Mayo Clinic has a distinguished history in the study and treatment of speech and language pathologies. It was Mayo researcher Frederick L. Darley, Ph.D., who coined the term apraxia of speech in 1969 to describe an acquired motor speech disorder characterized by an inability to produce sounds correctly. Apraxia of speech has generally been associated with stroke, and thus sudden onset. Progressive apraxia of speech occurring in neurodegenerative disease has largely been ignored and typically subsumed under aphasia.

Researchers at Mayo Clinic in Rochester, Minn., have identified primary progressive apraxia of speech as a distinct entity that can evolve into a movement disorder. “We have recognized patients who do not have any language problem whatsoever. Instead, they have a motor speech disorder — trouble producing sounds correctly. They have it for years, and it worsens over time,” says Keith A. Josephs, M.D., a neurologist at Mayo in Minnesota.

The identification of primary progressive apraxia of speech is one of several findings resulting from a National Institutes of Health (NIH) research grant that funds Mayo’s work on progressive speech and language disorders (SLDs) and neurodegenerative disease. Mayo’s grant, for which Dr. Josephs is the primary investigator, is the only one in the world focusing on apraxia of speech in the context of neurodegenerative cognitive and motor disorders.

Diagnosis and treatment implications
The key distinction between primary progressive apraxia of speech and primary progressive aphasia is the patient’s ability or inability to communicate. “Patients with apraxia of speech may ultimately become mute because they can’t produce sounds. Yet they can communicate by typing or writing,” Dr. Josephs says. “The patient who is aphasic has problems finding words or structuring sentences correctly, which affects both spoken and written forms of communication. These patients can’t rely on typing or writing to communicate.”

Yet primary progressive apraxia of speech is often misdiagnosed. Dr. Josephs cites two patients seen at Mayo who had the condition. One had experienced motor speech problems for several years and been treated for depression and anxiety. The other had been treated with onabotulinumtoxinA (Botox), a therapy for dystonia.

Speech therapy, which is offered at Mayo, doesn’t reverse or halt the progression of apraxia. But speech therapy can help muscles
adapt to producing better sounds. “Most patients tend to want to speak less because they are embarrassed by the inability to produce sounds correctly. But speech therapy can be beneficial,” Dr. Josephs says.

**Early sign of neurodegenerative disease**

Mayo researchers have designated the best-known form of apraxia of speech, characterized by distortions in the production of sound, as type 1 apraxia of speech. But type 2, a second type that was first recognized by Mayo speech pathologist and researcher Joseph R. Duffy, Ph.D., may account for as many as 80 percent of cases. In type 2 apraxia of speech, “the speech is very slow, and the segmentation — the breaks between syllables or words — is lengthened and abnormal,” Dr. Josephs says.

Imaging of these patients shows focal areas of abnormality, typically in the left brain but sometimes in the right (Figure), which are likely due to protein deposits in these areas. Most of the patients with primary progressive apraxia of speech are women older than age 65, although some patients have presented as young as age 40.

“We are surprised by how rapidly they are progressing,” Dr. Josephs says. “Within five to six years of experiencing apraxia of speech, the majority of these patients develop a widespread motor parkinsonian disorder with features that resemble those of progressive supranuclear palsy or corticobasal syndrome. The patients might subsequently start to lose coordination of the right hand, or the right leg may start to drag. Two to three years later, they may complain of double vision, trouble walking and falling. Eventually, they’re using a wheelchair and unable to communicate because they cannot speak, write or point. Some may even die soon after.”

Because amyloid deposits are rare in patients with primary progressive apraxia of speech, Dr. Josephs suspects that the protein responsible for this condition is tau. Mayo researchers will continue investigating that question and others under both the current NIH grant as well as a second NIH grant addressing the evolution of primary progressive apraxia of speech.

“Every patient we have diagnosed with an apraxia of speech in the context of neurodegeneration, and who has died, has had tau in the brain,” Dr. Josephs says. “I can’t think of another clinical feature that is as predictive for a brain protein as apraxia of speech.”

