

WHEN LESS OXYGEN HEALS

Novel spinal cord injury therapy put to the test



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On the Cover

Intermittent periods of hypoxia, or oxygen deficiency, can be quite harmful if taken to the extreme. But UF researchers are finding that modest intermittent hypoxia holds hidden healing benefits.



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UP FRONT

The color of hope

UF Health pediatric oncologist Paul Castillo, M.D., right, a clinical assistant professor in the UF College of Medicine, celebrates winning a \$200,000 Hyundai Young Investigator Grant as part of the Hyundai Hope on Wheels event. Castillo's white coat was adorned with colorful handprints from pediatric cancer patients who placed painted handprints on a new Hyundai to mark their fight for a cure to the disease.

— Greg Hamilton

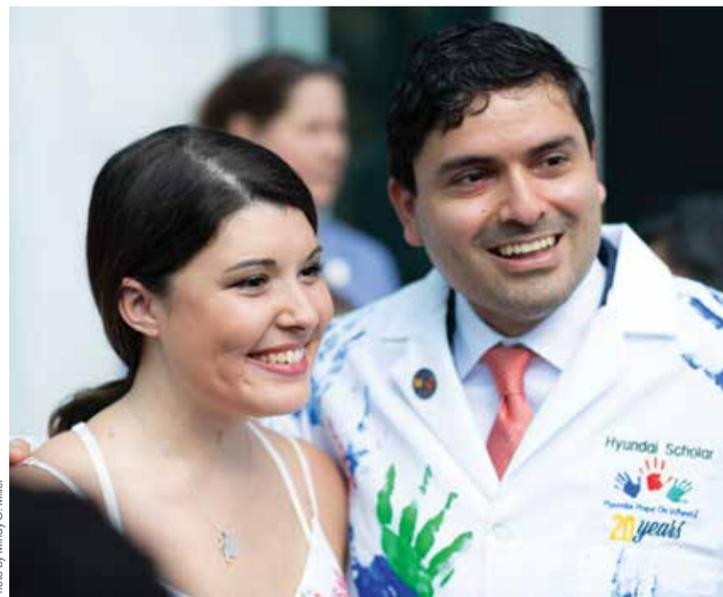


Photo by Mindy C. Miller

Mood Disorders Program earns national distinction

The University of Florida's Mood Disorders Program, spearheaded by the department of psychiatry at UF's College of Medicine, has been named a center of excellence by the National Network of Depression Centers, or NNDC. UF Health is the first academic health center in Florida to earn this distinction.

The NNDC is a consortium of leading academic health centers working to accelerate research, education and improved treatment options for patients suffering from depression, bipolar disorder and other mood disorders.

UF Health joins 21 other NNDC centers of excellence, including the Mayo Clinic, Stanford University and Johns Hopkins Medicine.



New dining options guide available

The new UF Health Shands Food & Beverage Options handout makes it easy for patients, visitors and staff to find eateries in the UF Health Archer Road facilities. From salad bars and sushi to Tex-Mex and smoothies, the two-sided resource lists all dining options and hours of operation. The back displays a map of UF Health Shands Hospital, UF Health Shands Cancer Hospital, UF Health Heart & Vascular and Neuromedicine hospitals, UF Health Medical Plaza and the 1329 Building — and highlights the location of each dining option.

View and print the handout from the Bridge, under the "Employee Services" tab and "Cafeteria Menus" link. Patients and visitors can go online at UFHealth.org and search "Meals and Dining Options." Or stop by a nursing station or Guest Services Desk to request a hard copy. For direct access to the map, visit ufhealth.org/sites/default/files/media/maps/uf-health-gainesville-dining-options.pdf.

Welcome the holiday season with plants from Wilmot Gardens

The holiday season is here and it's time to fill your home with fall colors. The 2018 Wilmot Gardens Fall Plant Sale will include Christmas cacti, succulents, tropical houseplants and more, with all proceeds from the free event going to support Wilmot Gardens and the therapeutic horticulture program.

The sale will be held from 11 a.m. to 5 p.m. Friday, Nov. 30 and from 9 a.m. to 1 p.m. Saturday, Dec. 1 at the Greenhouse at Wilmot Gardens, 1427 Gale Lemerand Drive, Gainesville.

For more information, contact Bailey Hillman at bahillman@ufl.edu or call 352-273-5832.



All of Us Journey visits UF Health to encourage participation

The National Institutes of Health's All of Us Journey educational trailer rolled into Gainesville recently as part of an effort to get 1 million or more people across the country to become part of a data bank of information in hopes of accelerating research discoveries and improve health care for everyone. UF Health is among 25 institutions participating in the program. Representing UF Health at the event were, from left, William Hogan, M.D., director, biomedical informatics program, UF Clinical and Translational Science Institute; Elizabeth Shenkman, Ph.D., professor and chair, health outcomes & biomedical informatics; and David R. Nelson, M.D., interim senior vice president for health affairs at UF and president of UF Health. — *Greg Hamilton*



UF College of Veterinary Medicine opens equine acupuncture center in Marion County

The UF College of Veterinary Medicine has opened an acupuncture center for horses in the Marion County area, often referred to as the "horse capital of the world." The UF Equine Acupuncture Center will function as a clinic through which Huisheng Xie, B.Sc.V.M., Ph.D., a clinical professor in the integrative medicine service at the UF Veterinary Hospitals, will provide acupuncture therapy. The center is adjacent to The Chi Institute of Traditional Chinese Veterinary Medicine, which Xie founded in 1998, about 2 miles west of Interstate 75 in Reddick. — *Sarah Carey*

Perfect 10: All medicinal chemistry tenure-track Ph.D. program faculty members are federally funded

Assistant professors Rob Huigens, Ph.D., and Yousong Ding, Ph.D., have each secured \$1.7 million grants from the National Institute of General Medical Sciences. For them, earning a National Institutes of Health grant is a first. For the department of medicinal chemistry in the UF College of Pharmacy, the grants mean 10 out of 10 tenure-track Ph.D.

program faculty members are federally funded. The 10 faculty members serve as principal investigators on 18 federally funded grants worth more than \$18.4 million. Their research spans broad interest areas from identifying novel cancer drugs in the ocean to developing new compounds to combat drug abuse. — *Matt Splett*

PUSHING BACK

New Comprehensive Spine Center unites experts to fight neck, back pain

By Todd Taylor

Back and neck care for residents of Gainesville, the Southeast and beyond has taken a significant step forward with the launch of the UF Health Comprehensive Spine Center.

Using a multidisciplinary approach, the center unites spine, neck and back pain experts from several UF College of Medicine departments under one roof, including neurosurgeons, orthopaedic surgeons, physical medicine and rehabilitation physicians, pain physicians and neurologists.

"The current state of spine care in the U.S. is very fragmented — patients go from location to location, seeing multiple doctors, often ending up frustrated and without any solutions," said Daniel Hoh, M.D., a UF Health neurosurgeon and an associate professor in the department of neurosurgery. "This center provides a system where patients don't need to see two or three different physicians for surgical and nonsurgical opinions, or wait to be referred elsewhere. The resources are all right here and are available for patients seeking same-day appointments."

Experts estimate that nearly 80 percent of the U.S. population will experience back problems during their lifetime. The root cause of back and neck pain can be wide-ranging, leaving patients unsure of where to seek an initial consultation. This type of pain is the second-leading cause of primary care physician visits, and E.R.s are another common point of entry for these patients.

Kevin Vincent, M.D., Ph.D., an associate professor in the department of orthopaedics and rehabilitation, said this often leads to a delayed diagnosis. The center, he said, represents a much-needed move toward more comprehensive back and neck care.

