OHSU INNOVATES

2023 Impact Report



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The mission of OHSU Innovates is simple yet far-reaching: We help brilliant OHSU scientists and physicians move their pioneering ideas forward—ideas that can someday change medicine and patients' lives.

The stories in this report underline how OHSU scientists and clinicians are always looking for ways to improve human health and well-being, and to make lives of the people of Oregon and beyond better. The stories also demonstrate the vital importance of continued support for these scientists and their ideas. That support comes not only from us at OHSU Innovates but from a wide range of public and private partners.

We thank our supporters. And we hope this report inspires you to get involved with our thriving innovation community—whether that's as a participant in a new clinical trial, a donor to OHSU programming, an entrepreneur or an investor in a startup company or a future scientific collaborator. This past year has been another outstanding year for innovation at OHSU. Moreover, we can now see the impact of OHSU Innovates, the collective of OHSU units that support entrepreneurship, technology transfer, industry partnerships and innovation in general.

Artificial intelligence has been big in the past year, at OHSU as it has everywhere. For example, a significant oncology collaboration utilizing AI was initiated; in this collaborative group, OHSU investigators will study tumors as they change over time and build computational models of cellular behavior. On another front, OHSU scientists are developing an AI-based app for improved management of type 1 diabetes.

Medical devices have hit the big time for OHSU. The OHSU startup ProMedix took home \$260,000 in investments at the Angel Oregon Life & Bioscience event—to continue to develop a device for monitoring of sepsis. OHSU also received a grant from the M.J. Murdock Charitable Trust to develop a device that could improve access for women seeking infertility assessments in rural and low resource clinics. There is more too; OHSU researchers are developing a novel imaging device to improve diagnosis of flesheating disease.

Oncology is often in the news, and this year was no different. An OHSU surgeon scientist is developing novel CAR T-cell therapies, and the Knight Cancer Institute's SMMART Clinical Trials is allowing for improved precision medicine approach to cancer and has attracted collaborators Lilly and AstraZeneca. Finally, it's time for a 10-year retrospective of the Biomedical Innovation Program. BIP awardees have secured over \$37 million in follow-on funding. Moreover, two of the first BIP awardees led to OHSU startups that had significant achievements in this year: Neuramedica received FDA approval for their dural clip, and Trace Bioscience received new investments for their development of fluorescent agents to help surgeons avoid nerves during surgery.

And that's just some of what happened in OHSU innovation during the last year. I look forward to another exciting year of innovation, startups, awards and more!



Peter Barr-Gillespie, Ph.D.

PitiBanger

EXECUTIVE VICE PRESIDENT & CHIEF RESEARCH OFFICER OHSU RESEARCH & INNOVATION

Advancing Health Care With Artificial Intelligence

Artificial intelligence, or AI, exploded into the mainstream this year with popular tools like ChatGPT. But AI is also building momentum behind the scenes in health care research. Scientists across OHSU are harnessing the power of AI in new ways to gain insights into biology and develop tools to improve patient care.

Early cancer predictions

Scientists at the OHSU Knight Cancer Institute are working with AI experts at NVIDIA to advance our understanding of the development and progression of tumors at the cellular level. NVIDIA is the world's leading developer of artificial intelligence and machine learning solutions, and the company strives to enter into collaborations where it can apply its products and expertise to make a positive impact on society.

The Knight Cancer Institute is deploying leading-edge microscopy techniques to deeply characterize tumor cells and their local environment in varying stages of development. OHSU is a leader in developing and employing these advanced imaging techniques, leveraging more than a decade's worth of investments in personnel and infrastructure.

NVIDIA is contributing machine learning and artificial intelligence expertise to help OHSU study tumors as they change over time, recognize various stages of the tumors and build computational models of cellular behavior as tumors advance through these stages. While this collaboration is in its early stages, we anticipate that these models will form the foundation for building digital twins of tumors. That will allow advanced computer modeling of tumor response to different therapies, which will ultimately benefit patients.



OHSU scientists develop AI-enabled smartphone app to help patients control their type 1 diabetes



The DailyDose app being displayed on a smartphone and the related diabetes tools with which it works: a glucose sensor transmitter and a smart insulin pen. (OHSU/Christine Torres Hicks) Living with type 1 diabetes can be challenging, requiring daily monitoring of glucose levels and management of insulin administration. OHSU scientists are using the power of AI to develop a tool that could help patients take the guesswork out of managing this disease. Using an AI algorithm that analyzes blood sugar data, OHSU scientists in the Artificial Intelligence for Medical Systems lab, in collaboration with the Harold Schnitzer Diabetes Health Center, have developed a smartphone app called DailyDose.

