



**THE POWER OF COLLABORATION
TO CHANGE MEDICINE**
2008 Annual Report

CIMIT[®]

Center for Integration of Medicine
& Innovative Technology

CIMIT OVERVIEW

**CREATING TECHNOLOGY SOLUTIONS
FOR HEALTHCARE**

**SUPPORTING TRANSLATIONAL
RESEARCH**

IMPROVING PATIENT CARE

FINANCIAL HIGHLIGHTS

Our Mission

In the domain of devices, procedures and clinical systems innovation, CIMIT's mission is to **improve health care** by seeking, selecting and supporting teams of clinicians and technologists.

We serve the patient of the future by facilitating the efforts of clinically-based investigators.

If we are to improve patient care, we need innovative healthcare solutions, out of the box thinking and new approaches to collaboration. And, this holds true for all healthcare settings: at home, in the hospital or on the battlefield.

Breakthroughs enabled by multidisciplinary, inter-institutional collaborations of clinicians, engineers and technologists are accelerating the pace of change and encouraging a growing convergence of medical devices, pharmaceuticals and delivery systems. These convergences are creating powerful new opportunities in medicine. CIMIT initiates and accelerates change in healthcare by supporting the ideas of innovators and their collaborators in academia, government and industry.

CIMIT is unique. A consortium of teaching hospitals, universities, engineering schools and science laboratories, CIMIT finds, funds and facilitates innovative technology solutions to clinical problems with emphasis on care for the injured soldier. By leveraging the expertise and experience of the clinical and engineering community of greater Boston, the ever expanding CIMIT network is catalyzing powerful changes in medicine and in how care is delivered.

Our mission is based on the core belief that better healthcare for people worldwide is within our reach and that technology can and should be a part of the solution.

A handwritten signature in blue ink that reads "John Parrish". The signature is fluid and cursive, with the first name "John" and the last name "Parrish" clearly legible.

John A. Parrish, MD
CIMIT Executive Director

CIMIT OVERVIEW

Mission & Vision

To improve patient care by facilitating collaboration among scientists, engineers and clinicians to catalyze the discovery, development and implementation of innovative technologies, emphasizing minimally invasive approaches.

CIMIT Priorities

- » **Seek solutions to unsolved clinical problems** by integrating the solution-rich environment of engineering and science centers and the problem-rich environment of our academic medical centers.
- » **Build a strong and vibrant CIMIT community** by finding and facilitating early stage ideas for devices, procedures and clinical systems.
- » **Contribute to improved patient care** through innovative leadership practices that reward performance through teamwork.
- » **Achieve financial sustainability** by diversifying funding sources, and employing financial and operational best practices.
- » **Support CIMIT investigators** by facilitating transition from idea to implementation including commercialization “hand-off.”

Innovation Leadership

PROGRAM LEADERS form the clinical nucleus of the CIMIT community. Program Leaders are visionaries, subject matter experts, accomplished innovators, mentors and compassionate clinicians. An authority on a given medical specialty, a Program Leader recruits new investigators and serves as head coach for the teams of investigators within each program area, imparting advice and offering encouragement as researchers explore the science for which they have received a CIMIT grant.

SITE MINERS are unique to the CIMIT network. They seek out, encourage and engage emerging innovators who show a passion for transforming patient care through technology. Boston’s teaching hospitals are a mecca for creative, passionate doctors, technologists and clinical researchers. So how does CIMIT find and fund those clinicians with the most promising ideas? Through its network of Site Miners.

Appointed as faculty within each consortium institution, Site Miners understand the unique complexities and cultures of their organization. They help innovators successfully navigate through any organizational challenge that might arise. A Site Miner is a scout, mentor, project manager, dealmaker, visionary and reality tester. These individuals network with other Site Miners to connect clinicians and engineers who might not otherwise meet.

The CIMIT community relies on the skills and expertise of many. Supporting this novel approach to translational research is a team of commercialization and business experts who are the full-time **CIMIT FACILITATORS**.

CONSORTIUM INSTITUTIONS

- » Beth Israel Deaconess Medical Center
- » Boston Medical Center
- » Boston University
- » Brigham and Women’s Hospital*
- » The Charles Stark Draper Laboratory*
- » Children’s Hospital Boston
- » Harvard Medical School
- » Massachusetts General Hospital*
- » Massachusetts Institute of Technology*
- » Newton-Wellesley Hospital
- » Partners Healthcare
- » VA Boston Healthcare System

*Founding Members

INTERNATIONAL AFFILIATES

- » University of Manchester, UK

2008 YEAR IN REVIEW: STRATEGIC GOALS & ACCOMPLISHMENTS

Clinical & Technology Programs

- » 3 new Programs — Inhalation Technology, Traumatic Brain Injury & Post Traumatic Stress Disorder
- » \$5.7 million in grants to 29 multi-institutional teams
- » The Edward M. Kennedy Award for Healthcare Innovation given for an imaging and nanoparticle delivery system to accurately identify and treat cancer metastases during surgery
- » \$150,000 CIMIT Prize for Primary Healthcare received 78 proposals from 44 engineering schools in 21 states
- » 6 Young Clinician Grants were given for \$50,000 each

CIMIT is a wonderful concept and made an enormous difference to my career and to the development of a state-of-the-art experimental cardiac electrophysiology lab at the MGH. I hope that CIMIT continues to flourish and expand to all major university hospital campuses.

