Northwester Medicine

WINTER 2020

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FIRST GLANCE

Northwestern Medicine Community Spotlight



A Night to Remember

MAKING TIME FOR FUN

Students enjoyed an elegant evening at A Night on Call, the annual Feinberg School of Medicine formal, on January 17 at The Drake in downtown Chicago.

Northwestern Medicine magazine is published quarterly for alumni and friends of Northwestern University Feinberg School of Medicine, Northwestern Memorial HealthCare, and the McGaw Medical Center of Northwestern University.

Editor: Gina Bazer

Editorial Assistants: Yesenia Navarro, Haleigh Ehmsen

Contributing Writers: Emily Ayshford, Will Doss, Bridget Kuehn, Melissa Rohman, Cheryl SooHoo

Editorial Advisors: Eric G. Neilson, MD, vice president for Medical Affairs and Lewis Landsberg Dean; Alan Krensky, MD, vice dean for Development and Alumni Relations; Nicole Mladic, executive director of Communications; Babette Nyka, director of Alumni Relations

Alumni Association: Rishi Reddy, '00 MD, president

Design: Taylor Design

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Address all correspondence to: Northwestern University, Feinberg School and check out more photos and of Medicine, Office of Communications 420 E. Superior Street, Rubloff 12th Floor Chicago, IL 60611

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Winter 2020

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NATURAL NETWORKER

Luisa Iruela-Arispe, PhD, a specialist in endothelial cell biology, joins Northwestern as the new chair of the Department of Cell and Developmental Biology.



KEEPING THE BEAT

Improving the detection and treatment of serious heart conditions such as atrial fibrillation will be the focus of Northwestern's new Center for Arrhythmia Research.



RIGHT TO THE HEART

Revolutionary transcatheter aortic valve replacement (TAVR) is saving the lives of people from all walks of life, from rock legend Mick Jagger to a retired insurance broker in Illinois.



NO BACKING DOWN

Daniela Matei, MD, is on the forefront of new treatment approaches for rare and life-threatening gynecologic cancers.

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ON THE COVER

A colored photograph of ovarian cancer cells, using a scanning electron microscope. Read about Northwestern investigators' innovative treatment approaches for ovarian cancer on page 26. (Steve Gschmeissner/Science Source)

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An Ever-Evolving Medical School



S 2019 CAME TO A CLOSE, I LOOKED BACK ON THE YEAR'S

accomplishments with a sense of pride. We opened a world-class research building - the largest of its kind in the United States: the Simpson Querrey Biomedical Research Center - making national headlines and cementing our stature as a world-class destination for biomedical research. We welcomed two new chairs, opened 10 new centers, and expanded educational offerings for students and trainees. Not coincidentally, this year, Feinberg School of Medicine ranked 19th in the nation among the best research-oriented medical schools in the nation, according to the U.S. News & World Report rankings.

At the same time, 2019 was an exceptional year of scientific discovery (read about the highlights on page 6). Feinberg principal investigators secured a record-breaking \$534 million in sponsored research funding and awards during the 2018–2019 fiscal year, a 10.2 percent increase in funding over 2018. More than 4,000 clinical trials and research studies were conducted at Feinberg, led by 652 principal investigators. And a total of 66 patents and five new start-up companies were established within the last fiscal year alone. These immense accomplishments don't happen by accident. They are inextricably tied to our mission of impacting the practice of medicine through discovery and education. This mission is activated through our strategic plan, deliberately designed to drive growth and change at the medical school by advancing, enhancing, and strengthening our research, educational, and clinical enterprises, while at the same time advancing diversity and inclusion, and focusing on community engagement.

To achieve these goals, we have given ourselves a challenge to be both responsive and bold, continually seeking

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The medical school is building teams who are relentlessly committed to the possibilities of discovery, particularly at the intersection of disciplines.

out and creating new knowledge, always with an eye toward solving the vexing problems — like health disparities and the challenges of an aging population that will profoundly impact our future.

In order to make progress on these ambitious efforts, Feinberg is actively investing in collaboration. Instead of clinging to outdated academic silos, the medical school is building teams who are relentlessly committed to the possibilities of discovery, particularly at the intersection of disciplines.

This forward-thinking approach can best be illustrated by the innovative

integrated research hubs we launched this year, including the Global Health Institute and more than 10 new research centers, including the Center for Translational Pain Research, about which you can read more on page 26, and the Center for Food Allergy and Asthma Research.

In fact, as you read this issue, I think you will be struck by the many mentions of the word *interdisciplinary* and by the surge in collaborations across departments and schools, from data science to artificial intelligence (AI) to using the Apple Watch to gather critical medical data (read about the latter on page 14) – all to advance scientific discovery and improve human health.

Indeed, 2019 was a fast-paced, transformative year. Yet, 2020 already promises to be even more dynamic. On New Year's Day, I opened *The New York Times* to see coverage of a team of Feinberg investigators who partnered with Google to develop AI that can not only read mammograms, but may even outperform physicians at detecting cancer in X-rays.

This was an auspicious start to the new year, which portends even more developments: As the sun set on 2019, we were already planning the opening of a comprehensive Institute for Augmented Intelligence in Medicine and an Institute for Aging Research in 2020. As always at Northwestern, a new year means new and inventive developments. We wouldn't have it any other way.

With warm regards,

Eric G. Neilson, MD

Vice President for Medical Affairs Lewis Landsberg Dean

ON CAMPUS

Four Feinberg Faculty Elected to the National Academy of Medicine

he National Academy of Medicine (NAM) is one of three academies that make up the National Academies of Sciences, Engineering and Medicine, and election to NAM is one of the highest honors in these fields. Founded in 1970, the Academy provides independent, evidence-based scientific and



David Cella, PhD

A recipient of NAM's Gustav O. Lienhard Award in 2016. Cella leads the development of scientific collaborations and projects, and oversees academic and research programs, financial operations, faculty affairs, and program development. An international expert in the measurement and application of patient-reported outcomes in healthcare settings, his research has helped advance the understanding of mechanisms and measurement of health and disease to improve patients' quality of life.

Director of the Feinberg Cardiovascular and Renal Research Institute and chief of Nephrology and Hypertension in the Department of Medicine



Susan Quaggin, MD

A kidney scientist and vascular biologist of international stature, Quaggin joined Northwestern in 2013 and has since has led efforts in closing the gap between scientific discovery and delivering innovative care for kidney and cardiovascular diseases. Her research has not only increased understanding of common glomerular diseases and inspired the development of promising therapeutics, but her groundbreaking discoveries regarding blood vessels, lymphatics, and specialized hybrid circulations have significantly advanced multiple fields.

policy advice to inspire action across private and public sectors. Current members of the organization elect no more than 90 regular members and 10 international members each year. The following Feinberg faculty have been invited to join the more than 2,200 active Academy members:

The Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Neurological Surgery



John Rogers, PhD

A materials scientist by training, Rogers is an innovator in bio-integrated electronic devices, joining Northwestern in 2016 to lead the Center for Bio-Integrated Electronics at the Simpson Querrey Institute. Holding faculty positions both at Feinberg and the McCormick School of Engineering, his research expands the capabilities of current biomedical technologies through creating innovative electronic devices that can be integrated with the human body and possess a wide range of diagnostic and therapeutic functions.

The William Deering Chair in Biological Sciences in the Weinberg College of Arts and Sciences and Professor of Neurology



Catherine Woolley, PhD

Almost 30 years ago, as a graduate student, Woolley discovered that estrogens drive synaptic plasticity in the hippocampus. Since then, her work has helped to explain how estrogens enhance learning and memory consolidation and, most recently, her team has discovered new estrogen-based targets for anti-epilepsy therapies. Her research has also helped to develop a deeper understanding of Alzheimer's, among many neurological diseases.

PULSE *On Campus*

MEDIA SPOTLIGHT

THE WALL STREET JOURNAL.

A Prescription of Poetry to Help Patients Speak Their Minds

Poetry may not be common in the medical setting. But more hospitals and medical schools are turning to the power of the written word, and poetry in particular, to help patients process their conditions and heal. Further study is being done on whether it's feasible for busy doctors to carve out time for poetry with inpatients. They're examining how patients reflect on the process, and they're also interviewing patients after the reading to see if the poetry affects their quality of life and relationship with the physician.

Joshua Hauser, MD, associate professor of Hospital Medicine, says the poems often elicit patients' memories about their youth or their parents, or reflections on their illness and mortality.

"By looking at a piece of text which has some uncertainty or ambiguity, I think they are able to reflect back on their illness in a way that direct questions might not get to," Hauser said.

USNews Health Day

FDA Gives Expanded Approval to Prescription Fish Oil for Heart Patients

The U.S. Food and Drug Administration gave expanded approval to a prescription form of fish oil called Vascepa to help prevent heart trouble in people who are at high risk and already taking statins.

In a recent study, Vascepa appeared to put the brakes on key aspects of plaque formation in vessels after nine months of use. These early results provide some insight into why Vascepa was found to reduce risk of heart-related disease and death by 25 percent in another study released last year, said Donald Lloyd-Jones, MD, chair of Preventive Medicine. Other high-dose fish oil clinical trials are ongoing, and will provide further evidence in the near future, Lloyd-Jones said.



The New Hork Times

AI is Learning to Read Mammograms

Artificial intelligence (AI) can help doctors do a better job of finding breast cancer, according to a study from a team of international researchers in the U.S. and U.K. at Google, Deep Mind, Northwestern Medicine, Cancer Research U.K. Imperial Center, and the Royal Surrey County Hospital that was published in the journal *Nature* on January 1, 2020. The AI model predicts breast cancer in mammograms more accurately than radiologists. This is incredibly important, as 50 percent of women who undergo screening over a 10-year period will experience a false positive. "We took mammograms that already happened, showed them to radiologists and asked, 'Cancer or no?' and then showed them to AI, and asked, 'Cancer, or no?'" said Mozziyar Etemadi, MD, PhD, research assistant professor at the McCormick School of Engineering and of Anesthesiology and a co-author of the study. This was the test that found AI more accurate than the radiologists.

(Also featured in CNN, BBC, Bloomberg, Wall Street Journal, Reuters, Time Magazine, Financial Times, NPR, ABC, Chicago Tribune)

CNN

New 'Smart Skin' May Let You Reach Out and Virtually Touch – Anyone

Technology allows us to connect with people around the world, but our devices still can't give us that kind of one-on-one sense of touch — that feeling of human connection.

John Rogers, PhD, professor of Neurological Surgery, and his team have developed a new wireless and battery-free smart skin that could shift the course of this technology. Through a fast, programmable array of miniature vibrating disks embedded in a soft, flexible material, this smart skin can contour to the body and deliver sensory input.

The applications for such a flexible smart skin vary from social media, entertainment, virtual reality and video gaming, to sensory feedback for amputees, or event telemedicine. At the office, employees could shake the hand of every businessperson attending a virtual meeting and feel a squeeze in return.

FACULTY AWARDS & HONORS





Franklin B. Saksena,









Barbara Pro, MD, professor of Hematology and Oncology and director of the Hematology and Oncology Fellowship Program, has been named the clinical director of the Lymphoma Program at Lurie Cancer Center.

Jan Winter, MD,

professor of Hematology and Oncology, has been named vice president followed by successive terms as president-elect and president of the American Society of Hematology.

Karen M. Sheehan,

MD, MPH, professor of Pediatrics and Preventive Medicine and associate chair for Advocacy in the Department of Pediatrics, received the Fellow Achievement Award from the American Academy of Pediatrics. **© 1** MD, FACP, clinical associate professor of Cardiology, has been awarded the Outstanding Volunteer Clinical Teacher Award from the American College of Physicians for his 50 years of service in the clinical practice of internal medicine and cardiology.

Inger E. Burnett-

Zeigler, PhD, associate professor of Psychiatry and Behavioral Sciences, has been named to the Chicago Mayor's Council for Mental Health Transformation. 22

Two Feinberg faculty were appointed to leadership positions at the American Association of Medical Colleges:

• Joshua L. Goldstein,

MD, associate dean for Graduate Medical Education and associate professor of Pediatrics and Neurology, was elected as chair-elect of the Group on Resident Affairs. 10 3

• Clara Schroedl, MD,

assistant professor of Pulmonary and Critical Care and medical director of Continuing Medical Education, was elected as incoming Continuing Professional Development Central Regional Representative.

Guillermo Ameer,

ScD, professor of Vascular Surgery and a professor at the McCormick School of Engineering, has been named a 2019 Fellow of the National Academy of Inventors. 10 4

Monica Rho, '01, '05 MD, '09 GME, was

named to the *Crain's Chicago Business'* "40 Under 40" list for 2019. Rho is chief of Musculoskeletal Medicine at the Shirley Ryan AbilityLab and team physician for the U.S. Women's National Soccer Team. Rho previously served as head team physician for the U.S. Paralympic Soccer Team and was the recipient of both the Teacher of the Year and Mentor of the Year awards in the Department of Physical Medicine and Rehabililtation at Feinberg.

