When
good health

is no longer
good enough.

DIREF
DETROIT INTERNATIONAL RESEARCH & EDUCATION FOUNDATION

Imagine your children and grandchildren living in a world in which chronic disease and traumatic injuries can be fully cured, a world in which their susceptibility to degenerative conditions like Alzheimer's and heart disease will have been removed before they are even born.

Imagine your own degenerative conditions being routinely cured, leaving you — in your seventies, eighties, nineties, and beyond — skiing and mountain-biking with your spouse, your children, and your grandchildren.

Sounds like science fiction:

Regenerate organs and other
body parts damaged by disease
or injury.

Cure existing conditions and prevent future
conditions, by correcting genetic mistakes.

Make drugs that will work —
for you and you alone.

End the distressing use of
animals in medical, drug, and cosmetics
research.

Slow the aging process.

But it's science fact.

Does living longer mean living better?

The 20th century saw extraordinary progress in medical science. Vaccines, antibiotics, more effective cancer therapies, and improved treatments for traumatic injuries enabled us to survive situations that used to kill us.

But while these therapies of “modern medicine” allow us to live with injuries and degenerative diseases, they seldom repair or cure them completely. We may survive catastrophic injuries, but at what cost to our quality of life?

As we grow older and become increasingly susceptible to chronic illnesses and degenerative diseases, frightening conditions such as Alzheimer’s, Parkinson’s, heart disease, diabetes, kidney disease, and cancer all occur more frequently as we age.

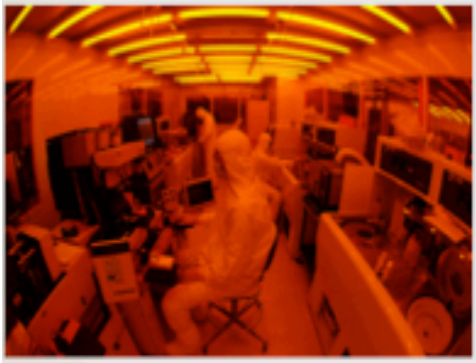
How “golden” are years spent in the tightening grip of mental or physical disability?

In fact, the golden years really *will* be golden, thanks to the transition from 20th century modern medicine to 21st century postmodern biomedicine.

The question is not If, but When?

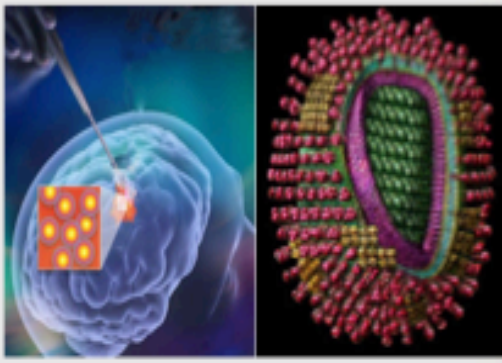
And that’s a question you can answer.

With your help, and the revolutionary work of the scientists at our affiliated biomedical institutions, that promising future can be here sooner than you think — for you, your children, and your grandchildren.



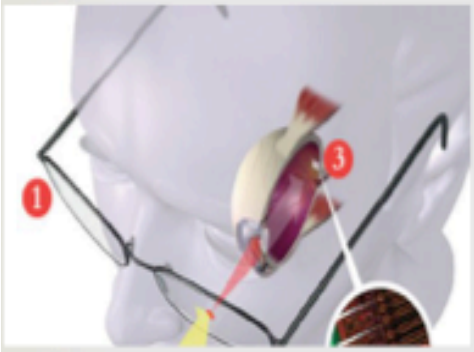
Micro & Nano Devices

Robotics



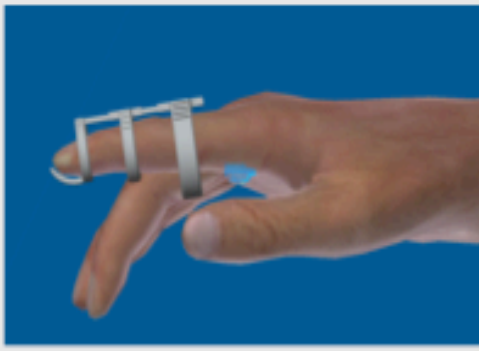
Pathogen & Cancer Detection

HOW?



