

INNOVATIONS IN CARDIOVASCULAR HEALTH

Annual Report 2019



KNIGHT
CARDIOVASCULAR
Institute

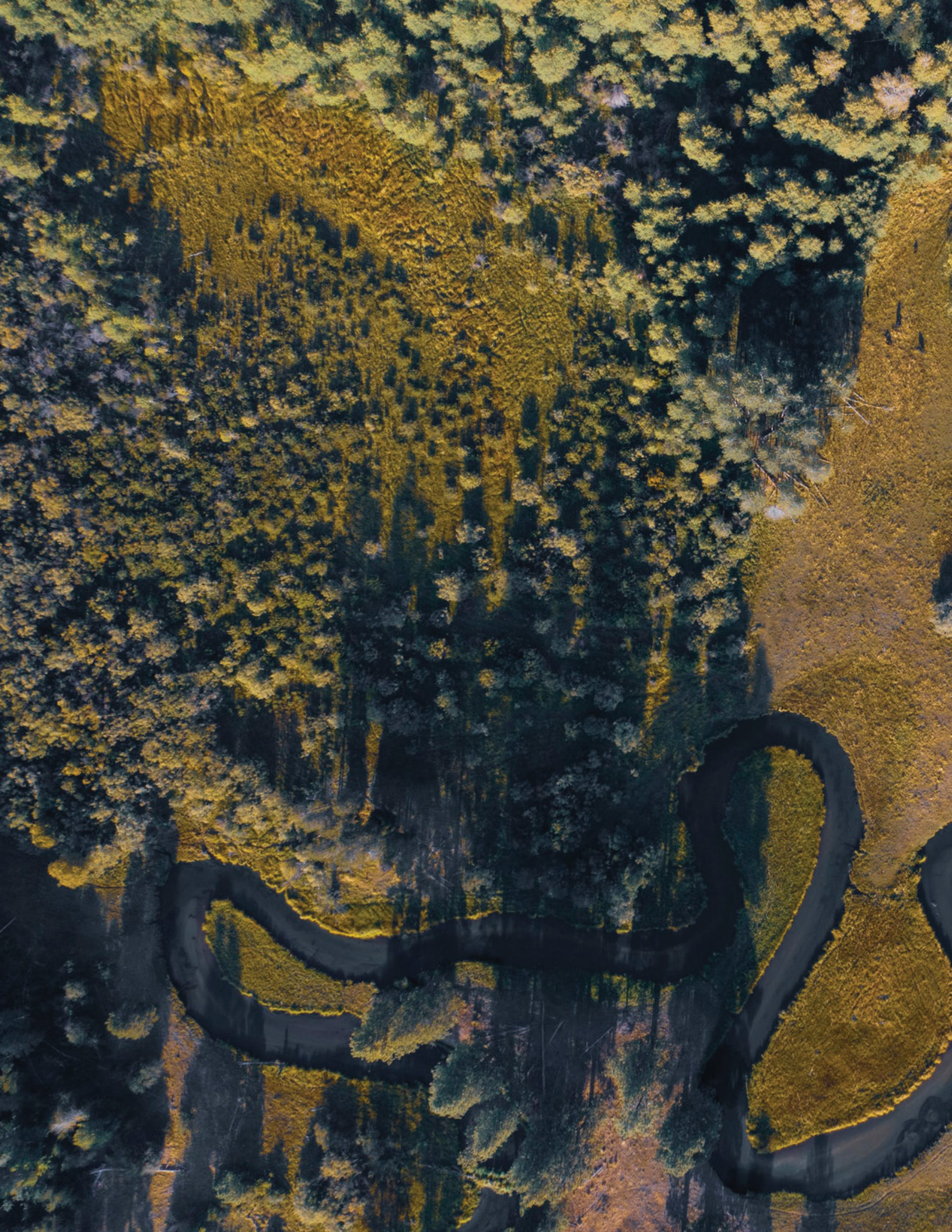


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Carrying the torch



Research

OHSU award dollars: \$486 million

NIH funding ranking: 28th

OHSU ranks No. 42 on the Reuters 100: The World's Most Innovative Universities 2019.

OHSU placed in the top 20 of Nature's Index 2019 Innovation ranking, which measures the quality and quantity of research by institutions and universities worldwide.



Community service

OHSU provides more than 200 community health programs in rural and urban areas across Oregon. In fiscal year 2017, the value of OHSU's contributions to the community totaled \$437 million.



Health care

One of 11 AMCs in the country recognized as a top performer in the 2019 Vizient Quality and Accountability Ranking.

Awarded 5 stars by Centers for Medicare and Medicaid Services



Ranked among the nation's best in multiple adult and children's specialties.



Facilities and employees

Employees: 17,532

OHSU occupies more than 7.9 million square feet of space on approximately 400 acres.



Education

OHSU helps educate more than 5,500 students and trainees each year.

Knight Cardiovascular Institute by the numbers

PHYSICIANS

79

Clinical Faculty

27

Fellows

RESEARCH

89

Researchers

100+

Clinical Trials

\$15.5 million

Research Funding



Pursuing knowledge to address gaps

As the only academic health system in Oregon, community is a strong concept at OHSU. As part of that OHSU community, the Knight Cardiovascular Institute is organized around the principle that the integration of clinical care and research expands possibilities for cardiovascular health.

We are committed to improving the lives of Oregonians and contributing to science that will impact people far beyond our borders. Whether it is filling clinical gaps in cardiovascular diseases, harnessing electronic records and artificial intelligence to identify patients at high risk, or leading unique, only-one-in-the-world clinical trials, we are on a relentless pursuit of knowledge that allows us to better counsel our patients and provide improved outcomes for them.

OHSU Knight Cardiovascular Institute's research focus is on the midterm: areas of study that within five to 10 years can have a material impact on patients. Our clinician investigators are actively researching methods to prevent cardiovascular disease, identify and treat individuals at risk, and respond to catastrophic cardiovascular events. Importantly, we also believe in promoting wellness and aging in a graceful way that allows people to remain healthy and vibrant in their overall health.

Teamwork is critical to this research. We assemble multidisciplinary teams that reflect our philosophy: Unique perspectives that challenge convention are important to discovery. These clinician investigators deliver premier care today, and they assess and develop new treatments to expand how care will be provided tomorrow.

Innovations at the institute

The OHSU Knight Cardiovascular Institute is an integrated center for translational research, clinical care, professional training and outreach in all aspects of heart and vascular disease. Some of the frontiers we are pursuing include:



Artificial intelligence—harnessing AI to:

- Identify patients with the rare genetic disease familial hypercholesterolemia.
- Diagnose hypertrophic cardiomyopathy.
- Identify early patterns of amyloidosis.
- Rapidly screen and identify patients with valvular heart disease by streamlining the labor-intensive and time-consuming analysis of echocardiography images.



Genomics

Using state-of-the-art genomic tools (including epigenetics and single-cell sequencing) to answer clinically compelling questions.



Gene therapy

Collaborating with the OHSU Center for Embryonic Cell and Gene Therapy to test the feasibility of correcting inborn DNA mutations that lead to hypertrophic cardiomyopathy and familial hypercholesterolemia in human embryos.



Artificial heart

Designing a battery-powered, permanent artificial heart device that mimics a pulse, unlike existing designs. The next step in development is a pre-clinical trial in animals to test the device.

Adult congenital heart disease

Serving a growing population of adults with congenital heart disease

OHSU Knight Cardiovascular Institute is now a fully accredited center for care of adult congenital heart disease. We are one of 32 institutions nationwide recognized by the Adult Congenital Heart Association and the only one in Oregon. Though OHSU Knight Cardiovascular Institute's program for adult congenital heart disease began in 1985, the new opportunity for accreditation emphasizes the comprehensive and interdisciplinary care available in Oregon.

"This accreditation acknowledges our institutional experience and ensures we can continue to help adult congenital heart disease patients navigate their health far into the future," said Craig S. Broberg, M.D., medical director of the OHSU Adult Congenital Heart Disease Program.

