

Taking Acute Stroke Care to the Streets: Mobile Stroke Treatment Units

Specialized CT-equipped ambulances are showing dramatic reductions in time to treatment for acute stroke.

**BY M. SHAZAM HUSSAIN, MD; SEBY JOHN, MD; ANDREW RUSSMAN, DO;
AND PETER RASMUSSEN, MD**

Stroke is one of the most time-sensitive situations in medicine. It is estimated that a patient who has an ischemic stroke loses approximately 1.9 million neurons per minute.¹ Acute stroke therapy has a significant time-dependent effect, where shorter time to treatment results in an increased chance of a positive outcome.^{2,3} Data from the Target: Stroke initiative suggest that for every 15-minute reduction in the time to treatment, 3.2% more patients are able to ambulate, and 5.1% more patients are able to return home.⁴ Although significant efforts have been made and national standards have been implemented to improve the rate and speed of acute stroke treatment, the overall rate of acute stroke treatment is low, and many patients are still not treated in a timely fashion.

Mobile stroke treatment units (MSTUs) have been developed to allow for treatment in the field, resulting in substantially decreased time to treatment.⁵ MSTUs include an on-board CT scanner, laboratory equipment, and specialized stroke-trained personnel to care for the patient. In Cleveland, Ohio, the on-board staff consists of a registered nurse, paramedic, emergency medical technician, and CT technologist. A neurologist evaluates the patient via telemedicine in the Cleveland unit, although other MSTU programs have a physician on board.

HOW IT WORKS

For any ambulance dispatch for a possible stroke within the city of Cleveland, the emergency medical services dispatcher activates both the standard city ambulance and the MSTU. The city emergency medical services team typically arrives first and performs an initial patient evaluation (including the Cincinnati Prehospital Stroke Scale). If a stroke is suspected, care is transferred to the MSTU team. The MSTU team will make a quick initial assessment of the patient and take his/her vital signs. A CT scan of the

patient's head is performed, and the results are transferred via a cellular network to the main campus of the Cleveland Clinic. There, the neuroradiologist and stroke neurologist view the CT scan. Intravenous (IV) access is achieved to perform laboratory testing (including complete blood count, serum glucose, and international normalized ratio [INR]) and to allow for administration of IV medications if necessary. The neurologist then evaluates the patient via telemedicine, which includes performing a National Institutes of Health Stroke Scale assessment with the assistance of the on-board team. If indicated, treatment—including IV thrombolysis—can be initiated. The patient is then triaged and transported to the appropriate hospital based on symptom severity and the patient's preference.

INITIAL RESULTS

A recent presentation from our Pre-hospital Acute Stroke Treatment research team compared intervention times between the first 100 patients evaluated on the MSTU (from July 2014–November 2014) and 53 comparable patients presenting to emergency rooms at Cleveland Clinic

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THE CLEVELAND CLINIC FOUNDATION'S MOBILE STROKE TREATMENT UNIT

"Our critical care nurse and paramedic will assess the patient, hook them up to our cardiac monitor, insert IVs, as well as draw the laboratory samples. Then, we will bring in a physician virtually to examine the patient."

—Stacey Winners, MSc, RT(R)(CT), EMT

<http://bit.ly/CCFMobileStrokeVideo>



TABLE 1. MEDIAN TIME TO KEY MANAGEMENT MILESTONES

Metric	MSTU Group (n = 100)	Control Group (n = 53)	P Value for Difference
Alarm to CT completion	33 min (IQR, 29–41 min)	56 min (IQR, 47–68 min)	< .001
Alarm to CT interpretation	44 min (IQR, 39–52 min)	64 min (IQR, 54–76 min)	< .001
Alarm to INR result	25 min (IQR, 22–34 min)	79 min (IQR, 70–105 min)	< .001
Alarm to IV tPA	55.5 min (IQR, 46–65 min)	94 min (IQR, 78–104 min)	< .001

Abbreviations: INR, international normalized ratio; IQR, interquartile range; IV, intravenous; MSTU, mobile stroke treatment unit; tPA, tissue plasminogen activator.
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hospitals in the Cleveland area during 2014.⁵ All control patients had a stroke alert called within 30 minutes of their hospital arrival and presented during the window in which the MSTU operates (8:00 AM–8:00 PM). The 100 patients evaluated by the MSTU were diagnosed as follows: 33 with probable acute ischemic stroke, 30 with possible acute ischemic stroke, four with transient ischemic attack, five with intracerebral hemorrhage, and 28 with other diagnoses. IV tissue plasminogen activator (tPA) was administered to 16 of the 33 patients initially diagnosed as having probable acute ischemic stroke (48.5%), which is much higher than the national average of 5% to 8%. Median time from alarm (vehicle dispatch) to specific management milestones was significantly shorter in the MSTU group compared to the control group, including the time from alarm to IV tPA (the primary endpoint) (Table 1).

The Cleveland Clinic MSTU is the only unit in the world that solely utilizes telemedicine for physician presence in the interaction; all other units have a physician on board. Telemedicine has been reliable, successfully completed in 99 (99%) patients.⁵ The single failure was attributed to crew error and was preventable. There were six instances of video disconnection, all lasting < 60 seconds, and they did not affect clinical care. If the telemedicine connection cannot be restored for any reason, the specialized on-board crew communicates with the physician by phone and rapidly transports the patient to the appropriate facility.

There are also other potential benefits to MSTUs. Intracranial hemorrhages have been successfully treated in our MSTU, including a patient who required anticoagulation reversal. After laboratory testing showed an initial INR of 3.2, four-factor prothrombin concentrate complex was administered. Fifteen minutes later, a repeat INR upon arrival in the neurological intensive care unit showed

complete reversal.⁶ MSTUs can also be effective in triaging larger strokes, allowing patients with large vessel occlusion or hemorrhage to be transported to larger centers with the resources to properly care for their condition (eg, interventional angiography suites).⁷

THE FUTURE OF MSTUS

Data from our MSTU confirm data from two centers in Germany as well as preliminary data from Houston, Texas.^{8–10} Published studies have shown that the time to treatment has been consistently reduced, and rates of IV thrombolytic administration are substantially higher than the national average. Although these factors are beneficial to patients, research is ongoing to

analyze both outcome improvement and cost-effectiveness. However, preliminary data and experience of existing MSTUs are so compelling that many centers and cities are exploring the possibility of implementing MSTUs. The future appears bright for this new paradigm in stroke care. ■

M. Shazam Hussain, MD, is with the Cerebrovascular Center, Neurological Institute, Cleveland Clinic in Cleveland, Ohio. He has stated that he has no financial interests related to this article. Dr. Hussain may be reached at HUSSAIS4@ccf.org.

Seby John, MD, is with the Cerebrovascular Center, Neurological Institute, Cleveland Clinic in Cleveland, Ohio. He has stated that he has no financial interests related to this article.

Andrew Russman, DO, is with the Cerebrovascular Center, Neurological Institute, Cleveland Clinic in Cleveland, Ohio. He has stated that he has no financial interests related to this article.

Peter Rasmussen, MD, is with the Cerebrovascular Center, Neurological Institute, Cleveland Clinic in Cleveland, Ohio. He has stated that he has no financial interests related to this article.

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