"Our multidisciplinary approach will allow us to address the reasons behind back pain more quickly," said Vincent, the medical operations director of the UF Health Orthopaedics and Sports Medicine Institute. "This will lead to less use of medications that frequently aren't beneficial, particularly narcotics and muscle relaxants. Additionally, it will lead to more appropriate use of advanced imaging and testing."

Centrally locating specialists from various medical disciplines also

will reduce referrals, expedite the process of connecting patients with the appropriate care expert and provide a wider range of treatment options.

"Modern comprehensive spine management involves a spectrum of treatments, from activity modification and therapy to minimally invasive pain management procedures to advanced surgical solutions," said Stephen Lucas, M.D., an associate professor in the department of anesthesiology and associate chair of pain medicine. "By bringing all the specialties together we can focus on how to best improve the quality of life of our patients."

With more funds being allocated to treat back and neck pain than nearly any other medical condition in the U.S., the center's model is the wave of the future, said Hoh.

"This is a very real-world societal issue that's putting a strain on our health care system," he said. "We expect the center will not only allow us to improve patient satisfaction and quality, but also increase the efficiency of hospital resources and lower the cost of care by reducing redundancies and variation in care."

From an educational perspective, the center will provide spine care trainees a unique opportunity to learn from a wide range of experts.

"The center offers an ideal educational environment for the training of our next generation of spine specialists, which will ultimately benefit our patients and advance research," said Rene Przkora, M.D., Ph.D., an associate professor in the department of anesthesiology and director of the multidisciplinary pain medicine fellowship program.

Brian Hoh, M.D., chair of the Lillian S. Wells Department of Neurosurgery and a member of UF's Evelyn F. and William L. McKnight Brain Institute, said the center's location within the UF Health Neuromedicine Hospital is the ideal setting for this enhanced approach to spine care.

"With a comprehensive spine center, patients benefit from the best possible patient-centric care that is personalized and individualized for each patient, whether the treatment is nonsurgical, a minimally invasive intervention, surgery or some combination, from a multidisciplinary team in one state-of-the-art location," he said.

SOBERING TRUTHS

BINGE DRINKING, BLACKOUTS AND THE LONG-TERM HEALTH RISKS THEY CAN CAUSE

By Jamie Smolen, MD



Jamie Smolen, M.D., is an associate professor of psychiatry in the UF College of Medicine.

Tens of thousands of college students cheer for their teams each weekend during the football season. Some of those who show up for the game after tailgate drinking may not remember the highlight touchdowns that they cheered so loudly for. Others may have trouble remembering even a rousing celebration of victory.

Binge drinking, the leading type of alcohol misuse for college students, is the culprit. Drinking too much too fast can cause memory loss, sometimes called a blackout, erasing any recollection of an enjoyable life event.

What's more, research is suggesting that binge drinking in the college brain can impair not only learning but memorizing. Deficiencies in both of these crucial neurocognitive processes would probably make studying very difficult, and far less productive. In such a case, maintaining a high academic standing might be impossible.

While many young people may euphemistically refer to binge drinking as

"partying," those of us who study addiction know that it is a serious health risk for young people. We have long known of the immediate risks from assault, death by motor vehicle and suicide linked to drinking. But the effects of binge drinking affect learning inside and outside the classroom and can have adverse effects on making successful transitions throughout life.

The ongoing battle of the college binge

Binge drinking is generally defined as drinking several drinks — four for women, five for men — within two hours and elevating the blood alcohol level to 0.08 or higher. It leads to the deaths of about 1,825 people between 18 and 24 each year and close to 700,000 assaults. About 40 percent of college students binge drink monthly.

Despite a lower frequency of alcohol use in young people compared with older adults, getting intoxicated is more prevalent, and binge drinking seems to be their favorite way to get there. In fact, as much as 90 percent of the alcohol consumed by young people occurs while binge drinking.

Binge drinking can have an immediate and neurotoxic effect on the still developing and susceptible college-age brain. And the damage done by heavy drinking can worsen from one episode to the next, harming the brain at an accelerating pace beyond what would be expected from chronic dependence on alcohol.

When a heavy episode of drinking has ended, and the hangover has cleared, there is still a great concern about the neurological insults that can interfere with the accumulation of textbook and classroom facts. It can result in neurocognitive deficits that are likely to cause serious academic problems. Beyond that, if a young vulnerable brain is subjected to four years of undergraduate partying, the development of maturational skill sets, necessary for a more successful shift into adulthood, may be impeded.

Further explanation of this may come from objective proof that young binge drinkers have a depletion of glutathione, an important antioxidant principally responsible for protecting the brain from the oxidative stress of free radicals. When depletion of glutathione occurs in the hippocampus, a part of the brain playing a major role in memory and learning, there is less of a neuroprotective effect that persists even during periods of abstinence between binges.

Throughout development, spanning decades, extensive and important changes occur in multiple areas of white and gray matter in the brain. Among these is the prefrontal cortex, a region governing executive functions. Any interference from alcohol during maturation can result in what amounts to "faulty wiring" with lifelong effects. The resulting altered brain functioning, even while sober, can set off the impulse to take risks with thrill-seeking

behaviors. Affected teens and those in their 20s are more likely to have less regard for the danger that may result from seeking extreme and dangerous pleasures.

Repetitive binge drinking is also known to impair social functioning. Young people who binge drink typically are not developing useful interpersonal skills. And, binge drinking cannot help the brain to learn and evolve into consistently making well-informed decisions, an executive ability useful for the achievement of success and the happiness that would naturally follow.

A particularly dark side of bingeing: Blackouts

Another big worry for those of us who study and treat alcohol abuse is blackouts. During a blackout, there is a failure of the brain to transfer memory, or what is called encoding. The information of facts and events cannot be remembered and is blocked partially or completely.

E.M. Jellinek, credited as being the first to view alcoholism as a disease, first documented blackout drinking as an important indicator of alcoholism. Now, experts acknowledge how frequently it can occur even in healthy young adult drinkers. About 50 percent of college students who drink have experienced a blackout.

Someone in a blackout may appear normal while engaging in conversation and even appear to interact appropriately and yet not remember any of it. That is because of a disruption in activity of the hippocampus, which also interferes with the acquisition of new autobiographical memories.

While the brain is caught in a process of rapidly forgetting, binge drinking can also functionally compromise the brain with uninhibited poor judgment. The

consequences can be embarrassing, and worse, can include injuries, sexual assault, unsafe sex, drunken driving and police involvement after drinking.

Researchers have a lot more to learn about blackouts. For one thing, we do not yet understand why blackouts continue in some people even after someone reduces his or her binge drinking. Genetic factors could hold the answer.

Earlier drinking in young people may also be associated with the continuation of blackouts even if binges become less frequent. Explanations for this require more scientific study like that done in Australia by Daniel Hermens and Jim Lagopoulos on the neurological underpinnings of alcohol-induced blackouts. They were looking for biological markers associated with alcohol-related brain damage affecting the hippocampus.

The greater question is can neuroscience rely on these brain changes as biomarkers to better understand what may be predisposing teen binge drinkers to blacking out and the resulting memory deficiencies that are far more worrisome.

What has been a common, expected and celebrated relationship with alcohol for college students should continue to be viewed with great concern. Enough of the facts are in from neurobiological research to understand that alcohol has a substantial impact on the brain's ability to transfer information into long-term memory. Binge drinking students experiencing blackouts could be compromising an opportunity to take advantage of a great education and perhaps diminish the probability of the success they anticipate.

A version of this column was published in the online magazine The Conversation.