Retina & Visual Cortex Implants

Bioimplants



Human interface

You *can* help make it happen.

DIREF provides grants of between $15-30,000 to support postmodern biomedical projects. In some cases, they serve as seed grants for a promising idea. In others, they help bridge the “valley of death” between public sector financing and private sector funding of technologies that have commercial promise.

The Surgical Innovations Program of the Michael and Marian Ilitch Department of Surgery at Wayne State University School of Medicine is one such DIREF-supported institution. The cornerstone of the Program is the Smart Sensors and Integrated Microsystems Labs — the **SSIM** Labs, a cutting-edge institution with a publicly funded pipeline of commercially valuable innovations that DIREF aims to help get into the hands of doctors for the benefit of patients.

We seek your support for DIREF’s grant and other programs.

DIREF believes that medical science must move beyond simply treating the symptoms of disease and disability. As the population ages, baby boomers are reaching their sixties and seventies and the incidence of degenerative and age-related illnesses is rapidly accelerating. Unless something changes, we will soon be confronting a major health crisis.

DIREF is dedicated to nurturing institutions and scientists developing technologies that will lead to a whole new perspective on what constitutes quality of life.

DIREF takes the academic knowledge, rigor, and excellence of the institutions it supports and adds the leanness and agility of an independent entrepreneurial organization able quickly to make, adapt to, and capitalize on new discoveries in postmodern biomedicine.

We think out-of-the-box thinking is the best way to generate breakthroughs.

The tools and methods we support are different.

From mice to cats, and from dogs to monkeys, animals are the misfortunate models of choice in most labs in the U.S. and indeed the whole world. They have been important to medical research, but SSIM has begun to develop kinder, gentler, and scientifically better ways.

First, it is close to perfecting a *bioreactor* – a biolab on a chip.

"The bioreactor represents a new paradigm for *in-vitro* analyses of biological processes, applicable to a wide variety of tissues or organ like structures including prostate, liver, breast, and brain. It can be built into artificial organs and used for cancer investigation and testing chemical mutagenic or carcinogenic problems (replacing animal studies), drug harvesting or development, and tissue grafts" says SSIM Labs founding Director Greg Auner, Ph.D.

Second, it employs the deepest, most advanced form of *machine learning* to model body systems and functions.

Third, it is the leading miniaturizer of *Raman spectroscopy* technology – a way of testing for cancer and other diseases and for bacteria and viruses. The ability to differentiate the latter will make a huge difference to the problem of antibiotics overuse.

Inside SSIM's Class 100 Cleanroom

No animal gets hurt by a bioreactor, deep learning algorithms, or Raman spectroscopy. True, we still need animal research today—but we can begin to eliminate it.

In traditional institutions (as most are) individual scientists run their own labs with their own teams. SSIM takes a different approach. All researchers share the sophisticated labs and equipment depending on their project needs and its stage of development, though scientists expert in a particular instrument may participate in multiple projects.

All projects start in the Design Lab, where doctors mingle and brainstorm ideas with scientists and engineers. Sometimes, the engineers spend time in the hospital operating rooms to better understand issues facing surgeons. To help them visualize projects, they have access to a holography pod, a 3D printer, a supercomputer (through an agreement with Argonne National Labs), and of course unlimited general computing and printing resources.

When a project design has been sufficiently specified, it moves on to one or more of SSIM's labs.

Raman Lab with (among many other things) various Raman systems integrated with super resolution imaging and atomic force microscopy, fully automated immunoassay machines, and a gene-sequencing system for genetic analysis in real-time.

Microfabrication Lab for building microfluidic chips, micro Raman systems, optical components, and more. The lab includes machines that can fabricate human-designed materials never seen in Nature.

Class 100 cleanroom for culturing human, bacterial, and animal cell lines with the highest levels of safety.

