

# Restore

## Innovations in Stroke Care and Rehabilitation

From the moment a stroke occurs, neuroplasticity is heightened, readying the brain for repair. However, says new Johns Hopkins Department of Physical Medicine and Rehabilitation faculty member **Preeti Raghavan**, traditional stroke care often doesn't capitalize on this critical period.

"At most institutions, stroke care is extremely siloed. Neurologists care for patients in the immediate aftermath of stroke, and physiatrists and therapists come in later for rehabilitation," she says. "It's a wasted opportunity to significantly improve patient outcomes."

Acting on this opportunity is an important goal within Johns Hopkins' new Sheikh Khalifa Stroke Institute, says Raghavan, who is the institute's director for recovery and rehabilitation.

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"THE INSTITUTE FOLLOWS PATIENTS THROUGH THE CONTINUUM, FROM INPATIENT REHAB, TO OUTPATIENT REHAB, THEN CARING FOR THEMSELVES AT HOME AND REINTEGRATING INTO THE COMMUNITY."

-APRIL PRUSKI

Established by a \$50 million gift from the United Arab Emirates (UAE) in early 2018, the institute was named in honor of UAE President Sheikh Khalifa bin Zayed Al Nahyan, who suffered a stroke in 2014. It will include a state-of-the-art facility in Baltimore and will partner with others in Abu Dhabi to build a stroke care organization.

The care delivered at the institute is markedly different from that conventionally delivered to stroke patients, explains Johns Hopkins physiatrist **April Pruski**, who serves patients at The Johns Hopkins Hospital's brain rescue unit. One major distinction is the strong collaboration between neurologists and rehabilitation specialists as soon as patients are admitted, a model that's unique globally.

Patients start rehabilitation in the brain rescue unit within a day of their stroke, Pruski says, instead of waiting until later in their hospital stay to be evaluated for future rehabilitation often delivered elsewhere. The therapy they receive is comprehensive and intensive, with up to six sessions a day including physical, occupational and speech therapy.

The information exchange between neurologists and physiatrists, through rounding together and daily meetings, can change the course of care. For example, Pruski says, she'll often make suggestions that aren't typically part of the neurology toolbox but that could optimize rehabilitation efforts, such as brain breaks to help patients tolerate therapy better, early neurostimulant prescriptions for patients with cognitive and attention problems, and toileting schedules for those with bowel and bladder issues.

