

WHITEPAPER



## MOBILE STROKE UNITS

A large white ambulance with an orange stripe is parked on a city street at night. The side of the ambulance features the text "Mobile Stroke Unit" and "AMBULANCE" in blue, along with a blue Star of Life symbol. The background shows city lights and a dark sky.

# *Bring the Hospital to the Home*

With CT scanners, tPA and more, MSUs are helping slash treatment intervals and should improve outcomes

By John Erich, Senior Editor

## LUCKY WOMAN, MAUREEN OSAKA.

Her stroke was an especially rare and lethal type, a basilar artery occlusion. Those have a mortality rate of more than 85%. Their survivors are often left paralyzed or severely disabled.

But Osaka, born in Nigeria and a world traveler doing philanthropic work, happened to be in Houston when her stroke occurred in 2014. Even better, she was within a few miles of Texas Medical Center, new home to the country's first mobile stroke unit.

A quick call to 9-1-1 when her symptoms began brought that unit to Osaka, and its crew—a paramedic, neurologist, critical-care nurse and CT technician—initiated a level of care at her home that was previously unknown in America's prehospital realm.

She got a CT scan in the ambulance courtesy of a CereTom portable scanner. Confirming her stroke was ischemic, the crew performed some quick point-of-care lab testing, then began treating Osaka on scene with intravenous tPA (tissue plasminogen activator), the only treatment for such strokes approved by the FDA. The stuff works, but only within three hours of symptom onset, and the faster, the better. With that accomplished the crew set out for the local comprehensive stroke center.

Once upon a time those critical interventions would have had to wait until a stroke victim reached the hospital, even as two million brain cells a minute died. Bringing them to the patient earlier in the process saves essential time—which means, in stroke, essential brain.

## Strokes are the fourth-leading cause of death in the U.S., and a top cause of disability. Around 800,000 Americans a year have them, to a price tag of about \$38 billion.

For Osaka it saved both: She received treatment about 78 minutes after symptom onset, faster than 99% of stroke patients. And within days she was moving her affected left side, speaking clearly and walking on her own. "In just one day," Osaka told media reps from the University of Texas Health Science Center at Houston (UTHealth), which fields the unit, "I went from not being able to speak to speaking but no one could understand me to now speaking and pronouncing things perfectly. Before the end of that same day, I could also move my hand again. It was like a dream! I could even stand up and walk!"<sup>1</sup>

### A BROAD RANGE OF SOLUTIONS

Mobile stroke units began in Germany almost a decade ago but have only recently come to the U.S.

UTHealth's was first, but others have quickly followed. The Cleveland Clinic rolled its out soon after in 2014. More started the next year in Toledo and Colorado. Another that debuted this year in Memphis raises the bar with a hospital-grade Siemens SOMATOM Scope scanner and CT angiography imaging of the brain and blood vessels.

These things aren't cheap, and that systems are investing in them underscores the difficulty we've had helping stroke victims in the timely way they need. To that end, mobile stroke units could represent a big advance.

"Historically strokes have had to be identified in the field and brought to the hospital for a CAT scan," says Andrei Alexandrov, MD, chair of the neurology department at the University of Tennessee Health Science Center and medical director for the Memphis project. "Only recently have the CAT scanners become mobile. So placing one on the ambulance essentially allows the door-to-needle time to become the time from the field to the door of the ambulance. This can shorten the time from symptom onset to treatment and in turn result in more patients recovering from stroke. It's a very exciting opportunity."

Indeed it is—the cost of strokes is terrible. They're the fourth-leading cause of death in the U.S., and a top cause of disability. Around 800,000 Americans a year have them, to a price tag of about \$38 billion.

The ischemic variety accounts for 87%, and while ischemic strokes are quite treatable with tPA, that needs to happen within a limited time window. All kind of obstacles work against that, from delays in recognition and calling 9-1-1 to prolonged scene and ED times and times to getting patients scanned and treated.

Mainly because of such delays, just 3%–8.5% of American patients who are eligible for tPA get it. More than 40% should.<sup>2</sup> So anything we can do to get it to them faster should benefit them—right?

That would seem to be the case with mobile stroke units (MSUs). Because they're so new, there's not yet a huge volume of data amassed, but what there is has been positive:

» **A 2014 JAMA writeup** of the German PHANTOM-S study reported alarm-to-treatment times averaged 15 minutes faster during weeks when a stroke vehicle (STEMO) was available, and patients for whom it was deployed had a mean alarm-to-treatment time 25 minutes shorter than during control weeks. Thrombolysis rates were 21% during control weeks, 29% during STEMO weeks and 33% after STEMO deployment.<sup>3</sup>

» **A 2012 Lancet report** found that prehospital stroke treatment reduced the median alarm-to-therapy-decision time from 76 minutes to 35. A team led by Silke Walter, MD, of Germany's University Hospital of the Saarland discovered similar gains in intervals from alarm to CT completion, alarm to end of laboratory analysis, and to the overall rate of IV thrombolysis for eligible ischemic stroke patients.<sup>4</sup>

» **A preliminary 2010 piece** by most of the same authors used case studies to show the "feasibility of guideline-adherent, etiology-specific and causal treatment of acute stroke directly at the emergency site."