David Keane, MD
Director, Cardiac Arrhythmia Service
St. Vincent's University Hospital, Dublin, Ireland

Technology Implementation & Commercialization

- » ASTM adoption of a standard for medical device interoperability and validation of the Integrated Clinical Environment
- » Actively pursuing 8 licensing options and spin-out companies for over ten products and/or platform technologies
- » Aggressively exploring commercialization strategies for simulation products for first responders (COMETS & EVE)
- » Developing a mature prototype for wireless handwashing alert system (jointly with DoD and VA) to decrease hospital-acquired infections
- » Developing a mature prototype with ST+D, a Northern Ireland company, for a miniaturized, wearable wireless device to monitor patient vital signs in traditionally unmonitored low-acuity settings

Convening, Facilitating, Collaborating

- » 650 individuals attended the 2008 CIMIT Innovation Congress, "Forging Partnerships in Healthcare"
- » 3 symposia: CIMIT Epilepsy Innovation Summit, CIMIT Cardiovascular Course, Trauma & Casualty Care Symposium
- » Participated in "War and Medicine," a UK exhibit sponsored by Wellcome Trust
- » Established affiliate relationships with MIMIT, a CIMIT-like consortium in Manchester, UK
- » Facilitated 137 ongoing collaborations, guiding and coaching progress toward commercialization
- » Named 9 Medical Engineering Fellowships



More than 600 attendees listened to keynotes at the 2008 CIMIT Innovation Congress, "Forging Partnerships in Healthcare"

Sustainability & Fundraising

- » VA Boston Healthcare System joined CIMIT Consortium
- » Secured multi-year financial support of CIMIT operations by consortium institutions
- » \$2.5 million gift from the Gelfand Family Trust
- » \$1.5 million gift from Air Liquide
- » \$195,000 sponsorship support for the 2008 CIMIT Innovation Congress
- » \$330,000 gift from Johnson & Johnson

CREATING TECHNOLOGY SOLUTIONS FOR HEALTHCARE

Program Overview

CIMIT Programs represent a balanced portfolio of multidisciplinary and inter-institutional research projects in every phase of innovation – from idea to adoption into clinical practice. Directing these programs are clinical or technical champions, each a nationally-renowned specialist in an emerging area of medical innovation.

BIODETECTION & SEPSIS CONTROL

Improving capabilities in the detection and therapy of serious infections in individuals and the population.

Naturally occurring infectious diseases and bioterrorism emergencies have the potential to cause shock- and sepsis-related fatalities. The ability to screen people efficiently for a wide variety of infections could significantly limit the devastating impact of an epidemic or bioterrorism incident on civilian or soldier populations.

CIMIT's Biodefense & Sepsis Control Program leverages CIMIT's extensive network of academic institutions and government agencies to develop novel technologies capable of detecting infection, screening antigens or developing vaccines.

BIOMATERIALS & TISSUE ENGINEERING

Helping solve organ shortages through the creation of "living replacement structures."

Nearly one hundred thousand Americans are waiting for a life-saving organ transplant. Thirty thousand patients a year need a new kidney, and while treatments like dialysis can buy time; on average, one in four die before receiving a transplant. This severe organ shortage could be mitigated if a viable substitute for human tissue could be found.

Tissue engineering is a complex challenge. An interdisciplinary field, innovators in tissue engineering seek to apply the principles of engineering and life sciences in the

pursuit of biological substitutes that restore, maintain, or improve tissue function.

CIMIT's Biomaterials & Tissue Engineering Program is working to create "living replacement structures" for organs, areas of tissues, and neural repair.

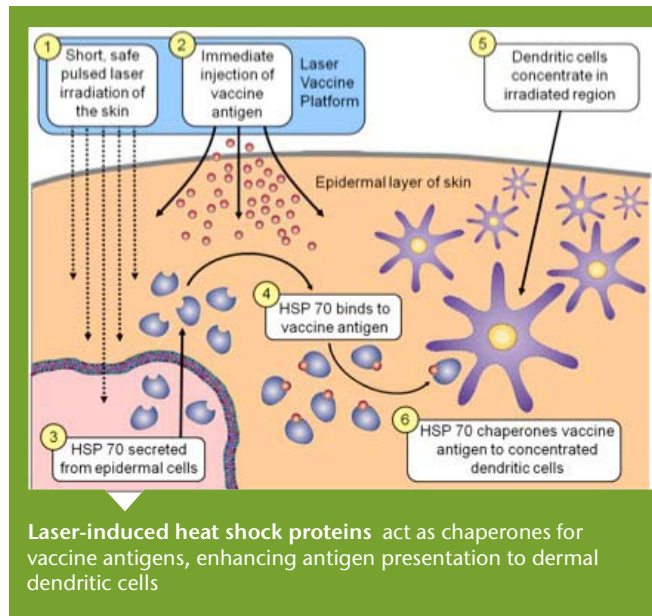
CARDIOVASCULAR DISEASE

Reducing deaths and disability from heart disease and strokes through improved diagnosis.

The leading cause of death and disability in the developed world, cardiovascular disease affects millions of people of all ages and frequently requires painful and invasive treatments. Most advances in treating heart disease have focused on technological innovations to treat cardiovascular disease symptoms, rather than improving methods of detection and diagnosis.

Heart disease costs the United States billions of dollars every year, yet much of the biology is still not understood. By continually evaluating the complex set of conditions cardiac patients experience, CIMIT investigators seek novel approaches to diagnosis and therapy.

CIMIT's Cardiovascular Disease Program is working to develop novel methods for the identification of and therapy for patients at highest risk for developing myocardial infarction and stroke.



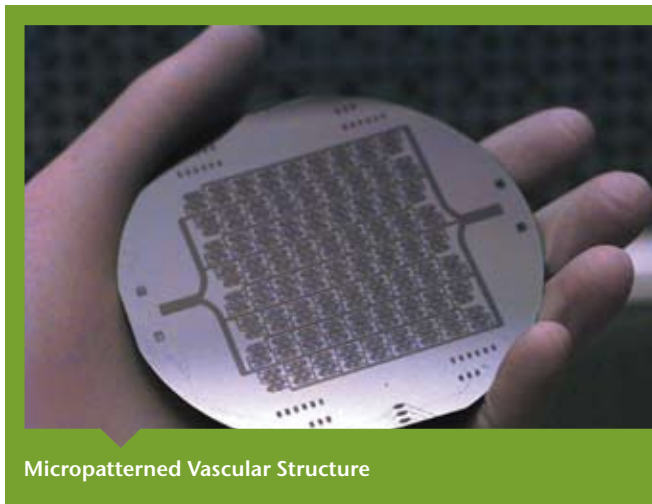
CLINICAL SYSTEMS INNOVATION

Making patient care safer, more accessible, more efficient, and less costly across the entire continuum of care.

