



## PAST TO FUTURE:

50 years of  
breakthroughs at the  
University of Minnesota  
Medical School

2007 Dean's Report  
UNIVERSITY OF MINNESOTA

Medical School

STEM CELLS



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## FROM THE DEAN

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A snapshot of where we've been, a vision of where we're headed—that's what we offer in this *2007 Dean's Report* from the University of Minnesota Medical School.

### LEARNER-CENTERED EDUCATION

We honor our past and anticipate our future in the profound responsibility of educating the next generation of physicians. In 1910, Abraham Flexner wrote in his famous report that we were doing it right. "Minnesota is perhaps the first state in the Union that may fairly be considered to have solved the most perplexing problems connected with medical education and practice."

Yet it would be an understatement to say that, since Flexner, times have changed. In everything from medical knowledge to health care delivery, medicine appears to be a new field. Our students are different, too; keenly aware of family responsibilities, they desire a balanced life. In one important aspect, however, our medical students today and in the future resemble those of the past: They feel called to study medicine to benefit their fellow human beings.

In addition, our Medical School's commitment to be at the forefront of medical education has not changed. In the *2006 Dean's Report*, we reported on our initial efforts to individualize learning through Medical Education Development 2010 (or MED 2010). Students come to our Medical School with different skills, talents, and knowledge; we encourage them to pursue their passions for medicine. When they graduate, we

want them not only to pass a licensing exam, but also to embody the competencies that will nurture a life-long practice in medicine. In "Roads Less Traveled" (page 14), you'll read about a few of our medical students who have taken advantage of one of our MED 2010 learner-centered educational reforms, the Flexible M.D.

Even as we advance MED 2010, learner-centered education for patient-centered care, we continue our important work of educating primary care and specialty physicians for Minnesota and beyond.

- In 2007, the University of Minnesota Medical School was recognized as one of the top 10 schools for educating family medicine physicians by the American Academy of Family Physicians. We are the only research-intensive medical school in that group.

- Our Rural Physician Associate Program, begun in 1971, has more than 360 alumni practicing in Minnesota small towns.

- The recent integration into our Medical School of the Duluth campus's medical education program, with its mission of preparing primary care physicians for rural and American Indian communities, positions us well to continue to address the needs of our state and region.

- We rank second nationally in educating American Indian physicians.

- And, whether they are in primary care or specialties, more than 5,700 of Minnesota's practicing physicians are alumni of our Medical School.



We've only begun MED 2010. We're very excited about its possibilities, including exploring new models of transition to residency based on individuals' needs for training. Next year, we expect to have more progress to report.

### **PATIENT-CENTERED CARE AND RESEARCH**

Our approaches to research and clinical care also are informed by our legacy. Our blood and marrow transplant program, renowned since 1968, takes advantage of team-based care to help children after transplant (see "We don't let go," page 22).

And we trace a proud heritage in cardiac care and research. From a University heart surgeon's collaboration on the first portable pacemaker 50 years ago to new cardiology

leaders today who will take advantage of our understanding of stem cells, we are poised to advance knowledge and enhance health in Minnesota and beyond. (See "Setting the Pace," page 10.)

Along with cardiovascular and pulmonary research and care, our strengths include neuroscience (cognition, brain imaging, and neurodegenerative disease); infectious disease and immunology (HIV/AIDS and emerging diseases); diabetes and the metabolic syndrome; and, cancer research, basic, translational, and clinical.

The Medical School is driven to discover. We are part of the University of Minnesota, an outstanding public research university, and our faculty collaborate with the Mayo Clinic in the Minnesota Partnership for Biotechnology and Medical Genomics, which this year received \$25 million from the State of Minnesota. This fall, we break ground on the new \$60 million Medical Biosciences Building, primarily funded by the state, which will house researchers in infectious disease, immunology, cancer, and neurosciences.

In all we do, we continue to build a foundation for excellence.

Deborah E. Powell, M.D.  
 Dean of the Medical School  
 Vice President for Clinical Affairs  
 McKnight Presidential Leadership Chair  
 University of Minnesota

## NEWS FROM THE MEDICAL SCHOOL



### Gold Medal for Garwood

**Michael Garwood** received the 2007 Gold Medal Award at the Joint Annual Meeting of the International Society for Magnetic Resonance in Medicine and the European Society for Magnetic Resonance in Medicine and Biology. Garwood, associate director of the University's Center for Magnetic Resonance Research, is internationally recognized for incorporating magnetic resonance imaging with magnetic resonance spectroscopy technology to advance noninvasive diagnosis of cancer and to monitor response to therapies. During his speech, Garwood thanked his colleague CMRR Director Kamil Ugurbil, who won the Gold Medal in 1996.

### Top 10 in educating family physicians

In April 2007, the Medical School received an Achievement Award from the American Academy of Family Physicians as one of the Top 10 medical schools in the nation for training physicians interested in family medicine. "We are very proud to be recognized for our success in educating family medicine physicians," says Dean Deborah Powell. "The education of primary care physicians is one of our core values and is the particular mission of our Duluth campus." Based on a three-year average ending October 2006, the University of Minnesota Medical School has placed 16.8 percent of its graduates in family medicine residency programs. The other top 10 medical schools in the nation who train and produce family medicine physicians include University of Kansas School of Medicine, University of Missouri-Columbia School of Medicine, University of Arkansas College of Medicine, University of North Dakota School of Medicine, Joan C. Edwards School of Medicine at Marshall University, Michigan State University College of Human Medicine, The Brody School of Medicine at East Carolina University, University of Oklahoma College of Medicine, and Loma Linda University School of Medicine.

*Tara Frerks, 2007 graduate who is now a family medicine resident, is shown with faculty member Nancy Baker.*



PHOTOGRAPH BY MARK LUNENBERG



## Archive on military medicine in war on terror

Under the leadership of **Steven Miles**, professor of medicine and ethicist, the University of Minnesota's Center for Bioethics and the Human Rights Library created a comprehensive archive of government documents describing medical operations in U.S. prisoner of war facilities in Iraq, Afghanistan, and Guantanamo Bay, Cuba. The archive follows Miles's book, *Oath Betrayed: Torture, Medical Complicity, and the War on Terror*, in which he asked the question, "Where were the doctors and nurses at Abu Ghraib while the notorious abuses were taking place?" The archive ([www.umn.edu/humanrts/OathBetrayed/](http://www.umn.edu/humanrts/OathBetrayed/)) contains more than 60,000 pages of indexed White House and Defense Department policies, prison medical records, autopsy reports, criminal investigations, sworn witness statements, and e-mails involving the Armed Forces and the FBI.

## Powell honored by Association of Pathology Chairs

Medical School Dean **Deborah E. Powell** was presented with the Distinguished Service Award by the Association of Pathology Chairs in July 2007. "To be honored by your colleagues in medicine is wonderful," says Powell. "The members of the Association of Pathology Chairs have been extraordinarily collegial to me, and I am pleased to receive the Distinguished Service Award from such a special group." Powell is the first woman to receive the award, which has been presented annually since 1986 to an individual who has made substantial contributions to academic pathology in research, in education, or in advancing the discipline of pathology in the medical community and to the public.

## New children's hospital to break ground

In late 2007, **University of Minnesota Children's Hospital, Fairview**, will break ground on a new, freestanding home. Fairview Health Services is a partner with the Medical School in education, research, and providing care. When completed in 2010, the new six-story, 207-bed facility will bring together pediatric and maternal services in a family- and patient-centered environment. The facility will be a children's academic medical center for researchers making the discoveries for the future and physicians providing care in a state-of-the-art hospital, which allows for the rapid transfer of research and education to patient care. It is expected that the new hospital will cost \$175 million to build.



