marquette

HEALTH SCIENCES

COLLEGE OF HEALTH SCIENCES MAGAZINE

2023

SOLUTIONS at Every Scale

The college's research labs and clinics drive spinal cord injury advances ranging from axon regeneration to zero-gravity rehabilitation therapies.

Continuity in Kinesiology

A specialty that has earned Marquette distinction passes from a heralded leader to an emerging one.

Pediatric Care Magnets

The college's pediatric clinics serve young patients with care, imagination and truly advanced therapies.

Calling Future Scientists

First Midwest site for NIH's U-RISE program helps diverse students prepare for research careers.

It is a pleasure to welcome you to the 2023 edition of *Health Sciences* magazine! We hope you enjoy the inspiring stories that highlight our faculty, students and alumni and their efforts to Be The Difference.

I'm particularly excited to share our cover feature on the breadth and depth of research on spinal cord regeneration conducted by our faculty. Dr. Murray Blackmore, professor of biomedical sciences, and Dr. Kristi Streeter, assistant professor of physical therapy, are conducting groundbreaking pre-clinical research aimed at restoration of function following spinal cord injury. Simultaneously, Dr. Kim DeChant and her team of specialized physical and occupational therapists are delivering leading-edge intensive neurorehabilitation treatment to individuals with spinal cord injury and related debilitating neurological conditions in our Neuro Recovery Clinic — the only one of its kind in Wisconsin. Collectively, our faculty researchers and clinicians and their respective teams are providing hope and healing to many on a daily basis.

Another feature highlights clinical offerings — from pediatric programs in physical and occupational therapy to the wide array of communication rehabilitation programs delivered through our Speech and Hearing Clinic. Our faculty and staff are powerfully advancing "the Science That Heals" through these programs and others.

This issue also introduces Dr. Jacob Capin, a new faculty member in physical therapy hand-picked to succeed the retiring Dr. Don Neumann, who literally wrote the industry-standard textbook on kinesiology. It highlights our new U-RISE training program, funded through a $1.6 million grant from the National Institutes of Health. Marquette is the first Midwestern university to secure this two-year undergraduate research training program for students pursuing doctoral studies and research careers in biomedical sciences. This issue also describes how, in a post-pandemic world, our Medical Laboratory Science program sharpens students' skills through analysis of critical laboratory tests and measures.

Through these and other stories and images in the coming pages, we hope to illustrate how the College of Health Sciences is putting science into action while educating the next generation of mission-driven leaders.

William E. Cullinan, Ph.D.
Professor and Dean, College of Health Sciences

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IGNATIAN MOMENT

College of Health Sciences' faculty, staff and students are advancing our college's commitment to *cura personalis* through research, student success initiatives and outreach that remove barriers and provide guidance. One such effort, funded by the National Institutes of Health, is U-RISE — a program that supports underrepresented students with opportunities to pursue advanced degrees and research careers in biomedical sciences. As always, the college is grateful for its Health Sciences ambassadors, who consistently share our message and accompany prospective students in discerning the right fit for their college experience.

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Spinal Cord Synergy

In research labs and clinics, College of Health Sciences faculty and staff are driving spinal cord injury advances ranging from axon regeneration to neural plasticity involving the peripheral nervous system and advanced rehabilitation therapies.









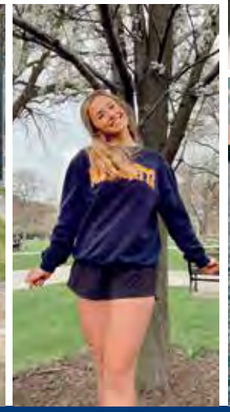















STRONG FIRST IMPRESSIONS

When they visit Marquette, high school students interested in the College of Health Sciences get more than a cookie-cutter tour. CHS Student Ambassadors (shown here) from each undergraduate program in the college provide personalized tours and make meaningful connections with prospective students interested in that major. "Our ambassadors are friendly, knowledgeable and eager to share their journeys," says Jennifer Klump, director of student success and recruitment. "Their enthusiasm for the college is contagious."

AWARDS & GRANTS

ON GUARD AGAINST ANTIMICROBIAL RESISTANCE

CDC-funded program in Medical Laboratory Science provides Wisconsin hospitals with valuable feedback on bacterial trends.

By Matt Hrodey

Wellcome Images / Science Source

Dr. Erik Munson, associate professor of medical laboratory science, gently wafts an overnight petri dish mottled with black and metallic gray spots. "This is one of the better smells we have. This smells like grape Kool-Aid," he says of a *Pseudomonas aeruginosa* sample, which he contrasts with the foul-smelling Proteus colonies he also encounters, another bacterium that can wreak havoc in humans.

Such odors are useful indicators in Munson's laboratory, which tests up to 1,500 bacterial samples annually from about two dozen hospitals around Wisconsin as part of a program that works to identify trends in antimicrobial resistance and epidemiology.

Wisconsin hospitals package up the microbes taken from blood, sputum, urine and other sources and send them to Munson's program, known as Surveillance of Wisconsin Organisms for Trends in Antimicrobial Resistance and Epidemiology, or SWOTARE. In return, SWOTARE cultivates the odorous petri dishes and tests them against 12 to 16 antibiotic drugs to gauge antibiotic resistance.

Doctors and health officials weigh the results, which they receive once a year from SWOTARE, against other factors to decide which antibiotic to prescribe to a patient. That can help improve treatment and prevent the overuse of certain antibiotics, which can lead to highly resistant "superbugs."

SWOTARE was founded in 2016 and recently received a $252,000 grant from the Centers for Disease Control and Prevention to fund three more years of operation. As founder, Munson drew on his years as a microbiology lab director for the Wheaton Franciscan Healthcare system, where he specialized in microbes.

In southeastern Wisconsin, the project has tended to find greater resistance to fluoroquinolone antibiotics, which doctors prescribe widely for respiratory and urinary tract infections. Past research has found that older people are more likely to struggle with antibiotic-resistant infections, as well as people of all ages who are patients in the state's intensive care and internal medicine departments.

Resistant superbugs do crop up in Munson's testing and can raise alarms in hospitals and land patients in isolation. SWOTARE slows down the creation of superbugs by reducing the usage of medications that have become overused. "The more these normal, happily living bacteria see antibiotics," Munson says, "the more they can gear themselves up to become resistant to them."

RESEARCHER USES $1.8 MILLION GRANT TO CLOSE KNOWLEDGE GAP OF MALE-FEMALE BODY CLOCKS

NIH R01 award helps biomedical sciences professor examine differences in function of suprachiasmatic nucleus in women and men.

By Roni Dengler

"Are you sure?" That's what Dr. Jennifer Evans, associate professor of biomedical sciences, wanted to know from the graduate students working in her lab. Using mice as a model, Evans investigates the brain's master clock, called the suprachiasmatic nucleus, that controls the body's responses to light and its circadian rhythms, including when we sleep and when our internal alarm wakes us up.

The students, both women, had told Evans they wanted to conduct their research with both sexes. Up until a few years ago, most biomedical research focused on males. With fluctuating hormones and the potential for pregnancy, females introduced too much variation in studies and could as much as double the workload. But Evans' graduate students felt that including females was worthwhile. Their insistence has paid off.

The team's research has revealed that while similar, the suprachiasmatic nucleus in males and females is not the same. "There are really pronounced sex differences in how we sleep, how our clocks function and in risk factors for disease," Evans says.

"We have evidence to suggest that this clock responds to light differently in males and females, and so this grant will enable us to begin filling the gap in our understanding of how this clock functions in females, and how it processes light in females." –Dr. Jennifer Evans

The National Institutes of Health has awarded Evans a $1.8 million, five-year R01 research grant, its top research funding tier, to better understand the causes of gender disparities in diseases related to the body's clock, such as the winter blues, which affect women much more than men.

"The brain's clock is telling the rest of the body to change with the seasons," Evans explains. "We have evidence to suggest that this clock responds to light differently in males and females, and so this grant will enable us to begin filling the gap in our understanding of how this clock functions in females, and how it processes light in females."

Using advanced genetics and microscopy techniques in collaboration with Dr. Alex Savtchouk, assistant professor of biomedical sciences, the researchers will track how the cells that make up the brain's clock respond to light in real time. Evans and her collaborators will use a technique called optogenetics that harnesses genetic engineering and light to control and isolate the activity of mouse brain cells. They will then track the cells' activity under the microscope using special dyes. Evans hopes the work will begin to reveal male-female differences in the suprachiasmatic nucleus at the cellular level.

"As a woman, I'm sad females have been neglected by science," Evans says, "But as a scientist, I'm excited about the possibility of doing some really groundbreaking work."