The OHSU program for ACHD oversees the care of more than 2,000 adult patients with congenital heart disease. In addition to cardiologists and a dedicated surgery team, the program staff also includes a

psychologist and experts in preventive cardiology. The ACHD team also works closely with the Pediatric Congenital Heart Disease Program at OHSU Doernbecher Children's Hospital. The OHSU-Doernbecher Transition Program begins working with patients in adolescence to seamlessly move their care into the adult program, ensuring specialized care across the life span. The two programs also closely collaborate for research and ACHD education.

Beyond patient care, the ACHD team is involved in a number of research activities. Broberg has studied how myocardial fibrosis affects the heart muscle in congenital defects over time, issues related to major blood vessels in individuals with a bicuspid aortic valve, as well as factors related to transplantation in ACHD. He is the lead researcher on a project creating the world's largest collection of clinical data on patients with a specific congenital heart condition called transposition of the great arteries.



Furthering ACHD expertise with ACGME-approved fellowship

In 2020, the OHSU Knight Cardiovascular Institute will graduate the first fellow from its ACGME-accredited fellowship for ACHD. In July, a second fellow will begin the two-year program that prepares participants to become clinicians and scholars skilled in ACHD care.



Leading national and international efforts in ACHD care

- OHSU Knight Cardiovascular Institute hosted the annual International Symposium on Congenital Heart Disease in the Adult for the 10th time in 2019. The event attracted more than 300 professionals from around the world.
- Craig Broberg, M.D., medical director of the OHSU Adult Congenital Heart Disease Program, serves on the board of directors of the Adult Congenital Heart Association, and also served on the committee that wrote the guidelines for ACHD published by the American College of Cardiology in 2018.
- Abigail Khan, M.D., who also directs the ACHD echo lab, has been working on an analysis of statewide claims data in congenital heart disease studying geographic disparities in health care delivery in rare populations. She and Broberg have worked on a number of scholarly publications in congenital heart disease.
- Adrienne Kovacs, Ph.D., director of Behavioral Cardiovascular Care for the Knight Cardiovascular Institute at OHSU, is president-elect of the International Society of Adult Congenital Heart Disease. She has published many articles on behavioral cardiology and is recognized worldwide for her expertise in the psychology of ACHD.



◀ Adrienne Kovacs, Ph.D., director of Behavioral Cardiovascular Care and Abigail Khan, M.D., director of the ACHD echo lab.

Heart failure and transplant

Expanding personalized treatment in heart failure and transplant

OHSU Knight Cardiovascular Institute is an epicenter in Oregon for comprehensive heart failure approaches and clinical trials. Our world-class programs extend lives and have a significant impact on quality of life for Oregonians and others who seek out the robust array of options available here.

“It’s such an exciting time in cardiovascular medicine,” said Frederick A. Tibayan M.D., cardiothoracic surgeon and the surgical director for Advanced Heart Failure and Transplant. “Over the last couple of decades, there have been milestone achievements in medications, the emergence of new mechanical devices with much improved risk/benefit profiles, nonsurgical valve interventions and more. OHSU Knight Cardiovascular Institute is on the forefront of advanced heart failure from every angle, including the ultimate option of heart transplantation.”



Region's resource for hypertrophic cardiomyopathy



The Hypertrophic Cardiomyopathy Clinic at OHSU is the first and only clinic in the Pacific Northwest dedicated to treating this complicated disease. It was among the first centers certified by the Hypertrophic Cardiomyopathy Association. OHSU's integrated team from cardiology, medical genetics and pediatric cardiology works with patients across the age spectrum.

At our high-volume center for myectomies, interdisciplinary collaboration led to the development of a novel and innovative surgical technique: OHSU performs a septal myectomy combined with papillary muscle realignment for the treatment of obstructive HCM that reliably relieves left ventricular outflow tract obstruction without the need for mitral valve repair or replacement.

Dedicated focus for amyloidosis



OHSU has the largest and longest-operating clinic in the Pacific Northwest focused on this rare and challenging disease. Specialists in cardiology, neurology, nephrology and oncology work as a team to provide patient-centric care. Five years ago, the clinic was the first in the Pacific Northwest to start a pyrophosphate (^{99m}Tc-PYP) scanning program — a way of diagnosing amyloidosis without a heart biopsy. Now, OHSU is helping other Oregon communities to develop their programs to allow for earlier and safer diagnosis of amyloidosis.

OHSU participates in every clinical trial related to amyloidosis, including leveraging artificial intelligence in amyloidosis diagnosis and using cardiac MRI and nuclear medicine to develop molecular-imaging capabilities in amyloidosis.

Options for all four heart valves



OHSU's heart valve experts can treat all forms of heart valve disease, including regurgitation, stenosis, insufficiency, prolapse and endocarditis. OHSU offers every form of percutaneous and surgical intervention for heart valve repair and replacement: percutaneous coronary intervention (PCI) with rotational atherectomy, valvuloplasties (aortic, mitral and pulmonic), patent foramen ovale (PFO)/atrial septal defect (ASD) closures, ethanol septal ablations, arterial embolizations and peripheral interventions.

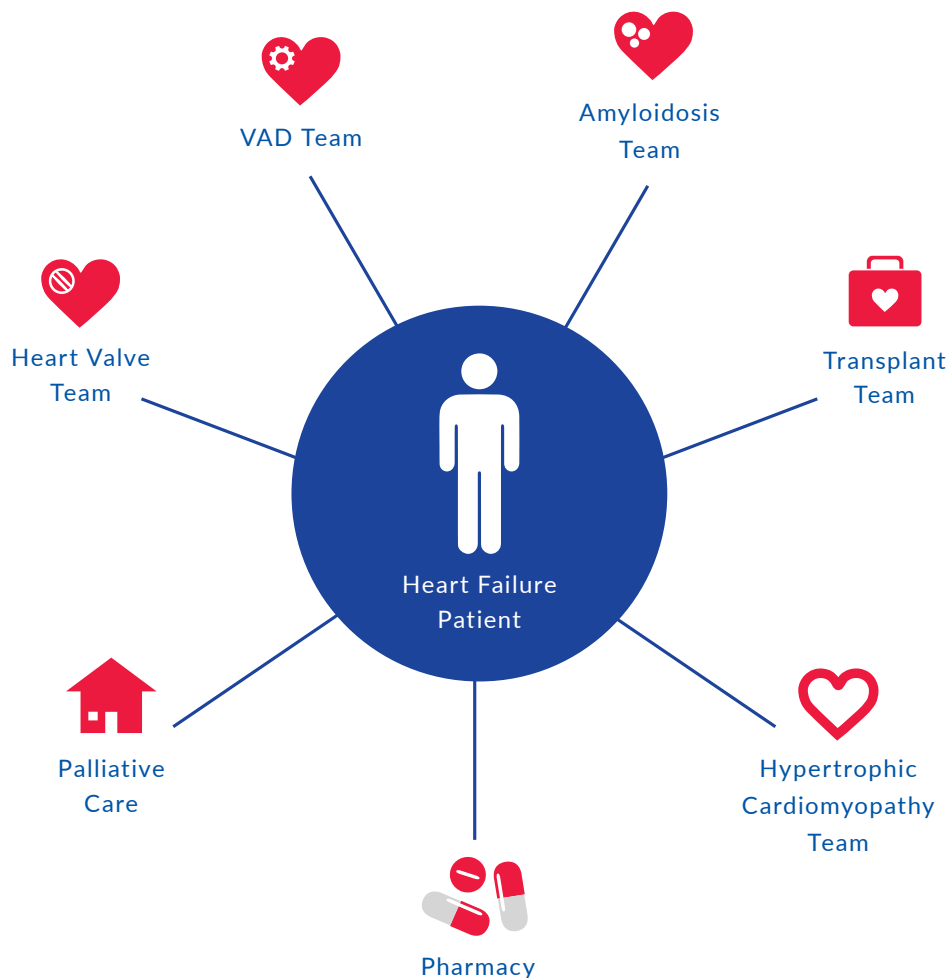
A leader in performing percutaneous mitral valve repairs and aortic valve replacements, OHSU Complex Heart Valve Program is at the forefront of the next wave of clinical studies for less invasive, more effective techniques for the tricuspid and pulmonic valves as well. Among the most advanced options to repair or replace cardiac valves are transcatheter aortic valve replacement (TAVR), percutaneous pulmonary valve (Melody Valve) replacement and mitral valve repair with MitraClip.

