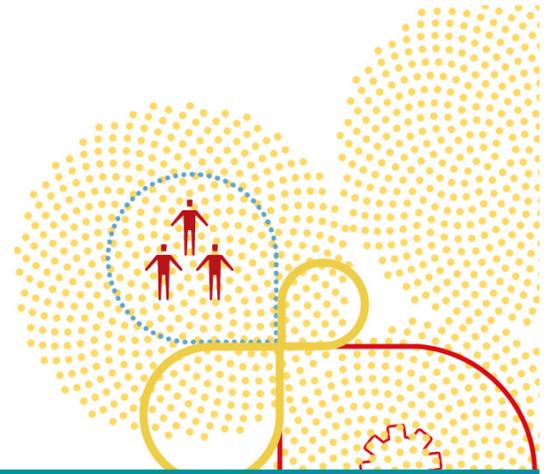




MAYO CLINIC ROBERT D. AND PATRICIA E. KERN  
**CENTER FOR THE SCIENCE OF  
HEALTH CARE DELIVERY**



## CLINICAL PRACTICE BRIEF

# Deploying and studying the healthcare delivery outcomes of a fully scaled, virtual Mayo Clinic acute stroke care: a model for high value, specialty telemedicine of the future

DEMAERSCHALK BM, BOYD EL, BARRETT KM, GAMBLE D, WIESER J, HENTZ J, SONCHIK S, COMER M, CHANG YH

### STUDY BACKGROUND

Stroke is one of the most significant health problems in the United States and with an aging population it is projected to continue to increase significantly. To contain the devastating effects of stroke it is pertinent to have access to effective preventive therapy, early critical care, and rehabilitation. With this importance on effective treatment, telemedicine applied to stroke care has demonstrated to extend the reach of stroke providers and improve the quality and timeliness of patient outcomes. Patients with acute ischemic stroke who present to community hospitals (non-stroke center) 'remote/rural' to the Mayo Clinic Hospital who are served 'remotely/virtually' via telemedicine by neurologists on the Mayo Clinic stroke team comprise the 'remote' group. Patients with acute ischemic stroke at Mayo Clinic Hospital (stroke center) who are served directly by neurologists on the Mayo Clinic stroke team comprise the 'standard' group. Our study aims to examine telemedicine as it applies to stroke care and the effect on patient outcomes, including the timeliness of response, quality of care, safety, morbidity and mortality when compared to standard stroke center care.

### RESULTS

There was no difference in the remote vs standard groups in identifying and making the correct decision on which patients to administer IV thrombolysis. For those patients who received IV thrombolysis, stroke alert activation to start of treatment was 62 min (remote) vs 71 min (standard) (p-value <.05). There was no difference among the groups

### KEY FINDINGS

- Evidence-based stroke thrombolysis eligibility decision making, thrombolysis administration, and thrombolysis emergency stroke metrics were uniformly excellent for the remote group when compared to standard.
- However, evidence-based stroke hospitalization and discharge metrics, for example length of stay, venous thromboembolism prophylaxis, antithrombotic, anticoagulant and cholesterol lowering medication administration (when indicated), and rehabilitation assessment were inferior for remote group when compared to standard.

### RECOMMENDATIONS

This healthcare delivery study highlights the importance of a continued stroke team presence, through to discharge. We recommend including an in-hospital stroke patient follow up pre-discharge telemedicine consult to ensure patients at remote telemedicine sites have met important pre-discharge quality metrics that have been shown to improve post stroke morbidity and mortality. Future studies are required to examine optimal post-emergency stroke telemedicine consultation delivery and reimbursement models.



in complication of symptomatic ICH, administration of IV tPA, and mortality. Patients in the remote group were less likely to have VTE prophylaxis, be administered antithrombotic therapy and be discharged on anticoagulation and cholesterol reducing treatment (Table 1). The initial acute care hospital length of stay was longer for remote group by one day. The timeliness from symptom onset to EMS, ED and stroke team response was evaluated (Figure 1). Compared to the standard group, the patients in the remote group had a longer time to stroke alert activation (135 vs 89.5 minutes, p-value <0.001), had longer time to stroke team examination (148 vs 99 minutes, p-value <0.0001), and longer time to treatment (159 vs 129.5 minutes, p-value <0.001).