AWARDS & GRANTS

EXERCISE SCIENCE FACULTY RECEIVE $3 MILLION GRANT TO STUDY PREDIABETES FATIGUE

Through a special exercise regimen, fatigue caused by prediabetes could be reversed.

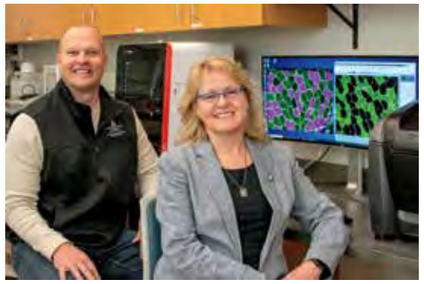
By Sarah Wells

Although doctors often recommend more exercise for patients diagnosed with prediabetes, exercise physiologists know of a complicating factor. Prediabetes, the elevated blood glucose condition affecting roughly 38 percent of Americans, can itself make exercise more difficult by creating muscle fatigue.

A major new clinical trial led by Dr. Sandra Hunter, professor of exercise science, and Dr. Christopher Sundberg, Grad '18, assistant professor of exercise science, addresses this issue, investigating exercise interventions that may protect against prediabetes muscle fatigue. A $3 million R01 award from the National Institutes of Health will fund the five-year project and enable the team to examine how strength training and blood-flow restriction training can improve prediabetes fatigue and, in turn, help patients better manage their condition with exercise, potentially even preventing it from progressing to Type 2 diabetes, Hunter says.

Despite its prevalence, prediabetes is still relatively understudied. Previous research conducted in Hunter's lab identified skeletal muscle as a primary contributor to prediabetic patients' fatigue. In their new work, Hunter, Sundberg and colleagues will investigate whether inadequate blood flow and oxygen delivery to a person's muscles is contributing to this fatigue.

They will also study whether strength training, and especially blood-flow restricted exercise, using an external pressure cuff, can improve blood flow and muscle metabolism in prediabetic patients. Restricting blood flow during exercise may seem like a paradoxical treatment for patients with already insufficient blood flow, Sundberg acknowledges, but it may help patients receive greater strength and endurance gains from less physically challenging workouts. "In young, healthy people, exercise coupled with blood flow restriction is thought to help increase muscle mass, strength and endurance, and is currently used in clinics. Our study will determine its effectiveness in people with prediabetes and Type 2 diabetes," he explains.



Dr. Christopher Sundberg and Dr. Sandra Hunter

In combining their expertise, the Hunter lab will focus on potential changes in the nervous system and the large vessels delivering blood to the muscles, while the Sundberg lab will use an MRI scanner to examine the structure of the muscle and the metabolism occurring during exercise. They will then take biopsy samples from the muscle to see how the individual muscle cells and small blood vessels change in response to the exercise training.

The ultimate aim is to help patients better manage prediabetes before it progresses to Type 2 diabetes, which is nearly irreversible, Hunter says. "Identifying the causes of muscle fatigability and interventions to stop or slow the potential progression from prediabetes to Type 2 diabetes are important steps to increasing the health, quality of life and life expectancy for these individuals."

Adults 40-70 with prediabetes, diabetes and healthy blood pressure are encouraged to participate in this study of muscle fatigue (compensation provided). Contact (414) 288-1631 or hunterlab@marquette.edu.

ENGINE OF STUDENT SUCCESS

Dr. Gigi Makky recognized for transformative teaching and leadership.

By Jack Goods, Comm '17

Dr. Khadijah (Gigi) Makky's efforts at Marquette are centered on one theme — improving the biomedical sciences student experience to help graduates differentiate themselves from their peers.

Programs that help students navigate college successfully are only the beginning. "I feel student success goes beyond that," says Makky, clinical professor of biomedical sciences. "Did we help them through Marquette and then get them started well after Marquette? Did we prepare them well for the job market? Did we prepare them well to go to professional schools if that's what they want to do?"

These questions have driven Makky to help establish multiple initiatives within the college. She revived and directs the internship and peer mentoring programs, collaborates with students to create community-based projects and often works to develop innovative courses. She's had such impact and success with these efforts that she was presented with a 2022 John P. Raynor, S.J., Faculty Award for Teaching Excellence, Marquette's top teaching honor.

Makky has a unique talent for spotting and targeting needs in the department.

Dr. Gigi Makky receives the 2022 John P. Raynor, S.J., Faculty Award for Teaching Excellence, with Provost Kimo Ah Yun and Dean William Cullinan.

When she arrived at Marquette in 2010, the biomedical sciences program had resources for students planning to go to professional schools. But what about those interested in healthcare administration, medical sales or biotech? "Through my advising, I found students who are not interested necessarily in becoming health care providers," Makky said. "They're interested in health care, but in so many of its different aspects." That realization spurred the formation of the internship program, which has included placements at the Milwaukee Health Department, Medtronic, Aurora Health Care and Direct Supply.

In keeping with her commitment to service learning, Makky supervised two students in designing a trauma-informed tutoring project at Cross Trainers Academy in Milwaukee. And the peer mentoring program, established last school year, aims to support first-generation students and students of color by pairing them with a senior mentor.

It all adds up to a remarkable legacy. "During my 20-plus years at Marquette, I have had the good fortune to meet truly outstanding scientists and scholars," wrote Dr. David Baker, professor and chair of biomedical sciences, in nominating her for the teaching honor. "I have also met extraordinary educators. I know colleagues who are remarkable for having entirely committed themselves to the betterment of our institution and to the well-being and development of our students. However, Dr. Makky distinguishes herself as one of the very few individuals who displays each of these traits."

AWARDS & GRANTS

MULTIPLE GRANTS TARGET IMPROVED THERAPIES FOR CHILDHOOD APRAXIA OF SPEECH

Two new research projects, including one clinical trial, will pursue optimal ways to overcome speech and motor deficits.

By Tracy Staedter

Imagine knowing what you want to say, but being unable to speak it. Children with the neurologic disorder known as childhood apraxia of speech, or CAS, face such a challenge. One to two children out of every 1,000 in the United States have the disorder — or about one child for every elementary school in the country.

Since not much is known about its causes, treating it is difficult. Children with CAS tend to struggle in other areas, such as performing fine and gross motor skills and coordinating movement of their jaw, lips and tongue. Many have problems reading, spelling and writing.

"It's really challenging for these children, their families and their teachers. My heart goes out to them," says Dr. Jenya Iuzzini-Seigel, assistant professor of speech pathology and audiology, who has spent her career researching CAS.

Two of her latest projects could help science get one step closer to finding effective treatments for CAS as well as other communication impairments.

With a $400,000 award from the National Institutes of Health, Iuzzini-Seigel will work with Dr. Sandra Hunter, professor of exercise science and the director of Marquette's Athletic and Human Performance Research Center, to investigate whether physical exercise can have a positive impact on learning for kids with communication impairments.

Iuzzini-Seigel says that although 30 percent to 85 percent of children with communication disorders, such as CAS, also have motor deficits, treatments are usually siloed from one another. This study will help show whether combining them is more effective.

With a $1.15 million grant from the Once Upon a Time Foundation, Iuzzini-Seigel and her team will conduct a clinical trial to determine how frequently a motor-based speech treatment commonly used for children with CAS, called Dynamic Temporal and Tactile Cueing, can be provided to have the most impact. Therapists who use the treatment help a child produce specific words accurately and consistently over time by providing lots of supportive cues in the beginning and then gradually pulling back on the support.

Over the course of two years, the researchers will work with 60 children in all — 30 who participate in therapy twice a week for 12 weeks and 30 who do it four times a week for six weeks. The study will help establish empirical evidence on treatment frequency, says Iuzzini-Seigel, and "ultimately help families and therapists care for the whole child in ways that lead to the greatest success."

MARQUETTE-BUILT APP ADVANCES PEDIATRIC FEEDING DISORDER RESEARCH

Dr. Amy Delaney initiated development of tool that connects caregivers to speech pathology researchers for data collection.

By Chaunie Brusie

When the COVID-19 pandemic seriously curbed the ability of both staff and families to visit her lab for feeding studies, Dr. Amy Delaney, assistant professor of speech pathology and audiology, overcame some initial frustration and realized what the future would hold: more virtual options for everything, including data collection.

Already collaborating with members of Marquette's Computer Science Department on a different project, the director of Marquette's Neurodevelopmental Feeding and Swallowing Lab pivoted to work with them on an app that would allow her research to continue. Two years later, Delaney and her team are using the app to collect data from parents for a study of pediatric feeding disorder — a diagnosis that encompasses various non-age-appropriate feeding activities including those related to medical and nutritional causes, feeding skill issues or psychosocial dysfunction. "Pediatric feeding disorder is a new diagnosis, more prevalent than autism and cerebral palsy," she says. "The goal is that we understand feeding development, and when it goes wrong, as early as we can so that we can get kids into treatment and help them have a really healthy, positive experience during their feeding development."