Five Feinberg faculty have been named to *Crain's Chicago Business* Notable Women in Healthcare list:

 Anna Shannahan,
 MD, assistant professor of Family and Community Medicine
 Amy Paller, MD,

chair of Dermatology, Walter J. Hamlin Professor of Dermatology, and director of Skin Biology and Diseases Resource-Based Center

• Susan E. Quaggin, MD, director of Feinberg Cardiovascular and Renal Research Institute and chief of Nephrology and Hypertension

• Diane Wayne, MD,

vice dean for Education 🔯 5

Teresa Woodruff,

PhD, dean and associate provost for Graduate Education.

Robert Garofalo,

MD, MPH, chief of Adolescent Medicine in the Department of Pediatrics and professor of Pediatrics and of Preventive Medicine, received the 2019 American Academy of Pediatrics Ellen Perrin Award for Excellence in LGBTO+ Health and Wellness. Garofalo directs the Center for Gender, Sexuality and HIV Prevention at Ann & Robert H. Lurie Children's Hospital of Chicago.

Rajesh Keswani,

MD, MS, associate professor of Gastroenterology and

Hepatology, was awarded funding from the Gordon and Betty Moore Foundation to further research using machine learning to reduce cancer due to colonoscopy diagnostic errors. The foundation's **Diagnostic Excellence** Initiative aims to reduce harm from erroneous or delayed diagnoses, specifically addressing three major categories of disease responsible for the greatest harm from diagnostic errors: acute vascular events, infections and cancer. 06

At press time, Hossein Ardehali,

MD, PhD, director of the Feinberg Cardiovascular and Renal Research Institute's Center for Molecular Cardiology and professor of Cardiology and of Pharmacology, was formally invested as the Thomas D. Spies Professor of Cardiac Metabolism. © 7

A Year of DISCOVERY Looking back on a year of scientific breakthroughs.

By Will Doss and Melissa Rohman

Feinberg has had an exceptional year of scientific inquiry, ranging from examining the most basic systems that make our bodies tick to developing breakthrough therapies and treatment strategies. With the opening of the new Louis A. Simpson and Kimberly K. Querrey Biomedical Research Center, the pace of discovery will only quicken.

During the 2018–2019 fiscal year, Feinberg principal investigators secured a record-breaking \$534 million in sponsored research funding and awards — a 10.2 percent increase over 2018. Led by 652 principal investigators, more than 4,000 clinical trials and research studies were conducted at Feinberg, and 66 patents and five new startup companies were established within the last fiscal year.

"The high-impact discoveries made by Feinberg investigators this year reflect the continued growth of our extraordinary research enterprise," said Rex Chisholm, PhD, vice dean for Scientific Affairs and Graduate Education and the Adam and Richard T. Lind Professor of Medical Genetics. In this issue of *Northwestern Medicine*, we are highlighting some of the most exciting publications of the year — just a small sampling of the substantial contributions our faculty members led across a range of scientific disciplines in 2019.





Tumor Mutations Predict Response to Immunotherapy

A study published in *Nature Medicine* found that patients with glioblastoma responded better or worse to immunotherapy depending on the presence of certain mutations in their tumors. Incorporating these findings — including how tumors with mutations in the MAPK pathway respond better to immunotherapy — into clinical guidelines could improve management of patients with glioblastoma, according to Adam Sonabend Worthalter, MD, assistant professor of Neurological Surgery and co-senior author of the study.

Newly Discovered Protein Explains Leukemia's Treatment Resistance



A previously-unknown protein called cTORC may explain why many

therapies are ineffective in treating leukemia, according to a study published in *Blood* and led by Leonidas Platanias, MD, PhD, the Jesse, Sara, Andrew, Abigail, Benjamin and Elizabeth Lurie Professor of Oncology, and director of the Robert H. Lurie Comprehensive Cancer Center of Northwestern University. A protein complex, called mTORC, drives cancer proliferation in leukemia but was previously believed to be the only complex of its kind exhibiting this behavior — until the current study, when Northwestern scientists discovered a never-before-seen counterpart that was being missed by current therapies.

Deep Learning Predicts Lung Cancer

In a joint study, Google and Northwestern Medicine found that deep learning — a form of artificial intelligence — was able to detect malignant lung nodules on low-dose chest computed tomography (LDCT) scans with a performance meeting or exceeding that of expert radiologists. Co-authored by Mozziyar Etemadi, MD, PhD, research assistant professor of Anesthesiology and of engineering at the McCormick School, the study was published in *Nature Medicine*. The deep-learning system also produced fewer false positives and fewer false negatives, which could lead to fewer unnecessary follow-up procedures and fewer missed tumors, if it were used in a clinical setting.



"Radiologists generally examine hundreds of twodimensional images or 'slices' in a single CT scan, but this new machine learning system views the lungs in a huge, single three-dimensional image."

Mozziyar Etemadi, MD, PhD, research assistant professor of Anesthesiology and of engineering at the McCormick School of Engineering



Total Heart Disease Deaths on the Rise

Total deaths from heart disease, stroke, diabetes, and hypertension — known collectively as cardiometabolic disease — have been increasing since 2011, according to a study published in *JAMA*. While the overall rate of heart disease deaths decreased over time, the rate of decline slowed after 2010. Deaths from stroke and diabetes declined from 1999 to 2010 but leveled off after that. Deaths from high blood pressure increased between 1999 and 2017, according to the study led by Sadiya Khan, MD, MSc, assistant professor of Medicine in the Division of Cardiology.



"We were actually able to create an inhibitor that can affect the tumor without too many side effects."

Sarki Abdulkadir, MD, PhD, the John T. Grayhack, MD, professor of Urological Research, vice chair for research in the Department of Urology, a professor of Pathology and member of the Robert H. Lurie Comprehensive Cancer Center of Northwestern University.

New Molecule Blocks 'Undruggable' Cancer Protein

Northwestern Medicine scientists have created a small molecule that reduces expression of MYC, a cancer-causing protein that has been implicated in a wide variety of cancers, according to a study published in *Cancer Cell*.

MYC's unorthodox structure had made it "un-druggable," but this new molecule may finally represent a breakthrough, according to Sarki Abdulkadir, MD, PhD, the John T. Grayhack, MD, Professor of Urological Research and senior author of the study.

Genetically Modified Protein Improves Repair of Muscle Injuries

Using microscopy, Northwestern Medicine investigators identified that annexin A6 — a protein previously identified as a genetic modifier for muscle injury and disease — can enhance the repair of acute injuries by more than 50 percent. The study, published in the *Journal of Clinical Investigation*, was led by Alexis Demonbreun, PhD, research assistant professor of Pharmacology, and senior author Elizabeth McNally, MD, PhD, the Elizabeth J. Ward Professor of Genetic Medicine and professor of Medicine in the Division of Cardiology.



"We've now shown in two different models — of chronic muscle injury and muscular dystrophy — that injecting annexin A6 can enhance repair."

Alexis Demonbreun, PhD, research assistant professor of Pharmacology



"Northwestern has an outstanding microscopy core facility, which really enabled this research."

Elizabeth McNally, MD, PhD, Elizabeth J. Ward Professor of Genetic Medicine and professor of Medicine in the Division of Cardiology

Experimental Drug May Reduce Cancer Growth and Progression

A team led by Sui Huang, MD, PhD, associate professor of Cell and Developmental Biology, found that an experimental drug called metarrestin suppressed metastatic tumors and extended tumor-bearing animal survival without prompting any adverse side effects. The study, published in *Science Translational Medicine*, could be used with existing drug therapies to help extend patient survival and ultimately improve a patient's quality of life.



"We were looking for a phenotypic marker that only exists in cancer cells and not in normal cells."

Sui Huang, MD, PhD, associate professor of Cell and Developmental Biology





Scientists Identify Therapeutic Target in Diabetic Kidney Disease

An international team of collaborators led by Susan Quaggin, MD, chief of Nephrology and Hypertension in the Department of Medicine and director of the Feinberg Cardiovascular and Renal Research Institute, demonstrated that inhibiting a protein called VE-PTP preserves microvascular and kidney function in diabetic mice. The findings, published in the *Journal of Experimental Medicine*, identify a new therapeutic target that may help protect kidney function in patients with diabetic kidney disease in addition to other diseases where the kidneys are targeted.

Discovery

Groundbreaking Sensors Wirelessly Monitor Babies in the NICU

An interdisciplinary team of Northwestern faculty developed a pair of soft, flexible wireless baby sensors that can replace wire-based sensors currently monitoring babies in the hospital's neonatal intensive care units. The team found that the sensors are gentle enough to stick to a newborn's fragile skin and ultimately could increase parent-baby physical and emotional bonding through allowing easier skin-to-skin contact between parent and child. The study was published in the journal *Science* and co-led by John Rogers, PhD, professor at the McCormick School of Engineering and of Neurological Surgery, Amy Paller, MD, chair and Walter J. Hamlin Professor of Dermatology and a professor of Pediatrics, and Shuai (Steve) Xu, MD, MSc, an instructor of Dermatology at Feinberg and a Northwestern Medicine dermatologist.



"Wires are not just a physical impediment to interacting with the baby, but also disrupt imaging."

Amy Paller, MD, chair and Walter J. Hamlin Professor of Dermatology and a professor of Pediatrics

New Link Between Mitochondria and Neurodegeneration

Mitochondria, the organelle that powers most cells in the body, may be the canary in the coal mine for neurological disease, according to new findings published in the *Journal of Cell Biology*.

Mitochondrial stress and dysfunction have long been suspected as an early step in diseases like Parkinson's or Alzheimer's disease, but Northwestern scientists have uncovered a mechanism that may explain how.

"Mitochondrial dysfunction triggers neurodegeneration resulting in the inability of flies to climb. If this is true in mammals, then it will be a significant finding."

Navdeep Chandel, professor of Medicine in the Division of Pulmonary and Critical Care, of Biochemistry and Molecular Genetics and a member of the Robert H. Lurie Comprehensive Cancer Center of Northwestern University.

The study found that mitochondrial stress in neurons can cause an enzyme imbalance that contributes to neuronal dysfunction and death. Reversing this imbalance showed promise in cell models, sketching an outline of a future therapy, according to Navdeep Chandel, PhD, the David W. Cugell, MD, Professor and a co-corresponding author of the study.

Personalized Approach to Parkinson's Treatment

Instead of trying to fix broken enzymes that contribute to Parkinson's disease, Feinberg scientists amplified healthy ones – an approach that successfully alleviated symptoms in human brain cells and in mouse models. The study, published in *Science Translational Medicine* and led by Dimitri Krainc, MD, PhD, chair and Aaron Montgomery Ward Professor of Neurology, points to the potential of tailoring treatments to the unique genetic conditions of patients.

"We've traded in a relationship for convenience in healthcare."

Jeffrey Linder, Chief of General Internal Medicine and Geriatrics and Michael A. Gertz Professor of Medicine

Number of Americans Receiving Primary Care Decreased Between 2002–2015

A study published in JAMA Internal Medicine found that the percentage of Americans who received primary care — especially those who were male, younger, of minority backgrounds, or who lived in the southern region of the United States decreased from 77 percent in 2002 to 75 percent in 2015.

"Having an established source of primary care can be associated with developing good habits or identifying problems earlier in life," said Jeffrey Linder, '97 MD, MPH, Chief of General Internal Medicine and Geriatrics in the Department of Medicine and a co-author of the study. "What I'm most nervous about from our findings is: Are we going to have an entire generation of Americans that have much lower rates of receiving primary care that, in turn, may have more health problems in the future?"

Investigators noted that the chronic underfunding of primary care in the U.S. and the popularization of convenient, immediate care clinics is reason to predict that the trend will continue.

Gene Mutation Causes Autism and Intellectual Disability

As described in a study published in the journal *Neuron*, Northwestern Medicine scientists have discovered why a specific genetic mutation causes intellectual disability and autism spectrum disorder in children. The lead author was Peter Penzes, PhD, director of the Center for Autism and Neurodevelopment and the Ruth and Evelyn Dunbar Professor of Psychiatry and Behavioral Sciences and of Physiology.

The Northwestern scientists discovered that genetic mutations in human patients in a gene called Usp9x result in the brain growing fewer synapses. That's because Usp9x protects another protein called ankyrin-G, whose role is to grow and stabilize synapses. The developing brain needs to build lots of synapses between neurons so cells can communicate while the brain grows, and to learn.