Clinical healthcare environments are demanding, fast-paced, and complex. The barriers to innovation are significant, including the need to avoid disrupting ongoing day-to-day activities.

CIMIT's model of developing clinical innovation "learning laboratories" across the continuum of care – from the hospital to the home – provides venues for technology and process innovation to address these challenges in realistic settings. It also provides a controlled environment to measure the impact of change.

The Clinical Systems Innovation Program is CIMIT's on-the-ground initiative to improve and advance the systems that support clinical care in real-world healthcare settings. CIMIT helps clinicians and institutions craft novel approaches to implementing a complex new care pathway or designing a new facility or better process, usually incorporating new technology.



Micropatterned Vascular Structure

GLOBAL HEALTH INITIATIVE

Providing programs to help those in emerging nations help themselves.

Delivering healthcare to patients in austere environments calls for innovative approaches. The challenge is to apply

proven problem-solving capabilities to the design and development of medical devices and technologies specifically targeted to improving care in underserved patient populations, both at home and abroad. Coupled to stimulate adoption and training, a "setting-driven" approach can serve to enable a culture of innovation. Building on existing resources and insights can be a model for decreased reliance on medical product importation and can

stimulate greater focus on developing local infrastructure, economy and clinical skills to maintain sustainable healthcare.

CIMIT's Global Health Program is focused on developing instruments, equipment and training programs for low-resource settings.

CREATING THE NICU OF THE FUTURE

Hospital environments to care for newborns have been evolving since the field of neonatology was established as a specialty in the 20th century. Hospitals are altering their NICU facilities to respond to increasing family expectations, new clinical research findings, staffing shortages, budget constraints and new technology for monitoring, clinical care and communications.

As part of its Clinical Systems Innovation Program, CIMIT established a multidisciplinary team of clinicians to identify the technology, space and workflow requirements for the NICU of the Future, which could optimize family-oriented research care. Clinicians from Children's Hospital Boston, Massachusetts General Hospital, and Beth Israel Deaconess Medical Center are collaborating with both large and small companies on novel platform solutions to address the needs of the NICU of the Future.

Industrial participants include:

- » GE Maternal and Infant Care: Advanced equipment and technologies that foster healthy development. Microenvironments for premature infants with sound monitoring, data collection, trending, archiving and advisory systems.
- » Aptima: A command and control system that will help improve intra-team coordination among the NICU caregiver staff and addresses challenges posed by individual private rooms for staff communications and shared situational awareness
- » Cooper Lighting: Unique LED lighting systems to improve efficiencies, reduce costs, and enrich the quality of the healing environment.
- » Med-Storm: A pain monitoring system for patients unable to communicate.
- » Volusense: A disruptive technology for infants to measure tidal volume and function.

IMAGE GUIDED THERAPY

Providing high resolution, three-dimensional images of the operating field in real time for minimally invasive procedures.

Imaging techniques like X-ray and MRI are invaluable for treating a wide variety of illnesses and injuries. The challenge remains to shorten the lapse of time between image acquisition and procedure to minimize change in the illness or injury. Patient preference for minimally-invasive surgery makes real-time imaging information vital

Image Guided Therapy techniques help improve therapeutic outcomes. By providing precise ways to “visualize” intra-procedural anatomical changes in real time, Image Guided Therapy helps clarify a surgeon’s understanding of the patient’s anatomy and enables minimally invasive procedures to be performed inside solid organs. Guided by real-time imaging, surgeons can make decisions based on accurate data – sometimes the crucial difference between life and death.

INHALATION TECHNOLOGY

Using the respiratory tract for the delivery of local lung-disease therapy and as a “highway” to deliver therapeutic agents systemically.

Respiratory diseases, from infections to obstructive lung disease to cancer, are major public health problems. Acute respiratory infections are the third largest cause of death worldwide. The goal of the Inhalation Technology Program is to develop technologies to facilitate inhalation therapy that will help reduce human suffering and eventually health care costs.

The program will apply inhalation technology to the diagnosis and treatment of both acute and chronic respiratory and non-respiratory ailments. The respiratory tract can be used not only for local delivery but also as a conduit to deliver therapeutic agents systemically for the treatment of non-respiratory diseases. The respiratory tract can also provide a “window” for monitoring biomarkers of disease states.

Areas for innovation will include use of novel combinations of gases, therapeutic agents, inhalation systems, delivery systems, “smart-delivery” or self-monitoring/dosing devices.



The “Car Part” Incubator, developed entirely with readily-available replacement car parts

“CAR PART” INCUBATOR

CIMIT’s Global Health Initiative helps people in poor countries to help themselves in technologically appropriate ways.

CIMIT has developed a low-cost incubator made from used car parts that keeps fragile newborns warm and alive during the critical first days of life.

The New York Times reported that modern incubators can cost \$40,000 or more – and may break down or go unused by people in developing countries: initial estimates suggest a price of \$1,000. Since it’s durable and easy to repair, the “cost to own” is much lower than current use devices.

The incubator project is being championed and led by Kristian Olson, MD, who, as Director of CIMIT’s Global Health Initiative, travels to many villages in emerging countries in his effort to improve the health of mothers and infants.

He knows from working in developing nations that, even in the most isolated, impoverished areas, there always seemed to be a supply of automotive parts nearby.

The result was a low-cost, low-maintenance incubator. Dr. Olson was aided in realizing his vision by a non-profit Cambridge firm, Design That Matters, that crafted the machine.

Dr. Olson believes widespread use of this sturdy, easy to build and use device could save millions of lives around the world in places with high rates of neonatal mortality.

MINIMALLY INVASIVE SURGERY

Making surgery safer and recovery faster and less painful for patients.