## New Institute for Engineering in Medicine builds on University strengths

Building on strengths in engineering, bioengineering, and medical devices, the Medical School and the Institute of Technology jointly established the Institute for Engineering in Medicine ([www.iem.umn.edu](http://www.iem.umn.edu)) in summer 2007. The new institute, headed by Jeffrey McCullough, promises to link researchers across the University and also promote connections with Minnesota's robust biomedical and medical device business community.



Gary Davis, above, now leads the Medical School-Duluth campus program. Doug Yee, below, is only the second Cancer Center director.

## Davis takes reins on Duluth campus

Gary Davis is the new academic leader on the University of Minnesota Medical School-Duluth campus. Davis, a licensed clinical psychologist, knows well the challenges and rewards of the Duluth campus mission to educate primary care physicians for rural and American Indian communities. Among other accomplishments, he established an award-winning mental health telemedicine program for rural Minnesota and was named a Minnesota Rural Health Hero in 2006.

Davis is responsible for all aspects of the Duluth campus mission: education, research, university service and outreach, and certain clinical services. Medical School Dean Deborah Powell says: "Davis brings integrity, thoughtfulness, and strong communication skills to this important role in our Medical School." Davis, named the interim leader in January 2007, accepted the position of senior associate dean in July.

Joining the faculty in 1975, Davis has been chair of the Behavioral Sciences Department on the Medical School-Duluth campus since 1984. He also is associate director of the Center for Rural Mental Health Studies. Davis, a diplomate and fellow in psychopharmacology and serious mental illness, succeeds Richard Ziegler, whose term as leader of the Duluth campus ended in 2006.

Duluth campus students, selected to fulfill the mission, begin their medical education with basic-science coursework combined with clinical exposure. Many pursue third-year experiences in the Rural Physician Associate Program, which places 35 to 45 students in sites around the state. They join their peers in the Twin Cities to complete their clinical rotations. Davis is excited to lead this community of learners. He says: "I am pleased to...work with the faculty and staff on this campus and physician-teachers from Minnesota communities who have shown unwavering commitment to our mission since this school began in the early 1970s."

## Yee is new Cancer Center director

"I would love to be out of business," says Douglas Yee, a medical oncologist who became the second director of the University of Minnesota Cancer Center in spring 2007. "Remember? We used to have TB sanatoriums."

While the day that National Cancer Institute-designated comprehensive cancer centers such as Minnesota's can close their doors may be distant, Yee sees a step in that direction coming from research investigating the pathways that cancers need to survive. And, the University of Minnesota can accelerate progress toward prevention and treatment of cancer with such resources as its renowned basic scientists in the Medical School, clinicians dedicated to improving





cancer care, epidemiologists interested in cancer within a robust School of Public Health, and a strong multi-disciplinary tobacco control program in the Transdisciplinary Tobacco Use Research Center.

Yee, who treats patients with breast cancer and studies growth regulation of tumors, came to the University of Minnesota eight years ago, after holding faculty positions at Georgetown University Medical Center and the University of Texas Health Science Center at San Antonio. He earned his M.D. from the University of Chicago, and trained at the University of North Carolina and the National Cancer Institute in Bethesda, Md. John Kersey, who led the Cancer Center from its founding in 1991 until 2007, plans to continue his research as holder of the Children's Cancer Research Fund Land Grant Chair in Pediatric Oncology and Founding Director Emeritus.

As the new director of the Cancer Center, Yee expects to promote translation of laboratory breakthroughs into better treatments for patients through clinical investigation. "If we design our systems to optimize clinical research, it optimizes clinical care." He adds that we live in an era of shared decision-making: "We're partnering with patients to improve cancer outcomes."

## Slack heads Stem Cell Institute

Stem cells hold great promise to improve health, says Jonathan Slack, who arrived in March 2007 from the University of Bath, England, to become the director of the Stem Cell Institute.

"We look back 150 years and we are horrified that so many women died in childbirth or that anyone with an abdominal wound would die of sepsis," Slack told a reporter. "Yet, I think our grandchildren will look back in 100 years' time and be amazed that we tolerated things like neurodegenerative diseases, severed limbs that cannot be restored, or spinal trauma leading to paralysis. And they may think those things are just as horrific as we think those supposed incurable conditions of the past are."

A developmental biologist, Slack uses model systems to examine mechanisms of transdifferentiation, such as reprogramming biliary tract cells into pancreatic beta cells, and of tissue regeneration: understanding the cellular responses that permit simpler animal systems to regenerate tissues that have been lost or severed. He and his laboratory also examine the molecular identity of stem cells and the rules for their differentiation to more mature progeny.

He earned his first degree in biochemistry at Balliol College, Oxford University, and his doctorate at Edinburgh University. Among his honors, Slack was elected a Fellow of the U.K. Academy of Medical Sciences in 2004.

Slack is the second director for the Stem Cell Institute, which was founded in 1999. The founding director, Catherine Verfaillie, still holds a part-time appointment at the University of Minnesota but now directs a stem cell institute at the Catholic University of Leuven, in Belgium.

"I believe our Stem Cell Institute, which was the first to be established, will benefit greatly from Prof. Slack's interest in advancing the science," says Dean Deborah Powell.



Jonathan Slack now leads the Stem Cell Institute, first to be founded in the nation.

# Setting the Pace

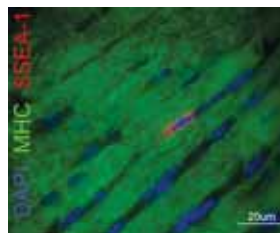
For 50 years, Minnesota physicians, scientists, and engineers have been driven to discover the next improvements for cardiac patients.

A bulky piece of equipment that needed to be plugged into the wall, the early heart pacemaker was quite a contraption. It was a lifesaving contraption, however—until the power went out across the Twin Cities and one of C. Walton Lillehei's patients died. Lillehei was a daring University surgeon who, with his team, developed new approaches to repair congenital heart defects such as tetralogy of Fallot. He often is called the Father of Open Heart Surgery.

It was 1957 when Lillehei turned to engineer Earl Bakken and asked for something remarkable: a heart pacemaker that would be reliable, with no need to plug into a wall socket, and more transportable than the models in use.

Bakken remembered a description of a battery-powered metronome in a back issue of a trade magazine. It inspired his invention of a portable pacemaker, about the size of a paperback book, connected to the heart via a wire inserted in the chest. After one day of testing on animals, Lillehei used it to successfully treat a child patient suffering from heart block. "It was an emotional moment the day I saw this pacemaker attached to the child's chest," Bakken told *Minnesota Medicine*.

Doris Taylor, left, who holds the Medtronic Bakken chair, and Daniel Garry, new head of the Lillehei Heart Institute, continue the legacy of University of Minnesota pioneers in cardiovascular research and care using heart stem cells (pictured at right).



Taken for granted today, this breakthrough treatment 50 years ago helped to set the pace for the University of Minnesota Medical School's prominent role in cardiovascular care, research, and education, while establishing a foundation for a multibillion-dollar Minnesota company, Medtronic. In the years since, the Medical School's physicians, collaborators, and patients benefited from an atmosphere of discovery and commitment to excellence. Today, the Medical School is launching on a new trajectory, one that promises to move the field of cardiovascular care into new territory.

"Stem cell biology and progenitor cell biology is going to teach us a considerable amount about how the heart develops, grows, and adapts to heart failure. We're going to be able to intervene," says **DANIEL J. GARRY**, the physician-scientist who recently became St. Jude Professor and director of the Lillehei Heart Institute, as well as cardiology division director in the Department of Medicine. Fifty years from today, he says, "we will be able to modulate the signals to allow the heart to repair itself."