## Inside the Gathering of Eagles: A Low-Tech Approach to Expediting Stroke Care

You don't always have to spend big money to make a difference. A low-cost, low-tech, decidedly simple mechanism in St. Louis is proving a novel way get faster help to stroke victims.

It's a basic business card that says this:

### **We Need Your Help**

**Please call 314-362-9123**

**Your friend or loved one may be having a stroke and is being taken to the Barnes-Jewish Hospital Emergency Room.**

**When the operator answers, please say, "Hello, I am calling with an ambulance stroke card. May I speak to the stroke doctor?"**

**A Washington University stroke specialist will assist you.**

With that minimalist mechanism—a simple statement of concise instructions given to a witness or bystander when someone's had a stroke—an ambulance crew can get a patient en route to Barnes-Jewish, the city's sole comprehensive stroke center; that person can pass on key information directly to the treatment team while the patient is being transported; and informed BJH clinicians can expedite the process to treat patients faster.

"When we went through and looked at our processes," says Scott Gilmore, MD, EMT-P, FACEP, medical director for the St. Louis Fire Department and an assistant professor of emergency medicine at the Washington University School of Medicine (Barnes-Jewish is part of Washington University Medical Center), "we identified that while EMS is driving from the scene to the hospital, we're losing valuable time that might be better spent in another process."

The solution, devised in conjunction with WU stroke physicians, is to let crews get off scene faster by employing witnesses (often friends and family) to relay key information to the hospital.

The card is carried with the glucometer, and a crew member will give it to the bystander and ask them to follow its instructions before heading to the hospital. The specialist they speak with gathers a brief medical history and, if possible, the last-known-normal time. At the same time, medics in transit alert Barnes-Jewish to activate its stroke team.

### **RESULTS TO DATE**

Without much data yet it's hard to draw conclusions on the card program's effect on treatment intervals, but from 2014 to 2015, BJH's average door-to-bolus time for ED administration of IV tPA dropped by 25% (from 40 minutes to 30), and its number of IV tPA patients jumped by about 50%.

Overall, Barnes-Jewish has worked to streamline its processes, and its stroke barometers have been trending positively for more than a decade. From 2005–2015, the hospital's average door-to-bolus time fell by 53% (from 64 to 30 minutes); arrival-to-CT-completed times fell by 53% (from 17 minutes to 8); and the number of IV tPA patients roughly quadrupled.

Multiple factors have contributed to the improvements, including best practices like starting the drug before the patient is removed from the CT scanner. "But what set that up," notes Gilmore, "was these witnesses and bystanders calling in ahead of time and talking to the neurologist, so the neurologist can get a lot of the inclusionary and exclusionary criteria out of the way. So as soon as the patient hits the door, we can do a quick stroke scale, scan 'em, finish it up and make a decision, right then and there.

"There are many opportunities for improving stroke care, and not everything has to be high-tech or expensive. The biggest advantage we've found is actually looking at our stroke process itself and seeing how you can change just a few little things here and there and make huge differences in the grand scheme."

*Scott Gilmore spoke about this program at the Gathering of Eagles in last February. Visit [gatheringofeagles.us](http://gatheringofeagles.us) for information on the 2017 conference.*

One of those patients had a hemorrhagic stroke; she received guideline-based differential blood pressure management. Both patients had call-to-therapy-decision times of approximately 35 minutes and good outcomes.

The cases, Walter and company concluded then, "illustrate the broad range of medical solutions made available by use of the MSU. The MSU... encompasses all major aspects of prehospital stroke medicine, such as prehospital organization of bridging to intra-arterial recanalization, prehospital inquiry regarding the need for surgical or other intervention with hospital experts via telemedicine, guideline-adherent and etiology-specific prehospital management of physiological variables (i.e., blood pressure), and prehospital decision-making about the target hospital (e.g., a more distant hospital with stroke unit, neurosurgery or neuroradiology vs. a closer hospital without those resources)."<sup>5</sup>

Note the second benefit there of getting the patient who may need more than tPA to a destination that can deliver it. Conversely, those with minor strokes can be identified and treated at primary stroke centers, leaving comprehensive stroke centers free for the more severe ones.

## **THE TELEMEDICINE OPTION**

The Cleveland Clinic's system includes one comprehensive and eight primary stroke/stroke-ready centers. But across that system a few years ago, just 15% of eligible patients were arriving in time for tPA.

The MSU is an attempt to change that. Clinic staffers traveled to Germany to observe its programs and talk to leaders, local EMS and vehicle manufacturers. "We tried to gather as many ideas as we could," says Peter Rasmussen, MD, director of the Clinic's Cerebrovascular Center and its medical director for distance health, "and just hone in on those that worked best for our particular location and facilities."

Funding, as it did in Houston, came from private sources. Excellance built the unit, which includes a mobile scanner and POC lab testing capabilities. As in Houston, dispatch occurs alongside EMS, which can call the MSU off if a stroke isn't the case. When it came to staffing, though, the Clevelanders changed course: Where the German and Houston projects included neurologists on their MSUs, Cleveland chose telemedicine to link patient to physician.