But when Usp9x is mutated, it can't stabilize the synapse-enhancing ankyrin-G. Thus, the would-be enhancer protein degrades and destabilizes, resulting in fewer synapses in the brain, scientists found. Individuals with this mutation have developmental delay, difficulty learning, increased anxiety and hyperactivity.



"We have solved an important piece of the puzzle in understanding how this mutation causes intellectual disabilities and mental illness."

Peter Penzes, PhD, Ruth and Evelyn Dunbar Professor of Psychiatry and Behavioral Sciences and of Physiology

Luisa Iruela-Arispe heads the Department of Cell and Developmental Biology.

A Natural Networker

IN 1989,

Luisa Iruela-Arispe, PhD, was holding a

brand-new doctoral degree. She had successfully defended her thesis on developmental biology at the University of São Paulo in Brazil, and she was ready to take the next step in her scientific career.

During her studies, she felt her scientific passion narrowing, from broad developmental questions to the specifics of endothelial cell biology, the layer of cells that line blood and lymphatic vessels. But, there was one problem.

"Nobody at São Paulo was studying endothelial cells," says Iruela-Arispe, who was recently appointed the Stephen Walter Ranson Professor and chair of the Department of Cell and Developmental Biology. "So, I decided to look for opportunities abroad."

By that time, big, life-changing moves had become second nature to Iruela-Arispe. Born in Spain, her parents relocated the family to Argentina when Iruela-Arispe was just five years old. The combination of the Franco regime and a lagging economy meant better opportunities could be found abroad, and Argentina was welcoming scores of Spanish and Italian immigrants. In Argentina, the family frequently relocated due to her father's engineering work, inculcating a certain wanderlust in the young Iruela-Arispe.

"Those experiences made me into an individual who appreciates new cultures, seeks connections to quickly adapt, and is not afraid of change," Iruela-Arispe said. "It allowed me to come into a new environment, which was different than previous ones, and embrace it."

In 1990, this adventurous attitude, along with a passion for endothelial cells that could no longer be fueled in her current home, led Iruela-Arispe to accept an offer at the University of Washington in Seattle (UW).

At the time, UW was one of the leading hubs for atherosclerosis research, an initiative that necessitated advances in the understanding of endothelial cells. Iruela-Arispe joined the laboratory of Helene Sage, PhD, to study endothelial cells using molecular and cell signaling tools.

"Our goal is to house outstanding investigators who are at the cutting edge of cell and developmental biology, to resolve long-standing questions, and advance therapeutic avenues."

"I found endothelial cells fascinating from the get-go because of their remarkable adaptability," she says. "Because endothelial cells and blood vessels are so critical to the function of all organs, they are an active participant in the resolution or worsening of any pathology. They sense and quickly adapt to their environment; there is always a response tailored to ensure the survival and well-being of the tissue."

Much like the interconnected vascular networks she studies, Iruela-Arispe aims to engender a sense of crossdisciplinary collaboration with her new leadership post at the Department of Cell and Developmental Biology, bringing together scientists investigating developmental processes and myriad human cell types to leverage those studies to treat illness throughout the body. "Our goal is to house outstanding investigators who are at the cutting edge of cell and developmental biology, to resolve long-standing questions, and advance therapeutic avenues," she says.

Always Seeking New Knowledge

At UW, Iruela-Arispe met her nowhusband, Timothy Lane, PhD, who also joined Northwestern as associate dean for Graduate Studies. They then went to Boston, where Iruela-Arispe joined the faculty at Harvard Medical School. In 1998, the couple traveled back to the West Coast for faculty positions at the University of California, Los Angeles (UCLA).

At UCLA, Iruela-Arispe investigated the molecular mechanisms that regulate blood vessel formation during development and pathogenesis, ultimately becoming the Distinguished Professor of Molecular, Cell and Developmental Biology and director of UCLA's Molecular Biology Institute.

Her work centered on the cells' ability to organize vascular networks, ready to divide but holding still until they receive an environmental cue that signals for new blood vessel formation. Once that happens, endothelial cells draw on their developmental knowledge, reactivating the same mechanisms used to create the blood vessels in the first place.

Iruela-Arispe believes investigating endothelial cells and their unique properties could have benefits for many areas of disease — both vascular and beyond. While vascular tissue cancers like angiosarcoma are deadly, they are incredibly rare compared to other cancers. The exceptional ability of endothelial cells to control division may be the reason, and Iruela-Arispe believes learning from this example could improve cancer treatment across the board.

"Studying why endothelial cells have this ability to reboot and yet not be as susceptible to mutations is fascinating," Iruela-Arispe says. "We could apply this knowledge to other cell types and try to use that knowledge to correct programs in other cells."

Looking to the Future

In 2018, Lane and Iruela-Arispe sent their second and final child off to college, and faced a decision many parents confront with an empty nest: What now?

"I thought, 'OK, now I think it's my chance," Iruela-Arispe said. "It was time to focus on my next academic and scientific chapter."

Right then, Northwestern presented her with an appointment she couldn't refuse.

"It was a very unique opportunity to significantly shape the growth of a department at an institution of the caliber of Northwestern — something that does not come twice in a lifetime," Iruela-Arispe said. "And, it was the right time, because the kids were gone and Tim was completely supportive."

Iruela-Arispe has a broad vision for the department and plans to explore therapeutic techniques like cell-based treatments controlling individual cells to fight disease, whether that's helping repair damaged cells or attack bad actors — while pursuing innovative collaborations across Feinberg's departments. One emerging area that intrigues her is bioprinting: using biological materials to create tissue-like structures that imitate natural tissue.

"It's an exciting challenge; it's a path for regenerative medicine," Iruela-Arispe says. "There is a lot of opportunity here at Northwestern, and I'm looking forward to connecting with the bioengineering community."

These intersections with oncology, organ-specific disciplines, and engineering are a direct result of the vascular system's interconnectivity, and this interdisciplinary aspect – combined with an eye toward treatment – inspires Iruela-Arispe.

"We are entering an era where cell biology is impacting clinical practice and therapies," she says. "To me, cell and development biology is probably one of the meccas of developing new avenues to directly affect resolution of disease." •

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THE OPENING of the new Northwestern University Center for Arrhythmia Research this year underscores just how far treatment and detection of irregular heartbeats has come since the electrocardiogram (EKG) was developed in the 19th century. At the time, the EKG was one of the first instances of technology providing physicians with objective data about what exactly was going on within our internal organs.

In 1909, the system was used to diagnose atrial fibrillation as the cause of an irregular heartbeat. Atrial fibrillation — commonly known as AFib — happens when the heart's upper chamber beats out of sync with its lower chamber. This arrythmia can come and go, or it may be persistent. In both cases, the resulting low blood flow can lead to clots, stroke, and heart failure.

Over the past 100 years, physicians and investigators have developed therapies to treat AFib, often through blood thinners (which can reduce clots), or through interventions like ablation, which destroys tissue in the heart that may be causing this irregularity. But as our lifespans grow longer, AFib has become more "We want to be able to use the technology available to us to better understand stroke prevention and to perhaps spare patients from being on blood thinners for the rest of their lives."



ROD PASSMAN, MD

"Northwestern is uniquely positioned to be a worldwide leader in this field," says Rod Passman, MD, professor of Medicine in the Division of Cardiology and of Preventive Medicine, the Jules J. Reingold Professor of Electrophysiology, and a cardiac electrophysiologist at Northwestern Memorial Hospital, who will direct the new center. "My goal is to change the way we manage these diseases to improve the lifespan and life experiences of our patients."

that may be causing this irregularity. But as our lifespans grow longer, AFib has become more INTERPTINE INFORMATION INFORMATI

common. More than six million Americans are currently living with the condition — a number that is expected to rise to more than 12 million by 2030 due to an aging population.

The risk factors from AFib vary greatly from person to person, which makes personalized care imperative. That's why, thanks to a generous \$10 million gift from several donors, Feinberg is opening the new center. Through the center, teams of interdisciplinary clinicians and scientists will work together to discover both the underlying molecular causes of arrhythmias and new standards of care for treatment.

And though the electrocardiogram is still used in clinics today, physicians and investigators now have many more technologies at their disposal — such as implantable monitors and Apple Watches — to bring a new level of detection and care to their patients.

DETERMINING WHO IS AT RISK FOR STROKE

Passman has always been interested in using the latest techniques and technology to provide the best surveillance and care for his patients since he joined the field as a professed lifelong learner.

"I don't think anyone says as a child, 'I want to be a cardiac electrophysiologist when I grow up," he says. "But I wanted to pick the area in medicine that made the least sense to me, that would be the most challenging, so it would hold my interest."

Nearly 30 years later, Passman is highly regarded in the field and is a leader in cardiac monitoring and stroke prevention. He helped pioneer the use of implantable cardiac monitors for AFib in stroke patients, and he recently published a study in the journal *Circulation* that » NEW CENTER FOR ARRHYTHMIA RESEARCH WILL DEVELOP NOVEL WAYS OF DETECTING AND TREATING CONDITIONS LIKE ATRIAL FIBRILLATION.

WRITTEN BY EMILY AYSHFORD





Evaluation of 3D blood flow dynamics in the human heart using 4D flow Magnetic Resonance Imaging (MRI). Left: Whole heart 4D flow MRI depicts blood flow in the heart and surrounding great vessels (color coding = blood flow velocity). Above: 3D blood flow in the left atrium and left ventricle in a patient with atrial fibrillation.



"You have to understand what's normal to best understand how abnormal a flow might be."

MICHAEL MARKL, PhD

used data from device-detected AFib to measure the risk of stroke. By linking two databases the electronic records of more than 11 million patients and a database of 300,000 patients with cardiovascular implantable electronic devices that could detect AFib — they found that not all cases of AFib lead to stroke.

By measuring the stroke risk of 21,000 patients using the CHA2DS2-VASc score — a clinical score that takes into account risk factors such as age and cardiovascular history — they found that only AFib of an increased duration was associated with a higher risk of stroke, even among those with other similar stroke risk factors.

"If you have a low amount of atrial fibrillation, and not a lot of other risk factors, your risk of stroke is very low," Passman says. That's important because most patients with AFib are treated the same way — a lifetime of bloodthinning drugs, which can be expensive and have unwanted side effects.

"The way we treat atrial fibrillation today is based on historical measures, and we don't individualize care very much," Passman says. "We want to be able to use the technology available to us to better understand stroke prevention and to perhaps spare patients from being on blood thinners for the rest of their lives."

A WATCH THAT CAN ALERT YOU TO AFIB

Passman showed in a recent study that implantable cardiac monitors could reduce patients' time on blood thinners by 95 percent. But those monitors are not scalable to the entire population of AFib patients. They cost thousands of dollars and often only send data to clinicians once a day, in the middle of the night. Instead of developing new technology, electrophysiologists are looking toward consumer products, like Apple Watches, which now have the ability to check heart rhythm. That means the watch could alert wearers when they are in AFib and then remind them to take their blood thinner. (Recent advances mean blood thinners can now thin blood within a couple hours of administration.)

Passman is in the final phases of evaluations for a large study that would test how well this system could work. Patients enrolled in the study would each receive an Apple Watch and would use the watch's pulse checker to track their AFib.

"It's a wearable AFib monitor that's built into a consumer grade electronic device for less than 1 percent of the cost of an implantable device," he says.

UNDERSTANDING AFIB AT ALL LEVELS

Passman and his colleagues are also searching for the underlying factors and mechanisms that cause AFib. In 2018, the American Heart Association awarded Feinberg a \$3.7 million grant as one of six centers in a national network dedicated to researching and understanding the causes of atrial fibrillation.

Understanding this disease extends to both epidemiological studies and basic science research. As part of the grant, Philip Greenland, "We want to tell patients that we are not only a great place for clinical treatment but we also are the place where cutting-edge research is done, where new treatments are going to come from."



RISHI ARORA, MD

MD, the Harry W. Dingman Professor of Cardiology, director of the Center for Population Health Sciences, and a professor of Preventive Medicine in the Division of Epidemiology, is studying cardiac structure and blood flow across populations to determine AFib prevalence and stroke risk.

At the same time, Rishi Arora, MD, professor of Medicine and director of Experimental Cardiac Electrophysiology in the Division of Cardiology, is studying the underlying molecular mechanisms of AFib and developing new gene-based therapies for the disorder. By using novel gene therapy approaches to target the fundamental molecular mechanisms underlying AFib, such as inflammation and increased "firing" of the heart's intrinsic nervous system, he and his laboratory team hope to prevent progression of AFib and potentially even cure the disease. "We want to create viable therapies to be able to target these fundamental mechanisms very soon," Arora says.