In addition to guiding parents through instructions and the completion of necessary forms, the app allows them to upload video for Delaney and her team to observe. Families participate in the study from their homes for more naturalistic observations compared with lab-only alternatives. "The app simulates what I would do to conduct a clinical feeding evaluation if this was my patient," she notes.

Her team can access a more diverse patient population too. "The app really serves the purpose of large-scale data collection of both regionally diverse and culturally diverse samples," says Delaney, Grad '98. "There are a lot of the opportunities for what we can do with it."

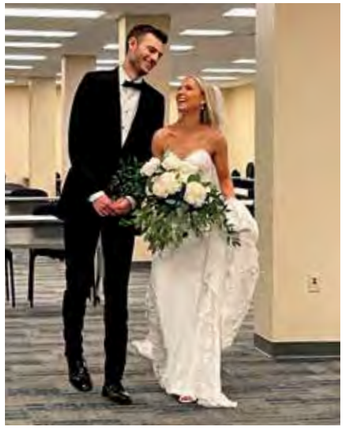
FROM LAB PARTNERS TO LIFE PARTNERS

The basement of a venerable academic building isn't the typical storybook setting for a blossoming marriage, but in June 2022, Katie Skrzypcak, M.D., and Matthew Simpson, M.D., made it so as they returned to Schroeder Complex to take wedding pictures before exchanging vows. The Simpsons, both H Sci '16, met in anatomy lab during their sophomore year in 2013. Although Katie and Matthew each discovered various extracurricular activities that engaged them, their shared experiences in Health Sciences proved transformative and brought them closer.

In particular, they bonded over their time in Global Brigades led by College of Health Sciences Records Coordinator Barb Burja. For the Simpsons, who became Global Brigades student leaders, a 2016 medical/dental brigades trip to Nicaragua represented a shared growth opportunity. "Global Brigades expanded our horizons and made us realize the good we can do and the services we can provide at any stage in our career," says Matthew, now a radiology resident at the University of Utah.

"The people we met were transformative as well," Katie adds. She is a general pediatrician in Salt Lake City, where the couple lives. "We grew closer on that trip and gained some lifelong friends as well."

On their wedding day, they returned to the basement lab, bringing their relationship full circle from undergraduate students to professionals beginning their lives together. "It's been so long since we were in that room, but it felt so natural walking down the hallway to the lab," Katie says. "It was definitely one of the highlights of our wedding day." — ALEX NEMEC



EXERCISE SCIENCE COLLEAGUES NAMED TO ESTEEMED JOURNAL POSITIONS

Dr. Christopher Sundberg was a postdoctoral fellow at Marquette in 2018 when he learned of the fellowships that enable junior scholars to serve on the editorial board of the *Journal of Physiology*, the flagship journal of the physiological community.

Board positions are coveted and typically go to academic scientists well established in their careers. The fellowships, however, provide rare early career opportunities for up to 10 junior scholars from across the globe and across specialties such as molecular, cellular, cardiovascular and renal physiology. Making serving on the editorial board a career goal, Sundberg, assistant professor of exercise science, received one of the fellowships in early 2022.

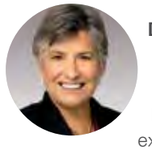
Sundberg, Grad '18, is honored to be working with leaders in his field as he serves as reviewing editor for submitted manuscripts that are aligned with his areas of research expertise, exercise and neuromuscular physiology. There are other duties too. "The most exciting experience, thus far, was attending the editorial board meeting in London in July," he reports. "It was very insightful to hear the historical context and priorities of the esteemed *Journal*, and it was invigorating to propose ideas and participate in open dialogue with so many brilliant and passionate physiologists on how to shape the strategic direction of the *Journal*."

Sundberg has company in journal service. Dr. Sandra Hunter, professor of exercise science and Sundberg's research partner in a major study of prediabetes muscle weakness (see p. 6), has been named editor in chief of the journal *Exercise and Sports Science Reviews*.
— STEPHEN FILMANOWICZ

ALUMNI WORTHY OF APPLAUSE

Recognizing the College of Health Sciences' 2022 Alumni National Award winners

By Guy Fiorita



DISTINGUISHED ALUMNA OF THE YEAR AWARD

Dr. Jo Anne Zujewski, Med Tech '76

Dr. Jo Anne Zujewski has touched an extraordinary number of lives in a large number of places. At the National Cancer Institute, she served as longtime head of the Breast Cancer Therapeutics, which made her the lead scientific liaison and disease expert for clinical trials sponsored by the NCI. Since retiring seven years ago, she has spent much of her time volunteering for clinical service in places such as Vietnam, Sri Lanka, Kenya and Bhutan. She has also joined Marquette colleagues on a Global Brigades medical and environmental mission in Nicaragua. Back in the U.S., Zujewski serves on the Board of Directors of Montgomery and Prince Georges Hospice in Rockville, Maryland, and the Maryland Responds Medical Reserve Corps. "Whether a patient in clinic, a student in class or a research colleague, I love having the opportunity to help someone every day."

PROFESSIONAL ACHIEVEMENT AWARD

Dr. Nunzio A. Gaglianello, H Sci '02

Dr. Nunzio Gaglianello has an impressive commitment to advancing heart care. As a board-certified cardiologist at the Medical College of Wisconsin, he specializes in advanced heart failure with extensive experience in care involving heart failure, assistive devices, heart transplantation, cardiomyopathy, pulmonary edema and arrhythmogenic right ventricular cardiomyopathy. As a researcher and writer, Gaglianello has co-authored 16 peer reviewed articles, including seven articles on the treatment of heart failure.

In addition to caring for patients, Gaglianello shares his expertise as associate professor of medicine at the Medical College of Wisconsin and program director for the cardiovascular medicine fellowship. "At Marquette I learned to truly value the Jesuit philosophy on education and I find mentoring trainees and guiding them the most fruitful part of my career," he says.

YOUNG ALUMNA OF THE YEAR AWARD

Dr. Holly Caretta-Weyer, H Sci '09

Few students can claim to be principal investigator on over $1.5 million in grant-funded research, but Dr. Holly Caretta-Weyer isn't like other students. As associate residency program director in emergency medicine at Stanford University, she is a global leader in competency-based medical education. That's her day job. She is also pursuing a doctorate in medical education from Maastricht University in the Netherlands. Her field of study is the improvement of the residency selection process aligned with a competency-based paradigm of training. Marquette holds a special place in her heart. "I met my husband at the orientation square dance. We got engaged senior year in the snow in front of Joan of Arc Chapel — just yards from where we first met."

Passing the Torch

Thanks to the pioneering Dr. Donald Neumann, Marquette has an esteemed reputation in kinesiology. Now, emerging leader Dr. Jacob Capin is ready to take the helm.

By Anna Funk Photos by Tom Grimm

Dr. Donald Neumann, professor emeritus of physical therapy, literally wrote the definitive kinesiology textbook used worldwide. He's defined excellence in kinesiology instruction at Marquette for decades and wasn't ready to hand the specialty over to just anyone. Fortunately, his replacement, Dr. Jacob Capin, is a young scientist already making a mark on the field.

But the real beginning of this story is before even Neumann, with his predecessor, Dr. Mary Pat Murray, whom Neumann replaced in 1986 after her death in 1984. "She set up a very strong foundation for kinesiology being very prominent at Marquette. She was probably infinitely better than either of us," says Neumann of Murray, who has a lecture hall named for her in the Walter Schroeder Health Sciences and Education Complex. "If there's any lineage in this story, it's these three people in a row that have set a high standard for kinesiology instruction at Marquette."

Today, the kinesiology legacy promises to continue as Capin sets up his new lab and settles into life at Marquette. "As one of my research techs said recently, we're moving and grooving," says Capin, an assistant professor of physical therapy. "It feels so much like home here already. I have a great community at Marquette and where I live — the people are wonderful. I love it here."

A PASSION FOR KINESIOLOGY

Neumann's interest in physical therapy — and kinesiology, its specialty focused on the mechanics of personal movement and its impact on broader health — was personal: He had experienced a motorcycle crash at 19 that resulted in a number of orthopedic injuries. His hip especially gave him trouble, and he would go on to study the hip — among many other parts of the body — for the duration of his 35-year career.

Along the way, Neumann made his mark in research, teaching at Marquette and service to the field around the world. The first edition of his textbook, Kinesiology of the Musculoskeletal System, came out in 2002, about the same time physical therapy first became a professional doctoral degree. He's been maintaining the text – which has since been translated into 10 languages

A renowned leader hands the baton to an emerging one: Dr. Donald Neumann and Dr. Jacob Capin.

and is considered the gold standard in the field – ever since. He's been awarded an astonishing four Fulbrights, two of them scholarships and two senior specialist grants, which have sent him to Lithuania, Hungary, Japan and Ireland. He says that in each of these places the main draw was for him to "go where the need is most," and that the door was opened by his book with its worldwide following. Neumann retired from full-time teaching in 2020, though he will continue to update his textbook for at least a few more editions.

