

CHANGING THE WORLD



THROUGH
IMAGINATION
INGENUITY
INNOVATION



Global Impact

Pitt innovators, via their innovations and entrepreneurial spirit, are making a significant impact on the University, patient care, local economic development, and the world.

When I consider the immensity of the University of Pittsburgh's collective and diverse research endeavor and the sheer quantity—and quality—of significant innovations arising from that research this past year alone, I can declare with confidence that Pitt Innovators and their University partners are, in fact, changing the world.

Just recently, for instance, I learned that ALung Technologies, Inc., a spin-off company in Pittsburgh based on Pitt innovations, had hired its 45th employee. Its employees include eight former Pitt students, and the company today is helping lung patients in Europe by providing a novel dialysis device that removes carbon dioxide from the blood. That's the kind of "changing the world" I'm talking about.

As you'll see in this year's annual report, the Office of Technology Management (OTM) and Office of Enterprise Development, Health Sciences (OED), have launched another nine companies this past fiscal year around innovations developed at Pitt, for a total of 98 start-up companies that have been established since OTM was launched in 1996.

Pitt Innovators are developing new cancer vaccines. They're building glucose sensors from carbon nanotubes. They're forming more collaborations between engineers and medical clinicians to create new devices that solve health care problems. Their novel research tools are attracting the attention of pharmaceutical companies and others across the country—and being licensed by them to enhance their own research. And many are embracing new technologies, such as smartphones and other mobile computer devices, to further propel their innovation development efforts.



Meanwhile, our offices this past year continued to partner actively with the Swanson School of Engineering, the schools of the health sciences, and others to create an even more collaborative innovation development environment; educate current and future Pitt Innovators; and generally foster a vibrant, meaningful culture of innovation and entrepreneurship among Pitt faculty members, staff members, and students and the community. I think our performance numbers, coupled with this showcase of stellar Pitt Innovators and support programs, aptly capture the exciting success of our innovation commercialization activities.

We are grateful to the University's leadership across campus for such activities and for helping to elevate innovation and entrepreneurship to their current place as cultural—and academic—priorities at Pitt. As such, I can promise that we will continue to innovate when it comes to providing education; commercialization services; and opportunities for Pitt Innovators to interact with industry, entrepreneurs, investors, alumni, and the local economic development community.

All the while, OTM and OED will continue to aggressively seek licensing opportunities for Pitt technologies, partnerships with industry, and start-up opportunities within the Pittsburgh community. We will continue to help to push Pitt ideas into the commercial marketplace and into the hands of those who will be helped the most because of your innovations.

Of course, we especially thank our Pitt Innovators, who tirelessly persist in the commercialization process even as they push for additional research funding, continue to conduct basic research, and keep asking the important questions that ultimately lead to new innovations and world-changing solutions.

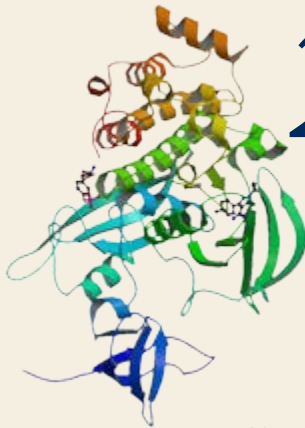
Respectfully,

Marc S. Malandro
Associate Vice Chancellor for Technology
Management and Commercialization
University of Pittsburgh

COMMERCIALIZATION IMPACT AT A GLANCE

\$759
MILLION

Pitt researchers received \$759 million in total sponsored research funding in fiscal year 2013. OTM's goal is to facilitate the commercialization of innovations that emerge from those research projects.



254 INVENTION DISCLOSURES

Pitt Innovators submitted 254 Invention Disclosures to OTM for commercial consideration in FY 2013, generating lots of opportunities for potential partners.

9 START-UP COMPANIES

Nine new start-up companies were launched around Pitt innovations in FY 2013, for a total of 98 that have been formed since OTM was established in 1996.

51 U.S. PATENTS

Pitt innovations received 51 U.S. patents in FY 2013, bringing Pitt's patent portfolio up to 541 issued U.S. patents.



155 LICENSES/OPTIONS

OTM and its partners have executed 155 licenses or options to outside partners for Pitt innovations in FY 2013, including start-up companies.

98 START-UPS SINCE 1996



\$6.5 MILLION

TOTAL REVENUE

Pitt received more than \$6.5 million in total revenue from its commercialization activities in FY 2013, including \$4.1 million in licensing revenue.

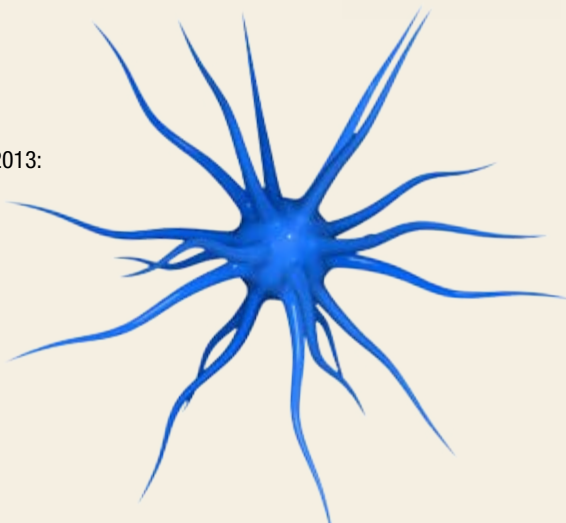


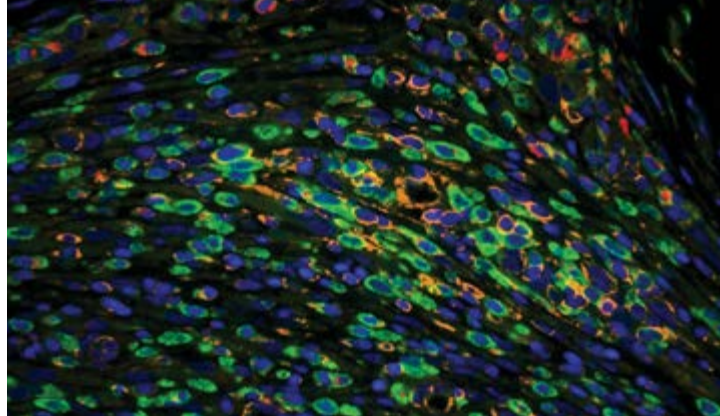
Start-up COMPANIES

Start-up companies based on innovations that were licensed/options in FY 2013:

Boston Mountain Biotech
Formabone, Inc.
Panther Learning Systems, Inc.
Peca Labs, Inc.
Iron Horse Diagnostics, Inc.

DiaVacs, Inc.
3Storm, Inc.
NanoPhoretics, Inc.
Wellbridge Health, Inc.