The investigators also collaborate with Michael Markl, PhD, vice chair for Research in the Department of Radiology, the Lester B. and Frances T. Knight Professor of Cardiac Imaging, and a professor of Radiology. A physicist by training, Markl has developed a new imaging technique that can measure the 3D blood flow in the heart without any radiation or contrast agents. Called 4D Flow MRI, the technique can measure blood flow through thousands of images. Markl and his collaborators are using their imaging tool to create a more patientcentric risk metric for stroke risk. Clinicians like Passman use the technique, which takes 5-10 minutes as part of a regular cardiac MRI, to understand how patient risk changes if they've had ablation or other therapies. "Sometimes, even if you cure the arrythmia, you don't

restore normal blood flow," Markl said. "We want to know if this group is still at continued risk for stroke."

Markl is also examining flow across a wide range of patients. "You have to understand what's normal to best understand how abnormal a flow might be," he says.

NEW CENTER WILL BE CATALYST FOR RESEARCH

It's collaborations like these that have fueled the founding of the new Center for Arrhythmia Research. The center, directed by Passman, will bring together faculty from across disciplines cardiology, radiology, engineering, and computer science — to better understand and treat arrhythmia disorders.

Conditions like these require a collaborative approach, Arora says. "At Northwestern, we are able to look at the disease from the molecular level all the way to the patient," he says. "The Center for Arrhythmia Research will enable investigators to more closely communicate with each other and to foster productive, cross-disciplinary collaborations among investigators at Feinberg and other schools at Northwestern, like the McCormick School of Engineering."

The center hopes to attract the best students and investigators through fellowship programs, and will provide catalyst funds for early-stage research at the university. It will also help Northwestern Medicine stay at the leadingedge of treatment. "We treat a lot of patients, and we want to tell patients that we are not only a great place for clinical treatment but we also are the place where cutting-edge research is done, where new treatments are going to come from," Arora says. **◊**

THERE'S AN APP FOR THAT

A wearable AFib monitor built into a consumer-grade electronic device, such as an Apple Watch, could alert patients that they need to take their blood thinner.



hat could retired insurance broker Robert Salata of Libertyville, Illinois, possibly have in common with Mick Jagger? Well, not much, except for a novel cardiac procedure that allowed both men to avoid open heart surgery and dance to their hearts' content just weeks later.

On March 30, 2019, the Rolling Stones postponed their North American tour: Jagger needed "medical treatment." Soon after, he underwent transcatheter aortic valve replacement (TAVR) at a New York City hospital, and by May 15, a viral video showed the 75-year-old flaunting his familiar moves.

Around the same time, Northwestern Medicine patient Robert Salata, 82, was preparing himself to undergo TAVR. He had discovered in February 2019 that in addition to blocked arteries, a defective aortic valve was contributing to his shortness of breath and lack of energy. In late April, the father of three and grandfather of eight underwent coronary angioplasty to widen his narrowed arteries: Five stents were used to improve blood flow through his overworked and weakened heart. Unfortunately, an infection landed him in Northwestern Memorial Hospital's ICU for 14 days in early May. Although he was able to regain some strength by June, Salata's overall condition put him at high to intermediate risk for open heart surgery to repair his aortic valve. TAVR was his best option.

"I don't think I would be here today without it," says Salata, who underwent the procedure at Northwestern Memorial Hospital on June 20, a day before the Rolling Stones performed their first concert since Jagger's treatment. By August, Salata was dancing at his granddaughter's wedding.

Proving a Hypothesis

With shorter recovery times and lower complications rates than surgery, TAVR is the first procedure to offer patients with severe aortic stenosis a revolutionary alternative to cracking open their chest to reach their heart. Initially approved for frail or ill patients who may not fare well during or after valve replacement surgery, TAVR now has been proven to be superior to open heart surgery for all patients with severe tricuspid aortic stenosis. »

Right to the Heart

Northwestern Medicine leads the development of a revolutionary cardiac procedure.

WRITTEN B<u>y Cheryl Soohoo</u>

"I don't think I would be here today without TAVR."

> Northwestern Medicine patient Robert Salata, 82, at his home in Libertyville, Illinois

•• New Direction Transcatheter aortic valve replacement (TAVR) is a game changer for hundreds of thousands of people who suffer from severe aortic stenosis.

In 2008, Northwestern's Bluhm Cardiovascular Institute became one of the first programs in the country to adopt TAVR as part of the Placement of AoRTic TraNscathetER Valve Trial of the Edwards SAPIEN Transcatheter Heart Valve or, for short, the PARTNER 1 trial. The inaugural multicenter study evaluated the safety and efficacy of the catheter-based device - an artificial heart valve made of cow heart lining tissue - in patients who were either inoperable or at high risk of surgical complications. Northwestern then participated in the PARTNER 2 trial that examined the procedure's efficacy and ability to improve outcomes in intermediate-risk individuals. In 2016, PARTNER 3 was launched to study the

"We don't stop the heart like in openheart surgery. The procedure has revolutionized the treatment of a life-threatening disease."



benefit of TAVR for low-risk patients. Now, three PARTNER trials later, TAVR is FDA-approved for all risk groups and is being heralded as a game changer for the approximately 200,000 patients a year who suffer from severe aortic stenosis.

groundbreaking results from the PARTNER 3 trial appeared in *The New England*

Charles Davidson, MD, '85 GME

Journal of Medicine. Findings from 71 participating centers revealed that low-risk patients benefit significantly from TAVR and that their outcomes were superior or at least the same as surgical aortic valve replacement. The rates of death, stroke, re-hospitalization, major bleeding, and new atrial fibrillation at one year were significantly lower with TAVR than surgery.

"This breakthrough opens the door to many more — if not most — patients being considered for treatment with TAVR," says co-author S. Chris Malaisrie, MD, co-chair of

NORTHWESTERN MEDICINE • WINTER 2020



the PARTNER 3 national case review board and professor of Surgery in the Division of Cardiac Surgery at Feinberg. "All three studies successfully proved the hypothesis: TAVR is not inferior to surgery."

Team Approach

One of four valves in the heart, the leaflets of the aortic valve open and close with every heartbeat to allow oxygen-rich blood to flow to the rest of the body. A malfunctioning aortic valve can disrupt this vital circulation of blood. Aortic valve stenosis arises when the leaflets of the valve become calcified and fail to open completely. This situation leaves a narrow opening for blood to flow through, which consequently forces the heart to work harder to pump blood to adequately sustain bodily functions. Symptoms of aortic stenosis include shortness of breath, chest pain, passing out, and even death. The incidence of aortic valve stenosis increases with age and can appear in patients in their 60s, 70s, and 80s.

Medication can help to manage symptoms for mild and moderate cases of aortic valve disease. However, severe aortic stenosis with symptoms demands mechanical intervention: It is associated with approximately 50 percent mortality at one year without valve replacement. Previously, patients with severe stenosis faced open heart surgery for their valve replacement in an operating room. Now, more likely than not, patients will undergo TAVR in the Cardiac Catherization Lab.

An interventional cardiologist and a cardiac surgeon jointly perform the novel 30- to 60-minute procedure, with the patient generally requiring only moderate sedation. The valve used in TAVR is mounted on a stent and is compressed on a balloon catheter or tube-like device. One specialist positions the artificial valve by inserting the catheter in through the patient's groin and across the blocked heart valve. The other operator deploys the device by expanding the balloon, which anchors the replacement valve to the diseased aortic valve. Unlike surgical replacement where the "native" valve is entirely removed and replaced, with TAVR the diseased valve is just pushed aside by the new valve.

During TAVR, the clinical team lowers the patient's blood pressure by increasing the heart rate for the 10 to 15 seconds it takes to properly deploy the new valve. "That's another one of the advantages of TAVR," says Charles Davidson, MD, '85 GME, vice chair for Clinical Affairs,

e-threatening ase." approximately 200,000 patien a year who suff from severe aortic stenosis In March,

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his grandchildren; thanks to TAVR, he was able to attend the wedding of his granddaughter, Taylor.

"It's gratifying for us to have played such a significant role in providing treatment options that otherwise, until recently, would not have heen available."



clinical chief of Cardiology, and professor of Medicine at Feinberg. "We don't stop the heart like in open-heart surgery. The procedure has revolutionized the treatment of a life-threatening disease by lowering the procedural risk, shortening recovery times, and extending the lives of our patients."

The presence of a cardiac surgeon ensures that if complications should arise during TAVR, the heart valve team can immediately take the patient to surgery. A rare occurrence hovering around 1 percent or less, surgery is required about two times a year for the 230 procedures performed annually at Northwestern Memorial Hospital, according to Malaisrie.

One of the nation's top 10 enrollment sites for PARTNER 3, Northwestern Medicine has led the development of this treatment option since TAVR's introduction. The academic medical center system currently offers TAVR at Northwestern Memorial, and in the suburbs of Chicago, at Central DuPage Hospital and McHenry Hospital. At Northwestern Memorial Hospital, the heart valve team has three cardiac surgeons and four interventional cardiologists - among them Davidson's daughter Laura Davidson, '11 MD, '18 MS, '18 GME experienced with performing TAVR.

A Life-Altering Procedure

Northwestern Medicine's depth and breadth of experience with TAVR brought Morton Grove, Illinois, resident Donald Weiss to Northwestern Memorial Hospital last summer. The Chicago Public Schools special education teacher quickly learned he needed a new aortic valve when he was left speechless and panting trying to catch his breath while walking in an airport. His friend, a retired physician who had undergone TAVR, had said Northwestern Medicine was the place to go. Meeting the criteria for being at low-surgical risk with relatively good health, Weiss, 74, was a candidate for the PARTNER 3 trial.

"They had to tell me about the risks of TAVR such as major bleeding or a stroke but I said, 'Do it the easy way. You are not opening up my chest," recalls Weiss, who had the procedure in September. "I was out of the hospital in three days and was back to my normal activities within a month. There were no other options for me!"

Fortunately, more and more patients like Weiss and Salata with severe aortic stenosis do have options thanks to TAVR. And their loved ones are grateful for it and the stateof-the-art care they received at Northwestern Medicine. "Between TAVR and the other advanced cardiac care my dad received, it truly is a miracle he is here with us today," says Salata's son, Bob Salata, Jr.

Salata's daughter Amy Shanahan agrees wholeheartedly and greatly appreciates the many more wonderful memories - from fishing trips to a granddaughter's wedding her father has shared with his family since his TAVR procedure. "We are so happy to have our dad to celebrate with us," she says.

Moving forward, Northwestern Medicine investigators and others are studying TAVR for use in asymptomatic patients - individuals who have severe aortic valve stenosis but haven't yet exhibited debilitating symptoms. The goal is to further broaden the benefits of TAVR.

"This is truly a life-changing and lifesaving procedure," says Malaisrie, who has served as site surgical principal investigator (PI) for all three PARTNER trials at Northwestern, with Davidson serving as site interventional cardiology PI. "It's gratifying for us to have played such a significant role in providing treatment options that otherwise, until recently, would not have been available." **◊**

WRITTEN BY MELISSA ROHMAN

NU BACKARG DOMN

Daniela Matei's career has been devoted to treating rare gynecologic cancers, despite the obstacles.

ne of the most disturbing headlines concerning women's health in the past few years has been the dramatic increase of diagnoses and deaths from endometrial cancer, more commonly known as uterine cancer. Not only is the rate of incidence increasing (particularly in aggressive subtypes among non-Hispanic black women), but the age of onset is also getting lower.

Though endometrial cancer is the most common gynecologic malignancy, it doesn't get the public attention that breast cancer or cervical cancer do. And even with an estimated 62,000 new cases diagnosed in the U.S. per year and a projection that more than 11,000 women will die of the disease, the cancer is classified as rare. A woman's lifetime risk for developing endometrial cancer is roughly 3 percent.

As such, research has been underfunded. In fiscal year 2018, the National Institutes of Health allocated a total of \$47 million toward endometrial cancer research; this year, the NIH estimates that total will drop to \$42 million.

Fighting a rare, underfunded, life-threating disease, Daniela Matei, MD, a Northwestern oncologist and scientist, finds herself in a catch-22. But it hasn't deterred her from pursuing trailblazing research and translating her discoveries into real-world clinical applications.

Recently, Matei, also a professor of Hematology and Oncology and of Obstetrics and Gynecology and co-leader of the Translational Research Program in Solid Tumors at the Robert H. Lurie Comprehensive Cancer Center of Northwestern University, completed a critical study to evaluate treatment options for women diagnosed with latestage endometrial cancer.

The unexpected results may change the standard of care for stage 3 uterine cancer. And Matei was as surprised as anyone by them.