**Enrolling patients with apraxia and aphasia**

Mayo’s NIH grant, which began in 2010, continues to enroll patients with progressive SLDs — both primary progressive aphasia and primary progressive apraxia of speech. Over 48 hours, study participants receive a comprehensive evaluation by a neurologist and a speech and language pathologist, as well as neuropsychological testing, a blood test, glucose positron emission tomography (PET) scan and a Pittsburgh compound B (PiB) PET scan, which can detect amyloid in the brain. As many as 10 Mayo specialists confer on each patient’s diagnosis.

Among other findings to date:

- Study participants include a high prevalence of teachers. However, Dr. Josephs says there is no evidence that teaching predisposes people to progressive SLDs. Teachers may simply be more attuned to detecting abnormalities in their speech and language and thus likelier to seek treatment.
- About 90 percent of patients with logopenic primary progressive aphasia — characterized by impairments in naming — have Alzheimer’s disease. Among those who have logopenic progressive aphasia but not Alzheimer’s, about half have a genetic mutation.

“The patients who join these studies get a baseline evaluation and diagnosis,” Dr. Josephs says. “But everyone wants to know what’s going to happen to them in five years. Which patients will become mute? Will they know their spouses? How long will they live? These are the answers we hope to find.”

**For more information**


Advances in Treating Aneurysm

Intracranial aneurysms are common disorders, occurring in approximately 2 percent of the general population. When an aneurysm ruptures, it is fatal in approximately 40 percent of patients. Over the past two decades, Mayo Clinic has been a pioneer in the use of less invasive treatment for unruptured cerebral aneurysms. Researchers at Mayo Clinic in Rochester, Minn., were involved in both the preclinical development and clinical trials of flow diverters — endovascular devices that direct blood flow away from the aneurysm.

Since 2009, Mayo physicians have treated more than 130 patients with flow diverters. “The results have been very good,” says Giuseppe Lanzino, M.D., a neurosurgeon at Mayo in Minnesota. “Flow diversion represents a paradigm shift, and is becoming the treatment of choice for some of the complex proximal internal carotid artery aneurysms.”

Complete obliteration
Placed across the neck of the aneurysm, a flow diverter redirects blood to the parent vessel, thus promoting thrombosis within the aneurysm (Figure). “The blood clot acts like a scar, contracting over time so that the aneurysm shrinks,” Dr. Lanzino says. “Eventually, the blood clot is covered with a layer of endothelium that basically seals the aneurysm.”

Platinum coils, the standard endovascular treatment for cerebral aneurysms, can fail to completely obliterate a large and complex aneurysm. Additional advantages of flow diverters include avoidance of any intra-aneurysmal manipulation and additional structural strength for the segment of blood vessel from which the aneurysm originates.

At Mayo, “we are seeing more aneurysms that are completely obliterated after flow-diversion treatment,” Dr. Lanzino says. “We know that for specific types of aneurysms — those that are large, have a large neck and involve the proximal portion of the internal carotid artery — the treatment works very well.”

The time interval between treatment and occlusion depends on the size and location of the aneurysm. Dr. Lanzino notes that about 70 to 75 percent of Mayo patients who have flow-diversion treatment for large internal carotid artery aneurysms have complete occlusion six months after the procedure.

Low morbidity
Because flow diverters work over time, there is a small risk that the aneurysm will rupture before it is obliterated. The blood clot also triggers an inflammatory reaction, which can increase the risk of rupture in extremely large and fast-growing aneurysms and in those with very thin walls.

However, in Mayo’s series of more than 130 patients, no delayed ruptures have occurred. To minimize the risk, Mayo neurosurgeons sometimes insert a loose coil in the aneurysm in addition to the flow diverter.

“The coil offers some degree of protection during the interval when the flow diverter is working,” Dr. Lanzino says. “Some of these ruptures are associated with too much clotting occurring in the aneurysm too quickly. Filling part of the aneurysm with coils decreases the clot burden. But because the coils are inserted loosely, they do not close the aneurysm. We rely on the flow diverter to accomplish that.”

Another possible but uncommon complication is distal intraparenchymal hemorrhage, which seems to occur in the first days after...
treatment. The cause of this bleeding, and the likelihood of its occurrence within a specific patient, is poorly understood. In Mayo’s series, only one patient experienced this complication. “Like any procedure, flow diverters are not devoid of complications. These must be balanced against the benefits of treating a complex aneurysm,” Dr. Lanzino says. “Flow diverters provide us with another tool in situations where all other treatments are inadequate, fail or pose too many risks.”