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When we say changing the world through imagination, ingenuity, and innovation, we're talking about Pitt Innovators. They are not only conducting world-class research across a diversity of disciplines at Pitt, but this driven community of academic collaborators also continues to transform more Pitt research—with help from OTM, OED, and other affiliated commercialization programs—into meaningful technologies that promise great potential impact on the beneficiaries of those breakthroughs.

Among the major beneficiaries are patients, who benefit from new medical devices, drug candidates and delivery systems, vaccines, cancer treatments, pain management therapies, and regenerative medicine. But the positive impact of Pitt innovations also can be felt in the community, where more and more start-up companies are emerging, hiring, and flourishing and where investors are finding more opportunities.

A diversity of industries, from environmental and energy to medical device and pharmaceutical companies, is discovering new ideas here that could propel companies to new levels of success. And more Pitt faculty members, staff members, and students are experiencing valuable education in innovation commercialization and entrepreneurship along the way.

Indeed, the University's innovation commercialization activities continue to strengthen, thanks in part to a collective research endeavor supported in fiscal year 2013 by an estimated \$759 million in total research expenditures. Consequently, the University continues to actively engage more Pitt Innovators in the process and to pursue innovative new approaches and programs designed to foster collaboration, innovation development, and entrepreneurship. Such combined efforts, as showcased in this annual report, have resulted once again in strong commercialization performance in FY 2013.

INVENTION DISCLOSURES

Pitt Innovators continued to keep up an active pace this past fiscal year in their development of innovations with commercial potential. For the year ending June 30, 2013, several hundred Pitt faculty members, staff members, and students submitted 254 invention disclosures across a broad diversity of academic disciplines to OTM for commercial consideration.

That brings the total number of invention disclosures to 1,300 over the past five years alone and 2,886 since OTM was established in 1996.

Such robust volume speaks well of the many activities of OTM, OED, and partnering programs aimed at promoting collaboration and a more innovative and entrepreneurial culture on campus as well as educating Pitt Innovators about successful commercialization. Of course, such volume does pose daily challenges for OTM and OED in managing the process for such a large and diverse portfolio of ideas, but the steady flow of world-changing breakthroughs that are being submitted to OTM is exciting.

LICENSES/OPTIONS

OTM's licensing managers, as well as OED's start-up team, closed out the year with a record amount of technology licensing activity with Pitt partners. All told, they executed 155 licenses and options, an increase of 17.4 percent over the previous year's record activity. That brings total technology licenses and options to industry and start-up companies since 1996 to 972.

Of those, 66 represent licenses and options, including 10 licenses to school districts across the country for the Learning Research and Development Center's Principles of Learning program and 13 options for Pitt innovations. Another 80 licenses/options fall under interinstitutional agreements in which

Pitt partnered with another institution in the deal, and nine represent sublicenses and amended licenses.

U.S. PATENTS ISSUED

The U.S. Patent and Trademark Office (USPTO) awarded the University a record 51 new U.S. patents in FY 2013, up from the previous year's 49 patents. While this does reflect patent filing activity that took place three to five years ago, it also demonstrates the growing success of Pitt's efforts to protect the intellectual property arising from Pitt labs.

Since 1996, the University has amassed a portfolio of 541 patents on Pitt innovations, 202 of which were awarded in the past five years. Meanwhile, the University submitted 78 new U.S. patent applications to USPTO in FY 2013.

TOTAL REVENUE

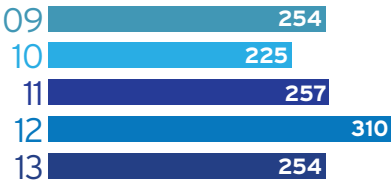
OTM's licensing activity resulted in the generation of more than \$6.54 million in FY 2013, bringing the five-year revenue total to \$32.1 million. Included in the 2013 number is \$4.1 million in licensing revenue and another \$2.4 million in patent expense reimbursement from licensees.

START-UP ACTIVITY

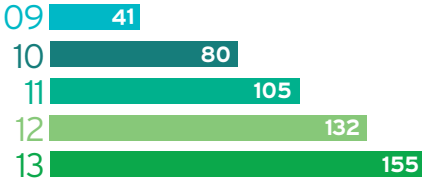
OTM and OED, with support from OTM's executives in residence and several program partners, pushed hard to maintain the previous year's start-up pace—and succeeded. This past year, the University did, in fact, spin out another nine start-up companies based on Pitt innovations.

This success can be attributed in part to the efforts of OED and its PittVentures initiative, OTM's executives in residence, and collaborative innovation development efforts such as the Coulter Translational Research Partners II Program, the Clinical and Translational Science Institute in the schools of the health sciences, and the Center for Medical Innovation in the Swanson School of Engineering.

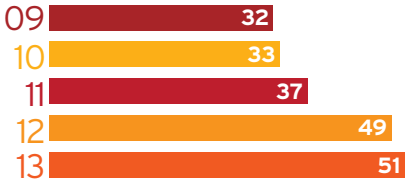
INVENTION DISCLOSURES



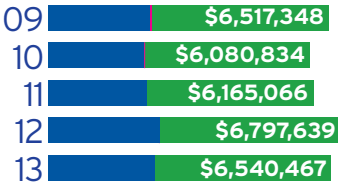
LICENSES/OPTIONS



U.S. PATENTS ISSUED



TOTAL REVENUE

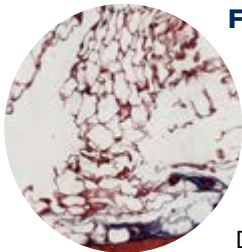


Legal Fee Reimbursements
Equity Sales
Licensing Income

That brings the total to 29 start-ups launched with Pitt innovations over the past five years and 98 start-ups spun out of the University since 1996. This past year's start-ups are as follows:

Panther Learning Systems, Inc.

Developed by psychology professor Christian Schunn in the Learning Research and Development Center, the innovation behind this start-up is a Web-based computer software system (called SWORD) that provides peer review of student writing and manages the reviews, basic score calculations, and the curving of scores to produce useful grades for the instructor and feedback for the students.



Formabone, Inc.

This start-up is based on a novel injectable bone cement and similar injectable pastes that contain proteins, cells, plasmid DNA, and drugs to promote bone regeneration.

Prashant Kumta, a bioengineering professor, and Charles Sfeir, a professor of dental medicine, collaborated on the development of this innovation.

Iron Horse Diagnostics, Inc.

Robert Bowser, an adjunct pathology professor at Pitt, launched this company based on his development of biomarkers aimed at rapidly diagnosing motor neuron diseases such as amyotrophic lateral sclerosis, or ALS. Applications for the biomarkers include diagnostic tests, methods to monitor disease progression and drug efficacy, and targets for new therapies for neurological diseases.