► From left to right: Fred Tibayan, M.D., surgical director of Advanced Heart Failure and Transplant; Luke Masha, M.D., M.P.H., cardiologist; Johannes Steiner, M.D., medical director of Mechanical Circulatory Support; Nalini Colaco, M.D., Ph.D., cardiologist; Heather Miller-Webb, R.N., heart transplant coordinator.



Active Heart Transplant Program

OHSU performed Oregon's first heart transplant in 1985. More than 700 transplants later, it remains the only program in Oregon approved by the United Network for Organ Sharing and the Centers for Medicare & Medicaid Services. Though the interdisciplinary expertise, sophisticated technical equipment and laboratories are in Portland, the OHSU Knight Cardiovascular Institute supports a shared care network of collaboration with physicians throughout the state enabling transplant patients to receive more follow-up care in their home communities.



◀ Every OHSU heart failure patient is cared for by a multidisciplinary team of heart failure specialists.

Newest mechanicals and surgical approaches

OHSU is the only health system in the Pacific Northwest offering air and ground transport for both pulmonary and cardiac adult extracorporeal membrane oxygenation (ECMO) patients. OHSU Knight Cardiovascular Institute has a comprehensive array of responses for both the short-term (with percutaneous ventricular assist devices Impella and TandemHeart) to long-term ventricular assist devices supported with nurse coordinators. OHSU Knight Cardiovascular Institute was part of the Momentum 3 clinical trial for HeartMate 3 LVAD (left ventricular assist device). Additionally, OHSU's team has expertise in the lateral thoracotomy approach, and is now educating other centers and surgeons in the technique.

Atrial fibrillation

Launching a holistic atrial fibrillation program

With a variety of new treatment options for atrial fibrillation (AFib) now available, OHSU Knight Cardiovascular Institute launched a multidisciplinary program in 2019 to encompass the full range of approaches. From the least amount of intervention involving modifiable behaviors through surgical options of ablation and insertion of the Watchman device, the program offers comprehensive care for AFib.

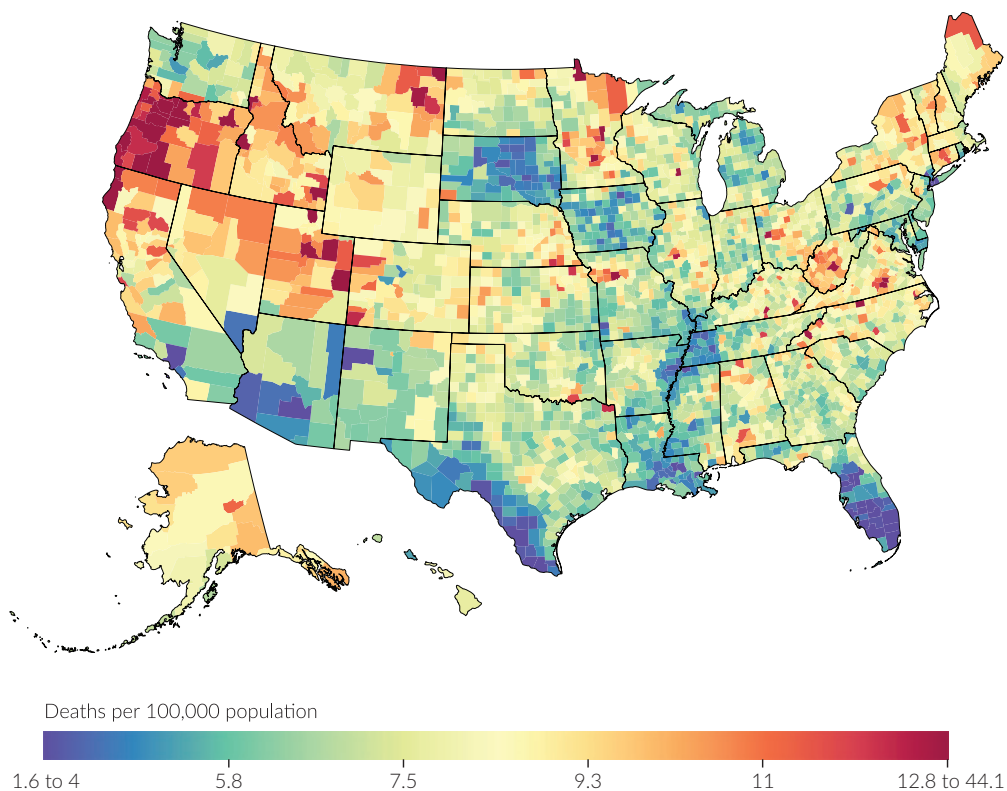
“Since outcomes for patients with AFib are better when treated by multi-disciplinary teams, our goal with this program is to tailor treatment to the individual patient,” said Charles Henrikson, M.D. the director of the electrophysiology program at OHSU. “In one clinic visit, we want to not only evaluate the disease but the contributing factors, such as sleep apnea, body mass index, stress, caffeine and alcohol intake. If you can improve these areas, some people will not need any other treatment for AFib. If symptoms don’t go away or the disease is more advanced, other treatments are more likely to work if lifestyle factors are mitigated.”

The effect of stress, weight and diet is relatively new information in the AFib arena, Henrikson noted.

“For a long time, we thought there was nothing we could do to lessen electrical problems of the heart, but that turns out not be true,” he said. “We want to assure our AFib patients that we view them as a whole person and that they will get an AFib evaluation from a perspective of overall wellness.”

That’s why the OHSU Knight Cardiovascular Institute’s AFib program services include experts in sleep medicine, psychology and nutrition. Henrikson and his collaborators are also working to scale AFib care to a population level at OHSU.

“We are working toward connecting every patient with AFib who comes into OHSU for any reason to the AFib program,” he said. “We are currently working with patients who come through the emergency room with AFib as a primary complaint or found incidentally. The AFib program will see these patients within a week to evaluate and treat them appropriately.”



U.S. county-level age-standardized mortality rate from atrial fibrillation and flutter, both sexes, 2014.

A holistic AFib program is much needed in Oregon. According to statistics compiled from 1980–2014 and published in The Journal of the American Medical Association in 2017, Oregon has a mortality rate due to atrial fibrillation greater than the 90th percentile. For overall mortality from cardiovascular disease, Oregon ranked comparatively low to the rest of the nation. Reasons for the spike in AFib deaths out of all forms of cardiovascular disease in Oregon are unclear at this time.

Incorporating clinical trials in specialty programs

Clinical research is not a stand-alone department at OHSU Knight Cardiovascular Institute, but very much folded into the clinical care of the patient. In the past three years, our clinical trials and research groups have tripled.



“Patients come to us not only for the highest quality in clinical care, but to move the needle scientifically for themselves and future generations by participating in clinical trials,” said Stephen Heitner, M.D., director of Clinical Trials and the Hypertrophic Cardiomyopathy Clinic. “If you see a doctor at OHSU Knight Cardiovascular Institute for heart failure, we will talk to you about the most contemporary therapies available and the standard of care in 2020. Then we will offer you any relevant clinical trials and gauge your level of interest. We may be able to offer a new therapy which may or may not make it to the market five years from now. If you choose to participate in a clinical trial, we partner you with a coordinator who shepherds you through the system, whichever study you are participating in at our hospital.”

“We are one of the few sites in the region to offer transcatheter options for all four valves. These new techniques represent options for people who previously had none.”

Firas Zahr, M.D.

Director of Interventional Cardiology and co-director of the OHSU Complex Heart Valve Program.

OHSU is a top enroller in:



Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients with Functional MR (COAPT) Continuing Access Study.

Transcatheter Mitral Valve Replacement with the Medtronic Intrepid TMVR System in Patients with Severe Symptomatic Mitral Regurgitation - APOLLO Trial.