Garry says, "It's rewarding to build on the U's rich history and pursue innovative molecular therapies." The heart and brain, he points out, were once thought to lack the ability to regenerate—to not have their own stem cells. But, while the capacity might be less, Garry thinks that every tissue and organ in the body has the capacity to maintain and regenerate itself, by utilizing stem cells that reside in the tissues.

He expects to benefit from infrastructure that connects University strengths in basic science, stem cell science, cardiovascular genomics, cardiovascular care, and imaging—as well as biomedical engineering. The University of Minnesota also is part of the Heart Failure Network, and Garry will work with physiologist Doris Taylor, Medtronic Bakken professor, and her clinical colleagues in the community. Garry also cares for patients in advanced heart failure, including those who need transplants.

Another emphasis for him is educating the next generation of physicians and scientists. "It's really exciting to build a program to help people develop their careers." Says Garry of himself and his physician and scientist colleagues: "We love to discover."

The tradition of Minnesota as "a powerhouse, in every sense of the word" attracted Garry to return to his alma mater this year. Among the other faculty members embodying the legacy of Lillehei and Bakken are renowned cardiologist Jay Cohn, pediatric cardiologist Julia Steinberg, and Taylor, who also is director of the Center for Cardiovascular Repair.

**JAY COHN** says of the University of Minnesota: "This was the place where the contemporary management of heart failure really developed." Cohn drove those advances in "an environment that encouraged clinical research and creativity."

Cohn describes his initial experience with vasodilator therapy in the 1970s. For a patient who was



Top: The first portable heart pacemaker, invented by Earl Bakken, working in collaboration with surgeon C. Walton Lillehei (lower photo).

apparently dying from severe heart failure and shock, Cohn began an infusion of nitroprusside, a potent vasodilator that he concocted from a powdered chemical. Within minutes, the patient woke up, opened his eyes and said, “What did you do? I feel so much better!” That success led to long-term treatment of heart failure with oral drugs that relax the blood vessels.

In the 1980s, Cohn and colleagues recognized that in progressive heart disease the heart underwent structural changes. That remodeling could be slowed, however, with medications. These hormone inhibitors are now standard therapy. Recently, these treatments have become increasingly individualized, he says, citing discoveries made in collaboration with cardiologist Anne Taylor that African-American patients may be best treated with BiDil, a vasodilator drug combination that supplies nitric oxide to the heart and blood vessels. Its use for a specific population was recently approved by the FDA.

Cohn trained dozens of physicians who now run cardiovascular medicine programs around the world. He also made connections with other researchers on the University campus, such as Kamil Ugurbil of the Center for Magnetic Resonance Research. With bioengineer Stan Finkelstein, Cohn began modeling the circulation and the elasticity of arteries. The results were a boon for physicians diag-

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## Doris Taylor is exploring using a patient’s own stem cells to build new blood vessels, hearts, and other organs on natural scaffolding.

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nosing heart disease, as well as becoming the foundation for a medical instrument that led to one of the first University-founded publicly traded companies, Hypertension Diagnostics, Inc.

Cohn stepped down as head of the Cardiovascular Division in 1996, but he remains the force behind the Rasmussen Center for Cardiovascular Disease Prevention. “The surviving but impaired patient is not our long-term goal,” says Cohn. “Our hope is to preserve health and an active lifestyle in individuals who might otherwise suffer from morbid events.”

**JULIA STEINBERGER** sees the obesity epidemic leading to another specter arising: type II diabetes and risk for early heart disease and stroke. “Younger and younger adults are getting heart disease, and this all begins in childhood,” says the pediatric cardiologist.

To help prevent that dire outcome, Steinberger runs the premier lipid clinic in Minnesota for more than 500 children. Some of these children are currently enrolled in one of three industry-sponsored trials to help develop drug treatments that lower cholesterol in high-risk children.

She launched a long-term study funded by the National Institutes of Health in summer 2007, with a fresh look at a large group of adults recruited 35 years ago, when they were 7 years old, who were followed closely with a number of measurements until age 24.

Now in their late 30s and early 40s, they will return and bring along their children; both parents and children will be extensively studied for risk of heart disease, stroke, and diabetes. This study has the potential to identify families at high risk for disease. By sharing genetic and environmental background, adults and their children will show similarities in risk factors. “We think that children grow up in the image of their parents,” Steinberger says. In the face of the growing obesity epidemic, these data may help caregivers in targeting prevention efforts toward those children who are at highest risk.

In another major project funded by the NIH, Steinberger studies the development of metabolic syndrome, a known risk factor for early heart disease, in a large group of children who survived cancer. She believes the data from this study may answer questions about the effects of cancer and its treatment on other health problems, and will help to improve the long-term health and quality of life of cancer survivors.

She collaborates on these studies with a team that includes pediatric nephrologists, endocrinologists, oncologists, exercise physiologists, epidemiologists, and others. In addition, Steinberger maintains a strong clinical interest in congenital heart disease and serves as director of Pediatric Echocardiography, continuing Lillehei’s legacy of improving the understanding and treatment of congenital heart defects.

Scientist **DORIS TAYLOR** says: “We are shaping the future of medicine.” With hope of improving treatments, she and her laboratory team are using cell therapies in animals to prevent heart attacks and to repair the heart after a heart attack or heart failure. And, looking forward, she is exploring using a patient’s own stem cells to build new blood vessels, hearts, and other organs on natural scaffolding.

In mouse models, Taylor and her research team already have been able to prevent plaque from forming in arteries using cell therapies. One of the unexpected insights has been that female cells work better at preventing or reversing plaque in both male and female mice.

She also is collaborating with University faculty who are part of the heart team at Abbott Northwestern, a Minneapolis hospital, on clinical studies of patients after a heart attack, and with colleagues at the Mayo Clinic (through the U-Mayo Partnership) to develop new ways to diagnose and treat heart disease using adult stem cells. Indeed, with Abbott colleagues, the University team is part of the National Institutes of Health Cardiovascular Cell Therapy Network participating in multiple clinical studies going forward. And Taylor and colleagues are hoping to convince NIH that the Twin Cities should host a national repository of patient samples to further genetic and cell-based cardiovascular research.

Finally, for the 50,000 people who die each year while waiting for an organ transplant, Taylor and colleagues (such as former CCVR scientific director and current surgical resident Harald Ott at Massachusetts General Hospital) hope to be able to build new organs from their own cells. She expects that such self-derived organ transplant patients could avoid the need for a life-long regimen of immunosuppression drugs. Academic medical centers differ in that way from typical hospitals, Taylor says. “We are in a position to try new, crazy ideas that will change medicine not just now, but 10 years out.”

Taylor says she’s “thrilled” about Garry’s recent arrival. “There’s finally a critical mass—again—at the University of Minnesota so that we can build cardiovascular medicine and the science that underlies it, the next generation of ideas.” ❖



The Flexible M.D. experience “will make me a better doctor,” says Rebecca Trotzky-Sirr, left, pictured with Katie Pastorius, who served an internship with *The Lancet* in summer 2007.

## EDUCATION

# Roads Less Traveled

By giving medical students time to pursue interests during their education, Medical School leaders believe that patients will benefit.

**R**ebecca Trotzky-Sirr has long been interested in pursuing international human rights work, but when she enrolled at the University of Minnesota Medical School, she knew she might have to put her passions on the back burner. After all, medical students often struggle just to fit sleep into their schedule, let alone any other activities. Yet, thanks to the Medical School's new Flexible M.D., Trotzky didn't have to choose between her passion and her education. The Flexible M.D. option provides students up to two additional years to complete medical school as long as they use the time to pursue activities related to their medical education.

