>Norbert Pelc, ScD</td>
<td>2016 Awarded Honorary Degree by Friedlich-Alexander Universität Erlangen-Nürnberg (FAU) 2017 Named a Fellow of SPIE, the Society of Photo-Optical Instrumentation Engineers</td>
</tr>
<tr>
<td>Sylvia K. Plevritis, PhD</td>
<td>2017 Selected for National Cancer Institute Board of Scientific Advisors 2017 Elected to AIMBE College of Fellows</td>
</tr>
<tr>
<td>Daniel Rubin, MD, MS</td>
<td>2017 Academy for Radiology &amp; Biomedical Imaging Research Distinguished Investigator Award</td>
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<tr>
<td>George Segall, MD</td>
<td>2017 Peter Valk Memorial Award at SNMMI</td>
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<tr>
<td>H. Tom Soh, PhD</td>
<td>2017 Named Chan Zuckerberg Biohub Senior Investigator</td>
</tr>
<tr>
<td>F. Graham Sommer, MD†</td>
<td>2016 Academy of Radiology Research Distinguished Investigator Award</td>
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<tr>
<td>Daniel Spielman, PhD</td>
<td>2017 Elected to AIMBE College of Fellows 2017 Named Fellow of the ISMRM</td>
</tr>
<tr>
<td>Tanya Stoyanova, PhD</td>
<td>2016 McCormick-Gabilan Faculty Award</td>
</tr>
<tr>
<td>Sheydas Vasanawala, MD, PhD</td>
<td>2016 Academy of Radiology Research Distinguished Investigator Award</td>
</tr>
<tr>
<td>Juergen Willmann, MD</td>
<td>2017 Elected to AIMBE College of Fellows 2017 Academy for Radiology &amp; Biomedical Imaging Research Distinguished Investigator Award</td>
</tr>
<tr>
<td>Joseph Wu, MD, PhD</td>
<td>2017 American Heart Association Merit Award</td>
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<tr>
<td>Greg Zabarchuk, MD, PhD</td>
<td>2016 Academy of Radiology Research Distinguished Investigator Award</td>
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</tbody>
</table>
In recent years, we have experienced exponential growth of our clinical imaging capabilities. With the planned opening of the Lucile Packard Children’s Hospital Expansion in December 2017, construction completion of the New Stanford Hospital in 2019, the newly added outpatient sites and the commitment to keeping our hospitals current, we have purchased more imaging equipment than ever before. In the last three years alone, we have acquired a staggering 15 new MRIs. Our ability to site the most cutting-edge equipment ensures that we can achieve our commitment to the highest levels of patient care.

The following is a summary of the major new sites that have been added to our enterprise in recent years, along with the upcoming openings of our new hospitals and the latest equipment installations at our adult hospital.

Expansion of Clinical Sites

<table>
<thead>
<tr>
<th>Location</th>
<th>Equipment</th>
<th>Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer Center</td>
<td>CT, MRI. PET-CT, 2 Digital Breast Tomosynthesis, ultrasound, X-ray</td>
<td>July 2015</td>
</tr>
<tr>
<td>South Bay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children’s Hospital</td>
<td>MRI, PET-MR, MRI in operating room suite, SPECT-CT, SPECT, X-ray, 2 Interventional Radiology Angiography suites (1 Bi-Plane system, 1 Single-Plane system)</td>
<td>December 2017</td>
</tr>
<tr>
<td>Expansion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emeryville</td>
<td>MRI, CT, SPECT-CT, Digital Breast Tomosynthesis, X-ray, ultrasound, BMD, Angiography Hybrid</td>
<td>March 2017</td>
</tr>
<tr>
<td>New Stanford Hospital</td>
<td>3 MRIs, 1 MRI in OR Suite, 3 CTs, X-ray, ultrasound, Angiography Equipment: 4 Single Plane systems, 3 Bi-Plane systems, 2 Hybrid systems</td>
<td>2019</td>
</tr>
<tr>
<td>Redwood City -</td>
<td>CT, ultrasound, X-ray, EOS</td>
<td>Spring 2018</td>
</tr>
<tr>
<td>Pavilion D Expansion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stanford Neurosciences Center</td>
<td>CT, MRI, PET-MR, ultrasound, X-ray/Fluoro</td>
<td>December 2015</td>
</tr>
<tr>
<td>Valley Care Medical Center</td>
<td>MRI, OI Fluoro, and Digital Breast Tomosynthesis equipment replacements in progress</td>
<td>April 2015</td>
</tr>
</tbody>
</table>

New/Upgraded Equipment in Stanford Hospital

<table>
<thead>
<tr>
<th>Location</th>
<th>Equipment</th>
<th>Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Hospital</td>
<td>Replaced MRT with 3T MRI</td>
<td>January 2017</td>
</tr>
<tr>
<td></td>
<td>Siting of HIFU Head Unit for Trans Cranial MRI guided Focused Ultrasound for non-invasive neurosurgery applications in the brain</td>
<td>January 2017</td>
</tr>
<tr>
<td></td>
<td>New Digital PET-CT</td>
<td>September 2016</td>
</tr>
<tr>
<td>Advanced Medicine</td>
<td>New Wide Bore MRI [shared with Radiation Oncology]</td>
<td>January 2017</td>
</tr>
<tr>
<td>Center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blake Wilbur</td>
<td>Replaced 1.5T with 3T MRI</td>
<td>January 2017</td>
</tr>
<tr>
<td></td>
<td>Upgraded 1.5T MRI to new platform</td>
<td>Winter 2017</td>
</tr>
<tr>
<td>Hoover</td>
<td>New Digital Breast Tomosynthesis System</td>
<td>Winter 2017</td>
</tr>
<tr>
<td>Redwood City</td>
<td>New Wide Bore MRI</td>
<td>Fall 2017</td>
</tr>
</tbody>
</table>

New/Upgraded Research Equipment

<table>
<thead>
<tr>
<th>Location</th>
<th>Equipment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clark Center SCP</td>
<td>7T MRI small animal system upgrade</td>
<td></td>
</tr>
<tr>
<td></td>
<td>microCT replacement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Magnetic Particle Imaging Instrument</td>
<td></td>
</tr>
<tr>
<td>Canary Center</td>
<td>Data Servers, H-Speed Centrifuges, Gas Chromatograph, Microscope(s), Fluorescence Imaging Systems</td>
<td></td>
</tr>
<tr>
<td>Lucas Center</td>
<td>MRI hardware and software upgrade with high-end gradients and new technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Siting of Investigational Neuro MR-guided focused ultrasound (MRgFUS) device designed to open the blood brain barrier (BBB) to allow treatment of primary and malignant brain tumors</td>
<td></td>
</tr>
</tbody>
</table>
The Cyclotron and Radiochemistry Facility

The Cyclotron and Radiochemistry Facility (CRF) develops and delivers radioactively-labeled imaging probes, also called radiotracers, for use in early detection, therapeutic monitoring, and theranostic treatment of disease. These radiotracers are used to support clinical imaging scans (such as PET and SPECT) as well as research studies at the Stanford Hospital, the Lucile Packard Children’s Hospital, and the Stanford Center for Innovation in In Vivo Imaging (SCI3). Radiotracers are injected into living subjects during a PET or SPECT scan to non-invasively visualize internal biological targets of interest; many of these radiotracers are applied in the areas of oncology, cardiology, and neurological diseases.

The CRF is the main radiochemistry facility at Stanford with the primary mission of providing expertise in the design, synthesis, and production of current and new imaging probes. Leadership of the facility is provided by Dr. Frederick T. Chin (Director, CRF since 2005) and Dr. Bin Shen (Manager, CRF since 2016). In total, nearly 30 radiochemistry personnel (including students, staff, and faculty) operate this facility daily and support its mission.

CYCLOTRON

The heart of the CRF is a 16.5 MeV GE PETtrace 880 cyclotron, which is used for the production of radioisotopes for both clinical and research use. The cyclotron runs on demand to support delivery of 18F-, 11C-, 15N-, and 15O-isotopes as needed for each day’s radiochemistry schedule. In addition, the CRF can provide other radiometals (e.g., 68Ga, 64Cu, and 89Zr) to chelate to various biologics. Timely delivery of radiotracers is the essential final step in the operation of the CRF, especially because several routinely-used clinical radiotracers have half-lives of approximately 110 minutes or less; using radiotracers beyond their designed timeframe (due to radioactive decay and required molar activity) renders them ineffective for clinical or research use.

CLINICAL RADIOTRACER PRODUCTION

Adjacent to the cyclotron is the GMP production facility, equipped to synthesize routine radiotracers while abiding to the current regulatory policies. Since 2006, the CRF continues to provide 18F-FDG to Stanford Hospitals and Clinics for patient standard-of-care (approximately 5,500 doses/year) and will begin serving other newly-acquired satellite Stanford Hospitals in the Bay Area. To date, more than 30 tracers (with many others currently pending under FDA/RDRC review) can be ordered from the CRF for clinical use, clinical research, or clinical trials. The number of available tracers has grown significantly over the past 12 years and is a statement of the dedication of the CRF to meet the needs of patients and its commitment to innovation in developing new imaging methodologies.

PRE-CLINICAL RESEARCH AND TRANSLATION

In addition to radiotracer production for clinical use, the CRF includes space for hot labs, fully equipped for research and development of new radiotracers. This key facet of the CRF supports the vision of the Molecular Imaging Program at Stanford (MIPS) which was established in 2003 as an interdisciplinary initiative at Stanford Medicine. The goal of these efforts is to advance molecular imaging of living subjects by providing state-of-the-art molecular imaging strategies to improve our understanding of the in vivo biological events during disease progression and to focus on clinical translation for improved patient care.
Over the past several decades, the value of translational research in advancing clinical care, that is, moving scientific discovery to clinical practice, is unquestionable. Radiology, as a discipline, has played a significant role in this “bench-to-bedside” transition, with the successful integration of physics and computer technology with clinical applications. Relatively new techniques evolving out of the imaging field are now integrated into routine clinical practice and are beginning to revolutionize the diagnosis of onset of disease, monitoring of progression, and the effectiveness of treatment.

During FY17, more than $55 million in sponsored funding was awarded to the department’s clinical and research divisions. By fostering multidisciplinary research partnerships between clinicians and researchers to address complex human health issues, faculty and researchers in the department continue to push the boundaries of scientific discovery and clinical practice with innovative translational research outcomes.

In the following few pages, we highlight four Translational Research programs that have had a positive effect on the lives of patients and offer great promise and inspiration to similar ongoing translational research projects.

I. Microbubbles and Early Detection of Cancer

II. Illuminating Pain Generators with PET-MR

III. Fluorescence Imaging for Visual Guidance in Cancer Surgery

IV. Emergency Neuroendovascular Surgery for Acute Ischemic Stroke Treatment

The translational stories are a result of the clinicians focusing on patient needs while partnering with their basic science colleagues to jointly ensure optimum performance in the clinic. The department aims to maintain this momentum in translational research by continuing to provide advanced resources and a strong environment where clinical care and research are valued and encouraged.
Microbubbles and Early Detection of Cancer

Is it now possible to distinguish non-cancerous from cancerous lesions without biopsy or surgery? A Stanford Radiology team, led by Juergen Willmann, MD, has compelling evidence that this may be possible using an advanced ultrasound imaging approach.

Motivated by the NCI's commitment to early cancer detection and improved patient outcome, Dr. Willmann began his work with microbubbles and ultrasound in 2008 as a new faculty member in the Department of Radiology at Stanford. His primary goal was to develop a relatively low cost, non-invasive method to diagnose breast cancer early, at manageable stages. His NC1-funded work in the research laboratory provided the foundation and encouragement toward translation of this work to patients. Dr. Willmann and his team have maintained a singular focus of reducing the number of false positive breast cancer diagnoses using a non-invasive ultrasound molecular imaging (USMI) technique.

Ultrasound is a valuable imaging modality that has the potential to be the ideal imaging and screening tool for early breast cancer detection. It is non-invasive and relatively inexpensive compared to other imaging modalities, it does not use ionizing radiation, it has a high spatial and temporal resolution, and it is available in nearly all clinical imaging facilities worldwide. However, ultrasound often lacks sensitivity and specificity, making accurate interpretation of findings more difficult. Recognizing this potential deficiency, the Willmann laboratory combined the advantages of ultrasound with the advantages of more sensitive imaging technologies and molecularly targeted ultrasound contrast microbubbles.

Microbubbles are small gas-filled spheres (1–4 micrometers in diameter), composed of a lipid or protein shell and filled with a harmless gas (air or perfluorocarbon); these are FDA-approved and have been in use for several years as a contrast agent for ultrasound imaging.

Through resources provided by the Molecular Imaging Program at Stanford (MIPS), Dr. Willmann has been able to carefully adapt the use of microbubbles. His team developed a new microbubble (MBKDR) that identifies and attaches to a specific receptor, the kinase insert domain receptor (KDR), which is found in abundance on newly formed blood vessels in cancerous lesions. This targeted USMI approach is proving to be a reliable method for earlier detection of breast cancer.

In pre-clinical work, Dr. Willmann and his colleagues have shown that KDR-targeted microbubbles successfully find and attach to the KDR receptor, effectively outlining the cancerous tumor on ultrasound, making it much easier to distinguish from non-cancerous tumors. In longitudinal screening exams in transgenic mice with mammary glands progressing from normal breast tissue to invasive breast cancer, the team demonstrated the diagnostic accuracy of ultrasound with KDR-targeted microbubbles in vivo.

This early work in the laboratory led to a first-in-human clinical feasibility, safety, and efficacy trial on KDR-targeted molecular ultrasound imaging in women with various breast and ovarian pathologies. As a collaboration between Stanford University Hospital and Catholic University Hospital in Rome, Italy, these two sites recruited and studied 21 women with focal breast lesions and 24 women with focal ovarian lesions. Histology was used as the gold standard in each case. Based on this early collaborative study, the team confirmed that USMI with MBKDR is well tolerated with no serious adverse events. Through this initial clinical study, the team has further refined molecular ultrasound imaging for early breast cancer detection and continues to evolve next generation contrast microbubbles targeted to breast cancer-specific molecular targets. As a direct result of their pre-clinical and early first-in-human studies, Dr. Willmann and team is now launching a recently funded NIH clinical trial (1 R01 CA218204 01) using the advanced USMI KDR-targeted microbubbles to continue the mission of improving patient care and survival by diagnosing breast cancer at a much earlier and more manageable stage.

The advantages of USMI and microbubbles are many, including that the procedure is non-invasive, well-tolerated, and also promises to reduce wait-time for results, thereby relieving an individual’s fear of disease and allowing those with cancerous lesions to move more promptly into treatment plans. Indeed, Dr. Willmann’s research focus perfectly aligns with the mission of the Canary Center at Stanford for Cancer Early Detection (pages 80–81); he has been a Full Member of the Canary Center since its formation in June 2009.
Illuminating Pain Generators with PET-MR

Pain encumbers the lives of millions of people around the world. The source of an individual's pain is often elusive. Each person's pain is unique in how they feel it and how much it affects their quality of life. In the United States alone, the number of individuals suffering from pain is staggering—more than half of the adult population suffers with some form of pain. Without an exact cause of a person's pain, treatment can often be unsuccessful and unnecessary.

A team of scientists from Stanford University and the University of Mississippi (Drs. Sandip Biswal, Fred Chin, Christopher McCurdy, et al.) have developed a novel way to visualize pain. They have created a radiotracer, 18F-FTC-146, that finds and illuminates the sigma-1-receptors (S1R) on cells. The sigma-1-receptor has been shown to have a direct effect in modulating pain. When a part of the body is in pain, a greater number of S1Rs are present on the cells in the area of pain. Researchers have now found a way to use these receptors to pinpoint pain in the body.

A patient participating in a recent PET-MRI clinical trial at Stanford Medicine had been suffering from debilitating knee pain for more than seven years—a sharp pain that started just behind the inside of her knee and radiated down into her leg and foot. The patient classified her pain as a 10 on a scale of 1–10, with 10 being the most severe. The knee pain had affected her mobility; she was unable to sit or stand, unable to walk on grass, downhill, or down the stairs without excruciating knee pain. Routine knee movements increasingly generated a stabbing pain that wrapped around to the front of her knee.

Since this patient with atypical pain of unknown origin had already endured multiple surgeries and other unsuccessful treatments, she was referred to the multidisciplinary Stanford Pain Management Center, where she was enrolled in a clinical trial led by Dr. Sandip Biswal, Associate Professor of Radiology. Using a new hybrid imaging technique, positron emission tomography (PET) with magnetic resonance imaging (MRI), PET-MRI images were acquired after injecting a sigma-1-receptor radiotracer, 18F-FTC-146, into the patient. PET-MRI imaging successfully illuminated a previously unseen inflamed mass inside the patient’s left knee. The same inflamed mass was located, biopsied and removed during a subsequent arthroscopic surgical procedure. Biopsy results revealed an inflamed synovial lipoma, a rare intra-articular lesion consisting of inflamed fatty tissue.

Immediately following the surgery, the patient rated her pain a 4, much improved over the 10 rating prior to surgery. Within days, the pain subsided to a level 2 and she reported being able to sit and stand comfortably, walk on grass, and walk downhill without distress. Five months after the final surgery, the patient unbelievably exclaimed, “I have no pain!”

While every case of pain is unique and not all will have an outright cure for the pain, this research is extremely promising, and a significant step forward in our understanding, management, and treatment of debilitating chronic pain. Imagine a world where your pain is visualized by a glowing tracer, a tracer that will point out the precise origin of the pain. Imagine a world where you get the most effective treatment for your pain right from the start, so that your quality of life is not impacted much.

Sandip Biswal, Stanford University, Associate Professor of Radiology, led a team of scientists, moves us closer each day to a type of personalized medicine that is not only considered unique, but is a critical part of routine patient care.
An ever-present concern for cancer surgeons is the issue of whether complete removal of tumor tissue has been achieved. For many years, surgical removal of solid tumors has relied on the surgeon’s skill for visual inspection and the ability to palpate the surgical site and tumor for any tumor tissue left behind. Unfortunately, this well-practiced, but very subjective skill set, frequently results in either removal of normal tissue or incomplete tumor excision, or both—all of which are suboptimal. In order to enhance tumor visibility for the surgeon, fluorescence imaging, a type of optical imaging that uses fluorescent dyes, was introduced during the 1940s; due to various limitations, this approach was not broadly adopted. Since then, both technology and chemistry have improved dramatically to develop more sensitive imaging equipment and accurately target specific fluorescent chemical compounds (fluorophores).