DISCOVERING THE UNEXPECTED

"Endometrial cancer is usually diagnosed at an early stage because women present with bleeding, but there is a subgroup of patients with endometrial cancer that are diagnosed at a late stage. For those patients, treatments are not curative," says Matei, who is the Diana, Princess of Wales Professor of Cancer Research.

Also, for that patient population, there has been debate in the medical community about the best approach to treatment. The standard course of care for locally advanced stages of endometrial cancer, which, according to the American Cancer Society, presents a five-year survival rate of 70 percent, is invasive surgery followed by a combination of chemotherapy and radiation. Some researchers and physicians, however, believed that chemotherapy alone might be sufficient.

"Previous studies had shown that chemotherapy was a crucial aspect of treatment. However, it was unknown if radiation needed to be added to the chemotherapy," explains Emma Barber, MD, assistant professor of Obstetrics and Gynecology in the Division of Gynecologic Oncology, who has collaborated with Matei on various translational research projects and, under Matei's guidance, developed two clinical trials for treating endometrial patients with drugs used to treat breast cancer. Still, Matei and her team did not expect their research to so conclusively counter the current treatment protocol.

"The trial was expected to be a positive trial demonstrating that the combined regimen was superior to chemotherapy given alone," Matei said. To the contrary, Matei's findings, published in *The New England Journal of Medicine*, revealed that radiation combined with chemotherapy did not in fact increase recurrence-free survival for this patient population, effectively ending the debate.

"This study showed that patients who had chemotherapy and radiation had the same amount of time before their cancer recurred as patients who had chemotherapy alone. It also showed, not surprisingly, that the combination of chemotherapy and radiation had more side effects than chemotherapy alone," said Barber. "These results allow us to minimize the toxicity of treatment for patients with endometrial cancer, while still providing the same cancer outcomes."

Even as she strives to uncover treatments, however, Matei expects the number of cases of endometrial cancer to continue to rise and suggests that the obesity epidemic could be the cause. "More than half of the cases of endometrial cancer in the U.S. are attributable to obesity," she says.

DRIVEN TO SAVE WOMEN'S LIVES

In addition to studying endometrial cancer, Matei's lab studies the cellular mechanisms of ovarian cancer metastasis — specifically epigenetic defects and tumor progenitor cells — and evaluates treatment options with the ultimate goal of improving survival outcomes for women who have been diagnosed. »

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With my research, I hope to try to improve a patient's clinical outcome, to help them overcome their fears, and to have more to offer them in terms of potential treatments.

DANIELA MATEI, MD Northwestern oncologist and scientist

A colored scanning electron micrograph depicting uterine cancer. Ovarian cancer is generally diagnosed in post-menopausal women when it has already reached advanced stages, as symptoms rarely show in early stages. At this point, the cancer has spread to a woman's pelvis and can be fatal if left untreated.

According to Matei, high-quality screening tests for ovarian cancer currently don't exist and the best course of treatment is a combination of surgery, chemotherapy, and drugs. This has been the standard course of treatment for the last 20 years and while many respond well to treatment, about 70 percent of patients will relapse.

"Most cases of ovarian cancer after treatment develop resistance to treatment, so my lab

About 70 percent of patients with ovarian cancer will relapse.

is interested in characterizing the metabolism of resistant cells, as well as some of the epigenetic modifications that occur in the resistant cells," Matei

said. "The point of this work is to find new targets and develop treatment options that have not yet been invented."

Recently, Matei and her team have been conducting clinical trials to test a variety of epigenetic drugs designed to reestablish response to chemotherapy for ovarian tumors that have become resistant to treatment. One such new class of drugs, called PARP inhibitors — which target the DNA repair enzyme PARP — were approved for the treatment of patients with chemotherapy-resistant ovarian cancer, but activity in late-stage disease remained unproven.

This past spring, Matei was co-author of a phase II trial published in *The Lancet Oncology*, showing that a PARP inhibitor drug called niraparib indicated clinically relevant activity in women with relapsed ovarian cancer who had exhausted all previous treatment options. Matei sees more such work in her future.

"Specifically, I think my niche will be to continue to develop new combinations of treatments for platinum-resistant ovarian cancer," Matei says. "I hope to also be able to lead a team of investigators in a collaborative effort focused on just ovarian cancer and we're working towards making that happen."

FROM THE LAB TO THE CLINIC

As passionate as Matei is about studying female gynecologic cancers, she didn't acquire a clinical interest in them while she was in medical school. In fact, her interest was sparked after she initiated research as a hematology/oncology fellow at the University of California, Los Angeles.

"My mentor at the time had an interest in looking at gene expression in ovarian cancer versus normal epithelium. I was a fellow in hematology oncology and was selected randomly to do this research project focused on defining transcriptomic changes in ovarian cancer," says Matei.

At the time, DNA microarrays — a tool used to determine if the DNA from an individual contains gene mutations — was beginning to emerge to the forefront of the field.

"Due to this project, I pursued some of the genes that we discovered to be highly expressed in ovarian cancer and ultimately ended up building my career in ovarian cancer," says Matei.

After almost two decades of studying female gynecologic cancers, Matei's motivation continues to remain patient-centered and she feels fortunate to be able to both treat and study the same diseases.

"With my research, I hope to try to improve a patient's clinical outcome, to help them overcome their fears, and to have more to offer them in terms of potential treatments," she says. "My research and practice are very nicely blended — it's very rewarding to be able to see the translation of some of the findings from the laboratory to the clinic, and also to use patient specimens from the clinic and bring them to the laboratory." ◊



WHAT'S IN A NAME?

On October 27, 2016, at The Peninsula Chicago, Daniela E. Matei, MD, was formally invested as the Diana, Princess of Wales Professor of Cancer Research.

Ann Lurie, president of Ann and Robert H. Lurie Foundation and Lurie Holdings, Inc., and longtime supporter of Northwestern, spoke during the gathering about her establishment of this professorship in 1996 to commemorate Princess Diana's visit to Northwestern.

"Back in 1996, I remember that Diana urged cancer researchers at Northwestern to avoid the other 'c' word — complacency — in their work. Today, we have adopted 'urgency' in its place," said Lurie. "I am happy that through this professorship that exists in perpetuity I could help to leverage the recruitment of someone like Dr. Matei."

Matei with Teresa Woodruff, PhD, associate provost for Graduate Education; Leonidas Platanias, MD, PhD, director of the Robert H. Lurie Comprehensive Cancer Center; Ann Lurie; Eric Neilson, MD, vice president for Medical Affairs and Lewis Landsberg Dean; and Serdar Bulun, MD, chair of the Department of Obstetrics and Gynecology

Enhancing Primary Care Education

tudents who participated in the Education Centered Medical Home (ECMH) program — a four-year, team-based clerkship that provides care to underserved populations — experienced superior primary care training compared to a traditional clerkship model, according to a study recently published in *Academic Medicine*.

Led by Daniel Evans, 'oo MD, 'oʒ GME, assistant professor of Medical Education and of General Internal Medicine and Geriatrics, the study suggests that graduating ECMH students are more prepared to practice in team-based, collaborative, and patient-centered healthcare settings than students who do not.

"ECMH is generating more interest in community, in taking care of vulnerable patients, and I think we're going to generate better quality primary care docs or specialists who have more understanding of what highquality primary care looks like," Evans said.

Unsatisfied with the lack of longitudinal care offered in traditional clinical rotational programs, Evans established the ECMH program as a pilot project in 2011. The goal of ECMH is two-fold: to provide continuous, primary care to underserved and diverse patient populations, and to help students better understand chronic conditions in a variety of clinical settings.

The program began with just 56 students (14 volunteers from each class) at four clinical sites. The program has now expanded to include all 600-plus Feinberg students who work at a total of 36 ECMH sites across Chicago. Half of students participating in ECMH are assigned to clinics located in primary care shortage communities, and it's estimated that two-thirds of all ECMH patients are either underserved, underinsured, or medically vulnerable.



An ECMH clinic consists of roughly 16 students and one faculty physician throughout all four years of medical school. During each clinical session, three junior students are paired with three senior students to provide primary care, lifestyle counseling, and assistance to patients navigating the healthcare system. Senior students serve as the clinic educator, while other students serve as care coordinators, arranging visits and tracking patient outcomes, including follow-up.

In the study, 329 students were randomized into the ECMH program or a mentored Individual Preceptorship (IP) for two years followed by a traditional four-week primary care clerkship. Over the course of the program, 96 percent of students participated in surveys at the beginning of their medical school careers

THE GOALS OF ECMH

- Provide continuous, primary care to underserved and diverse patient populations
- Help students better understand chronic conditions in a variety of clinical settings

and then at the end of their first, second, and third years.

Results showed that about 70 percent of ECMH students would recommend the program to incoming students and students reported a more positive learning environment, better patient relationships, and other positive results.

Team Science

These two new collaborative centers are committed to tackling two of the most pressing health and societal issues of the day: pain management and an aging population.

BUILDING ON DECADES OF PAIN SCIENCE

he Center for Translational Pain Research aims to advance basic and clinical science relating to chronic pain and analgesic therapies, as well as develop novel treatments to treat chronic pain conditions. With a core faculty made up of investigators from the Departments of Physiology, Psychiatry and Behavioral Sciences, Pharmacology, Neurology, and Physical Medicine and Rehabilitation, the center is interdisciplinary by design.

"This is a new, exciting phase for pain research at Northwestern," said A. Vania Apkarian, PhD, director of the center and a professor of Physiology, Anesthesiology, and Physical Medicine and Rehabilitation. "We are the only such program in the U.S. and as such, we hope to spearhead the science necessary to combat chronic pain; identify underlying mechanisms and relationships with opiate misuse and opiate analgesia; and uncover new drug targets in this domain."

Treating chronic pain is a difficult undertaking: The wide range of mechanisms underlying the condition are not very well understood, and there are currently no treatments that address the underlying cause of most chronic pain. Instead, current pain-relief drugs merely treat symptoms, and many of these drugs can leave a patient susceptible to addiction. Apkarian envisions a translational approach. Northwestern scientists have developed neuro-imaging methods for studying pain in the human brain and models to identify circuits and receptors that reorganize due to chronic pain. Working to improve these tools, along with new investigations, will feed into drug discovery and eventually clinical trials to develop novel, non-addictive drugs to treat different types of pain.

"We hope to rapidly expand to generate subgroups who would pursue these goals in specific types of chronic pain, such as chemotherapy pain, osteoarthritis pain, and chronic pain in children," Apkarian said.

A major priority of the center will be to identify clinical biomarkers than can flag patients who might be susceptible to opioid addiction, an innovation that could be put into practice sooner than later.

"These could be implemented in the clinic to identify patients who could be treated with opioids without developing dependence, and also to identify those who should not be treated with opioids as they would be at risk for dependence," Apkarian said. "We want to establish an experimental pain clinic and conduct trials with direct impact on pain management."



"We are the only such program in the U.S. and as such, we hope to spearhead the science necessary to combat chronic pain."

A. Vania Apkarian, PhD, director of the Center for Translational Pain Research

DEDICATED TO OPTIMAL HEALTH AND WELL-BEING AMONG SENIORS

aunched by Northwestern's Institute for Public Health and Medicine (IPHAM), the Center for Applied Health Research on Aging (CAHRA) will unite faculty across disciplines to investigate cognitive, psychosocial, community, and health system factors that affect a person's ability to manage their health. Center faculty will also work to design interventions to influence health-related behaviors and outcomes.

Directed by Michael Wolf, PhD, '02 MPH, associate vice chair for research in the Department of Medicine, and professor of Medical Social Sciences, the center will focus on six key research programs: health literacy and learning; cognitive aging; psychosocial support; life course health; treatment adherence; and measurement and analyses.

"At Northwestern, we have a very large portfolio of research that focuses on many different aspects of aging," Wolf said. "With CAHRA, the aspiration is to have a venue that can bring together Northwestern aging researchers so that we might innovate together and improve the care provided to the increasing number of Baby Boomers reaching older age and facing considerable healthcare needs. At this time, our health system is not fully prepared to manage all of the issues presented by older patients, as well as by their families who may play integral roles in their care. A mission of CAHRA will be to simplify the burden of treatment, while better engaging patients and families over time."

The center will also be home to a Clinical Psychology Training Lab, which trains pre- and post-doctoral fellows within Feinberg's clinical psychology PhD program behavioral medicine track, allowing an immersive experience in CAHRA's aging research projects.