The secret to his success? "I like it. I like what I do," he says. "It comes naturally."

A PASSION FOR HEALTH

Like Neumann, Capin's interest in the field is personal. A lifelong athlete, he played Division I basketball at Campbell University, where he majored in kinesiology. "It's the perfect merging of sports and science and academia and physical therapy and rehab all into one," he says.

When his college basketball career came to a close, he knew he'd need a new endeavor to keep active. He chose triathlon. "Literally the day after our team lost in the NCAA Tournament my senior year of college — we were still at the hotel for the tournament — I woke up early to get on the bike and get a run in," he says. "I did my first triathlon three months later." Today, Capin competes as an elite amateur for the Every Man Jack triathlon team.

This snapshot of Capin's history is very relevant: He is launching a major research study about the long-term health and function of former collegiate athletes, both those who've had major sports-related knee injuries and those who haven't. "My

research and teaching very much informs my personal life," he says. "And my exercise very much facilitates and enhances my professional life."

A core hypothesis is that former athletes may actually be less active, and therefore less healthy, than their non-athlete peers. That's because current athletes make habits around high amounts of vigorous physical activity that's highly structured and highly motivating, and tend toward greater sedentary behaviors outside their sport. Once the sport ends, they may lose the activity, but maintain the sedentary habits. "If the patterns of activity outside of the sport continue, and you no longer have that sport there, then potentially — this is all hypothetical — you are less active," says Capin.

Most studies to date have looked at predominantly male, professional athletes. Capin's work will be an important expansion for the field, as the results will be relevant for a much larger group encompassing men and women, as well as amateurs in college competing at any level.

Supporting this work is a distinguished National Institutes of Health Director's Grant, which Capin was awarded in October 2021. The five-year, $1.9 million grant is awarded through the NIH's High-Risk, High-Reward Research Program to exceptional young scientists embarking on independent research careers. He is the first — and only — recipient from Marquette University and likely the first in his field. "I am super grateful to have this funding," Capin says. "I believe I'm the first physical therapist ever to receive it ... I am beyond excited to have this opportunity to conduct research on long-term health in athletes."

IN THE RIGHT PLACE

Neumann and Capin speak highly of each other. They didn't know each other before Capin came to Marquette, though Capin says he certainly knew who Neumann was — not surprising, given the prevalence of his textbook. The duo have even spent some time together outside the classroom: When Capin first arrived in town, Neumann invited him out to an organic pizza farm an hour west of Milwaukee where he was playing guitar in the band.

"He's such a big name in the field, and a tremendous scholar and mentor and person," Capin says of Neumann. "He is so passionate and enthusiastic and knowledgeable about kinesiology and all of its related applications. He's also just a really kind person."

In the spring of 2022, Neumann mentored Capin as he taught his first course, Kinesiology I, Marquette's first-year doctoral physical therapy course. It went well. "I have a lot of respect for Jacob. I think he'll do a great job," he says. "You know, he's about the same age I was when I started."

Though Capin's appointment will keep him occupied with research 80 percent of the time, he'll continue to teach Neumann's Kinesiology I course — now Capin's Kinesiology I course — each spring. "It's a really exciting time in life," Capin says. "I feel very much like I'm in the right place doing the right thing. And I'm grateful for all of it."

Supporting Dr. Jacob Capin's research on long-term health in athletes is a distinguished National Institutes of Health Director's Grant, which is awarded to exceptional young scientists embarking on independent research careers.

SPINAL CORD SYNERGY

By Jennifer Walter, Comm '19
and Carrie Arnold

Illustration by Linda Nye
Photos by Kat Schleicher

Progress in spinal cord injury research and therapies is rare. But in the College of Health Sciences, faculty researchers and clinicians from several fields are pursuing promising cutting-edge strategies at scales ranging from microscopic axonal connections in the spinal cord to signals traveling through peripheral nerves to training involving myriad muscles and organs. Together, this work is offering spinal cord patients true hope.

GENES IN HARMONY

Dr. Murray Blackmore is employing precise combinations of genes to stimulate growth in spinal axons with aims of re-establishing severed connections and restoring a range of functions.

THOUSANDS OF TINY GREEN DOTS speckle the dimensional blob glowing on Dr. Murray Blackmore's computer screen. It's a map of a mouse's brain, and each of the dots represents a single cell connected to the animal's injured spinal cord.

Compared with a healthy specimen, the dots are sparse across many sections of the brain. Fewer connections mean the animal has less command over its physical abilities. Simple tasks like motor control and breath regulation might be compromised. After a spinal cord injury, these effects are common in humans too, leaving researchers hungry to understand the intricacies of how the brain disconnects from the body.

Blackmore, professor of biomedical sciences, created these brain maps as part of a collaborative project published in 2022 by scientists at Marquette and the University of Miami. With support from one of two grants from the National Institutes of Health that underwrite major projects in Blackmore's lab — collectively more than $5 million in funding from NIH's top R01 funding tier — the researchers have investigated how spinal cord injuries of varying severity wipe out brain-body connections in mice. They also tested treatments to restore these connections — vital information that will inform future treatments for human patients.

This project is the latest installment for Blackmore's lab, which has been on the cutting edge of spinal cord research since its inception in 2011.

Up to half a million people experience a spinal cord injury every year. Even as the body heals, some of the damage is considered irreversible. That's due to the reluctance of axons — the fibrous portions of neurons that transmit electrical signals from the brain to the body — to regenerate after injury.

Over the years, Blackmore's lab has made numerous strides in understanding which genes are associated with axon growth and how they might be harnessed to stimulate the revival of brain-body connections in animals. In lab tests, the team has been focused on therapies that employ viruses to carry reparative genes to damaged neurons.

Some treatments tested in the lab have stopped axons from further degrading, while others have coaxed them to steadily grow back. In petri dishes and mouse models, the team has witnessed the very beginnings of gene therapies that could one day carry over into treatments for humans.

The progress has been gradual, but it's provided vital information to the field of neuroscience. And in recent years, Blackmore explains, the lab has taken a more holistic approach toward understanding the underlying mechanisms of spinal cord injury.

While paralysis is a common outcome for the injured, Blackmore explains that patients have to deal with a lot more than just loss of motion. "There's bladder control, bowel control, blood pressure control, temperature control, posture. There are all kinds of regulation of sensation," he says.

Dr. Murray Blackmore builds holistically on his breakthrough: using viral gene delivery to spur growth of damaged axons.

It's because of the multifaceted outcomes of spinal cord damage that Blackmore's lab began to take what he calls a "whole-brain approach" to understanding how these life-changing injuries affect a range of bodily functions. Over the past few years, the lab has shifted from being laser-focused on learning how to restore motor control in paralyzed patients in favor of a more holistic outlook.

Working with injured animals, for example, gave researchers the opportunity to test how to target certain regions of the spinal cord with treatments that can restore specific brain-body connections. In one experiment, they tested a gene treatment on rats with optic nerve injuries and watched as axons regenerated to reconnect the animal's eye to its brain.

"For the first time, we're getting information about how the reconnections are happening to the whole brain," Blackmore says, instead of just focusing on regions that control walking and movement.

But some of the big research questions Blackmore and colleagues are tackling have remained the same since the lab's founding. Figuring out how to regenerate axons is still a main focus. That includes searching for genes that might be able to stimulate axon growth. Embryonic nervous systems have no problem growing axons back; the challenge is to translate that to adult patients.

One novel approach that the lab explored a few years ago investigated whether team members could turn on genes associated with cancer growth — which notoriously proliferates out of control — to stimulate axon growth.

After probing that connection for a few years, Blackmore says they realized genes that could influence cancer cells were almost always active in nerve cells, too. "It turned out to be so true that it's not even useful," he says.

The approach didn't help them discover a treasure trove of new solutions for axon growth. But it did help them develop a broader philosophy for finding promising gene candidates.

"We're now convinced that there's not going to be one gene, there's going to be a set of interacting genes that need to be supplied as a group" to stimulate the regeneration of axons, Blackmore explains. "The name of the game is not just finding genes that are relevant for growth. It's finding the set of synergizing genes."

Though Blackmore's lab still has a needle-like focus on the cutting-edge science of axon regeneration, the holistic approach he's taken to understand the mechanisms of spinal cord injuries — and how to heal them — has permeated just about every part of the lab's daily routines.

One recent development: Blackmore brought on a new lab member in 2020 with a spinal cord injury to weigh in on the research direction at weekly meetings. Nancy Nicholas, a retired Boeing executive who worked in manufacturing research and development, serves as a community representative, a sounding board helping to guide ideas based on her lived experience.