Preclinical work by Dr. Rosenthal’s group with tumor targeting antibodies has provided high tumor-to-background ratios in head and neck, skin, breast, brain, and other cancers. This work has eventually led to IND-application with near-infrared fluorescent dye-labeled antibodies (IRDye800CW to identify Cetuximab- and Panitumumab-labeled antibodies with near-infrared fluorescent dyes). Their work with collaborators at Stanford, University of Alabama at Birmingham, and from around the world, has resulted in novel probes, dyes, and devices for real-time cancer detection. We are well on our way to improving the efficacy of oncologic surgery and recognizing significant patient benefits from real-time surgical imaging.

Patient preparation for fluorescence imaging during a surgical procedure requires the patient to visit the clinic for a pre-surgical infusion of the fluorescently labeled antibody prior to surgery. During surgery, a portable near-infrared (NIR) imaging system is used to identify the lesion(s) prior to excision. Once the tumor is removed, the surgical field is imaged again to verify that all tumor tissue has been removed. Rapidly advancing intraoperative fluorescence imaging approaches, which allow for real-time imaging, maximize the surgeon’s ability for complete tumor resection.

Dr. Rosenthal’s work in surgical imaging within the operating room suite is being conducted to guide surgical removal of tumors by identifying clean margins to leave nothing of the lesion behind. They are currently evaluating a number of novel tumor targeting probes, including several antibodies labeled with near-infrared fluorescent dyes. Their work with collaborators at Stanford, University of Alabama at Birmingham, and from around the world, has resulted in novel probes, dyes, and devices for real-time cancer detection. We are well on our way to improving the efficacy of oncologic surgery and recognizing significant patient benefits from real-time surgical imaging.

The advantages of fluorescence imaging during surgery are many including: (i) Tumor margins become well defined. (ii) Clinically used probes are non-toxic and safe for patient use. (iii) There is no radiation exposure to the patient. (iv) Fluorescence imaging equipment is relatively low-cost and unobtrusive in the operating room.

While one can never be one hundred percent sure of “getting all of the tumor” and work towards this goal remains, it can be said with certainty that since the introduction of optical imaging, this approach has resulted in greater surgical visibility, an increased confidence level in surgical performance, and a higher surgical success rate in the operating room.
Emergency Neuroendovascular Surgery for Acute Ischemic Stroke Treatment

The Stanford Advanced Comprehensive Stroke Center was established in 1992 by Michael Marks, MD, an interventional neuroradiologist; Gregory Albers, MD, a vascular neurologist; and Gary Steinberg, MD, PhD, a cerebrovascular neurosurgeon. In 2004, the Stroke Center was designated by the Joint Commission as a Primary Stroke Center, and in 2012, the Stanford Stroke Center became the first ever stroke center designated as an Advanced Comprehensive Stroke Center. While more than 1,000 hospitals have become Joint Commission certified as Primary Stroke Centers, there are only 33 centers with the “Advanced Comprehensive” designation. This is a tribute to the leadership of the Stanford Stroke Center, coming from multiple fields and working together by focusing their expertise and dedication to research and clinical care in this area of medicine.

The patient presented with an ischemic stroke causing complete paralysis of the left side of the body. The patient walked out of the hospital after discharge two days after endovascular treatment with a favorable outcome. An MRI performed the day after emergency endovascular stroke treatment shows a small stroke in the right brain (first panel, arrowhead). An MR angiogram shows completely restored blood flow in the right middle cerebral artery (second panel, arrow). Blood flow is indicated by the black contrast dye injected from the catheter, and the blocked middle cerebral artery is evident (first panel, arrow). A digital subtraction angiogram performed after placement of a catheter into the internal carotid artery in the right neck before the blocked middle cerebral artery. Blood flow is indicated by the black contrast dye injected from the catheter, and the blocked middle cerebral artery is evident (first panel, arrow). The entire procedure was performed in 14 minutes.

Emergency Neuroendovascular Surgery for Acute Ischemic Stroke Treatment

The Stanford Comprehensive Stroke Center cares for patients with ischemic stroke from all over Northern California, and 89% of patients treated arrive by the Stanford Life Flight emergency helicopter transfer. Upon arrival, patients are transferred directly to the Department of Radiology CT and MRI scanners, where they are clinically evaluated by attending physicians and clinical fellows from the Department of Radiology (Division of Stroke and Neurocritical Care). These patients then undergo rapid imaging evaluation with advanced CT and MRI techniques to determine the best treatment. Research from the Stanford Stroke Center is advancing the treatment of ischemic stroke patients by extending the time window of treatment from 4.5 hours to 16–24 hours using new emergency neuroendovascular surgery techniques to open blocked arteries in the brain using these image-guided, minimally invasive brain surgeries in greater than 90% of patients eligible for treatment. Patients successfully treated with these endovascular surgeries are three times as likely to recover from their ischemic stroke without a significant neurologic deficit and return to a normal life.
In keeping with the department’s commitment of providing exceptional clinical care and cutting-edge research, the Department of Radiology offers both clinical and research training programs that encompass all radiology subspecialties and modalities. The programs offered include three residency programs, ten clinical postdoctoral fellowship programs, and six research training programs.

The goal of the residency programs (pages 53–55) is to develop and refine the broad capabilities necessary to become outstanding radiologists who are able to manage diverse patient cases with a broad range of disorders and diseases, with the highest ethical and professional standards of radiologic and medical care.

The department’s clinical fellowships (pages 56–57) are carefully designed to advance the knowledge and technical skills of fellows in subspecialty areas through extensive clinical, research, and teaching opportunities, and to prepare them for leadership positions in clinical practice.

Research training programs (pages 58–63) are available to graduate students and postdoctoral candidates, and also to undergraduate students specifically for training during the summer months. These programs provide training in mentored research and career development that prepares individuals to conduct innovative research in cancer imaging, molecular imaging, physics and instrumentation, systems biology, nanotechnology, and early detection of cancer.

All training programs are directed by exceptionally dedicated faculty with a strong management and administrative team to oversee every aspect of the program to ensure that trainees are part of a structured, well-organized, and positive learning environment. The following pages (52–63) provide highlights of each program offered through the Department of Radiology.
Clinical Training Programs

The Department of Radiology continues to offer comprehensive clinical training in all radiology sub-specialties through its residency and clinical fellowship programs. These programs offer an exceptional training experience by encouraging trainees to interact and learn from dedicated faculty who are devoted to teaching, outstanding patient care, and translational research. The robust learning experience is coupled with the opportunity to rotate through the Stanford University Hospital, the Lucile Packard Children's Hospital, VA Palo Alto Health Care System, and Santa Clara Valley Medical Center. Trainees function as part of a clinical team responsible for the performance and interpretation of inpatient and outpatient cases. Because Stanford Radiology faculty are actively engaged in research, residents and fellows alike are exposed to outstanding research opportunities with close ties to leading engineers, and physicists, thereby allowing for participation and presentation at national meetings, conferences, and workshops.

Radiology Residency Programs

The three residency training programs—the Diagnostic Radiology Residency Program, the Dual Pathway Nuclear Medicine and Diagnostic Radiology Residency Program, and the Interventional Radiology-Diagnostic Radiology Integrated Residency Program—provide a supportive yet rigorous environment for residency training. The Diagnostic Radiology Residency Program has historically been the largest and longest-offered program at Stanford Radiology, and has anchored the development of the two new residency programs to broaden the scope of training options.

Clinical Fellowship Programs

The department offers 10 one- and two-year postdoctoral fellowships across the different clinical divisions. Fellowships begin July 1 of each year.

Radiology Residency Programs

DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM

The goal of the Stanford Diagnostic Radiology Residency Program is to train future leaders of the field, leveraging the clinical strength of Stanford Health Care and affiliates, the research prowess of Stanford University, and the culture of innovation in Silicon Valley. Trainees will continue to help develop the diagnostic and therapeutically modalities of tomorrow, performing cutting-edge research, and translational clinical work. Graduates of the Stanford Radiology Residency Program have established leadership roles in academic radiology departments, research programs, and within industry.

The residency program provides a supportive yet rigorous environment to learn from an internationally acclaimed faculty, known for superb teaching, outstanding patient care, and world-class research. Our program offers a rich clinical exposure through a wide variety of rotations that provide care to the diverse patient populations and by understanding the role of imaging studies within the larger context of patient health care.

The curriculum of the Diagnostic Radiology Residency Program affords residents the flexibility to pursue personal and professional endeavors about which they feel truly passionate. Most residents devote time during their four-year residency to perform cutting-edge research, advance informatics, launch innovative companies, hone clinical skills through early clinical subspecialization, learn medical design innovation, and participate in hospital-wide quality improvement projects.

Since July 2015, the residency program has been directed by Dr. Payam Massaband, a staff radiologist at the VA Palo Alto since graduating from Radiology residency and fellowship at Stanford in 2010. He spent three years as the VA Palo Alto acting chief of Radiology, concentrating on clinical excellence, process improvement and residency education. Dr. Massaband is supported by five associate program directors (Dr. Bruce Daniel, Dr. Gloria Hwang, Dr. Michael Iv, Dr. Erika Rubesova, Dr. Ali Tahvildari) and two program managers, who oversee different aspects of the program.
DUAL PATHWAY NUCLEAR MEDICINE AND DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM

Restructured in 2015–2016, the five year ACGME-approved Dual Pathway Nuclear Medicine and Diagnostic Radiology Residency Program strives to educate the next generation of worldwide leaders in academic and clinical nuclear medicine and molecular imaging. The program includes education in all aspects of the basic sciences, diagnostics, and therapy as they relate to nuclear medicine. Ample research opportunities are provided to take advantage of resources such as the Molecular Imaging Program at Stanford (MIPS) and the Research PET-MRI Program at Stanford. Clinical training takes place at Stanford Health Care, Lucile Packard Children’s Hospital at Stanford, and the VA Palo Alto Health Care System. At the end of the residency, trainees are expected to successfully sit for the ABNM and ABR certification examinations.

Trainees spend one year in the Nuclear Medicine program, followed by the next four years in the Diagnostic Radiology program; the final diagnostic radiology year is spent with a focus on research, nuclear medicine, and molecular imaging. Trainees are fully integrated into both ACGME-accredited programs (nuclear medicine and diagnostic radiology). This dual pathway is being pioneered at Stanford University with the goal of offering dedicated research time throughout the five years of training.

The Dual Pathway Nuclear Medicine and Diagnostic Radiology Residency Program is directed by Dr. Andrei Iagaru, Chief of the Division of Nuclear Medicine and Molecular Imaging at Stanford Health Care.

INTEGRATED INTERVENTIONAL RADIOLOGY-DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM

The Integrated Interventional Radiology-Diagnostic Radiology Residency Program is a five year ACGME-accredited program that integrates three years of diagnostic radiology (DR) with two final years of dedicated interventional radiology (IR) training. The program offers a robust educational curriculum spanning the full spectrum of image-guided interventions and beyond, including cutting-edge protocols and treatments pioneered by Stanford Interventional Radiology. Candidates may enter the Integrated IR-DR Residency directly from medical school following a one year surgical internship.

After completing the residency, graduates will qualify to obtain a dual IR-DR certificate from the American Board of Radiology.

The Stanford Division of Vascular and Interventional Radiology is a tertiary and quaternary referral center that accepts complex cases from around the country and around the world, ensuring that our trainees are exposed to a broad and intriguing case mix. In addition to advanced specialty training at Stanford University Medical Center, the residency program integrates clinical training across multiple sites and disciplines including the VA Palo Alto Health Care System, Lucile Packard Children’s Hospital, Santa Clara Valley Medical Center, outpatient Interventional Radiology Clinics, multidisciplinary clinical electives and a dedicated Cardiovascular ICU rotation. The Integrated IR-DR Residency Program is directed by Dr. William Kuo.
Clinical Fellowship Programs

BODY IMAGING FELLOWSHIP | 11 POSITIONS
The one-year clinical fellowship in body imaging consists of four-week clinical rotations on the core body services including CT, ultrasound, and MRI. Three elective rotations are available and can include rotations in image-guided biopsies, cardiovascular imaging, musculoskeletal imaging, breast imaging, etc. Fellows will receive experience in all cross-sectional studies of the chest, abdomen, pelvis, and musculoskeletal system. Fellows will also receive training in vascular imaging, image-guided biopsies, CT colonography, and other procedures.

BODY MRI FELLOWSHIP | 4 POSITIONS
The Body MRI Fellowship provides a year of intensive training in clinical MRI across a wide range of diagnostic and therapeutic applications. Fellows are responsible for managing the clinical services, including protocols, initial interpretations, MR-guided procedures, scanner-side exam optimization and troubleshooting, translational research, and teaching. The service consists of thirty scanners across all vendors, which are 3T MRIs, including PET-MR scanners.

BREAST IMAGING FELLOWSHIP | 3 POSITIONS
Stanford’s Breast Imaging Fellowship offers training in digital mammography with CAD; breast tomosynthesis; breast ultrasound; core biopsies and preoperative needle localization under ultrasound; stereotactic; tomosynthesis; and MR-guidance; interpretation of breast MRI for breast cancer and implants; a research program in contrast-enhanced mammography; and outcome analysis of new technology. Research time is provided during the fellowship for academic projects.

CARDIOVASCULAR IMAGING FELLOWSHIP | 2 POSITIONS
The Cardiovascular Imaging (CVI) Fellowship provides one year of training in noninvasive cardiovascular imaging using CT and MRI. Fellows receive detailed training in the principles and use of state-of-the-art multidetector row CT and cardiovascular MR imaging systems within the context of a busy clinical cardiovascular imaging service. Fellows study cardiovascular diseases in adults as well as children thereby substantially enhancing the fellowship through a close working relationship with adult and pediatric cardiologists, surgeons, and interventional radiologists.

INTERVENTIONAL NEURORADIOLOGY FELLOWSHIP | 2 POSITIONS
The Interventional Neuroradiology fellowship is a key component of the Stanford Stroke Center providing a large number of referrals for intra-arterial thrombolysis, angioplasty, catheter-directed thrombolysis, IVC filtration, venous reconstruction, vascular stenting, fetal embolization, vascular anomaly ablation, pediatric interventions, TIPS, and aortic stent grafting. The Interventional Radiology service is an integral component of the Vascular Center at Stanford.

INTERVENTIONAL RADIOLOGY FELLOWSHIP | 6 POSITIONS
The Interventional Radiology Fellowship experience encompasses the entire range of IR involving both vascular and nonvascular interventions. Fellows perform a wide variety of treatments including loco-regional tumor therapy, transplant and hepatobiliary interventions, angioplasty, catheter-directed thrombolysis, IVC filtration, venous reconstruction, vascular stenting, fetal embolization, vascular anomaly ablation, pediatric interventions, TIPS, and aortic stent grafting. The Interventional Radiology service is an integral component of the Vascular Center at Stanford.

MUSCULOSKELETAL IMAGING FELLOWSHIP | 3 POSITIONS
The key features of the one-year Musculoskeletal Imaging Fellowship include extensive involvement in musculoskeletal MRI with an emphasis on sports injuries and musculoskeletal ultrasound and CT. In addition, a moderate volume of plain radiographic studies, arthrograms, and tenograms are performed. Dedicated time for research is provided. Fellows are expected to participate actively in research with faculty radiologists as well as Stanford’s world-renowned imaging physicists and engineers.

NEUROIMAGING FELLOWSHIP | 14 POSITIONS
The Neuroimaging Fellowship is designed to be a well-balanced academic training program that encompasses all of the basic and advanced clinical and research areas of both adult and pediatric neuroradiology. Neuroimaging fellows are exposed, during the course of the fellowship, to all imaging modalities used to evaluate neurologic disease, including CT, MRI, myelography, angiography, and ultrasound during the course of the fellowship. Fellows will also actively participate in state-of-the-art interventional neuroradiology procedures.

PEDIATRIC RADIOLOGY FELLOWSHIP | 5 POSITIONS
The Pediatric Radiology Fellowship is jointly sponsored by the Lucile Packard Children’s Hospital and Stanford University Hospital. The fellowship provides a comprehensive pediatric radiology imaging program utilizing state-of-the-art imaging technology, including two fluoroscopy suites, three ultrasound rooms, as well as 3T MRI, 1.5T MRI, and CT imaging suites. Fellows rotate through a series of services, including pediatric MR, pediatric CT, PET-CT, pediatric fluoroscopy, pediatric ultrasound, pediatric neuroradiology, nuclear medicine, interventional radiology, and general radiology.

THORACIC IMAGING FELLOWSHIP | 2 POSITIONS
The Thoracic Imaging Fellowship is designed to be a well-balanced academic training program that provides exposure to both basic and advanced clinical applications in cardiothoracic imaging including lung cancer screening and cardiac imaging. Clinical training consists of rotations on chest (eight months), cardiovascular (three months), and thoracic Interventional (one month) services. One day per week of research time is allotted.
Research Training Programs

NIH-Funded Training Programs

The Department of Radiology is home to six NIH-funded training and education programs, each reflecting specialized strengths of our highly regarded research divisions: Canary Center at Stanford for Cancer Early Detection, Integrative Biomedical Imaging Informatics at Stanford (IBIIS), Molecular Imaging Program at Stanford (MIPS), and the Radiological Sciences Laboratory (RSL). Through five of these programs, the department supports and trains, on average, 30 graduate and postdoctoral trainees each year encompassing a broad range of imaging related topics such as advanced cancer imaging, physics and instrumentation, molecular imaging, systems biology, and nanotechnology. The sixth and most recently funded program, the Canary CREST program, is the first and only program in the department targeted specifically for undergraduate students and is fully focused on early detection of cancer.

SMIS Program
Stanford Molecular Imaging Scholars Program

NIH/NCI 2 T32 CA118681-12A1
PI: Craig Levin, PhD
Program Manager: Sofia Gonzales, MS

The SMIS Program is a three-year interdisciplinary postdoctoral training program at Stanford University. The centerpiece of the SMIS program is the opportunity for trainees to conduct innovative molecular imaging research that is co-mentored by faculty in complementary disciplines. The SMIS program, with its distinctive focus on biology and chemistry, is in its 12th year and has provided training and support for 31 fellows to date.