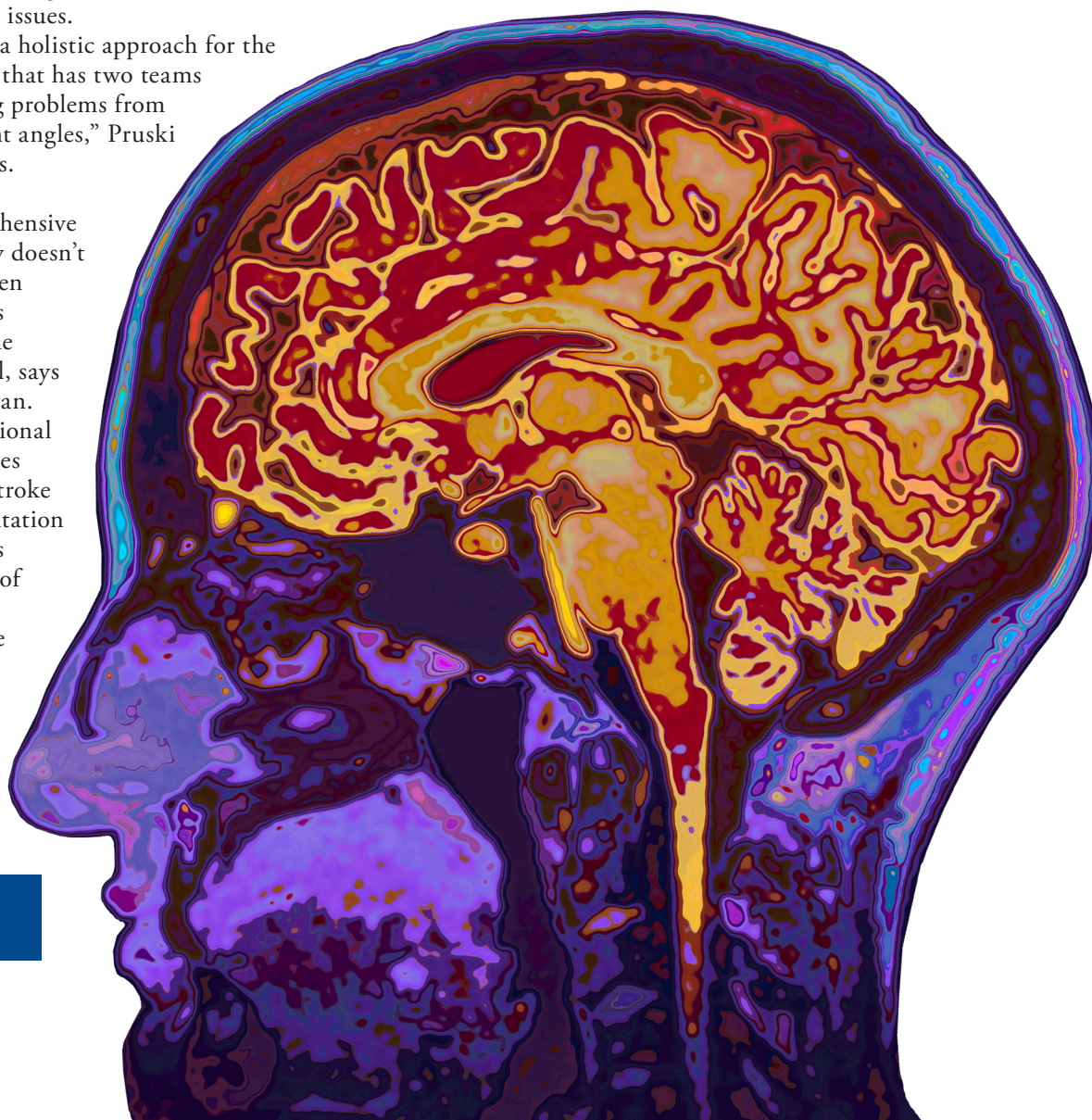
"It's a holistic approach for the patient that has two teams viewing problems from different angles," Pruski explains.

This comprehensive strategy doesn't end when patients leave the hospital, says Raghavan. "Traditional care loses many stroke rehabilitation patients to lack of follow-up," she

explains. "But the institute follows patients through the continuum, from inpatient rehab, to outpatient rehab, then caring for themselves at home and reintegrating into the community."

Another goal of the center is improving care through research and education, Raghavan adds. Through collaborations between the institute's two centers, providers are collecting a wealth of information about patients to determine how interventions affect outcome measures. They're also working together to establish best practices that providers in both locations can learn.

"We're working to get patients back to activities they love, whether it's work, an exercise regimen or holding their grandchildren," Pruski says. "We're helping them become as functional as possible and lead their most meaningful lives." ■



 Learn more about the institute at [bit.ly/hopkinsstrokerehab](https://bit.ly/hopkinsstrokerehab).