In mid-2006, with the help of a Fulbright Scholarship, Trotzky-Sirr and her young son, Zev, headed to Venezuela. She spent a year working with doctors in a national community medicine program, where she made house calls, arranged social services, and organized neighborhood health committees. When she returned to medical school this fall, she had fresh perspectives on the role of medicine in a society and a renewed focus on her goals. "The daily practice of doing what I loved firmly grounded my commitment to social medicine," she says. "Having time to refresh and reaffirm what I want to do within medicine will make me a better doctor."

Such flexibility, which has been extended to students informally in the past, allows them to personalize their medical education based on their interests. "Getting into medical school is superb, but it needs to be linked to a purpose," says Kathleen Watson, the associate dean for students and student learning. "Students need time to develop their ideas and explore them. This is an opportunity to take time out of the four-year plan to do something that prepares their minds—and their hearts—for what they want to do next."

While many medical schools offer students the chance to take time out of their medical education to pursue related opportunities such as research or internships, the University of Minnesota is unique in its willingness to provide financial relief to do so: it is the only school to charge the same tuition total

whether a student completes the M.D. in as much as six years or as little as three and a half. “We removed the penalty of progressive tuition increases that a student might otherwise experience,” says Watson. Currently, about two dozen students take advantage of the flexibility each year to pursue dual-degree programs, participate in internships, conduct research, or take part in other related activities.

The option isn't just beneficial to those who already have a clear career path in mind. Peter Ragusa, who initially planned to take advantage of the Flexible M.D. to get a joint degree in medicine and law, decided to forego that plan. Instead, he took a one-year hiatus in 2006 to take a position with the American Medical Association as the Government Relations Advocacy Fellow (GRAF) in Washington, D.C.

As the GRAF working on the legislative council of the AMA, Ragusa helped analyze federal legislation that was related to medicine and medical education, and offered advice

on modifying it or providing testimony on it. He says the experience has helped him develop an array of interests he may eventually pursue more seriously. “I've been able to get involved in things I never knew I was interested in—medical licensing, medical education curriculum development, and policy,” he says. The fellowship “has opened up more doors for me than anything I've ever done in my life, and that's not an overstatement.”

Minnesota encourages its medical students to develop individual programs that reflect their interests, but it also demands a high level of guidance and accountability to ensure that they still receive an education that allows them to meet the school's set of rigorous educational objectives. Students who pursue less-traditional paths must work closely with an advisor and outline their plans to an educational enrichment committee.

While Ragusa says the Flexible M.D. offers clear benefits, he saw the hesitation of some schools to allow students to take such

## EXPANDING EDUCATION

### >> STUDENT IS EARLY RISER

“I've always pushed myself, ever since elementary school,” says Sandra Sandstrom, who was one of the first to take advantage of the Early Admission Rural Scholars Program. “I've always done things faster.” Sandstrom says she is saving money and time in pursuing her medical education through the three-year-old program. Offered only on the Medical School-Duluth campus, the Rural Scholars program is an opportunity for students in Duluth who meet the qualifications to enter medical school after three years of undergraduate work. This fall, Sandstrom will spend her third year in the small town of Sandstone, as part of the Rural

Physician Associate Program. Like the Rural Scholars program, RPAP encourages future physicians to consider rural medicine and 361 of the RPAP alumni practice in rural areas in the state. “I've always loved northern Minnesota,” says Sandstrom, who is from Sturgeon Lake. “It's so peaceful—that's where I would love to raise a family.”

### >> GRADUATING AMERICAN INDIAN PHYSICIANS

“Each year 50 percent of the Stanford University freshman class—about 800 individuals—declare themselves to be pre-med. At the end of four years, only 15 percent actually apply to medical school,”

said faculty member David Perdue (Chickasaw). He was speaking at a May 3 gathering honoring the Medical School's seven American Indian graduates: Michael Arredondo, Christine Athmann, Melissa Deer, Jeffrey Pinnow, Charles Hightower, Michael Kroll, and Bryan Trotter. “Why? The good red road up that mountain is not so much a road, but a route up a craggy rock face, with many headwalls — a climber's term for steep faces requiring exceptional skill.” He encouraged the students to reflect on their roads, where they have been and where they are headed. The University of Minnesota Medical School consistently ranks among the top schools in graduating American Indian M.D.'s.



less-traditional paths when he helped out with the hiring process for the 2007 GRAF. "A lot of schools are reluctant to let students take a year off to do something other than medicine or research," he says. "But doing something like this can open up a world of possibilities in medicine." Thanks to his recent work in the AMA, he was asked to take part in a committee to evaluate and revamp the U.S. Medical Licensing Examination.

Some still aren't exactly sure where the opportunities might lead, but don't want to miss a chance to expand their options. Katie Pastorius has long wanted to become a doctor, but as an editor of her high school and college newspapers, she also had cultivated a passion for writing. When her chance meeting with an editor at the prestigious medical journal *The Lancet* turned into an offer of a month-long internship at the London-based publication this past summer, she knew she couldn't pass up the opportunity.

With the help of Watson, she applied for and received a

grant through the Minnesota Medical Foundation that will help cover her expenses. While she's across the pond, she's also linked up with a few other people in the medical profession who will allow her to do some shadowing at medical facilities in the United Kingdom. Such connections, she hopes, will lead to other opportunities. "I think everyone has a different reason for going into medicine, and the Flexible M.D. gives students a chance to tailor their own education," says Pastorius. "I think I'll benefit from having that extra education under my belt before I jump into a career."

By offering the Flexible M.D., Medical School leaders, including Watson, hope the school will attract even more bright, motivated, and passionate students who are willing to step outside the lockstep path of medical education. "The heart of this program is student innovation," she says. "This is a way to link students' idealism and aspirations as physicians with the opportunities." ♦

### >> U-MAYO PARTNERSHIP: MINNESOTA'S FUTURE DOCTORS

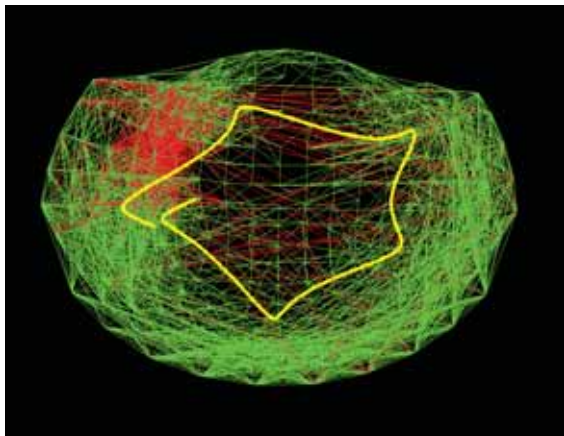
In its inaugural year of recruiting future physicians from groups underrepresented in medicine, the Minnesota Future Doctors program entered 23 promising college students from across Minnesota into a six-week immersion into medicine. This first cohort will come back for two more summer programs that offer exposure to the lives of physicians as well as concrete support in how to prepare for and apply to medical school. Minnesota's Future Doctors, the brainchild of medical students Gareth Forde and Matthew Fitzpatrick, is jointly supported by the University of Minnesota and Mayo medical schools.