CURRENT TRAINEES
Joshua Cates, PhD
Sayan Mullick Chowdhury, PhD
David Huland, PhD
Tae Jin Kim, PhD
Justin Klein, PhD
Jessica Klockow, PhD

MENTORS
Craig Levin, PhD
Juergen Willmann, MD
Sanjiv Sam Gambhir, MD, PhD
Guillem Pratx, PhD
Frederick Chin, PhD

SCIT Program
Stanford Cancer Imaging Training Program

NIH/NCI 5 T32 CA009695 25
PIs: Sandy Napel, PhD and Bruce Daniel, MD
Program Manager: Sofia Gonzales, MS

The SCIT Program is a two-year program that offers a unique research opportunity in cancer imaging. Currently in its 25th year of training, the program, initially called the Advanced Techniques for Cancer Imaging and Detection Program, was designed and directed by Dr. Gary Glazer, former chair of the department. The goal of the program is to provide MD and PhD research fellows advanced training in cancer-related imaging research with a focus that is primarily driven by physics and technology development and application. Since its inception in 1992, the SCIT program has provided support for the training of more than 40 fellows.

CURRENT TRAINEES
Hamed Arami, PhD
Joshua de Bever, PhD
Pooya Gaur, PhD
Hersh Sagreleya, MD
Slovash Youssefi, PhD

MENTORS
Sanjiv Sam Gambhir, MD, PhD and Robert Sinclair, PhD
Kim Butts Pauly, PhD
Daniel Rubin, MD, MS and Juergen Willmann, MD
Lei Xing, PhD and Juergen Willmann, MD

Radiology Department Report 2015–2017
Research Training Programs
TBI^2 Program
Training in Biomedical Imaging Instrumentation Program
NIH/NIBIB S1 T32 EB009653 07
PI: Kim Butts Pauly, PhD and Norbert Pelc, ScD
Program Managers: Barbara Bonini and Mary LeSene
The TBI^2 program, jointly led by faculty in Radiology and Bioengineering, offers unique multidisciplinary predoctoral research training in biomedical imaging technologies across all spatial scales, spanning magnetic resonance, computed tomography, and radiography, optical imaging, ultrasound, PET, and hybrid imaging such as X-ray/MR and PET-MR, as well as image processing and analysis for diagnostic, radiation therapy, and basic science. Since recruitment began in 2010, the program has supported and trained 20 graduate students.

CURRENT TRAINEES
Dylan Black
Ehsan Dadgar-Kiani
Phillip DiGiacomo
Ningxi Li
Elise Robinson
Christopher Sandino

MENTORS
Olav Solgaard, PhD
Jin Hyung Lee, PhD
Michael Zehetmayer, MD, PhD
Kim Butts Pauly, PhD
Sanjiv Sam Gambhir, MD, PhD
Shreyas Vasawada, MD, PhD

CSBS Program
Cancer Systems Biology Scholars Program
NIH/NCI R25 CA180993 03
PI: Sylvia Plevritis, PhD and Gary Nolan, PhD
Program Manager: Theresa McCann
The CSBS program is a two-year postdoctoral training program at Stanford University focused on innovative, multidisciplinary cancer research education that seamlessly integrates experimental and computational biology to systematically unravel the complexity of cancer. The program brings together 36 Stanford faculty mentors from 19 departments or divisions bridging the Schools of Medicine, Engineering, and Humanities and Sciences. The CSBS Program has trained five inaugural scholars and completed candidate recruitment for the next trainee cohort that started on September 1, 2017.

CURRENT TRAINEES
Gina Bouchard, PhD
Roozbeh Dehghannasiri, PhD
Aaron Horning, PhD
Barzin Nabet, PhD

MENTORS
Sylvia Plevritis, PhD and Arnato Giaccia, PhD
Julia Salmon, PhD and Steven Arandt, MD, PhD
Michael Snyder, PhD and Christina Curtis, PhD
Edgar Engleman, MD, PhD and Sylvia Plevritis, PhD
Max Dehm, MD, PhD, Andrew Gentles, PhD, and Rob Tibshirani, PhD
Canary CREST Program
Canary Cancer Research Education Summer Training Program
NIH/NCI 1 R25 CA217729 01
PIs: H. Tom Soh, PhD and Utkan Demirci, PhD
Program Manager: Stephanie van de Ven, MD, PhD
The Canary CREST Program, newly funded as of September 1, 2017, will recruit and train 25 undergraduate students each year in early cancer detection initiatives through a 10-week summer research program. This program, beginning June 1, 2018, is led by Drs. Tom Soh, Utkan Demirci, and Stephanie van de Ven, with a team of 28 mentors, all committed to research in early cancer detection. During the five-year award, the Canary CREST Program aims to train a total of 125 young scientists.

CURRENT TRAINEES
Timothy Blake, PhD
Viola Chen, MD
Ryan Davis, PhD
Anh Gouw, PhD
Ashwin Ram, MD
Travis Shaffer, PhD

MENTORS
Robert Waymouth, PhD and Paul Wender, PhD
Alice Fan, MD and Shan Wang, MD
Sanjiv Sam Gambhir, MD, PhD and Jianghong Rao, PhD
Dean Felsher, MD, PhD and Richard Zare, PhD
Michael Snyder, PhD
Sanjiv Sam Gambhir, MD, PhD and Jianghong Rao, PhD

Cancer-TNT Program
Cancer-Translational Nanotechnology Training Program
NIH/NCI 5 T32 CA196585 02
PI: Jianghong Rao, PhD and Dean Felsher, MD, PhD
Program Manager: Billie Robles
The Cancer-TNT Program is a synergistic three-year postdoctoral training program bringing together 25 faculty and nine departments from the Schools of Medicine, Engineering, and Humanities and Sciences to train the next generation of interdisciplinary leaders in cancer nanotechnology research and clinical translation. Trainees complete coursework and research with two complementary mentors to bridge multiple disciplines such as chemistry, molecular biology, bioengineering, molecular imaging, nanotechnology, and clinical medicine to advance cancer nanotechnology translation research, diagnosis, and treatment.

CURRENT TRAINEES
Timothy Blake, PhD
Viola Chen, MD
Ryan Davis, PhD
Anh Gouw, PhD
Ashwin Ram, MD
Travis Shaffer, PhD

MENTORS
Robert Waymouth, PhD and Paul Wender, PhD
Alice Fan, MD and Shan Wang, MD
Sanjiv Sam Gambhir, MD, PhD and Jianghong Rao, PhD
Dean Felsher, MD, PhD and Richard Zare, PhD
Michael Snyder, PhD
Sanjiv Sam Gambhir, MD, PhD and Jianghong Rao, PhD

ARTS Program
Advanced Residency Training at Stanford Program
NIH/NCI 5 T32 CA196585 02
PI: Jianghong Rao, PhD and Dean Felsher, MD, PhD
Program Manager: Sofia Gonzales, MS
In addition to the NIH-funded training programs, Stanford is also home to the Advanced Residency Training at Stanford (ARTS) Program that offers residents and clinical fellows the opportunity to combine their clinical training with advanced research training to complete a PhD degree during or upon completion of residency or clinical fellowship. The program begins with one or more years of postgraduate clinical training, followed by research training in one of twenty graduate programs from the Schools of Medicine, Engineering, or Humanities and Sciences. Through the ARTS Program that provides individuals with the tools needed to move freely between the laboratory and the clinic, Stanford demonstrates its commitment to the emerging disciplines of translational medicine and precision medical care.

CURRENT TRAINEES
Stephen Chang, MD
Asli Edilwickeemaa, MD
Deshika Foster, MD
Geoff Kirmpiliz, MD
David Kurtz, MD
Eugene Richardson, MD
Makeda Robinson, MD

MENTORS
Mark Krasnow, PhD
Ravi Majeti, MD, PhD
Michael Longaker, MD
Irving Weissman, MD
Sanjiv Sam Gambhir, MD, PhD
Andrew Zolopa, MD
Shari Binov, MD
Graduating PhDs 2015–16

Matthew Beniosek, PhD
Molecular Imaging Program at Stanford
Current Position:
PET Hardware Scientist, RefleXion Medical, Hayward, CA
Dissertation:
Electronic Readout Strategies for Silicon Photomultiplier-based Positron Emission Tomography Detectors

Sebastian Echegaray, PhD
Molecular Imaging Program at Stanford
Current Position:
Postdoctoral Scholar, Department of Radiology/IBIS, Stanford University School of Medicine, Stanford, CA
Dissertation:
Efficient Characterization of Shapes and their Contents in Volume Data for Decision Support in Radiology

Diego Munoz Medina, PhD
Radiological Sciences Laboratory
Current Position:
Data Scientist, Radius Intelligence, San Francisco, CA
Dissertation:
Developing Subtype-Specific Stochastic Simulation Models of Breast Cancer Incidence and Mortality

Wendy Wei Ni, PhD
Radiological Sciences Laboratory
Current Position:
Data Scientist, Analytics, Facebook, Menlo Park, CA
Dissertation:
Quantitative Brain Tissue Oxygenation Mapping Using Magnetic Resonance Spin Relaxation

Bryce Quist, PhD
Radiological Sciences Laboratory
Current Position:
Research Fellow, Massachusetts General Hospital, Boston, MA
Dissertation:
Model-Based Artifact Correction in MRI

Bragi Sveinsson, PhD
Radiological Sciences Laboratory
Current Position:
Apple, Mountain View, CA
Dissertation:
Model-Based Artifact Correction Methods in Body Magnetic Resonance Imaging
Graduating PhDs 2016–17

Akshay Chaudhari, PhD
Radiological Sciences Laboratory
Current Position:
Postdoctoral Fellow, Massachusetts General Hospital, Boston, MA
Dissertation:
Temporal Characteristics of Intrinsic Brain Activity Based on Functional Magnetic Resonance Imaging

Jingyuan Chen, PhD
Radiological Sciences Laboratory
Current Position:
Postdoctoral Scholar, Department of Radiology/RSL, Stanford University School of Medicine, Stanford, CA
Dissertation:
Advances in Morphological and Quantitative Musculoskeletal MRI

Haisam Islam, PhD
Radiological Sciences Laboratory
Current Position:
MRI Software Engineer, HeartVista, Los Altos, CA
Dissertation:
Methods for High-Resolution Functional MRI

Rebecca Sawyer Lee, PhD
Radiological Sciences Laboratory
Dissertation:
Quantitative Brain Tissue Oxygenation Mapping Using Magnetic Resonance Spin Relaxation

Evan Levine, PhD
Radiological Sciences Laboratory
Current Position:
Consultant, Boston Consulting Group, San Francisco, CA
Dissertation:
Visualization and Evaluation Tools of Quantitative MR in an ACL-Injured Population

Uchechukwuka Monu, PhD
Radiological Sciences Laboratory
Current Position:
Senior Software Engineer, Oracle, San Bruno, CA
Dissertation:
Quantification of Glomerular Filtration Rate using DCE-MRI in Children

Qiyuan Tian, PhD
Radiological Sciences Laboratory
Current Position:
Consultant, Boston Consulting Group, San Francisco, CA
Dissertation:
Advancing Diffusion-Weighted Magnetic Resonance Imaging Methods for Neuronal Fiber Mapping

Umit Yoruk, PhD
Radiological Sciences Laboratory
Current Position:
Postdoctoral Research Fellow, Martinos Center for Biomedical Imaging, Massachusetts Hospital, Boston, MA
Dissertation:
Data Sampling and Constrained Reconstruction for High-Dimensional MRI
Trainee Honors and Awards

Amin Ashpou, MD, PhD 2017 Named Paul & Daisy Soros Fellow
Maryam Alighi, PhD 2016 RSNA Trainee Research Prize Award
Hamed Arami, PhD 2016 Selected to present at the University of Washington’s “Distinguished Young Scholars Seminar” series
Hao Chen, PhD 2017 Young Investigator Award (2nd place) in the Chinese American Society of Nuclear Medicine and Molecular Imaging (CASMM)
Jingyuan Chen, PhD 2016 SMRM Summa Cum Laude Merit Award
Jang-Hwan Choi, PhD 2016 Orthopaedic Research Society (ORS) New Investigator Recognition Award
Ahmed El Kaffas, PhD 2016 Poster Award, World Molecular Imaging Congress (WMIC)
Audrey Fan, PhD 2016 SMRM Summa Cum Laude Merit Award
Jia Guo, PhD 2017 ISMRM Magna Cum Laude Merit Award
Anahul Hadjipas, MD 2017 SMRM Magna Cum Laude Merit Award
Anna Solter Karmann, MD, PhD 2016 Featured Paper Award, Cardiovascular and Interventional-Radiology Society of Europe (CIRSE)
Peter R. Block, PhD 2016 SMRM Top-Rated Scientific Abstract Award
Jessica Klockow, PhD 2016 American Chemical Society CIBA/YCC Young Scientist Award
Fellik Kogan, PhD 2017 Young Investigator Cum Laude Award Winner
Kai Li, PhD 2016 Poster Award, World Molecular Imaging Congress (WMIC)
Wilson Lin, MD 2016 RSNA Trainee Research Prize Award
Michael Manabungs, PhD 2016 Poster Award, World Molecular Imaging Congress (WMIC)
Aaron Repass, MD 2016 Invitation to the SR Grassroots Leadership Program
Alexander Sheu, MD 2016 Stanford Society of Physician Scholars (SSPS) Grant
2016 The Stanford University Radiology Residency Program Etta Kalin Moskowitz Fund Research Award
2016 Stanford Medicine Teaching and Mentoring Academy Innovation Grant
Subha G. Sinha, PhD 2016 SMRM Junior Fellow
Riccardo Stora, PhD 2017 SMRM Magna Cum Laude Merit Award
Ophra Verma, MD, PhD 2016 Best Paper Award of the SUURAS Postdoctoral Research Symposium
2016 Best Poster at IEEE Micro and Nanotechnology in Medicine
2017 NCI Poster Award
Hans Weber, PhD 2017 SMRM Junior Fellow
Martin J. Willemink, MD, MSc, PhD 2016 European Radiology Most Cited Paper Award of the European Society of Radiology
2016 Frederick Phillips Prize for Clinical Imaging of the Dutch Society of Radiology
2016 RSNA Cum Laude Award for Educational Exhibit
Renee Wilson, PhD 2017 Molecular Imaging Young Investigator Prize
Jinghong Xie, PhD 2017 Molecular Imaging Young Investigator Prize
Daeshyn Yoon, PhD 2016 SMRM Magna Cum Laude Merit Award

*Please see Sponsored Research for projects awarded funding

Radiology Department Report 2015–2017

3DQ Lab

The Stanford Radiology 3D and Quantitative Imaging Laboratory (3DQ Lab) supports the mission of the department by developing and providing alternative visualizations and quantitative analysis of images for Stanford's patients. Since 1996, the 3DQ Lab has steadily grown and now consists of 15 technologists performing 3D reconstruction and quantification for many clinical entities, including Stanford Health Care and Lucile Packard Children’s Hospital. Leadership of the 3DQ Lab includes Dr. Sandy Engel (Scientific Director), Dr. Domink Fleischmann (Clinical Director), Dr. Roland Banmer (Technical Director), and Mr. Shannon Walters (Executive Manager).

HIGHLIGHTS INCLUDE:

3D Printing: Over the last four years, the 3DQ Lab has steadily gained proficiency in 3D printing processes and policies, with a focus on scaling to meet future demands in healthcare. With several small 3D printers, the lab has been able to improve communication and influence the surgical planning process. In addition to serving emerging clinical needs, several researchers have been leveraging the skills and resources available in the 3DQ Lab for creating patient-specific models for pre-surgical/interventional planning.

Neuroimage Processing: Starting in 2014, the 3DQ Lab began processing functional Magnetic Resonance Imaging (fMRI) examinations for radiologists, freeing up their time for other activities. In 2017, the Lab added Diffusion Tensor Imaging processing which further frees up radiologists’ time and helps standardize the protocol.

Prostate Cancer Staging: Ultrasound guided prostate biopsy is limited because of its poor differentiation of normal from suspicious tissue, which is better accomplished by MRI. The 3DQ Lab segments images of the prostate from MRI scans for fusion with ultrasound images during biopsy, allowing accurate needle guidance to suspicious regions. This process has improved workflows within the Department of Urology and has nearly doubled the number of biopsies possible.

Percutaneous Pulmonary Valve Replacements: This is another intervention that benefits from precise measurements based on images made by technologists in the 3DQ Lab. This work builds upon the lab’s history of supporting Transcatheter Aortic Valve Replacements for over 1,000 patients since 2008.

Standardized Tumor Response Assessments: Teaming up with Dr. Christoph Becker, the 3DQ Lab is now providing tracking and standard reports of measurements of tumor response to therapy. This is one of the fastest growing segments of the 3DQ Lab, and could double the number of patients processed in a given year.

Prediction Model for Acute Type-B Dissections: Spurred by recent trials showing mixed outcomes between intervention and medical management, the research arm of the 3DQ Lab is developing prediction models for progression based on imaging features such as outflow vasculature and pre-existing conditions.

Education: In addition to clinical applications, the 3DQ Lab is an excellent resource for medical professionals to obtain clinical training in 3D imaging post-processing and quantitative imaging methods. A variety of educational opportunities are available for Stanford medical affiliates (residents and fellows) as well as technologists, radiologists, and imaging specialists from domestic and international medical imaging communities. The 3DQ Lab also hosts two types of Visiting Fellowships in the department.
Clinical Divisions

The Department of Radiology has 12 clinical divisions providing service at 11 hospital and outpatient clinic locations and many satellite sites (see page 36–37 for more about the growth of our outpatient sites and their imaging modalities). The divisions function as a group to provide expertise in all imaging modalities and techniques to offer the highest quality of medical care. Each division is led by a chief who oversees the clinical, research, and educational activities of the division, and is staffed by subspecialized radiologists, technologists, coordinators, and administrators who provide patient care, conduct research to advance the field of medical imaging, and support research and multidisciplinary training that covers the spectrum of radiology.

Clinical care and translational research in the divisions focus on diverse aspects of medical imaging including computed tomography (CT), magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), positron emission tomography (PET), single-photon emission computed tomography (SPECT), focused ultrasound (FUS), and hybrid imaging techniques such as PET-CT, PET-MR, photoacoustic imaging (PAI), and MR-FUS. This range of imaging approaches is possible due to the availability of the most technologically advanced equipment to diagnose, treat, monitor, and characterize diseases, as well as perform minimally invasive diagnostic and therapeutic procedures under imaging guidance.