DiaVacs, Inc.

If the innovation behind this start-up company succeeds, patients with type I diabetes may be able to reverse or prevent the destruction of insulin-producing pancreatic cells in their bodies, even before the onset of symptoms. Pathology professor Nick Giannoukakis and pediatrics professor Massimo Trucco developed a vaccine that stops T cells from attacking pancreatic islet cells by reprogramming dendritic cells that trigger the T cell assault. Phase I clinical trials are under way.

Wellbridge Health, Inc.

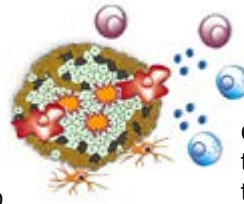
Social work professor Daniel Rosen, looking to help to reduce the number of unplanned readmissions to the hospital by older adults with chronic illness, developed a tablet-based program that will allow them to communicate their progress and other information to their health care providers. That product, which is the basis for this new start-up company, includes apps for medication management, weight monitoring, and monitoring of symptoms postsurgery.

3Storm, Inc.

This start-up is based on a mobile app that allows professionals, beginning with nurses, to manage their continuing education credits and requirements. It was developed by Steven Benso, a traumatic brain injury research nurse at Pitt, along with Anthony Chao, a fellow nurse and student in Pitt's nurse anesthesia program, and Richard Fera, information technology coordinator in the School of Nursing (see the related feature article "Apps in the Academy" on page 16).

NanoPhoretics, Inc.

The innovation behind this start-up company is a device and process that performs multiparticle separation, isolation, and assays of small particles in a portable low-power laboratory instrument. Developed by Steven Levitan, a professor of electrical and computer engineering, Donald Chiarulli, a computer science professor, and Samuel Dickerson, professor of



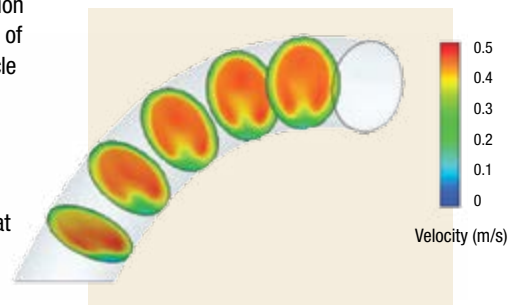
electrical and computer engineering, this new research tool uses 3-D CMOS technology to allow researchers to sort particles of interest and study their structure and composition without using destructive and expensive biochemical labeling equipment. The innovation also may provide a foundation for the development of a new class of point-of-care portable diagnostic devices.

Boston Mountain Biotech

This start-up is based on an multi-institutional collaboration that includes Mohammad Ataai, a professor of chemical and petroleum engineering at Pitt. The technology developed by this group is a proteomics-based approach to the purification of manufactured proteins that simplifies the process and reduces both the time and cost of purification using chromatography.

Peca Labs, Inc.

This local spin-off company, founded by three Carnegie Mellon University students, is based on an optimized bicuspid pulmonary valve conduit for children's hearts originally developed by Masahiro Yoshida, a professor of cardiothoracic surgery at Pitt. The pediatric heart valve was designed to repair a certain birth defect and eliminate the need for multiple heart surgeries as children with the defect grow into adulthood.



THE RIGHT EQUATION

What do you get when you add together innovative medical technology from Pitt, entrepreneurial savvy, local economic development support, and capital investment? You get ALung Technologies, Inc., which recently announced its 45th hire. Thirty-eight of those staff members—including eight Pitt graduates—work in the Pittsburgh headquarters. The remainder of the company's employees work in its European office.

Meanwhile, in February 2013, the company earned its CE Marking in the European Union for its Hemolung Respiratory Assist System. So ALung has begun to sell its system within the



European Union, providing advanced respiratory assistance to lung patients there. In addition, the company has received Health Canada approval for the system.

SLEEPER SUCCESS

When psychiatry professor Daniel Buysse and his team first began to develop their Pittsburgh Sleep Quality Index in the 1980s, they had no idea just how popular this self-reported outcomes survey would one day become among researchers around the world.



Since working with OTM in 2010 to offer this standardized sleep quality measurement survey as a licensed product to other

researchers, Buysse and OTM have, well, awakened interested researchers to the value of the research tool in their clinical trials. So far, the copyrighted survey has attracted close to 50 licenses for use by a who's who list of pharmaceutical companies and others—20 licenses in 2012 alone.

Moreover, the survey has been translated into at least 56 different languages and continues to generate a fair amount of licensing revenue for the University and Buysse. How's that for innovation?

EDUCATING EDUCATORS: AN LRDC LICENSING BOOM

When it comes to innovation commercialization, who would have thought that a program for training elementary and secondary education professionals would remain one of the most prolific generators of licensing activity for both the University and the School of Education's Learning Research and Development Center (LRDC)?

Since 2003, the innovative Principles of Learning program has garnered more than 150 nonexclusive licenses—at least 10 so far in 2013 alone—from large and small school districts across

the country. During that period, the training program has generated millions of dollars in licensing revenue, a large portion of which goes right back to LRDC to fund its current research efforts.

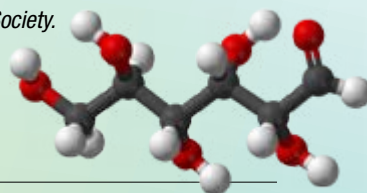


MONITORING GLUCOSE, BREATH BY BREATH

Diabetes patients may one day be able to avoid the pain of skin pricking thanks to a technology being developed by Alexander Star, a professor of chemistry at Pitt, along with his research colleague at the National Energy Technology Laboratory and Pitt graduate student Mengning Ding.

Star and his team have developed a glucose sensor by combining tiny but strong carbon nanotubes, which serve as the foundation for many of Star's innovations, with titanium dioxide to create a form of light-activated electrical semiconductor. The researchers call the hybrid combination "titanium dioxide on a stick." The resulting sensor measures acetone vapors.

The research team currently is developing a working prototype of its "diabetes Breathalyzer" test, which would allow patients to monitor their glucose levels through breath analysis alone. The team published its findings in the June 19, 2013, issue of the *Journal of the American Chemical Society*.



SKIN CANCER VACCINE CLINICAL TRIALS TO BEGIN

Dermatology professor Walter Storkus and his collaborator, medicine professor Hussein Tawbi, are gearing up for a clinical trial for what they hope will become a new skin cancer vaccine.

The vaccine targets novel antigens in the tumor microenvironment that provides the "soil" for tumor growth, Tawbi explains. The targeted therapy tests will use tyrosine kinase inhibitors to effect a positive response in the immune system as a way to augment the effect of the vaccine rather than using such drugs to directly affect the tumor cells.

Says Tawbi, "We are truly very excited about starting this clinical trial, which is quite novel on several levels."