"As we think about the questions that we want to go after, we've got someone in the room who can weigh in at that really early idea formulation stage," Blackmore says. So, as the lab focuses on the smallest facets of the human body, its ultimate goal is to improve the quality of life for those living with spinal cord injuries. Even if solutions are still years away, every incremental step takes Blackmore and other spinal cord researchers another step toward healing. — JW

BREATH WORK

Dr. Kristi Streeter explores the mysterious interaction through which signals from the diaphragm may help rewire the brain to help those with spinal cord injuries breathe better.

EVERY DAY, WE INHALE AND EXHALE approximately 22,000 times. Over a lifetime, the breaths we take number in the hundreds of millions. Although we can consciously control our breathing, most of the time we respire without deliberate thought. Even depriving our brains and bodies of oxygen for just a minute or two can be life-threatening.

It's why improving respiratory function in people with spinal cord injuries is so important, says Dr. Kristi Streeter, assistant professor of physical therapy. In people with the most severe types of neck injuries (affecting the cervical spinal cord that stretches from the base of the skull to the upper back), the neurons that connect the brain to the diaphragm muscle are severed, leaving a person in need of a ventilator to breathe. For those with less severe injuries, however, those nerves remain partially intact. Although many of these patients need help breathing and remain at high risk for respiratory problems like pneumonia, the persistence of some neural connections opens the door for rarely studied healing processes involving neural plasticity to help improve breathing.

That's where Streeter comes in. She has received a highly competitive $747,000 K99/R00 grant from the National Institutes of Health — a first for Marquette's Physical Therapy Department — to study neural plasticity involving the neurons that control breathing in people with spinal cord injuries. Like Blackmore, Streeter is advancing science and solutions on the cutting edge of spinal cord injury research, only in her case within the pathway where signals travel from the brain to the spinal cord and down to the diaphragm — and take the reverse course too.

By understanding how this interplay of diaphragm, nerves and brain responds to trauma that leaves the spinal cord partially intact — and how this system can adapt in healing ways — Streeter hopes to help those with neurologic injuries lead better, more fulfilling lives. "We're really at the tip of the iceberg in terms of what we understand," she says.

Dr. Kristi Streeter investigates how afferent signals from the diaphragm enable neural plasticity that improves breathing in injured patients.

REMEMBERING TO BREATHE

The impetus to inhale originates deep in the brainstem, in one of the most primitive parts of our nervous system. In humans, as in all mammals, that signal races down the brainstem and into the spinal cord, until it hits the phrenic nerve. Emerging from three spinal cord nerve roots, the phrenic nerve connects the spinal cord and the muscular diaphragm, which bends and flattens as it contracts. When this happens, our lungs can expand and fill with oxygen as we inhale. As the diaphragm relaxes, it forces air out of the lungs.

If the spinal cord is damaged above the C5 vertebra, the neural superhighway connecting the brainstem to the diaphragm is damaged. If the spinal cord is severed completely, signals can't travel to the phrenic nerve and the diaphragm. But if the spinal cord remains partially intact, some connectivity remains, a condition that Streeter can re-create in the lab using rodent models. "The breathing pattern is very similar to what we see in patients," Streeter says.

The rats respond to this injury by shifting their standard slow and deep breaths to rapid panting. The severed connection, Streeter explains, means that their diaphragm muscles aren't getting the normal signals to contract. As a result, the lungs can't fill with oxygen or expel carbon dioxide as well. To compensate for their inability to breathe deeply, the rats take quick, shallow breaths. Humans with similar injuries do the same thing, Streeter says.

Although these patients can still technically breathe, many still require a ventilator to ensure they receive enough oxygen and exhale enough carbon dioxide. But life on a ventilator is risky — and hard. To help some of their patients get off a ventilator, doctors began turning to diaphragm pacing. Similar to a cardiac pacemaker, the diaphragm pacer uses surgically implanted electrodes to stimulate muscle contraction. To the doctors' and patients' surprise, the diaphragm pacer enabled some patients to come off a ventilator and breathe on their own.

Then things took a very unexpected turn. Not only were patients able to stop using a ventilator, but over time, many also stopped needing the pacer altogether. "It's almost as if the pacer activated respiratory memories," Streeter says. She wanted to know how.

As a doctoral student at the University of Florida, Streeter learned not only how the brain sent messages to the

diaphragm muscle to stimulate breathing, but also how the muscle sent messages back to the brain. This latter direction of travel (muscle to spinal cord to brain) is called an afferent. The use of the diaphragm pacer also stimulated these phrenic afferents, and Streeter hypothesizes that it's the bolstering of this pathway through a process of neural plasticity that helps those with spinal injuries breathe more easily.

"Does the diaphragm paralysis improve if we stimulate these afferents for a while?" she asks. "I want to know the cellular mechanisms that enable this process." Her new grant will allow her to uncover details about how respiratory neurons receive electrical signals from the diaphragm muscle, and whether artificial electrical stimulation of these neurons will help restore sensory input to the spinal cord. Streeter hopes this neuroplasticity means patients can breathe better.

For Streeter, everything comes back to the patients in the clinic. "I want to know what patients care about, and then go back to the lab and find the way to get there," Streeter says. — CA

CLINIC OF REGAINED HOPE

Scientifically verified therapies, advanced equipment and clinical experts make the Neuro Recovery Clinic a unique regional resource.

IN MARQUETTE'S COLLEGE OF HEALTH SCIENCES, progress in addressing neurologic injuries extends beyond research into axonal regeneration or neural feedback loops. It also engages the newest and best existing therapies to help people with a brain or spinal cord injury regain function and improve their quality of life. For patients, the Neuro Recovery Clinic plays a unique role in the region, providing access to empirically tested therapies administered by experts in their fields. It aims to put "recovery within reach" in accordance with each patient's therapy goals, and is the only one of its kind in Wisconsin.

Walking through the doors of the small-but-impressive clinic reveals a state-of-the-art gym overflowing with specialized equipment, designed specifically for the needs of those with brain and spine injuries. Each has been carefully selected by the clinic's cadre of physical and occupational therapists based on scientific literature that verifies its value in helping patients recover. The combination of unique "high-tech/high-touch" apparatuses and research-backed rehabilitation is where the magic of the Neuro Recovery Clinic happens, says clinic director Dr. Kim DeChant, H Sci '05, PT '07, neuro clinic program coordinator in the Department of Physical Therapy. "We tend to get patients when they've gone everywhere else. They're kind of at the end of their line," DeChant says. "We have the expertise to pick up where others have left off."

The goal with all patients is to help them return to the activities they find important, DeChant says. For patients with the most severe types of injuries, that starts with the basics, such as eating, writing, speaking, walking, personal grooming and getting dressed. Others may want to return to an occupation or specific activities such as hiking, golfing or knitting. Although the specific objective may vary, rehabilitation from neurologic injury requires intensive, repeated practice to rewire the neural circuits that were disrupted by injuries or a stroke.

New studies have revealed that even a gravely injured brain or a damaged spinal cord can rewire itself and strengthen existing neural connections to work around the damage — again through the process of neural plasticity. "The NRC has been intentionally designed to incorporate neuroplasticity principles to optimize recovery and slow the decline associated with neurologic injury and disease," says Dr. Tina Stoeckmann, clinical professor of physical therapy and academic coordinator of Marquette's Neurological Residency Program. "Advanced technology, specialized staff and frequent, intensive training blocks over many weeks to months are required to push the nervous system to improve and are not offered anywhere else in our region."

Restoring hope with "high-tech/high-touch" therapies: the Neuro Recovery Clinic's Dr. Kim DeChant and Dr. Tina Stoeckmann.

Think of the neurological processes at work, says Dr. Mitchell Adam, H Sci '18, PT '20, a doctoral candidate in exercise and rehabilitation science who also works at the NRC, as similar to what happens if a major highway is destroyed with no chance of repair. Traffic may have to divert to little-used dirt trails that allow for vastly reduced speeds and volume. Rehabilitation, Adam says, "is like turning a dirt road into a highway."

Creating these nervous system bypasses doesn't happen overnight, and it requires months, even years, of learning new skills, explains Dr. Rose Tilton, NRC occupational therapist. Children don't learn how to play a sport or musical instrument with a few lessons. Mastery takes years of intense practice. What this means for patients is several hours each day of practice and therapy to bolster those new neurological superhighways.

That's where the technology comes in, Tilton says. Practicing grasping a spoon or bending down to tie your shoes for hours a day can be grueling and boring. Tilton says that virtual reality goggles can provide novelty and excitement that encourage patients to keep practicing.