Future possibilities

Current models of flow diverters are most suitable for side-wall aneurysms. Yet the majority of aneurysms occur at bifurcation points. A new type of flow diverter, made of mesh that can be placed directly into an aneurysm, may hold promise for treating bifurcated aneurysms. “The technology continues to evolve,” Dr. Lanzino says. “In our assessment, flow diversion is the treatment of choice for these larger aneurysms.”

For more information


Building Expertise Through Simulations

As a teaching institution, Mayo Clinic is committed to training young physicians to provide the highest standards of patient care. All three Mayo campuses have simulation centers where neurologists and neurosurgeons gain experience that builds clinical expertise and communication skills. Utilizing actors and realistic mannequins, the scenarios depict neurological assessments and emergencies, and even family disputes, at the “patient” bedside. Evaluations by staff physicians immediately after the scenario provide feedback for young physicians.

“Simulations provide an exact clinical scenario in a controlled environment. Residents can gain experience, confidence and competence so that they know what to do in an acute neurological situation,” says Dan J. Capampangan, M.D., a neurologist at Mayo Clinic in Phoenix, Ariz.

Realistic scenarios

The scenarios, which are written by Mayo neurologists, cover conditions such as acute ischemic stroke, status epilepticus, acute respiratory distress in the context of myasthenia gravis and raised intracranial pressure. Simulations are carried out in rooms modeled on emergency department or patient hospital rooms, complete with bedside monitors. Actors or programmable mannequins portray patients; Mayo staff physicians, nurses and respiratory therapists play themselves.

“The residents or trainees are expected to demonstrate their approach to the patient, in terms of the historical information that would be important as well as the examination findings,” says Kevin M. Barrett, M.D., a neurologist at Mayo Clinic in Jacksonville, Fla. “We also incorporate radiologic scans to make sure the trainees can recognize acute problems and respond to them appropriately.” Staff physicians can watch the scenario from behind a one-way mirror (Figure). A mannequin “patient,” voiced by an actor behind the mirror, is programmed to show changing vital signs and behavior.

“The mannequin might be answering questions from the trainee doctor and then suddenly lose consciousness — by which I mean that the mannequin stops speaking and the eyes close,” says Sara E. Hocker, M.D., a neurointensivist at Mayo Clinic in Rochester, Minn., who manages neurological simulations there. “The mannequin’s pupils can react, and we can run fluid through it so that it has a pulse. The vital signs can change at any time, and the doctor has to react to that.”

As the “patient” loses consciousness, nurses and respiratory therapists provide information and ask for instructions. Actors portraying family members react with distress and question the doctor; they may cry or start arguing with one another. Trainees may be required to quickly run through the informed consent process for administration of tissue plasminogen activator (TPA).

Effective communication with patients and their families is an important part of the simulations. “We want our residents and trainees to have experience with challenging interactions with patients and family members,” Dr. Hocker says.
Scenarios may be videotaped so that young physicians can observe their body language. “We can point out that they didn’t make eye contact with the patient or family, or maybe had a nervous fidget while speaking to them,” says Christopher J. Boes, M.D., a neurologist at Mayo in Minnesota. “The goal is not to stress out the trainees, but to get them to think through the process so that they provide better patient care.”

**Practicing surgical techniques**

Special 3-D simulators allow surgeons to practice procedures before performing them on specific patients. One recent simulation at Mayo Clinic in Florida involved a case of cavernous malformation in the brainstem. “We loaded the patient’s MRI into the simulator and practiced the approach that would take us to the part of the brain where the lesion was closest to the surface,” says Robert E. Wharen Jr., M.D., a neurosurgeon at Mayo in Florida. “The simulator helps us to exactly plan the craniotomy. We can see not only the path to the lesion but also all the 3-D anatomy along the path.”

**Positive results**

Trainees generally find simulations helpful. At an American Academy of Neurology meeting in 2012, Matthew T. Hoerth, M.D., a neurologist at Mayo in Arizona, and Dr. Capampangan presented abstracts describing the results of pre- and post-simulation tests taken by trainees. Trainees’ test scores — particularly trainees’ knowledge of criteria for prescribing TPA — improved after participating in a simulation. “The verbal feedback from residents is that the scenario feels very real,” Dr. Hoerth says. Dr. Hocker still remembers lessons she learned from simulations during her fellowship at Mayo. “They stick with you. For me, simulations built confidence. They provide a safe opportunity for trainees to experience uncommon scenarios before they happen with real patients.”

