Telestroke: Variations in Intravenous Thrombolysis by Spoke Hospitals

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Background: Telestroke extends stroke expertise to underserved hospitals and facilitates treatment with tissue plasminogen activator (tPA). We investigated the variability in tPA treatment rates across 2 large telestroke networks—consisting of hubs at Georgia Regents Medical Center (GRMC) and Medical University of South Carolina (MUSC) and their affiliated spoke hospitals—to identify spoke-related factors predictive of greater tPA use. *Methods:* Observational study of tPA treatment rate at 32 spoke hospitals within the GRMC and MUSC telestroke networks. Spokes were characterized by primary stroke center status, local stroke nurse coordinator, local neurology support, hospital size, post-tPA management strategy, whether the spoke hospitals paid to participate in the network, and whether the hub or the spoke hospital initially proposed the telemedicine linkage for consultations with a remote stroke specialist. Primary outcome was tPA treatment rate adjusted for emergency department (ED) volume. *Results:* There was substantial variation in the adjusted tPA rate across spokes (range, .85-8.74 administrations/10^4 ED visits/year). Only spokes with a stroke nurse coordinator ($4.75/10^4$ ED visits/year versus $2.84/10^4$ ED visits/year, $P = .03$) were associated with higher tPA use. *Conclusions:* The application of telestroke has variable results on tPA delivery in spoke hospitals. However, the presence of a stroke nurse coordinator at the spoke facilitated treatment of ischemic stroke cases with tPA. **Key Words:** Telemedicine—stroke—tissue plasminogen activator—telestroke.

Despite modest increases over the last few years, intravenous (IV) tissue plasminogen activator (tPA) remains underused in acute ischemic stroke.[1] In small and rural hospitals that often lack local neurologists, tPA administration is further reduced.[2] Telestroke removes geographic barriers to stroke care, linking stroke experts

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with underserved hospitals, thereby improving tPA decision making, facilitating tPA administration, and improving functional outcome.[3-5] Telestroke is cost effective from the societal and hospital perspective, and hub-and-spoke networks have become a widespread and expanding practice model.[6-8]

However, there are significant barriers to establishing and maintaining a telestroke program.[9] To improve stroke care, telestroke must become part of routine decision making in the emergency department (ED) at the spoke hospitals. This requires "buy in" by administrators and local physicians, education of health-care personnel (including emergency medicine physicians, hospitalists, nurses, and prehospital providers), establishment of protocols of care, and user comfort with telemedicine, and the associated information and communication technologies. Given the costs to initiate and maintain a telestroke network, potential hubs and spokes need to understand the factors that predict clinical success (measured through increased tPA administration) to determine whether or not they will have a return on their investment.

Previously, we conducted a qualitative analysis of the telestroke networks at the Georgia Regents Medical Center (GRMC) and Medical University of South Carolina (MUSC) by interviewing key stakeholders at the 2 hubs and selected spokes to gather a variety of perspectives on key enablers of telestroke assimilation.[10] Our objective in this study was to examine the variation in usage of telestroke for decision making related to tPA administration across spokes and to identify spoke-related factors predictive of greater usage of the telestroke system.

Methods

This study is a retrospective analysis of patients treated with IV tPA within the GRMC and MUSC telestroke networks. The telestroke program in Georgia was initiated in February 2003, when the Department of Neurology at GRMC signed a contract with the first spoke hospital. As of June 2012, 17 rural and community hospitals had become active spoke hospitals in the GRMC stroke program. Network spoke hospitals were located between 6 and 180 miles from the hub, covering 1831 beds (mean, 108 beds per hospital) and receiving 360,224 ED patients/year. Nine of the hospitals in the network were small (<100 beds) rural facilities, for which the hub subsidized the telestroke cart and technical support, and stroke consultation was provided at no cost to the spoke. In the remaining community and larger suburban hospitals, the spoke paid for technical costs and a per diem (spoke fee) to the GRMC Neurology Department for consultative coverage. The telestroke program at MUSC was initiated in May 2008, when the first spoke hospital signed a contract with MUSC for remote stroke consultations. By June 2012, 15 rural and community hospitals had joined the South Carolina telestroke network. Altogether, these spoke hospitals have 2482 beds (mean, 165 beds per hospital), receive 471,875 ED patients/year and are located between 61 and 191 miles from the hub. All spokes in the South Carolina network paid a daily spoke fee to the hub for call coverage.

The consultative process for GRMC and MUSC have been described in detail elsewhere.[3,11] In brief, both networks use the same telemedicine platform, REACH 3.0 (Alpharetta, GA), with technology and 24 × 7 maintenance support provided by REACH Health, Inc. A mobile telestroke cart (which has a mounted adjustable camera and a high-resolution monitor) is located in the ED of each spoke hospital and provides a web-based 2-way video link. Audio is supplemented via an attached telephone. An emergency medicine physician at the spoke makes a decision to seek consultation and places a call to the GRMC or MUSC emergency call center respectively. The GRMC stroke consultants consist of 6 vascular neurologists and 1 emergency medicine physician, and MUSC consultants include 7 vascular neurologists and 1 emergency medicine physician. One physician (R.J.A.) has taken call for both networks. To register a patient, the ED staff at the spoke hospital enters the patient name, symptom onset time, and blood pressure. The patient's computed tomography scan is uploaded to the REACH website for viewing by the consultant. A remote evaluation based on National Institutes of Health Stroke Scale is performed, and recommendations for or against IV tPA use are provided to the local emergency medicine physician including documentation of thrombolytic contraindication if indicated. Post-thrombolysis care instructions and a physician note are provided at consultation completion. Depending on patient and spoke hospital characteristics, patients are either transported to the hub ("drip and ship") or maintained at the spoke ("drip and keep") after the initiation of tPA treatment.[12]

Records of all consultations are stored by REACH Health, Inc. We queried each hub database for the total number of tPA treatments per spoke hospital. An average annual rate of tPA use at each spoke was calculated. To account for spoke hospital volume, we adjusted the annual rate by their reported ED volume (#tPA/year/10^4 ED volume). A few spokes required only partial telestroke coverage (for example, at nights only, or only certain days of the week). In these cases, we only considered tPA treatments that occurred as a result of a telestroke consultation with a hub specialist, and we further adjusted the tPA treatment rate by the period of partial coverage.

We were interested in determining whether certain prespecified spoke characteristics influenced treatment rate. Therefore, spokes were categorized in terms of their stroke capabilities including primary stroke center (PSC) certification, designated stroke nurse coordinator,