

Cost-saving innovations for acute ischemic stroke and transient ischemic attack

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Summary

Health care costs continue to rise toward unsustainable levels that will affect our nation's ability to support other key funding priorities for education, military, and infrastructure. Changing the way we deliver health care is critical to mitigating this financial crisis. This review highlights opportunities for redesigning care of acute ischemic stroke and TIA to maintain quality while substantially lowering costs. The recent innovations described are (1) adopting teleneurology networks to improve access to thrombolysis for acute ischemic stroke; (2) improving efficiency of emergency care for acute ischemic stroke; and (3) providing alternatives to inpatient care for TIA. Applying such process innovations will enable us to achieve the goal of patients and the nation—high-quality care at an affordable cost.



As government and private payer budgets tighten, and competing public sector goods continue to vie for limited financial resources from the government and private sectors, all stakeholders are taking a close look at health care value. Cost of care continues to rise and health insurance premiums continue to rise faster than inflation.¹ Under the Affordable Care Act of 2010, more Americans will become insured, thus increasing the demand for health care resources.² This will overtax an already overburdened yet inefficient delivery system.

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Clinical and cost burden of ischemic stroke

Stroke is the leading cause of disability in the United States and the fourth leading cause of death.³ It also hits people in their working years, with one-third of patients having their first stroke prior to age 65 years.^{2,3}

Ischemic stroke is a large health care burden, accounting for 87% of all strokes,³ with an estimated 700,000 events³ annually in the United States, costing an estimated \$22.8 billion in direct health care expenditures in the United States annually³ and an estimated €18.5 billion in the European Union.⁴ By 2030, the direct health care costs are projected to grow to \$184 billion.³

Health care delivery innovation, or the development of new ways to organize care around patients and their conditions, is thought to reduce substantial waste in health care spending⁵ and is key to relieving some this burden.⁶ If designed and implemented well, health care delivery innovations in acute ischemic stroke and TIA could have a considerable effect in this regard.

Teleneurology networks to improve access to thrombolysis for acute ischemic stroke

From the early 2000s, technology for remote, interactive audiovisual interactions with patients has grown in all aspects of medicine, but perhaps nowhere as much as in acute stroke neurology (telestroke care). Ischemic stroke is a time-sensitive condition and IV thrombolysis (tissue plasminogen activator [tPA]) is available only in the first 4.5 hours after onset of symptoms. Thus, it is vital to have early access to neurologists who can evaluate and determine the appropriateness of treatment. Improvement in telemedicine technology and networks allows expert supervision of care for stroke patients from the initial thrombolysis decision and beyond to poststroke care.⁷

A telemedicine model typically couples an expert consultant in a hub facility (geographically remote from the patient) with a spoke facility where the patient is present and needs evaluation by specialty services. Different models of telestroke have been established, varying in size, geographic reach of the hub hospitals or consultancy service groups, and workflows.⁸ Examples of different organizational structures of teleneurology networks are shown in table 1.

Telestroke has been shown to be cost-saving by facilitating treatment of more patients with IV tPA and increasing number of direct to home discharges, thus reducing long-term rehabilitation stays, saving up to \$44,000 annually per hospital within the network.⁹ Still, cost-sharing measures or support from the state and federal level are necessary to make telemedicine networks economically feasible, as current reimbursement for telemedicine is limited by law to certain specialties and low-access communities.¹⁰ Fee-for-service reimbursement traditionally requires in-person encounters, which teleneurology is not. The American Academy of Neurology supports the reimbursement of telemedicine encounters in the same fashion as face-to-face, telephonic, and e-mail clinical encounters.¹¹

Currently, many hub and spoke models work using a subscription fee model, where a hospital pays a flat access fee, sometimes with an additional per-patient consultation fee.⁸ Substantial technology capital investments can be incurred by both hub and spoke sites. As hospital reimbursements for acute stroke admissions are based on discharged patients, one potential benefit to a spoke hospital would be to increase the number of patients they can

Table 1 Organizational structure of telestroke programs and examples

| Organizational structure of telestroke programs | Examples |
|--|--|
| Academic center hub, surrounding community hospital spokes | Georgia Health Sciences University ¹⁰ |
| Large hub with surrounding community hospitals, stroke care extends to in-hospital management | Oschner Clinics ²⁶ |
| | Dignity Telehealth Network ²⁷ |
| Distant third-party consultation service provides expertise to community-based spoke hospital, and assists in transfer to local hub hospital | Specialists on Call ²⁸ |

ship and keep, where the spoke hospital may benefit from the expert advice from a remote consulting neurologist, but still benefit from the insurer reimbursements of acute IV tPA-treated stroke patients (thrombolysis-treated acute stroke patients have a higher remuneration than a nonthrombolysed patient). The hub hospitals may be incentivized to provide this service by adopting a subscription fee and increasing referrals for patients who benefit from transfer to a higher level of medical care.