**Figure.** Evaluators seated behind a one-way mirror assess a trainee neurologist’s performance in a simulation at Mayo Clinic in Phoenix, Ariz.

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**Treating Tumors at the Molecular Level**

Like many life-threatening diseases, brain tumors originate from altered biological processes at the molecular level. Nanomaterials — generally consisting of metal or nonmetal atoms or a mixture of both — are similar in scale to biological molecules and systems and can be engineered to carry out various functions.

At Mayo Clinic in Jacksonville, Fla., researchers are investigating ways to use the physical properties and characteristics of nanomaterials to diagnose and treat diseases at the molecular level. The Mayo scientists see great potential in nanoparticles as a means of not only delivering drugs to tumors but also changing the tumor microenvironment.

“In 10 years I envision a boom in nanoparticles for medical purposes. We are going to develop very smart, targeted devices,” says Betty Y S Kim, M.D., Ph.D., a neurosurgeon at Mayo in Florida. “In addition to using nanomaterials as a Trojan horse to deliver medication to disease sites, I foresee using the physical properties these materials possess in the nanoscale to monitor cell function and halt tumor progression.”

**What true nanoparticles can do**

Although nanomaterials have attracted great attention, Dr. Kim cautions that they are sometimes incorrectly defined in the literature. “In the strictest sense, nanotechnology deals...”
with materials in the nanoscale of 1 to 100 nanometers,” she says. “Above that range, you can’t fine-tune the optical or magnetic or other physical properties that are unique to nanomaterials.”

Those properties are the source of nanoparticles’ therapeutic benefits. Because of their small size, and scientists’ abilities to alter their surface chemistry, nanoparticles can cross the blood-brain barrier, facilitating delivery of chemotherapy into the central nervous system. Nanomaterials also have a high ratio of surface area to volume, allowing nanoparticles to carry a big payload (Figure).

“We can attach antibodies or peptides on the surface of these structures to target a particular cancer cell or stroma so that the nanoparticles reach the site of interest. We can also attach medications and potentially fluorescent probes that would allow us to see what is happening at the cellular level,” Dr. Kim says. “The fact that we can use a very small particle but have this tremendous surface area to play with is a huge advantage.”

**Engineering the tumor microenvironment**

Another focus of Dr. Kim’s research is the potential use of nanoparticles to change the tumor microenvironment. Because tumor cells constantly mutate, they become resistant to therapy. The tumor itself acts to suppress immune cells attempting to fight the tumor process.

“I think we can use nanoparticles to study which specific cells are involved in this process, and re-engineer those cells using nanomaterials to allow the immune system to be less suppressed,” Dr. Kim says. “The goal is to make the immune system an anti-tumor state.”

Blood vessels in the tumor might also be re-engineered to co-opt them into fighting the cancer. The vessels that develop within tumors are physically abnormal, resulting in poor blood flow that limits the amount of medication reaching the tumor. “If we can re-engineer the blood vessel formation so that the vessels are a little more normal, they could be the highways along which we will deliver our cancer medications,” Dr. Kim says.

**Biobank and personalized care**

In line with its commitment to nanotechnology, Mayo in Florida is also significantly expanding its tumor biobank — an initiative begun by Mayo researchers Kurt A. Jacekile, M.D., Robert E. Wharen Jr., M.D., and Panagiotis Z. Anastasiadis, Ph.D., through the generosity of the JLG Brain Cancer Foundation. The biobank contains not only tumor tissue, from which DNA and RNA are extracted for analysis, but also blood samples taken from patients prior to any incisions. Dr. Kim foresees a time when blood markers will be used to differentiate tumors and individualize therapies.

“We don’t have the technology to do that yet. But within the next few years, I think we will be able to code all of these tumors in ways that allow us to provide targeted, personalized therapies,” she says. “Nanotechnology will definitely bridge that gap.”
Skull base tumors pose significant challenges, due to their close proximity to important neurovascular structures and potential extension into neural canals or the cavernous sinus. Surgical resection can be associated with significant morbidity, including damage to the optic nerve and leakage of cerebral spinal fluid. Mayo Clinic in Rochester, Minn., has specialists with experience in a range of innovative surgical techniques for treatment of these complex cases.