SCIENCE CENTER SALUTES

The Carnegie Science Center in Pittsburgh honored four active Pitt Innovators this year with Carnegie Science Awards for their research, innovations, and teaching:

- Bioengineering professor Xinyan Tracy Cui received the Emerging Female Scientist Award for her research on conductive polymer-based neural electrode coatings.
- Bioengineering professor David Vorp, who also is associate dean for research in the Swanson School of Engineering, earned the Life Sciences Award for his innovations addressing aortic aneurysms, vein graft modification, and tissue-engineered arteries.
- Robert Enick, a professor of chemical and petroleum engineering, was presented with the Environmental Award for his development of a novel way to capture carbon dioxide from coal-fired power plant stacks. He also is developing a carbon dioxide thickener to improve crude oil extraction.
- Not only is chemical and petroleum engineering professor Steven Little an active innovator, he also has been recognized as a first-rate educator and mentor. For that, he was given the University/Post-secondary Educator Award.
- In addition, Patrick Daly, president and CEO of Cohera Medical, Inc., received the Start-up Entrepreneur Award. This Pittsburgh start-up is based on a novel polymer-based biodegradable, biocompatible medical adhesive originally developed at Pitt. The company's first product, TissuGlu, is being used for lipoplasty surgery and currently is available in the European Union.

The Carnegie Science Center established the Carnegie Science Awards program in 1997 to recognize and promote innovation in science and technology across Western Pennsylvania.



A \$400,000 BOOST FOR PITT INNOVATIONS

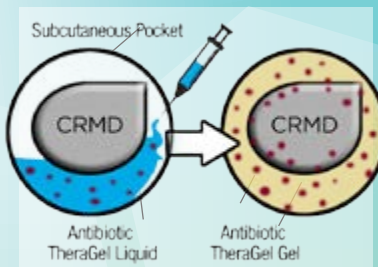


Four collaborating teams of Pitt Innovators that include bioengineering professors and medical clinicians each received \$100,000 from the Wallace H. Coulter Translational Research Partners II Program to support their innovation development and commercialization projects.

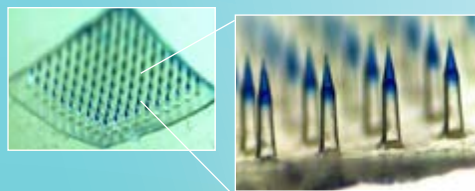
This is the second round of funding given by this five-year grant program in the Swanson School of Engineering whose aim is to foster commercialization collaborations between engineers and clinicians to solve health care problems.

This year's projects include:

- TheraGel, which delivers high-dose antibiotics for a sustained period into the region around a newly implanted device to prevent postsurgery infection. Collaborators include bioengineering professor Yadong Wang and David Schwartzman, a professor of medicine.



- MatriDisc, a novel off-the-shelf scaffolding device made from particulates and sheets of extracellular matrix for patients suffering from temporomandibular joint disorders. Typical treatment includes the removal of the joint meniscus. This device is designed to replace the meniscus with a resorbable "pillow" that mimics its shape and promotes the growth of new tissue. Collaborators include bioengineering professor Bryan Brown and dental medicine professors Alejandro Almarza and William Chung.



- Skinject PatchIT, a bandage-like patch that delivers a single dose of potent chemotherapy and immunization agents via novel microneedle arrays to the skin of skin cancer patients. Collaborators include dermatology professors Louis Falo and Larisa Geskin.
- FootStim, a wearable stimulator for people suffering from overactive bladder disorder that is designed to activate the nerves on the foot to alter nerve signals to the bladder. Collaborators include Changfeng Tai, a professor of urology and pharmacology, and Mang Chen, a professor of urology.



INNOVATIONS: WHERE TO FIND THEM

For a complete list of innovations that currently are available for licensing at the University of Pittsburgh, you can find our searchable database online at: innovation.pitt.edu

INNOVATION.PITT.EDU



"The challenge with commercialization for academic investigators is really twofold. One is knowing what's really amenable to commercialization, and two is identifying companies that will license technology."

Jennifer Grandis



Head and Neck Hero

Cancer researcher Jennifer Grandis champions the development of effective gene therapy treatments

In the constellation of cancers that attract the attention of the scientific community and inspire public outcry, those that affect the head and neck often are neglected.

Because of the relatively low rate at which they affect people and the demographics of the people they do strike, head and neck cancers have largely been ignored when compared to the resources devoted to, say, colon or breast cancer.

But that's a key reason why Jennifer Grandis, Distinguished Professor of Otolaryngology, has dedicated herself to targeting cancers of the head and neck.

Patients with head and neck cancers, she explains, often are poor, and their diseases sometimes are caused by factors such as smoking or drinking alcohol. She suggests that the public's perception of people with behavior-induced cancers was, for many years, that "the patients brought it on themselves, and the cancer was not worthy of study."

Meanwhile, she says, an emerging epidemic of these cancers has been prompted by an outbreak of human papillomavirus (HPV) infection in the head and neck. More HPV-related cancers are cropping up across North America, including at UPMC.

As a surgeon, though, Grandis still had the training to remove a cause of suffering. "I was tantalized by that possibility," she says.

Her dedication—and the extensive research she has conducted over the years as a result—have turned Grandis into a prolific Pitt Innovator with commercial aspirations for several gene-based therapies and a novel screening platform for mutated genes in cancerous tumors.

Targeted Therapies

Early in her medical career, while she was still an assistant professor, Grandis studied a growth factor receptor, which is a molecule that is expressed at higher levels in the tumors of patients with poor outcomes. By targeting that molecule with various treatments, she hoped to weaken the cancer. One approach, which uses gene therapy, was patented after a Phase I clinical trial and now is undergoing a Phase II trial.

Grandis also is pursuing another treatment that uses a therapeutic agent targeting the STAT3 gene, which is responsible for making proteins that are part of chemical signaling pathways within cells. Her lab, she says, has completed an early clinical trial with the targeted therapeutic agent and has worked with OTM to submit patent applications for that new treatment.

Most recently, her lab developed a platform that screens genetic mutations within cancerous tumors. The screen allows researchers to determine which of the mutations—which can number anywhere from 50 to about 150—are driving the tumor's growth and which are just "hitching a ride." By identifying the driver mutation, Grandis says that she hopes she then will be able to identify therapeutic agents that selectively block any cells containing that mutation.

Grandis credits her 15-year relationship with OTM with helping her to learn how to navigate the complex world of commercialization.

"They're very responsive," she says of OTM's staff. "They're willing to meet and engage in a dialogue."