Research and education like this has the ability to cut across departments and have an impact in a short amount of time, according to Ron Ackermann, MD, MPH, director of IPHAM and senior associate dean for Public Health. "This new center will drive innovation and amplify our collective impact in the field of healthy aging," he said.

innovation and amplify our collective impact in the field of healthy aging." Michael Wolf, PhD, '02 MPH, director of the Center for Applied Health Research on Aging

Below: Led by Michael Wolf, PhD, MPH (center), the Health Literacy and Cognitive Function Among Older Adults (LitCog) study is being conducted by Northwestern's Health Literacy and Learning Program (HeLP) to investigate the ways people understand health information with the aim of creating learning tools to help patients with their day-to-day healthcare









PULSE On Campus



Global Health Day Celebrates the Past, Present and Future

einberg's new Institute for Global Health hosted its inaugural Global Health Day, featuring presentations from each of the institute's constituent centers, a poster session, several panels, and keynote speakers.

Established earlier this year, the Institute for Global Health evolved from the Center for Global Health and the Global Health Initiative Fund, aiming to improve health in middle- and lower-income countries around the world and deepen the medical school's commitment to solving health problems worldwide.

"All of you here today clearly understand the burning urgency of digging into the issues involving global health around the world," said Robert Havey, '80 MD, '81, '83 GME, clinical professor of Medicine in the Division of General Medicine and Geriatrics, and deputy director of the Institute for Global Health, as he welcomed attendees to the symposium.

Robert Murphy, MD, '81, '84 GME, executive director of the Institute for Global Health, and the John Philip Phair Professor of Infectious Diseases, delivered an overview of the Center for Global Communicable Diseases, of which he is also the director.

According to Murphy, a country's wealth remains a major factor that influences mortality: In low-income countries, many of the most common causes of death are communicable diseases.

"A lot of the world is poor, so from a worldwide global health perspective, this is not going away," said Murphy.

SYMPOSIUM HIGHLIGHTS TRANSCRIPTIONAL REGULATION

orthwestern and Cell Press, publisher of *Cell* and *Neuron*, recently hosted a Cell Symposium on the Chicago campus, focusing on transcriptional regulation in evolution, development, and disease, highlighting the medical school's place at the forefront of recent developments in the field.

The conference featured educational sessions on gene enhancers, chromatin packaging, and epigenetics; tutorials on laboratory and computational tools; and a poster session and networking social.

"Our goal is to bring in superb scientists from all over the world to present their state-of-the-art studies and discoveries to members of the community here at Northwestern Medicine," said Ali Shilatifard, PhD, chair of Biochemistry and Molecular Genetics, the Robert Francis Furchgott Professor, director of the Simpson Querrey Center for Epigenetics, and a professor of Pediatrics.



Public Health Forum Focuses on Chicago Communities

unified vision of health equity in Chicago — understanding the countless factors that lead to persistent health disparities as well as developing strategies to overcome them — was the focus of the second IPHAM Population Health Forum, where scientists and community partners presented and discussed their work in a variety of areas.

Hosted by Northwestern's Institute for Public Health and Medicine (IPHAM), the event kicked off with a presentation from Allison Arwady, MD, MPH, commissioner of the Chicago Department of Public Health. Arwady outlined the Healthy Chicago 2025 initiative, a crossorganizational effort to identify and stamp out causes of health inequity in the Windy City.

"We've been moving more and more upstream, talking about living conditions, the racial life expectancy gap, and what we can do from a policy perspective to start addressing those problems," Arwady said. "It can be a hard conversation, but we think it's important."





ALS SYMPOSIUM

orthwestern physicians, faculty, staff, students, and trainees gathered for the ninth annual Les Turner Symposium on ALS and NeuroRepair, a one-day event highlighting the present and future of treating amyotrophic lateral sclerosis (ALS).

The symposium featured presentations about emerging ALS science, a poster session and a clinical panel where patients and family members could ask questions about the ALSrelated issues in their lives.

"We're very proud today, as the Les Turner ALS Center and Foundation, to be able to host this symposium," said Andrea Pauls Backman, chief executive officer of the Les Turner ALS Foundation. "We are truly honored to be able to partner with families dealing with ALS and we do this at every step of their journey."

ALS is a progressive neurological disease that attacks upper and lower motor neurons. There is no cure, and life expectancy is typically three to five years from the onset of symptoms.

The Les Turner ALS Center at Northwestern Medicine unites all ALS basic science, clinical investigation, and patient care under one umbrella. The center was established by The Les Turner ALS Foundation, one of the country's oldest independent ALS organizations.



\$10 MILLION GIFT EARMARKED FOR NEUROLOGICAL DISORDERS

new \$10 million gift from Northwestern University trustees and supporters Louis A. Simpson '58 and Kimberly K. Querrey will give scientists at Feinberg crucial resources to develop personalized treatments for neurological diseases. The gift will support a center now known as the Simpson Querrey Center for Neurogenetics and enable new investigations on the genetic and environmental factors that contribute to diseases such as Parkinson's and other genetic neurological disorders.

Scientists in the center are already conducting genome analysis to develop personalized action plans for patients. After detecting the cellular pathways and targets a disease disrupts in patient neurons, the team works to identify treatment strategies tailored to individual patients. "This tremendous gift will allow our scientists to build a platform for personalized medicine, one that will impact the lives of patients with devastating neurodegenerative diseases that today have few effective treatment options," said Eric G. Neilson, MD, vice president for medical affairs and Lewis Landsberg Dean.

The center will be led by Dimitri Krainc, MD, PhD, the chair and Aaron Montgomery Ward Professor of Neurology, whose research has focused on understanding how mutations in genes lead to degeneration in patientderived neurons.

On Campus

PULSE

MEDICAL STUDENTS PRESENT THEIR RESEARCH AT POSTER SESSION

his summer, second-year medical student Kamya Bijawat spent a month in South Africa pursuing her Area of Scholarly Concentration (AOSC) research project. In partnership with the Red Cross War Memorial Children's Hospital in Cape Town and Ann & Robert H. Lurie Children's Hospital, Bijawat found that wireless sensors known as Always-on Imperceptible Infant Monitoring (AIIM) have the potential to improve parentinfant bonding in low resource settings.

"What we wanted to see was how parents in South Africa, in a low resource setting, viewed their current relationship with their child, how comfortable they were touching and holding them, as well as what their thoughts were on how this would change if they used wireless versus wired technology," Bijawat said.

Bijawat's project was overseen by Debra Weese-Mayer, MD, the Beatrice Cummings Mayer Professor of Pediatric Autonomic Medicine, and supported by the Bill and Melinda Gates Foundation and the Institute for Global Health. AIIM was developed by John Rogers, PhD, the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering, and Neurological Surgery.

The range of scientific investigations from current medical students were on display at this year's AOSC poster session, showcasing longitudinal research findings from 141 secondyear medical students.

AOSC, or Area of Scholarly Concentration, is a four-year investigative project that requires students to conduct a research project regarding a chosen area of interest within biomedical research or a medically related field before graduation. The hands-on project allows students to not only develop critical thinking skills but also relationships with mentors and faculty.

"We have more posters this year than ever before, which speaks to the investment that our second-year students gave to performing research and to the many mentors who supervised them in doing so," said Craig Langman, MD, chief of Kidney Diseases in the Department of Pediatrics and director of Feinberg's AOSC program.



While in South Africa, second-year medical student Kamya Bijawat studied the effects wireless infant monitoring sensors (developed by Northwestern's John Rogers, PhD) had on parent-infant bonding.



WRITTEN BY Melissa Rohman

ALUMNI



Alumni Weekend 2020 **Class of 2000 20th Year Reunion**

A letter from Rishi Reddy, '00 MD (HPME)

ello, Feinberg alumni!

It has been an honor to work with the Feinberg Alumni Office and Development team over the past year. They are a committed group of people who want to help our alumni engage with current medical students and the medical school. Alumni Weekend is a great opportunity to come back to campus, reconnect with the school, and learn about how Feinberg has grown and advanced over time.

This year will be the 20th year reunion for my class. I'm hoping to get a great turnout, as I am extremely excited to learn how my classmates are doing professionally and personally. My class was the last class to take the "written" version of the two-day USMLE

"Feinberg has transformed into a powerhouse scientific institution. It will be great to re-connect, even for a night or two, with old friends." SANJIV SHAH. '00 MD

Step 1 exam together in Tarry. We were also the last class to complete our core M3 year in the old hospital pavilions. The current Northwestern Memorial Hospital opened during the start of our M4 year. I can't believe it has been 20 years already.

This year, Alumni Weekend formally starts on Friday, April 24, although there is

a networking reception with students and a separate "Morning Report" and dinner with Dr. Lewis Landsberg on Thursday night. Friday has a number of options to learn about campus, including tours. There is a mentoring lunch with current students followed by a presentation

"I'm interested in learning how I might support the school and its students in readying for tectonic shifts in medicine and care

delivery." CHRISTINA JENKINS, '00 MD

on the status of the medical school by Eric G. Neilson, MD, vice president for medical affairs and Lewis Landsberg Dean. The Women in Medicine tea is that afternoon followed by the "Celebrate in Chicago" kick-off event for all classes in the Lurie Building. Saturday in the early evening has more opportunities to tour around campus with the Nathan Smith Davis Society reception Saturday early evening and class dinners afterward.

I've had a chance to connect with two of my classmates, Sanjiv Shah, 'oo MD, and Christina Jenkins 'oo MD, and to pick their brains on the upcoming Alumni Weekend. Sanjiv left Chicago to complete his Internal Medicine and Cardiology training in California before returning to be on faculty, where he recently became the Neil J. Stone, MD,

Professor in Cardiology. He has had the opportunity to witness the changes occurring at Feinberg.

"It has been very meaningful to see the level of change," he said. "Feinberg has transformed into a powerhouse scientific institution. It will be great to re-connect, even for a night or two, with old friends."

Christina moved to New York, where she completed her Internal Medicine residency. She has built a successful career in healthcare leadership and venture investing. She remembers our medical school days fondly, including, she said, "PBL sessions, bonding at Borders, and even that Streeterville basement bar that is likely gone!" (Streeters Tavern is still there, Christina!).

She is also "interested in learning how I might support the school and its students in readying for tectonic shifts in medicine and care delivery."

I hope to see both Sanjiv and Christina at Alumni Weekend this year, as well as our entire class, if possible. Remember that Alumni Weekend is open to all alumni every year, but it takes personal connections to get the most out of these opportunities to re-connect.

Thank you for staying engaged and GO CATS!

Alumni Weekend 2020

Friday, April 24 – Saturday, April 25 For a schedule of events and to register, go to feinberg.northwestern.edu/alumni/ alumni-weekend/





ALUMNI **Profile**

FUTURE Focused

CATHERINE LUCEY, '82 MD, PREPARES FUTURE PHYSICIANS, EMPHASIZING EQUITY AND TECHNOLOGY

or the past 15 years Catherine Lucey, '82, MD, has focused her career on redesigning medical education with an eye toward preparing physicians to solve the societal and clinical challenges that lie ahead.

Her goal, she says, is to "not just to tweak things from within, but to begin by thinking more expansively about what type of physician we need for the 21st century."

At the School of Medicine at the University of California, San Francisco (UCSF), where she served as vice dean of Education for eight years and has been executive vice dean for the past two, Lucey and her colleagues take a broad approach to that mission. They continue to nurture enduring skills like patientcenteredness, accountability, personal excellence, and lifelong learning. But they also are working to prepare clinicians to use modern technologies and help them develop the skills they need to work effectively in interprofessional teams to measurably improve the safety, quality, and equity of healthcare.

"It's important that we prepare this next generation to understand what healthcare in the digital era looks like, and how to critically evaluate digital tools," she says. For example, she believes that artificial intelligence is going to increasingly be used in medicine, but physicians need to be able to assess whether what the computer is telling them is correct. Additionally, she believes it's important for physicians to be at the table when systems are designed and to know how to design data-driven systems.

She also feels strongly that medical education is a public good, and those working at a public institution



should especially keep public service in mind.

"The physician workforce we need must also understand how to influence society to improve the social determinants of health as public citizens as well as professionals," she says.

AN EDUCATOR'S LENS

Lucey was inspired by her experiences during her third year of clerkship at Northwestern to pursue a career in internal medicine.

"I had tremendously interesting patients at that time and a really wonderful faculty and residents that I worked with," she says. That experience "ignited a passion" for developing meaningful relationships with patients and the intellectual challenge of diagnosing patients who often present with a disparate set of symptoms. "You can help patients through some of the most challenging moments of their life," she says.

She also credits Northwestern, where she worked as an anatomy teaching assistant, with planting the seed that education and patient care could go hand-in-hand. She later pursued her internship and residency at UCSF, where she became chief resident.

"That cemented a belief that I really wanted to craft a career that would enable me to use my skills to both take care of patients and to help other people learn to take good care of patients," she says.

Since then, she has practiced internal medicine in health systems across the country, including in Boston, San Antonio, and Columbus, Ohio. She took her first leap into a leadership role as a director of the residency program at Washington Hospital Center, a private hospital in Washington, D.C., and became active in many national medical education organizations. Over the course of her teaching career, she has been recognized with more than a dozen awards for excellence.