Minimally invasive surgery decreases risk and shortens post-surgical recovery time. Improved minimally invasive techniques, like laparoscopic surgery, are most effective when the tools are flexible, sophisticated, and incorporate advanced imaging techniques.

New devices, better optics and creative multimodal approaches to disease management have set the stage for the next phase of less invasive surgical therapy.

CIMIT's Minimally Invasive Surgery program is focused on making surgery safer and more precise, exploring the next generation of less invasive surgical therapy. Recent projects involve developing tools and procedures for Natural Orifice Translumenal Endoscopic Surgery (NOTES), which could make surgery completely free of incisions, while reducing pain and disability. Through the NOTES initiative, complex surgeries could eventually become outpatient procedures.

NEUROTECHNOLOGY

Finding more effective, minimally-invasive ways to prevent, detect and treat neurologic disorders.

One in five Americans suffers from a neurological disease. Epilepsy alone affects four to six million Americans. Many neurological diseases are diagnosed in their advanced stages, and treatments tend to be palliative rather than curative, leaving patients debilitated. One in three epileptic patients continues to have seizures, which may be fatal or cause serious disability.

New engineering techniques, coupled to recent discoveries in neuroscience, could dramatically improve patient quality of life. Potential benefits include reversing or ameliorating a variety of neurological diseases and making earlier diagnosis possible.



Advancing Inhalation Technology through basic sciences

CIMIT's Neurotechnology Program is focused on developing novel approaches to diagnosis and treatment that integrate the expanding field of neuroscience with the rapidly evolving technology of engineering.

NEW INITIATIVES

Nurturing high-risk, potential high-impact projects.

CIMIT supports early stage, collaborative research projects for improving patient care, with emphasis on devices, procedures, diagnosis

and peri-procedural systems. CIMIT recognizes that novel ideas that support CIMIT's model may not fall into one of the established Programs. Therefore, CIMIT has created the New Initiative Program to nurture individual projects with high impact and high potential that may lead to establishing new CIMIT Science Programs or solutions to unsolved clinical problems.

IMPROVING PATIENT SAFETY

Medical Device Interoperability Achieves Major Milestone

CIMIT's MD PnP initiative, directed by Julian Goldman, MD, is leading a national effort for adopting medical device interoperability requirements in vendor selection criteria and procurement processes. Six clinical societies have endorsed the initiative and the American Society of Anesthesiologists published the "Integrated Clinical Environment" draft standard in December 2008. The national collaboration of Massachusetts General Hospital, Kaiser Permanente and Johns Hopkins Medicine is working closely with the FDA to define a pathway for regulatory clearance of networked medical devices.

OPTICAL DIAGNOSTICS

Reducing pain, discomfort and deaths by developing minimally invasive tools and procedures effective at diagnosing diseases.

Early diagnosis is critically important for effective therapy. Studies have conclusively shown that the earlier a disease is diagnosed, the greater the patient's chance of recovery. Current diagnostic techniques for many diseases, however, are often invasive and inefficient. Certain types of cancer, like esophageal cancer, are diagnosed through repetitive random biopsies. Other diseases leave markers that are not feasible to access surgically, like the vulnerable plaque that can indicate heart disease.

CIMIT's Optical Diagnostics Program seeks to make diagnosis efficient, effective, and non-invasive. Projects like Optical Coherence Tomography and Optical Frequency Domain Imaging make it possible to identify precancerous lesions or arterial plaque at very early stages.



Phantom Validation of Guided Focal Ultrasound Therapy Targeting

SIMULATION

Providing realistic training tools for clinicians to avoid practicing painful, risky procedures on people.

Whether the medical practitioner is a new resident, an ICU nurse, a young battlefield medic, or an experienced surgeon, the traditional method of learning a new technique is to observe or read about a new technique, then attempt it on a patient. Contemporary technology is making it possible for physicians and caregivers to practice some high risk techniques on simulators. However, these simulators are rarely sophisticated enough to provide a realistic experience that immerses the trainee in realism that replicates the psychological pressures of a true procedure.

CIMIT's Simulation Program is focused on creating effective, realistic training tools so that doctors, nurses, medics and first responders can practice on systems that teach and evaluate their performance using relevant metrics, so that simulator-based learning can transfer to the bedside. Projects like COMETS, an interactive, full-body trauma casualty system that reacts autonomously to an extensive range of situations, allow medics and first responders to access and practice treatments involving complex medical conditions in environments that are similar to where care will be given.

ENCOURAGING INNOVATION IN THE NEXT GENERATION

CIMIT Prize for Primary Healthcare Attracts Nationwide Interest

CIMIT announced a dynamic new engineering prize competition: the CIMIT Prize for Primary Healthcare. The top three entrants will receive \$150,000, \$100,000, and \$50,000, respectively, to help advance their winning clinically-relevant, primary care solutions.

Open to graduate and undergraduate engineering students from accredited engineering programs, this competition is de-

signed to encourage development of technological innovations in the frontlines of care. In this, the first year of the prize, over 78 preproposals were received from teams at 44 universities in 21 states.

The CIMIT Prize for Primary Healthcare is made possible through a generous gift from the Gelfand Family Trust.

TRAUMA & CASUALTY CARE

Preventing deaths in the critical minutes following trauma.

Trauma care has improved dramatically. A victim with near-fatal injuries who reaches the hospital alive is likely to survive. However, little progress has been made to treat patients in the critical period before they reach a treatment facility. As a result, most traumatic deaths occur in the pre-hospital setting and before any meaningful medical intervention becomes available. Translational research efforts are targeting the early phases of an injury in order to develop novel therapies and interventions for prehospital and early in-hospital trauma care.

CIMIT's Trauma & Casualty Care Program facilitates projects that enable first responders to stabilize patients at the site of the casualty (on the battlefield or at home), offering critical care to the patient rapidly and effectively. Several projects aim to explore solutions to stop internal and external bleeding as well as improve resuscitation and survival.