Many of the patients of NRC physical therapist Dr. Melissa Dygulski have lost strength and balance as a result of their injuries and need specialized gear to help get them standing and on a path to restored movement. She relies on state-of-the-art treadmills that assist them in developing balance. A special ZeroG system supports body weight and prevents injuries to patients and staff. Over time, as patients' bodies regain strength, the equipment provides less and less assistance until the individuals are doing all the work on their own. The process can take years, but Dygulski says it can help patients regain a sense of purpose and meaning in their lives.

"It allows you to put those repetitions into practice," Dygulski says. "Without this equipment, you're really not even getting close to what the research is recommending in terms of intensity."

Tilton mentions the case of an individual who arrived at the NRC after a partial spinal cord injury left him with a loss of strength and sensation in his arms. The clinic, Tilton says, offers a range of therapy options to help support recovery. Clinical staff can stimulate arm muscles with precise patterns of electrical stimulation to mimic actions such as brushing hair and teeth – a process that will make the therapy meaningful and optimize the principles of neural plasticity, Tilton says. Virtual reality and robotic equipment provide additional opportunities to practice functional movements that support repetition and patient engagement that can lead to nervous system recovery (or improved functional use of the arms).

"If we give people the proper dosage and intensity of therapy, we're seeing recovery seven or 10 years after an injury," Tilton says. Again and again, the NRC finds a pathway to recovery, where one previously hadn't seemed possible. — CA

A Culture of Care, Rigor and Joy

The College of Health Sciences' many pediatric programs serve young patients in the region with truly advanced therapies — delivered with care and imagination.

By Haley Wasserman, H Sci '20
Photos By Alex Nemec

A young physical therapy patient gains function through developmental therapies in the Neuro Recovery Clinic.

"Lemonade, fresh lemonade!"

A young boy stands on the sidewalk near Wisconsin Avenue waving his arms at pedestrians. Behind him, a colorful lemonade stand is tucked under the overhang of the Olin Engineering Center. Other children, some with hearing devices, cluster around the stand, talking and smiling. The boy has only recently found his voice and enthusiasm, thanks to the therapeutic assistance of faculty and students from the Speech Pathology and Audiology Department of the College of Health Sciences.

This is Camp HILS — for Hearing Intensive Language and Speech — a clinical summer camp that is part of the Marquette University Speech and Hearing Clinic (MUSHC). Through the camp, faculty in speech pathology and audiology and their students help children who are deaf or hard of hearing learn about speech and language awareness, about caring for and using their hearing devices, and about advocating for their communication needs in social settings.

Over the camp's three-week sessions, clinical faculty supervise students who provide individualized and group therapy — some of which is disguised as play, such as participating in scavenger hunts, engaging in field trips or running a lemonade stand. Children are able to learn and practice communication skills they'll need in the real world, including language revolving around sharing or collaborating on tasks.

"Our work is fun, and I think the kids would agree," says Bridget Valla, CJPA '91, Grad '92, clinical associate professor of speech pathology. A licensed speech-language pathologist, she helps operate a handful of pediatric clinical programs within the department, including Camp HILS.

All told, College of Health Sciences faculty and students run 10 pediatric clinical programs in specialties ranging from speech and audiology to physical therapy and occupational therapy. Children

Faculty and students in speech pathology and audiology serve pediatric clients with a range of specialized clinical programs.

served in this array of clinical settings range from those with autism spectrum disorder to those with muscular dystrophy or those recovering from brain and spinal cord injuries.

Each clinical program provides exceptional care to children and their families, coupling cutting-edge clinical techniques with compassion to serve clients in the Milwaukee community. Simultaneously, the clinical programs use hands-on involvement to train the next generation of health professionals. "These clinics harness faculty expertise and state-of-the-art care that families in the area would otherwise be unable to access. They serve as magnets within the region for specials needs therapies," says Dr. William E. Cullinan, dean of the College of Health Sciences.

CREATIVITY AND COLLABORATION

In the speech and audiology department, Camp HILS is one of several programs that collectively offer an array of speech therapy services through the Speech and Hearing Clinic. Overseen by Wendy Krueger, Grad '92, clinical associate professor and director of clinical education in the department, the clinic and its programs offer highly respected services for adults and children — but more than half of the caseload is pediatric. And when clients cannot afford care, they're treated on a "pay-what-you-can" basis.

The clinic serves a majority of these clients in tailored individual sessions, while also offering an impressive array of specialized groups and camps. The Adolescent Social Skills Group is one such program, imparting students and clients with valuable opportunities to engage with one another in creative clinical settings. A group of teenagers with developmental disabilities meets with faculty and students to learn and practice speech for social situations in theme-based immersive experiences. In one instance, the group spent time learning about language usage for movie theaters, then ventured to the Weasler Auditorium to practice purchasing movie tickets and concessions. "It's difficult to do these kinds of activities in a clinic that is not on a university campus, but here we have the opportunity to treat outside of the box," Valla says.

All speech-language services are provided by student clinicians under the direct supervision of Valla and Katherine Czelatdko, clinical assistant professor of speech pathology and audiology, and other clinical faculty who are all licensed, certified speech-language pathologists with specialization in a wide range of communication disorders. For the students, these experiences in campus clinics hone collaboration skills that are essential in pediatric treatment. So, a focus of her clinical instruction in the Speech and Hearing Clinic, Czelatdko says, is emphasizing the importance of joining forces with caregivers and community and school personnel when treating children of all ages, coming together as a team to help children apply their skills generally across home, school and clinic environments.

> "Families receiving services in all of Marquette's clinics are being treated by leading clinicians in their respective fields. Our clinical faculty have such a strong reputation in the community for their expertise and decades of experience."
>
> — WENDY KRUEGER

LEARNING TO LIVE YOUNG LIVES

Occupational therapy focuses on teaching or rehabilitating individuals so they can carry out necessary and desired daily tasks, also known as occupations. In serving young clients,

MORE CLINICAL PROGRAMS, MORE IMPACT

Social Learning Camp
Children with developmental disabilities in this Marquette University Speech and Hearing Clinic (MUSHC) summer camp learn and practice peer-to-peer interaction and conversational skills.

Hablamos Marquette
Led by Stacy Ko, CJPA '92, clinical associate professor of speech pathology and audiology, this camp for bilingual preschoolers with speech and language disorders fosters functional communication skill development in a group setting. Graduate students in the bilingual English-Spanish specialization track in speech pathology collaboratively plan three weeks of group intervention, including age-appropriate activities that address each child's goals, behavior management practices for preschoolers and communication with caregivers.

The college's newest pediatric clinic — in occupational therapy — "helps children with the job of living."

Dr. Ann Millard, associate chair and clinical assistant professor of occupational therapy, incorporates creativity and play into the work she does as a pediatric occupational therapist in the interdisciplinary Neuro Recovery Clinic.

In this pediatric setting, the activities vary for clients, including those who have a genetic or developmental disorder or those learning to live with a disability that affects mobility, such as cerebral palsy. This therapy is often long term for the children, evolving as they meet their treatment goals and plan for daily life as they get older.

"Play is both a means and an end in therapy," says Millard. "This is a holistic profession where we help children with the job of living, working to give them confidence and independence to live their lives." Millard works with children in one of the college's newest clinical offerings since the Occupational Therapy program was founded in 2019 and welcomed its first students in 2020. In a colorful gym in the Occupational Therapy program's building on West Wells Street, Jenga blocks help children fine-tune motor development, and slides and swings aid in focus on sensory processing skills. Students assist during designated clinic trainings built into their curriculum.

MAKING STRIDES

Also opened in 2019, thanks to donor support, the interdisciplinary Neuro Recovery Clinic with its main location in Cramer Hall offers multiple clinical programs to treat patients of all ages with neurologic disorders, including spinal cord or brain injury, stroke, Parkinson's and other complex conditions.

Dr. Anne Pleva, PT '93, clinical assistant professor of physical therapy, oversees the pediatric physical therapy clinic within the Neuro Recovery Clinic. She is the sole faculty provider handling the pediatric cases in the clinic. Like the other clinical programs, Pleva works to create joyful, play-based therapy sessions for her clients, while also working to train students.

Her outpatient clinic is bursting with color and light, with adaptive and therapy equipment, plus many toys and games. The space is used for treatment and teaching. Physical therapy students serve as volunteer assistants, and those interested in pediatric specialization can be paired with a client for an entire semester as part of an advanced pediatric elective class. In each session, Pleva and her students develop children to their fullest potential using creative play strategies to strengthen muscles, improve balance and develop new patterns of movement.

"The College of Health Sciences offers me, the students and the families this unique setting, with state-of-the-art equipment, energetic student helpers and clinical expertise all focused on helping their child make progress, while educating the next generation of pediatric therapists," Pleva says. "Many of the children we work with have complex, multi-system disabilities. Along with their families, we celebrate every inchstone of progress together."