WHEN LESS OXYGEN HEALS

Novel spinal cord injury therapy put to the test

By Michelle Koidin Jaffee



Using sensors to measure the core muscles that contribute to breathing, Kate Cavka, D.P.T., N.C.S., places a mask over a participant's mouth and nose to alternate giving low-oxygen air followed by normal air.

Photo by Jesse S. Jones

“Superman” actor and disabilities activist Christopher Reeve often traveled the country to visit teams of neuroscientists working to discover possible treatments for spinal cord injuries. A framed photo of Reeve during one such visit — in his wheelchair with his portable ventilator, the result of a horseback-riding accident — sits prominently today in the office of Gordon Mitchell, Ph.D., a pioneering researcher known internationally for his innovative studies concerning how to strengthen breathing and other movements among those with severe spinal cord injuries.

The photo of the late movie star-turned-activist serves as inspiration to Mitchell, who came to the Evelyn F. and William L. McKnight Brain Institute and the department of physical therapy at the University of Florida from the University of Wisconsin at the end of 2014 to found UF’s Center for Respiratory Research and Rehabilitation and advance efforts to develop therapies for one of medicine’s most vexing conditions.

“I once saw Christopher Reeve speak, and during his talk, he expressed that his greatest fear was that the power would go out — and that would mean the ventilator that sustained his life would stop,” said Mitchell, preeminence professor of neuroscience in UF’s College of Public Health and Health Professions. So, while the inability to walk may be the most visible sign of a spinal cord injury, for those most severely injured, it is the inability to breathe on one’s own that poses the gravest danger and creates the most fear.

“For people with chronic spinal cord injury, the No. 1 cause of death is respiratory failure,” Mitchell said. “For people who have suffered these catastrophic injuries, once they’ve had all the benefits that conventional rehabilitation has to offer, there is little hope of further improvement. So what we need are new strategies — and we think we may have found one.”

AN UPSIDE OF LOW OXYGEN

This promising new strategy is called “therapeutic intermittent hypoxia.”

Hypoxia is a word that makes some people brace. Defined as “a deficiency of oxygen reaching the tissues of the body,” hypoxia can be quite harmful if taken to the extreme. Intermittent periods of hypoxia are one major consequence of sleep apnea, which contributes to high blood pressure, diabetes — even cancer growth. In the worst cases, hypoxia can be fatal.

But what Mitchell has discovered is that modest intermittent hypoxia holds hidden benefits: He has developed a technique that involves breathing a lower level of oxygen in short, repeated bursts for a limited period to strengthen breathing ability. One remarkable surprise, Mitchell said, is that it also strengthens other movements, including walking and grasping.

Mitchell is gaining confidence in the possibilities of this technique. Over more than two decades of research — including very basic molecular studies in rats and advancing in recent years to human clinical trials at collaborating institutions — he and his team have demonstrated that this technique shows promise as a potential therapy to improve breathing and other movements in people with chronic incomplete spinal cord injury, including those with quadriplegia, or paralysis from the neck down.

This discovery could also have implications for many other clinical disorders that compromise the ability to

breathe or move, including amyotrophic lateral sclerosis, or ALS, multiple sclerosis, post-polio syndrome, stroke and traumatic brain injury.

It holds the promise of a potential low-cost, noninvasive therapy to build strength in multiple ways.

“The work we’re doing is really focused on helping those with spinal cord injuries to regain movements: Those movements would be breathing, arm movements like grasping, and it might even be standing up or walking,” Mitchell said.

Monica Perez, Ph.D., of the Miami Project to Cure Paralysis, said while there’s still much to be learned about how intermittent hypoxia works in humans, preliminary data suggest the technique could be a significant advancement in the recovery from spinal cord injury.

“Dr. Mitchell is a world expert in the field of respiratory biology and the use of intermittent hypoxia,” said Perez, a professor in the department of neurological surgery at the University of Miami and a collaborator of Mitchell’s. “What’s interesting about intermittent hypoxia is it’s a noninvasive technique that is easy to use and has shown to be effective in improving voluntary motor output.”

Now, Mitchell and co-principal investigator Emily Fox, D.P.T., Ph.D., are launching UF’s first human clinical trial to test their hypothesis that intermittent hypoxia improves breathing ability.



Under a \$2.4 million Defense Department grant, Gordon Mitchell, Ph.D., left, and Emily Fox, Ph.D., will test therapeutic intermittent hypoxia over four years.

PUTTING INTERMITTENT HYPOXIA TO THE TEST

Under a new \$2.4 million grant from the U.S. Department of Defense, Fox and Mitchell will test therapeutic intermittent hypoxia over four years in about 55 people with chronic spinal cord injuries in a collaboration between UF and Brooks Rehabilitation in Jacksonville. The clinical trial, starting this fall, will be carried out at the Brooks Rehabilitation Clinical Research Center.

“We are testing our hypothesis that a combined approach of breathing low oxygen and conventional respiratory strength-training exercises will be better than either strategy alone,” said Fox, a research assistant professor in UF’s department of physical therapy in the UF College of Public Health and Health Professions and a clinical research scientist at Brooks Rehabilitation. “Our hypothesis is that when we combine these strategies, it’ll have the most beneficial effect.”

Using sensors attached to the skin to measure activity in the core muscles that contribute to breathing and additional sensors that measure blood oxygen levels and the amount and force of air being inhaled and exhaled, the research team will place a mask over a participant’s mouth and nose to alternate giving low-oxygen air (9 percent oxygen) for a minute, followed by normal room air (21 percent oxygen) for a minute, about 15 times in all.

“Then the participant will have a rest period to allow the treatment effects to take place,” Fox said. “After we wait about 45 minutes, we do those tests again, testing the breathing function and core muscle function again. We also test the ability to sit up and to stand, because the effects of intermittent hypoxia can be profound and affect other motor functions.”

Mitchell explained the science behind the treatment: “After years of work, we came to realize that repeated exposure to low oxygen — just slight decreases in oxygen — triggered events in the brain and spinal cord that lead to what we call ‘neural plasticity,’” he said. “It’s basically

like turning up the volume on a stereo so you can hear the signal more. This, we realized, could be very useful in restoring breathing after spinal cord injury in the cervical region of the neck or in a lot of neurodegenerative diseases, all of which end life because of failure to breathe adequately.”

For the participant, the difference between breathing 21 percent oxygen and 9 percent oxygen for one minute is so subtle, Fox said, that most people are unable to reliably report whether they were breathing normal air or low-oxygen air.

In current research efforts, the machine that provides the oxygen-reduced air is similar to those used by mountain climbers and endurance athletes who are training to compete in high-altitude environments. But as intermittent hypoxia research is taken to the next level, Mitchell is collaborating with engineers, including Neil Euliano of Convergent Engineering in Gainesville, to develop a standardized device specific to this use.

“When we expose the subjects to the low oxygen, it’s a level of oxygen that’s about the same as if they had climbed Denali, which is the highest peak in North America,” Mitchell said. “But on the other hand, they never really get there. It’s a journey that lasts one minute, and at the end of that minute, we return them to Gainesville.”

Mitchell warns against any patients attempting this technique at home, as for now it remains experimental — and could be harmful if unmonitored by professional treatment providers. Dosages, frequency and duration are the focus of multiple ongoing studies.

Furthermore, the ultimate safety and lasting benefits of intermittent hypoxia as a treatment have yet to be proven. The benefits appear to be temporary and to last from a number of hours to a number of weeks. Like exercise, the treatment most likely would need to be repeated regularly to maintain its benefits.

HOW DOES INTERMITTENT HYPOXIA WORK?

Intermittent hypoxia works, Mitchell said, because it prompts the body to adapt to repeated changes in oxygen levels.