The app aims to identify concerning trends and recommend steps to help patients keep their glucose levels within a healthy range. The Leona M. and Harry B. Helmsley Charitable Trust awarded OHSU a \$4.3 million grant in 2022 to support the research, led by <u>Peter Jacobs, Ph.D.</u>, associate professor of biomedical engineering and <u>Leah Wilson, M.D.</u>, clinical assistant professor of medicine (endocrinology, diabetes and clinical nutrition) in the OHSU School of Medicine.

The team will carry out a randomized clinical trial to evaluate the impact of using DailyDose. For those who do not improve with the app alone, the trial will also incorporate diabetes education specialists to overcome challenges some may face making the recommended changes. Read more about <u>DailyDose</u> and its potential impact for patients with diabetes.



The goal of our research is to develop technologies that can improve the lives of people with diabetes. It is exciting and rewarding to receive feedback from people who use DailyDose that they want to continue using the app because it has helped them better manage their diabetes.



Leah Wilson

Finding New Answers in Mental Health

Mental health and neuroscience research have long been centers of innovation at OHSU. Our scientists continue to make breakthroughs in these fields, from developing an online cognitive behavioral therapy program for new mothers in need of mental health support, to creating new molecules that target neuronal receptors. OHSU-developed compounds enter clinical trials for major depressive disorder

Tom Scanlan, Ph.D., professor of chemical physiology and biochemistry in the OHSU School of Medicine, and his colleagues at OHSU were studying the thyroid hormone system when they designed a new class of compounds that could activate thyroid hormone receptors. Importantly, some of these compounds could also cross the blood brain barrier, the filter in capillaries in the human brain that limits what substances in the blood can get into brain cells.

The ability for these compounds to reach the brain meant they could have therapeutic potential for numerous neurological disorders. That led to the formation in 2018 of an OHSU startup company called <u>Autobahn Therapeutics</u>. Autobahn completed in September of 2023 Phase 1 clinical trials of its compound—ABX-002—which selectively activates the beta version of the thyroid hormone receptor in the brain and is based on the original discovery from Scanlan and his colleagues.

ABX-002 is being evaluated as a potential treatment for major depressive disorder and may provide relief for the estimated 50% or more of patients that experience an inadequate response to current antidepressant drugs. Read more about <u>ABX-002</u> and the clinical trial in the press release.

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I got into science because it provides a way to create something new that has practical value that can improve quality of life. There is nothing more gratifying than creating a new medicine that can improve quality of life for patients in need.



Tom Scanlan

Addressing maternal mental health

Roughly one in four women suffers from mental health disorders during or after pregnancy. But fewer than 15% of these women receive treatment, and mental health issues are the leading cause of maternal death in the U.S. <u>Ellen Tilden, Ph.D., CNM, FACNM</u>, associate professor of nursing in the OHSU School of Nursing and a certified nurse mid-wife at OHSU's Center for Women's Health, wanted to improve care for these patients and see if there was a better way to provide mental health support during and after pregnancy.

Tilden and her colleagues designed a mindfulnessbased cognitive behavioral therapy program to prevent depression during pregnancy and the post-partum period. Tilden now serves as the chief scientific officer at Center M, an OHSU startup company that is developing an app-based version of this training to improve access, availability and appeal of mental health resources for women during pregnancy.

Tilden was awarded funds from the Biomedical Innovation Program in 2020 and Center M initiated pilot phase studies of its program in 2021. In August 2023, the company was awarded a Small Business Technology Transfer, or STTR, grant for \$416,000 by the National Institutes of Health to continue app development and pilot testing.

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The ultimate goal of this work is to improve the physical and mental health of people during pregnancy, birth, and early parenting. While my primary research focus is on maternal health, better maternal health also directly benefits children and families.

Ellen Tilden (OHSU/Christine Torres Hicks)

Biomedical Innovation Program: A Decade of Supporting Early OHSU Innovations

University research has always been at the forefront of biomedical innovation. But getting these early concepts through the long journey of product development—including validation, clinical testing and regulatory approval—is arduous.

The Oregon Clinical and Translational Research Institute, or OCTRI, created the Biomedical Innovation Program, or BIP, in 2013. OCTRI serves as a catalyst for scientific collaboration and translation of biomedical advances into the community—in Oregon and beyond. With support from OCTRI and OHSU Innovates, the BIP provides funding, project management, mentorship and entrepreneurial education to develop early-stage OHSU technologies. The goal: to help jump-start technologies' journey down the path to societal impact.