State licensure is another barrier to interstate practice of teleneurology. Current legislation and compact initiatives led by the Federation of State Medical Boards is underway to try to reduce the hurdles of interstate practice of medicine. This would allow expedited credentialing pathways for physicians who desire to practice telemedicine in other states, after designating one state as their home state and demonstrating board certification in a specialty.

In the future, teleneurology can expand to beyond just the acute IV tPA decision-making evaluation to care in the acute stroke hospitalization, other neurologic evaluations, and in the postacute care setting such as rehabilitation or clinic.⁸

Improved efficiency of local emergency care for acute ischemic stroke

As described, acute ischemic stroke is an emergency, requiring expeditious evaluation and treatment to reduce disability. IV tPA treatment is Food and Drug Administration–approved up to 3 hours after symptom onset, but national and international guidelines recommend treatment up to 4.5 hours after symptom onset.¹² However, delaying IV tPA administration to 3–4.5 hours after symptom onset drastically reduces odds of clinical benefit.¹² Furthermore, only 5%¹³ of all patients with acute ischemic stroke receive IV tPA. A literature review suggests that fewer than half of potentially eligible patients are receiving IV tPA.¹⁴ Several system-level factors (not related to individual patient clinical characteristics) identified as causes of potential delay¹⁵ include lack of patient education regarding symptoms of stroke, delays in pre-hospital emergency care including dispatch and transport, and delays within emergency departments.

Several groups have developed interventions that reduced treatment times considerably. One group in Finland¹⁶ adopted a strategy that enabled efficient use of ambulance transportation time by preregistering ischemic stroke patients during transport and having the neurologist obtain essential clinical history by mobile phone during transport. On arrival in the emergency department, patients bypass the triage area and go directly to the CT scanner, where they receive point-of-care laboratory testing. By providing only essential diagnostic and evaluation services that would lead to patient treatment, and avoiding or delaying other treatment steps until after thrombolysis treatment, they were able to reduce their door-to-needle time to 20 minutes.¹⁶ In St. Louis, Missouri, emergency department reorganization borrowing from manufacturing principles have also considerably reduced time for acute ischemic stroke treatment.¹⁷ Systems of care changes have demonstrated

Table 2 Optimal care for rapid tissue plasminogen activator delivery

| |
|--|
| Improve prehospital communication between emergency medical services and neurology providers to decrease time latency for pertinent stroke history |
| Shorten emergency department time by taking appropriate patients directly to the CT scanner to get essential imaging |
| Perform point-of-care laboratory studies crucial to thrombolysis decision-making |

reproducible benefits of increasing the number of patients receiving IV tPA under 60 minutes to 41% (previously only 26%).¹⁸ Key elements of evidence-based redesigned rapid thrombolysis are identified in table 2. These changes can potentially increase the number of patients receiving this disability-reducing medication.

Alternatives to inpatient care for TIA

Closely related to ischemic stroke, TIA is a syndrome of focal neurologic deficits caused by temporary lack of blood flow to a part of the brain. While time-limited in nature, TIA portends a higher risk of stroke, so these patients should be quickly evaluated and treated with preventive medicines or surgeries.¹⁹ The traditional model of TIA care in the United States results in the large majority of patients being admitted to the hospital.²⁰ Innovators around the world have looked for safe alternative solutions for rapid evaluation and treatment of TIA.

Protocol-based, expedited care for TIA in observation units results in good quality at lower cost.²¹ Borrowing from colleagues who safely evaluate and treat transient cardiac symptoms using this extension of the emergency department, it seems natural to extend observation units to transient cerebrovascular events as well. An accelerated diagnostic protocol in the observation unit was found to provide safe TIA care with equally low rates of recurrent events at 90 days compared with inpatient care, and at a median reduced cost of \$1,643 per patient.²¹

TIA clinics provide an even more efficient care method. For example, the Monash clinic in Melbourne, Australia, instituted a triage program²² in their emergency department to select low-risk patients who could safely return home with timely outpatient follow-up. Most patients were agreeable to this disposition and all willingly returned to the clinic for further care and were found to have equally low rates of stroke in both the admitted and discharged groups of patients. Similarly, clinician innovators in Spain demonstrated an 80% reduction in spending and safe outcomes with TIA clinic follow-up rather than inpatient care.²³ Electronic clinical support tools²⁴ to assist non-neurologists in providing appropriate outpatient TIA care may also improve access to high-quality neurologic care in communities with limited neurologist access. Creating a TIA clinic is not without challenges.