Vascular neurologists are a scarce resource, so the Cleveland Clinic turned to telemedicine to connect its stroke unit to physician expertise.

Cleveland Clinic



The reasoning: Vascular neurologists are a scarce resource, and serving on mobile units isn't the optimal use of their time.

"We didn't think that was a very cost-effective model," says Rasmussen. "We now have good technology that does reliable, HIPAA-compliant telemedicine interactions in a portable fashion, coupled with good availability of 4G broadband wireless connectivity. Germany initially experimented with telemedicine, and the reason it didn't work is that they didn't have the broadband capabilities that exist here in the United States."

## **In Memphis stroke incidence beats the national average by 37%. Its MSU is billed as the most comprehensive in the world.**

Instead the Cleveland MSU is staffed by a paramedic, critical care nurse, CT technologist and EMT driver. CT scans from the unit are obtained in a minute or two and sent to Clinic neuroradiologists, who confirm the stroke and its type. Neurologists can videoconference and monitor symptoms in real time during transport.

The telemedicine alternative was evaluated by Akron neurologist Ahmed Itrat, MD, and colleagues in a recent *JAMA Neurology* article; they reported a median duration of telemedicine evaluation of 20 minutes, and found times from the door to CT completion (13 minutes) and door to IV thrombolysis (32 minutes) were significantly shorter in the MSU group versus a control group (18 and 58 minutes, respectively).

Cleveland's data thus far is promising. Door-to-drug times are averaging about 20–30 minutes faster for MSU patients, and 9-1-1-activation-to-drug times about 40 minutes faster. And overall, around 40% of MSU patients are getting tPA—many within that first "platinum hour," when it works best—compared to 12%–18% across the system's EDs.

"Roughly what we've found," says Rasmussen, "is that almost any aspect of care that's delivered in an emergency room in our healthcare system is delivered equally as good if not better on the mobile stroke unit."

### **CT ANGIOGRAPHY**

In Memphis stroke incidence beats the national average by 37%. Its MSU is the first in the southeastern "stroke belt" and billed as the most comprehensive in the world.

That's largely due the CT angiography of which it's capable. The SOMATOM scanner has an automated gantry that moves the patient and provides as many slices (pictures) as can be obtained in the hospital. This allows visualization of blood vessels and the ability to identify patients who need endovascular interventions, neurosurgery and neurocritical care from the field.

These capabilities make the Tennessee unit the mobile equivalent of the ER at any primary stroke center.

"Imagine if you are able to both give IV tPA, as any primary stroke center does, and quickly identify the patient with emergent large-vessel occlusion," says Alexandrov. "Then you can bypass the nearest primary stroke center and go directly to the comprehensive stroke center. And then bypass the emergency room and bring the patient directly to the cath lab. The CT angiography images can be sent directly to the endovascular

# \* Two Years In With the Nation's First Mobile Stroke Unit

In the Houston area, its on-scene times are averaging 20 minutes

The first mobile stroke unit (MSU) in the United States was created in 2014 by the McGovern Medical School at the University of Texas Health Science Center at Houston (UTHealth).

"It is a research study," explains Stephanie Parker, RN, program manager for UTHealth's MSU. "We want to compare the treatment of stroke patients that are brought into the stroke receiving hospitals by the Houston Fire Department (HFD) ambulances versus those treated by the MSU. It is a controlled, randomized study. The mobile unit is on for seven days and off for seven days. This is a collaboration with the other four comprehensive stroke centers within the city of Houston: Harris Health, Memorial Hermann, Houston Methodist and St. Luke's Baylor. We are looking at the cost-effectiveness, patient outcomes and if permanent MSUs are feasible."

The MSU is funded by donations. There is no grant funding for the program. Many organizations, businesses and individuals donated money to fund the equipment and personnel.

**"We are hoping to show better outcomes with faster treatment. If we can, it will show a cost savings to the healthcare industry."**

The MSU is based out of the UTHealth Medical Center and embedded within the Houston 9-1-1 system. It is dispatched immediately if a stroke is suspected within an eight-mile radius of the hospital. If first responders suspect a stroke on a scene that's been dispatched as something else, they will add the MSU to the call. If the HFD



**The Houston MSU's box includes a power source for the CT scanner.**

UTHealth

ambulance is ready to leave the scene with the patient before it arrives, the MSU will meet them en route to a stroke center.

"We are considered just another apparatus of the HFD," says Parker. "We have developed a fantastic working relationship. They consider us one of their own. It is really a collaboration between us."

## THE MOVE TO TELEMEDICINE

For the project's first two years, the MSU's crew included a neurologist. That's since been scaled back. Staffing now consists of two off-duty HFD paramedics, Parker or another neurology critical care-trained nurse, and a CT technician. Technology now links them to a remote physician.