Annular Reduction for Transcatheter Treatment of Insufficient Mitral Valve.

Evaluation of the GORE TAG Thoracic Branch Endoprosthesis in the Treatment of Lesions of the Aortic Arch and Descending Thoracic Aorta.

The CASCADE FH Registry longitudinal observational study.

OHSU is one of only a few centers in the world for:



Heart failure phase 1 immuno-modulation/immunotherapy with a molecule from Salubris Pharmaceuticals to regenerate the myocardium of heart muscle and reverse heart failure with systolic function beginning in early 2020.

A phase 1 Gene Therapy Study for Homozygous Familial Hypercholesterolemia.

OHSU is leading in:



Revolutionizing the therapeutic paradigm of HCM. As a leader of the MAVERICK-HCM phase 2 trial, results showed the impact of mavacamten in patients with non-obstructive HCM, significantly reducing their NT-proBNPs after 16 weeks of therapy. Planning is underway for the phase 3 international pivotal study in non-obstructive HCM patients, the biggest study ever done in HCM.

OHSU Sterol Analysis Laboratory is the national reference lab for this screening study as well as another national study of cerebrotendinous xanthomatosis.

Bringing science to the patient

The OHSU Knight Cardiovascular Institute supports OHSU's mission of delivering breakthroughs for better health by discovering new ways of understanding disease and quickly bringing new treatments to patients. To accomplish this goal, OHSU Knight Cardiovascular Institute supports a collaborative culture in which translational science can thrive. More than 80 of our faculty members partner with experts across OHSU, the region, the nation and the world to advance our understanding of cardiovascular disease. The result is better patient care.

► Jonathan Lindner, M.D.,
Lowell Edwards Professor
of Medicine, and Tamara
Atkinson, M.D.



Impacting clinical care



Structural Heart Program: Our Structural Heart Program, which includes members of cardiothoracic surgery and cardiology, is a national leader and pioneer in adopting and conducting early feasibility clinical trials on all heart valves with minimally invasive catheter-based procedures. Currently, OHSU is the only program in the region to perform this procedure.

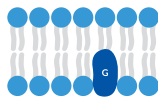


Peripheral Arterial Disease (PAD): PAD is a strong predictor of death from cardiovascular disease and is difficult to treat. OHSU Knight Cardiovascular Institute has assembled a multidisciplinary team with such diverse expertise as vascular biology, chemistry, acoustic physics, animal models of disease, clinical medicine and clinical ultrasound, to uncover the potential therapeutic benefit of ultrasound. OHSU Knight Cardiovascular Institute has recently initiated a clinical trial to determine if ultrasound can be used to improve blood flow in patients with PAD.

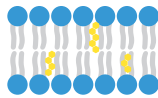


High blood pressure: OHSU Knight Cardiovascular Institute performed the first renal denervation procedure to treat high blood pressure in Oregon, in 2019. The multidisciplinary effort included experts from the OHSU Dotter Interventional Institute, nephrology and interventional cardiology, with support from the clinical trials team. This is the first procedure done at OHSU as part of the SPYRAL hypertension clinical trial. OHSU and Stanford are the only sites on the West Coast participating in this pivotal trial, which aims at reducing blood pressure without medication, freeing patients from dependence on antihypertensive medications.

Near translational



Therapeutic target discovery for hypertension: A team of OHSU Knight Cardiovascular Institute clinicians and scientists with expertise in vascular, cell and molecular biology, medicinal chemistry, pharmacology and computational science collaborated to discover a G-protein-coupled receptor that regulates small vessel diameter. This discovery can be used to develop drugs for vascular diseases, including coronary artery disease and hypertension.



High density lipoprotein cholesterol (HDL): Researchers at OHSU Knight Cardiovascular Institute are using advanced proteomics to determine how well HDL executes its function of removing cholesterol from cells, how HDL function is regulated, and how it is inherited. With an eye toward bringing these innovations to the clinic, OHSU Knight Cardiovascular Institute is leveraging collaborations to gain access to national databases and analyze large numbers of patient samples from nationally established biorepositories.

“OHSU is special because of our culture of collegiality, collaboration and team science. There is no place that I've been where physicians and scientists can so seamlessly work together as they do at OHSU.”

Nabil J. Alkayed, M.D., Ph.D.

Director of Research in the Knight Cardiovascular Institute



◀ OHSU Center for
Radiochemistry Research

Cutting-edge resources

OHSU has invested heavily in unique, translational resources for cardiovascular disease. One example is nonhuman primate models of cardiometabolic disease, which mimic human patients with complex cardiovascular risk due to obesity and diabetes. To support translational research in humans and preclinical models of cardiovascular disease, OHSU has developed the following advanced imaging capabilities:

- The Center for Radiochemistry Research supports a cyclotron for local production of short-lived imaging labels, a radiopharmacy, and a PET/MR for preclinical and human use.
- The Primate Multimodality Imaging Center is a state-of-the-art imaging suite that provides support for nuclear imaging with PET and SPECT, computed tomography, ultrasound and angiography.
- The Small Animal Imaging Research Core offers researchers microPET/SPECT/CT, ultrasound, biophotonics imaging, two-photon microscopy and OCT-based optical imaging.

Research groups

Adult Congenital Heart Disease

Craig S. Broberg, Professor
Grant Burch, Associate Professor
Abigail Khan, Assistant Professor
Adrienne Kovacs, Associate Professor

Cardiovascular Imaging

Craig S. Broberg, Professor
Scott Chadderdon, Assistant Professor
Maros Ferencik, Assistant Professor
Stephen Heitner, Associate Professor
Sanjiv Kaul, Professor
Abigail Khan, Assistant Professor
Elizabeth Le, Associate Professor
Jonathan Lindner, Professor
Hind Rahmouni, Assistant Professor
Diana Rinkevich, Associate Professor
Xubo Song, Professor
Kevin Wei, Professor

Cardiometabolic

Sergio Fazio, Professor
Jonathan Lindner, Professor
Jeanne Link, Professor
Jonathan Q. Purnell, Professor
Charles Roberts, Professor

Center for Developmental Health

Natasha N. Chattergoon, Assistant Professor
George Giraud, Professor
Sonnet Jonker, Associate Professor
Alina Maloyan, Associate Professor
Kent Thornburg, Professor

Electrophysiology

Beth Habecker, Professor
Charles A. Henrikson, Professor
Adrienne Kovacs, Associate Professor
Jonathan Lindner, Professor
Babak Nazer, Assistant Professor
Eric Stecker, Associate Professor
Larisa Tereshchenko, Associate Professor
Zhengfeng Zhou, Professor

Genomics/Genetics

Andrew Adey, Assistant Professor
Lucia Carbone, Associate Professor
Sergio Fazio, Professor
Stephen Heitner, Assistant Professor
Meghan Mannello, Instructor
Cheryl Maslen, Professor
Dhandapany Perundurai, Assistant Professor

Hypertrophic Cardiomyopathy and Amyloidosis

Reyhaneh Akhavein, Assistant Professor
Rupali Avasare, Assistant Professor
Stephen Heitner, Associate Professor
Chafic Karam, Associate Professor
Meghan Mannello, Instructor
Ahmad Masri, Assistant Professor
Eva Medvedova, Assistant Professor
Shoukhrat Mitalipov, Professor
Sarah Nagel, Assistant Professor
Rebecca Silbermann, Assistant Professor

Interventional Cardiology

Joaquin Cigarroa, Professor
Punag Divanji, Assistant Professor
Harsh Golwala, Assistant Professor
Firas Zahr, Associate Professor

Preventive Cardiology

P. Barton Duell, Professor
Sergio Fazio, Professor
Nathalie Pamir, Assistant Professor
Jonathan Q. Purnell, Professor
Hagai Tavori, Assistant Professor