Ideally, a TIA clinic pathway would be both expedient and efficient, being able to identify those patients who are most appropriate for directly to clinic, have patients attend clinic urgently (ideally in less than 48 hours), and have the clinic be staffed optimally by providing top of license care with a midlevel provider (such as nurse practitioner or physician assistant) with physician supervision and review of complex cases. The patient should have access to urgent diagnostic testing that is commonly used for TIA patients such as MRI, cardiac imaging, and echocardiograms. This will require coordination with other departments and services such as radiology and cardiology.

One possibility of restructuring patient flow may include assistance by a physician extender such as a nurse practitioner or other advanced practice provider first, then completion of diagnostic testing, followed by review of test results by neurologist of advance

From the patient perspective, emerging models of value-based insurance design encourage patients to choose providers who provide high-quality care at relatively low cost.

practice provider with neurologist oversight. Examples of different workflows are listed in table 3.

Emerging payment reform to spur health care delivery innovation

While innovations are exciting unto themselves, one of the main reasons these delivery improvements are developing is that the financial context in which physicians work has evolved. The Centers for Medicare and Medicaid Services (in essence, the largest health insurer in the country) is moving towards bundled payments.² Bundled payments are set on the basis of expected costs for episodes of care. Physicians will be increasingly rewarded by payers for the value they bring to patients as measured by quality outcomes and cost of care. Thus practicing neurologists should consider both cost and additional yield of diagnostic testing, as well as direct treatment decisions, in a safe, but lowest cost manner. Care will be measured not in discrete input units (fee-for-service) but rather in the outputs of health care: mortality and morbidity, quality of life, and patient satisfaction.

Merging a continuum of stroke care from acute neurologic event to postacute stroke care will allow more opportunities to identify upstream interventions to reduce disability (such as faster IV tPA delivery, perhaps with the aid of teleneurology) as well as evaluations of neurologic patients in a lower-cost setting (outpatient clinic or observation units vs costly hospitalizations or a remote consultant via teleneurology). This new payment reimbursement model will allow systems to reorganize to deliver the best value care to patients, even if it means a reduction in in-hospital charges.

Table 3 Sample TIA workflows

| Type of TIA practice | Workflow | Examples | Exclusion criteria for pathway ^a |
|---------------------------------|---|---|---|
| Same-day access | Providers triage via telephone, divert to same-day access clinic with same-day diagnostics | Victoria General Hospital, Stroke Rapid Assessment Unit; Neurology and Neurosciences Institute, Akron, Ohio | Not available publicly |
| Next day, or access soon | Protocols for referral by ED, clinic access soon based on triage tiers | Monash clinic ²² Stanford TIA clinic ²⁹ | Ipsilateral carotid disease >50%, atrial fibrillation would warrant expedited review ABCD2 score ≥4 |
| Observation unit | ED triages and sends TIA patients to observation unit for diagnostic tests and neurology consultation | Emory ²¹ | Head CT positive for bleed, mass, or acute infarction; a known extracranial embolic source, known carotid stenosis ≥50%; any persistent acute neurologic deficit or crescendo TIAs; nonfocal symptoms, acute medical or social issues, previous history of disabling stroke; or pregnancy |

Abbreviation: ED = emergency department.

^aCriteria for patient selection for TIA pathway if published or publicly available.

Take-home points

- Implement and broaden telestroke systems to increase access to thrombolysis (IV tPA) for acute ischemic stroke.
- Allow expert supervision at a distance to improve emergency stroke care delivery in economical fashion.
- Redesign workflows to improve speed of thrombolysis (IV tPA) to improve clinical outcomes (and decrease long-term costs) for acute ischemic stroke.
- Offer patients with TIA the right intensity and location of care (observation unit or outpatient), avoiding admission for patients who have appropriately low risk for near term stroke or recurrent event.

From the patient perspective, emerging models of value-based insurance design encourage patients to choose providers who provide high-quality care at relatively low cost. Private insurers are moving to tiering neurologists by value. This means they are grouping neurologists by metrics of quality and value, and making some physicians more preferred than others in terms of copayments for their services.²⁵

In the near future, provision of the best quality care at the lowest cost will thus benefit all stakeholders—patients, physicians, and health care delivery systems. Ultimately, payment reform and the push for transparency in quality and cost will drive adoption of health care delivery innovations, including some of the above, to improve the affordability of high-quality care.

Working together, neurologists and their health care delivery systems are well-equipped to further improve the value of the stroke care they provide, and increase access to such care, while meeting the challenges of the rapidly evolving regulatory and economic climate.

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