“Everything we do centers around maximal safe resection of tumors, limiting comorbidity to patients and trying to get them back to the normal work or family life they previously had,” says Jamie J. Van Gompel, M.D., a neurosurgeon at Mayo Clinic in Minnesota.

Mayo’s experience with skull base lesions ranges from rare types — esthesioneuroblastomas, chordomas and chondrosarcomas — to the more common meningiomas, pituitary tumors, craniopharyngiomas and sinonasal malignancies. Mayo’s expertise extends across several specialties. In addition to neurosurgeons, the skull base surgery team at Mayo is comprised of radiologists, otorhinolaryngologists, otologists, oncologists, radiation oncologists and plastic surgeons.

“There are a lot of advantages to having a facility with expertise in all fields,” Dr. Van Gompel says. “We have developed a team with deep experience.”

Neuroradiologists play a key role in diagnostic work and preoperative planning, as well as interpreting postoperative CT scans and MRI. During surgery Mayo neuroradiologists can use intraoperative MRI, which is particularly helpful in cases of more-complex lesions based in the central skull. The surgery is usually performed by both a neurosurgeon and an otorhinolaryngologist. “There are two expert sets of eyes, and often intraoperative discussion about what’s best for the patient,” Dr. Van Gompel says.

Mayo’s practice focuses on using minimally invasive procedures whenever possible. In addition to an endoscopic endonasal approach, in which the tumor or lesion is removed through the nose (Figure), Mayo is also expanding its practice of endoscopic-assisted cranial surgery. That procedure requires a smaller craniotomy than cranial surgery performed with a microscope because while the microscope focuses light narrowly on a tumor, the endoscope emanates light outward. Endoscopic-assisted craniotomy can be used to reach very deep lesions with less morbidity.

“The microscope, craniotomies often are large because the opening determines the light at the resection,” Dr. Van Gompel explains.

Proton beam therapy
To enhance treatment options for skull base tumors, Mayo is constructing a proton beam therapy facility in Rochester. When it opens in 2015, Mayo will be one of the few centers in the Midwest capable of offering both minimally invasive skull base surgery and proton beam therapy in a single center. That treatment regimen is particularly appropriate for patients with chondrosarcoma or chordoma — tumors that tend to occur in older adolescents and young adults, for whom complex resection and large doses of radiation pose risks of long-term complications.

Approaches tailored to the patient
The range of experience and expertise at Mayo Clinic allows patients to receive care appropriate to their individual needs. “Endoscopic techniques are absolutely critical for treating chondrosarcomas and chordomas, in order to reach the portion of the skull base that can’t be reached in any other way,” Dr. Van Gompel says.

Yet open procedures remain necessary. Dr. Van Gompel is currently conducting research that indicates that in remotely located lesions, a traditional open approach can address one portion of the petrous apex. “But there is a smaller subsegment that you cannot see in the open approach,” he notes. “So there actually are places and particular pathologies that need both open and endoscopic approaches.”
Vertebral tumors and deformities can cause significant morbidity and pain. Surgery to treat patients with these conditions is inherently complex, posing risks to critical neurovascular structures. Mayo Clinic in Jacksonville, Fla., has a large team of neurosurgeons with experience in complex spine surgeries for tumors, deformities and other conditions.

“We treat a full range of spine problems including trauma, complex deformities, disk problems, and tumors of the spinal cord and spine, both primary and metastatic,” says H. Gordon Deen Jr., M.D., a neurosurgeon at Mayo in Florida.

Among the spinal deformities treated is scoliosis — both idiopathic scoliosis in older adolescents and adult degenerative scoliosis. The latter may be seen in older adults who had minor scoliosis in adolescence and were treated with a brace.

“We with the degenerative changes of aging on top of previous adolescent scoliosis, these older adults may again experience progression of spinal deformity and benefit from surgery,” notes Mark A. Pichelmann, M.D., a neurosurgeon at Mayo in Florida.

