



UNIVERSITY OF CINCINNATI NEUROSCIENCE INSTITUTE

Comprehensive Stroke Center

FY 2015 ANNUAL REPORT

WELCOME

The Comprehensive Stroke Center at the University of Cincinnati Neuroscience Institute, a collaboration of the UC College of Medicine and UC Health, plays a leading role in the treatment and research of stroke. The impact is felt locally by the patients we treat directly; it is felt regionally by the patients we treat via telemedicine; and it is recognized nationally through our role as America's coordinating center for stroke research and internationally as one of the foremost stroke research centers in the world.

Our specialists are routinely named to the regional and national lists of best doctors. We played a leading role in the development and testing of the clot-busting drug tissue plasminogen activator, or tPA, the first FDA-approved treatment for stroke caused by a blood clot, and we played a role in recent landmark research that demonstrated the effectiveness of endovascular treatment following tPA in people who suffer large-vessel strokes. We have led national treatment studies of intracerebral hemorrhage and genetic studies of intracerebral hemorrhage and aneurysms. We are co-leaders of the surgical portion of MISTIE, an international treatment study of patients who have suffered intracerebral hemorrhage. And today we are leading the largest ongoing biracial population-based study of stroke in America.

In our accelerating effort to help patients who survive stroke but suffer disability afterward, our researchers have found that high-intensity interval training is a promising rehabilitation strategy and that brain stimulation may help patients improve function of their hands and arms.

The UC Medical Center was certified by the Joint Commission in 2013 as an Advanced Comprehensive Stroke Center. We were the 47th institution nationally and the fourth in Ohio to receive this designation since its launch in 2012 in partnership with the American Heart Association/American Stroke Association and with the guidance of the Brain Attack Coalition. There is no higher stroke certification.

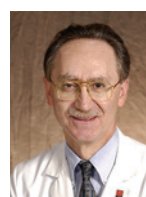
In 2015 we received our second straight Get With The Guidelines–Stroke Gold-Plus Quality Achievement Award for implementing specific quality improvement measures outlined by the American Heart Association/American Stroke Association for the treatment of stroke patients.

Our accomplishments during the 2014-2015 fiscal year reflect the hard work of our clinicians, scientists and associates; they reflect the courage of our patients, who make discovery possible through their participation in research; and they reflect the commitment and support of our generous donors and volunteers. We thank everyone who made the past year a success, and we invite you to learn more in the pages that follow.



Dawn Kleindorfer, MD

Professor of Neurology
 Director, Division of Vascular Neurology
 Co-Director, Comprehensive Stroke Center



Mario Zuccarello, MD

Chair, Department of Neurosurgery
 Frank Mayfield Chair for Neurological Surgery
 Co-Director, Comprehensive Stroke Center

Meeting the Gold Standard for Clinical Care

The UC Comprehensive Stroke Center is one of the nation's premier tertiary centers for the treatment of stroke, the fourth leading cause of death in the United States and a leading cause of long-term disability. The UC Comprehensive Stroke Center cares for more stroke patients than any other institution in the region, and it cares for those with the most complex disease scenarios.

Certified by the Joint Commission as an Advanced Comprehensive Stroke Center, the UC Stroke Center provides comprehensive treatment for cerebrovascular conditions that include transient ischemic attack (TIA), ischemic stroke, brain aneurysms, arteriovenous malformations and moyamoya disease. Treatment is provided by the multidisciplinary UC Stroke Team, which includes neurologists, emergency physicians, interventional neuroradiologists, neurosurgeons, nurses and critical care specialists.

Treatments are performed both on an emergency and elective basis, depending on whether a stroke has occurred, or whether the patient has been found to be at risk of suffering a stroke. The Stroke Team is renowned in its ability to provide expert treatment of acute ischemic stroke (one caused by a blockage) within the 4½-hour window when treatment is effective. The team can perform diagnostic tests, make a diagnosis and administer treatment within an hour a patient's arrival at the UC Medical Center.

The UC Comprehensive Stroke Center also excels in surgical and endovascular treatments of ischemic



Andrew Ringer, MD, Professor of Neurosurgery, in the angiography suite.

and bleeding stroke, which can be used to open stubbornly clogged arteries, remove persistent clots or shut down bleeding aneurysms. During endovascular procedures, catheters are threaded up from the groin to the blockage. Once at the site of the problem, a specialist can open the blockage with a stent or use a device to suction out the clot. Radiosurgery is a noninvasive treatment option for some vascular malformations. In these cases, specialists aim precise beams of radiation at the malformation, damaging DNA within the cells and negating their ability to reproduce. Over time, the malformation shrinks and disappears.