Center for Radiochemistry Research

Kenneth Krohn, Professor
Jeanne Link, Professor
Dexing Zeng, Assistant Professor

Vascular Biology

Nabil Alkayed, Professor
Joseph Aslan, Assistant Professor
Amir Azarbal, Associate Professor
Anthony Barnes, Assistant Professor
Sanjiv Kaul, Professor
Jonathan Lindner, Professor
Steven Mansoor, Assistant Professor

Vascular Surgery

Cherrie Abraham, Associate Professor
Amir Azarbal, Associate Professor
Enjae Jung, Assistant Professor
Gregory Landry, Professor
Timothy Liem, Professor
Greg Moneta, Professor

Aortic Diseases

Cherrie Abraham, Associate Professor
Amir Azarbal, Associate Professor
Abigail Khan, Assistant Professor
Cheryl L. Maslen, Professor
Lynn Sakai, Professor

Cardiothoracic Surgery

Castigliano Bhamidipati, Assistant Professor
Gurion Lantz, Assistant Professor
Danielle Smith, Assistant Professor
Howard Song, Professor
Frederick Tibayan, Associate Professor

Limb preservation

Initiating a limb preservation program emphasizing functionality and follow-up

Our new Functional Limb Preservation Program brings together four core services: vascular surgery, podiatry, plastic surgery and physical therapy. Together, providers care for patients with foot ulceration, peripheral artery disease and other conditions with high risk of amputation. “It’s our goal to not just preserve the limb but to keep these patients moving,” said podiatric surgeon David W. Griffin, D.P.M., the co-director of the program with vascular surgeon Gregory J. Landry, M.D., F.A.C.S. “We have embedded physical therapists to teach patients how to avoid decompensating. We evaluate patients before they ever leave the clinic for exercises they can do and the right assistive devices for them to mobilize safely.”

Tapping into the synergistic advantages of a diverse, interdisciplinary team, the Functional Limb Preservation Program has a weekly PAD/wound meeting to

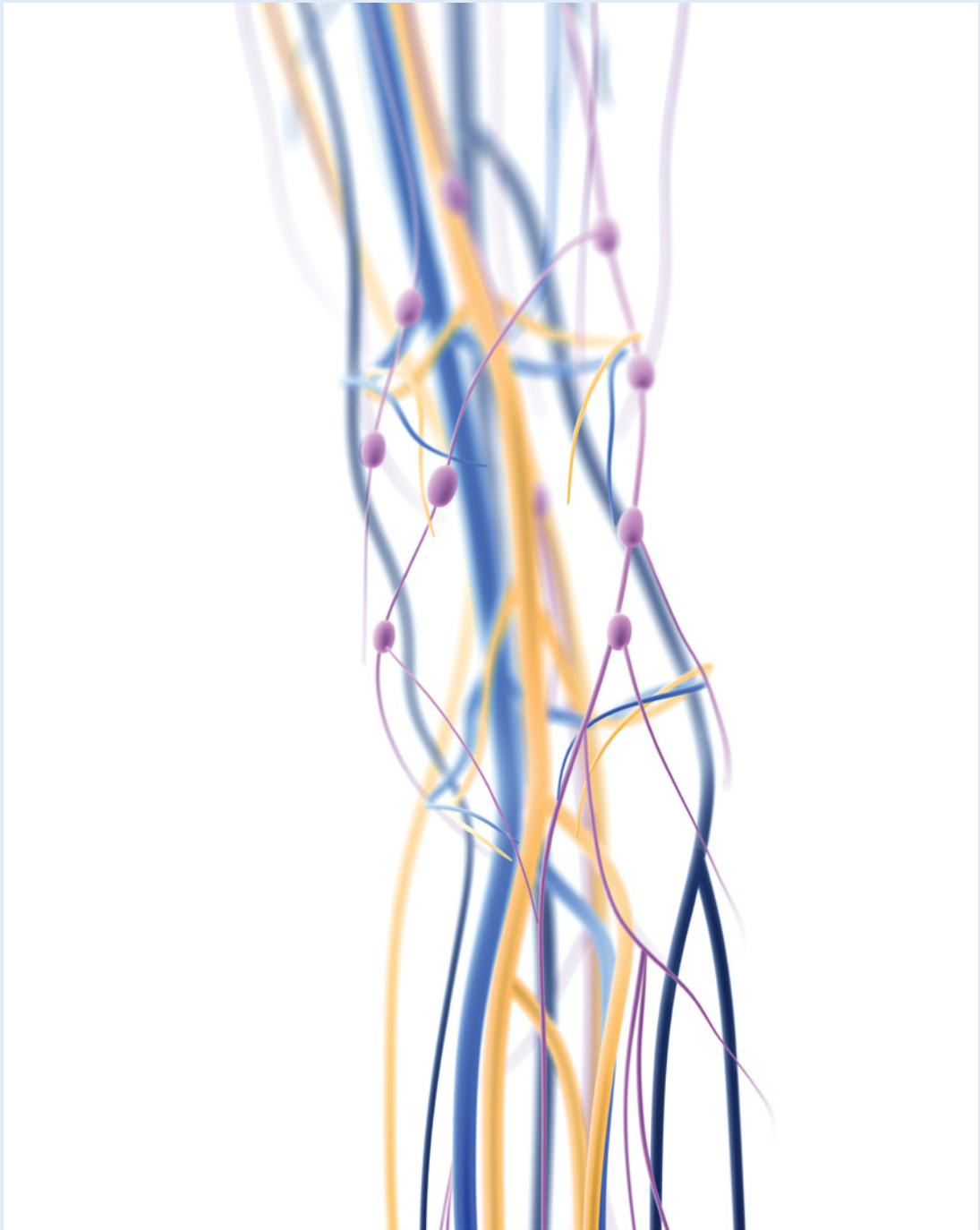
discuss difficult cases. The program also offers convenience for the patient to see all necessary specialties with warm hand-offs as they progress to each phase of treatment. Patients also benefit from access to the OHSU Hyperbaric and Wound Center.

Because the recurrence rate in ulceration is 40% in one year, OHSU Knight Cardiovascular Institute has also enlisted the help of Oregon podiatrists.

“We work hard to get patients healed and help them manage their biomechanics, but they will need monitoring,” Griffin said. “We’ve recruited and vetted podiatrists around the state to collaborate with us and serve as resources for the patients in their local communities. We want our patients to be ulcer-free, hospital-free, and enjoy enriched days capable of favorite activities.”

“We want our patients to be ulcer-free, hospital-free, and enjoy enriched days capable of favorite activities.”

David W. Griffin, D.P.M.



Clinical programs

► Greg Landry, M.D.,
head of the Division
of Vascular Surgery



Aortic conditions

Nationally and internationally recognized clinicians and researchers in vascular surgery, cardiothoracic surgery, interventional radiology, cardiovascular medicine and related disciplines partner to provide consultation, treatment and comprehensive surgical and medical management for any aortic condition. Services include the latest multimodality aortic imaging, medical monitoring, aneurysm repair, endovascular surgery, hybrid open/endovascular surgery and minimally invasive vascular surgery such as endovascular aneurysm repair (EVAR) and thoracic endovascular aortic repair (TEVAR).

Cardiogenetics

This multidisciplinary team of experts provides personalized care and support to patients and families with hereditary cardiovascular diseases such as familial hypercholesterolemia, Marfan syndrome, familial amyloidosis, dilated and hypertrophic cardiomyopathy, and Long QT syndrome, among others. Genetic counselors, cardiologists, electrophysiologists, surgeons, neurologists, primary care providers, nephrologists, nurses and other health care providers work together to ensure patients receive precision health care tailored to their genetic diagnosis. Genetic counselors consult with patients and families to understand the hereditary nature of cardiovascular diseases, provide genetic testing, address the physical and emotional implications of having an inherited cardiovascular condition, and connect patients to research opportunities.

Cardio-oncology

This unique program specializes in the cardiovascular care of patients currently undergoing or previously treated with chemotherapy, radiation therapy or bone marrow transplantation. To ensure long-term health and overall survival from cancer, experts provide care for prevention of chemotherapy-induced cardiotoxicity and radiation-induced heart damage. They also provide management of existing heart conditions during cancer treatment and cardiac complications after cancer treatment, and assessment of long-term cardiovascular risk with optimization of preventive treatments for cancer survivors. The multidisciplinary program brings together cardiologists with a special interest in the cardiovascular effects of anti-cancer therapies and oncologists to provide comprehensive and personalized care for our patients.