### >> STUDENT RECEIVES AMA FOUNDATION MINORITY SCHOLAR AWARD

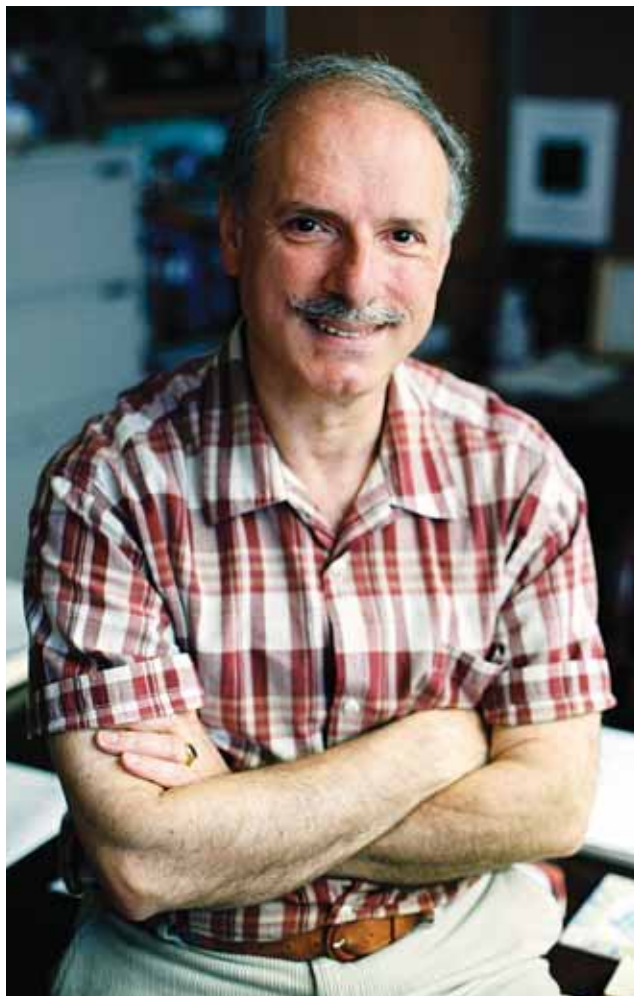
First-year medical student Charles "Chuck" Branch was awarded an American Medical Association Foundation 2007 Minority Scholar Award. Branch is one of 11 recipients selected from 113 students nominated by medical schools across the country and the only Native American to receive the award this year. Branch will receive a \$10,000 scholarship. Branch says his goal as a Native American physician is to "advocate for Native American patients in regard to health and healing by acknowledging the value of both western medicine and traditional medicine in maintaining physical and spiritual well being."

### >> JANUARY SNMA PRE-MEDICAL CONFERENCE DRAWS EAGER GROUP

More than 200 aspiring doctors from Minnesota and nearby states took part in "The Heart of Medicine," the first annual Pre-Medical Forum at the Medical School, hosted by Student National Medical Association's Twin Cities Chapter. Medical students Sunil Evan Saith and Marissa Lightbourne were among the team that led and organized the forum. Attendee Charles Hollins of Chicago said: "Everyone was from different walks of life, different schools, and cultural backgrounds, but we all shared the same goal, which is the pursuit of excellent medicine for mankind."



A picture of the brain at work on a shape-copying experiment, produced by the magnetoencephalography instrument in the laboratory of Apostolos Georgopoulos, right, director of the Brain Sciences Center.



**RESEARCH**

# In Control

Refining technology to harness the power of brain waves.

**M**ore than 2,000,000 Americans suffer some form of severe motor disability, the result of any number of causes, including ALS (Lou Gehrig's disease), brain and spinal cord injuries, cerebral palsy, and multiple sclerosis. Some of these disorders, like ALS and MS, are progressive, slowly robbing victims of the ability to move on their own. Others, like the brain injuries suffered by many troops stationed in Iraq, can cause sudden paralysis and traumatic amputations.

For many patients, these motor disabilities can mean a lifetime of dependency and immobility. But what if it were possible to control the movement of prosthetic devices easily and automatically just by reading signals produced by the motor cortex of a patient's brain? That's precisely the goal of the Non-invasive Neural Control of a Prosthetic Device Project (NNCPD) underway at the Brain Sciences Center, a partnership of the University, the V.A., and the American Legion.

Researchers began exploring the possibility of using brain waves to control the movement of prosthetic devices back in the 1980s by implanting electrodes directly into the brain. Unfortunately, those early electrodes not only irritated the brain but also gave less than accurate readings. Better, more accurate electrodes were developed in the late 1990s. But while they provide more precise information, the newer electrodes are only viable for a few months. Given the highly invasive nature of implantation surgery, the approach is clearly not a long-term solution for paralyzed patients.

The NNCPD project traces its origins to the Brain Sciences Center's acquisition of a state-of-the-art magnetoencephalography instrument (MEG) in 2002, making it one of the few in the world to possess this advanced piece of equipment. Using high-speed computation and an array of 248 sensors distributed over the skull, MEG provides detailed information about brain activity every millisecond. The availability of MEG inspired an idea for Apostolos Georgopoulos, Regents Professor of Neuroscience and director of the Brain Sciences Center, who first became involved in brain-wave controlled prosthetics in the 1980s.

"When we got the MEG, I decided to do an experiment recording signals around movement," he

explains. What his research team for the first time established was the possibility of accurately predicting the movement of limbs based upon brain signals using a completely non-invasive technique. “If you take neural data we got from MEG and you look at the brain signals *preceding* movement, you get amazing predictions of movement,” he says. “This raised the issue of non-invasive prosthetic control.”

In 2005, the Brain Sciences Center team published the results of a study involving 10 right-handed human subjects. Each volunteer was asked to copy the image of a pentagon for 45 seconds while hooked up to the MEG. When the brain signals were digitally cleaned up there proved to be a 97 percent correlation between predicted and actual muscle movement —

more than good enough to control a prosthetic device.

No matter how accurate the brain signals read by MEG, however, the machines are large and stationary and therefore impractical for use by paralyzed patients. That is not the case with electroencephalography (EEG). This past year, the Brain Sciences research team demonstrated that a 64 electrode EEG cap, hooked up to a microprocessor to read and sort out signals, can have a predictive accuracy almost as good as MEG. This paved the way for Georgopoulos’s latest inspiration.

“We have been working on an ambulatory EEG,” he explains. When it turned out that there were no U.S. manufacturers producing an EEG small enough for this purpose, Georgopoulos located a company in Germany that produced

## DRIVEN TO DISCOVER

### >> WORKING FOR A CMV VACCINE

Cytomegalovirus (CMV), which affects 40,000 babies each year, is the second most common cause of mental retardation after Down syndrome, is a leading cause of deafness in children, and also can cause cerebral palsy, seizure disorders, and other neurological problems. For the past 15 years, Mark Schleiss, director of the division of pediatric infectious diseases, has been studying this virus that is transmitted from mother to fetus. Recently, he developed an experimental vaccine that protects the offspring of guinea pigs infected with it. “Most adults will be infected with CMV sometime in their lifetime, and most do not even realize they have the virus,” Schleiss says. “Finding an effective vaccine for women before they become pregnant could go a long way in preventing often devastating long-term

disabilities that result from CMV infection.” As a result of this promising research in animals, the researchers will set up clinical trials to test a vaccine in people.

### >> CARDIOVASCULAR DISEASE KNOWLEDGE ABOVE AVERAGE

Minnesota women surveyed about cardiovascular disease know it’s the leading cause of death among women — 95 percent of them compared with about 57 percent nationally. But they still don’t know enough, say researchers at the Deborah E. Powell Center for Women’s Health. The majority do not know that fatigue, nausea, and anxiety are physical symptoms of acute myocardial infarction (heart attack) that are more likely to be experienced by women. More than 1,000 women surveyed last year by the center, in partnership with the Women’s Health Clinic, recognized that high

blood pressure, smoking, family history, sedentary lifestyles, and being overweight are risk factors for cardiovascular disease. They less often recognized depression, diabetes, and menopause as risk factors. Health-care professionals should target these knowledge gaps — and remind patients to call 9-1-1.