Bio-integration Lab (with integrated class 1000 cleanroom)

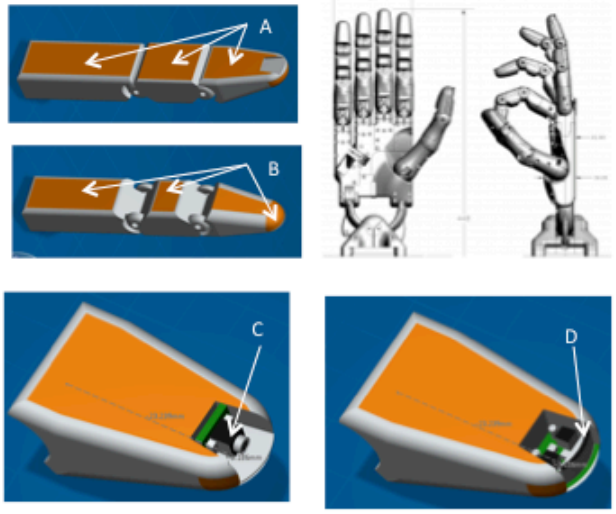
Characterization Lab, where an atomic force microsope (AFM), nuclear magnetic resonance (NMR) and X-ray photoelectron spectroscopy (XPS) machines, and other technologies enable materials to be understood and exploited at atomic scales.

Design Lab with computational tools for Raman analysis including "deep learning" artificial intelligence algorithms for real-time identification of pathogens and toxins from Raman signatures.

The research DIREF supports may sound like the stuff of science fiction. But it is real, and it puts within our reach technologies that increase lifespan, optimize health, and delay or potentially eliminate the onset of age-related diseases.

The opposite page lists just a few current DIREF-supported projects.

Shadow Robotic Hand Fingertip Sensors



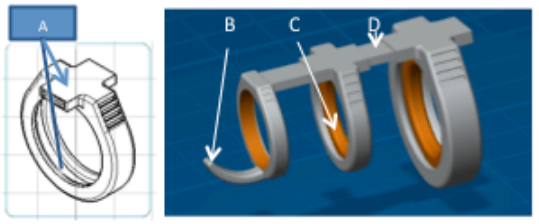
Features:

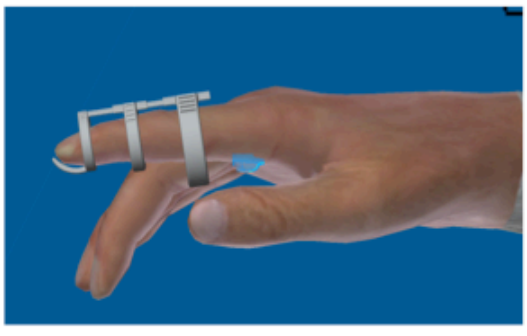
- Piezoelectric haptic sensors on robotic finger (A Top View) (B Bottom View)
- Fingertip Camera System (C)
- Fingertip Ultrasound System (D)

Piezoelectric Haptic Feedback Ring System

Features:

- Two Piezoelectric haptic feedback actuators per ring (A)
- Finger tip actuator (B)
- Finger sizing flexible inner ring (C)
- Flexible shape memory alloy wire actuators for force feedback (D)





Some exemplary projects you could help advance with your gift:

Rapid Influenza Detection System (RIDS): A portable detection device providing accurate diagnosis, and strain-type, of flu within less than 30 minutes.

Helmet-Integrated Neurospinal-Hydration Sensor: Measures the force of blows to the brain and the state of hydration of the wearer. A related **mTBI Biomarkers project** is investigating blood markers that would reveal mild traumatic brain injury (mTBI), enabling treatment before further hidden damage is accrued.

Brain Implants: Wirelessly powered flexible microelectrode arrays stimulate discrete populations of neurons and provide real-time wireless feedback via high frequency magnetic field transmission. This project is in collaboration with Henry Ford Health System's Detroit Institute of Ophthalmology.

Cardiac Pump: Will provide 20% cardiac assist for patients with congestive heart failure and other cardiac abnormalities. Current pumps damage blood cells, leading to thrombosis. The pump under development will prevent thrombosis by utilizing a unique geometry and pumping actuation mechanism.