Pablo Celnik  
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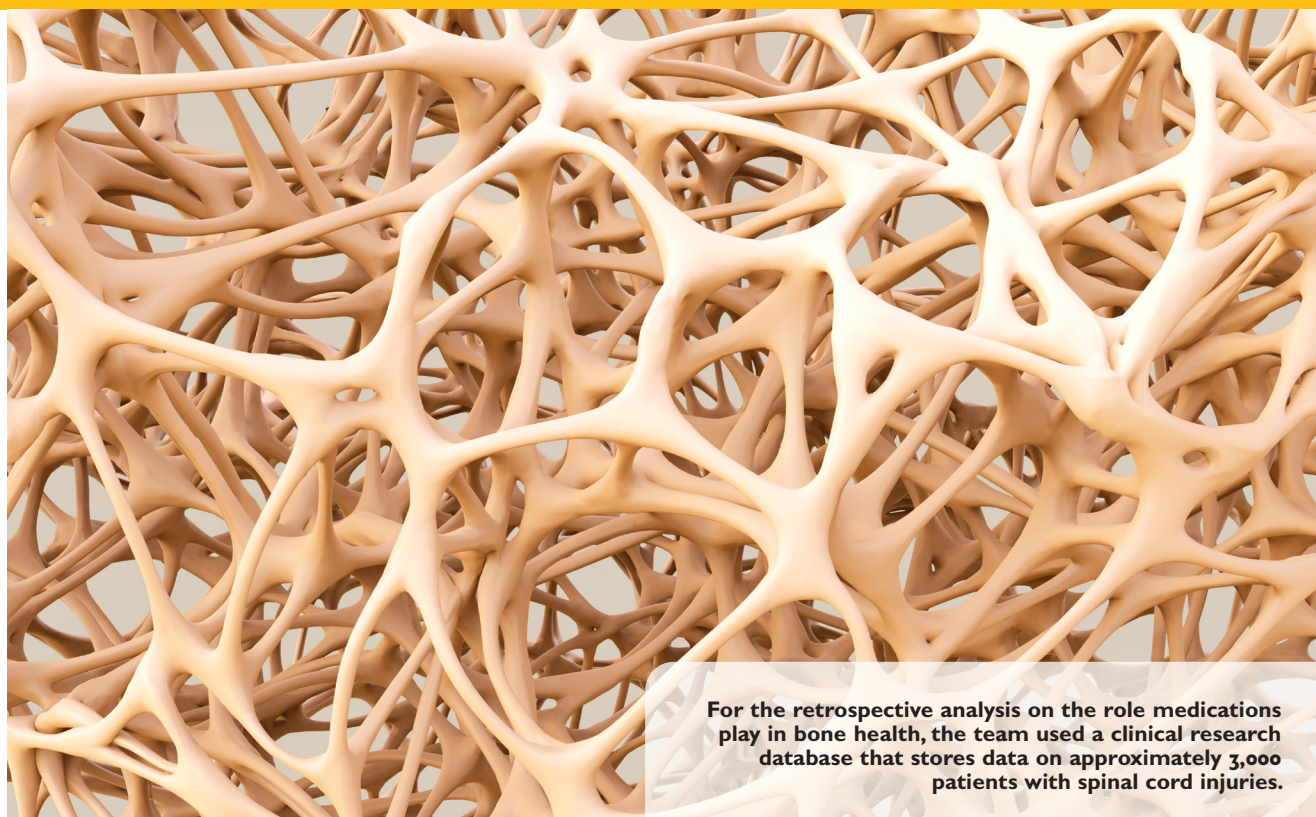
For innovation to take place within the field of physical medicine and rehabilitation, physiatrists must become intimately connected with experts inside and outside the field. For me, working with experts in other fields is exciting and beneficial because it cultivates new ideas and approaches to help patients.

A recent success for the Johns Hopkins Department of Physical Medicine and Rehabilitation came from collaborating with the Johns Hopkins Department of Neurology and Neurosurgery at the Sheikh Khalifa Stroke Institute. This institute provides a model of care for stroke patients in which rehabilitation specialists team up with neurologists as soon as a patient is admitted to the hospital for a stroke. Within a day of having the stroke, patients start rehabilitation and receive up to six therapy sessions per day.

Another example of successful teamwork is on the research side: A current study is examining new technology that enables people to control prosthetic limbs with their thoughts. In collaboration with neurosurgeons, neurologists and engineers, we implant electrodes on both sides of the brain to give people with quadriplegia some “mind control” of motorized prosthetic arms. There were several poster presentations on this work at the Society for Neuroscience conference in October 2019.

Whether they are research or clinical practices, these innovations wouldn't be possible without collaboration among experts from many specialties. We all share the same common goal of helping people get better, so why not do it together?

As always, please let us know if we can help: **443-997-5476**.



For the retrospective analysis on the role medications play in bone health, the team used a clinical research database that stores data on approximately 3,000 patients with spinal cord injuries.

## Anticonvulsants Correlate to Low Bone Mass in Patients with Spinal Cord Injury

“People with spinal cord injury are living longer and longer, and low bone mass is a well-recognized complication in this group,” says **Christina Kokorelis**, a Johns Hopkins physiatrist. In a recent study published in *Spinal Cord Series and Cases: Clinical Management in Spinal Cord Disorders*, Kokorelis and her colleagues examined the role medications play in bone health for patients with spinal cord injuries. Results showed that patients taking anticonvulsants commonly had low bone mass.