### >> OCD PATIENTS MAY RESPOND TO DRUG THAT AFFECTS LEARNING

A drug originally developed to fight tuberculosis may help people with obsessive-compulsive disorder make more progress in therapy sessions, say psychiatric researchers Matt Kushner, Suck Won Kim, and Christopher Donahue. Now they want to see if this drug could have a similar effect on people who want to quit smoking. The drug, D-Cycloserine, is believed to help accelerate “extinction

EEG machines the size of a pocket paperback. Approval of these mini-EEGs for use in this country is now pending before the FDA.

The idea is to use this machine to process brain signals and turn them into accurate predictors of movement. To make those signals even clearer – and to bypass logistical issues presented by the need for patients to wear headgear outfitted with EEG sensors – Georgopoulos envisions using 32 intra-cranial screws that double as electrodes with microchip amplifiers attached to them directly. “Screw technology is very advanced because of its widespread application in surgery,” he points out. “My idea is to place screws in a patient’s skull, attach them to thin wires hooked up to a signal amplification system like

that used for deep brain stimulation.”

Animal experiments already indicate that this method yields clean signals free of background noise. Georgopoulos now is working with Penn State neurosurgeon and bioengineer Steven Schiff to perfect the device for humans using absorbable screws. “After a few weeks you end up with your leads going into your skull without any screws visible,” he says.

If the pair succeed in their quest, Georgopoulos predicts: “The device will be like the best of both worlds, combining the safety of EEG with the accuracy and portability of implanted electrodes.” It may also put thousands of victims of motor disabilities on the road to fuller, more active, and autonomous lives. ❖

learning.” Kushner says: “This offers another therapeutic approach where we can attempt to manipulate the memory process and the brain’s reward/punishment system so people can learn healthier responses to various cues.” The researchers found that those who took the drug made progress in therapy more quickly and were less likely to quit therapy compared with the placebo group. The research subjects who took the drug reported feeling less distress or anxiety due to their obsessions or compulsions.

#### **>> SEEKING CAUSES FOR OSTEOSARCOMA**

With a \$1.7 million grant from the National Cancer Institute, pediatrics researcher Logan Spector will lead the largest and most comprehensive study to date on the causes of pediatric osteosarcoma, the most

common cancer of the bone in children under 20 years of age in the United States. Each year about 400 children are diagnosed with the disease. The University of Minnesota is a national research and treatment site for children with bone cancer. This four-year research study will include 500 children in the United States and Canada who have been diagnosed with osteosarcoma. Their parents also will be enrolled in the study. The research will examine the possible genetic basis for the disease. “We also will study how well the cells repair DNA damage naturally, and if the genes are impacted by diet, physical activity, family health history, and other lifestyle-related habits,” says Spector, who will work with other pediatric cancer researchers at the University of Minnesota; The Hospital for Sick Children in Toronto, Canada; Cincinnati Children’s Hospital

Medical Center; Memorial Sloan-Kettering Cancer Center in New York; and the NCI.

#### **>> COMFORT FOR THE HOMELESS AT THE END OF LIFE**

Homeless people’s concerns about end-of-life care are in some ways very similar to everyone’s, says physician John Song, who researched the issue with the help of six Twin Cities social service agencies. They would like to remain comfortable and free of pain. They also have unique concerns: Who might be contacted to make decisions about their care? If they are estranged from their families, that could cause them stress. Health-care providers need to talk with the homeless people they treat. “It’s important to understand, from their voices, what they’re concerned about,” Song says. Respecting their wishes is one way to offer comfort to this marginalized population.



“We treat the whole child,” says pediatric neurologist Lawrence Charnas, who works with a team. At right, he’s pictured with another of his patients.

## CARE

# 'We don't let go'

Care for patients near and far extends beyond transplant.

**F**riends in Ohio ask Vicki Berger: "Why Minneapolis?" She tells them it's the best place for her son Mitch, 16, who has the rare disease adrenoleukodystrophy (ALD) depicted in the movie *Lorenzo's Oil*.

"The miles are very short if it's your child," says pediatric neuropsychologist Kendra Bjoraker, who in turn traveled to Ohio to help Mitch's school staff. The University of Minnesota has become a nationally renowned center for treatment and research on metabolic diseases such as ALD. It is one of the largest such centers in the world, says pediatric neurologist Lawrence Charnas. Its unique strengths include the team approach to care, care that extends after a transplant to treat ALD.

A terrifying disease that strikes young boys, ALD is generally inherited, although a few cases arise from genetic mutations. ALD attacks the adrenal glands and myelin, the "insulation" around the brain's nerve cells. Those stricken start to have trouble walking and talking, and their senses and nervous systems can quickly deteriorate. If untreated, the disease typically is fatal within five years.

While the Bergers' pediatric neurologist Lawrence Charnas notes that ALD can be misdiagnosed because the symptoms are similar to multiple sclerosis, in Mitch's case, an older brother died of the disease. So, starting at age 4, Mitch began coming to Minneapolis regularly to visit his health-care team. At 10, brain scans showed the beginnings of trouble.

On Dec. 12, 2001, Mitch received the current treatment for ALD, a bone marrow transplant. The BMT program at the University of Minnesota was the first to perform a successful procedure in 1968 and continues to be a national leader in patient-care outcomes and in advancing the science.

Although the mechanism is not fully understood, BMT seems to work on this brain and nervous system disease because it shuts down the inflammation of myelin, says Charnas. "We don't cure the disease; we stabilize it," he adds. He believes BMT is a "rescue therapy," however, and will not be the final word on treating this devastating disease, which is diagnosed in some 30 to 40 boys a year in the United States.

"Our long-term goal is to develop new therapies to attack it better." To accomplish that goal, Charnas is working with pediatrician Paul Orchard and other Minnesota colleagues, as well as connecting with

national and international researchers at events such as the annual conference hosted by the United Leukodystrophy Foundation.

In February 2007, Charnas published the results of a small, significant study on patients who typically would not be good candidates for BMT alone, as their symptoms had advanced too far. Charnas combined a drug therapy with BMT and all three boys' disease stopped progressing and they survived. The therapy did not, however, reverse the damage.

This is just the start, says Charnas. "We're not content doing the same old thing." He'd also like to carry out a long-term study of the patients, who are spread around the country and around the globe. The oldest is about 20 years post BMT.

In the meantime, he, Bjoraker, and other team members focus on their patients. "We treat the whole child. We treat the family," Charnas says. "We treat the medical condition. We

give them skills to become a productive adult.

"We don't let go."

Bjoraker's role, for instance, is not only to assess patients' cognitive function and their developmental trajectory after treatment but also to follow them over time—and space. She strives to make parents feel part of the team, and helps them, after a frightening diagnosis, structure their family lives to restore some certainty and routine.

Bjoraker also is a certified school psychologist, so when Mitch was having trouble in school, she flew to Ohio to talk with staff there—all in the effort to improve Mitch's quality of life.

Vicki Berger notes that some of Mitch's problems arise from his low social skills, as well as depression over losing an older brother and having the other one (who does not have ALD) move away to college. He also has suffered from toxic-

## COMMITTED CARE

### >> CORD BLOOD PROMISING FOR LEUKEMIA PATIENTS

Blood cancer patients may experience better outcomes after treatment with umbilical cord blood transplants than bone marrow transplants, according to a *Lancet* article on a study by senior investigator John Wagner, pediatrics professor and director of the division of Pediatric Hematology/Oncology and Blood and Marrow Transplantation in the Medical School. The goal of the study was to provide guidelines to transplant physicians on the selection of the best donor for children with leukemia.