Learning a New Language

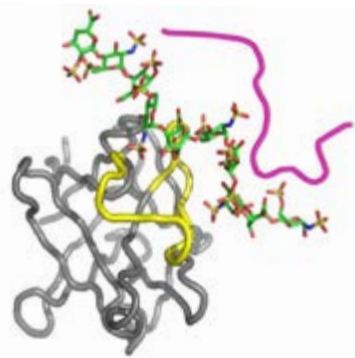
For a scientist, Grandis admits, the task of bringing an idea from lab to bedside can be daunting.

"The challenge with commercialization for academic investigators is really twofold," she explains. "One is knowing what's really amenable to commercialization, and two is identifying companies that will license technology."

While she has confidence in her innovations, Grandis says that she has felt awkward approaching potential licensees because she feels biased as the inventor. The staff at OTM helped her to learn how to think differently and find people at professional meetings who are open to discussing inventions.

As she continues to innovate, Grandis expresses hope that her work will lead to better treatments for this population.

Says Grandis: "Once I began to learn about what OTM did, I was more active about engaging them when I thought something was meaningful."



Growth, One Molecule at a Time

Bioengineering professor Yadong Wang is working with OTM to transform his novel growth factor delivery system into a new company

When Yadong Wang was pursuing postdoctoral studies, he had a dilemma: Trained as a chemist, he loved the creativity of a science that allowed him to make new molecules but hated the idea that his work would be largely theoretical, taking hundreds of years to translate into a practical application.

So he turned his sights to a different discipline: biomedical engineering, which was geared more toward applied research. Fourteen years later, he hasn't looked back.

"I like to observe how nature works and see if I can use that to do something different, something new," says Wang, W.K. Whiteford Professor in the Department of Bioengineering. "That's always been my personal interest."

Wang's professional curiosity has led him to explore an area of science that he says has been lying fallow for a few years, owing to disappointing results in earlier attempts at commercialization. Since the 1970s, he explains, researchers have known about the importance of growth factors, which are highly potent molecules that can profoundly affect biology. Growth factors dictate whether a cell will proliferate, stay the same, or die, and throughout much of the 1990s, the pharmaceutical industry poured billions of dollars into their development only to realize a weak return on investment.

The problem, Wang now says, is that researchers didn't know how to use the molecules effectively. If they were injected as free-form proteins into the body, they simply were consumed by normal body chemistry or flushed away.

Birth of an Idea

After stumbling on some literature about the structure of growth factors, Wang says he began working on methods that would allow him to anchor the elusive molecules to the targeted cells—whether they were damaged heart muscles, spinal cords, or stubborn wounds—to promote faster healing. He finally found a novel way to create that anchor, and the early results of tests in his lab have been dramatic enough to win him federal funding to pursue his idea further.

In early 2011, Wang began thinking about ways to commercialize his innovation. He credits OTM with helping him to determine what steps to take when he had promising preliminary data that still were in relatively early stages. Wang, with help from OTM and an executive in residence there, wrote a business plan for a possible start-up company and began making initial contact with entrepreneurs, investors, and others for funding and other support. He anticipates that he soon will be armed with enough convincing data to present to investors and larger pharmaceutical companies for their consideration.

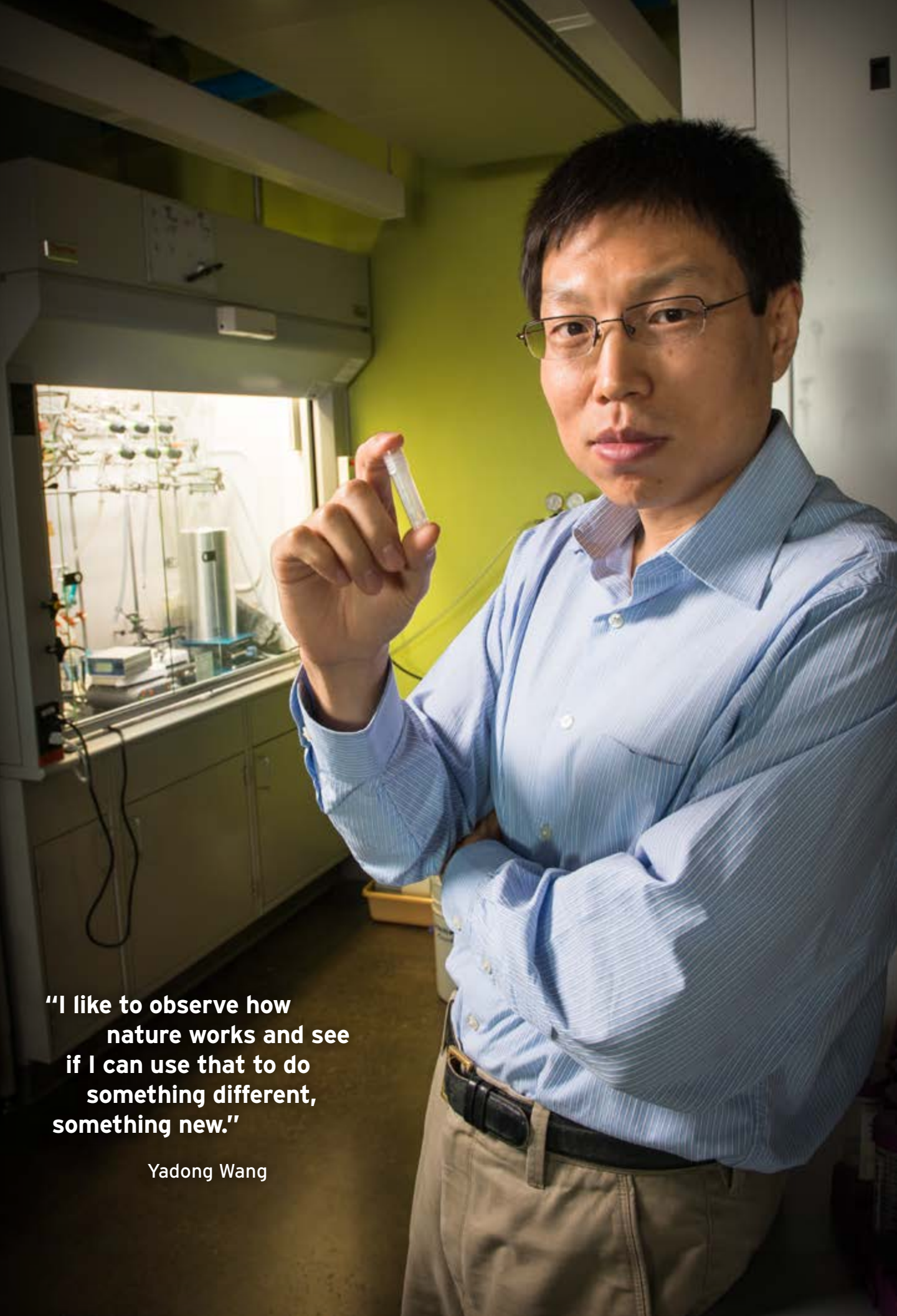
Wang currently is exploring three commercial uses for his innovation. First, he is working to apply growth factor to the damaged muscle tissue of heart attack patients. Second, he hopes his growth factor delivery method will allow wounds to heal faster in patients with diabetes or other complicating conditions. He also is studying ways to treat the devastation caused by spinal cord injuries. His method uses much smaller amounts of growth factor than did earlier efforts; the molecules are delivered in an aqueous solution through a hair-thin needle, making the procedures far less invasive and widening the range of possible applications.