Shadow Hand: Attaches to a surgeon's fingertips to give a sense of touch during robotic surgery.

Automated Hepatic Blood Pressure Regulating Device: Regulates blood flow automatically to a transplanted liver lobe. This will allow the use of living donor small lobe transplant instead of deceased donor livers, which are in short supply.

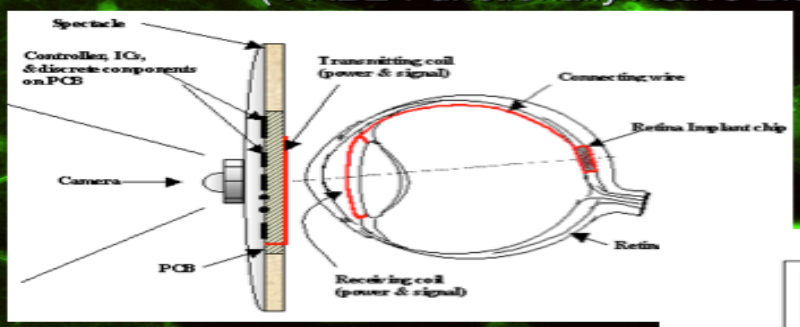
Oriented neuronal cell growth on micropatterned substrates

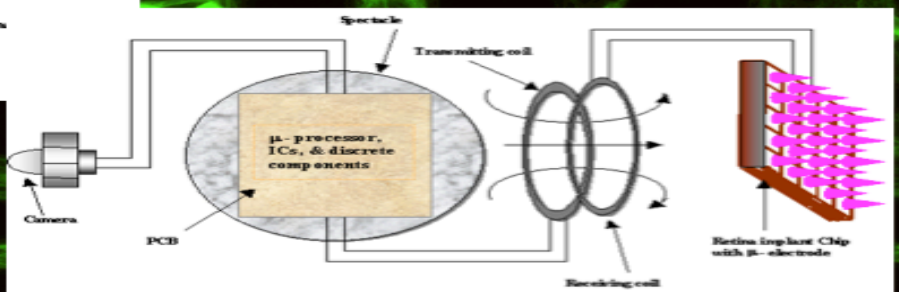
Most of us know someone who has suffered from the pain and disability of nerve damage. It has many varied causes, including diabetes and cancer treatment using chemotherapy. The symptoms can be truly debilitating, ranging from numbness or intense pain to loss of physical coordination and mobility. Worst of all, nerve damage caused by chemotherapy may force the termination of life-saving treatment.

DIREF supports an SSIM project that has already succeeded in guiding neurons to grow in precise patterns such as those shown above and below.

FABE based prototype for the neural stimulation system

(FABE-Functionally Active Biocompatible Encapsulation)





Other DIREF programs:

To promote and foster international research into surgical oncology, DIREF provides fellowships and participates in surgical oncology research conferences as follows:

- A Detroit Fellowship, established in association with the Indian Association of Surgical Oncology. It provides stipends to cover accommodation and living expenses for five international physicians, who come to Detroit to undertake advanced studies in oncology at the Karmanos Cancer Institute.

- Participation in international conferences including the annual Indian Association of Oncological Surgery Conference and an annual conference on surgical oncology that rotates between hospitals in Curitiba, Recife, and Fortaleza, Brazil.

At the leading edge of postmodern biomedical research.

The transition from modern to postmodern medicine is marked by acceleration in both demand for, and supply of, treatments and cures. Demand is increasing as populations grow and more people live longer — but do so often with debilitating disease. Supply is accelerating because institutions like DIREF are making it happen.

DIREF supports institutions at the leading edge of this important work — postmodern biomedical research institutions focusing on meeting the accelerating demand not only for new, unconventional approaches to treating and preventing disease but also for functional enhancements that make people superhealthy.

The outstanding faculty at our supported institutions came because they, too, believe that the unconventional approach is the quickest path from research to cures.