Cardiothoracic surgery

We are a regional resource for patients with advanced heart diseases that require complex treatments. OHSU's cardiac surgery team cares for adult patients with congenital and acquired heart diseases, including coronary artery disease, valvular heart disease, aortic aneurysms and heart failure, using innovative surgical techniques. Minimally invasive approaches are used whenever possible to give patients the best outcomes while minimizing discomfort and recovery time.

Center for Preventive Cardiology

For patients with increased risk of heart disease (e.g., dyslipidemia, diabetes and hypertension), the Center for Preventive Cardiology offers a combination of advanced medical intervention and lifestyle modification. We work with genetic counselors, behavioral health experts and lipid experts to offer specialized care for patients with complex lipid abnormalities such as familial hypercholesterolemia, intolerance to statins, and early family history or premature coronary artery disease. Our multidisciplinary team includes endocrinologists, cardiologists and nutritionists, who together offer a team approach to managing other high risk factors. The center also includes OHSU's three-phase inpatient/outpatient cardiac rehabilitation program, which is nationally certified by the American Association of Cardiovascular and Pulmonary Rehabilitation.

Congenital heart disease

One of only 32 institutions nationwide recognized by the Adult Congenital Heart Association and the only one in Oregon, our program is made up of a full-service team of adult, pediatric and interventional cardiologists, geneticists, psychologists, and heart surgeons who specialize in the inpatient and outpatient care of adults with congenital heart disease, including the full spectrum from undiagnosed lesions to complex palliated patients. OHSU offers state-of-the-art diagnostics, catheter intervention, electrophysiologic study and surgery, and patients have access to congenital heart disease clinical trials not available elsewhere in the state.

Heart failure and transplant

OHSU is Oregon's first and only heart transplant program approved by the United Network for Organ Sharing and the Center for Medicare & Medicaid Services. A multidisciplinary team of cardiac surgeons, cardiologists, intensivists, clinical coordinators, advanced practitioners and social workers specializes in the care of patients with advanced heart failure and works together to provide the most appropriate advanced therapies available, including augmented medical therapy, inotropes, ventricular assist devices and other forms of mechanical circulatory support, and heart transplantation. OHSU has performed more than 700 heart transplants and more than 200 mechanical support device implants.

Heart rhythm disorders

We offer a full range of electrophysiology procedures, including pacemaker and defibrillator implantation; electrophysiology study and ablation of supraventricular tachycardia, atrial fibrillation and ventricular tachycardia; laser lead extraction; and epicardial access and ablation. OHSU is the first hospital in the region to offer a cryoballoon procedure to isolate, freeze and ablate the pulmonary veins, and is the only hospital in the region with a research protocol that permits safe MRI scans on patients with a permanent pacemaker or implantable cardioverter defibrillator.

Hypertrophic cardiomyopathy

The first program of its kind in Oregon, this multidisciplinary team from cardiology, medical genetics and pediatric cardiology provides expert care for a condition characterized by abnormal thickening of the left ventricular muscle. The program is registered with the Hypertrophic Cardiomyopathy Association and provides treatment that includes medical therapies (beta blockers, certain calcium channel blockers, disopyramide), septal reduction therapies (surgical or catheter-based), implantable cardioverter defibrillators and advanced heart failure therapies.

Ischemic heart disease

Advanced medical, interventional, diagnostic and surgical procedures to manage diseases of the coronary arteries, including percutaneous coronary intervention and coronary artery bypass grafting. OHSU is home to Oregon's first accredited chest pain center and is one of the few hospitals in the country to offer myocardial contrast echocardiography to quickly and accurately detect decreased blood flow in arteries.

PCI Mortality Index for Northwest AMCs		
	2018	2019*
OHSU	0.74	0.33
UW-WASHINGTON	0.86	1.56
STANFORD	0.98	0.83
UTAH	1.20	0.96
*January - June 2019		Source: Vizient CDB/RM

Maternal cardiac

Unique to the region, this clinical partnership between cardiology and maternal fetal medicine at OHSU provides comprehensive care for women with diagnosed or suspected cardiac disease who are pregnant or planning for a pregnancy. The program offers preconception counseling, cardiac monitoring during pregnancy, and early postpartum follow-up. Wherever possible, the program partners with local providers to give the best ongoing care available to our patients.

Structural heart disease

A multidisciplinary team, including imaging specialists, interventional cardiologists, nurses, advanced practitioners and surgeons, provides a comprehensive approach to valvular heart disease, congenital defects and acquired cardiovascular conditions. Catheter and surgical approaches are available to patients with all types of valvular heart disease, hypertrophic cardiomyopathy, coronary arteriovenous fistulae and other acquired heart defects. For patients with a patent foramen ovale, joint evaluation by neurologists and cardiologists determines whether closure might reduce the risk of future stroke. Active clinical trials are available to patients for the treatment of many of these conditions. This comprehensiveness of our structural heart program results in superior outcomes.

Vascular disease

OHSU's vascular disease program includes nationally renowned experts specially trained to diagnose and treat the entire spectrum of arterial, venous and lymphatic disorders. A team of providers, including vascular, cardiothoracic and endovascular surgeons, treats the carotid artery and extracranial cerebrovascular system, aneurysms of the thoracic and abdominal aorta, intestinal and kidney arteries and veins, upper and lower extremity arteries and veins, patients with Raynaud's syndrome, those requiring vascular access for hemodialysis as well as patients with varicose veins, venous thrombosis, lymphedema and vascular malformations.

TAVR Mortality Index for Northwest AMCs		
	2018	2019*
OHSU	0.31	0.00
STANFORD	0.39	0.75
UTAH	0.88	0.00
UW-WASHINGTON	1.22	1.16
*January - June 2019		Source: Vizient CDB/RM

Women's heart

In collaboration with the OHSU Center for Women's Health, the women's heart program focuses on primary prevention to reduce risk in women without known cardiovascular disease, secondary prevention to improve the health of women diagnosed with disease, and cardio-oncology to manage heart risks in women who have undergone breast cancer treatment. By understanding the differences in how heart disease manifests in women and studying the disparities in treatment and response to medication, this program aims to provide a forum for providers to improve care and health outcomes using the most current evidence-based information.

Cardiovascular health system

Evolving health system simplifies access to cardiovascular care

Applying the lessons learned by developing a health system approach in rural community health, OHSU and partner community health systems Adventist Health and Tuality Healthcare are coordinating to provide superior cardiovascular care in the densest population area of the state. In 2019, those partnerships transitioned into a full health system, OHSU Health.