"If you think about it, just about everywhere in your body there is a growth factor—or multiple growth factors—working, spinal cord included," he says.

Next Steps

Wang is collaborating with Johnny Huard, the Henry J. Mankin Chair in the Department of Orthopaedic Surgery and director of the Stem Cell Research Center, on possible orthopaedic applications. David Schwartzman, a professor of medicine and member of the UPMC Heart and Vascular Institute, is collaborating on cardiovascular work. And Michael Lang, an OTM executive in residence, is assisting with the business plan.

"It will take significant effort to communicate the preclinical results to a large audience," says Wang, who is cautious but excited about the prospect of working toward real products. "Theory is beautiful, but I want something real as well."



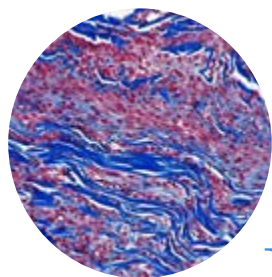
**"I like to observe how
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Yadong Wang



**"OTM seems
to understand my
motivation and
my mind-set."**

Stephen Badylak



Joint Ventures

Surgery professor Stephen Badylak's prolific innovations target joint regeneration

When Stephen Badylak interviewed for his job at the McGowan Institute for Regenerative Medicine in 2003, he had an unusual requirement: He wanted to meet with OTM before he decided whether he wanted the position.

A surgeon with decades of expertise in patenting innovations related to cell experience, Badylak already was extremely savvy in negotiating the commercialization of his discoveries. He says it was important to him to land in an environment that would assist in commercialization without disengaging him from the entrepreneurial process.

And he did.

"OTM seems to understand my motivation and my mind-set," Badylak, who today serves as the McGowan Institute's deputy director, says of the OTM staff.

"It was a terrific move for me," says Badylak. "I did not recognize what I was missing by not being at a university with a medical school that was part of it."

From Jaw Joints to Gels

Badylak has been characteristically prolific in the decade he has spent at Pitt, submitting roughly 25 invention disclosures on his innovations to OTM for commercial consideration. His research explores the world of extracellular matrix (ECM) materials and the use of those materials to create novel scaffolds that allow the body to regenerate its own tissue and heal from a variety of conditions.

Among his most recent innovations is a reconstructive device that enhances the regeneration of the temporomandibular meniscus, which connects the jaw to the skull but can degenerate, particularly in women 18–40 years old. Currently, when the joint wears down, it is replaced with hardware, and efforts to produce a synthetic meniscus, Badylak says, have not succeeded so far.

But Badylak's ECM-based device replaces the native meniscus, and he believes it's far enough along in its development now to be licensed and commercially viable within a few years.

Badylak says that the underlying technology could serve other areas of the body as well.

In addition, Badylak's lab is working to identify and characterize the breakdown products of ECM—which consists of growth factors, structural proteins, and other functional biomolecules—in an effort to possibly find new drug candidates based on these breakdown products. And his group is collaborating with other Pitt researchers to develop next-generation "bio-hybrid" scaffolds that combine naturally occurring ECM materials with polymers.

Badylak's lab also is developing an injectable gel version of ECM, which normally is a solid, allowing doctors to deliver it directly to the target site—be it a stroke lesion in the brain or a knee joint—without surgery.

"Minimally invasive approaches make it very attractive now, not only to companies but also to physicians," he says.

Targeting the "Middle Ground"

When developing projects for commercialization, Badylak says that one challenge is finding the right fit for an invention that targets what he calls the "middle ground." In other words, it addresses a problem that is not small enough to be an orphan cause and not big enough to put a dent in a pharmaceutical giant's bottom line. But the invention does create a solution for the patient, which is important to him as a physician.

Badylak says that finding the right commercial partner to back such ideas creates a perfect investment opportunity: The company identifies a niche for its selective investments, and an unmet clinical need is addressed. And therein lies the synergy in his relationship with OTM at Pitt. "Right now, I'm very comfortable with the way I work with OTM," he says.



Apps in the Academy

Research nurse Steven Benso and others are turning to smartphones and other mobile computing devices to accommodate their new health care innovations

Is there a mobile app for that? That's the question Pitt Innovators such as Steven Benso, a traumatic brain injury research nurse at Pitt, and two of his friends asked when trying to figure out how to better manage the cumbersome continuing education (CE) requirements for nurses. When they couldn't find a good solution, they simply developed their own.

"Part of being a nurse is having to take continuing education courses," says Benso, a clinical coordinator in the Department of Neurological Surgery. "Every two years, I have to have 30 credit hours, but how do I keep track of that? And what do I do with the certificates—put them in a trunk or folder? You have to be very organized about it."

Benso, along with Anthony Chao, a student in Pitt's School of Nursing, and Richard Fera, IT coordinator in the School of Nursing, set out a couple of years ago to develop a mobile app-based service that keeps track of CE credits, certificates, current requirements, and even course offerings. Initially, they're developing a product for the nursing profession, but they have their sights set on other professions that require CE credits as well. This past year, they licensed the innovation from Pitt and started a company called 3Storm, Inc.

So it goes for a growing number of Pitt researchers who are taking advantage of the surge in the use and abilities of smart mobile communication devices such as phones and tablets to better manage and analyze data and even to monitor patients. Helping to cultivate such commercialization activities is Greg Coticchia, an executive in residence with OTM, who searches the University for useful computer software and mobile apps with commercial—and especially start-up—potential.

"This is really just the next generation of software [development]," says Coticchia, who works with Benso and others on campus to develop and commercialize their innovations. "It's bringing accessibility and ease of use to a level that has never been there before, particularly in health care."

From Anxiety Treatment to Knee Rotation Analysis

Taking advantage of such accessibility, for instance, is Jennifer Silk, associate professor of psychiatry and psychology at Pitt, who has developed a smartphone

app that provides a new and more immediate level of cognitive behavioral therapy to children with anxiety disorders. Her Ecological Momentary Treatment Enhancement app enables children to respond daily via their smartphones to a series of questions about their real-life emotional situations.

Volker Musahl, associate professor of orthopaedic surgery, and colleague Freddie Fu, Distinguished Service Professor and department chair, have developed an Apple iPad-based image analysis tool for more accurate quantitative measurement of pivot shift tests for the knee. This test is used for evaluating rotational instability of the anterior cruciate ligament (ACL)-deficient knee. This new app is designed to enable a simpler, more affordable quantitative measurement of the test.