Visionary leadership:

J. Edson Pontes, M.D. is a pioneer in the diagnosis and treatment of prostate cancer. He has served at the Department of Urology (Chair) at Wayne State University School of Medicine, the Karmanos Cancer Institute, the Detroit Medical Center (as a surgeon and as Head of International Services), the John A. Dingell Veterans' Hospital, and as director of urologic oncology at both the Cleveland Clinic and Roswell Park Cancer Centers. He is internationally recognized as a specialist in genitourinary cancer surgery, and treated French President Francois Mitterand in the 1990s. Dr. Pontes is chair of DIREF.

Donald Weaver, M.D. is Chair of the Michael & Marian Ilitch Department of Surgery at Wayne State University School of Medicine and Surgeon-in-Chief for the Detroit Medical Center. He is an active clinical surgeon with expertise in surgical oncology and minimally invasive surgery. He has traveled extensively abroad, particularly India, the Middle East, and Brazil for workshops, lectures and activities of charity. Dr. Weaver is vice-chair of DIREF.

Gregory W. Auner, Ph.D. is the founder and director of SSIM. He has over 20 patents. Dr. Auner's vibrant energy and Raman-laser-like focus on finding solutions to the serious health problems of the future, his creative strategies and forceful advocacy have brought millions of dollars of new funding and brilliant experts in bioengineering to the institution. Those dollars have led to discoveries and inventions that are having a significant impact on human health issues, from cancer to flu and from biopsies that don't need the patient to be cut open, to bringing the benefits of robotic surgery to small children.

David Ellis, M.S. is a health futurist. He was chief futurist for eight years at the Detroit Medical Center under Mike Duggan, now mayor of a resurgent Detroit, and was for many years a columnist for the American Hospital Association publication *Hospitals & Health Networks Daily*. Besides *Technology and The Future of Health Care: Preparing for the Next 30 Years*, which won the 2000 HIMSS Book of the Year award, he is the author of *Deus ex Machina sapiens: The Emergence of Machine Intelligence*. Mr. Ellis is DIREF's executive director.

The DIREF Board.

Also serving on DIREF's Board are:

James Binson, Chairman of Binson's Medical Equipment & Supplies, a multifaceted supplier of durable medical equipment and supplies that enables people to meet their medical needs at home.

Susan Brueckman, regional manager of corporate affairs and chief of staff at Huntington National Bank. Previously chief of staff at the Detroit Medical Center, Ms. Brueckman serves or has served as a trustee of the Michigan Roundtable for Diversity and Inclusion, a director of the Arab American and Chaldean Council, and as a Board member of the Detroit Golf Foundation.

Keith Crain, Chairman of Crain Communications, known internationally for his contributions in both the automotive and publishing industries. His firm's publications include *Modern Healthcare, Advertising Age, Automotive News* and *Crain's New York | Chicago | Cleveland | and Detroit Business*. Mr. Crain's services to the automotive world were recognized by his Induction in 2014 into the Automotive Hall of Fame, the single greatest honor in the automotive business. Mr. Crain is chairman of the board of the College for Creative Studies and sits on the boards of The Concours d'Elegance of America, The Detroit Metro Convention & Visitors Bureau, Downtown Detroit Partnership, Gilmore Car Museum, and the Automotive Hall of Fame.

Janet Damm, who serves as DIREF's secretary and treasurer. She has worked for over 20 years as an executive assistant in various posts at the Detroit Medical Center and most recently in the Michael and Marian Ilitch Department of Surgery at Wayne State University School of Medicine.

Orlando Padilla, President & CEO of *Padilla Networks LLC,*

which provides global public policy, strategic planning and issues management expertise on domestic and international business topics. He has served on numerous boards. Mr. Padilla retired from General Motors as Global Senior Director, Public Policy, Corporate & Government Relations. He was named by Hispanic Business Magazine as one of the most influential Hispanics and listed on the Corporate Elite – Top 100 Hispanic Executives.

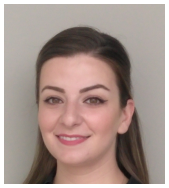
Extraordinary scientists.

Nabeel Alsaab has Master's degrees in Electrical Engineering and Engineering Systems Management. His extensive programming and project management skills are applied to the design of smart sensors.