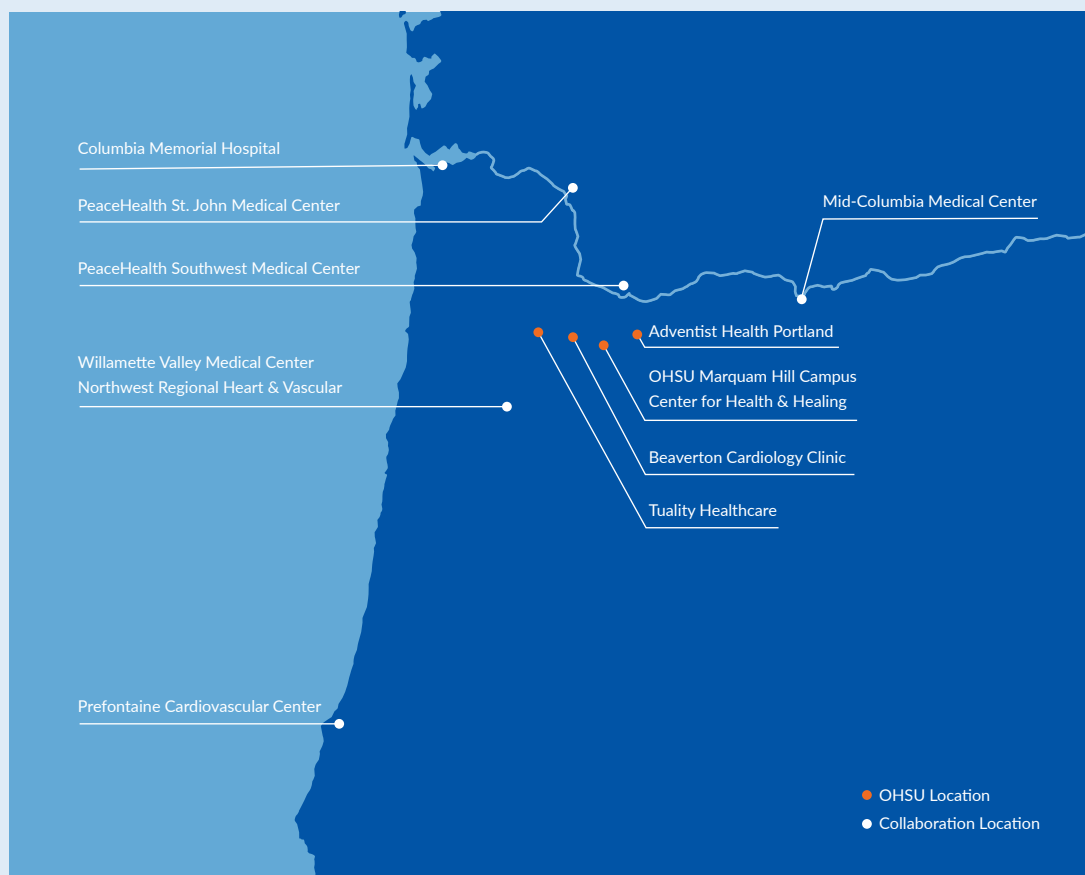
“Just because there are many providers in an area doesn’t ensure the right care at the right time in cardiovascular health,” said Joaquin E. Cigarroa, M.D., head of the Division of Cardiovascular Medicine. “We are now working through a health system to improve access to cardiovascular clinical care in Portland metropolitan communities in an organized and systematic way among two community hospitals and the university. So, wherever a patient enters the system, they have the same access to the highest expertise and clinical trials. They will no longer be defined by barriers between hospital A or B but get the benefit of having clinicians in their community integrated across the system.”

Uniquely positioned in the region’s only academic health center, OHSU Knight Cardiovascular Institute is leading statewide efforts to create standards for heart health screening, treatment and prevention. Now with regional rural and metropolitan clinical partners, OHSU Knight Cardiovascular Institute is developing initiatives to help set and implement statewide standards for care of heart patients.

Efforts began with communities lacking subspecialty physician/surgical care, including the Columbia River region of Oregon and southwest Washington. OHSU and Mid-Columbia Medical Center developed a joint program in cardiovascular diseases with full-time

OHSU cardiologists located in The Dalles (pop. 14,000) and a similar program at Columbia Memorial Hospital in Astoria (population 10,000). Collaborating with PeaceHealth Southwest Washington Medical Center, OHSU Knight Cardiovascular Institute jointly hires and shares cardiovascular faculty with St. John Medical Center in Longview, Washington (pop. 37,000). These faculty spend 80% of their time at the community locations and 20% at the main OHSU campus in Portland. OHSU Knight Cardiovascular Institute also collaborates with PeaceHealth Southwest Washington Medical Center to bring heart surgery providers to the Vancouver, Washington area.

“The aim of these partnerships is to provide outstanding primary and secondary cardiovascular care in the community with tertiary and quaternary care provided at OHSU, as well as to develop strong academic programs in these settings,” Cigarroa said.



► Map of cardiovascular locations. OHSU Health includes 52 care locations in the Portland-metro area, with OHSU Doernbecher Children's Hospital and nearly 1,000 beds at the three adult hospitals.

Locations

Locations

Marquam Hill Campus

3181 S.W. Sam Jackson Park Road
Portland, OR 97239
503-494-1775

Center for Health & Healing

3303 S.W. Bond Ave.
9th floor
Portland, OR 97239
503-494-1775

Beaverton Cardiology Clinic

15700 S.W. Greystone Court
Beaverton, OR 97006
503-494-1775

Adventist Health Portland

10123 S.E. Market St.
Portland, OR 97216
503-257-2500

Tuality Healthcare

335 S.E. 8th Ave.
Hillsboro, OR 97123
503-681-1111

Community Collaborations

PeaceHealth**St. John Medical Center**

1615 Delaware St.
Longview, WA 98632
360-414-2730

PeaceHealth**Southwest Medical Center**

200 N.E. Mother Joseph Place
Vancouver, WA 98664
360-514-4444

Columbia Memorial Hospital

2095 Exchange St., Ste. 301
Astoria, OR 97103
503-338-4087

Mid-Columbia Medical Center

551 Lone Pine Blvd., Ste. #303
The Dalles, OR 97058
541-506-6530

Prefontaine Cardiovascular Center

1775 Thompson Road
Coos Bay, Oregon 97420
541-269-8111

Willamette Valley Medical Center**Northwest Regional Heart & Vascular**

2700 SE Stratus Ave., Ste 406
McMinnville, OR 97128
503-435-1200

Providers by department

Anesthesiology and Peri-operative Medicine

Mark Baskerville, M.D., J.D., M.B.A.
Tonya Miko Enomoto, M.D.
Ryan Fink, M.D.
Alan J. Kovar, M.D.
Matthias Johannes Merkel, M.D., Ph.D.
Peter M. Schulman, M.D.
Michael Wollenberg, M.D.

Cardiovascular Medicine

Shaun Ageno, M.D.
Reyhaneh Akhavein, M.D.
Bassel Beitinjaneh, M.D.
Craig S. Broberg, M.D.
S. Albert Camacho, M.D.
Scott Chadderdon, M.D.
Joaquin Cigarroa, M.D.
Nalini Colaco, M.D., Ph.D.
Punag Divanji, M.D.
Thomas Dewland, M.D.
P. Barton Duell, M.D.
Sergio Fazio, M.D., Ph.D.
Maros Ferencik, M.D., Ph.D.
Harsh Golwala, M.D.
Nandita Gupta, M.D.
Allan Harrelson, D.O., Ph.D.
Stephen Heitner, M.D.
Charles Henrikson, M.D.
Peter Jessel, M.D.
Sanjiv Kaul, M.D.
Abigail Khan, M.D.
Adrienne Kovacs, Ph.D.
Elizabeth Le, M.D.
Jonathan Lindner, M.D.
Steven Mansoor, M.D., Ph.D.
Luke Masha, M.D., M.P.H.
Ahmad Masri, M.D.

Jared Miller, M.D.
Edward Murphy, M.D.
Shashima Nakahara, M.D.
Babak Nazer, M.D.
Jonathan Purnell, M.D.
Hind Rahmouni, M.D.
Diana Rinkevich, M.D.
David Rutlen, M.D.
Eric Stecker, M.D.
Johannes Steiner, M.D.
James Suero, M.D.
Sahar Taqui, M.D.
Yen Tibayan, M.D.
Kevin Wei, M.D.
Catherine Wong, M.D.
Firas Zahr, M.D.

Cardiothoracic Surgery

Castigliano Bhamidipati, D.O., Ph.D., M.Sc.
Robert DuBose, M.D.
Gurion Lantz, M.D.
Ashok Muralidaran, M.D.
Irving Shen, M.D.
Terry Shih, M.D.
Danielle Smith, M.D.
Howard Song, M.D., Ph.D.
Frederick Tibayan, M.D.

Vascular Surgery

Cherrie Abraham, M.D.
Amir Azarbal, M.D.
Leo Daab, M.D.
David Griffin, D.P.M.
Enjae Jung, M.D.
Gregory Landry, M.D.
Timothy Liem, M.D.
Robert McLafferty, M.D.
Amani Politano, M.D., M.S.