Stroke Center clinicians not only provide superior care to patients at the UC Medical Center, they also extend their mission outward. In FY 2015 the UC Stroke Team provided immediate consultation for 3,180 acute stroke

patients from 31 different regional hospitals and emergency diagnostic centers in Ohio, Kentucky and Indiana. Of those consults, 104 were performed via the UC Health Telestroke Network, which is extending the UC Stroke Team's excellence to underserved and rural areas.

For people who have survived a stroke but continue to have difficulty thinking or remembering, the UC Stroke Team is now making strides in the field of long-term recovery, rehabilitation and renewal. Each year dozens of stroke survivors are benefiting from sustained and intensive rehabilitation efforts through the Stroke Team Assessment and Recovery Treatment (START) Program at UC Health's Daniel Drake Center for Post-Acute Care. The new realm of long-term recovery, researchers believe, is the next great frontier in stroke.

UC Health Telestroke Network



In a demonstration of the UC Health telestroke network, neurocritical care specialist Opeolu Adeoye, MD, consults with a neurologist who examines the patient from a remote location.

UC Health's mission to bring world-class stroke care to hospitals beyond the 275 beltway and to underserved areas of Ohio's surrounding states is being realized with the UC Health Telestroke Network, which marked its 3-year anniversary in April 2015.

"Telestroke adds a dimension that allows us to improve upon the care we have been delivering and to provide expert care to more people," says Pamela Kimmel, RN, BSN, Director of Telehealth for UC Health. "This model has allowed us to extend our stroke services to rural communities in the Greater Cincinnati region."

The Telestroke Network, which includes eight outlying hospitals, enables physicians from the UC Stroke Team to "examine" stroke patients long-distance with the help of video conferencing via telehealth devices. During FY 2015 the Stroke Team provided 104 total consults via robot, 53 of them for patients who were suffering from acute stroke and who received thrombolytic therapy. During FY 2016 the UC Stroke Team will begin to expand telestroke services to hospitals located within 275 beltway.

Time is precious when a stroke occurs, as brain cells lacking oxygen begin to die. People who have suffered an ischemic stroke – one caused by a blood clot – can reduce or eliminate their risk of death and disability through early treatment and the administration of the tPA within 3 to 4 ½ hours of the onset of the stroke's first symptoms.

The telestroke devices play a critical role in expediting evaluation and treatment of patients in hospitals in rural or outlying areas. The telehealth equipment enables audio-video communications in real time between a patient and clinician at a distant site and a UC Stroke Team member (with laptop) wherever he or she is at the time. The Stroke Team physician can interview the patient and observe while the patient performs simple tasks, such as touching his or her nose or repeating words or phrases.

The physician also will be able to confirm or rule out facial droop and will even be able to see the size of the patient's pupils. Ultimately, this co-evaluation by the community hospital's emergency department and the Stroke Team specialists determines whether the patient should receive care at the outlying hospital or should be transferred to the UC Comprehensive Stroke Center for tertiary treatment.

Telestroke can also help determine when less is best. Because the drug tPA carries a small risk of bleeding in the brain, a patient who avoids unnecessary administration of tPA avoids that risk.

* Adams County Medical Center, Winchester, Ohio; Clinton Memorial Hospital, Wilmington, Ohio; Dearborn County Hospital, Lawrenceburg, Indiana; Fort Hamilton Hospital, Hamilton, Ohio; West Chester Hospital, West Chester, Ohio; McCullough Hyde, Margaret Mary Community Hospital, Batesville, Indiana; St. Elizabeth Grant County Hospital, Williamstown, Kentucky.

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— Pamela Kimmel, RN, BSN,
Director of Telehealth for UC Health

Sharing our knowledge, on campus and beyond

The Comprehensive Stroke Center is a research powerhouse whose history as a global leader is founded in its trailblazing study of tPA for the treatment of acute ischemic stroke in the 1980s. Since then we have implemented new interventional treatments for acute ischemic and hemorrhagic stroke; have illuminated the underlying genetic, behavioral and cultural risk factors for stroke; and have been awarded millions of dollars in research grants each year from the National Institutes of Health (NIH). In 2013 we cemented our role as a leader in federally funded research when we were named the national coordinating center for StrokeNET, a network of 25 regional stroke centers across the United States.