When the level of oxygen reaching the tissues drops, the body has “watchdogs” that respond, he explained. These so-called watchdogs “are sensory neurons in your neck called the carotid body chemoreceptors, and when oxygen goes low — for even a very brief period — they are activated and tell your brain that something important is changing,” he said.

This increases the activity of a kind of neuron in the brain that contains the neurochemical serotonin, and the neurons “broadcast” across the brain and spinal cord. “When they release serotonin, it triggers changes that we refer to as plasticity,” Mitchell said. “The plasticity is in motor nerve cells that innervate the muscle. So what happens is that plasticity makes them work better.”

The key is to activate the carotid body chemoreceptors and the neurons that contain serotonin while minimizing the amount of hypoxia in tissues throughout the body. By shortening the episodes of hypoxia, researchers are able to accomplish this goal.

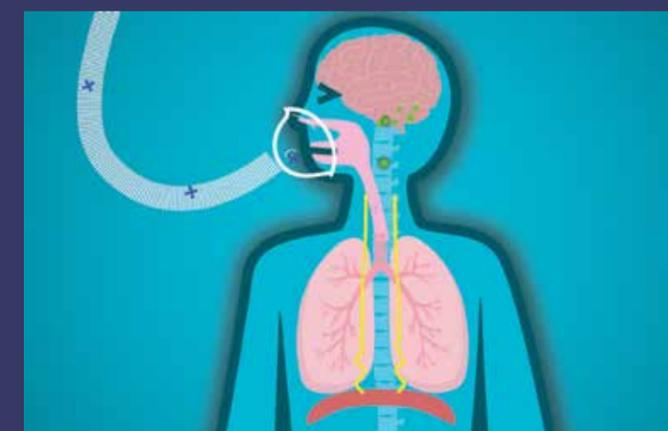
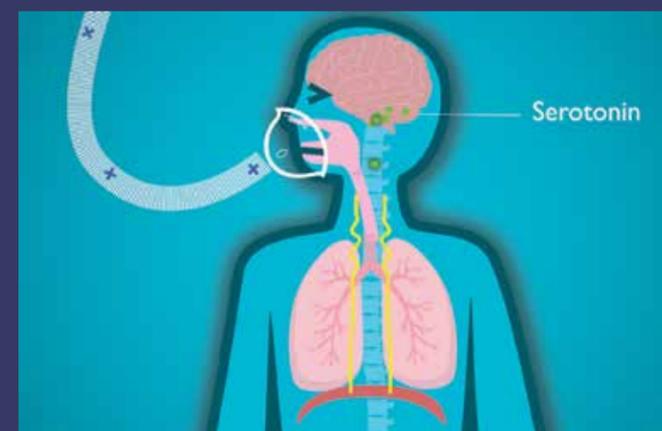
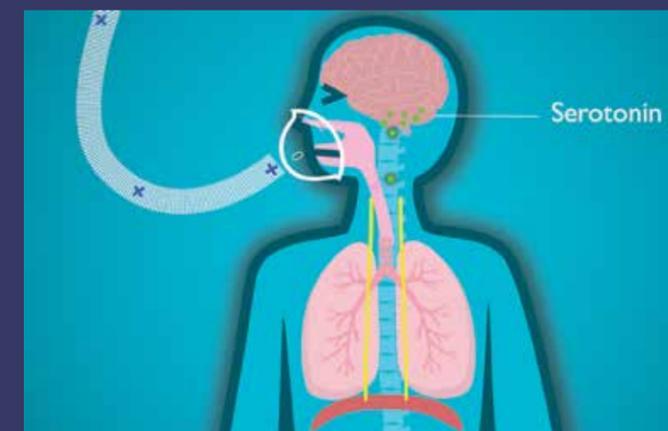
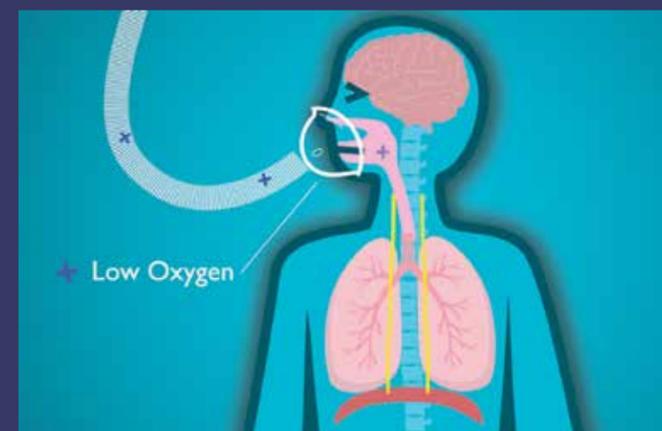
Once serotonin has worked its magic by triggering neuroplasticity, the motor nerve cells are more active, causing the diaphragm to make stronger contractions — making each breath deeper.

After two decades of basic research on rodent models in an effort to understand this process and why it might work, Mitchell’s team started to translate their findings to humans in 2010, with clinical trials at partner institutions Emory University and the Rehabilitation Institute of Chicago. Thus far, Mitchell’s team and collaborators have published seven articles in high-profile journals indicating they can produce changes in limb movements. Because of greater difficulties working with ventilator-dependent patients, they began studies in those with less-severe injuries that impact walking and arm use. Now, they are turning their efforts to improving breathing in people with chronic spinal cord injuries.

The initial studies demonstrated an increase in leg strength and substantial improvement in walking ability in patients who had no prognosis for functional gains. These were followed up with a preliminary study demonstrating improved hand function in people with quadriplegia, like Christopher Reeve had.

But more research is needed before intermittent hypoxia could become a clinical treatment.

“Eventually there will need to be a full-scale clinical trial involving multiple sites. Only after we understand the outcome of that trial, we’ll be able to really say this is a clinical treatment,” Mitchell said. In the meantime, there is much work to be done to prepare for that comprehensive clinical trial.



Intermittent hypoxia works through the body’s attempt to compensate for repeated changes in oxygen levels. When the level of oxygen in the arterial blood drops, sensory neurons are activated. This change increases the activity of a kind of neuron in the brain that contains the neurochemical serotonin. When the neurons release serotonin, it triggers neuroplasticity in motor nerve cells that supply muscles, making them work better.

Gordon Mitchell, Ph.D., is helping bring together people with various expertise to advance the science for intermittent hypoxia patients.



BUILDING AN INTERNATIONAL CONSORTIUM

Traditional goals of spinal cord injury research have focused on restoring the ability to walk. But to Mitchell, the goal has always been restoring critical yet perhaps under-appreciated automatic functions like breathing.

Mitchell first became captivated by the process of breathing while studying diving mammals and marine biology as an undergraduate at the University of California, Irvine. He happened upon a comparative respiratory physiology lab, where he discovered a passion for understanding how animals control their breathing.

Today, Mitchell has taken that early interest and become a worldwide leader, forming an international therapeutic intermittent hypoxia consortium to accelerate progress and, this past April, hosting a first-ever retreat that brought 130 researchers to Gainesville from as far away as Australia, France and the Ukraine.

He has positioned UF for prominence in this field by bringing together researchers from UF and Brooks Rehabilitation, and by collaborating — rather than competing — with colleagues at other institutions who have multiple different studies now underway.

“What Dr. Mitchell has done is tremendously important because he brings people with different areas of expertise together to address different aspects of a central question,” said Perez, of the Miami Project to Cure Paralysis. “Since we all have different areas of expertise, we all help each other. Our role (at Miami) is to help understand the effects of acute intermittent hypoxia in the human central nervous system — what are the mechanisms that contribute to those improvements in performance.”