For the retrospective analysis, the team used a clinical research database that stores demographic, injury, therapy and clinical outcome measurements on approximately 3,000 patients with spinal cord injuries. Clinicians at the International Center for Spinal Cord Injury (ICSCI), a program shared by the Johns Hopkins Department of Physical Medicine and Rehabilitation and the Kennedy Krieger Institute, have been recording patient data since 2005.

“We were ahead of our time 15 years ago with the database,” says **Cristina Sadowsky**, clinical director of the center and one of the authors on the study. “Now we are beginning to see the fruits of our efforts.”

The team first searched the database for male patients who were 21 and older, with traumatic complete or incomplete spinal cord injury, and who were evaluated at the center between June 2005 and June 2015. Of the 279 men who fit the criteria, 76% had low bone mass.

“BONE LOSS IS A COMPLEX PROCESS THAT CAN INCLUDE NEUROLOGICAL CHANGES INDUCED BY PARALYSIS, LIMITED PHYSICAL ACTIVITY AND MEDICATIONS.”

—CRISTINA SADOWSKY

When compared with the 24% of patients with normal bone mass, the researchers found no association to the factors typically known to predispose people to low bone mass, such as age, race and history of previous fractures.

However, two significant risk factors for low bone mass did emerge: having paralysis for more than a year and having tetraplegia. The team also found anticonvulsants and bisphosphonates were more commonly used by individuals with low bone mass.

“It can be surprising because we don't tend to think young males have bone loss, but they do,” says Sadowsky. “Bone loss is a complex process that can include neurological changes induced by paralysis, limited physical activity and medications.”

The correlation between anticonvulsive medications and low bone mass is important, say Kokorelis and Sadowsky; similar research in 2013 found anticonvulsants in SCI patients to be associated with an increased risk of fractures.

Kokorelis suggests clinicians consider the results of the analysis when choosing medications for patients with SCI, who are expected to live between eight and 53 years after the onset of paralysis. “We can't control the time since their injury or whether they have tetraplegia, but medication is something that providers can control,” she says.

Since 2007, the clinical research database at ICSCI has been used for three published studies and numerous poster presentations. A current project is looking at the neurologic and functional outcomes of children with acute flaccid myelitis over time. ■



Learn more about Cristina Sadowsky's research at [bit.ly/hopkinscw](https://bit.ly/hopkinscw).

# Harnessing the Power of Data and Precision Medicine for Rehabilitation



Over the past several decades, increasingly sophisticated technology and analytical tools have helped doctors make ever more precise diagnoses, allowing them to tailor care in ways never before possible. However, explains **Pablo Celnik**, director of Johns Hopkins' Department of Physical Medicine and Rehabilitation, his field still largely relies on low-information content measures to guide decision-making, such as patient questionnaires or basic functional tests.

"This lack of data stymies the ability to deliver care proactively," Celnik says, "when it has the highest chance for positive outcomes."

That's why he and colleagues launched the Johns Hopkins Precision Rehabilitation Center of Excellence, an effort devoted to developing new interventions tailored to patients' specific needs across the continuum of care based on their functional status — many that use technology in new ways that could revolutionize the field. Celnik co-directs the center

with rehabilitation psychologist **Stephen Wegener** and materials scientist and engineer **Peter Searson**.

The new center has pulled together a multidisciplinary team that has started developing new diagnostic tools and interventions.

One of these efforts, developed by Searson and his colleagues, is currently being tested in the progressive cardiac care unit at Johns Hopkins. Previous research has shown that the more patients walk during their recovery from cardiology procedures, the less likely

**"FIGURING OUT WHICH PATIENTS MIGHT NEED HELP EARLIER COULD HELP US INTERVENE PROACTIVELY WHEN IT'S MORE EFFECTIVE, BEFORE MORE DRASTIC INTERVENTIONS ARE NECESSARY."**

**-PETER SEARSON**

**At Johns Hopkins, new Precision Rehabilitation Center of Excellence will develop personalized diagnostics and interventions.**

they are to be readmitted after discharge. However, explains Searson, measures of ambulation have traditionally conveyed little information, consisting mainly of chart recordings from nurses on whether patients walked on a particular day or not.

By using a remote tracking location system, Searson says, he and his team are recording thousands of data points per day, learning more about how far and how fast patients walk, how often and when these walks take place. By analyzing this data, the researchers can come up with better predictors that could help the care team intervene earlier to get patients moving, potentially lowering readmission rates.