Team approach
Mayo’s commitment to team medicine is apparent in its approach to complex spine surgery. Two attending neurosurgeons often work together on highly complex cases. “There are a lot of decisions that must be made during the surgery. With two of us in the operating room, we can bounce ideas off each other,” says Stephen Pirris, M.D., a neurosurgeon at Mayo in Florida.

The treatment team also includes anesthesiologists and nurses with experience in complex spine surgery. After surgery, patients work with an inpatient pain management service as well as physical, occupational and speech therapists to help with rehabilitation.

Another key component of Mayo’s approach is intensive patient monitoring during surgery. Sensory and motor functioning of the spinal cord is monitored in real time, to minimize the patient’s chances of developing new complications or neurological deficits.

Neurosurgeons at Mayo in Florida also have pioneered the use of 3-D image-guidance techniques, which allow spinal implants to be placed more safely. Enhanced image guidance facilitates placement of more robust implants with novel trajectories to better stabilize complex spinal deformities. These technologies, along with improvements in instrumentation and surgical techniques, enable Mayo neurosurgeons to treat more-complex cases than was previously possible.

“We are doing more osteotomies for complicated three-dimensional curvature,” Dr. Pichelmann says. “We can essentially take the spine apart and put it back together with minimal risk to the spinal cord.” Minimally invasive surgery and anterior-posterior surgery also are offered when appropriate.

Dr. Pirris notes that patients who undergo complex spine surgery must be able to tolerate a long and complicated procedure. Candidates for surgery are therefore selected according to their medical history and bone quality. The patients who tend to benefit most from spine surgery are those with sagittal imbalance, the most common determinant of back pain (Figure).

“Chronic back pain that persists after surgery is frequently due to sagittal imbalance, and that is a potentially correctable problem,” he says.

For more information
Expanding Epilepsy Monitoring in Arizona

Treating patients with epilepsy requires careful characterization of seizure activity. All three Mayo Clinic campuses have an inpatient epilepsy monitoring unit where patients have continuous electroencephalography (EEG), measurement of oxygenation and cardiac status, and audiovisual recording of their activities.

In Arizona, Mayo is extending its epilepsy expertise across the state. Since 2011, Mayo Clinic specialists have collaborated with officials from Banner Health to create an epilepsy monitoring unit at Banner Good Samaritan Medical Center in downtown Phoenix. The six-bed unit is staffed by Mayo neurologists (Figure 1), with technicians and support teams from Banner Good Samaritan. Patients evaluated at the unit may receive treatment from Banner or be transferred to Mayo Clinic Hospital in Phoenix. Banner Good Samaritan draws patients from the Banner network throughout Arizona.

“This collaboration allows us to bring Mayo Clinic quality and safety of care to a large population of the state of Arizona,” says Joseph I. Sirven, M.D., a neurologist at Mayo Clinic in Arizona. “This unit, which is Mayo branded but located within a Banner hospital, allows access to Mayo Clinic for patients who otherwise would not have it.”

The unique clinical cooperation was launched in 2011. Neurologists from Mayo and Banner were already collaborating on research on dementia and Parkinson’s disease. At the time Banner Good Samaritan lacked an epilepsy monitoring unit.

“Banner physicians wanted very much to have epilepsy monitoring capability to care for their large network of patients,” Dr. Sirven says. “So they approached us with the idea of creating a Mayo epilepsy monitoring unit in their hospital.”

As at other Mayo Clinic epilepsy monitoring units, an important component of care at Banner Good Samaritan is multidisciplinary case conferences (Figure 2). Those meetings bring together neurologists, medical technicians, nurses and psychologists to assess the safety and quality of the testing and treatment plan for each patient. A satellite connection allows epilepsy specialists at Mayo Clinic Hospital in Phoenix to participate in discussions with their Mayo colleagues at the Banner Good Samaritan unit.

According to a study published in the June 2009 issue of Mayo Clinic Proceedings, EEG monitoring is a safe and valuable tool for epilepsy classification, diagnosis of recurrent spells and evaluations for surgery in patients with intractable partial epilepsy. “At Mayo Clinic, we are committed to bringing the best safety and quality to care for patients with epilepsy,” Dr. Sirven says. “Being part of the Banner Good Samaritan system extends Mayo’s interactions with patients to a very large swath of Arizona and allows us to set the tone for safety and quality of care for the state.”