Zev Rymer, M.D., Ph.D., a professor at Northwestern University and director of Research Planning Engineering in Neuroscience at the Shirley Ryan AbilityLab, said his lab relies heavily on the work of Mitchell and that of his team to drive their clinical work. “We have been using the basic information Gordon provided from animal models and extending that into humans, not just in breathing but in how intermittent hypoxia might affect other parts of the body,” said Rymer, whose lab recently launched two major clinical trials testing intermittent hypoxia in humans. “The protocols we use and the basic science that motivated us came from Gordon’s work.”

“AS CLINICIANS, WE WANT TO HAVE AS MANY TOOLS IN OUR TOOLBOX AS POSSIBLE TO MAXIMIZE THE NUMBER OF INTERVENTIONS WE’RE PERFORMING IN THERAPY, SO WE CAN ACHIEVE MORE: MORE FUNCTIONAL CAPACITY, MORE INDEPENDENCE, BETTER QUALITY OF LIFE.”

— KATE CAVKA, D.P.T., N.C.S.

HOPE FOR THE FUTURE

As a physical therapist at Brooks Rehabilitation, Kate Cavka sees patients with spinal cord injuries in an outpatient facility, shortly after they’ve returned home from the hospital.

“They’re just getting home and realizing what their new world looks like at that moment in time,” Cavka said. “Generally, there’s a lot of anxiety.”

She helps patients to set new, realistic, incremental goals. One aspect of treatment might be focused on walking again, but Cavka, D.P.T., N.C.S. also highlights the importance of respiratory function, such as coughing: Muscle strength to keep the airway clear is essential to prevent pneumonia.

Assisting with the intermittent hypoxia research gives Cavka a sense of hope.

“As clinicians, we want to have as many tools in our toolbox as possible to maximize the number of interventions we’re performing in therapy, so we can achieve more: more functional capacity, more

independence, better quality of life,” she said.

One patient, 21-year-old college student Francois Fried, was left in a wheelchair from a dirt-bike racing accident in November 2016. While he has built core strength and improved his ability to move around through five-day-a-week physical therapy sessions, he feels his progress has begun to plateau.

During a recent therapy session, Fried said he was intrigued by the possibilities of intermittent hypoxia. “I hope they do a long-term study and see if we can get really good results out of it,” he said.

Like Fried, many who have spinal cord injuries suffered them at a young age, with a whole life ahead of them.

“What we think is really important,” said Mitchell, “is if this does work, it offers hope to individuals that have suffered so very long.”

As time passes post-injury, hope tends to dwindle.

“We hope,” he said, “to give that hope back.”

MEDICAL MILESTONE

UF Health Shands: 60 years of moving medicine forward

By Michelle Moore



Photo by Mindy C. Miller

Sixty years ago, the UF Teaching Hospital opened as the first hospital in Florida affiliated with a medical school, the University of Florida's new College of Medicine. Pausing to celebrate this significant milestone and the birth of what is now UF Health, the Gainesville community can look back on the hospital system's history and its profound impact on health care not only in Florida, but across the nation and around the world.

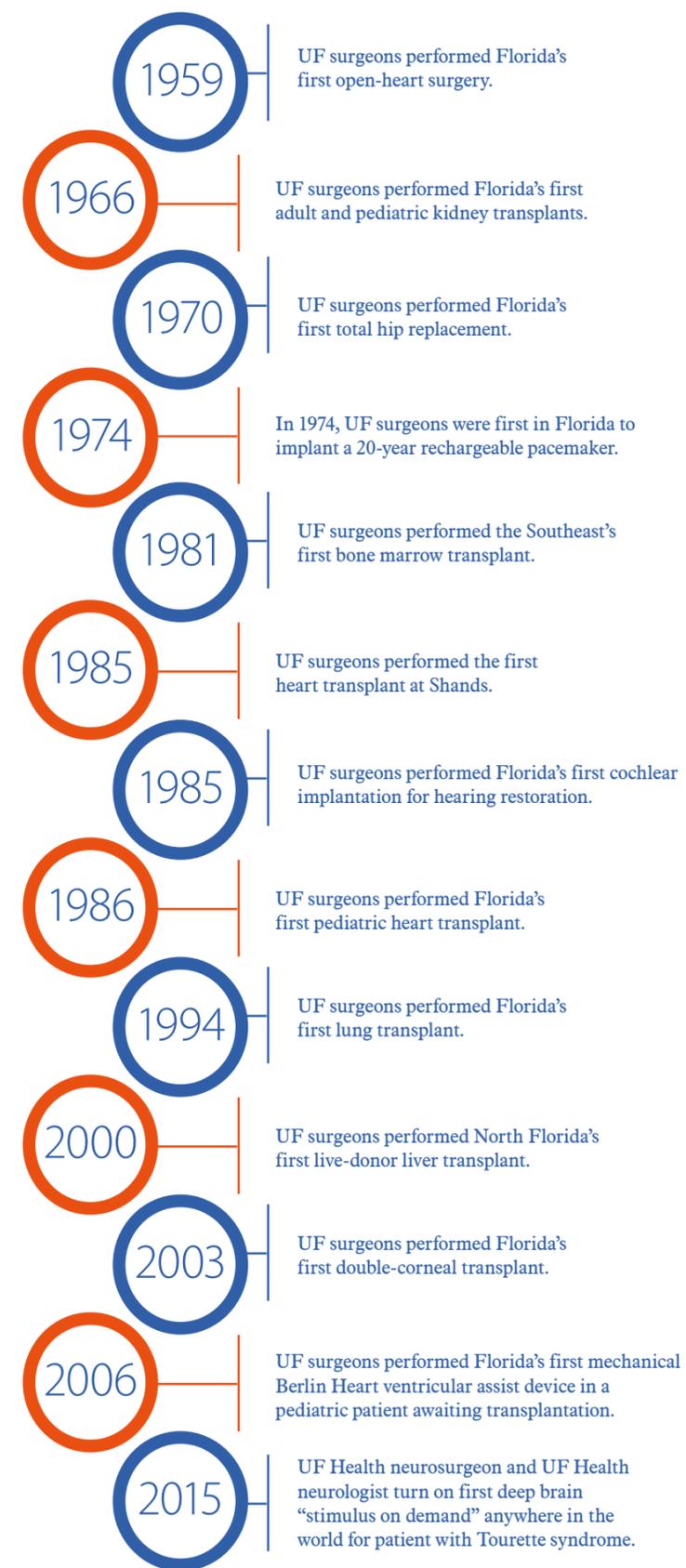
Since the hospital first opened its doors on Oct. 20, 1958, UF College of Medicine faculty physicians and UF Health Shands Hospital nurses and staff have treated more than 2.75 million patients. They have opened new hospitals, primary care and specialty medical practices and branched out with affiliations and partnerships to expand their reach, providing highly specialized and complex care to many communities throughout the state.

There have been many changes since 9-year-old Nancy Sue Smith of Williston was admitted as the hospital's first patient, but one thing has been consistent: the mission to provide the highest level of clinical care and the best possible patient experience with every patient served.

Over the years, UF Health Shands has been at the forefront of many clinical innovations, dating back to 1959, when UF College of Medicine surgeons performed the state's first open-heart surgery. There have had numerous other firsts over the last six decades, including Florida's first kidney transplant and first pediatric heart transplant. UF physicians also implanted the nation's first computerized 20-year rechargeable pacemaker, to name a few milestones.

UF Health Shands has been ranked among the Top 50 in the U.S. News & World Report's "Best Hospitals" and "Best Children's Hospitals" lists for numerous years, and the nursing services recently earned a fourth consecutive national Magnet designation from the American Nurses Credentialing Center, the nation's highest honor for quality nursing care and practice.