Over the last several years we have played a key role in the emerging era of the stent retriever, advanced technologies that enable interventional specialists to retrieve life-threatening blood clots from large blood vessels. We led the Interventional Management of Stroke (IMS) III trial, which involved 58 centers from around the world and found, in 2013, that the use of devices or medication within the arteries to treat stroke-causing blood clots at the site of blockage failed to improve stroke outcomes compared with the current standard treatment of intravenous (IV) clot-busting medication alone.

More recently, Pooja Khatri, MD, MSc, Director of the Acute Stroke Program for the UC Stroke Team, served as international neurology principal investigator of the THERAPY study, which suggested that a new generation of clot-retrieval devices was indeed more helpful to patients than treatment with rtPA (recombinant tPA) alone. The results of this study and others have ushered in a new age in acute stroke care for patients who suffer large-vessel strokes.

These findings were welcomed by our center's talented surgical/interventional team, which uses the most advanced procedures and technologies to treat stroke and complex vascular conditions. These specialists – leaders in the multi-institutional Endovascular Neurosurgery Research Group – test the potential for complex surgery, endovascular procedures and new medical devices to maintain blood flow for patients whose lives are compromised by the threat of recurrent stroke.



Pooja Khatri, MD, MSc, Director of the Acute Stroke Program, has led several international, multi-center clinical trials.

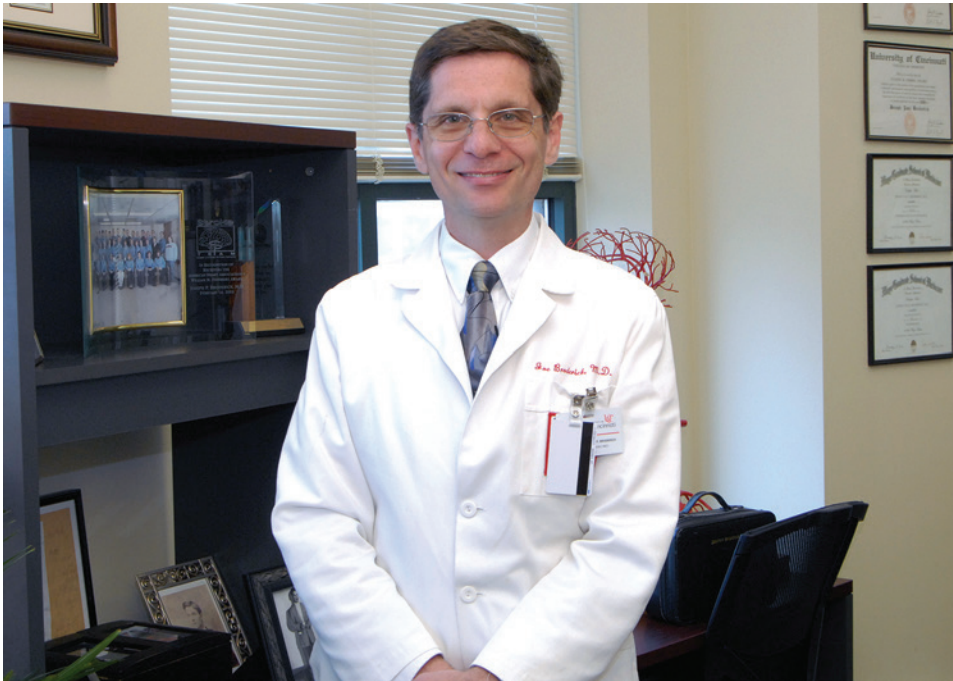
Meanwhile, Mario Zuccarello, MD, Co-Medical Director of the Comprehensive Stroke Center, has served as one of two principal investigators in the international MISTIE trial for patients who have suffered an intracerebral hemorrhage. The study is evaluating the effectiveness and safety of surgical aspiration of a clot plus rt-PA for three days compared to conventional medical treatment. Researchers also seek to learn whether greater surgical reduction of the clot and hemorrhage is related to improved functional outcome.

During the 2014 calendar year we received \$9.4 million

"It is exciting to be able to offer our patients who suffer acute strokes a new therapy that can dramatically improve their outcomes. This is the biggest development in the last 20 years in the field of stroke care."

— Pooja Khatri, MD, MSc, Director of the Acute Stroke Program, UC Stroke Team

in NIH grants for the study of brain aneurysms, genetics, acute stroke, intracerebral hemorrhage, neuro-imaging and neuro-recovery. Daniel Woo, MD, MS, stroke researcher and Associate Director of Clinical Research for the UC Neuroscience Institute, ranked 9th nationally among



Joseph Broderick, MD, Director of the UC Neuroscience Institute, led the UC Comprehensive Stroke Center to national prominence in stroke research and care.

principal investigators in NIH research awards in 2014 with \$6 million in funding. Our output was equally impressive: during the 2014-2015 academic year, our faculty authored or co-authored 76 peer-reviewed journal articles.