"When we get on scene with Houston FD units," explains Parker, "I will be wearing a headset and have a telemedicine camera in my hand. So the

telemedicine doctor, the paramedic on scene and I will all assess the patient for a stroke. If they meet the stroke protocol, we will put them in the MSU. Once the CT scan is done, it is transmitted to the doctor, and they read it and give orders. It is very protocol driven. We also transmit the scan to the receiving hospital physician. If the scan is negative and they are still having symptoms, we will start the tPA. We have an average on-scene time of 20 minutes. We will transport the patient based on their home healthcare provider. So far we have treated about 160 patients with tPA on the MSU.

"We can also assess for large-vessel occlusions and triage those patients to a comprehensive stroke center," Parker adds. "We can then alert the endovascular team at whatever comprehensive stroke center is our destination. We are also collecting that data and hopefully are getting those patients into the cath lab faster. In 2014-15 there were five endovascular studies published that showed the fastest average symptom-

onset-to-groin-puncture time was 270 minutes. Our average has been 172 minutes. So we are saving a significant amount of time with these patients.

"We are hoping to show better outcomes with faster treatment. If we can, it will show a cost savings to the healthcare industry. If we could prove this, we could get a higher reimbursement for MSUs on the front side and will provide an increase in the quality of life for the patient and save money long-term. That would show the value of the MSU and make the program sustainable." \*

## ABOUT THE AUTHOR



**Barry D. Smith** is an instructor in the Education Department at the Regional Emergency Medical Services Authority (REMSA) in Reno, NV. Contact him at [bsmith@remsa-cf.com](mailto:bsmith@remsa-cf.com).



## Inside the Gathering of Eagles: Utilizing Dispatchers Against Stroke

If time is essential for the stroke patient, it makes sense to enlist the earliest link in the 9-1-1 chain in the cause.

A program in San Antonio uses dispatchers to help launch a rapid response across multiple fronts when a call for a suspected stroke comes in.

“What we’re trying to do,” says David Miramontes, MD, FACEP, NREMT, medical director for the San Antonio Fire Department and an assistant clinical professor of medicine at the UT Health Science Center San Antonio, “is decrease the time from call to arrival at the emergency department, so we can then expedite the hospital response and get more people eligible to actually get tPA.”

When a suspected stroke is called in to 9-1-1, the dispatcher does a simple screening exam using MPDS card #28. They’ll ask why the caller thinks it’s a stroke and inquire about the FAST elements. Answers are scored to determine the likelihood of stroke.

If the total score exceeds 2, they notify the responding crew of a positive stroke score and instruct them to initiate rapid assessment, stroke center notification and speedy transit if alert criteria are met.

### AT THE SCENE

The first-arriving fire crew will assess the ABCDs and get vitals, then do a FAST assessment and obtain a blood sugar. Patients only get oxygen with a pulse oximetry below 94%, and nothing is given orally. Then, if the time last known well is less than six hours past, the crew starts readying for a rapid extrication, doing things like moving the patient toward the door and relaying any additional info to incoming paramedics.

The medic unit has its own choreography: On arrival crew members will

bring the stretcher to the patient as their first action, then take a report from the fire crew and do their own FAST exam. If signs are positive, they’ll initiate the stroke alert and radio the receiving facility. The goal is 10 minutes to load and go, and IVs, EKGs and other treatments wait till en route. Communication with the hospital is maintained throughout.

The hospital (there are nine primary and two comprehensive stroke centers in the San Antonio area) has its own responsibilities. The CT staff is notified of the stroke patient coming, and the ED nursing staff readies to work through an established checklist. When the patient arrives they’re taken straight to CT on the EMS stretcher, stopping only for a brief registration and safety check.

A nurse then takes what’s called an EMS time out report. A locally developed mechanism for standardizing patient handoffs, the report is based on the MIST acronym: *mechanism or medical complaint*, including age/sex; *injuries/inspection*; *vital signs*, including glucose and any changes; and *treatment*.

When the nurse calls “EMS time out,” all activities stop so full attention is on the report. It takes just 30 seconds, and the overall door-to-treatment goal is an hour or less.

### RESULTS TO DATE

Collectively these measures, implemented at the end of 2015, are helping shave down response intervals. Median on-scene times went from 16.3 minutes last December to 13.1 in February/March (a decrease of 20%), and median dispatch-to-hospital-door times from 33.3 minutes to 30.5 (a decrease of 8.4%).

*David Miramontes spoke about this program at the Gathering of Eagles in February. Visit [gatheringofeagles.us](http://gatheringofeagles.us) for information on the 2017 conference.*

suite, so the interventionist can see what kind of occlusion they will be dealing with when we bring the patient in.”

The Memphis truck was funded through a public-private collaboration that raised more than \$3 million to run it for three years. Built by Medical Coaches, it will be based in the city’s most stroke-heavy area but available throughout the metro region.

## “To make progress here, we need Medicare and third-party payers to recognize that this can be a cost-effective and lifesaving approach.”

When it came to staffing, UTHSC chose a middle ground between doc and box, using fellowship-trained, doctorally prepared nurses certified as advanced neurovascular practitioners.

“We wanted to explore the presence of a fellowship-trained nurse practitioner just because we want to understand all the nuances of the paramedics’ work and how we can best integrate mobile technologies

and treatment capabilities into it,” says Alexandrov. “The United States has the advantage of several hospitals and stroke teams and cities that have fellowship-trained nurse practitioners.”