The pages that follow (72–77) describe the department’s clinical divisions and faculty and staff, their research efforts, and their achievements that continue the strong history of clinical success of the department.
Body Imaging
Juergen Willmann, MD

The Body Imaging Division consists of 15 nationally and internationally renowned faculty, seven adjunct faculty, and 11 body fellows who are specialized in the interpretation of diseases of the abdomen and pelvis, as well as additional body parts such as the thyroid, carotid, and peripheral venous system. With experts in computed tomography, magnetic resonance imaging, ultrasound, molecular imaging, X-ray, and fluoroscopy, our division is committed to training the next generation of body radiologists while delivering cutting-edge clinical care. The breadth of experience among the faculty is reflected in the wide range of academic pursuits enjoyed by the division, ranging from clinical assessment of dual-energy and low dose CT protocols, novel pulse sequences in MRI, molecular imaging with ultrasound and photoacoustic technologies, ultrasound spectroscopy, hyperpolarized MR spectroscopy, as well as imaging-guided delivery of novel therapeutics, such as microRNAs, into liver cancer in preclinical animal models.

ACHIEVEMENTS
• Dr. Willmann: 2016 SAR Best Translational Science Paper award; Dr. Daniel: 2017 ISMRM 2nd place Best Interventional Study Group Presentation Award; Dr. Kamaya: 2016 ARRS Bronze Award Education Exhibit Paper award; Dr. Daniel: 2017 ISMRM 2nd place Best Interventional Study Group Presentation Award; Dr. Willmann: 2016 SAR Best Translational Science Paper award; Dr. Daniel: 2017 ISMRM 2nd place Best Interventional Study Group Presentation Award; Dr. Kamaya: 2016 ARRS Bronze Award Education Exhibit Paper award.

Body MR Imaging
Shreyas Vasanawala, MD, PhD

The Body MR Division aims to provide outstanding patient care, lead innovations in the practice of Body MR, and train the next generation of clinician scientists, while developing a tight link between diagnosis and therapy for highly personalized care. We provide services that are personally tailored for each patient and delivered with state-of-the-art MRI technology and highly trained staff. Most exams use techniques developed and uniquely available here at Stanford. Faculty members are internationally recognized experts in body MRI, and have deep experience developing new methods to improve diagnostic precision. Body MRI research at Stanford is fostered by close collaboration and friendships between clinicians and research scientists in the Department of Radiology, the University, and throughout the Bay Area.

ACHIEVEMENTS
• Launched clinical PET-MRI program.
• Introduced clinical emergency treatment program.
• Launched new services in Emeryville.
• Recognized as MRI Guided Focus Ultrasound Center of Excellence.

Breast Imaging
Wendy DeMartini, MD

The Breast Imaging Division provides compassionate and evidence-based patient care, conducts research, and trains future leaders in the field. Our faculty are internationally recognized experts in mammography and breast MRI. All mammography studies are performed using 3D digital breast tomosynthesis, and all breast MRI studies are performed using 3T magnets. For breast surgery lesion localization, we offer a wireless, non-radioactive method done prior to surgery to provide a better experience for patients and surgeons. We will soon install mammography room “sensory suites” that allow patients to select a sensory ambience (light-scent-sound) to improve their visit. Our research includes (1) investigating factors contributing to false negative screening mammograms, (2) understanding comparative effectiveness of breast imaging tests to guide personalized care, (3) improving breast MRI techniques using high temporal resolution and novel sequences, and (4) developing a mixed augmented reality breast cancer surgery system.

ACHIEVEMENTS
• We conduct mammography studies with 3D-like digital breast tomosynthesis and synthetic 2D techniques to improve diagnostic accuracy while using only “single mammogram” radiation dose.
• We offer breast surgery localization with a wireless non-radioactive method that can be performed ahead of surgery.
• We emphasize performing breast biopsies on the same day as diagnostic imaging, decreasing the time to diagnosis, and requiring fewer patient visits.
• Dr. Wendy DeMartini was elected President of the Society of Breast Imaging.

Cardiovascular Imaging
Dominik Fleischmann, MD

The Cardiovascular Imaging (CVI) Division uses dedicated image post-processing techniques to provide unprecedented 3D and 4D visualization and quantification of cardiovascular anatomy and pathology to establish an accurate diagnosis and facilitate treatment planning for surgical or endovascular procedures, some of which are pioneered at and unique to Stanford. Our internationally-recognized imaging experts in cardiovascular imaging have extensive clinical and research expertise in CT, MRI, and nuclear medicine imaging technology applied to the clinical management of acquired and congenital cardiovascular diseases. Also, with a deep understanding of radiation exposures, we are highly trained leaders in promoting the latest dose reduction techniques, thereby allowing us to provide the best quality images under the most advanced conditions for our patients, one at a time.

ACHIEVEMENTS
• Coronary calcium score screening to modify risk factors and stabilize current disease state.
• Coronary CTA (CCTA) allows coronary artery imaging without coronary catheterization.
• Working together as a team of radiologists, basic scientists, and technologists to reduce radiation exposure according to international safety principles of ALARA [As Low As Reasonably Achievable].
Interventional Radiology
Lawrence “Rusty” Hofmann, MD

Interventional Radiology (IR) offers the entire range of vascular and non-vascular Image-guided procedures. We are experts in treating endovascular arterial disease, stenting (expandable) blood vessels, endovascular repair of aneurysms, deep vein thrombosis (DVT), and chronic venous occlusions. We also specialize in Image-guided tumor treatments including chemoembolization, radiofrequency ablation, cryoablation, Nanoknife ablation, and radioembolization. Our group also provides services to alleviate pelvic pain due to symptomatic fibroids and gonadal-vein embolization for pelvic congestion syndrome. As pioneers of minimally invasive surgery, we employ advanced imaging techniques to eliminate the need for open surgery and allow shorter recovery times.

ACHIEVEMENTS
• Dr. William Kuo featured on NBC Nightly News with Lester Holt, related to his expertise in IVC filters.
• Opening an advanced IR practice, staffed by three IR physicians, at Valley Care, October 2017.
• Dr. Rusty Hofmann, Global PI of the first FDA-approved trial for venous stenting, completed enrollment of 273 patients on October 31, 2016.
• The Stanford IR Residency matched its inaugural class on October 31, 2016.

Musculoskeletal Imaging
Christopher Beaulieu, MD, PhD

The Musculoskeletal Division provides state-of-the-art imaging services and special interventions for patients with bone, joint, and soft tissue disorders. Over 65,000 examinations are performed annually including radiography, MRI, CT, ultrasound, and injection/aspiration procedures. Seven full time faculty at Stanford and three faculty at the VA Palo Alto oversee resident and fellow training. Research efforts include the development of efficient imaging methods for assessment of arthritis, imaging around metallic implants, imaging of peripheral pain, MRI, neurography, and biostatistics applications to bone tumor diagnosis. Additional cross-specialty research includes targeted microbubble studies for early detection of ovarian cancer and development of machine learning and artificial intelligence applications to liver lesions.

ACHIEVEMENTS
• Expansion of peripheral nerve imaging with our “MR neurography” service.
• Pre-clinical implementation of PET-MRI for imaging of peripheral pain and other musculoskeletal disorders.
• Ongoing imaging and interventional services for Stanford Athletics and the San Francisco 49ers.
• Established a prototype user interface to assist radiologists with bone tumor diagnosis.
• Reached over 6,500 subscribers on YouTube channel with MSK educational videos.

Neuroimaging and Neurointervention
Max Wintzemark, MD, MAS, MBA

The Neuroimaging and Neurointervention Division consists of 17 world-renowned faculty and 16 fellows who specialize in interpreting imaging studies of the brain, spine, and head and neck. We offer minimally invasive treatment of cerebral aneurysms and other cerebral vascular malformations, stenting of carotid arteries, vertebroplasty, and image-guided biopsy. We have unique expertise in advanced neuroimaging techniques, including dual-energy CT, functional MRI, DTI and tractography, spectroscopy, and perfusion imaging. We are the only Bay Area center to offer the brain “stress test,” advanced blood flow imaging to evaluate cerebrovascular reserve. We offer rapid, dedicated stroke MRI and CT imaging to differentiate between completed stroke and “at-risk” tissue, with automated decision support software that has been validated in multicenter trials.

ACHIEVEMENTS
• Contribution to a facility for Integrated neurological Imaging (CT, MRI, PET-MRI) and care, in collaboration with colleagues in Neurology and Neurosurgery.
• Implementation of Visualization-based neurosurgical MRI procedure for minimally invasive brain surgery.
• Multiple NIH and industry-sponsored clinical trials, in diverse areas such as acute stroke, chronic fatigue syndrome, and traumatic brain injury.
• Combined PET-MRI Imaging of cerebral blood flow using 15O water.

Nuclear Medicine and Molecular Imaging
Andrei Iagaru, MD

The Nuclear Medicine and Molecular Imaging Division at Stanford University offers a broad range of capabilities including SPECT, SPECT-CT, PET-CT, PET-MR and targeted radionuclide therapy. In line with the goal of advancing patient care, we actively participate in translational research, as well as state-of-the-art clinical imaging. We make every effort to support collaborations across academia, as well as with industry. We are committed to improving health through excellence in image-based patient care, research and education. We also offer the first ever combined Nuclear Medicine and Diagnostic Radiology residency training program in the U.S.

ACHIEVEMENTS
• First installations worldwide of GE SIGNA PET-MRI and GE Discovery MI PET-CT, moving PET technology from photomultiplier tubes to silicon photomultipliers.
• Targeted radionuclide therapy center for thyroid, prostate, and neuroendocrine tumors.
• Comprehensive prostate cancer imaging program including PSMA and bombesin-targets.
Pediatric Imaging
Richard Barth, MD

The Pediatric Radiology Division aims to improve the health of children through excellence in clinical imaging and image-guided diagnosis and therapy, translation of pediatric-specific innovations into clinical practice, and the education of future leaders in pediatric radiology. Pediatric Radiology at LPCH offers a comprehensive program that works every day to improve the health of children through the application of state-of-the-art technology. Children are not small adults and present unique challenges including different physiology, small anatomy, and radiation sensitivity. The pediatric radiology faculty are internationally recognized and have collaboratively developed safe, minimally invasive, non-ionization high-resolution imaging methods to benefit the care of children.

ACHIEVEMENTS

- Diagnosis of stress injuries in fingers of adolescent competitive rock climbers: Evaluation by ultrasound and MRI. SPR 2017 Annual Mtg: Most Promising Investigator award paper (Garcia, Jaramillo, Rubesova).
- Validation of ultrasound contrast cystography as an alternative to radiographic voiding cystourethrography (Larson, Chen, Lungren, Halabi, Langlotz).
- Combined fMRI and MR Tractography for pre-surgical planning of brain tumor resections in children to minimize neurologic deficit (Vasanawala).
- Development of printed flexible MRI coils as a more comfortable high resolution coil alternative for children (Vasanawala).

Thoracic Imaging
Ann Leung, MD

The Thoracic Imaging Division aims to sustain and improve health through high-quality, state-of-the-art imaging of the chest. The division expanded with the arrival of a new faculty member, Dr. Emily Tu, and the addition of a second thoracic imaging fellow. As part of the daily provision of clinical care, our fellowship-trained thoracic radiologists work closely with referring physicians including pulmonologists, oncologists, and surgeons to enable multidisciplinary care that directly benefits patients. The division's educational efforts range from the teaching of medical students and housestaff to community outreach efforts on the indications and benefits of low-dose CT screening for lung cancer. In recent years, our research has focused on optimization of CT techniques for nodule evaluation and determining barriers to entry into a CT lung cancer screening program for the medically underserved.

ACHIEVEMENTS

- Dr. Henry Guo was awarded a Society of Thoracic Radiology seed grant for his project "Assurance of subsolid pulmonary nodule visualization by low-dose CT, facilitated by 3D printing."
- Dr. Leung is a co-author of the 2017 Fleischner Guidelines for Management of Incidental Pulmonary Nodules.
- Implementation and growth of CT clinical applications of dynamic always evaluation and quantitative lung analysis for broncholiths ablaters.
The Department of Radiology continues to make significant progress in research. During FY17, more than $55 million in sponsored funding was awarded to the department’s research and clinical divisions. The resulting research accomplishments reflect a deep and growing commitment to elucidating the underlying physiologic processes of disease, developing new methodologies and therapies to improve patients’ lives, and to educating and training the next generation of interdisciplinary scientists. Faculty leading sponsored projects in the department include experts in the fields of magnetic resonance imaging (MRI), ultrasound, X-ray, computed tomography (CT), positron emission tomography (PET), single-photon emission computed tomography (SPECT), spectroscopy, chemistry, molecular imaging, genomics/proteomics, bioinformatics, and computational sciences.

The following pages summarize the research carried out in investigative laboratories and groups within the research divisions in the department.

I. Canary Center at Stanford for Cancer Early Detection
II. Integrative Biomedical Imaging Informatics at Stanford (IBIIS)
III. The Molecular Imaging Program at Stanford (MIPS)
IV. The Radiological Sciences Laboratory (RSL)
V. Precision Health and Integrated Diagnostics (PHIND) Center at Stanford

Researchers in the department include faculty members, visiting scholars, staff scientists, postdoctoral fellows, and graduate and undergraduate students who actively collaborate with colleagues across Stanford, at affiliated institutions, other research institutions, industry partners, and foundations. Our collaborations span broadly across the Stanford campus, the United States, and reach out internationally.
DIVISION LEADERSHIP
Sanjiv Sam Gambhir, MD, PhD
Stephanie van de Ven, MD, PhD
Mark Strauss, PhD

SELECTED FUNDING
The Canary Foundation
Center for Cancer Nanotechnology Excellence for Translational Diagnostics
NCI-CA199075 (Gambhir/Wang)
Sloan-Kettering Institute for Cancer Research:
Excellence in Translational Diagnostics
NIH/NCI 5 U54 CA199075 03
Canary Cancer Research Education
Summer Training (Canary CREST) Program
NIH/NCI 1 R25 CA217729 01 (Soh/Demirci)

SELECTED PUBLICATIONS


Micro-environmental forces lead to spatial patterning of benign (green) and malignant (red) cancer cells within a tumor. Image courtesy of Mallick lab.

Micro-environmental forces lead to spatial patterning of benign (green) and malignant (red) cancer cells within a tumor. Image courtesy of Mallick lab.
Demirci BAMM Lab
Utkan Demirci, PhD

One of the greatest achievements in medicine is the remarkable progress that has been made in understanding, diagnosing, monitoring, and treating disease conditions by creating innovative micro/nanoscale technologies. We have made seminal contributions and inventions for the development of microfluidic bio-imaging/enhancing platforms for point-of-care diagnostics with broad medical applications. We have developed tools for detecting cell/cancer biomarkers and isolating exosomes from body fluids. We have created microfluidic tools to mimic the cancer microenvironment for investigating metastasis. We made breakthroughs in cell-sorting and single-cell imaging by magnetically levitating cells to isolate circulating tumor cells from blood with applications in precision medicine; developed a microfluidic technology for sperm selection resulting in 5,000+ newborns globally and integrated it with lens-free, super-resolution imaging. We created successful start-ups bringing these technologies into the clinic.

ACHIEVEMENTS
• The Academy for Radiology & Biomedical Imaging Research Distinguished Investigator Award (2017).
• Basic Scientist of the Year, Stanford University School of Medicine, Department of Radiology (2014).
• Elected to AIMBE College of Fellows (2017).

Multi-scale Diagnostics Lab
Parag Mallick, PhD

The Mallick lab focuses on translating multi-omic discovery into precision diagnostics. In particular, we use tightly integrated computational and experimental approaches to discover the processes underlying how cells behave (or misbehave) and accordingly how cancers develop and grow. We hope that by exploiting these processes, and by formalizing our knowledge in predictive mathematical models, we will be able to better identify biomarkers that can be used to detect cancers earlier and describe how they are likely to behave (e.g., aggressive vs. indolent, drug sensitive vs. resistant). We are specifically working in three focus areas: Cancer Systems Biology, Multi-scale Biomarker Biology, and Technology Development.

ACHIEVEMENTS
• Development of the DISK/Spellbook ecosystem—a set of open-source tools to accelerate the extraction of knowledge from complex multi-omics data.
• Machine reading tools for extracting biomarkers from scientific articles.
• Use of multi-dimensional pathology data to demonstrate the role of micro-environment in driving tumor heterogeneity and drug resistance.

Early Lung Cancer Detection Lab
Viswam Nair, MD, MS

Dr. Nair’s group focuses on (1) integrating clinical imaging and non-invasive biomarkers to develop new, improved diagnostic models for personalizing medicine, (2) understanding the current limitations of “omics” and biomarker studies in clinical practice, and (3) identifying and reducing health disparities for patients at risk for lung cancer. Dr. Nair is a clinical researcher who currently holds a faculty appointment in the Division of Pulmonary and Critical Care Division (Medicine) and the Canary Center at Stanford for Cancer Early Detection (Radiology), where he leads clinical programs in lung nodule evaluation and lung cancer screening.

ACHIEVEMENTS
• Our group has successfully established the Northern California Novel Cell and Radiology (NO CANCER) Biomarkers Initiative, an ongoing investigation of nearly 500 patients who undergo PET-CT imaging and molecular biomarker analysis in all stages of lung cancer.
• We partner closely with basic investigators to define the utility of innovative assays designed to detect cancer in the blood.
• We are using unique epidemiological, imaging, and molecular data to define how best to approach evaluating the Solitary Pulmonary Nodule (SPN), a radiologic finding that physicians can expect to encounter in 1.5 million adults and where cancer must be effectively ruled out.

Cancer Molecular Diagnostics Lab
Sharon Pitteri, PhD

The Pitteri Laboratory is dedicated to early detection of aggressive cancer through the development of new in vitro diagnostic strategies. We are investigating molecules in blood, tissue, and other bodily fluids that can be used as disease biomarkers. To develop molecular signatures for disease diagnosis, we are particularly interested in exploiting aberrant glycosylation—a well-established but poorly understood feature—in tumorigenesis. Our recent work has focused primarily on breast and prostate cancers, where we have focused on distinguishing benign from malignant lesions and distinguishing indolent from aggressive disease, respectively. We have active collaborations with clinicians and other scientists to apply our technologies to study clinical samples, cell lines, and mouse models.