"This study suggests is that cord blood need not be considered a second line therapy any longer. The fact that cord blood is banked and readily available with little notice is a great advantage. Today,

leukemia patients can wait months for an appropriately matched bone marrow donor, during which time their disease might return," Wagner said. "For the first time, the timing of transplantation can be dictated by the patient's needs as opposed to the availability of the matched bone marrow."

The outcomes research was carried out by investigators at the Center for International Blood and Marrow Transplant Research, Medical College of Wisconsin, Milwaukee. Mismatched cord blood performed as well as matched bone marrow as measured by leukemia-free survival rates, providing the degree of mismatch was limited and the number of cord blood cells available was sufficient. Furthermore, study participants who received matched cord blood had a 20 percent higher survival rate than matched

bone marrow recipients, though the number of matched cord blood transplants was small. The study was done in collaboration with the National Cord Blood Program of the New York Blood Center, New York.

### >> ADVANCING STEREOTACTIC BODY RADIOTHERAPY TO NEW TARGETS

Delivering targeted radiation therapy to treat lung cancer tumors has proved effective with patients at the University of Minnesota Medical Center, Fairview. The medical center is one of the few places where this therapy is available and it may be able to help more patients with different cancers. "Stereotactic body radiotherapy is an extremely accurate method of delivering high-dose radiation therapy," says L. Chinsoo Cho, a professor in the Department



ty caused by an anti-rejection drug, contracted life-threatening hemolytic-uremic syndrome in 2002, and now awaits his second cataract surgery.

Also, when he returned to school after a year and a half out for treatments, she says: "It wasn't a happy time. Middle school is never nice and then when you have something..." Mitch, who had gained weight from steroids, was not known to the kids at this new school and suffered teasing. It was so bad that his mother pulled him out of school and, with a tutor's aid, taught him at home.

Yet Mitch entered high school two years ago with the assistance of BJORAKER. "She is awesome," says BERGER of BJORAKER, who also helped to engage a high school staff member, FUZZIE DAVIS, in helping with Mitch's issues. Adds BERGER, "Having a special needs child, there is a constant fight for others to understand, to help make your child accepted for whom he is,

and not for what he is supposed to be." She now has "irreplaceable help," she says, in these two additional advocates for him. BJORAKER notes that: "Just because the treatment ends here doesn't mean the patients don't have needs. If I have knowledge that can help the patient beyond these walls, I'll share it."

A lot of her work in the school, BJORAKER says, is to simply help staff and teachers understand this rare disease. "The difference between children with ALD and other genetic diseases," BJORAKER adds, "is that the boys look good. They look normal." And with the help of CHARNAS, BJORAKER, and the other members of their patient-care team, they also can in good measure enjoy lives as normal children.

Mitch now has not only his Minnesota health-care team but also benefits from a good support system at his Ohio high school. Of the last year, says his mother: "He's been great." ❖

of Radiation Therapy. "It opens the doors to thinking about treatment options for cancer patients in a whole different way." Cho is conducting a clinical trial to use this targeted therapy for patients whose cancer has spread to their livers. And, in collaboration with colleagues at UT Southwestern Medical Center, Dallas, and University of Colorado, Cho is studying the effectiveness of stereotactic body radiotherapy for patients with prostate cancer. It may trim the number of treatments from 42 to 5—a welcome relief.

#### >> STROKE INITIATIVE ADVANCES CARE AND RESEARCH

The Stroke Initiative, led by interventional neurologist Adnan Qureshi, promises to help stroke victims in Minnesota and

beyond, by shortening the time between the onset of a stroke and treatment and by using research to improve existing therapies. He and his fellow Stroke Initiative interventional neurologists Robert Taylor and Vallabh Janardhan are trained to interrupt a stroke in progress.

Qureshi, who arrived at the University of Minnesota in October 2006, has already received kudos from patients. One was a University of Minnesota professor who had suffered two transient ischemic attacks. His treatment by the Stroke Program Initiative team included receiving a stent approved for humanitarian use by the FDA. "I am also pleased to now be a research subject," he wrote in an e-mail, "which may be helpful to others facing similar problems in the future."

That research also includes studying

gene function in the cells that line blood vessels to see if they hold clues the deposition of plaque, which is as dangerous in arteries of the brain as in those of the heart. Qureshi also is conducting a multicenter clinical trial funded by the National Institutes of Health to test the safety and benefit of blood pressure medications in the treatment of hemorrhagic stroke.

Better understanding should lead to better care. As the professor wrote: "I must say that I was grateful and proud to be associated with this great University and receive the benefits of great science, great technology, and great health care service." The Stroke Initiative is a partnership between the University of Minnesota Medical Center, Fairview, and Hennepin County Medical Center.

# Exceptional and Essential

News briefs from community partners who help educate future physicians

The University of Minnesota and Mayo Clinic also partner in research. In March 2007, the Minnesota legislature approved \$25 million in biennial funding and committed \$8 million for each of the following two years. State and private funding has facilitated 30 research projects and infrastructure or commercialization initiatives by the Minnesota Partnership for Biotechnology and Medical Genomics, which started in 2003.

## Improving patient safety, patient care

“In-situ” simulation training brought significant process improvements for patient safety at **University of Minnesota Medical Center, Fairview** and **University of Minnesota Children’s Hospital, Fairview**. The hospitals were among several at Fairview that partnered with the University of Minnesota’s School of Public Health to offer the simulation program that creates pseudo emergencies based on sentinel events using robotic simulators as patients. Lung cancer patients unable to undergo surgery to remove their cancer now have another option available at the medical center: stereotactic body radiotherapy (SBRT), which delivers radiation through several beams 360 degrees around the patient, targeting the tumor and sparing the healthy lung. Clinical trials to use this therapy for liver and prostate cancer patients are expected. Innovations such as these help the medical center continue to be ranked among the nation’s best hospitals, according to *U.S. News & World Report*. The medical center was named among the nation’s top hospitals in nine specialties this year.

## Regions: Leaders in hospitalist medicine

The Hospitalist Medicine program at **Regions Hospital** was one of the first to be started in the United States and is now ranked among the top such programs. There are close to 50 hospitalists involved not only in the daily care of patients, but also in major process improvement projects throughout the health care system. Regions’ hospitalist leadership and members provide consulting and program development expertise to numerous other hospitalist programs across the country. They are also well recognized for their skills in teaching students, residents, and fellows. For their outstanding clinical and service accomplishments, they have won the Society of Hospital Medicine awards for excellence on almost a yearly basis since the inception of these awards, being the only group in the country to do so.

## Capital campaign and new look at Hennepin County

**Hennepin County Medical Center** plans to add more inpatient beds, renovate a significant portion of its downtown facility, and replace a community outpatient clinic as part of the first phase of a major renovation and expansion project. In June, the Hennepin County Board approved allocation of \$80 million in general obligation bond support for projects that will address the steady increase in outpatient care as well as the need for significant renovation and expansion of inpatient units for critical care patients on the downtown campus. In addition to the upcoming physical changes, Hennepin County Medical Center has also introduced a new visual identity. The new graphic mark and refreshed visual imagery provides a strong visual cue that supports its message—*Every Life Matters*—and that Hennepin County Medical Center is entering an era of growth, renovation and expansion.

## News from Children's Hospitals and Clinics of Minnesota

In June 2007, **Children's of Minnesota** announced a multi-year initiative to expand and modernize its St. Paul and Minneapolis campuses. Children's expects to break ground for new construction in Minneapolis later this year, and begin work on the St. Paul campus within the next 12 to 18 months. The estimated cost of the projects is \$300 million. In addition, in late 2006, Children's of Minnesota was ranked among the top eight U.S. children's hospitals in a watershed survey of hospital quality and safety by the respected Leapfrog Group. Also in 2006, Children's of Minnesota received designation of Magnet status, a prestigious honor from the American Nurses Credentialing Center, which recognizes the top standards in nursing practice. Children's was the first hospital in the Twin Cities to gain the coveted honor. Children's is Minnesota's leading provider of specialized pediatric care, and the sixth-largest children's health care organization in the United States.