While anniversaries are a time to reflect on accomplishments, the goal of the hospital's 60th celebration is to recognize all the ways that UF Health Shands has always been focused on the future. Imagine what will be accomplished in the next 60 years.





PIONEERING RESEARCH

UF Health among elite group selected to create 3D cellular map of human body

By Bill Levesque



University of Florida Health is one of five institutions nationwide selected by the National Institutes of Health to help create a groundbreaking 3D cellular map of the human body that may one day transform understanding of diseases.

UF Health officials describe this effort as similar in ambition to the Human Genome Project, an international collaboration that catalogued all human DNA and led to the discovery of more than 1,800 disease-associated genes.

The NIH has awarded a multidisciplinary team at UF Health a \$5.1 million, nearly four-year grant as part of the Human BioMolecular Atlas Program, or HuBMAP. Using advanced microscopy, UF Health researchers will map key components of the lymphatic system, which includes the lymph nodes, spleen and thymus. The lymphatic system is a critical part of the immune system that helps ward off infection and disease.

"The goals of this program are quite lofty, like those of sequencing the human genome, but far more complex because it's not just DNA," said Mark Atkinson, Ph.D., director of the UF Diabetes Institute and a principal investigator on the UF Health HuBMAP team. "We will seek to understand how genes influence cells, cells influence tissues and how those organ systems work together. It's exploring the new world of the human body. That's exciting. This is absolutely at the crux of our understanding of life and biology and I

think it will form a framework for medicine moving forward."

UF Health and other institutions tackling different organs or tissue systems will map normal tissue from deceased donors, from the very young to the elderly.

"Knowing the normal baseline of the individual cells as they reside in that tissue will be very, very helpful in terms of understanding how that is altered in any disease," said Harry Nick, Ph.D., a professor in the UF College of Medicine's department of neuroscience and a principal HuBMAP investigator.

The project's aim, Nick added, is "to target an understanding of the cells in each tissue of the human body and how those cells function, what proteins they make and how they fit in a 3-D manner in each respective tissue."

UF Health researchers decided to map the lymphatic system because it is central to health, and the project may eventually lead to insights in the battle against 80 autoimmune diseases, from Type 1 diabetes to lupus and some cancers.

"The impetus for this is that most of the data that exists now is from rodent organs," said Nick. "And because the spleen, the thymus and lymph nodes are not transplantable, there hasn't been a lot out there on what the 3D structure of these organs looks like. The assumption is that they're very similar to our animal models. But we know, especially in the spleen, that is not completely the case."

The UF Diabetes Institute already operates a biobank of pancreatic tissue, the Network for Pancreatic Organ Donors with Diabetes, or nPOD. UF Health's history of successfully operating nPOD played a key role in its successful bid to participate in HuBMAP, Nick said.

With nPOD, UF Health has developed the critical infrastructure necessary to procure human tissue and work with donor organizations around the nation, he said. "Dr. Atkinson's reputation of bringing people together all over the world to study Type 1 diabetes . . . was a major strength, combined with the groundbreaking methodology of Dr. Bernd Bodenmiller," Nick said.

UF Health's HuBMAP team is working in collaboration with Bodenmiller, Ph.D., a professor at the University of Zurich in Switzerland.

The challenges facing the consortium are going to be daunting, said Atkinson, who noted, "It's almost science fiction in terms of the goals."

Perhaps the biggest challenge, he said, is "Data. And data. And data."

Consider this. Scientists in an unrelated project recently created a 3D map of a fruit fly's brain, which is the size of a poppy seed. That effort took 7,000 slices of the brain to produce 21 million images.

Multiply that by the size of human tissue systems.

"If a fly brain takes more than 20 million images, and we have been tasked to perform a somewhat similar effort on the entire body, it's going to be challenging," said Atkinson, the American Diabetes Association eminent scholar for diabetes research in the UF College of Medicine. "But the genome project was a similar daunting effort in terms of technologies available when it started, yet they succeeded. So the pressure's on us. I believe it will work in the end."

Atkinson said the team was not yet sure how many images would be required to map the lymphatic system, but they will be participating with other HuBMAP centers over the coming months to gather estimates.

UF Health HuBMAP team leaders also include Michael Clare-Salzler, M.D., a professor and chair of the UF College of Medicine's department of pathology, immunology and laboratory medicine; Todd Brusko, Ph.D., an associate professor in the UF College of Medicine's department of pathology, immunology and laboratory medicine; Kevin Otto, Ph.D., a professor in the UF College of Engineering's J. Crayton Pruitt Family Department of Biomedical Engineering; and Clive Wasserfall, M.S., a faculty member in the UF College of Medicine's department of pathology, immunology and laboratory medicine. All are members of the UF Diabetes Institute.

FAST AID

Quick action on concussion symptoms helps athletes recover faster, researchers say

By Doug Bennett



In the warrior ethos that permeates sports, athletes sometimes shake off injuries and stay in the game. It's considered a measure of toughness.

It also is the worst step a concussed athlete can take, according to UF Health researchers who have found that immediately getting medical care reduces concussion symptoms and ultimately gets the player back in action sooner.

An analysis of 506 sports-related concussions among college athletes in 18 sports found that those who ceased their activities once they were injured missed about three fewer days of competition than those who delayed reporting their injuries.

Prompt reporting also reduced concussion symptoms by two days and decreased the likelihood of missing more than two weeks of sport participation by 39 percent. The findings were published online in *The American Journal of Sports Medicine*.

While current guidelines call for athletes who suspect they have a concussion to immediately stop playing and get an evaluation, this and other studies have shown that as many as 60 percent of them don't disclose their injury or stop playing right away, for a multitude of reasons.

The findings make clear that athletes who "tough it out" are actually delaying their recoveries, said James R. Clugston, M.D., a UF College of Medicine associate professor and UF Athletic Association team physician.

"We've always had concerns about athletes hiding concussion symptoms. This gives athletes greater incentive to be more frank in letting the sports medicine staff know that there may be something wrong. The sooner you tell us about concussion symptoms, the sooner you get back to your sport," he said.

To establish their findings, Clugston and his collaborators analyzed concussion data from August 2014 to September 2016 among athletes at 25 universities and military service academies involved in the National Collegiate Athletic Association and the Department of Defense's Concussion Assessment, Research and Education, or CARE, Consortium. After controlling for other factors in a statistical model, they

found that lost competition time and the duration of concussion symptoms were directly related to when athletes stopped their activity.

"It's important to recognize and report concussion-related symptoms immediately. The faster you allow a medical team to make a diagnosis, the better your chances for a shorter recovery," said Breton M. Asken, a doctoral student in the UF College of Public Health and Health Professions and lead author of the paper.

The findings also apply to more than just football: Concussion-related data from college athletes in sports such as swimming, softball, tennis and field hockey were part of the study. Clugston said the findings also suggest it is important to have someone available during sport activities to whom athletes can report potential concussion issues.

"Coaches are getting better at recognizing concussion symptoms, but it's not fair to put it all on them. Athletes need someone like a certified athletic trainer to do an evaluation and decide whether or not they should be removed from competition," Asken said.

Younger athletes might also benefit from exiting competition at the first sign of concussions, the researchers said.

While the findings establish the value of stopping physical activity as soon as concussion symptoms appear, researchers don't know exactly how or why that benefit occurs. Studying that in humans is difficult because directly and prospectively studying these mechanisms would essentially require knowingly allowing some athletes to continue competing with concussions, Asken said.