ACHIEVEMENTS
• We are collecting interstitial fluid in the Breast Imaging Clinic to measure proteins in the tumor microenvironment that are capable of distinguishing benign from malignant lesions.
• We have developed methods to systematically identify, localize, characterize, and quantify glycosylated proteins in biological samples.
• We are understanding differential protein glycosylation in prostate tumor samples from men with aggressive vs. indolent cancer, and in blood samples from men with benign vs. malignant disease.
Molecular Targets for Diagnosis and Treatment Discovery Lab

Tanya Stoyanova, PhD

Dr. Stoyanova’s research focuses on understanding fundamental molecular mechanisms underlying cancer development. Currently, her group studies signaling cascades initiated by cell surface receptors, which are involved in the early event of prostate cancer initiation and regulation of the transition from indolent to aggressive disease. The Stoyanova lab is also interested in developing new clinically relevant animal models to study genetic events and molecular mechanisms underlying cancer development. The goal of Dr. Stoyanova’s laboratory is to improve the stratification of indolent from aggressive prostate cancer and aid the development of better therapeutic strategies for the advanced disease. Additionally, the lab is interested in understanding molecular mechanisms that govern the self-renewal activity of adult stem cells and cancer stem cells.

ACHIEVEMENTS
• Defining molecular drivers of aggressive prostate cancer.
• Developing novel tissue and blood based biomarkers for prostate cancer.
• Evaluating new therapies for advanced prostate cancer.
• Developing new clinically relevant models to study cancer.

In order to achieve early and accurate detection of diseases, antibodies have been extensively used to specifically bind to disease biomarkers. Unfortunately, there are many types of important disease biomarkers, such as metabolites and carbohydrates, which antibodies cannot recognize. This has been a major problem for advancing molecular diagnostics in the clinic. In order to address this problem, our lab develops synthetic antibodies (“aptamers”) that can outperform natural antibodies. In order to achieve this, we use the principles of evolution (mutation, selection, and amplification) to create novel molecules that do not exist in nature. We then use these aptamers to develop advanced biosensors that can achieve extremely sensitive detection of multiple biomarkers in clinical samples. For example, our laboratory pioneered the development of “real-time biosensors” that can continuously measure target molecules directly in live animals. We hope to expand these measurement techniques and bring them into the clinic to accurately detect diseases at their earliest stages.

Soh Lab

H. Tom Soh, PhD

In order to achieve early and accurate detection of diseases, antibodies have been extensively used to specifically bind to disease biomarkers. Unfortunately, there are many types of important disease biomarkers, such as metabolites and carbohydrates, which antibodies cannot recognize. This has been a major problem for advancing molecular diagnostics in the clinic. In order to address this problem, our lab develops synthetic antibodies (“aptamers”) that can outperform natural antibodies. In order to achieve this, we use the principles of evolution (mutation, selection, and amplification) to create novel molecules that do not exist in nature. We then use these aptamers to develop advanced biosensors that can achieve extremely sensitive detection of multiple biomarkers in clinical samples. For example, our laboratory pioneered the development of “real-time biosensors” that can continuously measure target molecules directly in live animals. We hope to expand these measurement techniques and bring them into the clinic to accurately detect diseases at their earliest stages.

ACHIEVEMENTS
• Developed high-throughput technology to generate synthetic antibodies (“aptamers”) with higher performance than monoclonal antibodies.
• Developed non-natural aptamers that can target biomarkers that antibodies cannot recognize.
• Demonstrated the first real-time closed-loop control of drug level in live animals.

ivaluable for storing and displaying clinical imaging data. However, a clinical PACS is not well suited for research applications because frequent retrieval of large volumes of research study data can significantly impede the clinical PACS performance. To address these challenges, Stanford is creating a “research PACS” to facilitate the usage of clinical imaging data for research.

Advancements in computer vision have created a particularly compelling need for massive clinical imaging data sets to be mined and explored. In the past, the creation of decision support systems to assist medical imaging professionals required “feature engineering”—the painstaking manual design of algorithms to analyze images. Recent progress in artificial intelligence has replaced feature engineering with a more efficient and scalable neural network process, based on machine learning from large sets of annotated training data.

Inspired by ImageNet, Stanford Radiology’s research PACS is called Medical ImageNet, and is a cloud-based, petabyte-scale (that is a million gigabytes), fully anonymized, searchable, and shareable repository of diagnostic imaging studies for the development of intelligent image analysis systems. Natural language processing methods will be used to label this repository of 5 million imaging studies for machine learning applications. The imaging data will become part of the School of Medicine’s enterprise data warehouse, where it will be linked to information from the electronic patient record, including genomic data. Tools created from this platform will significantly improve radiologists’ ability to detect and respond to emergency events, improve image quality control, and automate report drafting. These machine learning tools also have the potential to reduce diagnostic medical errors, which can cause significant patient harm and play a role in up to 10% of patient deaths. Medical diagnosis is a highly perceptual task that will always require human interaction—with those who adapt to using these advanced diagnostic tools outperforming those who do not.

Stanford’s Medical ImageNet is currently being used to develop systems in computer-aided detection and classification, image-derived prognosis, and image-gene relationships. The long-term vision is to continue the development of this facility within a center of excellence for artificial intelligence in medical imaging, which develops, evaluates, and disseminates artificial intelligence systems that reduce diagnostic medical errors. This effort will draw upon collaborative informatics research with faculty in the Department of Biomedical Data Science, and the Division of Biomedical Informatics Research in the Department of Medicine, and leverage expertise from the Departments of Computer Science, Electrical Engineering, Psychology, and Bioengineering. Furthermore, because of Stanford’s presence in Silicon Valley, it is easily accessible to potential commercial partners, both startups and established companies.

The vision for Stanford’s Medical ImageNet and the development of the research PACS has been spearheaded by Dr. Curtis Langlotz (Professor and Associate Chair for Information Systems, Radiology).
The image shows a “saliency map”, highlighting the areas of the image used by a machine learning algorithm to formulate a recommendation. Algorithms like this will help the human and machine work cooperatively, by exploring the machine’s rationale.
Langlotz Lab
Curtis Langlotz, MD, PhD

Our lab investigates the use of deep neural networks and other machine-learning methods to help radiologists detect disease and eliminate diagnostic errors. We use artificial intelligence techniques to evaluate image quality, identify critical findings, and classify imaging abnormalities. When our results show potential, we evaluate their clinical utility in the reading room and disseminate them as open source or commercial software.

To support our efforts, we are developing a massive research database containing 5 million images from our hospital picture archiving and communication system (PACS). The laboratory develops natural language processing methods that extract information from narrative radiology reports to label the imaging studies automatically. This labeled image dataset serves as large annotated image training sets for supervised machine learning experiments. We call this resource, as large annotated image training sets for supervised machine learning algorithms to make inferences from the integrated data. Ultimately, we aim to translate these developments into clinical applications, including content-based medical image retrieval and decision support systems for radiologists. We primarily work with cross-sectional images, including CT, MRI, and ultrasound, and specialize in cancer imaging, focusing mostly on lung, liver, and brain cancer.

ACHIEVEMENTS
- Created a machine learning algorithm that performs at the level of expert human radiologists in estimating the physiologic age of children.
- Developed a machine learning classifier of knee MRI reports and conducted a multi-institutional evaluation of its accuracy.
- Published a probabilistic model that calculates the differential diagnosis of bone tumors.
- Developed software tools that enable rapid image labeling.
- Implemented a software pipeline that enables bulk transmission and de-identification of clinical imaging data in the cloud.

Radiological Image and Information Processing
Sandy Napel, PhD

Our lab focuses on developing new techniques to determine diagnosis and to predict prognosis, response to treatment, and outcomes from images and other associated data. This involves the development of algorithms to make image features computer-accessible (e.g., volumes, lengths, shapes, edge sharpness, curvatures, textures), the building of integrated databases combining features of multidimensional radiological images and other clinical data, including molecular assays of biopsies and/or resected tissue, and machine learning algorithms to make inferences from the integrated data. Ultimately, we aim to translate these developments into clinical applications, including content-based medical image retrieval and decision support systems for radiologists. We primarily work with cross-sectional images, including CT, MRI, and ultrasound, and specialize in cancer imaging, focusing mostly on lung, liver, and brain cancer.

ACHIEVEMENTS
- Participated in international networks for tool and algorithm sharing for cancer imaging.
- Developed a community-accessible and expandable resource for computation of image features from collections of 2D and 3D medical images.
- Completed several databases linking images to molecular properties of tumor tissue.
- Built several novel models linking image features to outcomes and molecular properties of lung, brain and liver tumors.
- Awarded several major grants for developing tools and databases for quantitative imaging.

Cancer Systems Biology Lab
Sylvia Plevritis, PhD

Our Cancer Systems Biology Laboratory (CSBL) aims to unravel the molecular mechanisms underlying cancer progression to identify novel approaches to early detection and effective treatment of cancer. Our work involves the analysis of cancer as a complex system whose components can be reverse-engineered from multi-omics data. Our active research projects include: (1) reconstructing intra- and inter-cellular communication networks of cancer from genomic, proteomic and radiomic data, (2) optimizing combination drug therapy strategies, and (3) quantifying the impact of risk-based screening and molecularly targeted therapeutics on population cancer incidence and mortality rates. Ultimately, our goal is to develop a multiscale view of cancer progression for improving early detection and treatment strategies for the individual patient. CSBL brings together computer scientists, statisticians, engineers, biological experimentalists and clinical researchers for a multidisciplinary approach to tackle cancer.

ACHIEVEMENTS
- Discovered novel quantitative imaging features in MRI images of brain cancer that identify subtypes of this disease that are sensitive to particular drug treatments.
- Expanded the ePAD semantic image annotation technology (http://eypad.stanford.edu) by integrating it with the Quantitative Imaging Feature Pipeline (http://qifp.stanford.edu) platform—both developed by our group—to enable large scale science with images and machine learning to recognize disease subtypes and predict clinical outcomes.
- Developed novel natural language processing methods to automatically code and summarize narrative radiology reports, enabling pursuit of health services research questions.

Quantitative Imaging Lab
Daniel Rubin, MD, MS

Our laboratory develops artificial intelligence methods and computational tools to realize precision health and to enable better care in disease. We translate our discoveries into practice through decision support applications to reduce variation in clinical care and to improve patient outcomes. Our work spans the spectrum from basic science discovery (discover image phenotypes to define subtypes of disease and to understand their molecular characteristics) to clinical practice through translational research (decision support, disease profiling, treatment response assessment, and personalized treatment selection). Our vision is that computational approaches to mining large collections of integrated molecular, clinical, and imaging data will drive scientific discovery, help to predict/detect disease, and guide clinical practice. Our ultimate goal is to bring cutting-edge radiological data and knowledge into disease prediction and to promote precision care of patients.
DIVISION LEADERSHIP
Sanjiv Sam Gambhir, MD, PhD
Gundula Jacobson, PhD

SELECTED FUNDING
Cancer Translational Nanotechnology Training (Cancer-TNT) Program. NIH/NCI 5 T32 CA196585-02 (Rao/Felsher)
Stanford Molecular Imaging Scholars (SMIS) Program. NIH/NCI 2 T32 CA118681-12A1 (Levin)
Center for Cancer Nanotechnology Excellence for Translational Diagnostics (CCNE-TD). NIH/NCI 5 U54 CA199075 03 (Gambhir/Wang)
Multiple funding sources by individual faculty grants and industry collaborations

SELECTED PUBLICATIONS

Molecular Imaging Program at Stanford (MIPS)

Our continuing vision for the Molecular Imaging Program at Stanford (MIPS) has been to bring molecular imaging technologies to basic science cancer researchers. We create an environment in which non-invasive imaging technologies that permit longitudinal studies of tumor initiation, progression, metastasis, and response to therapy is adopted by basic scientists studying cancer. Within the MIPS program, we continue to develop animal models of cancer in which molecular imaging adds new dimensions to experimental design and allows investigators to acquire time-dependent data that could not be obtained in any other way. The MIPS program is supported by numerous funding sources, including the National Institutes of Health, multiple foundations, and strong industry partnerships. Since the inception of MIPS (2003), we have followed a clearly defined roadmap toward translating our work into clinical use to benefit patients.

ACHIEVEMENTS
• Eight new faculty joined MIPS, establishing a total group of 28 faculty spanning 11 different departments on campus.
• Dr. Heike Daldrup-Link joined the MIPS leadership team as Director of Pediatric Molecular Imaging.
• A new Molecular Imaging Young Investigator (MIYI) prize was established, and the first two recipients were Dr. Katherine Wilson, and Dr. Jinghong Xie.

Noninvasive Neurointerventions Lab

Raag Airan, MD, PhD

The Noninvasive Neurointerventions (n²) Lab is focused on developing novel molecular interventions for interrogating and treating the nervous system, primarily through focused ultrasound mediated targeted drug delivery. We are adapting the use of “phase-change” nanotechnology to focally deliver neuromodulators to the brain to enable spatiotemporally-precise and receptor-specific noninvasive neuromodulation. In addition, we are implementing clinical protocols for targeted, safe, and reversible blood-brain barrier opening to increase chemotherapeutic delivery to the brain. Finally, we are exploring methods to use these technologies to focally modulate cerebral perfusion and the neural immunological response. Working in a multidisciplinary space that involves radiology, neurosurgery, neurology, and psychiatry, the n² lab is driven to combine advances in drug delivery nanotechnology and focused ultrasound to enable noninvasive, spatially, and temporally precise drug delivery to the brain.

ACHIEVEMENTS

• Established neuro-electrophysiology and neuro-behavioral assays as new core techniques for the department.
• Developed a variety of drug-encapsulated ultrasound-sensitive nanoparticles that may be used to focally modulate varied brain receptor systems.
• Successfully implemented these tools to focally and selectively modulate evoked brain electrical activity.
• Developed and validated aspetic methods to produce these nanoparticles at scales relevant for eventual clinical translation.

Molecular Imaging of Nociception and Inflammation Lab

Sandip Biswal, MD

Chronic pain sufferers are, unfortunately, limited by poor diagnostic tests and therapies. Our lab is interested in the “imaging of pain” by using multimodally molecular imaging techniques to study molecular and cellular changes specific to nociception and painful inflammation as a means of improving objective, image-guided diagnosis, and treatment of chronic pain disorders. We develop new molecular contrast agents for use in positron emission tomography (PET) and magnetic resonance imaging (MRI) and are currently conducting two clinical trials using the relatively new hybrid imaging technique of PET-MR. The overarching goal of our efforts is to develop an imaging approach that will pinpoint the exact cause of one’s pain, improve outcomes of pain sufferers, and to help develop new treatments for chronic pain.

ACHIEVEMENTS

• Clinical trials to identify chronic pain generators:
  • [18F]FTC-146 PET-MR in healthy volunteers and in patients with CRPS and sciatica.
  • Use of [18F]-FDG PET-MR to diagnose increased nociceptive activity and neural inflammation in patients with chronic pain.
• Publications:
  • First-in-human application of [18F]FTC-146, the sigma-1 receptor radiogand.
  • Redistribution and dosimetry of FTC-146 in healthy subjects.
  • Initial experience with clinical-grade [18F] FTC-146: Radiosynthesis and first-in-human PET-MRI evaluation.

Cancer Molecular Imaging Chemistry Lab

Zhen Cheng, PhD

The overall objective of this laboratory is to develop novel molecular imaging techniques and therapeutic agents for early diagnosis and treatment of severe diseases, including cancer, neurological, and cardiovascular diseases. We have aimed to identify novel cancer biomarkers with significant clinical relevance, explore new chemistry and platforms for translating preclinical research, and develop new imaging strategies for clinical translation. To accomplish these goals, a multidisciplinary team composed of members with expertise in organic chemistry, radiochemistry, biochemistry, bionanotechnology, molecular and cell biology, radiological sciences, medicine, and molecular imaging has been built to implement several research projects related to molecular imaging.

ACHIEVEMENTS

• Developed a new class of small molecule-based dyes for in vivo near-infrared window II imaging of a variety of diseases models.
• Developed a variety of new nanoplasters such as metalin nanoparticles, gold-trapped nanoparticles, Au-iron oxide heterostructures, and Perylene-diimide-based nanoparticles for cancer multimodality imaging and theranostics.
• Developed several clinical translatable PET probes for cancer, cardiac, and neurological disease imaging.
• Established Cerenkov luminescence imaging (CLI) as a new approach for biomaging and further developed new molecular probes for CLI.

ACHIEVEMENTS

• Cross-species multi-modal imaging to investigate GABA physiology in Fragile X syndrome. (Collaboration with Lawrence Fung, Scott Hal, Jennifer McNab, and Dan Spielman).
• PET-MRI imaging of peripheral neural sigma-1 receptor expression in a neuropathic pain model. (In additional collaborations with Sandip Biswal, Chris McCurdy, Joe DeMarti, and Mathieu Spriet clinical studies with [18F] FTC-146 are ongoing in both human and equine pain subjects).
• Developed novel clinically translatable imaging probes (e.g., PET MR-tracers) to study cancer biology, specifically the tumor microenvironment.

ACHIEVEMENTS

• Developed novel clinically translatable imaging probes (e.g., PET MR-tracers) to study cancer biology, specifically the tumor microenvironment.
PEDIATRIC MOLECULAR IMAGING LAB

Heike Daldrup-Link, MD

Our research team aims to provide pediatric patients with more efficient and accurate disease diagnoses than currently available. In the past, pediatric radiology essentially depicted human anatomy. Modern medicine needs more advanced information. We combine innovations in nanotechnology development and medical imaging towards the development of novel imaging techniques, which can detect specific cells in the body and monitor their function at a molecular level. We developed novel imaging techniques for radiation-free cancer staging, imaging techniques for tracking of stem cell transplants in leukemia patients and “theranostic” (combined diagnostic and therapeutic) nanoparticles for image guided cancer therapy. A number of these molecular imaging technologies have been successfully translated from our basic science lab to clinical imaging applications, thereby creating direct value for our pediatric patients.