Across the Health Sciences clinical programs, collaboration between care providers is crucial to maximize benefits to individual clients and to advance research. In complex cases, clinical faculty team up for treatment, occasionally providing physical and speech therapy simultaneously, or referring clients to other programs based on their needs.

"Our clinical programs are built on the foundation of collaborative care," adds Krueger. "It is important that we instill in our students the importance of interprofessional clinical practice to carry into their future careers. Families receiving services in all of Marquette's clinics are being treated by leading clinicians in their respective fields. Our clinical faculty have such a strong reputation in the community for their expertise and decades of experience."

Marquette University Summer Communication, Literacy and Enhanced Socialization (MUSCLES)
Through this joint program with the College of Education, students and faculty from speech-language pathology and occupational therapy help children with autism spectrum disorder improve reading fluency, comprehension and social communication skills.

TIM's Camp
This summer program in MUSHC helps teenagers and young adults with Down syndrome work on communication and language skills through speech therapy and immersive activities.

On Your Marq
Run by the Office of Disability Services, this program collaborates with students and faculty in occupational therapy to assist neurodivergent Marquette students with independent living and skills needed to live on a college campus. The MUSHC clinic also provides services to these students, focusing on improving social communication skills for academic, vocational and social settings.

Tiny Listeners and Communicators
Through this MUSHC program, faculty and students help children under 3 years old with speech, language and/or feeding disorders through individual and group therapy.

Opening Doors for Future Scientists

Through a $1.6 million grant from the National Institutes of Health — the first of its kind in the Midwest — Marquette's U-RISE program is helping undergraduates from underrepresented groups prepare for careers in scientific research.

By Brian Hudgins | Photos by Alex Nemec

Junior Ahman Edwards received a strong signal that helped better define his emerging interest in science and medicine: Seeing his late great-grandmother battle Alzheimer's disease stimulated his interest in neurology.

"She did not know my name," Edwards says in describing her final months. "She would ask me who my mom was, and that intrigued me, to find out how she could ask me the same question a minute later."

After he completed his first two years as an undergraduate biomedical sciences major at Marquette, Edwards faced a dilemma. If he did not have enough financial resources, the Sidon, Mississippi, native would have to pass on doing lab work — mentored by Dr. Matthew Hearing, H Sci '03, assistant professor of biomedical sciences — that would have special value for him as a pre-med student and instead get a better-paying summer job.

Enter U-RISE. The two-year undergraduate research training scholarship program is designed to provide guidance for underrepresented students, including first-generation students and women, who plan to pursue doctoral study (M.D. and Ph.D. degrees) and research careers in biomedical sciences.

Marquette is the first Midwestern university to receive a National Institutes of Health grant to implement U-RISE. The $1.6 million, five-year grant was awarded in April. Dr. SuJean Choi, professor of biomedical sciences, heads the U-RISE at Marquette program. Three other principal investigators collaborated with her on the grant planning: Hearing; Dr. Laurieann Klockow, clinical professor and associate chair of instruction in biomedical sciences; and Dr. Kimberly D'Anna-Hernandez, associate professor of psychology.

"We have four students in U-RISE and hope to grow to eight per year staggered over two years," Choi says. "Hopefully, we can grow that up to 20 students."

The initial student stages involve choosing a research lab and mentor prior to the start of the junior year. The students go through a Summer Research Training Bootcamp to meet the U-RISE leadership team and their student peers. During that junior year, students are required to enroll in a Path to Research course and participate in a weekly U-RISE seminar.

Marquette's first U-RISE cohort: (from left) Analise Segarra, Lara Koutah, Jehan Khaled, Ahman Edwards. Previous page, U-Rise scholar Ahman Edwards conducts mentored research.

For Edwards, the beginning of U-RISE is the next step in a journey that started taking shape early during his teen years. "Ever since ninth grade, I told people I was going to Marquette," Edwards says. "I knew I wanted to go into medicine. A lot of U-RISE was geared right up my alley. You have to do an essay talking about how you can contribute."

An April interview was the next step. "I got an interview and I was sweating during that interview," Edwards says with a laugh. "That was in April and I got the decision in May. I was nervous during that whole time."

The U-RISE green light meant Edwards could keep working in Hearing's lab heading into his junior year before the intro bootcamp (fortunately, he'd already made that research connection as a sophomore). The juniors will present their research at U-RISE Research Day, work on preparing grad school applications and participate in a scientific seminar series.

Choi and the principal investigators created six credit hours of course work for the U-RISE students, which includes the three-credit Path to Research course, designed to give juniors more familiarity with the postgraduate path to becoming a researcher. The process builds on the beginning bootcamp by preparing students to do lab research, work on their own projects and learn how to write a research grant during the junior and senior years. "The goal is to get students accepted into Ph.D. postgrad programs," Choi says.

In addition to the academic benefits, there is another perk for students who might be hundreds or thousands of miles from home. The grant allows for the payment of up to $16,000 in tuition each year and a monthly stipend. "Hopefully, the students will not need to pick up a second source of income outside their schoolwork," Choi says.

Becoming part of the U-RISE community has enabled Edwards to connect with fellow aspiring neuroscientists. After he completed the program application and interview, Edwards discovered that a fellow student had also discussed her neurology interests during the process. He encountered familiar faces during each step. "I thought it was cool that Dr. Hearing, a man I worked with, also got to interview me for U-RISE," Edwards says.

That support system is designed to help Edwards and his peers flourish. "Society portrays scientists generally as male and Caucasian, so these students have few role models," Choi says. "Research isn't a commonly considered profession, and we hope to change that."

Providing an Ultrasound Advantage

As portable ultrasound devices emerge as a key asset in patient diagnostics, the Physician Assistant Studies program leads the way in teaching this technology.

By Sarah Wells | Photos by Patrick Manning

Faculty member Amie Billstrom instructs student Samantha DeLeeuw in the diagnostic uses of a portable ultrasound device.

Amie Billstrom is no stranger to providing medical care under pressure. Before joining Marquette in 2020 as a clinical assistant professor in the Physician Assistant Studies program, Billstrom provided emergency medical care to patients in mountainous regions of Central America through the U.S. Joint Command's Operation Central Skies.

When staff or access to technology was limited, Billstrom could always rely on a pocket-sized piece of technology to help her make a life-saving diagnosis — a point-of-care ultrasound device. These portable devices, known by the acronym POCUS, are transformative for health care because clinicians can use them to make quick bedside diagnostic assessments on their own, rather than having to wait for specialized technicians to operate large scanning machines. And now, Billstrom is part of an initiative at Marquette to bring this technology into the hands of new PAs like never before.

Instead of learning about POCUS only in clinical and emergency medicine courses at the end of their program, future PAs at Marquette are now introduced to the technology from day one, making this one of the first PA programs to incorporate ultrasound technology throughout its curriculum. "POCUS is being integrated into a lot of medical school programs and is frequently called a 'new age stethoscope,'" Billstrom says. "We want to stay on par with these colleagues."

Mary Jo Wiemiller, department chair and Physician Assistant Studies program director, says that incorporating more portable ultrasound device use into the PA curriculum is an exciting innovation that should serve students far beyond their studies. "This curriculum will hopefully make POCUS second nature in clinical practice," Wiemiller says. "Our hope is that Marquette PA students can lead the way among other learners for point of care ultrasound use."

When you think of ultrasound, the first images that likely come to mind are the fetal ultrasounds done periodically throughout a pregnancy to measure developmental progress. Yet, the uses for POCUS devices have expanded in recent years, Billstrom says, extending their relevance to many other clinical situations as well, such as identifying fluid in a patient's lungs or evaluating heart function.

Additionally, POCUS devices can be used repeatedly without exposing patients to radiation, as an X-ray or CT scan would. "It uses sound waves," Billstrom says. "It's low risk to put a probe on a patient."

Ultrasound probes can come in many different shapes and sizes, but Billstrom often opts for a portable POCUS that looks more like an electric razor than a complex medical tool. Regardless of their shape, POCUS devices are designed to operate in two different modes: high frequency for evaluating superficial structures like the lungs, and low frequency for deeper evaluations, such as within the abdomen.

In both cases, "echoes" of these ultrasound waves bounce back when they hit something in the body, such as tissue or bone. To make sense of these echoes, clinicians are trained to interpret feedback-formed images on a screen or attached tablet. Understanding how these often grainy images correspond to a patient's anatomy is one of the steeper learning curves for POCUS, says third-year PA student Liz Horn.

"Things on an ultrasound do not look like they do in textbooks," says Horn. "It requires a lot of focus, good technique, and a lot of overall consolidation of my medical knowledge to be able to discern what I am looking at."