Since its inception, the BIP has supported an average of five new projects a year with a focus on drug development, diagnostics, software and medical devices. The BIP provides critical funding for initial proof-of-concept work, which has helped project teams secure more than \$37 million in follow-on funding. Two examples of recent successes are highlighted here and come from some of the very first projects to receive BIP funding.

Preventing nerve damage in surgery with new fluorescent agents

Nerve damage during surgeries affects 25 million patients annually and can cause lifelong pain, loss of function and high costs for follow-on treatment and pain management. OHSU startup <u>Trace Biosciences</u> is developing Nerve Trace, a novel fluorescent contrast agent to help surgeons see nerves during surgery and avoid damaging them. The fluorescent agents were designed in the laboratory of <u>Summer Gibbs</u>, Ph.D., professor of biomedical engineering in the OHSU School of Medicine.

Gibbs and her team used BIP funds to optimize the fluorescent contrast agents for compatibility with existing clinical imaging equipment. Trace Biosciences was subsequently co-founded by Gibbs with Lei Wang, Ph.D., research assistant professor of biomedical engineering, and Connor Barth, Ph.D., senior research associate in the OHSU School of Medicine. In 2023, Trace Biosciences received investments from the Oregon Nanoscience and Microtechnologies Institute and the Elevate Innovation Gap Fund, and was awarded a \$4 million grant from the Advanced Research Projects Agency for Health. These funds will allow the company to continue development of its nerve-specific fluorescent contrast agents in preparation for its Investigational New Drug application with the Food and Drug Administration.

An improved dural closure device for spinal surgery

OHSU startup company NeuraMedica is on its way to providing surgeons with a better way to close the dura mater—the membrane covering the brain and spinal cord—during spinal surgery. Watertight closure of the dura mater is a difficult and time-consuming procedure.

To develop a better solution, former OHSU neurosurgeon Neil Roundy, M.D., teamed up with biomedical engineer and entrepreneur Rachel Dreilinger to acquire BIP funding to develop initial prototypes of an

innovative surgical clip that could quickly and securely close the dura.

Roundy and Dreilinger, a member of the Diné (Navajo) Nation, went on to co-found NeuraMedica, a rarity as a woman- and Native-owned and led medical device startup.

In 2022, the FDA issued clearance for NeuraMedica's dura clip, called DuraFuse. That clearance was a critical milestone in NeuraMedica bringing this innovation to the surgical suite.

The BIP played a critical role in the early stages of development for our bioabsorbable dural closure clip and applier technology. The funding allowed us to complete proof-of-concept work and submit two patent applications which led to additional follow-on funding and the eventual commercialization and FDA Clearance of our surgical device. The support and guidance of the BIP team was invaluable to our success!



Illustration of DuraFuse device closing the dura mater during spinal surgery.



Rachel Dreilinger



Designing the Next Generation of Medical Devices

OHSU clinicians and scientists are uniquely positioned to see medical procedures and patient care standards every day and wonder: "How could we do this better?" Many of these OHSU members are addressing this question head-on by designing new medical devices to improve providers' ability to deliver the best care possible to their patients.

OHSU team develops device to improve in-office assessment of tubal occlusion

Infertility affects 8% to 12% of couples trying to conceive. A leading cause of female infertility is occlusion of the fallopian tubes; however, current approaches to identifying tubal occlusions require expensive imaging equipment and specialized expertise, which is often not available in rural communities.

To address this need, Jeffrey Jensen, M.D., M.P.H., professor of obstetrics and gynecology in the OHSU School of Medicine, and his colleagues are developing a device to allow for low-cost assessment of tubal occlusions. The team's device could allow health care workers—including those who don't have medical degrees—to perform this assessment during a standard office visit, thereby reducing health care costs and improving access.

In 2022, the M.J. Murdock Charitable Trust awarded this team a Commercialization Initiation grant. The team is using the grant to clinically validate the device, in the hope that OHSU can help bring it to market to allow for improved fertility assessments in lowresource settings.



Imaging device may help detect necrotizing fasciitis without surgery

Necrotizing fasciitis—sometimes called "flesheating disease"—is a life-threatening infection of the skin and soft tissue, which can be very difficult to distinguish from other disorders. Currently, diagnosis of this condition often requires surgery, which is invasive and costly.

<u>Albert Chi, M.D., M.S., FACS</u>, OHSU associate professor of surgery, and Xiao-Yue Han, M.D., resident in general surgery in the OHSU School of Medicine, asked the question: "How could we do this better?" They started developing a technique that would enable diagnosis of necrotizing fasciitis without the extra costs and risks of surgery.