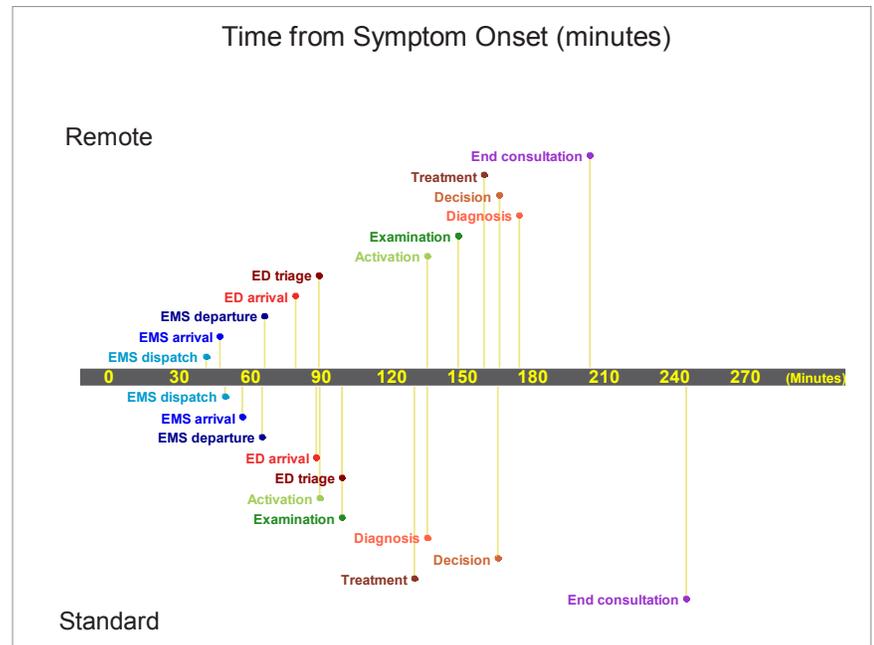
## METHODS

A retrospective electronic and paper record review of prospectively entered quality/performance stroke/telestroke patient catalog data were completed for 1000 adult patients (age ≥ 18) who presented with an acute ischemic stroke syndrome to the Mayo Clinic Hospitals in Arizona (730 patients) and Florida (270 patients). The primary outcome of interest was the percentage of accurate decision making for eligibility of IV tPA administration, and this was assessed by blinded adjudication using the tPA inclusion/exclusion criteria by ASA/AHA. We evaluated whether the differences existed in the primary outcome and the secondary outcomes (the administration of IV tPA, complication, discharge outcomes and the timeliness of the stroke team responses) between the remote and standard groups.

**Table 1**

	Remote (N=500) n (%)	Standard (N=500) n (%)	Total (N=1000) n (%)	p value
Primary Outcome				
IV tPA correct decision	478 (95.6%)	484 (96.8%)	962 (96.2%)	0.32
Secondary Outcomes				
IV tPA administered	200 (40.1%)	180 (36.0%)	380 (38.0%)	0.18
Post thrombolysis symptomatic ICH	13 (6.5%)	5 (2.8%)	18 (4.7%)	0.09
Favorable outcome (NIHSS:0-1 or mRS:0-1 or GOS:0-1)	104 (20.8%)	173 (34.6%)	277 (27.7%)	<0.001
Death	26 (5.4%)	19 (3.8%)	45 (4.6%)	0.25
VTE prophylaxis	215 (45.8%)	312 (63.4%)	527 (54.8%)	<0.001
Antithrombotic therapy administered by the end of hospital day 2	338 (84.5%)	422 (89.6%)	760 (87.3%)	0.02
Discharged on anticoagulation	78 (56.1%)	128 (64.3%)	206 (60.9%)	0.01
Discharged on cholesterol reducing treatment	299 (68.3%)	348 (71.8%)	647 (70.1%)	<0.001
Assessed for or received rehabilitation services during hospitalization	364 (86.3%)	445 (92.5%)	809 (89.6%)	0.002
Length of stay for initial acute care hospitalization (days), median (IQR)	4 (3-6)	3 (2-5)	3 (2-6)	<0.001
Time from stroke alert activation to start of treatment (minutes), median (IQR)	62 (21-173)	70.5 (59-80)	66 (54-81)	0.03

**Figure 1**



## ROBERT D. AND PATRICIA E. KERN CENTER FOR THE SCIENCE OF HEALTH CARE DELIVERY

Through the center, Mayo Clinic will continue to lead the way in patient-centered health care innovation. By developing best care practices at Mayo Clinic and with partners across the country, Mayo Clinic is working to alleviate the nation's health care problems and improve the standard of care nationwide. Combining data analysis, engineering principles and health care delivery research, the center puts its theories, models and care delivery methods through the scientific rigor necessary to determine whether or not they improve patient care, outcomes and cost. Ideas developed and tested in the center can be seamlessly implemented into the Mayo Clinic practice.