One of our most important findings during the last 15 years is that stroke is rising in people under 45. Fifteen years ago, four percent of all stroke patients were under 45. Today, seven percent of all stroke patients are under 45. The most likely culprit is the epidemic of obesity and diabetes, which is causing people to develop risk factors in young adulthood and even childhood rather than in middle age.

We also found that high-intensity interval training is a promising rehabilitation strategy for stroke survivors who are still continuing their recovery six months or more after their stroke and may be superior to the current guidelines of moderate-intensity continuous exercise.

We have also published findings related to:

- Geographic and racial differences in stroke
- Heredity and stroke
- Trends in substance abuse and stroke in young adults
- Risk factors according to hemorrhage location
- Spreading depolarizations in patients following subarachnoid hemorrhage
- Carotid artery stenosis as a cause of stroke
- Stent-assisted coiling of cerebral aneurysms

In the laboratory, basic science researchers are studying underlying vascular and molecular mechanisms of ischemic and hemorrhagic stroke, cognitive dysfunction, cortical spreading depolarizations in stroke, and the potential for improving the delivery of tPA. Researchers are also testing the possible benefits of brain stimulation on hand and arm function for people who are recovering from stroke.

LONG-TERM RECOVERY AFTER STROKE: THE NEXT GREAT FRONTIER

Known around the world for its pioneering work in the area of treatment and research into acute stroke, the Comprehensive Stroke Center is stepping up efforts to help those who face deficits in language, memory and movement after a stroke has occurred. Hundreds of patients have benefited from sustained and intensive rehabilitation efforts through the five-year-old Stroke Team Assessment and Recovery Treatment (START) Program at UC Health's Drake Center. "There's a long-held conception that, following a stroke, a patient will improve spontaneously for about six months and then hit a plateau, beyond which further recovery is minimal or impossible," says Brett Kissela, MD, the Albert Barnes Voorheis Chair of the Department of Neurology and Rehabilitation Medicine at UC and Co-Director of Drake's Stroke Recovery Center. "We now know that this is totally wrong. The new realm of long-term recovery is the next great frontier in stroke."

ACCOMPLISHMENTS

76

Peer-reviewed journal articles

\$9.4M

NIH research grants

5

Book chapters / books

Paula's Story: New Treatment for Large-Vessel Strokes

No one ever wants to suffer a stroke. But when Paula suffered a major, life-threatening stroke in September 2013 while working at a local deli, one might say that her timing was perfect.

First and foremost, Paula got to the University of Cincinnati Medical Center quickly and in time for effective treatment. Paula's manager realized that Paula couldn't speak and that her mouth was drooping – classic signs of a stroke caused by a blockage. The manager called 9-1-1, ensuring that Paula could be evaluated, diagnosed and treated within the 4½-hour window for acute stroke care.

Then, in a turn of fate, Paula's arrival at the emergency room also coincided with a pivotal moment in the history of stroke treatment: the arrival of the successful clot-retrieving device.

For years stroke researchers around the world had been trying to prove that in a case like Paula's, where oxygen to the brain is cut off by a large clot in a major blood vessel, it would be most effective to remove the clot rather than to simply try to dissolve it. But the doctors who wanted so desperately to retrieve those clots were unable to prove that this method was any better or safer than administering the clot-dissolving drug tPA, which for years was the only FDA-approved therapy for acute ischemic stroke.

By the time Paula received her diagnosis of an intracranial left carotid occlusion – a major stroke on the left side of her brain – some of those same stroke specialists at the UC Comprehensive Stroke Center were poised with new clot-retrieval technologies. At that very moment, they were prepared to begin testing one of those technologies in



Timely treatment and a new technology allowed Paula to resume a normal life following a life-threatening stroke.

Cincinnati as part of an international study called THERAPY.