ACHIEVEMENTS

- Seven trainees honored for innovative imaging research (K.G U. twice), Priess Sugarak, Anat Kvitko, Maryam Agnigh, Christoph Kieron, Hussain Nejadnik
- Patent US 9579351 filed for in vivo iron labeling of stem cells and tracking these stem cells after transplantation; currently evaluating in a “first-in-patient” clinical trial.
- Patent WO 2015014756 A1 filed for tumor enzyme-activatable therapeutic drug that provides image guided cancer therapy without side effects; now being evaluated by the NIH Cancer Nanocharacterization Lab, a first step to clinical translation.
- Discovery of unexpected intrinsic therapeutic effect of iron oxide nanoparticles on the immune cell composition in cancer: nanoparticles can prevent or inhibit the growth of early cancers (Nature Nanotechnology 2017).
Molecular Imaging
Instrumentation Lab
Craig Levin, PhD

The goal of the lab is to create novel instrumentation and software algorithms for in vivo imaging of molecular signatures of disease in living subjects. These new cameras efficiently image emissions from molecular contrast agents to probe disease biology in tissues residing deep within the body, using measurements made from outside the body. The technology goals are to advance the sensitivity and spatial, spectral, and/or temporal resolutions, to create new camera geometries for special biomedical applications, to understand the entire imaging process comprising the subject tissues, radiation transport, and imaging system, and to provide the best possible image quality and quantitative accuracy. The ultimate goal is to introduce these new imaging tools into studies of molecular mechanism and treatments of disease in living subjects.

ACHIEVEMENTS

• Awarded a Coulter institute translational grant to design and develop a high performance and cost-effective solution for PET-MRI.
• Developed a practical photon detector technology that achieves <100 picoseconds coincidence time resolution to advance time-of-flight PET.
• Developed image reconstruction methods to enable ultra-high resolution imaging with a prototype of the world’s first 1 mm resolution clinical PET system.

Body MR Translational Research Lab
Andreas Loening, MD, PhD

The lab focuses on research projects toward expanding the capability of MR and PET-MRI as it relates to applications in body imaging. Clinical research aims include the application of new or improved MR sequences and reconstruction mechanisms to increase the speed, robustness, and diagnostic capability of body MRI protocols, and combining PET molecular imaging agents with MRI to improve the diagnostic power of clinical imaging. Translational research aims include exploring new MR contrast mechanisms and contrast agents, such as for the stratification of cancer within the prostate and the identification of metastatic disease involvement of lymph nodes.

ACHIEVEMENTS

• Improved accuracy of multi-parametric prostate MRI by incorporating small-field of view 3D T2-weighted imaging techniques.
• Implementation of variable refocusing flip angles and outer volume suppression techniques into single shot fast spin echo imaging to increase speed, imaging quality, and robustness of body MRI protocols.
• Clinical validation of complementary poisson-disc sampling with compressed sense reconstruction to add robustness to dynamic contrast enhanced abdominal MRI examinations.
• Creation of high-throughput and clinically relevant contrast agent screening mechanisms using a human derived prostate tissue slice cancer model.

Small Molecule Design Lab
Sanjay Malhotra, PhD, FRSC

Our laboratory focuses on the design and discovery of synthetic and natural product-inspired small molecules, which can be used as probes to understand biological phenomena, including protein-protein interactions and modulation of signal transduction pathways. We employ the tools of synthetic and medicinal chemistry, molecular modeling, and chemical biology for translational research in drug discovery, development, imaging and radiation. Our current projects include design of new scaffolds/molecules as chemical tools to study various solid tumors, Alzheimer’s disease, and markers for screening of hypoxic metabolically active cells.

ACHIEVEMENTS

• Identified the first small molecule anti-cancer agent against paclitaxel resistant cancer cells.
• Developed a prototype of boronic acid-based flurescent acridone sensor for detection of gastrointestinal cancer.
• Designed indolo-pyrido-isoquinolin-based synthetic alkaloid that inhibits growth, invasion, and migration of breast cancer cells via activation of p53-miR34a axis.
• Book: Molecular Materials: Preparation, Characterization, and Applications. Sanjay Malhotra, B. V. Prasad, Jordi Fraxedas.
Koen Nieman, MD, PhD

The objective of Dr. Nieman’s research is the development of accurate diagnostic techniques and more effective pathways to improve the management of patients with cardiovascular disease. Ongoing research includes: (1) randomized controlled trials on fixed, comprehensive cardiac CT protocols for stable chest pain, and CT angiography (CTA) for the image of acute chest pain in the emergency room, (2) new functional cardiac CT applications such as stress myocardial perfusion imaging, and CTA-derived fractional flow reserve, (3) characterization of atherosclerotic plaque, (4) contrast media, and (5) 4D flow imaging with cardiac MRI.

ACHIEVEMENTS
• Since his arrival late in 2016, Dr. Nieman has been working closely with the Cardiovascular Imaging Division in Radiology and with Cardiovascular Medicine in the Department of Medicine.
• Functional cardiac CT applications for the hemodynamic interpretation of CAD.
• Clinical validation of cardiac CT in cardiovascular medicine.
• Comprehensive evaluation of patients with symptoms after coronary revascularization.
• Cardiac CT in structural heart disease.

Ramasamy Paulmurugan, PhD

The main focus of CPL is to develop in vivo imaging strategies to study cellular signal transduction networks in cancer. Specifically, we study the signal transduction networks involved in estrogen receptor α and β/hormone interactions, epigenetic histone modifications, Nf12-Keap1, Wnt-β-catenin, and Nf12 regulatory pathways and their roles in the pathogenesis and therapeutic responses of different cancers to various therapeutic interventions and drug resistance. Additionally, we develop microRNA-mediated reprogramming approaches to enhance cancer chemotheraphy. With regard to breast cancer, we investigate the possible association of microRNAs with breast cancer development and tamoxifen resistance in particular. We also study signaling pathways to establish immunotherapy for cancer.

ACHIEVEMENTS
• Developing multiplex imaging assays to simultaneously measure histone methylations in various lysine marks of histone proteins.
• Developing FDA-approved polymer nanoparticles to co-deliver therapeutic sense- and antisense-microRNAs for cancer therapy.
• Studying estrogen receptor (ER) α and β cross talk in breast cancer.
• Nf12-Keap1 antioxidant mechanism in drug resistance and chemotheraphy in cancers.
• Studying the role of stem cells in cancer and targeting Wnt-β-catenin and Nf12 signaling to improve cancer chemotherapy.

Jianghong Rao, PhD

The Rao lab is engaged in the quest for novel molecular imaging techniques to be ultimately deployed for patients at bedside, thus contributing to the detection and treatment of human diseases. Cost-effective, non-invasive, low dose molecular probes are the tangible output and the reason to be part of the Rao lab, working both from the fundamental and applied standpoints. Among the latest research results accomplished, we must emphasize the development of a new approach, Target Enable in Situ Ligand Aggregation (TESLA), for detection of intracellular apoptosis in vivo, through a biocompatible condensation reaction, photoswitchable nanoparticles for background-removing photoacoustic imaging, and also the novel nanoparticle sensors for detection of reactive oxygen species induced by radiation therapy.

ACHIEVEMENTS
• A patent was granted on 2016 on novel molecular probes for specific Imaging and detection of mycobacteria species.
• Dr. Antonio Benayas Hernandez received a 2016 MSCA (Marie Sklodowska-Curie Action) fellowship from the European Commission. Dr. Benayas joined the Rao lab in April 2017, to develop a 20-month research project sponsored by the European Commission. Dr. Benayas joined the Rao lab in April 2017, to develop a 20-month research project sponsored by the European Commission.
• Initiation of GMP manufacture and IND application of fluorescently labeled antibody as an optical agent used for surgical and pathological navigation during the surgery of head and neck cancer, brain cancer, and pancreatic cancer. We are also studying the role of optical imaging for quantification of antibody accumulation and distribution in the tissue and developing noninvasive imaging biomarkers to identify patients amenable to targeted therapy.

Eben Rosenthal, MD

The Rosenthal lab focuses on development and clinical translation of novel imaging probes and multimodal imaging strategies for improving cancer detection and treatment. Our recent research has been mainly working towards first-in-human clinical trials using near-infrared labeled antibodies (cetuximab, panitumumab) for surgical and pathological navigation during the surgery of head and neck cancer, brain cancer, and pancreatic cancer. We are also studying the role of optical imaging for quantification of antibody accumulation and distribution in the tissue and developing noninvasive imaging biomarkers to identify patients amenable to targeted therapy.

ACHIEVEMENTS
• Two internal grants: 2016 Stanford nano shared facilities (NSF) Bio/Medical Seed Grant and 2016 CCNE-TD Pilot Project 2.
• Three first-in-human clinical trials for evaluation of fluorescently labeled antibody as an optical agent used during surgery to detect head and neck cancer, malignant glioma, and pancreatic cancer.
• Initiation of GMP manufacture and IND application of radiolabeled panitumumab for clinical work.
• Dr. Tarn Teraphongphom received a Student Travel Stipend Award, a Women in Molecular Imaging Network Scholar Award, and an Industry Selected Poster Award from 2016 WAMC.
• Sarah Miller received a Poster Award from the Medical Student Research Symposium at Stanford.
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Thakor Lab
Avnesh Thakor, MD, PhD

Our laboratory’s research primarily focuses on the pancreas. We conduct research related to diabetes by investigating beta cell regeneration using mesenchymal stem cells with the use of pulsed focused ultrasound for mesenchymal stem cell homing, islet cell transplantation, and the construction of novel “active” bioscaffolds for islet transplantation. We also study pancreatic cancer by developing novel intra-arterial delivery techniques to the pancreas and the synthesis of theranostic nanoparticle platforms.

ACHIEVEMENTS
• Development of novel techniques for intra-arterial delivery of therapeutics to the pancreas in rodent models.
• New strategies for islet co-transplantation with mesenchymal stem cells.
• Development of novel bioscaffolds for islet transplantation.
• Development of Raman nanoparticles that can detect oxidative stress which are targeted to pancreatic cancer.

Translational Molecular Imaging Lab
Juergen Willmann, MD

The Willmann lab develops and tests ultrasound molecular imaging for identifying and monitoring diseases with the goal of using this approach in the clinic for improved patient management. This novel imaging modality uses intravascular contrast microbubbles which are modified to bind to regions of the diseased vasculature expressing unique proteins. Using these microbubbles, we can detect small foci (<1 mm) of pancreatic and breast cancer and can monitor regions of diseased bowel undergoing active inflammation. We have also successfully explored their use as a drug delivery vehicle for cancer therapy. Finally, our lab has performed the first-in-human clinical trial using these novel contrast agents in women with ovarian and breast cancer.

ACHIEVEMENTS
• Lab member honors: Katheryne Wilson, PhD: 2017 Molecular Imaging Young Investigator Award; Sayan Mullick Chowdhury, PhD: 2016 RSNA Introduction to Academic Radiology for Scientists Program; 2016 WMIC Best Pre-Clinical Paper; Ahmed B Kaffas, PhD: RSNA 2nd place Best Poster Award, 2016 WMIC Industry Selected Abstract Award.
• Published first-in-human clinical trial results on KDR-targeted ultrasound molecular imaging.
• Performed first-in-human clinical trial: 3D liver perfusion imaging with ultrasound in patients and preclinical 3D perfusion imaging studies to predict treatment response.
• First-in-human study on ultrasound spectroscopy in patients with hepatocellular carcinoma (HCC); also developed an imaging-guided drug delivery approach for therapy of HCC.
• Three new clinical trials on ultrasound molecular imaging of pancreatic, breast, and ovarian cancer.

Cardiovascular Stem Cell Lab
Joseph Wu, MD, PhD

The Wu lab studies the biological mechanisms of adult stem cells, embryonic stem cells, and induced pluripotent stem cells. We use a combination of next generation sequencing, tissue engineering, physiological testing, and molecular imaging technologies to better understand stem cell biology in vitro and in vivo. For adult stem cells, we are interested in monitoring stem cell survival, proliferation, and differentiation. For embryonic stem cells, we are currently studying their tumorigenicity, immunogenicity, and differentiation. For induced pluripotent stem cells, we are interested in cardiovascular disease modeling, drug screening, and cell therapy. We also develop novel vectors and therapeutic genes for cardiovascular gene therapy applications.

ACHIEVEMENTS
• Performed “clinical trial in a dish” using patient-specific iPSCs to understand drug cardiotoxicity.
• Human-induced pluripotent stem cell–derived cardiomyocytes recapitulate the predilection of breast cancer patients to doxorubicin-induced cardiotoxicity.
• Demonstrated modeling of congenital heart disease (left ventricular non-compaction) with disease-specific iPSCs.
• Developed a comprehensive TALEN-based knockout library for generating human iPSC-based models for cardiovascular diseases.
The Richard M. Lucas Center for Imaging is one of the few centers in the world with major centralized resources devoted to research in magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), and X-ray/CT imaging. The Center has pioneered MRI/MRS/X-ray/CT technology while developing new techniques that benefit patients with stroke, cancer, heart disease, and brain disorders. The Center, dedicated to imaging research, houses four GE whole-body MRI systems (three 3.0T, one 7.0T) and occupies 37,000 square feet on the Stanford campus. The Lucas Center also houses data analysis laboratories, an electronics laboratory/machine shop, and office space. The Lucas Center offers MRI access to hundreds of researchers, both within and outside the Department of Radiology. All researchers are trained in magnet safety and scanner operations by the magnet manager or MR research technologists.

HIGHLIGHTS INCLUDE:

**Neuro MR Imaging:** Neuroimaging studies at Lucas are led by research groups from Radiology, Psychiatry, Psychology, Anesthesiology, Neurology, and others. Their research investigations include stroke, Alzheimer's disease, Parkinson's disease, mild cognitive impairment, obsessive compulsive disorder, chronic pain, learning disorders, anxiety and depression, bipolar disorder, schizophrenia, and autism, among others. Imaging studies are also being conducted to monitor post-treatment by focused ultrasound (FUS) of the brain for essential tremor (ET) and to monitor cerebral perfusion during heart surgery.

**Musculoskeletal MR Imaging:** Imaging research is also conducted in the areas of joint disease for evaluation of osteoarthritis, rheumatoid arthritis, treatments for bone marrow lesions, improvements in arthroscopic surgery, evaluation of anterior cruciate ligament (ACL) injury, and many others. Pediatric studies include monitoring of treatments for muscular dystrophy, whole body cancer staging, and the differentiation of bone sarcomas vs. osteomyelitis.

**Breast MR Imaging:** Advances in imaging research of breast cancer and disease include development of non-contrast screening methods, diagnostic imaging, and staging approaches using dynamic contrast-enhanced perfusion, diffusion, and T2 imaging, all at considerably higher spatial resolution than the current standard-of-care. Image-guided biopsy techniques using advanced visualization methods, including augmented reality, are being developed and tested.

**Abdominal and Pelvis MR Imaging:** Imaging of the abdomen is conducted to monitor pharmaceutical treatments and to improve early detection of a variety of diseases including splenomegaly, myelofibrosis, insulin resistance, and NASH (non-alcoholic steatohepatitis). Prostate imaging is conducted to monitor treatment by focused ultrasound for localized low and intermediate risk prostate cancer.

**Focused Ultrasound Treatments Guided by MR Imaging:** Clinical trials are conducted at the Lucas Center using MR-guided focused ultrasound (MRgFUS) to treat bone metastasis, essential tremor, and soft tissue sarcomas. A recently installed 220 kHz FUS neuro system will be used to develop techniques to temporarily and sufficiently open the blood-brain barrier for drug delivery to metastatic brain tumors.

**Hyperpolarization:** Hyperpolarized ^13C MR spectroscopy (MRS) is a functional MR technique for probing in vivo perfusion and metabolism with injection of hyperpolarized substrates. Studies include the assessment of glycolysis, oxidative phosphorylation, and other key metabolic pathways, optimized mapping of ^1H metabolite distributions throughout the body, and quantifying neurotransmitter levels and cycling rates in the brain.
DENOISING CAN BE NOISY. BRAIN CONNECT, MAGNETIC RESONANCE IMAGING DATA: CHEN JE, JAHANIAN H, GLOVER GH. NUISANCE 43(9):5170. PMCID: PMC5001977.


Ferroelectrics and Frequency Control, 2016 reverberation with coherent flow power

J, DHAL JJ. VISUALIZATION OF SMALL-DIAMETER VESSELS BY REDUCTION OF INCOHERENT


NIH/NIMH 5 R01 MH111825 02 (Butts Pauly)

Neuromodulation of Deep Brain Structures. NIH/NICHD 5 R01 HD086252 13 (Dahl)

Center for Advanced Magnetic Resonance Technology of Stanford [CART]: NIH/NIBIB 5 R24 EB015389 23 (Glover)

SELECTED PUBLICATIONS


A Simple Analytic Method for Extracting 3D from the Knee-from-1D. Magnetic Resonance Imaging, 2017 May; 35: 49–57. PMCID: PMC5360502

SELECTED FUNDING

Divisions of Neuroscience (Butts Pauly)

niSink 1H MRS of GABA, Glutamate, Glutamine, and GSH. Moseley et al. (Glover)

Integration of Diffusion MRI-Renal Tracking and CLARITY 3D histology for improved Neurosurgical Targeting. NIH/NINDS 5 ROI N0209314 02 (McNab)

High Sensitivity Flow Imaging of the Human Pancreas with Coherence-Based Doppler Ultrasound. NIH/NICHHD 5 ROI HD062592 13 (Dahl)

MR-guided Focused Ultrasound Neuronal manipulation of deep brain structures. NIH/NIMH 5 R01 1B25 02 (Butts Pauly)

ACHIEVEMENTS

• Rapid acquisition and quantitative T2-mapping: 5-minute 3D knee MRI exam, in Stanford Clinic. (Hargreaves).

• Three-fold reduction in Artifact-Corrected MRI scans in subjects with Joint Replacements, in Stanford Clinic. (Hargreaves).

• Developed a novel and unique way to study the tissue motions in brain, liver, and tumors caused by cardiac and arterial pulsations (Moseley).

• Developed robust new 1H MRS approach for measuring GABA, glutamate, glutamine, and glutathione in the human brain (Spielman).

• Identified new hyperpolarized 13C MRS probe, 13C-labeled glycerate for measuring glycolysis in subjects with Joint Replacements, in Stanford Clinic. (Hargreaves).