Better, earlier awareness of concussion symptoms allows players to avoid exposing the injured brain to more impacts and exertion during the "window of vulnerability" thought to occur after a concussion, the researchers concluded. It also lets athletes get a jump on their recovery, Asken added. Ideally, an athlete who feels the effect of a force to the head would immediately quit their game or practice, get evaluated and rest for 24 to 48 hours.

"Then, in a very supervised and controlled way, they might be able to go back to physical exertion," Asken said.

PULSEPOINT RESPONSE

Smartphone app empowers citizens to help in case of cardiac emergency

By Tyler Francischine

A UF Health respiratory therapist demonstrates the correct way to administer CPR during the PulsePoint launch event.

Photo by Jesse S. Jones

David R. Nelson, M.D., interim senior vice president for health affairs at UF and president of UF Health, announces the arrival in Alachua County of the smartphone app PulsePoint.



Photo by Jesse S. Jones

University of Florida Health officials and Alachua County and city of Gainesville emergency first responders have joined to launch a smartphone app that alerts citizens to a nearby cardiac emergency and empowers them to help, which officials say could double the survival rate from cardiac arrest in Gainesville and the surrounding area.

PulsePoint Respond is now available throughout Alachua County, thanks to funding from the Jerome H. Modell, M.D., Professorship of Anesthesiology in the UF College of Medicine's department of anesthesiology.

UF physicians Nikolaus Gravenstein, M.D., a professor in the department of anesthesiology, and Torben Becker, M.D., Ph.D., an assistant professor in the department of emergency medicine, collaborated with local officials from the Alachua County Sheriff's Office, Alachua County Fire Rescue and Gainesville Fire Rescue to get the lifesaving app activated through the county's 911 system, part of the Alachua County Combined Communications Center. Other agencies, including the Gainesville Police Department, the University of Florida Police Department and the High Springs Police Department are participating in the initiative, and the app notifications will occur countywide.

More than 3,300 communities in 42 states have implemented the CPR mobile alert program, which was released in 2010 by Bay Area nonprofit PulsePoint Foundation. The free mobile app alerts potential responders — citizens and off-duty medical professionals — who are within a quarter-mile of the person experiencing a cardiac arrest.

The app, which does not alert participants to a cardiac arrest occurring in a private residence, provides directions to the person in need and reminds responders how to deliver hands-only chest compressions. Multiple responders may report to the scene.

Civilian responders are granted immunity from civil liability in accordance with the Florida Statute Good Samaritan Act. The alert occurs simultaneously with the dispatch of local paramedics and firefighters.

Cardiac arrest occurring outside of the hospital is a leading cause of death in the United States, accounting for more than 1,000 deaths each day. Effective bystander CPR, provided immediately after cardiac arrest, can double or triple a person's chance of survival, according to the American Heart Association. PulsePoint Respond was designed to increase cardiac arrest survival rates through improving bystander performance and encouraging active citizenship. To date, more than 153,000 users have been notified of a cardiac arrest through the app.

"Our community is the perfect place to activate the PulsePoint program because we are fortunate to have a large number of citizens with health care training," said David R. Nelson, M.D., interim senior vice president for health affairs at UF and president of UF Health. "If most of us participate, we can double the survival rate from out-of-hospital cardiac arrests, as experienced by other communities with this smartphone app."

Jim Lanier, technical services division manager at the Alachua County Sheriff's Office, said the Combined Communications Center is proud to collaborate with PulsePoint to save lives.

"The PulsePoint app allows the rapid transfer of information received by CCC telecommunicators to alert the PulsePoint network in a sudden cardiac event," he said. "This will provide an enhanced opportunity for our public safety and community members to provide lifesaving CPR as well as be made aware of automatic external defibrillator locations during these emergencies."

Joseph A. Tyndall, M.D., M.P.H., interim dean of the UF College of Medicine and chair of the UF department of emergency medicine, said the survival rate with a good neurological outcome after cardiac arrest in Alachua County is now less than one in 10. PulsePoint, he said, has the potential to significantly improve the odds of survival with good neurological outcomes by getting people care even faster.

"This is a wonderful way to use modern technology to engage ourselves as health care professionals as well as everyone else in the community in making Alachua County an even safer place to live," Tyndall said.

Visit Pulsepoint.org/pulsepoint-respond/ for more information on the app. To download PulsePoint Respond, visit the Google Play Store or Apple App Store.

TOPS IN TRAUMA CARE

UF Health TraumaOne earns Level I verification from the American College of Surgeons

By Dan Leveton and Dee Russell



TraumaOne has been nationally recognized for providing the highest level of lifesaving care.

Photo by Karel Darczie

It's the lifesaving medical care no one wants to think about until they or their loved one needs it. UF Health TraumaOne is the only Level I trauma center in the region and has been providing the most critically injured patients in Northeast Florida and Southeast Georgia with the highest level of coordinated, specialized care to save lives.

TraumaOne is now nationally recognized for those resources and received Level I verification from the American College of Surgeons, or ACS — an honor only given to trauma centers that meet the most stringent criteria.

"Our level of commitment and expertise is something we have focused on since we opened the first trauma center in the state 35 years ago," said Leon L. Haley Jr., M.D., CEO of UF Health Jacksonville and dean of the University of Florida College of Medicine – Jacksonville. "It shows that we have the best people and resources available to save as many lives as possible. I could not be prouder of this organization."

The ACS Verification, Review and Consultation Program helps hospitals evaluate and improve trauma care. It provides an objective, external review of a trauma center's resources and performance. A team of trauma experts completes an on-site review of the hospital and assesses relevant features of the program. The ACS verification was given to UF Health Jacksonville after a two-day visit in June and is valid for three years.

"We went through this detailed, rigorous process because we believe it will continue to help us grow as a health care leader in this region," said Julia P. Paul, M.S.N., UF Health Jacksonville's trauma program manager, who spearheaded

the effort for verification. "Our team put the same passion into this project as they do every day in our trauma center, and this exclusive national organization recognized that."

Trauma centers in the United States are identified through two processes, designation and verification. Designation is a process outlined and developed at a state or local level, which in Florida is handled through the Department of Health. UF Health Jacksonville houses one of only 10 Level I trauma centers in the state.

The verification process is voluntary and confirms that a hospital has demonstrated its ability to provide all necessary resources for trauma care for all injured patients, 24 hours a day, seven days a week, meeting the national guidelines established by the ACS. Level I status verifies that in addition to providing all of the necessary services, the hospital also has a training program and actively conducts research on trauma.

"The equation is quite simple," said Andrew Kerwin, M.D., chief of acute care surgery at UF Health Jacksonville. "Trauma centers help save lives, verified centers are at the top of the list, and now UF Health Jacksonville has proven itself again to be among the best."

UF Health Jacksonville's trauma services were thoroughly evaluated using ACS guidelines, where more than 200 standards related to trauma resources, care processes and continuous performance improvement were met. UF Health Jacksonville is the ninth verified trauma center in Florida and joins approximately 500 verified trauma centers nationwide. The closest Level I-verified centers are in Tampa and Miami in Florida and Macon and Atlanta in Georgia.

"There is no question about it, we are equipped and ready for any kind of trauma or emergency that enters our doors," Kerwin said. "This verification confirms we have the resources and experience when you need us most."

"There is no question about it; we are equipped and ready for any kind of trauma or emergency that enters our doors."

– Andrew Kerwin, M.D.