In anticipation of an eventual switch to teleneurology and teleradiology, project leaders plan to run connectivity tests throughout the city and make sure there are no dead spots. (Cleveland did the same to ensure broadband reliability.)

The main goal of the Memphis project is to treat as many patients as possible in the first 60 minutes after symptom onset; leaders will also track 90-day functional outcomes. That’s something they expect to interest the payers who will, if the MSU is successful, have to sustain it beyond its initial three years.

“We are looking to address this issue with Medicare,” says Alexandrov. “To make progress here, we need Medicare and third-party payers to recognize that this can be a cost-effective and lifesaving approach.”

### ‘QUITE A SURPRISE’

Down in Houston they’re already incorporating lessons from the first two years of their MSU, including switching to the telemedicine option. But as far as data, try this: Forty-two percent of the patients being treated by the UTHealth MSU are being treated within the first hour of their symptoms. In the control group, that number is zero.

“What we can hopefully say we know,” says David Persse, MD, Houston’s EMS physician director and public health authority, “is that way more patients are being treated within the first hour of their symptoms with a mobile stroke unit than among those who go by ambulance to the hospital.”

That’s particularly exciting in light of another finding observed in Cleveland and elsewhere: “What we’re seeing is that when patients are given tPA early on, particularly within that platinum hour, even the most severe type of ischemic strokes, like carotid artery occlusions, frequently open up,” says Rasmussen. “That was very surprising to both our neurointerventionalists and stroke neurologists. We really hadn’t seen that before—it was quite a surprise.”

Challenges remain in all these systems. Politics have reared their head in more than one, with stroke centers vying for patients and a playing field they feel equitable. The optimal blend of staffing and technology has yet to be worked out. Supporting data still needs built. MSUs may be better turned over to the local EMS or fire department than operated through other entities.

And of course there’s funding. Operating an MSU with a critical care nurse, CT tech, paramedic and EMT could cost up to a million year.<sup>7</sup> Units so far generally aren’t operating 24/7 or covering whole cities. Costs and benefits have to be balanced. “These vehicles are so specialized; it’s not like we can use it as a regular ambulance while we’re waiting for strokes,” notes Persse.

An early projection in Houston calculated the total fixed and continuing costs for operating their MSU for five years at almost \$1.5 million, and concluded it would be cost-neutral if it resulted in seven additional patients completely recovering over five years.<sup>8</sup>

The Cleveland Clinic project is roughly breaking even, Rasmussen says, “but it likely is saving the healthcare system overall in terms of longitudinal care.” Its truck is at about half capacity serving roughly 550,000 people. Fewer than that wouldn’t be profitable.

All that considered, though, the promise held by mobile stroke units seems undeniable. And if and as they’re proven successful, they could even serve as a care model for other time-critical conditions.

“I think one way of looking at this truck,” says Rasmussen, “is perhaps as an entree to the larger concept of treating time-critical diagnoses. Perhaps trucks someday get converted over to be coresponders with traditional EMS to things like an accident or burn or suspected MI. All these things can begin to be treated at the scene. Maybe the mobile stroke unit is really just the beginning of the mobile time-critical diagnosis response unit.”

**Article references available online at  
[EMSWorld.com/12228322](http://EMSWorld.com/12228322).**

### Table 1: Outcomes in All Patients and Patients With Ischemic Strokes Receiving Thrombolysis Comparing STEMO Groups With Control Weeks

The PHANTOM-S (Prehospital Acute Neurological Treatment and Optimization of Medical Care in Stroke) study was a randomized-week, open-label clinical trial conducted in Berlin. Authors allocated weeks to either STEMO services (STEMO weeks) or routine care (control weeks). To evaluate STEMO effects on overall stroke care, they compared the prespecified outcome parameters of all patients included during STEMO weeks with those of control weeks. To assess the effects on stroke care in patients for whom STEMO was available and deployed, they compared patients for whom STEMO was deployed with patients of the control week. They found alarm-to-treatment times averaged 15 minutes faster during weeks when STEMO was available, and patients for whom it was deployed had a mean alarm-to-treatment time 25 minutes shorter than during control weeks. Thrombolysis rates were 21% during control weeks, 29% during STEMO weeks and 33% after STEMO deployment.

	Pts. w/STEMO deployment	Pts. during STEMO weeks	Pts. during control weeks
All patients	1,804	3,213	2,969
Pts. w/ischemic stroke treated w/thrombolysis	200	310	220
Pts. treated within 90 mins. of symptom onset	115	149	82
Deaths within 7 days (1 missing)	9 (4.5%)	14 (4.5%)	10 (4.5%)
Discharge home, post hoc	87 (43.5%)	134 (43.2%)	105 (47.7%)
Deaths within 90 days (4 missing)	33 (16.7%)	48 (15.6%)	27 (12.4%)

#### Times in tPA treatments in first assessment

Number of patients	192	300	218
Mean hospital door-to-needle time			42.0 mins.
Mean alarm to hospital arrival time	84.6 mins.	66.9 mins.	34.6 mins.
Mean alarm to imaging time	37.7 mins.	44.0 mins.	52.4 mins.
Mean imaging to treatment time	14.1 mins.	17.4 mins.	23.8 mins.
Mean alarm to treatment time (1 missing)	51.8 mins.	61.4 mins.	76.3 mins.