This work may have an extraordinary impact on patient care. Our goal is to identify early stages of high-risk coronary atherosclerotic plaques by in-vivo assessment of endothelial shear stress and vascular remodeling behavior. Since we pieced together a number of small grants, we now have a \$6 million multicenter clinical trial going on in Japan and have had funding from industry, foundations, philanthropies and others. We have sold patents to industry and have others pending. We could not have succeeded without CIMIT's help.

Peter H. Stone, MD
Cardiovascular Division
Brigham and Women's Hospital, Boston

STRATEGIC INITIATIVES

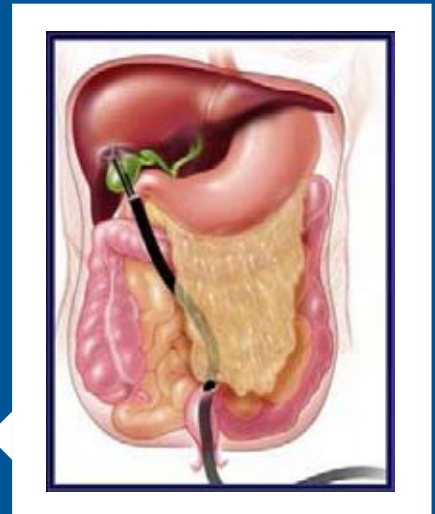
CIMIT Selects NOTES as a 3-year Strategic Project

CIMIT awarded its \$2.1 million Strategic Project to a multi-institutional NOTES collaboration. The award of \$700,000 annually for three years represents CIMIT's largest investment, and it makes CIMIT the largest sponsor of this revolutionary technology.

By offering the potential for scarless, relatively painless procedures while cutting costs at the medical center, NOTES may emerge as a new "stable working platform" that will be a disruptive technology having many surgical applications, including gastric bypass, fallopian tube ligation, removal of ovaries and diagnostic work.

A novel technique for performing surgical procedures, NOTES utilizes flexible endoscopes through the mouth, anus or vagina to enter the abdominal, pelvic or thoracic cavities. The Boston-based NOTES team represents four institutions and three scientific disciplines: medicine, surgery and engineering.

Illustration of Natural Orifice Transluminal Endoscopic Surgery (NOTES)



SUPPORTING TRANSLATIONAL RESEARCH

Grants & Awards

CIMIT provides critical seed funding for investigators whose research may be considered too embryonic or high-risk by traditional funding sources.

CIMIT grants enable individual investigators or multi-disciplinary teams to explore emerging technologies, develop systems to improve healthcare facilities or processes, or create novel approaches to managing a specific disease. CIMIT awards support the career development of investigators, young clinicians, and graduate students whose interests align with the CIMIT mission.

CIMIT encourages grant proposals by teams that reach across member institutions and whose novel ideas may lead to technologies that can benefit several medical disciplines. In particular, CIMIT seeks innovative approaches that can benefit soldiers, civilians and populations in austere settings.

CIMIT SCIENCE GRANTS

Science Grants recognize early-stage, interdisciplinary and inter-institutional research projects for improving patient care, with emphasis on diagnosis, intervention and peri-procedural systems. Three types of science grants help innovators with proof of concept or proof of principle.

CIMIT CLINICAL SYSTEMS INNOVATION GRANTS

Clinical Systems Innovation Grants are awarded to teams seeking to address a specific need at a CIMIT healthcare institution. These grants are designed to help the institution re-think its approach to implementing a complex care pathway or design a new facility or process.

CAREER DEVELOPMENT AWARDS

Career Development Awards allow an individual with established expertise in one medical or technical area to acquire knowledge in a second medical or technical area; experience that will allow the clinician to make unique subsequent interdisciplinary contributions.

WORKING GROUP GRANTS

Working Groups are interdisciplinary and inter-institutional teams formed to explore emerging areas of new health care technology. These grants help new teams investigate a novel idea. Working Groups seek to understand current solutions, determine new approaches being developed by industry, and evaluate other areas of opportunity.

CLINICAL FAST-FORWARD GRANTS

Jointly funded by the sponsoring hospital and CIMIT, Clinical Fast-Forwards help clinicians bring promising new clinical techniques from other sites (national or international) to CIMIT Consortium institutions.

Grants in this category must involve direct patient care. Clinical Fast-Forwards seek to change the way care is delivered.

YOUNG CLINICIAN AWARDS

This award is funded by gifts from industry. The Young Clinician Award recognizes outstanding clinicians, early in their careers, who are engaged in the development of breakthrough medical devices and technologies.

MEDICAL ENGINEERING FELLOWSHIPS

Jointly funded by CIMIT and its engineering universities, this fellowship offers multi-year support for graduate engineering students to work in highly innovative yet classically under-funded areas of healthcare research.

This CIMIT-supported project to study the development of a laparoscopic-based NIFT detection system for the molecular characterization of intraperitoneal and ovarian cancer in women has not yet impacted patient care, but I suspect it will. This (CIMIT) support led to an additional \$2 million grant from the Doris Duke Foundation and a partnership with a commercial partner to build second generation scopes that look both in white light and NIR. The first in human trials will be in early 2010!

Michael Seiden, MD
President and CEO
Fox Chase Cancer Center, Philadelphia

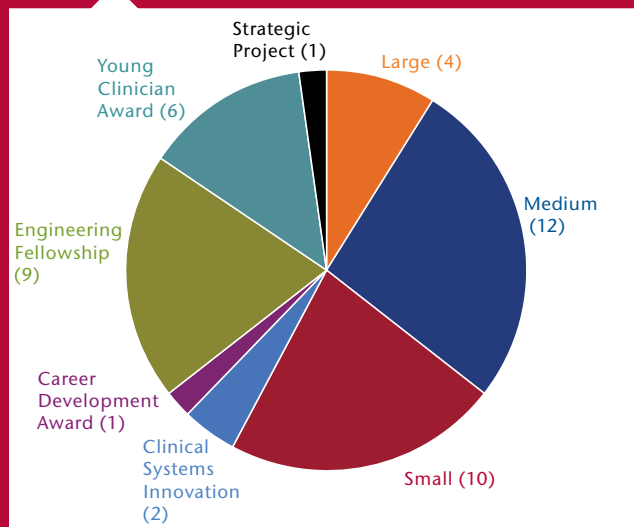
Facilitation

What makes CIMIT unique – and effective – is the in-house team of full-time experts who facilitate the complex process of introducing technological innovations into healthcare. This highly experienced, multidisciplinary team provides support and specialized expertise to investigators in intellectual property protection, licensing, technology implementation, small business grant processes, regulatory issues, fundraising, commercialization, and much more.

