If stroke advocacy groups and doctors have one goal in their public education campaigns, it’s speed. The FAST acronym used as a mnemonic to help detect signs of stroke changed only marginally to the current American Heart Association-endorsed BE FAST, in order to include balance and eye problems. If “location, location, location” is the unified directive of real estate agents, “speed” is the repetitious rally cry of cerebrovascular-minded physicians.

Targeting this facet for improvement in Cleveland now means deploying a truck-like ambulance for stroke treatment to the patient. The vehicle, known as mobile stroke unit, operates inside the city of Cleveland proper under the guidance of the Cleveland Clinic and in cooperation with Cleveland EMS. Previously, two German medical centers have successfully launched mobile stroke units. From the time the alarm sounds for a stroke case, they have been able to begin treating patients within 32 minutes.

Practical Neurology spoke about the unit with Shazam Hussain, MD, Head of the Stroke Program at Cleveland Clinic’s Cerebrovascular Center.

Can you give us a little background on the birth of the mobile stroke unit, including what logic went into creating it?

Dr. Hussain: When we’re in the situation where someone has stroke symptoms, time is really of the essence. We know that if a person has a blocked artery and it’s a lack of blood flow to the brain, you lose about two million brain cells per minute. That means every minute we can save in terms of getting their artery open is a benefit to that patient.

The trouble with stroke is that until you get a CAT scan of the brain, you really don’t know if it’s a blood clot type of stroke versus a bleeding type of stroke. Until you know that information you really can’t offer definitive treatment to the patient.

The idea of the mobile stroke unit has actually been around for a bit of time, but it’s just now that technology has come to the point where we’re actually able to realize it. Germany actually had the first units. The University of Saarland, they were first ones to do it and have probably doing it for seven to eight years. They have much different model where they put physicians on the truck, so a neuroradiologist was on board to interpret the imaging. That’s of course not practical in the United States.

But in addition to having CAT scanners that are small enough to fit inside an ambulance, we also have better technology for transmission of images. Using LTE networks and 4G we’re able to transmit images much more quickly so that they can be read at a remote location. In addition, we can use telemedicine to allow our physicians to beam into the vehicle and see the patient, make an examination, and talk to family and the crew on the truck.

Can you walk us through what happens from the time the unit gets an emergency call to the completion of care?

Dr. Hussain: We’re working with city of Cleveland on this, so if someone has stroke symptoms and they call 911 the Cleveland EMS dispatchers will take the phone call. They already have an algorithm they use to identify possible
stroke, and when they identify that they will dispatch both a regular EMS ambulance and notify us to send the mobile stroke unit to the scene.

Cleveland EMS will typically get there first and they will make an assessment to make sure it actually is a stroke. Sometimes they’ll find it’s something else like hypoglycemia or some other condition that doesn’t warrant us, in which case they will call us off. Otherwise we usually arrive within a couple of minutes of their arrival. They will then get the patient on the mobile stroke unit to first do the CAT scan and transmit those images over to our Cleveland Clinic main campus where the neuroradiologists and neurologists can start interpreting them. They will also be drawing lab work on the vehicle—we have point of care lab testing for CBC, INR, glucose and other basic labs that we can do on the vehicle that would be needed to give the tPA treatment. At the point, they’ll get the patient out of CAT scanner and can drop the telemedicine unit—it hangs off a little arm at the top, and swings down so that we can see into the vehicle and do an examination.

Based on the information gathered we can determine what kind of stroke the person is having and depending on what kind of stroke we can start initiating treatment. For ischemic-type strokes we see if they are a candidate for tPA and in that case we can get the tPA started right on the vehicle. In the case of a bleeding-type stroke we can also lower their blood pressure if they’re on blood thinners. There are a lot of treatments we can give depending on the type of stroke we’re seeing.

From there, we determine based on the severity of stroke and the location in the city and send them to the most appropriate hospital. If it’s a primary stroke center, we can send them the more routine strokes or if it’s a more complicated stroke that might need to have a catheter-based treatment, we can send them to centers with interventional capabilities. For strokes that might need ICU care, they will come to our main campus.