Similarly, the team is testing wearable sensors that could detect health problems between follow-up appointments for chronic conditions such as chronic

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# Aquatic Therapy for Patients with Neurologic Paralysis and Invasive Devices May Improve Outcomes

**A**lbert Recio recognizes the difficulty of using aquatic therapy as an intervention for patients with neurologic paralysis. But that doesn't stop him. In fact, he and his colleagues perform aquatic therapy with patients who have neurologic paralysis and invasive devices such as colostomy bags, tracheostomy tubes, pressure ulcer dressings and indwelling or suprapubic catheters. His retrospective analysis on such patients, recently published in the *American Journal of Physical Medicine & Rehabilitation*, shows they can safely participate in aquatic therapy without complications, and they seem to achieve clinically significant benefits.

"We're very excited about the results," says Recio, an assistant professor of physical medicine and rehabilitation at Johns Hopkins and medical director of aquatic therapy at the Kennedy Krieger Institute. "These are the hardest patients to place in the pool,

but there were no major issues."

With more and more pools being placed in rehabilitation facilities, Recio says there is potential for more patients — regardless of any invasive devices they might need — to benefit from aquatic therapy. "We have the facilities, but we need to do what is needed to accommodate special populations," he says. "Looking back at our experience, we're hoping to eliminate barriers to participation in aquatic therapy for patients with a complicated medical condition."

Analysis by Recio and colleagues included a retrospective chart review in which they identified patients with chronic spinal cord injury (SCI) who use invasive appliances and who had skilled aquatic therapy between 2009 and 2017.

Of the patients who met the criteria, all were age 18 or older and were attending the outpatient clinic at Kennedy Krieger's International Center for Spinal Cord Injury, a program run by faculty members of the Department of Physical Medicine and Rehabilitation at the Johns Hopkins School of Medicine. Most patients had pressure ulcer dressings and suprapubic catheters; some had indwelling catheters, colostomy or tracheostomy tubes.

Clinicians used two warm pools with options for elevating floors, underwater treadmills, horizontally and vertically placed jets and removable parallel

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PHOTO COURTESY OF KENNEDY KRIEGER INSTITUTE



Two pools provide a range of warm-water temperatures, built-in treadmills, video systems for monitoring, jets for resistance and floors that operate on lifts.

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obstructive pulmonary disease, potentially preventing emergency department visits.

“Figuring out which patients might need help earlier could help us intervene proactively when it’s more effective, before more drastic interventions are necessary,” Searson says.

The center is also working on using data more effectively, Wegener says. For example, he and his team have been involved in testing a nine-item questionnaire known as StartBack to identify patients with acute back pain who may be at risk for chronic pain. When patients complete this survey in the waiting room on a tablet, their answers are transferred into their electronic medical record in real time so their physicians can immediately assess their risk and implement interventions.

“By collecting better data,” says Wegener, “rehabilitation can harness the power of precision medicine to improve outcomes and reduce cost.” ■

## Aquatic Therapy for Patients with Neurologic Paralysis and Invasive Devices May Improve Outcomes

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bars. They prepared the patients for aquatic therapy in numerous ways, such as using gauze to cover all wounds, peripheral lines and deaccessed ports.

Recio found the entire cohort experienced improved overall mobility and self-care scores. Almost all patients demonstrated significant improvement in motor scores, and some walked longer distances. Importantly, however, aquatic therapy alone may not be responsible for the benefits — other interventions performed in the clinic may have contributed to the results.

Recio says the No. 1 barrier to incorporating aquatic therapy into treatment for people with SCI and invasive devices is a perceived safety risk. “Out of an abundance of caution, nobody wants to put these patients in the water,” he says. “But I think that is a disservice.” ■



Learn more about the study at [bit.ly/sciaqua](https://bit.ly/sciaqua).

To learn more about the Johns Hopkins Department of Physical Medicine and Rehabilitation, visit [hopkinsmedicine.org/pmr](https://hopkinsmedicine.org/pmr).

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A newsletter from Johns Hopkins  
Physical Medicine and Rehabilitation

**Johns Hopkins Medicine**  
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This newsletter is one of the many ways we seek to enhance our partnership with our referring physicians. Comments, questions and thoughts on topics you would like to see covered in upcoming issues are always welcome.

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