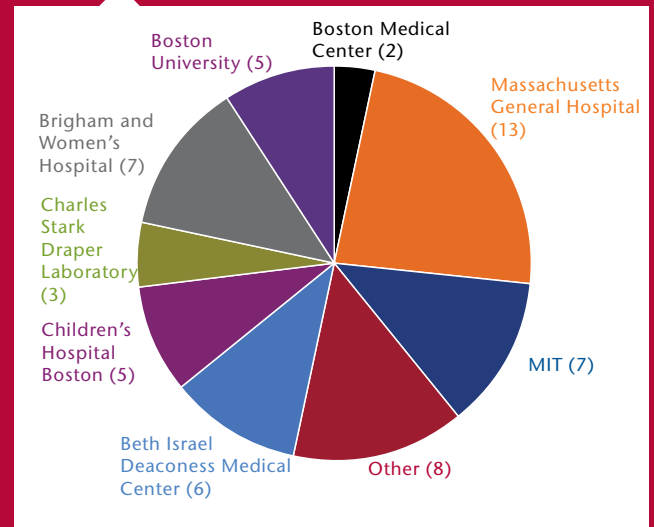
The goal of all CIMIT Facilitators is to leverage the strength of their backgrounds in business, law, intellectual property protection and product development. By integrating this collective expertise, CIMIT facilitators help investigators navigate the complex challenges of technology implementation. They also serve as a magnet to attract innovative thinkers, especially those individuals who are early in their research careers.

CIMIT invests heavily in sustaining this powerful, mission-focused, facilitative team of experts who support the clinical and engineering champions who lead CIMIT's programs and site mine the consortium institutions for novel opportunities to improve patient care. The CIMIT Facilitators are an integral part of the CIMIT mission and form its innovation support infrastructure. This team exists to enhance CIMIT's mission to accelerate the pace of innovation by actively facilitating the investigators' progress through a highly customized approach.

Number of Awards granted in 2008. 26 Science Awards (Large, Medium and Small); **16 Fellowships** (Young Clinician Award, Engineering Fellowships and Career Development Award); **2 Clinical Systems Innovation Awards** and **1 CIMIT Strategic Project**.



Institutions receiving grants in 2008.



Military Medicine

The CIMIT community continues to be a leader in fostering discussion of serious military medical issues and is dedicated to the development and deployment of novel technology for the unmet medical needs of soldiers and civilians. High technology devices and systems are enabling new approaches to characterize and manage acute care. Progress is being made in restorative and rehabilitative care, yet there continues to be an urgent need for novel solutions for care on the battlefield, during evacuation and for injured veterans seeking care at home.

Several CIMIT Programs seek to explore these important areas of research: Traumatic Brain Injury & Neurotrauma; Post Traumatic Stress Disorder; Neurotechnology; and Trauma & Casualty Care. During 2008, CIMIT supported 45 soldier care projects, including prevention, diagnosis, treatment, rehabilitation, monitoring of poly-trauma and hemorrhage control.

TEAM IS RESEARCHING BEST SOLUTIONS FOR SOLDIERS ADJUSTING TO RAPID ASCENTS

A team of MGH doctors, led by Aaron Baggish, MD; Peter Fagenholz, MD; and N. Stuart Harris, MD, is determining how soldiers adapt to changes in altitude and which acclimatization routines enable the soldier to adjust most effectively. The team, which has been carrying out research in Pikes Peak, CO, with a summit of 14,100 feet, is exploring the impact of moderate altitude staging on pulmonary artery pressure as a means to prepare troops for rapid ascent. One goal is to optimize preparedness for troop operations at high altitudes, such as those found in Afghanistan. The work, which CIMIT has supported, is being done in collaboration with the U. S. Army Research Institute of Environmental Medicine (USARIEM) in Natick, including Stephen Muza, PhD, leader of the thermal and mountain medicine division at USARIEM.

Caring for Injured Soldiers

High technology devices and systems are enabling new approaches to characterize and manage acute care, rehabilitation, trauma and disease. By funding early-stage, high-risk ideas for patient care, CIMIT encourages its project teams to seek solutions that benefit soldiers, civilians and populations in austere environments.

In the early days, CIMIT gained a reputation for innovation through its Simulation and Clinical Systems Innovation initiatives. Since that time, CIMIT has become a national leader in new systems for patient safety, caregiver training, and systems designed to deliver care in the most appropriate and efficient setting. While the technical and medical practice skill sets for these improved processes apply equally to civilian and military medicine, CIMIT emphasizes the unique needs of the soldier.

CIMIT has a diverse and growing portfolio of projects that benefit soldiers.

DEVICES FOR SCREENING & DIAGNOSTICS

- » Improved tools for triage
- » Imaging techniques for base-lining and classifying traumatic brain injury (TBI) and post traumatic stress disorder (PTSD)
- » High field MRI for differentiating TBI from PTSD
- » Devices for detection and characterization of infection
- » Serum screens for TB, HIV, and other infectious diseases
- » Tools for early detection of hemorrhage
- » Ways to identify post-acute patients at risk of heart attack and stroke
- » Systems and monitoring devices to help manage large numbers of casualties



TRAINING AND IMPROVED CARE SYSTEMS

- » Realistic trauma simulators for medic and first responder training
- » Systems for improved care safety (hand washing compliance)

THERAPY

- » Treating at point-of-injury for abdominal hemorrhage
- » Improving intravenous access for drug and fluid delivery
- » Designing new systems to characterize and mitigate traumatic pain
- » Predicting seizure onset in traumatized patients to initiate therapy
- » Quantifying benefits of novel surgery (reduced infection rate, faster recovery)
- » Localizing therapy in the brain non-invasively with focused ultrasound
- » Exploring ways to mitigate TBI: laser therapy, transcranial magnetics
- » Improving vaccines
- » Moderating inflammatory response to traumatic injury (cooling and pharmacologic therapies)
- » Introducing longitudinal imaging approaches to manage TBI care
- » Using nerve function sensors to stage therapy
- » Evaluating brain-body interface characterization for TBI, prosthetic therapies



WHAT CAN CIMIT DO FOR THE SOLDIER WITH MUD ON HIS BOOTS?