For more information
Stroke Telemedicine Launched in the Midwest

Mayo Clinic has been a leader in the field of stroke telemedicine, which uses audiovisual technology to connect patients in rural areas with stroke specialists at hub hospitals. Starting at Mayo Clinic in Phoenix, Ariz., stroke telemedicine subsequently expanded to Mayo’s campus in Jacksonville, Fla. Now, Mayo Clinic in Rochester, Minn., is a stroke telemedicine hub serving 18 hospitals in the Mayo Clinic Health System in Minnesota and Wisconsin (Figure 1).

“We’re expanding the Mayo Clinic Model of Care for stroke telemedicine to the Upper Midwest. The goal is to bring Mayo Clinic stroke expertise to each of the sites in our health system, through collaboration with physicians and other providers at those sites, and then expand later this year to non-Mayo sites as well,” says Robert D. Brown Jr., M.D., a neurologist at Mayo in Minnesota.

Like the Mayo campuses in Arizona and Florida, the Minnesota site has a stroke subspecialty neurologist available around-the-clock for consultation with emergency room providers in network hospitals. The stroke specialist conducts patient evaluations remotely, using technology brought to the patient’s bedside (Figure 2). CT scans can be uploaded and immediately reviewed by the stroke specialist in Rochester, and therapeutic options discussed with the treatment team at the network hospital.

“The system provides a high-quality audiovisual connection, with the ability to focus the camera on the patient, zoom in and out, tilt up and down, and pan from side to side. We can both review the imaging and share the image back again with the team at the bedside, pointing out any key findings for the patient, their family or the providers,” Dr. Brown says.

Stroke telemedicine increases the likelihood that patients who need clot-dissolving or other advanced therapies receive them quickly, thereby lessening the risk of significant deficit after stroke. “If intra-arterial therapies are required, patients can be immediately airlifted to Rochester, where emergency diagnostic cerebral angiogram and endovascular therapy capabilities are available 24/7 for advanced intervention,” Dr. Brown notes. Patients may also be transferred to the Mayo system’s hospitals in La Crosse, or Eau Claire, Wis.; or Mankato, Minn.

Expansion beyond Mayo Clinic Health System

The goal over time is to extend stroke telemedicine to hospitals outside the Mayo Clinic Health System. That effort will draw on Mayo’s experience in Arizona and Florida, where network hospitals typically aren’t part of the Mayo Clinic Health System, but some are affiliated in other ways, such as through the Mayo Clinic Care Network.

“We’re basing our model on the very advanced and mature program that exists at Mayo Clinic in Arizona and in Florida,” Dr. Brown says. Telemedicine at Mayo in Minnesota will also be extended eventually to other neurological conditions, such as epilepsy, neurological emergencies other than stroke, and sports concussion, as it has been at Mayo in Arizona.

“Connecting with patients and referring physicians is critical to Mayo Clinic’s strategic direction,” says Bart M. Demaerschalk, M.D., a neurologist at Mayo in Arizona and founder of the Mayo Clinic telestroke network there.

“Telestroke is supported by a strong body of evidence demonstrating its reliability, validity, safety, efficacy, and clinical and cost effectiveness compared to face-to-face stroke care.”

Figure 1. The stroke telemedicine network with its hub at Mayo Clinic in Rochester, Minn. Stars indicate communities with hospitals in the Mayo Clinic Health System served by the telemedicine network. Mayo Clinic Hospital in Phoenix, Ariz., and Mayo Clinic Hospital in Jacksonville, Fla., also are stroke telemedicine hubs serving hospitals in their respective regions and beyond.

Figure 2. The Clinical Assistant telemedicine cart. Photo courtesy of Avizia Inc.
Seizure Outcomes After Corpus Callosotomy