"HOW DO WE CREATE A PHYSICIAN WORKFORCE SO THAT EVERY SINGLE PATIENT IN THE UNITED STATES HAS ACCESS TO THE TYPE OF DOCTOR WE WOULD SELECT FOR SOMEONE WE CARE ABOUT AND LOVE?"

"I had the great opportunity to work with a lot of very talented educators who helped me learn the ropes and develop an educator's lens to compliment my clinical lens," she says. "That was really instrumental in helping me advance in my career."

TACKLING DISPARITIES

Lucey is an outspoken advocate for the need to revamp the way medical schools recruit and train students. That work, she says, has been inspired by working in safetynet hospitals.

"I've seen firsthand how the lack of diversity in medicine makes it difficult for us to even tap into the experiences that are relevant for understanding a patient's life," she says. "I've also seen how a more diverse workforce provides better care for patients."

She believes that patients of color often experience delayed diagnoses and only receive care very late in the course of their illness, missing opportunities for care that could prevent complications or improve their quality of life. Her experience of seeing each of her own four siblings misdiagnosed has helped her realize the profound impact of simply having access to an excellent physician. As a physician, she has been able to help her family, but many patients don't have the benefit of a trusted individual who can help guide their care, or may lack access to a physician at all, she says.

One of the first steps toward that goal of a more diverse workforce is ensuring that structural racism doesn't stop medical students from attending or succeeding in their medical training and career. For example, at UCSF Lucey and her colleagues use a diverse set of metrics, not just standardized tests, in admissions and assessments.

"To create a truly equitable environment means that we really give people opportunities based on their achievement and their potential," she says. "When we measure achievement and potential, we have to measure it in a way that doesn't just reinforce structural disadvantages."

Doing that, she says, doesn't just help students from underrepresented groups, but also helps the entire institution.

"It provides a better education for our learners," she says. "We ask different questions, we look at problems through different lenses, and it makes us wiser, more insightful, and more impactful."

All her work, she says, is focused on "How do we create a physician workforce so that every single patient in the United States

-LUCEY'S CAREER TRAJECTORY

1982

Graduated from Northwestern's Honors Program in Medical Education

1985

Completed internship and residency at the University of California-San Francisco (UCSF)

1986

Served as chief resident at UCSF

1986-1999

Worked as an internist and instructor at several institutions, including Harvard Medical School, Brigham and Women's Hospital, the University of Texas Health Sciences Center, and Walter Reed Medical Center

1999

Became program director for the residency program at Washington Hospital Center in Washington, D.C.

2002

Joined the Ohio State University College of Medicine as residency director and vice chair of Education

2011

The Ohio State University College of Medicine Student Award for Professionalism Award named in honor of Lucey

2011

Became vice dean for Education at the School of Medicine at UCSF

2017

Appointed as executive vice dean at the School of Medicine at UCSF

has access to the type of doctor we would select for someone we care about and love?"

Lucey feels rewarded every day by her career. "To take an aspiring physician and in four years turn them into someone who's going to go on and become a great doctor," she says. "That's an amazing thing to be able to be a part of."

PROGRESS NOTES

We'd love to hear from you! Please share your recent news, accomplishments and important milestones with us.

Send your updates and high-resolution photos to medcommunications@northwestern.edu. We will publish them in an upcoming issue of the magazine.

Letter to the Editor

DEAR EDITOR,

ALUMNI

I read with great interest about the work of Dr. Jeremiah Stamler, professor emeritus of Preventive Medicine in the Division of Epidemiology ("A Trailblazing Professor Turns 100 Next Month," Fall 2019).

I was in the first graduating class of Feinberg's public health program in 1981 one of two students. Dr. Stamler and his wonderful wife and collaborator, Ruth, checked in on me on a regular basis and were always measuring the effectiveness of the program. I never stopped being amazed at how this globe-trotting investigator would take such a ground-floor interest in a new student in a very small program. I can't help but think that the current public health program, with all its devoted faculty and staff, mature curriculum, and assets, has seeds in the work that Dr. Stamler and his team created back in 1978.

Thank you so much for the update and the photos of this genuinely special man.

Michael J. Steinhauer OTR, '81 MPH

Nathaniel Wisch, '58 MD, has retired from practice. He served as chair of the Hematology/ Oncology division at Lenox Hill Hospital and clinical professor of Medicine at the Icahn School of Medicine at Mount Sinai in New York City. In celebration of his incredible career, Wisch now plans to spend more time with his family, his grandchildren, and his wife, Helen.

Trent W. Nichols, Jr., '69 MD, '76 GME, '78 GME,

has a publication entitled "Treatment of Neurodegeneration: Integrating Photobiomodulation and Neurofeedback in Alzheimer's Dementia and Parkinson's: A Review" in the October 2019 edition of *Photobiomodulation, Photomedicine, and Laser Surgery* and, on November 20, co-presented research on "Photobiomodulation (PBM) and Neurofeedback in Clinical Placebo Controlled Trials of Near Infrared (NIR) Light Helmets in Alzheimer's and Parkinson's Disease" at the New York Academy of Science's recent conference, Alzheimer's Disease Therapeutics: Alternatives to Amyloid 2019.

He writes, "Not only are we 'Untangling Alzheimer's' (as published in the Summer 2019 issue) amyloid plaques and tau tangles and increased removal, we are generating mitochondial ATP and decreasing neuronal inflammation. Our 1078 nm NIR Light penetrates the brain three to five centimeters and is also anti-herpetic. Additionally, neurofeedback and PBM enables neuronal plasticity and is safe, affordable, and doesn't cause brain swelling as in Biogen's aducanumab, which requires IV monthly."

Nichols, who has a long career in gastroenterology, neurogastroenterology, and pharmaceutical and device clinical trials, is also writing and editing a textbook for CRC Press on "Nutrients and Directed Energy in Medicine," slated for publication in July 2020. He has several U.S. patent applications for biomagnetic and pharmaceuticals this year. His work on Prucalopride for constipation for Janssen Pharmaceutical and then Shire, with a PowerPoint presentation of chemical structure and safety for a FDA hearing, resulted in its approval in 2019. 1

Bruce F. Scharschmidt '68, '70 MD, current board member of the Northwestern Medical Alumni Association (MAA) and former MAA board president, participated in the first annual Northwestern Advanced Degree Biotech Trek to San Francisco this past summer. Scharschmidt kicked off the event, giving a lecture entitled "Wolves, Horses, and Bulls: Ten Things I Wish Someone Had Told Me" to a group of engaged PhD students and post docs, in which he shared his insights about the biotech field.

Leo A. Gordon, '73 MD, delivered the keynote address at the annual Oregon Health Sciences University Professionalism Week in Portland, Oregon. Gordon's remarks, "The Fourth Quarter Physician — Issues, Policies and Challenges,"

CHARLES S. MODLIN, '87 MD, MBA, PARTICIPATED IN A PANEL CALLED "UNSUNG HEROES: BEHIND THE SCENES OF ORGAN, EYE, AND TISSUE DONATION," HELD AT THE CLEVELAND CLINIC.



reviewed the evolving policies and recommendations for evaluating late career physicians as they undergo recredentialling and reappointment in the face of increasing scientific data on the effects of age on the medical workforce. Gordon is the senior consultant in Clinical Surgery at the Surgery Group of Los Angeles, a surgical multispecialty group. He is a professor of Surgery at the Cedars-Sinai Medical Center in Los Angeles. 10 2

Charles S. Modlin, '87 MD, MBA, participated in a panel called "Unsung Heroes: Behind the Scenes of Organ, Eye, and Tissue Donation," held at the Cleveland Clinic. Modlin is director of the Minority Men's Health Center and kidney transplant surgeon at Glickman Urological & Kidney Institute of the Cleveland Clinic. In the panel, Modlin and other Ohio leaders discussed the state of transplantation.

Harvinder Sandhu, '87 MD, was named co-chief of Spine Service at the Hospital for Special Surgery. Sandhu focuses on minimally invasive spine surgery, microsurgery, computer-assisted surgery, and spinal biologics. Previously chief of the spinal service at University of California, Los Angeles, he joined Hospital for Special Surgery in 1997. He is actively engaged in the research, development, and invention of a variety of devices and instruments, and holds several patents on the diagnosis and treatment of spinal disorders.

Carla R. Hightower '85, '87 MD, '91 GME,

'o2 *MBA*, former MAA Board member, was a recipient of the 2019 Service to Northwestern Award. Hightower is active in numerous Northwestern organizations, including the Council of One Hundred, Northwestern University Black Alumni Association, and Kellogg Executive Women's Network. She also has served on the Northwestern Alumni Association Board, Ward Rounds Editorial Board, and Education Advisory Forum. A certified integrative health coach and corporate wellness consultant, Hightower earned her BS and MD through the Feinberg School of Medicine Honors Program in Medical Education. She completed her anesthesiology residency at Northwestern Memorial Hospital and holds an MBA from the Kellogg School of Management.

Diane Bronstein Wayne '88, '91 MD, vice dean for Education, was invited to speak at the Stanford University Faculty Club as part of their Lecture Series on August 30. Wayne's popular and highly-regarded lecture, "Calculating the Return on Investment for Medical Education," was attended by a number of fellow Northwestern medical alumni, as well as some of her former students.

Laura A. Offutt, '94 MD, was recently featured on CNN as part of Dr. Sanjay Gupta's special report, "Here's to Your Health," regarding teen health and the dangers of vaping. Offutt is the founder of the annual International Adolescent Health Week (IAHW). This upcoming year, IAHW will take place March 15–21, 2020. IAHW's goal is to "reach as many youth as possible around the world [in order] to improve the lives and health of adolescents all over the globe." Offutt is an active member in the Society for Adolescent Health and Medicine and the International Association of Adolescent Health. She also serves on the Board of Directors for the National Alliance to Advance Adolescent Health. Additionally, Offutt is the host of "Real Talk with Dr. Offutt," an interactive digital health resource for adolescents. 103

Michael S. Beaubaire, '95 MD, '98 GME, was appointed to the board of directors of Applied BioSciences, a company focused on developing science-driven biopharmaceuticals and producing products targeting the endocannabinoid system. Most recently, Beaubaire served as CEO at Immunomodulation.

Treating a Murderer

LeRoy Smith, MD, GME '67, '71,

who practiced orthopaedic surgery in Fort Lauderdale, Florida, shared a fascinating story about his career:

On July 14, 1966, Richard Speck broke into the homes of eight young nurses who worked at South Chicago Community Hospital, then stabbed and strangled them.

Two days later, Smith, then an emergency room doctor at Cook County Hospital, was tending to the wounds of a patient whose face resembled a ruthless killer he'd just read about in the newspaper during his dinner break. As he sponged blood off his patient's arm, Smith saw yet more evidence that his hunch was correct: The man in his care had a tattoo that said "Born to Raise Hell" that matched the description from the article.

The man Smith was treating was Richard Speck.

"I was just as amazed as everyone that this despicable person landed on my surgical service that evening," Smith wrote in an email to a reporter with the *Chicago Tribune*, which published a story about the murder in 2016.

Thanks to Smith, the murderer was captured.



Speck Found After Suicid uicago's

ecalled



ALUMNI \ Progress Notes





Carol D. King, '96 MD, was appointed system chair of Family Medicine for IHA of Michigan on September 1. King is site director at IHA Canton Family Medicine. King replaces outgoing chair, Kevin J. Bohnsack, '98 MD, MPH, of IHA Milan Family Medicine. Bohnsack is now medical director of the Southeast Michigan Clinically Integrated Network.

Jeffrey Linder, '97, MD, MPH, was interviewed this past fall on an episode of CNN/HLN's *Something's Killing Me* about Lemierre's Syndrome, which presents as a painful sore throat and what seems like the symptoms of a common cold, but can soon spiral into a life or death situation. MELISSA A. SIMON, MD, '06 GME, WAS APPOINTED TO THE U.S. PREVENTATIVE SERVICES TASK FORCE, AN INDEPENDENT, VOLUNTEER PANEL OF 16 EXPERTS IN PREVENTION AND EVIDENCE-BASED MEDICINE.

GME

Jeffrey Sherman, MD, '84, '85 GME, MAA Board member, is chief medical officer of Horizon Therapeutics, which was recently recognized in *Crain's Chicago Business's* "Most Innovative Companies" list for 2019. Horizon Therapeutics is a company engaged in researching and developing medicines that address metabolic diseases.