In early 2023, OHSU's Biomedical Innovation Program awarded funds and support to the research team, composed of Chi, Han and Whitney Menzel, research engineer in the OHSU School of Medicine. This award will allow the team to build a proof-of-concept hyperspectral imaging platform, which uses a broader spectrum of light, to diagnose necrotizing fasciitis. The goal is to continue developing the imaging device to help many patients avoid surgery, thereby eliminating invasive procedures and preserving critical operating room space for those who need surgery.



Xiao-Yue Han and Whitney Menzel (OHSU/Christine Torres Hicks)

ProMedix wins big at regional investment event

The OHSU startup company <u>ProMedix</u> gained the attention of investors this year at the 2023 Angel Oregon Life & Bioscience, or AOBIO, event. AOBIO is the premier Pacific Northwest bioscience investment event and is hosted by the Oregon Entrepreneur's Network in partnership with the Oregon Bioscience Association, the Oregon Bioscience Incubator/Oregon Translational Research and Development Institute and OHSU.

ProMedix is developing a device to measure how quickly blood refills small peripheral capillaries—called "capillary refill time"—to improve early diagnosis of sepsis. Sepsis is the body's extreme reaction to an infection and can cause organ failure and death. About 30% of patients who get sepsis do not survive. Quick diagnosis is critical to prevent major health problems. ProMedix was co-founded by <u>David Sheridan, M.D.</u> and <u>Matt Hansen, M.D., M.C.R.,</u> associate professors of emergency medicine in the OHSU School of Medicine.

At the AOBIO event, ProMedix recently took home the top angel investment award of \$185,000, as well as an additional investment of \$75,000 from the Oregon Nanoscience and Microtechnologies Institute. ProMedix was also the national first place winner of the "Project MedTech" Conference at the Cleveland Clinic in August 2023.



Steven Baker, chief technical officer of ProMedix and adjunct professor of emergency medicine in the OHSU School of Medicine, and Scott Filer, chief executive officer of ProMedix at the AOBIO finale. (Jason DeSomer/Whatever.Photo)

Discovering New Cancer Treatments

OHSU's Knight Cancer Institute experts are making powerful discoveries that change cancer patients' lives. These leading-edge scientists are studying how to optimize cancer treatment protocols by leveraging the body's own immune system, and moving these innovations into clinical trials. The ultimate goal is to develop more effective and less toxic treatment strategies for people with cancer.



Improving CAR T-cell therapies

Over the past decade, immunotherapies have emerged as a promising new cancer treatment. Immunotherapies rely on the body's own immune cells to target and kill cancer cells. One such treatment involves genetically modifying immune T-cells, a type of white blood cell in the body, to better detect cancer with the use of "chimeric antigen receptors," or CARs. CARs detect and then bind to specific proteins on the surface of a cancer cell, which helps the modified T-cells kill the cancer.

<u>Robert Eil, M.D.</u>, assistant professor of surgery and cell, developmental and cancer biology, in the OHSU School of Medicine, OHSU Knight Cancer Institute, and his colleagues are exploring new strategies that could make CAR T-cell approaches even more effective in killing cancer cells. One innovative approach from the Eil team includes genetically modifying CAR T-cells to work better in the cancer environment. This approach has the potential to improve the efficacy of current treatments.

Eil and his colleagues are also working on strategies that would limit the off-target effects of CAR T-cells, which include damage to healthy tissues surrounding the tumors. The research team received funding from the Biomedical Innovation Program in August 2023 to further validate this CAR T-cell strategy. If successful, those improvements could mean the therapy could be applied to treat solid tumors. <u>Read more</u> about Eil's innovative research.

Getting SMMART about fighting cancer

The OHSU Knight Cancer Institute is pioneering a state-of-the-art precision oncology program that is benefiting patients and attracting industry collaborators. SMMART, which stands for Serial Measurement of Molecular and Architectural Responses to Therapy, is a novel platform that allows clinicians and scientists to collaboratively track a patient's tumor response to treatment over time. A patient's clinician can then use this information to recommend the best treatment drug or combination therapy—most often using two or more drugs—for that patient. This allows for more individualized care for OHSU patients with cancer. It also allows scientists to better understand why certain tumors do not respond to a drug, or become resistant over time.

Major therapeutics companies, including AstraZeneca and Lilly, are understanding the benefits of this one-of-a-kind approach and have already begun collaborating with the Knight Cancer Institute's SMMART Clinical Trials Program. Ultimately, this biomarker-driven protocol could allow drug developers to identify new patient populations who would benefit from their drugs. The SMMART platform will also provide OHSU patients with unprecedented and rapid access to the best drug for their cancer.