Source: Ebinger M, Winter B, Wendt M, et al, for the STEMI Consortium. Effect of the Use of Ambulance-Based Thrombolysis on Time to Thrombolysis in Acute Ischemic Stroke: A Randomized Clinical Trial. JAMA 2014, Apr 23–30; 311(16): 1,622–31.

# How the 'Neuroscience Care of the Future' Is Playing in Toledo

Younger patients helped drive the Mercy system to field an MSU

Most of the U.S. mobile stroke units thus far are in major cities: Houston, Cleveland, Denver, Memphis. Toledo, OH, isn't quite as large as those burghs, but its citizens are getting the same level of care with an MSU fielded by the Mercy Life Flight Network.

Sponsored by Mercy St. Vincent Medical Center, the MSU debuted in January 2016. It was in part a response to a demographic peculiarity: Stroke victims in the area skew young. The most-affected demographic in Lucas County is 46–65 years old.

"We have no idea why that is," says Julie Goins-Whitmore, RN, MBA, EMT-P, manager of the MSU and head of Mercy St. Vincent's neuroscience research and outreach. "But when you look at stroke patients, those younger ones have 20 years of work left in them! And if you have a stroke that takes away that ability to work and provide for your family, the costs are astronomical."

Mercy's unit is also unique in another way: It operates 24/7, a rarity among those first few American MSUs.

"We don't feel the citizens of Lucas County should have any different treatment at night compared to 9 in the morning," says Goins-Whitmore. "The bulk of our runs come during the day, but it's a point of commitment we've made. We don't want to miss patients. And I have to admit, it makes me a little happy when my pager goes off at 2 in the morning. We're thrilled to be providing this service."

The idea for Mercy's MSU originated with CEO Imran Andrabi, an MD. When preliminary research found it feasible, the Mercy Health Foundation kicked in a million-dollar grant to purchase the needed vehicle and equipment, which includes a CereTom portable CT scanner from NeuroLogica and telemedicine technology from In Touch Health.

Staffing consists of a critical care nurse, paramedic and CT technician. Because state regulations require two EMS providers on the vehicle, the nurses and techs became certified as EMTs.

"Based on their feedback, that was one of the best things we could have done," says Goins-Whitmore. "It gave them a great understanding of the way the prehospital environment works. A nurse in a hospital is different than a nurse with prehospital experience, and the CT techs, we joke that they never even get out of the basement. Putting them in a squad at somebody's house is going to be a major culture shock.



Mercy Health

So doing the EMT program proved to be a huge advantage in helping them get out and understand how EMS operates."

That was part of an extensive training curve, with new staffers also going through endovascular labs, witnessing embolectomies; doing rounds with neurologists and neurovascular docs; observing stroke alerts in emergency departments; watching craniotomies in the OR; and doing ambulance ridealongs with local EMS and even portable CT scans in the hospital parking lot. They also had to be familiarized with point-of-care lab testing.

"They really had, along with EMS ridealong time, a lot of scenarios where they would practice runs," says Goins-Whitmore. "We tried to put them through any possible situation they might encounter in the field."

As they've been with other mobile stroke units, the early returns in Toledo have been promising. CT scans are usually done within 10–15 minutes of the unit's arrival, and while only 8%–10% of MSU patients are getting tPA, they're typically getting it less than 30 minutes. On-scene times are averaging about 25 minutes. Total times from symptom onset to tPA are running less than two hours.

And besides providing direct help for victims of ischemic stroke, the entire Mercy system is learning more about its other patients as well. The MSU is seeing quite a few hemorrhagic stroke victims too—those are really its sickest patients, Goins-Whitmore says—and controlling blood pressure on a surprising 15%–20%.

Other lessons learned include keeping an open mind—MSU scene times, with the POC testing and physician consults, can seem long to those in traditional EMS. Providers should keep in mind that the hospital is basically coming to the patient, and the time spent is in that patient's best interests.

"This the neuroscience care of the future—it really is," says Goins-Whitmore. "We've had great reactions from EMS and from patients, the patients have had awesome outcomes, and actually we're finding that, even in patients who are stroke mimics, like your TIAs, those essentially are critical-care patients too. We kind of went in with this idea that we were going to treat stroke patients, but we're seeing such a variety of other neuro patients as well." 🌟



# Surviving a Stroke: How Almost Dying Taught Me How to Really Live

A close call in her 20s led to a more fulfilling life that's now spent helping others

By Amanda Dyar

It was the week of my final exams. I was a 27-year-old mother of two trying my best to balance college, work and everyday life. Being young, I thought I was invincible. I worked almost-80-hour weeks as a mental health worker with little to no sleep. There was just too much to get done in a day, and I was too stubborn to ask for help.