## Advanced care at Abbott Northwestern

**Abbott Northwestern Hospital** is the largest not-for-profit hospital in the Twin Cities. Each year, the hospital provides comprehensive health care for more than 200,000 patients and is consistently recognized as one of the best and most technologically advanced hospitals in the country. For example, *U.S. News & World Report* ranks Abbott Northwestern among America's Best Hospitals in heart and heart surgery, neurology and neurosurgery, orthopedics, cancer, endocrinology, geriatrics, gynecology, and digestive disorders. The Centers for Medicare and Medicaid Services ranks Abbott Northwestern as the best in the state and among the 17 best in the country (out of more than 4,400 hospitals) for heart attack survival. And, the hospital recently completed construction of an advanced neurosurgical operating room that is equipped with a six-ton, movable, high field iMRI scanner. The scanner is the first of its kind in Minnesota, and one of only five worldwide. Abbott Northwestern is part of Allina Hospitals & Clinics.

# Financials

The University of Minnesota Medical School by the numbers

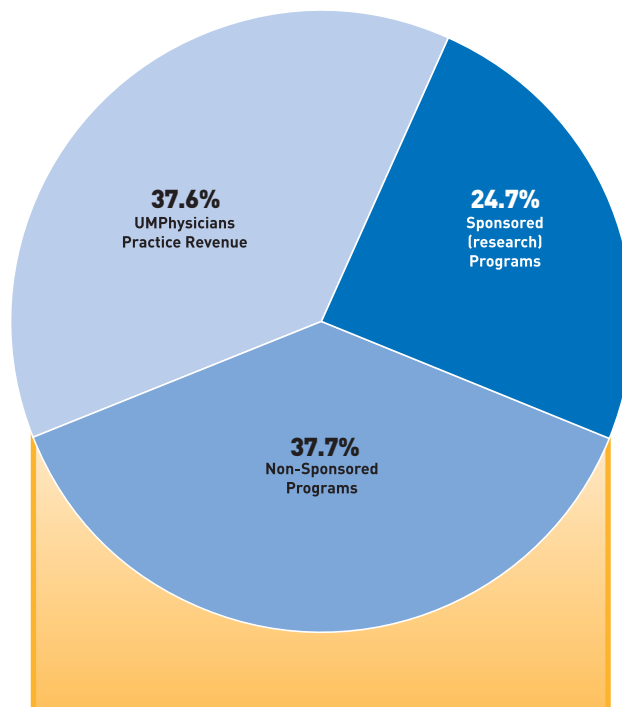
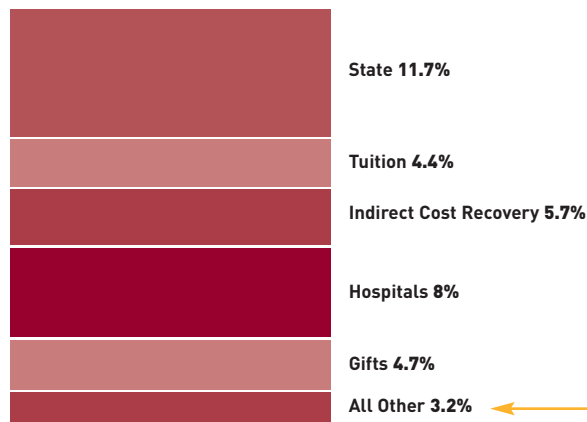
The University of Minnesota Medical School benefits from the support of the state of Minnesota, which has designated funds for faculty recruitment; from transfers from the faculty practice plan, University of Minnesota Physicians; and from the Minnesota Medical Foundation. In fiscal year 2007, the Minnesota Medical Foundation supported hundreds of faculty research and education projects, while earnings from endowments and outright gifts provided more than \$1.57 million for student scholarships.

## Medical School Funding

**University of Minnesota Medical School  
Major Funding Sources, Fiscal Year 2007  
Budget = \$672 million**

Includes UMPHysicians revenue

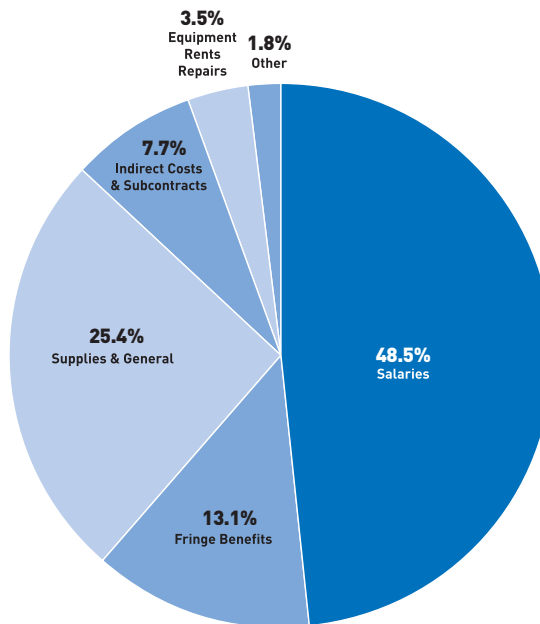
### Non-Sponsored Programs Breakdown



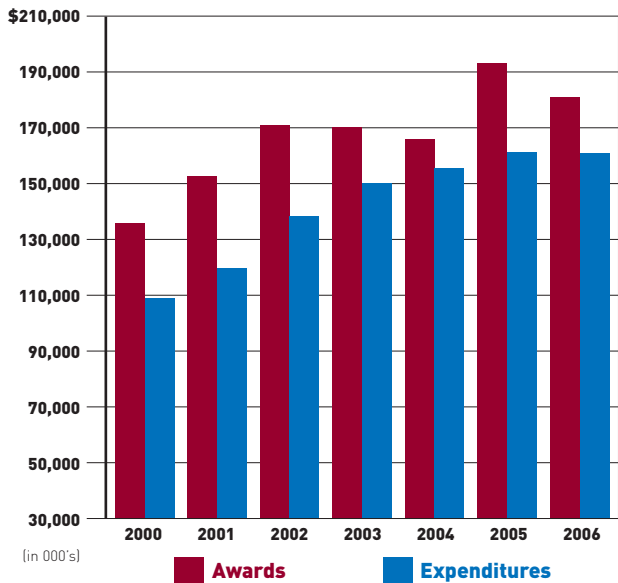
## Medical School Spending

**University of Minnesota  
Medical School Expenses  
Fiscal Year 2007  
Budget = \$667 million**

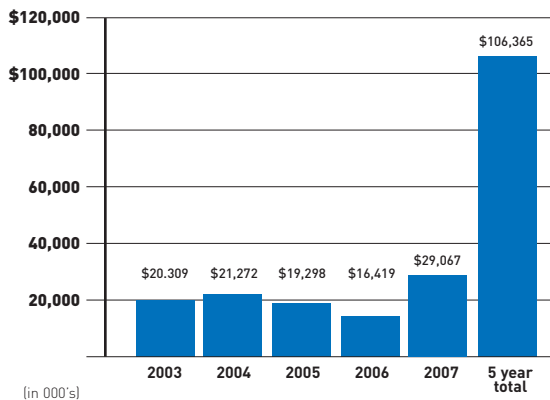
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## Medical School Sponsored Research



## Minnesota Medical Foundation's Disbursements to the Medical School



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