A real benefit of this model seems that not only are you getting to the patient in time, you are also getting him or her to the appropriate facility for their needs.

Dr. Hussain: I think this is a really intriguing thing about this model. Normally when someone has stroke symptoms the model in the US is just to get them to the closest center. But stroke centers come in varieties. Currently, a patient might first go to the smaller center but once they’re evaluated they would have to be transferred to a bigger center. In that case you end up losing a lot of time.

People might say, “well, rather than waiting for the vehicle to come, if we’re really close to a smaller hospital, wouldn’t it be better to just go there so they can start getting care in a hospital?” It turns out when we look at the time when they enter the ambulance to the time treatment is delivered and compare that to the time a person would enter the hospital and the time they would receive treatment in a hospital, our times are very similar and in fact bit better than what we get inside a hospital.

What kind of results have you seen so far? How are you defining success?

Dr. Hussain: We launched this on July 18, 2014 and the main thing we’ve been focused on is the time to treatment. We’ve been comparing not only the time they get in the ambulance to the time we treat them—we’re trying to compare it to the door-to-needle time in hospitals. Nationally if you look at that metric we aim for 60 minutes but only half of patients will achieve that standard. When we look at the mobile stroke unit we have been much faster than that: our average time is about 30 minutes from the door of the ambulance to when we treat them.

Taking that a step further, if we take it from the 911 call or ambulance dispatch it would typically take them 20 to 30 minutes to get that patient to a hospital and then you would add on another 60 minutes for the treatment to take place. Our dispatch times—the time to scene—have been about 10 to 15 minutes. We’re in the process of collecting outcome measures and we want to analyze the cost-effectiveness of this strategy. Given the strong data out there that the faster you treat stroke patients, the better the outcomes, that should correlate to less disability meaning less cost for both patient and the healthcare system.

Do you have any plans to publish your data and go the peer-reviewed route?

Dr. Hussain: We actually have submitted abstracts to the international stroke meeting in February and will be presenting our time data. We’re also in the process of writing several papers on different aspects.

What are the financial implications of the mobile stroke unit, and how does the cost-benefit analysis breakdown compare to traditional stroke care or traditional telestroke care?

Dr. Hussain: Everybody’s concerned about the cost, so this a question that needs to be addressed. There’s the cost of the physical unit, which is probably around $1 million and then staffing costs. We are going to have to show that if we can improve outcomes and improve disability, that this is going to translate into cost-savings down the line. I think in the current healthcare environment where people
are very concerned about cost that we have to prove this is going to be cost-effective.

**Do the recent results of the MR CLEAN trial impact your approach in anyway?**

**Dr. Hussain:** Not so much our approach, but it does add emphasis to the type of model we're proposing. I think one of the big reasons it was a positive trial was because they were directing the most severe strokes to one center that had the interventional capabilities and didn’t have to stop at a smaller center before transferring to a bigger center.

I think the time-to-treatment was one of the big reasons it was a positive trial. Given that, I think having a mobile stroke unit where you get to the patients very quickly, see how severe their stroke is, and get them to the right place the first time fits in very well with the message of MR CLEAN.

I don’t know the exact number but we've done about six or seven catheter-based treatments on patients who came in from the mobile stroke unit and we've saved a lot of time. In one of the cases we were near one of the smaller hospitals and normally the patient would go to the smaller hospital first and then go to the interventional center. Usually the total time of that process would be about four to four and a half hours. But by treating that patient with the mobile stroke unit we were able to take the patient to the correct hospital in an hour. Looking at the time-to-catheter it was hours faster.

**What do you think is in store for mobile stroke units in 2015? What do we need to learn or do to improve their chances at success?**

**Dr. Hussain:** It’s a very innovative model and I think there’s a lot of excitement in general about this concept. Besides our self and Houston, which are the only two in the US that have the units, I think there are other centers around the country that are looking closely and trying to develop and launch these units.

Our big things are going to be looking at the data. We’re pretty confident about the time element and really focusing on outcomes and cost. Even with the technology itself, we’re still trying to refine certain parts of the process to see if we get the time down even a little more.

*M. Shazam Hussain, MD is Head of the Cleveland Clinic Stroke Program*