Medically intractable epilepsy is a debilitating condition that can be difficult to manage. Patients with severe epilepsy may experience not only significant trauma from falls during drop attacks but also cognitive decline from frequent seizures. Corpus callosotomy is a surgical procedure in which the corpus callosum is partially or completely resected, resulting in disconnection of the brain hemispheres. In theory, corpus callosotomy interrupts the spread of a rapidly generalized seizure, and has been shown to be particularly effective in reducing or eliminating drop attacks. Previous studies of corpus callosotomy have focused on only pediatric patients or drop seizures. A retrospective analysis of patients who underwent corpus callosotomy from 1990 to 2011 at Mayo Clinic in Rochester, Minn., found that corpus callosotomy for medically refractory generalized epilepsy is effective for both adults and children who have drop seizures as well as other types of seizures. Records from 50 patients were included in the study. All patients had experienced drop seizures. Other preoperative seizure types included myoclonic, absence, secondary generalized, partial complex, simple partial and spasms. After surgery, 40 percent of patients studied had complete resolution of drop attacks; 64 percent experienced a decline of at least one frequency category. Other seizure types also significantly decreased in frequency after corpus callosotomy. Younger age at surgery correlated with better seizure outcomes, suggesting that corpus callosotomy should be considered soon after a patient has been deemed medically refractory. (Bower RS, et al. Seizure outcomes after corpus callosotomy for drop attacks. Neurosurgery. 2013;73:993.)

Higher Risk of Dementia in MCI Cases That Revert to Normal

The risk of dementia is high in people with mild cognitive impairment (MCI) compared with people who are cognitively normal. Although some patients with MCI revert to cognitively normal status, this reversion hasn’t been fully characterized. Results from the Mayo Clinic Study of Aging indicate that patients with MCI who revert to cognitively normal status nevertheless have a high risk of progression to dementia. The population-based, progressive Study of Aging evaluates residents of Olmsted County, Minn., who were ages 70 to 89 on Oct. 1, 2004. The MCI reversion analysis included 2,050 participants. After a baseline assessment, participants were examined every 15 months for MCI or incident dementia. Over a median follow-up period of 5.1 years, 28.7 percent of participants with prevalent or incident MCI progressed to dementia. The risk of progression was higher in MCI cases compared with cognitively normal subjects. Although 38 percent of participants with MCI reverted to cognitively normal status, 65 percent of them subsequently developed MCI or dementia: a 6.6 times higher risk of dementia than in people who were cognitively normal at the start of the study and didn’t receive a diagnosis of MCI. The findings corroborate evidence that MCI is an important clinical entity and that diagnosis of MCI at any time has prognostic value. (Roberts RO, et al. Higher risk of progression to dementia in mild cognitive impairment cases who revert to normal. Neurology. 2014;82:317.)

DBS for Parkinson’s Patients With Mood Disorders

Parkinson’s disease (PD) is associated with substantial comorbidity for depression, sleep disturbances, and psychotic and anxiety disorders. Deep brain stimulation (DBS) has been shown to significantly improve motor symptoms and quality of life in patients with PD. Yet the most common site for DBS placement for PD is the subthalamic nucleus — an area associated with new-onset psychiatric adverse events — raising concerns about the safety of DBS for patients with PD and mood disorders. A study conducted at Mayo Clinic in Rochester, Minn., suggests that patients with PD and a history of psychiatric comorbidity can safely respond to DBS with no greater risk of psychiatric adverse events. The six-month, prospective naturalistic follow-up study involved 49 patients with PD who were treated with DBS at Mayo from 2008 to 2010. Based on clinical evaluation before treatment, participants were divided into three groups: those with depression, those with mania-impulse dyscontrol or those with no comorbidity. Roughly half the study participants had a history of psychiatric disorder. In follow-up exams six months after treatment, all patients had significant improvement in PD rating scale scores. Both depressive and manic-hypomanic symptoms also improved significantly, with no significant difference in motor and mood outcomes by presence of comorbidity. The results suggest that with careful screening, patients with PD and a history of psychiatric comorbidity can be safely treated with DBS. (Chopra A, et al. Mood stability in Parkinson disease following deep brain stimulation: A 6-month prospective follow-up study. Psychomatics. In press.)

To read more about Mayo Clinic neurosciences research and patient care, visit www.MayoClinic.org/medicalprofs.
Expedited Patient Referrals to Mayo Clinic
Departments of Neurology and Neurologic Surgery

While Mayo Clinic welcomes appointment requests for all neurologic and neurosurgical conditions, patients with the following conditions are offered expedited appointments:

1. Cerebral aneurysms
2. Cerebral or spinal arteriovenous malformations
3. Brain, spinal cord or peripheral nerve tumors
4. Epilepsy with indications for surgery
5. Carotid disease