—ADVANCING RESEARCH ON ASTHMA

One thousand military recruits are discharged each year due to asthma. Thousands more are hampered during battlefield operations. Leading doctors and researchers including Bruce Levy, MD, of Brigham and Women's Hospital; Michael Singer, MD, of the Boston VA Hospital; and John Guttag, PhD, of MIT, are developing a remotely monitored inhaler to predict and prevent asthma attacks. The team is engaged in studies with asthma patients and in developing a prototype monitoring system.

VA BOSTON JOINS CIMIT CONSORTIUM

Several collaborations are already underway with VA Boston Healthcare System, an integrated system of 3 medical centers and 6 outpatient clinics offering specialized training and research opportunities to over 1,100 residents and fellows, 250 medical students, and 400 students in other areas of clinical practice. VA Boston joined CIMIT in summer 2008. Among the growing portfolio of emerging technology collaborations are novel approaches to hand hygiene, physiologic monitoring and device interoperability. VA Boston has one of the largest VA research programs in the nation. Recognized as a leader in technology applications in healthcare, VA Boston is an invaluable research partner and offers a unique environment as a collaborator for testing CIMIT-supported innovations. VA BHS is a major center for interventional cardiology, and maintains a large program in spinal injury and Post Traumatic Stress Disorder neurosciences.

WAR & MEDICINE BOOK CITES CIMIT-SUPPORTED ADVANCES

Director John A. Parrish, MD, is a key contributor to the recently published book "War and Medicine" (Black Dog Publishing, London, 2008). This illustrated text was published to coincide with the "War and Medicine" exhibit at the Wellcome Trust. Dr. Parrish wrote the foreword and contributed to a section explaining advances in modern medicine since serving as a battlefield doctor in Vietnam. With William Wiesmann, MD, and Nicole Draghic, Dr. Parrish noted several advances in soldier medicine that CIMIT has supported, including the development of a portable insufflator device to control abdominal and thoracic bleeding preoperatively; the evolution of COMETS (Combat Medic Training System) prototype; and the "Digital Diagnostic Glove" that is designed to help medics assess and report the condition of injured soldiers.

IMPROVING PATIENT CARE

CIMIT concentrates on early-stage, high-risk ideas in the first phase of innovation. Many projects got their start because of early funding from CIMIT. Some are already in patient care, many are in clinical trials and dozens more are showing promise while still “in the pipeline.”

Devices & Procedures In Care or In Clinical Trials

- » Allergy Documentation and Alert in Operating Room
30% error rate reduced to 10% within a few days of implementing system
- » Reorganizing Patient Care and Workflow in a Minimally Invasive Surgery Operating Room at MGH
Non-operative time compared to standard OR is 40% less
- » “Surgical Laboratory” Operating Room Suite for Testing Devices and Procedures at BWH
Methods of improved tracking and decision making
- » E-visits in Primary Care Practice
100+ patients enrolled
- » Hand Washing and Compliance Training
Entering clinical trials 2009

TRANSFORMATIONAL
CHANGE

TRAUMA & EMERGENCY CARE *sustaining life*

- » Real-Time Incident Preparedness Simulator (RIPS)
Communities and first responders can simulate disaster scenarios
- » Telestroke
Real-time diagnosis can minimize disability

- » Laser Treatment for Vocal Cord Dysplasia and Papillomatosis
Patients now treated in outpatient setting
- » MR-Guided Brachytherapy of Prostate Cancer
Fewer complications; quicker return to work
- » Uterine Fibroid Surgery with Focused Ultrasound
Shorter hospital stays
- » Distraction Osteogenesis for Jaw Reconstruction
No ICU needed; no bone graft
- » Laparoscopic Obesity Surgery
Fewer post- or peri-operative complications; reduces stay from 3+ days to 1 day
- » Laparoscopic Uterine Fibroid Surgery
Return to work in 1 week instead of 6 weeks
- » Laparoscopic Nephrectomy
Home in 2 days
- » Therapy Staging for Ovarian Cancer Using Near Infrared Spectroscopy
Detects sub-mm tumors as small as 8-10 cells

TREATMENT

- » Portable Gait Evaluator and Biofeedback Intervention Tool
Decreases falls; 28 patients enrolled in clinical trials
- » Photochemical Tissue Bonding: Nanosuture Approach to Skin & Vascular Repair
Entering Clinical Trials 2008
- » Remotely Monitored Inhaler to Predict and Prevent Asthma Attacks
Allows time-sensitive intervention; 400 patients enrolled in clinical trials