Zachary Auner has a degree in Physics with a minor in biology. His area of research is Raman spectroscopy with a focus on the identification and mechanisms of antibiotic resistant bacteria.

Brandy Broadbent holds degrees in biology, military studies, and teaching. She flew helicopters in the US Air Force for 9 years before pursuing her PhD in biomedical engineering. Brandy's research interests include micro-fabrication and machine learning.

Michelle Brusatori conducts basic and applied research related to the development of novel materials, methods, and prototype devices for automotive, environmental and biomedical applications.



Angela Elias has degrees in Biochemistry and Psychology, and is currently work on micro-fabrication of retinal implants for patients with Retinitis Pigmentosa and Age-Related Macular Degeneration.

Barbara House is the SSIM Program Coordinator/ Research Assistant in the Department of Surgery. Barbara has a Master's in Mathematics and experience working with Raman spectroscopy for pathogen detection and experience in cell culturing.

Changhe Huang has a PhD in Physics and over 30 years' experience in advanced materials and innovative device research, including modeling & simulation, automation, and data processing. Dr. Huang is also experienced in root cause analysis.

Kiran Koya has a Phd in Molecular Biology. His current projects include using Raman spectroscopy to diagnose diseases; identify a blood biomarker for traumatic brain injury, identify C. diff. toxins in blood and stools; and differentiate tumor from normal breast tissue.

Katlyn Mehne has degrees in Chemistry and Chemical Engineering. She worked in industry for 4 years on chemical formulation and development engineering in the coating industry and the automotive industry.

David Sant is a Senior Engineer with 20 years experience in electronics and control systems design using state-of-the-art EDA (Electronic Design Automation) Software on projects such as smart muscle stimulators. Current work includes a portable, ruggedized Raman spectrometer.

Micaela Trexler is pursuing her PhD in Biomedical Engineering. She uses Raman spectroscopy to study viral pathogens. She has used synthetic biology methods to improve T-cell survival in the tumor microenvironment and to develop devices for cardiac surgery.

Christopher Thrush has 40 years of practical experience developing sensors for automotive and medical applications. He uses microfabrication, material science, prototyping, analytical chemistry, and spectroscopy to characterize physical properties of a system.

Sally Yurgelevic is a Research Scientist with a Master's in Chemical Engineering. Her specialty is biological spectroscopy. She is responsible for coordinating all spectroscopy experiments in the SSIM labs. She came to SSIM after working for the Delphi Research Laboratory.

In addition to its core scientific staff SSIM employs graduate assistants and hires professional scientists with skills needed for specific projects on a temporary/part-time basis.