Tumor cells stained with antibodies. Cyclic immunofluorescence image by Dave Kilburn and Gordon Mills, M.D., PhD.

Helping At-Risk Youth

OHSU Doernbecher Children's Hospital excels in pediatric and adolescent medicine. Our health care teams provide the best and most advanced care possible to help children thrive. And because of their expertise, our clinicians also continually search for ways to improve the health care system for all children.

Two innovative projects highlight that work: one targets the social drivers of health, to help children with the life challenges that can hurt their health, and the other is developing a wearable device that can detect early signs of suicide risk in teens. Innovative OHSU program targets social drivers of health in pediatric patients

When families experience significant life challenges like houselessness, transportation issues, language barriers and other social determinants of health, complex medical conditions can become nearly impossible to manage. And these complex conditions almost always lead to significant deterioration in health and hospitalizations. Michael Harris, Ph.D., professor of pediatrics and Kimberly Spiro, Ph.D., associate professor of pediatrics in the OHSU School of Medicine, OHSU Doernbecher Children's Hospital, saw an opportunity to help these patients by designing a program that directly intervenes in these life challenges—also known as social drivers of health.

Harris and Spiro are the co-founders of Novel Interventions in Children's Healthcare, or <u>NICH</u>, at Doernbecher. NICH assigns a staff member, known as an interventionist, to help address the lived experience of young people with complex and chronic medical conditions, and their families. The program brings resources directly to families, assists with navigating the disjointed health care system, and addresses the social factors that impact health.

CONTINUES ON NEXT PAGE



Developing, implementing and testing interventions to address the social drivers of health are very much needed. We also do this work because it's the right thing to do—taking care of our most vulnerable.



Michael Harris

Since its inception, NICH has reduced hospitalizations, emergency room visits and associated health care costs among program participants. Most importantly, young people enrolled in NICH have the resources and support to manage daily life challenges, along with their health. These successes have led to the expansion of the program to Stanford University and the University of California San Francisco.

In June 2023, NICH was one of three winners—among 60 applicants—of the American Diabetes Association's first Innovation Challenge pitch competition. Harris pitched the program to an in-person and online audience of more than 1,000 people, highlighting the program's success at reducing medical expenses and hospitalizations for pediatric patients with type 1 diabetes.

The NICH team is currently working with OHSU entrepreneurs-inresidence to explore expanding the program to other geographic locations.

<u>Read more</u> about NICH and watch the winning pitch.



NICH team members from left to right: Michael Harris (director), David Wagner (research director), Aurora Silva-Ramirez, (interventionist), Kristen Torres (Ph.D. student), Sydney Melnick (research assistant). (OHSU/Christine Torres Hicks) OHSU works with Analog Devices to develop a wearable technology targeting suicide prevention in adolescents

Adolescent suicides and attempted suicides have increased significantly in recent years. <u>David Sheridan, M.D.</u>, associate professor of emergency medicine in the OHSU School of Medicine, has long experienced this first-hand. He and his colleagues continue to deal with the challenges of effectively treating in the emergency department adolescents who've attempted suicide.

Over time, Sheridan and his colleagues began developing an innovative approach to following the mental health of potentially suicidal teens outside the hospital. The work is built on the team's research, which identified specific physiological changes that often come with increasing thoughts of suicide. Ongoing investigation aims to measure these physiologic signals and apply advanced machine learning analytics to process the signals into clinically relevant information.

Sheridan and his colleagues have

teamed up with global semiconductor company Analog Devices, or ADI, to develop a wrist-wearable technology that aims to detect these physiologic changes and provides a monitoring system for suicidal thoughts and possible actions. In parallel, Bonnie Nagel, Ph.D., professor of psychiatry (clinical psychology) and behavioral neuroscience in the OHSU School of Medicine, is working with Sheridan on a study using the wrist-wearable technology in adolescents who are at high risk for attempted suicide. The study's goal is to better understand which biometric signals might be early warning signs for possible suicide risk.

This technology could ultimately allow for medical interventions before individuals reach a crisis point of actually attempting suicide. It could also provide a system for remote monitoring of at-risk teens at home, where the environment is often less stressful than the emergency department. <u>Read more</u> about this research and collaboration.

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The ultimate goal of my team's research is to better understand what factors place youth at greater risk for mental health problems and in turn, develop prevention and treatment strategies to mitigate those factors and thereby improve lives.



Bonnie Nagel (OHSU/Studio McDermott)



David Sheridan demonstrates the wrist-wearable device that measures a person's heart rate. (OHSU/Christine Torres Hicks)



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Includes invention disclosure and presidsclosures.

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