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The Radiological Sciences Laboratory presently com-prises nine faculty and approximately 60 graduate and post-doctoral trainees, research staff, and others devoted to advancing imaging technology for diagnostic, basic science and therapeutic applications within the department and in collaborations across campus and beyond. Our research focuses include the imaging modalities of MRI, CT, X-ray, PET, ultrasound imaging and MR imaging-guided focused ultra- sound therapy. In addition to its basic and applied research, the RSL administers the Lucas MRI Service Center, which is in its 25th year of operation offering research scan capabilities to the local and extended community. Many of RSL’s members at both faculty and trainee levels achieve high international distinction with awards and honors. For example, RSL, which includes the RSL Division and many of its Radiology collaborators, includes four past presidents of the International Society for Magnetic Resonance in Medicine, a distinction unique in the world. Besides exceptional research and collaboration, a high priority for the RSL is the training of the next generation of scientists and engineers, who derive from many departments within the schools of engineering, medicine, humanities and sciences, and law. In addition, our faculty and their students and fellows teach a variety of highly-regarded biomedical imaging courses including didactic classes, lab work, and seminars.

RADIOLICAL SCIENCES LABORATORY (RSL)

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• Identified new hyperpolarized 13C MRS probe, 13C-labeled glycerate for measuring glycolysis in vivo (Spielman).
Pooja Gaur received a SCIT fellowship.

Patrick Ye received a Siebel Scholars fellowship.

Kim Butts Pauly received a Brain Initiative grant.

**ACHIEVEMENTS**

in vivo CT and MR. Simulations are then validated against MR parameters as a function of imaging parameters, both planning beam simulations by measuring the acoustic investigating the bioeffects from the ultrasound, and developing methods for guiding these procedures, alone for ultrasound-based neuromodulation. We are with microbubbles to open the blood-brain barrier, or case of cancer ablation. It can be used in combination (MRgFUS) can be used to ablate tissue, such as in the interventional tissues. MR-guided focused ultrasound high intensities can be achieved without effect to surrounding tissue. We are using the system to implement harmonic coherence imaging with pulse-echo ultrasound.

**Ultrasonic Imaging Research Lab**

Jeremy Dahl, PhD

Our lab develops and implements ultrasonic beamforming and imaging methods and has been focusing on the difficult-to-image patient. More recently, we have been developing high sensitivity applications based on coherence beamforming for flow imaging and molecular imaging. We have developed theories and estimation strategies to limit the computational effort of these coherence-based techniques in order to build these imaging methods into real-time imaging systems. We have used our real-time coherence-based imaging system in clinical and preclinical studies, including cardiac imaging, liver imaging, flow imaging in the placenta, and molecular imaging of early cancer.

**ACHIEVEMENTS**

- Dongwoon Hyun successfully defended his PhD thesis on “Efficient Spatial Coherence Estimation for Improved Endocardial Border Visualization in Real-Time.”
- PhD student Rehman Ali received a four year NDSEG fellowship to study speed of sound estimation techniques with pulse-echo ultrasound.
- We developed a real-time ultrasound imaging system to implement harmonic coherence imaging and successfully applied it to stress echocardiography patients.
- We developed angular coherence theory for ultrasound and applied it to implement a fast coherence beamforming method.

**Functional Neuroimaging Lab**

Gary Glover, PhD

Obtaining a fuller understanding of how the brain performs cognitive processing has fascinated intense investigation because of its importance in health and disease. Our group is developing better tools for visualizing cognitive processing with functional magnetic resonance imaging (fMRI), a goal that is challenging because the signals are weak and easily obscured by on-going physiological processes, such as breathing and cardiovascular function. Our acquisition and processing methods are in widespread use by many investigators, including contributions to multimodal neuroimaging to obtain greater information (e.g., PET-fMRI, EEG-fMRI), and neuromodulation to causally perturb brain function to gain deeper understanding (e.g., with transcranial magnetic stimulation or transcranial electric stimulation). We seek to obtain higher sensitivity and specificity, while illuminating the neurobiological underpinnings of fMRI signals.

**ACHIEVEMENTS**

- Showing the neurobiological correlates of impulse targeting for ablative therapies for essential tremor.
- Demonstrating the use of biofeedback with real-time fMRI to reduce intensity and salience of chronic pain in patients.
- Understanding the nature of high temporal frequency brain fluctuations.
- Developing more efficient fMRI acquisition methods that reduce signal dropout for better depiction of frontal brain regions.
- Developing fMRI methods to enable more precise targeting for ablative therapies for essential tremor patients.
- Showing the neurobiological correlates of impulse control in subjects.
- Developing the use of biofeedback with real-time fMRI to reduce intensity and salience of chronic pain in patients.

**Joint and Osteoarthritis Imaging with Novel Techniques**

Gary Gold, MD

The JOINT lab’s research is focused on improving imaging of musculoskeletal conditions including osteoarthritis. We would like to detect disorders at an early stage when intervention is more likely to be successful. Our work improves detection of musculoskeletal disease as well as functional imaging of bones, muscles, and joints under loaded conditions. Current projects include advanced MR imaging of early osteoarthritis, multidisciplinary molecular imaging of joint degeneration and pain, improved imaging around metal, and new methods of imaging the joint using weight-bearing CT. We are also exploring the use of gait retraining to treat osteoarthritis.
Body MRI Research Group
Brian Hargreaves, PhD

Our research links basic science with clinical practice and industry product development to broadly impact patient care. We focus on MRI of breast cancer, abdominal MRI, and orthopedic MRI. High-resolution images improve diagnosis of breast lesions and enable detection of smaller lesions, while use of multiple contrast images improves discrimination of different cancer types. Rapid abdominal imaging is essential to avoid problems from respiratory, cardiac or digestive motion. We support fast techniques that are used in almost every body or breast imaging scan at Stanford Hospital. In orthopedic MRI, we aim to shorten knee MRI to 5-10 minutes while offering quantitative information to study development of osteoarthritis. Finally, we have led development of robust MRI in the presence of metal, resulting in techniques to help assess complications from joint replacements, spinal fixation hardware, or other metal devices that are increasingly present in imaging subjects.

ACHIEVEMENTS
• Substantially reduced MRI exam times for patients who have implanted metal hardware, as well as enabling MR-guided focused ultrasound (MRgFUS) surgery for patients with metal devices.
• Demonstrated near-equal performance of a fast, 5-minute knee MRI protocol, which could replace 20-30 minute exams and improve access to MRI while lowering cost.
• Used an automated approach to quantifying kidney function using MRI.
• Working with Microsoft to enable surgeons to see lesions inside patients using the HaloLens mixed-reality glasses.
• Hans Weber was given the prestigious “Junior Fellow” award. Brian Hargreaves was selected as a Bodesign Faculty Fellow, and completed this 5-month program in May 2017.

Lab for Ultra-High-Field MRI of Human Brain Microstructure
Jennifer McNab, PhD

The central mission of the McNab lab is to develop the next generation of MRI techniques that probe the structural and functional architecture of the human brain. This requires new MRI contrast mechanisms, strategic encoding/reconstruction schemes, brain tissue modeling and validation. Our current research is focused on the development of MRI pulse sequences and analysis strategies that capitalize on the benefits of ultra-high-field (7T) MRI and stronger and faster magnetic gradient technology. Current projects include the development of new methods for lesion characterization, neurosurgical targeting, mixed reality neuroanatomical validation and MRI validation using CLARITY 3D histology.

ACHIEVEMENTS
• Developed clinically feasible double diffusion encoding for improved characterization of multiple sclerosis lesions.
• Demonstrated clinical value in diffusion tractography-based targeting for treatment of essential tremor with MR-guided focused ultrasound (MRgFUS).
• Demonstrated mixed reality holographic visualization of MRI on top of a subject’s head in the real world.
• Developed an MRI method that identifies granular cortices based on cerebral cortical fiber patterns.
• Improved capabilities for comparing MRI and CLARITY 3D histology in the same specimens.

Clinical Center for Advanced Functional Neuroimaging (CAFN)
Michael Moseley, PhD
Greg Zaharchuk, MD, PhD

CAFN develops and implements quantitative MRI tools to understand the basic foundations of the human brain, map neural anatomy and vascular microstructures via functional network connectivities, and thus precisely diagnose and treat complex neurological disease in individual patients. We foster interdisciplinary and international collaborations focused on providing cutting-edge MRI imaging to our patients. Our tools include high-resolution diffusion mapping of abnormal brain development and loss of function, rapid and non-contrast blood flow and oxygenation mapping, time-resolved connectivity of the brain’s many networks, and resolving brain CSP and dynamics for intracranial pressure mapping. Our mission is to improve investigation and treatment of disorders of the nervous system.

ACHIEVEMENTS
• Developed a comprehensive array of novel non-contrast agent cerebral blood flow (rCBF) methods for clinical diseases of the CNS.
• Created and applied a clinical time-resolved method to map the brain’s neural circuitry and metabolic oxygenation in patients with CNS disease.
• Collaborated with LPCH to use PLURAL image processing and cross-talk in photon counting X-ray detectors.
• We demonstrated the clinical utility of a piecewise-linear CT dynamic beam attenuator (bowtie filter).
• We demonstrated the system impact of charge sharing and cross-talk in photon counting X-ray detectors.
• We showed that much of the noise reduction with statistical image reconstruction can be achieved by image domain filtering.

Inverse Geomerty CT and Conventional CT
Norbert Pelc, ScD

Computed Tomography (CT) has become an indispensable tool in diagnostic imaging and image guidance because of its reliability and high information content. Although the radiation dose per exam is modest, the high use means that population dose burden is high. We (and others) are working on technologies that could significantly reduce radiation dose, including more efficient detectors, reconstruction methods and systems. As part of this work, we are also exploring how to reduce the dose without decreasing the information content. In addition to this work on CT system design, we are also working to improve specific CT applications. In particular, we are developing methods to validate and optimize the measurement of brain perfusion with contrast-enhanced CT.
The overall goals of the Rutt lab are to develop, optimize and exploit ultra-high-field (7T) whole body MRI in a variety of research applications, starting with the broad area of neuroimaging but progressing to other anatomical regions and applications. MR imaging at such high magnetic fields faces a number of significant technical challenges that have slowed its widespread application. The objectives of the group are to conceive, implement and apply novel strategies that solve these technical challenges, and then to develop methods that will enable routine high-quality MR imaging at 7T. Our longer term aim is to employ these technical developments to study fundamental structural, physiological, metabolic and functional changes associated with important human diseases of the brain and eventually other anatomical regions.

ACHIEVEMENTS
• Developed new parallel transmit MR methods for 7T MRI.
• Developed new “focused RF” methodology for targeted hyperthermia.
• Developed new sequences and post-processing methods that delineate thalamic nuclei and characterize T1 relaxation.

The Spielman Lab for MRS and Multinuclear Imaging
Daniel Spielman, PhD

Medical imaging provides a wealth of information ranging from gross anatomy to biochemical processes. The Spielman laboratory focuses on the development of novel methods for the non-invasive imaging of metabolism and their translation to the clinic. Our current research efforts focus on using 1H magnetic resonance spectroscopy (MRS) to measure neurotransmitter function and oxidative stress in the human brain and hyperpolarized 13C MRS and PET imaging to study glucose metabolism in both small animal models and clinical patients. Active collaborations include studies of autism, schizophrenia, obsessive-compulsive disorder, cancer diagnosis and treatment monitoring, and metabolic diseases including diabetes and non-alcoholic steatohepatitis (NASH).

ACHIEVEMENTS
• Demonstrated the use of hyperpolarized 13C-pyruvate to measure acute metabolic changes in glioma in response to anti-VEGF therapy.
• Developed robust new 1H-MRS approach for measuring GABA (gamma-aminobutyric acid), glutamate, glutamine, and glucose in the human brain.
• Identified new hyperpolarized 13C MRS probe, 13C labeled glycerate for measuring glycolysis in-vivo.
• Identified new hyperpolarized 13C MRS probe, 13C labeled atrazine for in-vivo measurement of tissue redox state in the liver.
• Preparing for first-in-human PET-MR hyperpolarized 13C pyruvate studies of prostate and brain cancers.

The Project Baseline Study
Mapping Human Health and the Transition to Disease

A landmark four-year study was launched in 2017, the Project Baseline study, as a collaboration between Verily (an Alphabet company), Stanford Medicine, Duke University School of Medicine, and Google to characterize human health with unprecedented depth and precision. At Stanford, the study is directed as a joint effort by the departments of Radiology and Medicine, led by Dr. Sam Gambhir (PI, Chair, Radiology) and Dr. Kenneth Mahaffey (Co-PI, Vice Chair of Clinical Research, Medicine).

The Project Baseline study is a quest to map human health through a comprehensive study of health and the transition to disease, including lung, breast, and ovarian cancer and cardiovascular disease. This multicenter longitudinal, prospective cohort study will collect and analyze an unprecedented breadth of data for a group of 10,000 participants representative of the diversity within the U.S. population. This study will characterize participants across clinical, molecular, imaging, sensor, self-reported, behavioral, environmental, and other health-related measurements from onsite visits, continuous data collection through sensor technology, and regular engagement via an online portal and mobile app.

Participants come to Stanford for five annual visits, which include 1–2 full days of study protocol-specific assessments at the initial visit. Biospecimens collected include blood, saliva, stool, swabs, tears, and urine, which will be analyzed along with clinical data acquired. Participants also wear an investigational study watch and use a sleep sensor to provide continuous monitoring of their health for the full term of the study. When integrated and compiled into a digital platform, the data will allow researchers to see values among a diverse population that was not previously possible, and hopefully provide biomarkers of disease-related transitions, particularly those related to cancer and cardiovascular disease.

Stanford enthusiastically hosted its first participant onsite on June 27, 2017. A distinguishing focus of the Project Baseline study is to engage participants with a seamless and positive experience throughout the four-year study, rather than merely regard them as research subjects. These efforts include a mobile app, a participant advisory counsel, in-person events, and return of results. The study is open to anyone across the health spectrum provided they meet basic eligibility criteria. The study has been reported extensively in the national media—CNBC, Business Insider, Wired, and Fortune— to name a few, with thousands of potential participants registering in just a few days after study launch.

The Project Baseline study is envisioned to shift the paradigm of how health is viewed. Specific findings from the study may change the science of systems biology by understanding the variation in the “normal” population of many biomarkers and the transition from health to disease. Multi-dimensional analysis may enable an unprecedented comprehension of the relationships between individual assessments and related biological, physiological, and behavioral systems. In the long-term, the study could transform the current approach to healthcare and launch the next generation of medical practice into the era of precision health and integrated diagnostics.

The Project Baseline study team members are in the forefront of a new paradigm of research which includes fundamental insights into the health and wellness of the U.S. population. The project aims to transform the current approach to healthcare and launch the next generation of medical practice into the era of precision health and integrated diagnostics.
The Precision Health and Integrated Diagnostics (PHIND) Center is the first center in the world focused on precision health and integrated diagnostics. The PHIND Center plays a critical role in mobilizing the components needed to advance this new vision of healthcare. It is developing, testing, and disseminating the next generation of healthcare mechanisms for precision health. Whereas precision medicine is focused on the treatment after the manifestation of disease, precision health is focused on early prediction and prevention of disease onset. The PHIND Center integrates diagnostic information collected from multiple sources both on the body, and in one’s home. It also studies the fundamental biology underlying early transitions from health to disease and the associated biomarkers (molecules) of health and early disease. The new Center aims to fundamentally revolutionize healthcare leading to better and more productive lives for individuals by integrating several key areas. These areas include: (1) fundamental studies on the biology of disease formation to understand the earliest transitions from healthy humans, organs, and cells to a diseased state, (2) biomarker research to study molecules that indicate both healthy states and early signs of disease, and (3) diagnostic technology and information to accurately monitor and detect health changes early. This can be achieved by collecting information from multiple sources on the body and in the home, office, or wider community.
Active Sponsored Research
as of August 31, 2017

NIH

Amin, Raag RF1 Noninvasive Neuromodulation via Focused Ultrasound Drug Uncaging

Butts Pauly, Kim R01 MR-Guided Focused Ultrasound Neuromodulation of Deep Brain Structures

Chin, Frederick R21 A New Class of CSF-1R Radioligands for Monitoring Glioblastoma Prognosis and Therapy

Churko, Jared K99 Notch Signaling in Cardiomyocyte Transcriptome Signatures

Dahl, Jeremy R01 Improved Image Quality of Focal Liver Lesions Using the Coherence of Ultrasound

Daldrup-Link, Heike R21 Imaging Tumor Associated Macrophages in Bone Sarcomas

Demirci/Cunningham R01 (MPI) Portable Nanostructured Photonic Crystal Device for HIV-1 Viral Load

Demirci/Kaye R01 (MPI) Platform Technology for Detection of Cancer-Associated Viruses in HIV Patients

Datta, Keshav F31 Improved Metabolic Imaging Using Hyperpolarized 13C MR Substrates

Dahlgren Link, Heike R21 Cardiac Diffusion Imaging for Heart Transplant Surveillance

Fleischmann, Dominik R21 A Novel Positron Emission Tomography Strategy for Early Detection and Treatment Monitoring of Graft-Versus-Host Disease

Gambhir, Sanjiv Sam R01 Nanoparticle-Based Triple Modality Imaging and Photothermal Therapy of Brain Tumors

Gambhir, Sanjiv Sam R01 Optimization of an Activatable Photoacoustic Agent to Image Thyroid Cancer

Gambhir, Sanjiv Sam R01 Reporter Gene Technologies for Integrated Cancer Diagnostics

Gold, Garry R01 Cancer Systems Biology Scholars Program

Hargraves, Brian R01 Comprehensive MRI Near Total Joint Replacement

Hargraves, Brian R01 Quantitative 3D Diffusion and Relaxometry MRI of the Knee

Hargraves/Daniel R01 (MPI) High-Resolution Whole-Brain MRI at 3.0T

Harris, Kenneth F52 An "F" PET/NIRF Smart Probe for Identifying, Grading, and Visualizing Acoustic Glomus Tumors

James/Longo R21 (MPI) New PET Imaging Agent for Monitoring Treatment Response in Alzheimer’s Disease

Kubanek, Jan R01 Ultrasonic Neuromodulation: From Mechanism To Optimal Application

Lee, Brian Jun R01 Exploring a Promising Design for the Next Generation Time-of-Flight PET Detector

Levin, Craig R01 RF-Penetrable PET Ring for Acquiring Simultaneous Time-of-Rise PET and MRI Data