**RESTORATION,
REHABILITATION
& MONITORING
CHRONIC ILLNESS**

DIAGNOSTICS

- » Optical Diagnosis in the Esophagus
Real-time screening for early cancer and dysplasia
- » Video Rate OCT for Early Diagnosis of Glaucoma
Licensed for development and commercialization; 23 patients in clinical trials
- » Video Rate OCT for Early Diagnosis of Age-related Macular Degeneration
Licensed for further development and commercialization; in clinical trials
- » OCT for Vulnerable Plaque
Allows minimally invasive detection pre-event; 93 patients in clinical trials
- » OCT for GI Endoscopy
Allows minimally invasive detection that is superior to biopsy; 885 patients in clinical trials
- » Sentinel Lymph Node Mapping of Breast Cancer Using Invisible NIR Fluorescent Light
Entering clinical trials 2008
- » Sentinel Lymph Node Mapping of Human Lung Cancer
Entering clinical trials 2008
- » Motion Tolerant Respiration Monitor
Entering clinical trials 2008
- » Image Guided Plastic Surgery
Ensure perforator artery inclusion in graft; entering clinical trials 2009
- » Seizure Prediction and Vagus Nerve Stimulation
Enables early detection of seizure onset; 6 patients entered in clinical trials
- » Fine Needle Aspiration and Genomics for Early Detection of Lung Cancer
Earlier diagnosis improves care and outcomes; 62 patients in clinical trials
- » Real-Time Emergency Room Breath Analysis For Infectious Disease
Early detection improves outcomes; 20 patients enrolled in clinical trials

- » Radianse
RFID systems, now used in 60+ hospitals
- » LiveData
Operating Room Dashboard now used in 8 hospitals
- » OMNIGuide
Laser System for Tumor Ablation

**COMMERCIAL
COLLABORATIONS**

Devices and Procedures in the Pipeline



- » Tissue-engineered tooth and jaw replacement
- » Non-surgical repair of meniscus or ACL
- » Wearable wireless sensor network to monitor motor recovery in post-stroke patients
- » Percutaneous, image-guided cochlear implantation
- » Tissue-engineered pulmonary valves

RESTORATION & REHABILITATION
restoring quality of life

MANAGING CHRONIC ILLNESS & HOMECARE
maintaining wellness & early detection

- » Indwelling intrapericardial catheter for long-term access and therapy
- » Controlled release technology to prevent tracheal stenosis
- » Remotely monitored inhaler to predict and prevent asthma attacks

CIMIT funding was critical in allowing this project (radiofrequency ablation with a needle-tipped catheter in the heart) to move forward. It fostered several investigative careers and we are anticipating that BWH will be an initial site for human trials after the first feasibility phase is completed in Canada.

William Stevenson, MD

Director, Clinical Cardiac Electrophysiology Program
Brigham and Women's Hospital, Boston

Metrics

460 Projects Funded

500+ Peer-reviewed Publications

200+ Invention Disclosures

200+ Patent Applications Generated

30+ Patents Issued

10+ Licenses

15+ Companies Formed or Redirected into Healthcare

10,000+ Patients Benefiting from CIMIT-supported Devices and Procedures

FINANCIAL HIGHLIGHTS

Year in Review

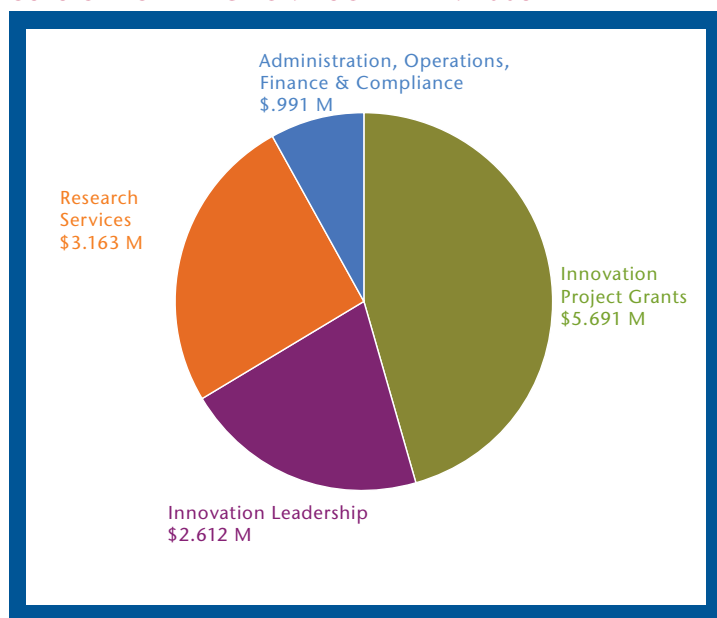
CIMIT is a careful steward of its financial resources. Operating on a fiscal year calendar (October 1 – September 30), CIMIT derives its funding from a variety of sources including consortium member institutions, government agencies, foundations, industry, philanthropy and gifts of CIMIT Friends. Total funding received for 2008 was \$15.03 million.

CIMIT awards monies to support innovation in healthcare through its grant programs. Moreover, CIMIT supports research scientists through facilitation of their work, educational programming and a variety of convening initiatives. Less than ten percent of funds support administrative operations.

SOURCES OF FUNDING FOR FISCAL YEAR 2008

Source	Amount (in Millions)
Federal Government	12.61
Philanthropy	1.23
Industry	.19
Consortium	1.00

USES OF FUNDING FOR FISCAL YEAR 2008



Annual Report of Giving

Making a gift to CIMIT is very important and rewarding. Gifts help support innovation in healthcare and provide the means for leading-edge, collaborative research and career development grants for the scientists, clinicians and engineers who have a passion for transforming healthcare through technology. Moreover, donor gifts help build a growing and vibrant CIMIT community through education and convening.

Robert C. Almond
Richard Anders
Jeff Ashe
Daphne Bascom
Morry Blumenfeld
John M. Bordes
Lee Bordes
Beverly A. and Robert A. Brown
Izi Bruker
Paula Buick
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Vera Tice
Mary Tolikas
Stuart Tuthill
Kirby G. Vosburgh
Allan P. Weeks
David Weissburg
Michael Wootton
Raymond Zambuto

CIMIT support to study cardiomyocyte repopulation by percutaneous delivery of tissue engineered cells gave us insight into the feasibility of cell delivery by catheters and led to industry investment in the device technology and the formation of a joint venture to test the hypothesis in humans. Ultimately industry invested over \$100 million and the technology remains the preferred device for biologic transfer to the heart by percutaneous means.

Stephen Oesterle, MD

Sr. Vice President, Medicine and Technology
Medtronic

former CIMIT Program Leader for Endovascular Devices

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