Advances in Stroke Care and Prevention
The last 30 years have seen tremendous progress in primary and secondary stroke prevention in the United States with better control of hypertension, decreasing smoking rates, antithrombotic treatment for atrial fibrillation, use of statins, and blood transfusions for children with sickle cell disease.1 In 1996, intravenous tissue-type plasminogen activator was approved for treatment of acute ischemic stroke,2 and in 2014 to 2015, endovascular treatment of major arterial occlusion, primarily by stent retrievers, was demonstrated to result in better outcomes for patients with ischemic stroke when compared with patients treated with intravenous tissue-type plasminogen activator alone.3 During this same time period, the field of neurocritical care grew tremendously in terms of physician and nurse training, standardization of care, and technology. Finally, standardization and certification of primary and comprehensive stroke centers have improved the quality of acute stroke care and the use of secondary prevention medications when patients are hospitalized for acute stroke.4,5 These cumulative advances have resulted in the decline in stroke mortality rates from the third to the fifth cause of death in the United States.6

The bulk of these advances have occurred in 2 settings—the office of primary care physicians who manages stroke risk factors in persons with and without a prior stroke; and the acute care hospital. Yet, the stroke patient follows a complex path from first onset of symptoms to the years after the onset of stroke, and the transitions between the respective places of care along the path represent major challenges and opportunities.

Transition From Place of Stroke Onset to Acute Hospital
One of the first major transitions of care is when emergency medical services (EMS) respond to a 911 call for a potential stroke. EMS personnel assess the patient at the site of the event with input from family or other witnesses to see whether a stroke has occurred. After assessment, EMS has to transport the patient to a hospital for treatment of their potential stroke. Unlike trauma patients, where there is a defined process of triage to various levels of hospital care based on severity of the trauma and prior certification of hospitals regarding level of care, there is no such triage process for stroke patients. Legislation in several states and a policy statement from the American Heart Association (AHA) recommend that patients with a possible acute stroke be taken to a primary or comprehensive stroke certified hospital,7 but current triage of patients to a given hospital is not based on severity of the stroke.

Why is this important? Stroke severity is strongly associated with the presence of large artery occlusions in patients with ischemic stroke,8 which are most effectively treated with rapidly administered endovascular therapy at regional comprehensive stroke centers. Also, patients with severe hemorrhagic stroke are best cared for in centers with experienced neurocritical care units.9 Thus, ideally, patients with severe stroke should be transported directly to a comprehensive stroke center rather than taken to the nearest hospital, unless the comprehensive stroke center is substantially further away. As yet, there is no currently accepted diagnostic method for EMS personnel to identify those patients with a more severe stroke. Several abbreviated stroke severity scales, such as the Cincinnati Stroke Triage Assessment Tool (C-STAT), the 3-Item Stroke Scale (3SS), the Los Angeles Motor Scale (LAMS), or the Race Arterial Occlusion Evaluation Scale (RACE), have been proposed and are in various stages of testing.8 Another method of triage currently being tested in a few communities is the use of ambulances equipped with brain imaging and assessment by a stroke physician in person or by telemedicine.10 Regardless of whether systems use low-tech or more resource intensive approaches to stroke triage, we urgently need regional approaches to assess and triage stroke patients so we can deliver the best therapy as quickly as possible. Such approaches must focus on patient outcomes and national or state certification of levels of acute stroke care at regional hospitals rather than market share of competing hospital systems.

Transitions From Acute Care Hospital to Other Medical Care Facilities and Home
The next major transition for stroke patients and their families is at discharge from the hospital which can be to home, to a skilled nursing facility, or to a rehabilitation hospital. This transition is a complex process, which first requires an assessment of the functional status of the patient by the physicians, therapists, and social workers and which determines where the patient should go or even can go. This decision and the timing of hospital discharge are heavily influenced by their medical
insurance coverage or lack of insurance. Continuity and coordination of care after hospital discharge usually involve physical therapy, occupational therapy, speech therapy, social work, management of stroke risk factors and associated medical conditions like hypertension, diabetes mellitus, heart disease, and depression, and reintegration of patients into their social and work settings as much as possible. Much of the long-term coordination is often the responsibility of the primary care physician, who may not receive the necessary information from the hospital discharge or the stroke follow-up clinic that they need to understand and execute the plan of care.

Not surprisingly, there is a substantial variability in the post-transitional care across the United States as demonstrated by a survey of participating hospitals from the National Institute of Neurological Disorders and Stroke’s (NINDS) StrokeNet, the Neurological Emergencies Treatment Trials (NETT) network, the AHA’s Get With The Guidelines (GWGT) hospitals, and the Michigan Health and Hospital Association. Of 82 hospitals, which responded from the 4 networks, 65 hospitals reported that they had a stroke-tailored transitions of care program and 17 reported that they did not. Transitional care components reported included inpatient physical rehabilitation, care coordination, transitions planning, support services (including education, coaching, self-management, and support groups), neurology follow-up clinics, call-backs, home visits (including homecare and home assessment), telemedicine, and anytime access. Facilities reported their programs having one or more of these components in various combinations. Of the 61 facilities that provided information about the program components, 33 (51%) had 1 component, 15 (23%) had 2, 8 (12%) had 3, and 5 (8%) had 4 components. One of the major limitations of the survey is that even the description and designation of various components in transitions of care programs at the various centers are not standardized.

Stroke patients often have language, cognitive, motor, or visual impairments that substantially hinder contact by phone to schedule and confirm appointments, and subsequent transport to a physical, occupational, and speech therapist, or a physician. For indigent patients, who often have limited access to personal transportation, the continuity of care is even more difficult. The use of telemedicine and even telerehabilitation is one potential way to improve continuity of care for such patients but depends on available technology and ability of the patient or patient’s family to use it.

**Call to Action and Opportunity to Improve Outcomes After Stroke**

As early as the year 2000, The Institute of Medicine and National Quality Forum identified evaluating transitions of care from acute care facilities to other care settings and home as a national priority. Given that funding sources, such as the Patient-Centered Outcomes Research Institute (PCORI), have invested upwards of $30 million toward clinical research in transitions of care, it is obvious that substantial gaps remain. The stroke population has been described as the ideal model for studying complicated transitions and for improving the quality of transitional care programs because of the commonality and complexity of their transitions. Medicare beneficiaries with acute stroke have a 30-day readmission rate of 14.4%, with 1 in 8 of these readmissions being judged as preventable. Thus, transitions of care represent great opportunities for improved care of stroke patients over the next decade which must start now. Success will depend on regionally organized and integrated stroke care within a given system or coordination across health systems through a patient-centered home for stroke as has been done for primary care, advocacy and legislation at the state and federal level for stroke triage and rehabilitation care following stroke, and implementation of currently available and developing technologies that connect the disabled stroke patient and their family with health professionals and their support system.

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