Jerome M. Klafta, MD, '90 GME, has been awarded the 2019 Excellence in Education Award by the American Society of Anesthesiologists (ASA). The award is presented to "an ASA member who has made significant contributions to the specialty through excellence in teaching, development of new teaching methods, or the implementation of innovative educational programs." Klafta is professor and vice-chair for education in the Department of Anesthesia and Critical Care at the University of Chicago and also serves on their Recruitment, Resident Development, and Clinical Competency committees. A four-time recipient of his department's Teacher of the Year award and a master in the University's Distinguished Medical Educators group, Klafta also serves as senior examiner for the American Board of Anesthesiology and vice chair of the Basic Examination Committee.



ALUMNI WEEKEND 2020 FRIDAY, APRIL 24 SATURDAY, APRIL 25

REGISTRATION OPEN feinberg.northwestern.edu/alumni/alumni-weekend

Progress Notes

In Memoriam

Northwestern Medicine expresses its condolences to the families and friends of the following alumni (listed in order of their graduation year) and faculty who have passed away.

ALUMNI

James Oliver, '43 MD Moorhead, Minnesota DECEMBER 1, 2019

Edward A. Millar, '45 MD, '50 GME Libertyville, Illinois JANUARY 3, 2020

Robert M. Herman, '50 MD Los Gatos, California OCTOBER 31, 2019

Charles J. Nagy, '51 MD La Jolla, California OCTOBER 26, 2019

Josef R. Smith, '51 MD Tuscon, Arizona OCTOBER 7, 2019 Robert N. Jennings, '52 DDS Huntington, West Virginia NOVEMBER 7, 2019

Robert "Bob" C. Good, '54 PhD Mount Pleasant, South Carolina OCTOBER 15, 2019

Thomas J. Zwemer, '54 DDS Augusta, Georgia остовег 26, 2019

Janet Holmquist Mueller, '55 BSPT Dallas, Texas AUGUST 19, 2019

Eugene Y. Lowe, '56 MD Fresno, California NOVEMBER 3, 2019

Rodgers Whittington, MD, '56 CERT Opelika, Alabama остовеr 24, 2019

Clifford D. Stiles, '57 MD St. John, Virgin Islands DECEMBER 1, 2019

Steven H. Feagler, '57 MD Albuquerque, New Mexico NOVEMBER 26, 2019 Herbert K. Mameda, '59 DDS Rocky Ford, Colorado SEPTEMBER 12, 2019

John F. Marquardt, '60 MD, '62 GME Northfield, Illinois OCTOBER 18, 2018

Robert P. Purpura, '62 MD Surprise, Arizona NOVEMBER 13, 2019

Allen D. Bagdade, DDS, '63 MS Chicago, Illinois NOVEMBER 10, 2019

William J. Lawton, '66 MD, '70 GME Sutton, Massachusetts SEPTEMBER 18, 2019

James B. Hall, Jr., '67 DDS, '69 MS Macon, Georgia octoBER 8, 2019

Gregory D. Uematsu, '71 DDS Los Angeles, California SEPTEMBER 12, 2019

Samuel P. Pejo, MD, '73 GME Binghamton, New York SEPTEMBER 16, 2019 Jeffrey Lee Blumer, '77 PhD Moreland Hills, Ohio OCTOBER 21, 2019

Gerda Joseph, '78 BSPT Chicago, Illinois JULY 2019

Helen Kraus, '80 MD, '83, '86, '87 GME Cocoa Beach, Florida october 31, 2019

Srinivas P. Reddy, '95 MD, '98, '02 GME Frankfort, Illinois october 10, 2019

FACULTY

Ronald F. Krasner, MD associate professor emeritus of Psychiatry Wilmette, Illinois DECEMBER 28, 2019

Virginia Bishop, MD, MPH assistant director of Diversity and Inclusion (Latino Affairs and Community Engagement) assistant professor, Preventive Medicine Chicago, Illinois FEBRUARY 3, 2020

Melissa A. Simon, MD, 'o6 GME, was appointed to the U.S. Preventative Services Task Force, an independent, volunteer panel of 16 experts in prevention and evidence-based medicine. Simon, a upcoming featured speaker at Alumni Weekend 2020, is the founding director of the Center for Health Equity Transformation, vice chair for Clinical Research in the Department of Obstetrics and Gynecology, the George H. Gardner, MD, Professor of Clinical Gynecology, and professor of Obstetrics and Gynecology in the Division of General Obstetrics and Gynecology and of Preventive Medicine and Medical Social Sciences.

Inger Burnett-Zeigler, 'oo PhD, was the author of an opinion piece entitled "Young Black People are Killing Themselves," published in *The NewYork Times* on December 16,

2019. "While much needed attention has been given to homicide as the No. 1 cause of death among young black males, conversations about suicide — one of the top four leading causes of death among young black males — have been inadequate," wrote Burnett-Zeigler, who is associate professor of Psychiatry and Behavioral Sciences.

Jeffrey Ryan Cara, DO, '17 GME, has been appointed director of Spine and Wellness Centers of America's new Palm Beach Gardensbased institute. Cara is an interventional pain management physician and physiatrist.

Aroop K. Kar, MD, '18 GME, composed Stormy Seas for Symphonic Orchestra, which made its premiere at the Northwestern Medical Orchestra (NMO) Winter Concerts. Kar specializes in pediatric hematology and oncology at the Ann & Robert H. Lurie Children's Hospital of Chicago. The NMO concerts were held at the Shirley Ryan AbilityLab and the Thorne Auditorium this past December.

INGER BURNETT-ZEIGLER, '09 PHD, WAS THE AUTHOR OF AN OPINION PIECE ENTITLED "YOUNG BLACK PEOPLE ARE KILLING THEMSELVES," PUBLISHED IN THE NEW YORK TIMES.

Campaign Update

Generosity from 66,000+ donors helping Northwestern Medicine transform human health.

hanks to committed alumni, faculty, friends, and foundation and corporate partners, we have surpassed our \$2 billion goal for WE WILL. The Campaign for Northwestern Medicine. Gifts since the campaign launched in September 2014 have funded scholarships for our students, important clinical and research initiatives and programs, and enabled us to build the Louis A. Simpson and Kimberly K. Querrey Biomedical Research Center and a new Northwestern Medicine Lake Forest Hospital.

Our work, however, is just beginning. With the generous support of every single donor to

the campaign, we are to continuing to drive high-impact clinical innovation, accelerate leading-edge scientific discovery, and educate the next generation of physicians, scientists, and healthcare leaders — all in service of patients and families everywhere.

TOTAL RAISED SINCE LAUNCH OF CAMPAIGN



GOALS THAT CONTINUE:

- Build out ten core Institutes at Northwestern Medicine, bringing together patient care, research, education, community service, and advocacy
- Create endowed professorships that accelerate the efforts of our most accomplished and promising faculty physicians and scientists
- Establish endowed and expendable innovation grants for breakthrough research
- Create scholarships for our exceptional medical, PhD, and physical therapy students and nurses
- Establish fellowships to support our best and brightest trainees



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SCHOLARSHIPS



of \$800 million goal for a tuition-free medical school raised prior to and during campaign

Your gift has allowed me to enter medical school confident in both my ability and my financial

situation. I feel the freedom to explore a variety of specialty options no matter what their potential future for financial compensation, and for that, I have you to thank.

Ali Mahmoud, Class of 2023 Scholarship Recipient

I knew Feinberg's medical education model would help me become a well-rounded, compassionate, and



knowledgeable physician, but without a scholarship it was cost inhibiting. Truly, this scholarship was pivotal for me in my medical school choice. I am humbled and overwhelmed by the generosity and support you and Northwestern have shown to me. I will always remember that kindness in my future career.

Ashley Young, Class of 2023 Scholarship Recipient

FACULTY CAMPAIGN



of department chairs contributed for third year in a row

Our family has always valued education and community. We give back to support these same values that are upheld at

Northwestern with a commitment to educating our trainees and providing exceptional patient care to our community.

Roopal Kundu, '01 MD, '02 GME

Associate dean for Admissions, Jacob R. Suker, MD, Professor of Medical Education, associate professor of Dermatology



The Feinberg School trifecta of academic edge research pushing the scientific frontier;

outstanding clinical care informed by best practices; and training, education, and mentoring that has no equal. It is a privilege to work at Feinberg, which begs the question, 'Why wouldn't I give back?'

Lori Post, PhD

Director of the Buehler Center for Health Policy and Economics, Buehler Professor of Geriatric Medicine, professor of Emergency Medicine and Medical Social Sciences

Brandi Jackson, '15 MD

DE-MYSTIFYING MEDICINE

When I was growing up, I never imagined I would become a doctor. There weren't any doctors in my family, and I never saw a black doctor in the flesh. Even though I always excelled academically, no counselor ever recommended to me that I consider a career in medicine.

I'm from an Ohio town that was both a wonderful and problematic place to grow up in. It was a diverse place overall, but it was quite segregated, with lower-income, primar-

THERE'S A TEMPTATION to feel like you've fmade it' once you get into medical school, but, in reality, it's the start of a whole new leg of the journey.

ALUMNI

ily African-American residents living in a smaller section of the city. That part of town is where I, along with my twin sister Brittani, was raised.

We have similar stories. We tied for second in our high-

school class and went on to attend Cornell University. In college, we agreed that we should use our brains to do good in the world. We both ultimately decided on a career in medicine. With few role models, we relied on each other for support along the journey.

I still remember the day I got accepted into Northwestern's Feinberg School of Medicine. I was ecstatic to train at one of the most prestigious medical institutions in the country. It was (and still is) one of the defining moments of my life.

There's a temptation to feel like you've "made it" once you get into medical school, but, in reality, it's the start of a whole new leg of the journey. Medical training is a huge challenge. For me, it brought up feelings that I wasn't good enough and didn't belong. There were times I felt like giving up. In those times, the thing that kept me going was the people back in my hometown. Not just my family, but the African Americans I grew up around in that small, segregated corner of town. I just kept going back to them in my head. These were good people with hopes and dreams like everyone else. They worked hard and dreamed of better futures, despite their circumstances. They loved and laughed, despite how the outside world saw them.

Pushing through training meant being able to amplify their voices. It meant being able to advocate for them.

And so I pushed. But I didn't do any of it by myself. I found a tight-knit community at Northwestern that supported me throughout my training. The Office of Diversity and Inclusion was my home base. The staff there is outstanding. Dr. John Franklin, who serves as the associate dean for Diversity, Inclusion and Student Support, is one of my earliest and most important mentors. Dr. Franklin was the first black psychiatrist I got to know personally. He helped set me on the path toward becoming a psychiatrist myself. The classmates I met through the Office of Diversity remain lifelong friends. In fact, three of my former classmates will be standing in my wedding this summer.

A lot has changed since my med school days. I am now a practicing psychiatry attending at Rush Medical Center in Chicago. I treat patients on the south and west sides of the city, who struggle with severe mental illness. I also serve as the director of the community psychiatry fellowship.

My twin sister, Dr. Brittani James, is a family medicine attending physician. She also works with vulnerable patients on Chicago's south side. My sister and I are determined to help regular folks understand all that medicine entails. Last year, we created a website called Med Like Me (www.medlikeme.com). Through our site, we provide advice to aspiring doctors, offering guidance on the application process and what to do if they hit a roadblock along the way. Besides writing articles for the site, my sister and I engage with pre-med students in person, through speaking engagements and at conferences. We are teaching a seminar at the University of Illinois College of Medicine, Chicago, about navigating medical training as a minority.

We also seek to empower everyday people to better understand their medical care and health. To this end, we break down complicated medical jargon so that patients can make sense of their doctor's recommendations. We also teach people about common medical disorders in terms that they can understand. In addition, we teach people how to advocate for themselves at the doctor's office.

It's an honor and a privilege to serve my community as a practicing physician. Even though I've come a long way, I feel my work is just beginning.

Northwestern Medicine Through the Years

WARD ROUNDS



Class in session at Feinberg School of Medicine, then called Chicago Medical College, which was located at 26th Street and Prairie Avenue from 1870 to 1893 (the medical school's third location).



1885 & 2020

Learning, Then and Now

EVOLUTION OF MEDICAL EDUCATION orthwestern has come a long way since the days of lecture halls filled with male students clad in black suits. The contrast could not be more stark between this Feinberg anatomy class from 1885 and Feinberg's new Premier Active Learning Environment (pictured at right), which opened late last year in the McGaw Medical Center on Huron Street. The spacious 165-seat, 4,800square-foot classroom strikes the

right balance between students, technology, and pedagogy. With movable tables, a teaching station and audio system that allows for communication and collaboration across adjacent rooms, digital displays that support wireless connectivity, mobile whiteboards, ceiling and podium-mounted document cameras and video/audio conferencing capabilities, this modern way of learning prepares our students for medicine in the 21st century.



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