And in the School of Social Work, Associate Professor Daniel Rosen has developed a tablet-based app enabling older heart failure patients to communicate their progress more effectively to their health care providers after a hospital stay, thereby helping to prevent costly readmissions to the hospital. This innovation recently was licensed to a new start-up company called Wellbridge Health, Inc.

Coticchia says that the mobile app opportunities at Pitt are available to "anybody who is doing research in an area where there are lots of data to be analyzed and visualized or any process that requires better compliance."

Still, as Benso and his partners are quick to acknowledge, the commercialization journey for mobile apps does take a commitment of time, money, and education. "It's challenging," says Benso, "but it has been well worth it because we want to prove that this kind of model will work."

Benso and his partners competed last year in the Wells Student Health Care Entrepreneurship Competition—and won \$10,000. They also attended the Office of Enterprise Development's From Benchtop to Bedside educational course as well as training programs offered by Pitt's Small Business Development Center. As of this printing, Benso says, the start-up company has an alpha product called CE Agent and is preparing for a beta test.

Says Benso of the experience so far, "Even a simple idea requires lots of work, but I think we all have learned a lot."

**"Even a simple idea
requires lots of work,
but I think we all
have learned a lot."**

Steven Benso





Seeding Collaborations

The Center for Medical Innovation is training the next generation of medical device engineers and funding new innovations

Critically care medicine professor John Kellum began to strategize in late 2010 about how to more effectively remove toxic carbon dioxide from the blood of critically ill patients who require mechanical ventilation assistance to breathe. He and his research team found a novel solution—what he considered a promising translational research project—but funding such a project would prove to be difficult.



Alan Hirschman

That is, until Kellum had an encounter with Alan Hirschman, a visiting professor of bioengineering. Hirschman, a former Bayer AG executive, helped to launch the fledgling University of Pittsburgh Center for Medical Innovation (CMI) and now serves as its executive director. The mission of the center, which was conceived in 2011 in the Swanson School of Engineering, is, in part, to link engineering faculty members and students to health care clinicians for the early stage development of innovative medical technologies and to provide funding for those projects. That encounter led to a pilot partnership in which Kellum teamed with longtime collaborator William Federspiel, a bioengineering professor working in artificial lung research. Theirs was one of several initial pilot projects funded by CMI in 2012 and one of 14 early stage collaborations that have been funded overall.

“Ours is one of many stories where we have these kinds of ideas, but they’re hard to fund with traditional grant mechanisms,” says Kellum, who also is vice chair for research in the School of Medicine’s Department of Critical Care Medicine. “CMI has provided seed money so that we can develop a proof of concept and some animal data.”

CMI is largely the brainchild of Mark Redfern, former associate dean for research in the Swanson School and now the University’s vice provost for research. “The vision for CMI is to bring the talent and expertise from the sciences and engineering together with clinicians who see problems and opportunities in health care,” Redfern says.

Leading the charge is Hirschman, an electrical engineer and technology manager who had retired from Bayer’s MEDRAD division after 31 years with the medical device

company, most recently as a member of its senior management team. “I was looking for something to do in retirement and thought I could develop and teach a course [at Pitt] in methodologies for concept development and medical product engineering,” Hirschman says, laughing. “Turns out, there was a much bigger job that needed to be done.”

Since then, Hirschman has helped to establish CMI’s mission with help from Pitt’s Coulter Translational Research Partners II Program, which has provided half of the funding for CMI’s early stage projects. The Swanson School has provided matching funds. Hirschman describes CMI as a feeder system for later-stage commercialization projects funded by the Coulter program.

Currently, CMI provides up to \$25,000 a year per early stage project along with “advice on how to make the projects more valuable,” Hirschman says.

CMI is organized as a multidisciplinary effort involving the Swanson School, schools of the health sciences, Joseph M. Katz Graduate School of Business, and OTM, with guidance from a new advisory board. On the educational front, Hirschman, Redfern, and CMI’s associate directors have developed an extensive curriculum as part of a new professional master’s degree in bioengineering with a medical product engineering specialization and a new professional certificate in medical product innovation.

As for Kellum and his team, which has included clinician-scientists Matthew Cove and Ayan Sen, the CMI funding has allowed them to develop a way to remove carbon dioxide in the blood of critically ill patients in the form of bicarbonate using a standard continuous renal replacement therapy device, but with some unique modifications. They include the development of a novel dialysate that enables the removal of the bicarbonate before it turns into carbon dioxide. Current dialysates actually add bicarbonate to the blood rather than removing it, and prior efforts to remove bicarbonate have, Kellum says, been “fraught with severe metabolic acidosis.” The new innovation solved this problem.

Kellum credits CMI with allowing such progress. “I think it has been very helpful,” he says. “If you want to have an impact on patients, the only way is to generate evidence. As a physician, having an impact on patients is what has always motivated me.”



"If you want to have an impact on patients, the only way is to generate evidence. As a physician, having an impact on patients is what has always motivated me."

John Kellum

Innovation commercialization and entrepreneurship, without question, are fast becoming an integral part of the academic endeavor at the University of Pittsburgh thanks to the growing number of participating Pitt Innovators with support from OTM, OED, the University's economic development partners, and business mentors, among other partners.

It's a cultural shift that has made its way through Pitt's diversity of academic disciplines across campus and spawned new dialogue, collaborations, educational programs, and opportunities for interaction with potential commercial partners over the past fiscal year.

Leading the way into that continued shift in fiscal year 2013, with support and direction from Pitt's senior administration, were OTM and OED, which not only facilitated the patenting and licensing of innovations but also continued to educate Pitt Innovators about commercialization, business planning, developing value propositions and "elevator pitches," and entrepreneurship. OTM and OED then spent considerable time creating opportunities for those innovators to compete for prizes; work with mentors; and interact with entrepreneurs, investors, industry, and other potential partners in their quest to find licensing partners or start-up opportunities.

Moreover, OTM and OED continued to work closely with Pitt Innovators along the entire commercialization process to help them facilitate the process, including navigating programs such as the Small Business Innovation Research grant program, coordinating iLab Innovation Brainstorming sessions for their innovations and research endeavors, and other services.

To celebrate their successes, OTM and the Office of the Provost hosted the University's eighth annual Celebration of Innovation. As part of the event, which was attended by more than 150 people, including Chancellor Mark A. Nordenberg, Provost and Senior Vice Chancellor Patricia E. Beeson, and Senior Vice Chancellor for the Health Sciences and Dean of the School of Medicine Arthur S. Levine, those Pitt Innovators whose innovations had been licensed/optioned to industry or start-up companies in FY 2013 were awarded Pitt Innovator Awards.