HealthQuake SUMMIT

The Convergence of Medicine and Technology

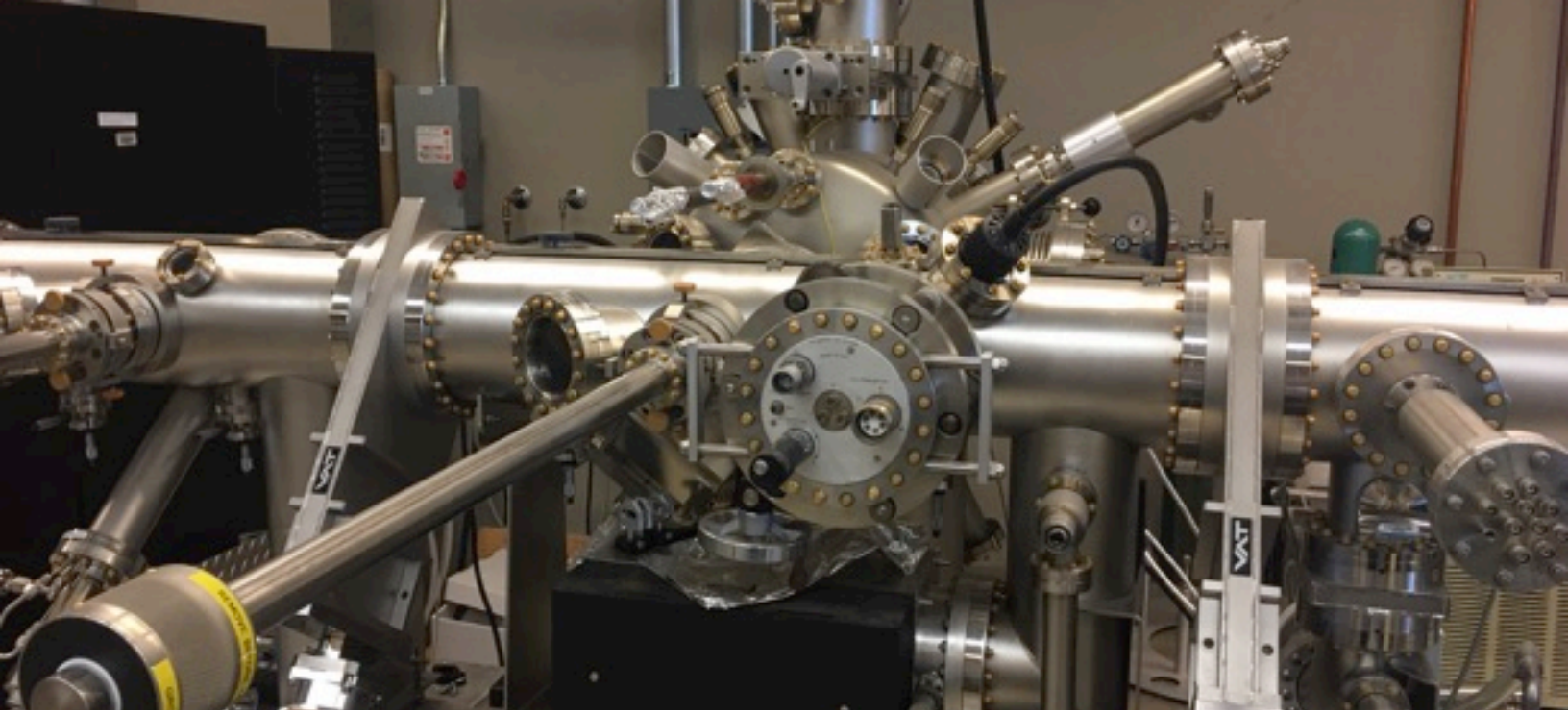
REPORT 2017

Educating the world about the earthquake in healthcare.