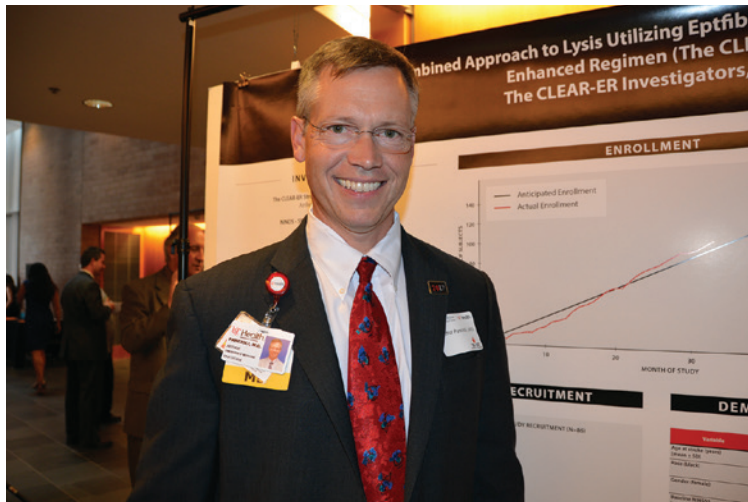
The THERAPY study, a Phase 3 clinical trial, was comparing standard delivery of rtPA (recombinant tPA) through an IV with the delivery of rtPA plus “mechanical thrombectomy,” an endovascular (in-the-artery) procedure in which a catheter is threaded up from the groin to the brain to allow doctors to retrieve the clot. The THERAPY study's name stands for “Assess the Penumbra System in the Treatment of Acute Stroke.”

Because Paula was unable to speak or understand, Dawn Kleindorfer, MD, a neurologist and Co-Director of the Comprehensive Stroke Center, discussed the study with Paula's husband, a UC graduate who recognized the value of clinical trials and agreed to have Paula participate in the research study. By enrolling in the study, Paula had a 50-50 chance of

being treated in the conventional way – with rtPA alone – and a 50-50 chance of being treated with both rtPA and the promising new clot retrieval device.

With a flip of a coin, Paula was assigned to receive the newer treatment from members of the UC Comprehensive Stroke Center. Paula received rtPA through an IV from Dr. Kleindorfer, then received endovascular treatment from Andrew Ringer, MD, an endovascular neurosurgeon and member of the UC Stroke Team, who used the Penumbra System to evacuate her clot. Paula's outcome was dramatic. Despite the severity of her stroke, she went home a few days later and recovered without major deficits.

“The stroke has caused lingering effects,” Paula acknowledges. “I don't have the strength in my right leg or right arm, and I walk with a limp. But I'm walking. My voice is raspy and I can't talk any louder than I am right now. But I'm talking.”



Art Pancioli, MD, Professor and Richard C. Levy Chair for Emergency Medicine and a member of the Greater Cincinnati/Northern Kentucky Stroke Team.



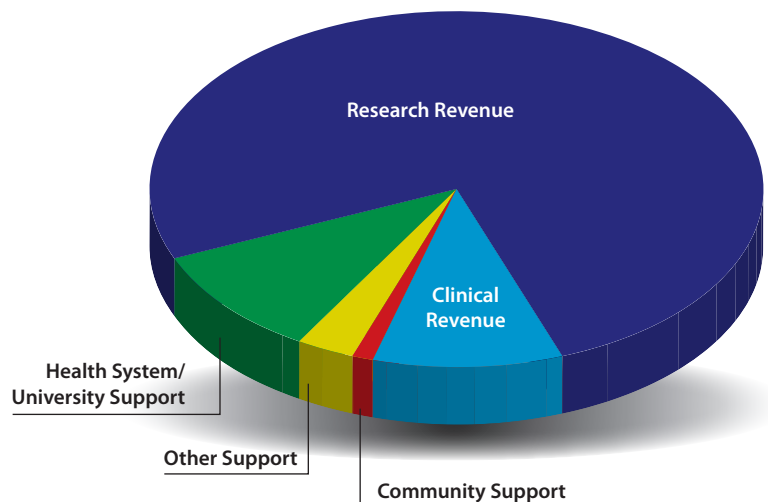
"The UC Comprehensive Stroke Center continues to benefit from gifts and the ongoing legacy of Bonnie Mitsui and her foundation."

— Mario Zuccarello, MD, Co-Medical Director

Comprehensive Stroke Center 2015 Financial Snapshot

DONATIONS FY2015

Clinical Revenue	\$898,269
Research Revenue	\$6,776,595
Health System/University Support	\$897,167
Community Support	\$49,491
Other Support	\$260,994
TOTAL	\$8,882,516



Comprehensive Stroke Center Donor Recognition

\$100,000-\$249,999

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\$50,000-\$99,999

Meshewa Farm Foundation

\$1,000-\$2,499

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