EDUCATION AND TRAINING

This past year, OTM and OED continued to offer a number of departmental introductory presentations and workshops via the Office of Human Resources' Faculty and Staff Development Program aimed at encouraging researchers to get involved in the commercialization process. The sessions attracted dozens of attendees, many of whom were planning to submit invention disclosures to OTM for commercial consideration.

In addition, OTM once again partnered with the Office of the Provost and the Joseph M. Katz Graduate School of Business' Center for Executive Education last

fall to offer its annual Academic Entrepreneurship: The Business of Innovation Commercialization course for those who are considering the commercialization of their innovations. The seven-week hands-on course attracted 28 participants, including faculty members, staff members, and graduate students.

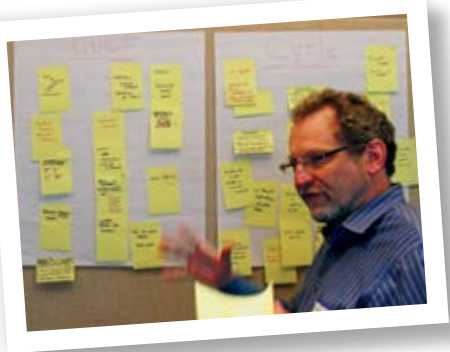
OED, meanwhile, continued to refine its popular course From Benchtop to Bedside: What Every Scientist Needs to Know expanding it to a full 14 weeks and offering academic credit to students in the course. The latest course began in January 2013. In addition, OED launched a second section of the course in partnership with the Swanson School of Engineering's Coulter Translational Research Partners II Program. Research collaboration teams vying for Coulter grant funding (and who had made the first cut in the review process) were required to participate in the course before submitting their final grant proposals for consideration.

Altogether, the two course sections drew more than 70 participants and were deemed an overwhelming success. Consequently, OED plans to host two sections of the course again this year in conjunction with the Coulter program.

IGNITING COMPETITIVE SPIRITS

As part of the training process for Pitt Innovators, OTM and OED hosted two competitions this past year and cosponsored a third to help the innovators to hone their business planning and marketing skills. Last fall, OED hosted its second annual Wells Student Health Care Entrepreneurship Competition, which included a \$10,000 award for use by the winner to move his or her innovation forward in the commercialization process. The contest is named after Pitt alumnus Michael G. Wells, who contributed the funds to support the competition.

The latest winner was an entrepreneurial team led by Steven Benso, a traumatic brain injury research nurse, and two Pitt partners. Together, they developed CE Agent, a smartphone application that enables nurses and other professionals



John Kellum, vice chair for research in the Department of Critical Care Medicine, enlisted OTM and its iLab Innovation Brainstorming Workshop this past May to explore new research opportunities.

to better manage their continuing education credits and ongoing requirements (see the related feature “Apps in the Academy” on page 16).

That same team placed third in an elevator pitch competition that was held as part of the region’s 2013 3 Rivers Venture Fair. The showcase and competition, sponsored by Pitt and Carnegie Mellon University, included innovations from both universities that offered start-up potential.

OED also hosted an elevator pitch competition on behalf of researchers in Pitt’s McGowan Institute for Regenerative Medicine at the institute’s annual retreat. Winning first place was Kathryn Farraro of bioengineering professor Savio Woo’s lab. Her topic was “Biodegradable Scaffold for Repair of a Torn ACL.”

Education for Pitt Innovators also remained central to OED’s annual Technology Showcase, which kicked off the University’s 2012 Science conference. This past year, innovators featured 34 different innovations that were available for licensing. The event itself attracted more than 250 people.

As part of the experience, participating innovators were paired with mentors from Pittsburgh’s business, entrepreneurship, investment, and economic development communities who worked with the innovators to refine their value propositions and improve the way they convey their business opportunities.

MARKETING PITT INNOVATORS

OTM and OED remained vigilant in their outreach in FY 2013 on behalf of Pitt Innovators. OTM paid for staff members and Pitt Innovators to attend numerous international conferences to promote themselves and their technologies, including the BIO International Convention in Chicago, Ill.; the Association of University Technology Managers Annual Meeting in San Antonio, Texas; and the Angel Capital Association Summit in San Francisco, Calif.

Licensing managers and business development staffers attending those

conferences met with dozens of industry contacts to market specific technologies as well as the innovators developing them. OTM also hosted exhibit booths at several of the conferences to give greater marketing exposure to Pitt’s commercialization efforts.

To support those efforts, OTM this past year added to its portfolio of marketing materials that promote specific areas of research collaboration representing Pitt strengths. The latest brochure focuses on drug discovery and Pitt’s Drug Discovery Institute. It now is available on the OTM Web site, innovation.pitt.edu, along with others in the series. OTM also updated brochures covering energy and medical imaging research.

OED also took several Pitt Innovators to the by-invitation-only University Research & Entrepreneurship Symposium in Cambridge, Mass., a one-day conference showcasing promising innovations to a group of New England’s top entrepreneurs and venture capitalists. Three Pitt Innovators were invited to participate.

REGIONAL PARTNERSHIPS

OTM and OED continued to partner actively with the region’s supportive economic development community to promote innovation commercialization and entrepreneurship and provide funding support and guidance in such activities. Among their partners were the following:

- Innovation Works
- Pittsburgh Life Sciences Greenhouse
- Idea Foundry
- Urban Redevelopment Authority of Pittsburgh
- Pennsylvania Department of Community and Economic Development (DCED)
- Pittsburgh Venture Capital Association
- Pittsburgh Technology Council
- MIT Enterprise Forum of Pittsburgh
- The Indus Entrepreneurs (TIE)

NEW START-UP INITIATIVE

This past February, the University partnered with Carnegie Mellon to develop a new

initiative to spin out more companies based on university technologies. The collaboration is being funded with \$200,000 from DCED’s Keystone Innovation Network grant program along with \$25,000 from DCED’s Greater Oakland Keystone Innovation Zone. Each school has contributed an additional \$75,000.

As part of the initiative, the two schools have teamed up in the development of mentoring advisory teams that have begun to consult actively with innovators from both schools throughout the commercialization process. The initiative also includes additional resources for OTM’s executive in residence program and commercialization gap funds for specific innovation development projects.

The bottom line with all of these activities for Pitt Innovators and partners is this: The success of Pitt’s innovation commercialization and entrepreneurship activities depends largely on the willingness of Pitt Innovators to participate actively in the process and on the continued support of commercial partners, including entrepreneurs and other business leaders, investors, economic development organizations, and industry.

The activities of OTM and OED are designed to fully engage Pitt Innovators in the commercialization process, teaching them along the way how to do so more effectively. And the activities are developed in a way that fosters strong long-term relationships with outside partners who support Pitt Innovators and their efforts. Combined, such activities have made Pitt’s innovation commercialization and entrepreneurial endeavors a success once again.



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