Around that same time, I had purchased an older farmhouse and was remodeling it as well. My body had reached its limit and started to wear down. I knew something wasn't right with me, but I didn't want to take the extra time during the day to think about it.

After work one day, I went home and crammed for a final exam. I was feeling extremely nauseated, and by the time I went to bed that night, I felt so unwell that I thought I was coming down with the flu or something. The next morning I awoke to a thunderclap headache that seemed to go from bad to worse within minutes. Never in my life had I endured such pain during a headache. I went on to college as normal that day, gritting my teeth through the pain and taking Tylenol, but the pain

**After almost a week of it, I caved and let someone drive me to the emergency room. I wasn't sleeping, eating or drinking and was extremely weak.**

never eased up. After almost a week of it, I caved and let someone drive me to the emergency room. I wasn't sleeping, eating or drinking and was extremely weak. I could barely stand without getting so dizzy that I would immediately fall down. It was a Sunday evening, and the emergency room was packed. I waited for hours for my name to be called and then gave them my list of symptoms. The hospital personnel then placed me in an empty room where I waited another two hours before the doctor saw me.

Once the doctor arrived, she checked my vitals and said I was dehydrated and needed to be put on an IV drip. She concluded I was just having bad migraines and sent me home. The hospital had placed some kind of painkiller in my IV that actually decreased the symptoms that evening, and I was able to actually drift off to sleep. By 2 a.m., though, I woke to ferocious jolt of pain, like my brain was literally on fire. The headache



**Amanda Dyar (center) and her children**

returned and was worse than before. I endured another week of horrible agony before returning to the emergency room again. They did a CT scan and told me there was nothing abnormal, and put me in a room with barely any light and a Coca-Cola (since caffeine is supposed to help with tension headaches), telling me once again it was just migraines.

This process went on and on for over a month and half. Things got so bad I actually wished for death. Never in my life had I imagined such pain.

One evening as I lay in bed, where I had been for over a month, I had a weird numbness. It started in my arm and slowly overcame my entire body. I couldn't move. I was paralyzed and afraid. A loved one came in to check on me, and I tried to talk, but nothing would come out. Tears rolled down my face as I struggled to communicate and thought, *This is it, I'm about to die.*

I later found out what I had experienced was a stroke—something most people would never associate with a girl in her 20s.

## **MIRACULOUS SURVIVAL**

I finally got in to see a neurologist, and by this time my eyes had crossed, and I was literally blind. Right off the bat the doctor thought I had some kind of condition that caused fluid to build up on my brain and did a spinal tap to drain some of it. He suggested I have surgery to place a device in my brain to help keep this fluid drained off.

The doctor ordered more brain scans and asked the hospital to send over the original CT scans from my ER visit over a month before. One morning at around 4 a.m., I was jerked out of bed by family members telling me to get up and get dressed. Apparently my doctor had tried to call me during the night, and when he didn't get an answer, he called some family members to come over to my house. He said I needed to get to the hospital ASAP. I wasn't even able to change out of my pajamas before being rushed to the hospital, where I was immediately checked

in and placed on blood thinners. He showed the scans to my family and pointed out the three clots on my brain—not one, but three! These clots had formed in the areas where blood drains off the brain in a condition called cerebral venous sinus thrombosis. I'd not only had a stroke, but a rare form of stroke that only impacts five people per million each year.

After about a week and a half in the hospital on an IV heparin drip, I was able to go home. I was told I had a rare genetic mutation that caused my blood to become hypercoagulant and would have to take blood thinners for the rest of my life. My doctor told me what I'd survived was miraculous and that I'd have had more of a chance of winning the lottery than experiencing and surviving what I had.

This terrifying endeavor caused me to come to terms with my own mortality. Both my parents died before age 50, my mother from a heart attack and my father from liver cancer. Here I was at 27, facing the prospect of death and coming out alive.

They never did find out what brought on the condition—perhaps it had always been there, dormant, waiting for something to coax it to the surface. Regardless of the cause, the horrible incident had at least one good result: I was determined to live the rest of my life to the fullest.

## STOP PUTTING IT OFF

It was difficult to come to terms with what had happened to me. It's still difficult looking back. I started to develop severe anxiety, because all I could think about was what if it happened again and how afraid I was of dying. I started to have incredibly vivid nightmares of lying in a casket with my children distraught in the background. I blamed myself for being so reckless with my health. Things had to change, and that had to be sooner than later.

I quit my stressful job a few months after coming out of the hospital. It was time for me to pursue my dreams and stop putting it all off until tomorrow. I had an ample amount of savings and decided I would do what made me happy from then on out.

I wanted to be a writer, a dream I'd had since childhood, and decided to start my own publication, *BioGamer Girl*. I had five degrees before I was 30, but not one of them was in writing. I had always let everyone else tell me what I should do, and this was the first time I was taking the reins in my own life.

I didn't have a lot of support when I started. I freelanced for any publication that would have me and started to slowly build my writing experience. I'd decided to write about video games and movies, since those had always been a big part of my and my children's lives. I wanted to do something we could enjoy as a family.