Levin, Craig T32 Stanford Molecular Imaging Scholars (SMIS)

Mallick/Gil R01 (MPI) A Discovery Engine For Reproducible and Comparable Multi-Omic Analysis

McNab, Jennifer R01 Integration of Diffusion MRI Fiber Tracking and CLARITY 3D Histology for Improved Neurosurgical Targeting

Napel/Daniel T32 (MPI) Stanford Cancer Imaging Training (SCIT) Program

Napel/Plevritis R01 (MPI) Tools for Linking and Mining Image and Genomic Data in Non-Small Cell Lung Cancer

Napel/Rubin U01 (MPI) Computing, Optimizing, and Evaluating Quantitative Cancer Imaging Biomarkers

Pek, Norbert R21 Change Cloud Tracker: A High-Resolution, High-DQE, Photon-Counting Energy Discriminating X-ray Detector

Pek/Fadee/Wang U01 (MPI) High Dose Efficiency CT System

Petrini/Bernuzzi U01 (MPI) Making Glycomics a Tool for Personalized Medicine

Plevritis/Sylvia R25 Cancer Systems Biology Scholars Program

Plevritis/Clarke U01 (MPI) Clinically-Relevant Regulatory Networks in the Lung Tumor Microenvironment

Plevritis/Nikos U54 (MPI) Modeling the Role of Lymph Node Metastases in Tumor-Mediated Immunosuppression

Rao, Jianghong R21 An Activatable PET Tracer for Imaging PARP-1 Activity in Breast Cancer

Rao, Jianghong R01 Beta-Lactamase Fluorescent Probes for Bacterial Detection

Rao, Jianghong R01 Nanoprobes for Imaging BONS and Drug-Induced Hepatotoxicity

Rubin, Daniel U01 Qualification and Deployment of Imaging Biomarkers of Cancer Treatment Response

*Note, multiple PI (MPI) awards are listed only once. All partnering PI names are shown with contact PI as the lead name. Awards listed in alphabetical order by PI.
NIH SUBCONTRACT AWARDS

Daniel, Bruce UC Office of the President Technologies for Augmented Reality Breast Surgery

Dominitz, Urban Gia Medical Institute NEXT-GEN Oral Tool for Monitoring HIV/AIDS in Point-of-Care

Dominitz, Urban UCSF Single Cell Characterization of Latent HIV-1 Reservoirs

Dominitz, Urban U of Illinois Rapid Disease Diagnostics Using Photonic Crystal Enhanced Antigen Biomarker

Gambrill, Sanjiv Sam U Texas MD Anderson Cancer Center Biopspecimen Banking and Biomarker Validation for Lung Cancer Early Detection in Cohort: Recasting Low Dose Helical Computed Tomography Screening

Glover, Gary U Penn Non-Invasive Neuro modulation Mechanisms and Dose/Response Metrics

Kothary, Nihita U Penn A phase 2 randomized multicenter trial to compare hepatic progression-free survival following bland embolization, lipiodol chemoembolization, and drug-eluting bead chemoembolization of neuroendocrine liver metastases

Langlois, Curtis U Wash Natural Language Processing of Neuroradiology Reports

Levin, Craig Zino Medical, Inc. A Hand-Held PET Imaging Camera for Intra-Operative Use

Mallek, Pang Ohio State U High Performance Analytics and Unified Visual Platform for Integrating Genomics, Proteome and Histology Images in Cancer Subtyping

Mallek, Pang USC L2KG2: Learn to Read to Know, Know to Learn to Read

Mallek, Pang USC Towards Automating Discovery: Systematic Data Analysis of Science Repositories

McNah, Jennifer UC Berkeley Foundations of MRI Cytometry for Mesoscale Organization and Neuronal Connectivity

Napoli, Sandy Kirevere, Inc. Accelerating Community-Directed Medical Innovation with VTK

Napoli, Sandy MgH Informatics Tools For Optimized Imaging Biomarkers For Cancer Research & Discovery

Napoli, Sandy Vanderbilt U Radiomics & Deep Learning Approaches for Screen Detected Lung Adenocarcinoma

Paulmurugan, Ramasamy Mayo Clinic Imaging of Mitochondrial Function of Progenitor Cells Transplanted to the Ischemic Myocardium

Burns, Pady, Kim UCSD Diffusion Imaging in Gray Matter

Pels, Norbert Georgia Tech Volumetric CT Imaging Using Primary Modulation

Plevritis, Sybiba Georgia Tech Comparative Modeling: Informing Breast Cancer Control Practice and Policy


Rabin, Daniel Leidos Biomed Research, Inc. AIM-DICOM SR Harmonization Project

Rabin, Daniel Mt. Sinai Sch of Medicine Genome-Wide Association Study of Mammographic Density

Rabin, Daniel RSNA Medical Image Sharing Through a Patient-Controlled Exchange System

Rabin, Daniel RSNA Unification of LOINC Radiology and the RadLex Playbook

Soh, H. Torn UC Santa Barbara Encode-Sort-Decide (ESD): Integrated System for Discovery of Non-Natural Affinity Reagents

Soh, H. Torn UC Santa Barbara Systems Biology of Gagagolysis and Trauma-Induced Coagulopathy

Sap, Domin R25 (MPI) UC Office of the President Technologies for Augmented Reality Breast Surgery

Spal, Daniel R01 Imaging Brain Metabolism Using MRS of Hyperpolarized 13C-Pyruvate

Spal, Daniel R21 Novel MRS Methods for Measuring Brain Energy and Neurotransmitter Cycling

Spal, Daniel R01 Robust 'H MRSI of GABA, Glutamate, Glutamine, and Glutathione

Spal/Recht R01 (MPI) Metabolic Therapy of GBM Guided by MRS of Hyperpolarized 13C-Pyruvate

Soyan, Tanja R00 Protocellular Linearized Receptors as Oncogenes and Therapeutic Targets

Toumazis, Iakovos F32 Personalized Dynamic Risk-Based Lung Cancer Screening

Vasnav, Shreya R01 Rapid Robust Pediatric MRI

Vasavada/Payal R01 (MPI) Development and Translation of High-Performance Repetitive Arrays for Pediatric MRI

Willman, Juergen R21 Molecular Spectroscopic Photoacoustic Imaging for Breast Lesion Characterization

Willman, Juergen R01 Quantification and Monitoring Inflammation in IBD with Molecular Ultrasound

Willmann/Dahl R01 (MPI) Automated Volumetric Molecular Ultrasound for Breast Cancer Imaging

Willmann/Dahl R21 (MPI) High Sensitivity Molecular Ultrasound Imaging in Pancreatic Cancer

Willmann/Dahl/Paulmurugan R01 (MPI) Therapeutic miRNA Modulation of Hepatocellular Carcinoma Using Ultrasonic Guided Drug Delivery

Willmann/Hermer R01 (MPI) SD Dynamic Contrast-Enhanced US for Monitoring Chemotherapy of Liver Metastasis

Willmann/Park US1 (MPI) Molecular Imaging Methods for the Detection of Pancreatic Ductal Adenocarcinoma

Willmann/Paulmurugan R21 (MPI) SD Passive Cavitation Imaging-Guided Therapeutic Delivery of MicroRNA into Cancer

Wilson, Katherine K99 Spectroscopic Photoacoustic Molecular Imaging for Breast Lesion Characterization

Winkler, Simone K99 Human Connectome Mapping Using Ultra-High-Resolution MRE: A Technological Pathway

Wintermark, Max R01 MR-Guided Focused Ultrasound Combined with Immunotherapy to Treat Malignant Brain Tumors

Wu, Joseph T52 Multidisciplinary Training Program in Cardiovascular Imaging at Stanford

Wu, Joseph R01 Genome Editing of Human iPSCs to Study Inherited Hypertrophic Cardiomyopathy

Wu, Joseph R01 Assessment of Low-Dose Radiation Risk and Mechanisms of Individual Radiosensitivity

Wu, Joseph R01 Molecular Imaging of Cardiac Hapten Resent Stem Cells

Yoos/Mosley R21 (MPI) A 5 Minute Motion-Corrected Pediatric Brain MRI Protocol

Zaharchuk, Greg R01 Imaging Collaterals in Acute Stroke (iCAS)

Zavala, Cristina R21 A New Raman-Based Strategy to Identify Tumor Margins and Guide Surgical Resection

Zavala, Cristina K22 A New Strategy for Cancer Detection Using Raman Spectroscopy with Nanoparticles

Zoucha, Michael R01 Real-Time MRI Motion Correction System
### Industry Funded Projects

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Project Description</th>
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<tr>
<td>Cheng, Zhou</td>
<td>Infinitus (China) Company Ltd.</td>
<td>Molecular Imaging of Treatment Response of Infinitus Products</td>
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<td>Cheng, Zhou</td>
<td>Infinitus (China) Company Ltd.</td>
<td>Molecular Imaging Research of Slimming Wast Circumference Efficacy and Its Mechanism</td>
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<td>Cheng, Zhou</td>
<td>Infinitus (China) Company Ltd.</td>
<td>Research on Vascularization of Cancer Prevention and Early Migration Action</td>
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<td>Iagaru, Andrei</td>
<td>Sam Pliant Therapeutics, Inc</td>
<td>Develop and Evaluate Nuclear Imaging Reporter Genes (NI-RGs) for the CNS</td>
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<tr>
<td>Gambhir, Sanjiv</td>
<td>Biogen MA, Inc.</td>
<td>Develop and Evaluate Nuclear Imaging Reporter Genes (NI-RGs) for the CNS</td>
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<td>Ferrari, Dominik</td>
<td>Siemens Medical</td>
<td>Combined Investigations: zeego flexibility and image quality improvement Phase II</td>
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<td>Ghanoussi, Pijman</td>
<td>InfSight Inc.</td>
<td>A Phase IV Post-Approval Clinical Study of Exablate Treatment of Metastatic Bone Tumors for the Palliation of Pain</td>
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<td>Ghanoussi, Pijman</td>
<td>InfSight Inc.</td>
<td>A Phase IV Post-Approval Clinical Study of Exablate Treatment of Metastatic Bone Tumors for the Palliation of Pain</td>
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<td>Ghanoussi, Pijman</td>
<td>InfSight Inc.</td>
<td>A Phase IV Post-Approval Clinical Study of Exablate Treatment of Metastatic Bone Tumors for the Palliation of Pain</td>
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<td>Gold, Barry</td>
<td>GE Healthcare</td>
<td>PET-MRI Advanced Research and Development Project</td>
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<td>Siemens Medical Solutions USA, Inc.</td>
<td>Combined Investigations: nogo-flexibility and image quality improvement Phase II</td>
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<td>Hargrave, Brian</td>
<td>GE Medical System</td>
<td>Advanced MR Applications Development - Tiger Team Year 9 &amp; 10</td>
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<tr>
<td>Iagaru, Andrei</td>
<td>GE Healthcare</td>
<td>Advanced Research for Digital PET-CT</td>
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### Other Government Funded Projects

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<tr>
<td>Spielman, Daniel</td>
<td>U Maryland</td>
<td>Metabolomics of Involatible Fatty Liver Disease</td>
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<td>Siv, Daniel</td>
<td>Vanderbilt U</td>
<td>Radiation-fusing SIR-Spheres in Non-reconverible (RESIN) Liver Tumor Registry</td>
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<tr>
<td>Visanenka, Shyam</td>
<td>U Wisconsin</td>
<td>Development and Validation of Quantitative MRI Biomarkers of Iron Overload</td>
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<td>Willmann, Juergen</td>
<td>NetOnx Pharma LLC</td>
<td>Rf-453-Targeted Contrast Agent for Ultrasonic Detection of Breast Cancer</td>
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<tr>
<td>Willmann, Juergen</td>
<td>NetOnx Pharma LLC</td>
<td>Pancreatic Ductal Adenocarcinoma Targeted Ultrasound Contrast Agent Development</td>
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<td>Wintermark, Max</td>
<td>Medical U of South Carolina</td>
<td>POSITIVE trial</td>
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<td>Wintermark, Max</td>
<td>UCSF</td>
<td>Seizure in Pediatric Stroke (SIPS) II</td>
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<tr>
<td>Wintermark, Max</td>
<td>UCSF</td>
<td>The Vascular Effects of Infection in Pediatric Stroke Study</td>
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<tr>
<td>Wintermark, Max</td>
<td>U Cincinnati</td>
<td>NStN National Clinical Coordinating Center</td>
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</tbody>
</table>

### Sponsored Research

- [Radiology Department Report 2015–2017](#)
- [Sponsored Research](#)
Ghanouni, Pejman  Focused Ultrasound Surgery Foundation  Lumbar Back Pain
Going, Catherine  American Society for Mass Spectrometry  ASMS Postdoctoral Award
Guo, Haiwei  Society of Thoracic Radiology  Assurance of Subsolid Pulmonary Nodule Visualization by Low-Dose CT, Facilitated by 3-D Printing
Hen, Jeremy  RSNA  Resting State Spontaneous Fluctuations of the BOLD Signal for Penumbra Assessment in Endovascular Stroke Candidates
Je, Michael  RSNA  Using Ferumoxytol-Enhanced MRI to Assess Tumor-Associated Macrophages in Human Glioblastoma Multiforme
Kendelman, Andrew  Society for Interventional Radiology  Endovascular Removal of Fractured IVC Filter Fragments: A 5-year Prospective Study
Larson, David  Intermountain Healthcare  Intermountain - Stanford Grant Program
Lunsgren, Matthew  GERRAF  Machine Learning Classification of Radiology Reports to Develop and Evaluate a Clinical Decision Support Intervention that Optimizes Imaging Utilization
McNab, Jennifer  The Dana Foundation  Localization of Deep Brain Stimulation Targets Using Diffusion MRI Fiber Tracking Validated Against CLARITY 3D Histology
Pattishal, Sherseen  RSNA  Characterizing the Radiologic Abnormalities Observed in Chronic Fatigue Syndrome and Assessing the Potential Use of Advanced MRI in Clinical Diagnosis
Paul, Citrig  American Brain Tumor Association  Hypoxia-Inducible Factor-Alpha and Statin Inhibition in Glioblastoma in Conjunction with Tumor Treating Fields
Rubin, Daniel  ECOG-ACRIN  Medical Research Foundation  ECOG-ACRIN Network Group Operations Center
Rubin, Daniel  RSNA  Medical Image Sharing Through a Patient-Controlled Exchange System
Rubin, Daniel  RSNA  Unification of LOINC Radiology and the RadLex Playbook
Sagoyu, Hiroh  RSNA  Quantitative Analysis of Ovarian Cancer with Novel Molecular Ultrasound Agents BRR
Smith, Bryan  American Association for Cancer Research  Treatment Enhancement by Specific Manipulation of Tumor Immunossuppression
Stoyanova, Tanya  Prostate Cancer Foundation  Prostate-specifically Channeled Recapture as Oncogenes and Therapeutic Targets in Advanced Castration Resistant Prostate Cancer
Wilmanns, Juregen  Focused Ultrasound Surgery Foundation  A Novel Genetic Reprogramming Therapy for Hepatocellular Carcinoma Using Focused Ultrasound-Guided Delivery of microRNA
Yi, Kisten  Foundation of the American Society of Neuroradiology  Radiographic Approaches to Non-Invasive Molecular Subtyping of Pediatric Posterior Fossa Ependymoma
Zeinoh, Michael  Duke Duke Charitable Foundation  The Role of Iron in Alzheimer’s Disease: from Ex Vivo to In Vivo
Funded Projects Summary

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<th>Funding Source</th>
<th>Total Amount</th>
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<td>NIH</td>
<td>$26M</td>
<td>80 awards</td>
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<td>Industry</td>
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<td>Other Government</td>
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<td>NIH Subcontracts</td>
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<td>36 awards</td>
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<tr>
<td>Stanford Internal</td>
<td>$0.3M</td>
<td>6 awards</td>
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</table>
Thank you for Your Dedication

We appreciate the dedication of staff, including nurses, technologists, informatics teams, coordinators, and administrators who help make our department as successful as it is today.

Thank you for Your Dedication

We are deeply grateful for your continued support, and the ongoing support from all basic science and clinical chairs, throughout the School of Medicine.

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Jeffrey Camara
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Cindy Chan
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Tony Cho
Chuy Cho
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Melissa Cisternas
Mark Cote
Judy Contento
Patricia Cook
Nattie Cordero
Nattie Cordero
Dale Corey
Janette Cortes
Danyel Corst</p>
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Stanford Department of Radiology thanks the following foundations for their generous support of our research in the imaging sciences including technology development and solutions for the early detection, monitoring, and treatment of disease.

- Alpern Family Foundation
- American Association for Cancer Research
- American Brain Tumor Association
- Association of University Radiologists
- Ben and Catherine Ivy Foundation
- Canary Foundation
- Dana Foundation
- Doris Duke Charitable Foundation
- Etta Kalin Moskowitz Fund
- Foundation of the American Society of Neuroradiology
- Focused Ultrasound Surgery Foundation
- Intermountain Healthcare
- Musculoskeletal Transplant Foundation
- Prostate Cancer Foundation
- Radiological Society of North America (RSNA)
- Rafael and Lisa Ortiz Foundation
- Samarth Foundation
- Sir Peter Michael Foundation
- SITA Foundation
- Society for Interventional Radiology Foundation

We also thank our generous industry partners for their ongoing support.

Supporting the Stanford University Department of Radiology

If you would like to learn more about ways to support any area of research or training in the Stanford Department of Radiology, please feel free to contact any of the following members of the department.

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- **Elizabeth Gill**
  Executive Assistant to Dr. Gambhir
  eagill@stanford.edu
The Canary Challenge is an annual cycling event and 5K walk/run that increases awareness and raises funds for the Canary Center at Stanford for Cancer Early Detection. Each year in September, an amazing community of cyclists, volunteers, and sponsors come together to take part in one of Northern California’s premier fundraising events. Together, they have raised millions of dollars to support research programs that are improving cancer detection and survivorship. In 2017 alone, more than 800 participants raised nearly $735,000. Established in 2011, the Canary Challenge is organized by the Canary Foundation, the world’s first non-profit organization dedicated solely to the funding, discovery, and development of tests for early detection of cancer. Learn more about the Canary Challenge at www.canarychallenge.org.

**Funds Raised**
(cumulative total over years)

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http://radiology.stanford.edu/about/annualreport/