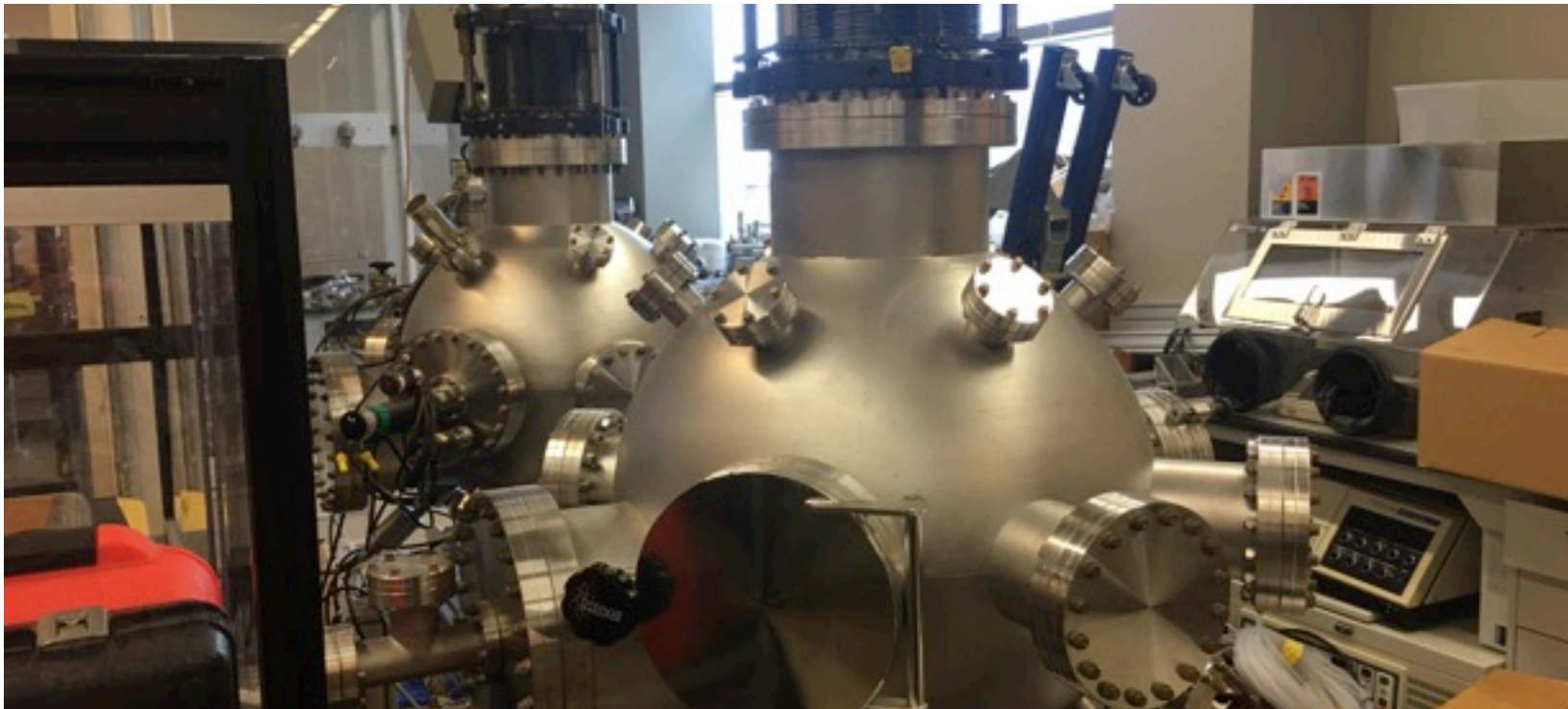
In 2017 DIREF held the first by-invitation-only Summit meeting of 30 delegates from around the nation who discussed the current and future state of healthcare in the context of the convergence of health and technology through the new forms of medicine collectively labeled *postmodern*.

Taking *regenerative medicine* as representative of postmodern medicine as a whole, delegates discussed its potential impacts and implications for health policy, practice, business, research, commercialization, and education. By design, the delegation represented all of these sectors.

HealthQuake 2017 was a great success. With your help, we would like to establish it on a sound annual basis.



We need you to be bolder and dream bigger than the corporations and government agencies that have traditionally funded biomedical research.



You can choose to have a profound impact on countless lives ... now and in the future.

DIREF's main goal is to accelerate the transfer of important discoveries from the lab and into the hands of physicians and patients. Your generous support will enable us to:

- **Promote and foster international research into the future of medicine and surgery in general, and surgical oncology in particular through participation as part-organizers/partners in international medical futures and surgical oncology research conferences.**

- **Advance the care of the surgical patient through medical/surgical device development, personalized cancer therapies, surgical simulation, and molecular simulation.**

- **Enhance the prestige and productivity of biomedical research in southeast Michigan by identifying, supporting and promoting the most promising innovative research at its most critical yet financially most neglected stage—proceeding from concept to concrete proposal with potential for next-level funding.**

- **Benefit the world in general and the greater Detroit and southeast Michigan community in particular through the establishment of international educational and research facilities, relationships and partnerships, both in the public and private sectors.**

We are on the brink of making revolutionary improvements in human health.

But we can't succeed without your partnership and support.

Together, you and DIREF can be a catalyst for creating superhealthy human beings.


Help us turn
health into
superhealth.
Invest in a
better future
for you, your
children,
and generations
to come.

DIREF is an independent 501(c)(3) non-profit institution dedicated to improving human health and well-being through research, education, and ventures that transform modern medicine into postmodern medicine; health into superhealth.

Please contact:

David Ellis
Executive Director

300 Riverfront Drive #21E
Detroit, MI 48226

313.405.6054

www.diref.org

DIREF
DETROIT INTERNATIONAL RESEARCH & EDUCATION FOUNDATION