Continuing medical education

OHSU offers accredited continuing medical education for medical professionals. OHSU School of Medicine is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

2021 Multidisciplinary Aortic Dissection Symposium

June 18–19, 2021

OHSU Robertson Life Sciences Building

Portland, Oregon

www.ohsu.edu/MADSymposium

6th Annual Pacific Northwest Cardiovascular Summit

Sept. 11–12, 2020

Portland, Oregon

www.pnwcvsymposium.com



National leadership

Nabil Alkayed

- Chair of the NIH Small Business Panel on Drug Discovery for Aging, Neuropsychiatric and Neurologic Disorders
- Chair of the American Heart Association Brain Fellowship Study Section
- Member of the Brain Injury and Neurovascular Pathologies Study Section
- NIH study sections Vascular Cell and Molecular Biology and Neuronal Oxidative and Mitochondrial Death Neural Oxidative Metabolism, Mitochondria and Cell Death.
- Scientific Advisory Board of the Association of University Anesthesiologists (AUA)

Maros Ferencik

- Society of Cardiovascular CT – Executive Committee Member, Member Liaison,
- Society of Cardiovascular CT – Director, Board of Directors
- Society of Cardiovascular CT – Co-Chair, Education Committee
- Society of Cardiovascular CT – Chair, Membership Committee
- Society of Cardiovascular CT – Member, Annual Scientific Meeting Committee
- American College of Radiology – Member, Appropriateness Criteria Panel
- Radiological Society of North America – Member, Quantitative Imaging Biomarker Alliance (QIBA), Multi-disciplinary Collaborator for Plaque Imaging by CT Angiography

Charles Henrikson

- HRS EP Fellowship Training Program Directors Subcommittee
- NCDR: LAAO LAAO registry publications committee, ICD registry steering committee, Science and Quality oversight committee
- ACC: Section Editor (Devices), EP SAP
- Editorial Board for Heart Rhythm and Circulation arrhythmia & Electrophysiology
- Abstract Reviewer: HRS and AHA

Sonnet Jonker

- Chair-elect of the American Physiological Society (APS) Animal Care and Experimentation Committee (ACE). My term is 2020-23.

Adrienne Kovacs

- International Society for Adult Congenital Heart Disease
2018–Present | President-Elect (the first non-MD to hold this position)
- American College of Cardiology
2016–Present | Invited Member, Geriatric Cardiology Section Palliative Care Work Group
- Heart & Stroke (Canada)
2018–2019 | Member, Expert Advisory Group, Annual Report
- Congenital Heart Public Health Consortium
2015–Present | Member, Cardiac Neurodevelopmental and Psychosocial Quality of Life Workgroup
- National Pediatric Cardiology Quality Improvement Collaborative (NPC-QIC)
2017–Present | Leader, post-Fontan coping and resilience group (to understand and improve late outcomes following Fontan surgery for patients born with single ventricles)
- American Board of Pediatrics
2017–Present | Collaborator, "A Change Package to Support the Resilience, Emotional and Mental Health of Pediatric Patients with Chronic Conditions and Their Families"

Elizabeth Le

- Member, American Heart Association Women in Cardiology (WIC) Council

Greg Moneta

- Associate editor Journal of Vascular Surgery Venous and Lymphatic Disorders
- Society for Vascular Surgery Patient Safety Organization Governing Council

Babak Nazer

- ABIM Electrophysiology Board Examination Standard Setting Committee

Tracy Severson

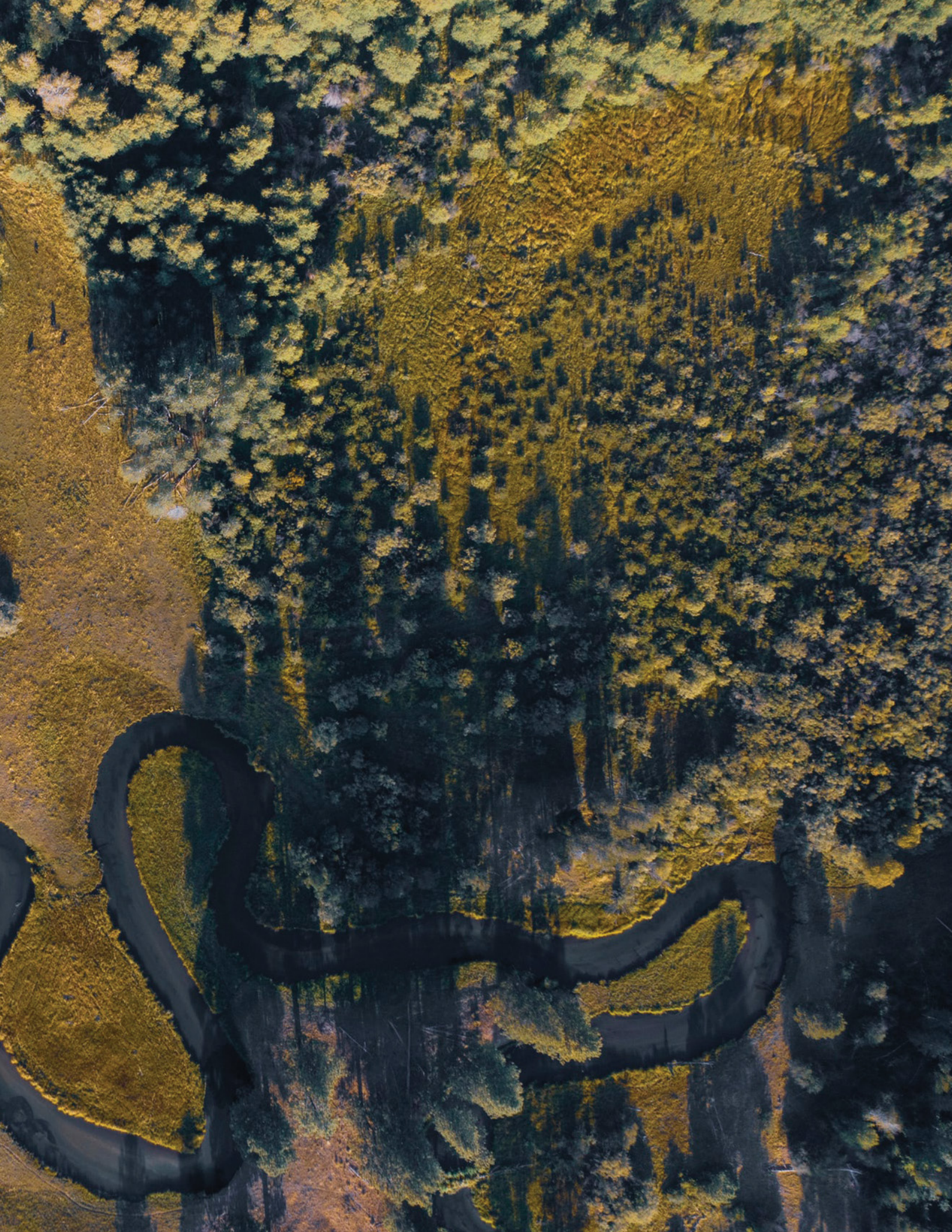
- Regional Representative for the Pacific Lipid Association Board of Directors for the 2019-2020 term

Hagai Tavori

- ATVB council member – Membership & Communication Committee.
- AHA peer review committee of the Lipids pre/post doctoral fellowship study section.
- Abstract Reviewers for the "Vascular Discovery: From Genes to Medicine" conference (previously ATVB/PVD Scientific Sessions).
- Member of the Continuing Professional Development committee of the SoM

Larisa Tereshchenko

- Heart Rhythm Society Young Investigator Awards Subcommittee member
- Editorial board member: Circulation Arrhythmia and Electrophysiology, Heart Rhythm Journal, BMJ Heart, Journal of Electrocardiology, Annals of Noninvasive Electrocardiology.
- OHSU Faculty Council Committee member
- Granting agencies peer reviewer: American Heart Association, Clinical Bioengineering and Clinical Cardiac Electrophysiology Study Sections, Israel Science Foundation, German Centre for Cardiovascular Research, The Netherlands Organization of Health, Research and Development, Wellcome Trust, United Kingdom.



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