Evidence for the Increased Use of Mobile Stroke Units

Mobile stroke units have shown impressive reductions in time to treatment for acute stroke, but cost remains a challenge to widespread adoption.

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Time is critical in the treatment of acute stroke. It is estimated that a patient experiencing an ischemic stroke loses approximately 1.9 million neurons per minute.[1] Although improvements have been made to emergency department stroke care, many patients nationally still do not receive timely treatment. Acute stroke therapies such as thrombolysis with intravenous tissue plasminogen activator (IV tPA) or intra-arterial stroke therapy are time dependent, with shorter times to treatment resulting in a better chance of positive outcome.[2,3] Data from the Target Stroke initiative suggests that for every 15-minute reduction in time to treatment, 3.2% more patients are able to ambulate and 5.1% more patients are able to return home.[4]

Evidence for improved outcomes and cost-effectiveness of mobile stroke units (MSUs) are emerging. MSUs are specialized ambulances with an on-board CT scanner, laboratory equipment, and specialized personnel trained to care for stroke patients (Figure 1). Our MSU team at the Cleveland Clinic includes a critical care nurse, paramedic, emergency medical technician (EMT), and a CT technologist who is also cross-trained as an EMT (Figure 2). The physician's presence is via telemedicine, although other MSU programs may utilize a physician or advanced practice provider on board. The MSU concept is gaining traction in the United States and around the world, with at least 15 active programs and many others in development.

Photography by Russell Lee.

Figure 1. The MSU at the Cleveland Clinic.

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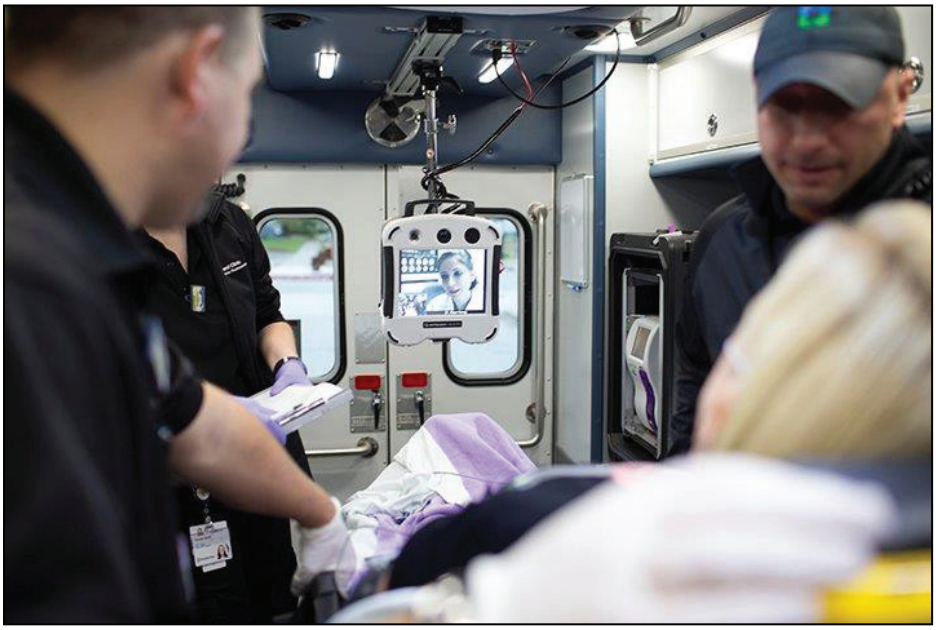

Figure 2. The MSU team at the Cleveland Clinic includes a clinical care nurse, paramedic, EMT, and CT technologist.

TIMES TO TREATMENT

Published data from our program at the Cleveland Clinic as well as programs in Germany have shown substantial reductions in time to treatment.[5-8] Initial published data on MSUs were from the University of Saarland, showing a 41-minute reduction in time to treatment in their week-on, week-off randomized controlled trial of MSU treatment.[7] The STEMO project in Berlin, Germany, subsequently showed a similar 24-minute reduction in time to treatment and an effective tPA utilization rate of 50%.[8]

Our group published our experience with the first 100 patients evaluated on the MSU (July 2014–November 2014) and 53 comparable patients presenting to the emergency department at Cleveland Clinic hospitals in or adjacent to the city of Cleveland, Ohio, during 2014.[6] All control patients had a stroke alert called within 30 minutes of their hospital arrival, and all presented during the time window that the MSU operates (8:00 AM–8:00 PM). Of the 100 MSU patients, 33 were diagnosed with probable acute ischemic stroke and another 30 with possible acute ischemic stroke. Five patients had intracerebral hemorrhage. Twenty-eight patients had nonstroke diagnoses, half of which were other neurologic emergencies (ie, seizures). IV tPA was administered to 16 of 33 patients initially diagnosed with probable acute ischemic stroke—a rate of 48.5%, which is much higher than the national average of 5% to 8%.

Times to treatment were significantly reduced in the MSU group compared with the control group. A particularly interesting new metric is the median time from alarm (vehicle dispatch) to treatment. In our study, alarm-to-treatment time in the MSU group was 55.5 minutes versus 94 minutes in the control group, saving approximately 40 minutes of time to treatment. Even in the preliminary phases, MSUs have demonstrated reduced alarm-to-treatment times as compared with the best published alarm-to-treatment times for patients treated in the emergency department.[5] In addition, a significant proportion of patients are treated within the "golden hour," the first hour after symptom onset, which is very rare in traditional systems where patients are treated within the emergency department.[5,9]

MSUs can also be valuable for triage of emergent large vessel occlusion, allowing the most effective system of triage. With the full assessment of a neurologist in the field, patients can immediately be directed to interventional-capable centers, saving critical time and often reducing hours off time to treatment.[10] CTA has been performed on MSUs, which can greatly aid in triage decisions and further reduce time to interventional therapy.[11]

EMERGING OUTCOME DATA

Research is ongoing to assess the outcome benefit and cost-effectiveness of MSUs, although preliminary data suggest that patient outcomes are improved for those treated on MSUs. Data from the STEMO group in Germany revealed reduced mortality and better modified Rankin Scale (mRS) scores of 0 to 3 in those treated on the MSU; however, mRS scores of 0 to 1 were no different between groups.[12] Preliminary data from the Cleveland Clinic MSU also show reduced length of stay, reduced mortality, and improved outcome. Further data will be needed, but given the strong link between time to treatment and outcome, the results will likely be favorable.

COST-EFFECTIVENESS

Cost remains a concern of the MSU model. The cost of building the MSU can range from $700,000 to $1,500,000, with additional yearly costs for personnel, medications, and equipment. However, when looking at the long-term costs of stroke, improving outcomes, and having patients with less-disabling strokes, MSU implementation could yield substantial costs savings. An analysis from the University of Saarland estimated that approximately €18,000 would be saved per patient treated via MSU.[13] The STEMO group also reported that despite a net annual cost of €963,000, the cost-effectiveness ratio was €32,500 per quality-adjusted life-year, which is generally considered positive from a cost-effectiveness perspective. The incorporation of telemedicine may further improve cost-effectiveness, as one physician can cover many MSUs as well as other duties rather than being committed to travelling with the ambulance. These and other strategies may reduce the overall cost of such programs and will aid in further proliferation of MSUs for stroke care.

CONCLUSION

The future appears very bright for MSUs. The improvement in time to treatment is now well established in multiple data sets from around the world. Although further research on improved outcomes and cost-effectiveness data are ongoing, preliminary data are positive. It is an exciting concept for patients, practitioners, and systems of care, with continued innovation and refinements on the horizon. ■

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