LAB NOTES

1) Novel drug inspired by a marine natural product may help treat pancreatic cancer

A novel drug candidate based on a marine natural product discovered 20 years ago could be the basis for a new approach to treating pancreatic cancer. UF College of Pharmacy researchers have developed a novel molecule based on marine cyanobacteria, Apra S10, to target pancreatic cancer cells. In laboratory testing, Apra S10 inhibited the growth of pancreatic cancer cells derived from patients and maintained high concentrations in the pancreas compared with other organs. Apra S10 originates from a family of molecules known as apratoxins, found in select areas of the Pacific Ocean near Micronesia. — *Matt Splett*

2) UF researchers find genetic 'switch' that can impact asthma, parasitic treatments

UF Health researchers have discovered that a novel molecular switch can activate certain target genes in mice and block expression of others. Mice that lacked a particular gene transcription factor known as Bcl11b had less-severe asthma but also a diminished ability to clear parasitic infections, the researchers found. That genetic deficiency influences how certain immune cells evolve, which ultimately affects the severity of asthma and parasitic infections. While the missing genetic factor diminishes the response to parasitic infections, it can be manipulated to boost that response. — *Doug Bennett*

3) Long-term use of proton pump inhibitors raises risks for cystic fibrosis patients

Long-term use of a class of drugs that suppress stomach acid is linked to a higher risk of hospitalization for cystic fibrosis patients, who are widely prescribed the medications, a study by UF Health researchers has found. The study looked at acid-suppressive drugs called proton pump inhibitors, which are used to treat reflux, heartburn, ulcers and other conditions. A review of the medical history of 114 patients found those using the PPIs long term were more often hospitalized for complications of the disease than those patients not on the drugs. — *Bill Levesque*

COLLEGE OF DENTISTRY



Seunghee Cha

Seunghee Cha, D.D.S., Ph.D., a professor in the oral & maxillofacial diagnostic sciences, was one of 33 faculty named a University of Florida Research Foundation Professor for 2018-2021. Cha was also named the director of the Center for Orphaned Autoimmune Disorders, or COAD. Established in 1992, COAD is a multidisciplinary center that provides patient care and clinical research protocols for oral manifestations of autoimmune diseases.



Marcelle Nascimento

Marcelle Nascimento, D.D.S., Ph.D., M.S., an associate professor in restorative dental sciences, has been elected to the board of directors of the American Academy of Cariology, or AAC, as chair of the Caries Research Pillar. Nascimento was also an invited speaker for the AAC Second Annual Conference in Denver.



Shahd Nawari

Shahd Nawari, a predoctoral student, was one of only 38 dental students in the United States to receive a \$5,000 scholarship from the Dental Trade Alliance Foundation. Nawari graduates in May 2019 and eventually plans to specialize in endodontics.

COLLEGE OF MEDICINE



Shawn Larson

Shawn Larson, M.D., an assistant professor of pediatric surgery, has been named to the editorial board of the journal SHOCK, which focuses on scholarly research reports on basic and clinical studies of shock, trauma, sepsis, inflammation, ischemia and related pathobiological states. Among his duties, Larson will review manuscripts and submit his own articles for publication.

COLLEGE OF PUBLIC HEALTH AND HEALTH PROFESSIONS



Sherrilene Classen

Sherrilene Classen, Ph.D., M.P.H., OTR/L, FAOTA, FGSA, a professor and chair of the department of occupational therapy, received the Scholar Award from the Association for Driver Rehabilitation Specialists at the association's annual conference held in August in Richmond, Virginia. The award recognizes outstanding scholarly achievement in driver evaluation, education, research and/or engineering.

COLLEGE OF NURSING



Gee Su Yang

Gee Su Yang, Ph.D, R.N., a postdoctoral associate, has been awarded the college's first National Institutes of Health F32 Ruth L. Kirschstein Postdoctoral Individual National Research Service Award. The three-year \$180,778 fellowship will allow Yang to further her clinical research knowledge and skills in symptoms science, specifically focused on aromatase inhibitor-associated musculoskeletal symptoms in breast cancer survivors.

UF COLLEGE OF NURSING RESEARCHERS AWARDED NIH GRANTS TOTALING MORE THAN \$5 MILLION

Three UF College of Nursing leaders have been awarded grants from the National Institute of Nursing Research that total more than \$5 million. Leslie Parker, Ph.D., ARNP (NNP-BC), received a four-year, \$2.4 million grant for a project that will seek to determine the optimal time feeding tubes should be left in premature infants to prevent contamination and other complications.

Debra Lyon, Ph.D., R.N., FAAN, the executive associate dean, and Joyce Stechmiller, Ph.D., ARNP, FAAN, the undergraduate program director, received a five-year, \$2.7 million grant to identify the biobehavioral mechanisms responsible for symptoms and healing outcomes for older adults with venous leg ulcers, and for the development of targeted therapies that address patient-oriented outcomes and healing outcomes. — *Kelly Sobers*



Leslie Parker



Debra Lyon



Joyce Stechmiller

COLLEGE OF PHARMACY



Josh Brown

Josh Brown, Pharm.D., Ph.D., an assistant professor of pharmaceutical outcomes and policy, has been selected by the National Institutes of Health's Division of Loan Repayment for a loan repayment award and has been named an NIH Loan Repayment Ambassador. As a loan repayment awardee, Brown will receive financial support paying off his student debt in return for a commitment to engage in NIH mission-relevant research. Congress established the program to address the escalating costs of advanced education and training in medicine and clinical specialties, which is forcing some scientists to abandon their research careers for higher-paying private industry or private practice careers.



Almut Winterstein

Almut Winterstein, Ph.D., a professor and the Dr. Robert and Barbara Crisafi Chair of Pharmaceutical Outcomes and Policy, has been named president-elect of the International Society for Pharmacoepidemiology, or ISPE. She was installed on Aug. 25, at the ISPE Annual Conference in Prague, Czech Republic. As president-elect, Winterstein will serve on the executive board and chair the strategic planning committee. She will take over as president of the organization in August 2019.

SEE YA!



Photo by Jesse S. Jones

UF Health pediatric heart transplant candidate Antonio Smith enjoyed a special moment with UF Health ShandsCair flight team members in front of UF Health Shands Hospital. The UF Health Congenital Heart Center team made this wish come true for Antonio knowing his love for fire engines and ambulances, and the first responders who save lives every day.



Photo by Jesse S. Jones

Nicole Iovine, M.D., Ph.D., a UF Health infectious disease expert, practices what she preaches about preventing the flu virus from spreading by getting her flu shot in the UF Health Shands Hospital Atrium.



Photo by Jesse S. Jones

UF College of Nursing students enjoy a laugh during their Pinning Ceremony, a milestone moment in their professional career.

THE POST 11 • 2018

Published by
UF Health Communications

Interim Senior Vice President for Health Affairs at UF and president of UF Health

David R. Nelson, M.D.

Chief Communications Officer, UF Health

Melanie Fridl Ross, M.S.J., E.L.S.

Editor
Greg Hamilton
gregoryhamilton@ufl.edu

Graphic Designer
Selena Carter

Photo Editor
Jesse S. Jones

Photographer
Mindy Miller

Staff Writers

Doug Bennett, Sarah Carey, Tyler Francischine, Michelle Koidin Jaffee, Bill Levesque, Dan Leveton, Michelle Moore, Dee Russell, Matt Splett, Todd Taylor

Contributing Writers

Kacey Finch

Support Staff

Cassandra Mack, Beth Powers, Kim Smith

The POST is the monthly newsletter for UF Health, the most comprehensive academic health center in the Southeast, with campuses in Gainesville and Jacksonville and affiliations throughout Florida. Articles feature news about research, patient care and education at UF Health. Content may be reprinted with appropriate credit. Ideas for stories are welcome. The deadline for submitting items to be considered for each month's issue is the 1st of the previous month. Submit to the editor at gregoryhamilton@ufl.edu or deliver to UF Health Communications in the Communicore Building, Room C2-018.