Horn says that prior to Marquette's PA program she'd had few interactions with POCUS, but she has now seen how the technology can be an incredibly important tool across medical specialties. This appreciation is something Billstrom hopes all PA students will take away from the new ultrasound curriculum, as they receive lessons on POCUS use in each semester starting in their first semester in conjunction with their gross anatomy course.

"This curriculum is built longitudinally so that they start very generically looking at anatomy using POCUS alongside their anatomy and physical exam course," Billstrom says. "Then in their clinical medicine and clinical decision making, we would use POCUS to look at particular patients who have a chief complaint, for example shortness of breath."

The goal is for students to be more comfortable using POCUS to diagnose pathologies by the time they enter their clinical years, so that they can use a POCUS just as easily as any other diagnostic tool. "Ultrasound has been such a growing field, especially during the COVID pandemic," Billstrom says. "As we're putting students out into the workforce to be primary care providers and emergency medicine PAs, they need to know this technology. If they're only getting on-the-job training, they're behind the curve."

Assured in the center of the action

Medical laboratory science students benefit from small class sizes and guaranteed internships while learning to master instruments and critical tests that are essential to patient care.

Text and photos by Alex Nemec

Dr. Valerie Everard-Gigot, H Sci '99, Grad '06, describes diagnosing patients as a puzzle – a critical puzzle requiring confident accuracy. "Our students learn how to ensure that the final piece of the puzzle fits perfectly," says Everard-Gigot, the chair and director of medical laboratory science at Marquette.

From blood banking and hematology to toxicology and microbiology and more, medical laboratory science plays a crucial part in health care. The scientists ensure the accuracy and fidelity of critical laboratory tests and do so by mastering extremely technical scientific diagnostic instruments for optimal sensitivity and specificity. This commitment to accuracy prevents errors that could be incredibly harmful to human health.

Marquette's Medical Laboratory Science program is modest — three dozen students and three full-time professors — but poised to grow in line with the heightened demand for more laboratory scientists. Not only is the industry growing, but the nature of the science itself is always changing, bringing an exciting and fascinating element to the expertise students develop.

Prior to joining Marquette, Dr. Erik Munson, associate professor of medical laboratory science, worked for 15 years as lab director for the Wheaton Franciscan Healthcare system in Milwaukee. "The most fun part of my job was never getting the same thing every day. There was always something different that came up," Munson says. "Those new obstacles test your ability to adapt to a situation or, frankly, give you something new to learn. … Bacteria and pathogens change all the time. It gives you tremendous opportunities to learn even while you're working."

Given the level of intimacy within the Medical Laboratory Science program, students and professors build strong relationships that help students thrive in their studies and in their careers. Senior Maia Villaflor emphasizes how important those relationships have been to her success as a student. "Whether it's in class or outside of class, the professors in the program never hesitated to offer one-on-one help to ensure my success," Villaflor says.

Students like senior Amanda Zapp, middle, operate critical lab equipment and conduct essential diagnostic tests.

Everard-Gigot thinks the student who wants to be in this program is one who wants a direct role in patient diagnosis. "They're right in the middle of the action," she says.

Brittany Cassel, H Sci '19, a biomedical sciences graduate who returned to Marquette to earn a medical laboratory science postgraduate certificate, says she always knew she wanted to work in health care. While exploring jobs, Cassel found a job opening for a laboratory scientist and became enamored with the program after learning more about it and the endless learning opportunities it enables. "It's never boring," Cassel says. "There's always something exciting or atypical that arises, and it's fascinating to learn about."

GUARANTEED, LOCAL INTERNSHIPS

A key factor that makes Marquette's program stand out from other laboratory science programs in the region is the guaranteed internship offered during the student's senior year. At bigger programs, students have to vie with other candidates for each spot, Everard-Gigot says. "Those interviews could primarily be based on GPA, and other students might have to travel out of state to get a clinical spot. All of our internships are in the Milwaukee area."

Amanda Zapp, a medical laboratory science senior, says the guaranteed internship gives her something to look forward to. "I view it as a way to take everything I have learned in my studies and show myself how far I have come and get an opportunity to apply my skills in a clinical setting," Zapp says. "I feel more inspired to focus on my current classes, so I get to perform at my best once I reach that internship."

STANDING OUT FOR MED SCHOOL AND CAREER OPPORTUNITIES

Morgan Hays, H Sci '20, who now works in North Carolina, says the best practices she learned at Marquette have set her apart from co-workers at various jobs; she is ready for all the curveballs the job throws at her. "Marquette did such a good job of teaching us how to problem-solve issues," she says. "Thanks to what I learned at Marquette, I know how to approach the problem and not get flustered about it. They gave us the tools to be successful."

"Our students are driven to think outside of the box and arrive at a diagnosis by thinking critically," Everard-Gigot said. "There are a lot of factors in play when a student applies to a graduate program, but the skills learned in our program put the student in a great place to succeed."

All-Pro Approach

Alumnus Michael Falk combines athletic training, physical therapy and NFL insights to help clients overcome injuries and aim for peak performance.

By Mary Schmitt Boyer, Jour '77 | Photos by Front Room

"He's the top student I've ever had."

David Leigh, the longtime head athletic trainer at Marquette who became a clinical instructor and helped develop the athletic training major in the College of Health Sciences, is talking about Dr. Michael Falk, H Sci'12, PT'17, owner of Kinetic Sports Medicine and Performance.

"He's probably the brightest kid I've ever had," says Leigh, who retired as Marquette's trainer in 2001 and continued as a Health Sciences faculty member till 2018. "He worked his tail off. It was never enough to be a good student. He wanted to be the best."

That is also the attitude Falk brought to establishing Kinetic Sports Medicine and Performance after earning his doctorate in physical therapy at Marquette. "Looking around the Milwaukee area, we just didn't see anywhere that was doing the type of work that we wanted to do — a clinic truly for athletes," Falk says. "High school students, college students home on break or in the summers and professional athletes who spend the off-season here." Kinetic now has two offices in the area.

Growing up in Dallas, Falk was an enthusiastic, if slightly injury-prone, athlete with a history of knee issues. "I just couldn't stay healthy," he says. "That's what sparked my interest in the field."

Even before enrolling in Marquette's Athletic Training program in the College of Health Sciences, Falk sent out a lot of letters and applications and struck up a friendship with head trainer Pepper Burruss of the Green Bay Packers. Falk served as a summer intern with the Packers all the way through college and, after earning his undergraduate degree in 2012, spent two years as a season-long intern.

With that on his resume, Falk had his pick of jobs when he finished his internships. He interviewed with NFL teams and NBA teams, even was offered his "dream job" as director of rehabilitation for a team he declined to name.

Burruss had another suggestion. "His survey of the professional sports landscape was that having a dual credential as an athletic trainer/physical therapist was going to be really important going forward," Falk recalls. "He saw the writing on the wall that eventually all teams were going to have a physical therapist on staff. So, he pushed me to go back to PT school."

Burruss didn't have to push too hard. Falk had become friends with Lauren Boyler while he was an undergraduate, and she was the athletic trainer for Marquette's men's soccer and men's and women's tennis teams. He saw how hard she worked, and he'd learned the kinds of hours the job required during those internships with the Packers.

"Professional sports are great, but it's a grind," Falk said. "During an NFL season, from the time training camp started through the Super Bowl, I virtually lived at the facility. Being young and single, it was easier than it would be today."

When friendship with Boyler turned to romance and, eventually, marriage and parenthood, that sort of work-heavy schedule was much less appealing. So, following graduation from Marquette's doctoral physical therapy program, they decided to launch their own unique clinic together, where she's now Dr. Lauren (Boyler) Falk, PT '17.

"We truly focus on the specialized needs of athletes," Michael Falk says. "Most PT clinics are general orthopedic clinics for the everyday person. For us, 80 to 85 percent of our clients are competitive athletes — high school, college or pro — and the remaining percentage are recreational athletes, like runners. "The other biggest differentiator for us is our advanced technological approach and our ability to provide an environment similar to what people would experience in a professional organization or at a DI school."

As it happened, their first client in 2018 turned out to be Ben Heller, the former Whitewater High School star pitcher who was playing with the New York Yankees and coming off Tommy John surgery. When the Yankees gave Heller the option of doing his rehabilitation close to his family's home in Brookfield, the Yankees head trainer (a former classmate of the Packers' Burruss) recommended Falk — even though his Kinetic clinic had yet to officially open.

"I think they opened a month or two earlier than they'd planned," said Heller, now with the Minnesota Twins organization. "From the get-go, I could tell they really cared about me accomplishing my goals. I felt like I was in a really good spot."

That's exactly why the Falks created Kinetic Sports Medicine and Performance. "Our vision was to take what Lauren did at Marquette, what I'd seen in Green Bay and as best as possible create that environment for local athletes," Michael Falk says.

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