Today it has been over six years since I started my journey to a happier and more fulfilling life. My publication took off, and I've traveled the world to places like Germany, Spain and Poland to write about video games. I even had the opportunity to write for top industry publications like *Fangoria*, *The Escapist*, *Geek and Sundry* and *Blumhouse*.

My children and I even got to be in some blockbuster movies and television shows while making creations for our very own production

company. We have attended red carpet events and been invited to parties with celebrities I never thought I would meet. When I was 32, I marked the last item off my bucket list, then had to make an entirely new one! I never thought I would live to complete my first list, much less make a new one.

## TODAY IS ALL WE HAVE

The last two years I have pursued a career in marketing and PR, with my first job in the field being for Curse, Inc., a multimedia and technology company for gamers based in Huntsville, AL. Last November I decided to venture out of video games a bit and make more of a difference in the lives of people who had endured what I had.

## Having a stroke ended up being the best thing to ever happen to me, because it showed me how fragile life really is and all I was taking for granted.

I'd seen an opening for a position at Excellance, Inc., a well-known maker of ambulances and emergency vehicles. The company was paving the way for a new kind of ambulance that could actually treat patients suspected of having a stroke while on scene. I was impressed by the technological advances in the mobile stroke industry and thought it was a company I could make a real difference at. I knew if we could get the word out about these lifesaving units, there would be fewer people who'd endure the pain and suffering I did.

I am now 34, and it has been over seven years since I had a stroke. I often tell people my story, and many can't believe that happened to me. If you look at me today, there are no exterior signs of what I endured, but the memories and internal scars are still present.

Having a stroke ended up being the best thing to ever happen to me, because it showed me how fragile life really is and all I was taking for granted. That experience woke me up and put me on the road to a more fulfilling life—one I never dreamed I could have. I hope my story can help others realize their true potential and make them stop procrastinating in their own lives. Don't put off your happiness for another day, because sometimes today is all we have. ☺

## ABOUT THE AUTHOR

**Amanda Dyar** is public relations manager for Excellance, an Alabama-based manufacturer of ambulances and emergency vehicles. Contact her at [amanda@excellance.com](mailto:amanda@excellance.com).

## Vendors in the MSU Space

There aren't many mobile stroke units on U.S. streets yet, and not a lot of ambulance manufacturers who have yet established a footprint in the area. Frazer, Excellence and Medical Coaches are among those who have led the way.

Frazer owners John and Janice Griffin were instrumental in helping bring America's first MSU, based in Houston, to reality. More than three years ago they approached program architect James Grotta, MD, after he'd first presented the idea to members of the UTHealth Development Board. Grotta, director of stroke research at the Clinical Institute for Research & Innovation at Memorial Hermann-TMC and director of the local MSU consortium, had discovered the German model and wanted to bring it to the U.S. The Griffins offered to help.

"We really liked the possibilities of moving medicine forward," Laura Griffin Richardson, the company's president and CEO, told UTHealth media reps. "Our company likes to push the limits, and this had never been done before... Once everyone sees the possibility of putting a CT scanner in an emergency vehicle, the question is what else can we do?"

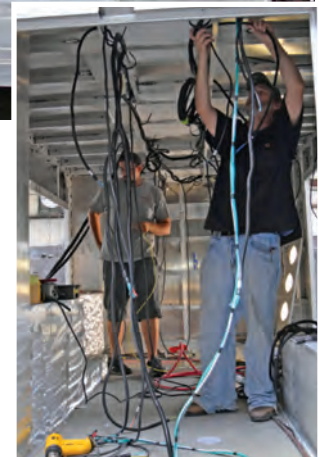
Because of the stroke unit's unique needs, Frazer engineered it from the ground up. It also built models that debuted in 2015 for the Mercy Life Flight program in Ohio and UHealth in Colorado. Learn more about Frazer's MSU at [EMSWorld.com/11647059](http://EMSWorld.com/11647059).

Meanwhile, Excellence was developing a model for the Cleveland Clinic, which also hit the streets in 2014 (for more: [EMSWorld.com/11569671](http://EMSWorld.com/11569671)), and Medical Coaches would do one for the University of Tennessee Health Science Center. Medical Coaches actually built the first mobile head scan CT unit for EMI Medical in the 1970s, and continued until EMI left the market ([seemedcoach.com/products/lithotripsy/](http://seemedcoach.com/products/lithotripsy/)). Canada's Tri-Star Industries is also soon to enter the game.



**Excellence constructs a new mobile stroke unit.**

Excellence



The most popular CT scanner about MSUs thus far is the CereTom from Samsung subsidiary NeuroLogica. The University of Tennessee Health Science Center's model uses the more powerful SOMATOM Scope from Siemens; Tri-Star is working with Siemens as well.

InTouch Health has been the telemedicine vendor for the Cleveland, Mercy and Colorado projects; its RP-Xpress is a portable device that uses standard 802.11 Wi-Fi. In Houston, UTHealth is using Max Life's system, which users can test at EMS World Expo, October 3-7 in New Orleans. ☼



**Max Life's advanced telemedicine system.**

Max Life



**Max Life's telemedicine display.**

Max Life