Acute Stroke Care in a Neurologically Underserved State: Lessons Learned from the Iowa Stroke Survey

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Prior studies have suggested that stroke care is more fragmented in rural or neurologically underserved areas. The purpose of this study was to determine the availability of diagnostic and treatment services for acute stroke care in Iowa and to identify factors influencing care. Each of the 118 facilities in Iowa with emergency departments was surveyed by telephone. This survey consisted of 10 questions, focusing on the existence of pre-hospital and emergency room acute stroke protocols and the availability of essential personnel and diagnostic and treatment modalities essential for acute stroke care. Of the 118 hospitals with emergency departments, 109 (92.4%) had CT available. Within the subset having CT capabilities, 89.9% (98/109) had intravenous tissue plasminogen activator (IV t-PA) available. Of those facilities with both CT and IV t-PA, 46% (45/98) had around-the-clock in-house physician coverage. Further, 31% (14/45) of sites with CT, t-PA, and an in-house physician had a radiology technician on site. Only 12% (14/118) of centers could offer all essential components. Despite 88% of Iowa hospitals not providing all of these components, only 31% of these hospitals reported protocols for stabilization and immediate transfer of acute stroke patients. These findings indicate that the development of a stroke system is still in its infancy in Iowa. Collaborative efforts are needed to address barriers in rural Iowa and to assist facilities in providing the best possible care. Creativity will be paramount in establishing a functional statewide system to ensure optimum care for all Iowans. **Key Words:** Stroke—acute—emergency medical services—stroke management—tissue plasminogen activator.
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As the leading cause of serious, long-term disability and the third leading cause of death in the United States, stroke remains at the forefront of today's public health issues. The projected national direct and indirect cost of stroke for 2008 is $65.5 billion.[1] Efforts to address this epidemic include increasing the awareness of the signs and symptoms of stroke, promoting the importance of calling 911 to activate emergency medical services when symptoms begin, and improving emergency response systems.[2]

Although stroke is treatable, the fragmentation of care and lack of an integrated stroke network can be barriers to optimal care. While all individual components of this system may be in place in some areas, it has been suggested that stroke networks are more prone to be fragmented in rural or neurologically underserved areas.[3-6] Incomplete systems may compromise the care of patients, cause safety concerns, and lead to inefficient utilization of healthcare resources in these locations. Recognition of this issue has led to the evaluation of resources available in a number of regions with the goal to identify deficits and create comprehensive services.

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Received August 20, 2008; accepted October 13, 2008.

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1052-3057/$—see front matter

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doi:10.1016/j.jstrokecerebrovasdis.2008.10.003

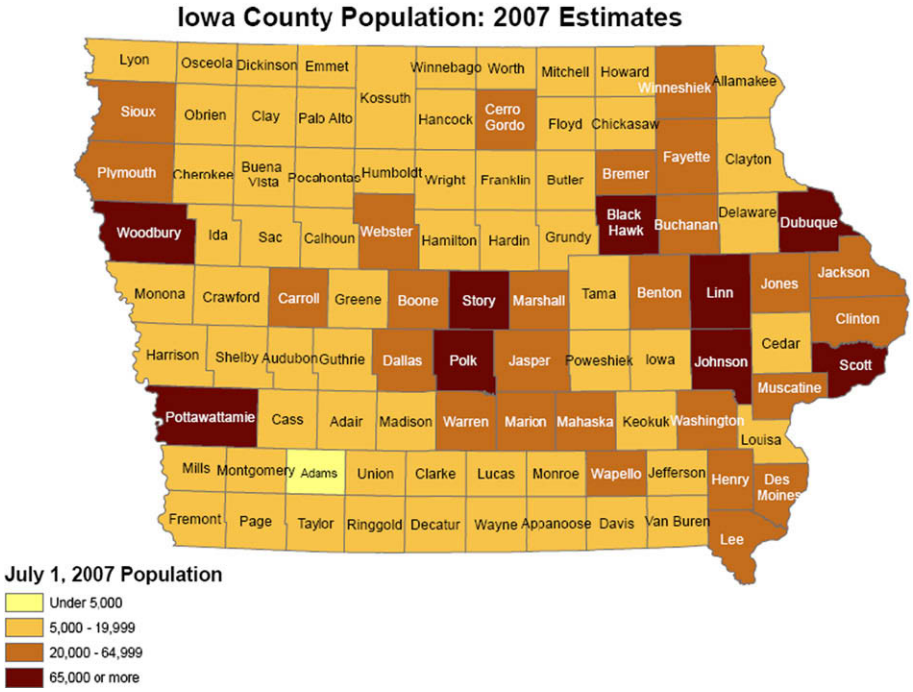

Figure 1. *Iowa population map. Source: U.S. Census Bureau, Population Division, Released 3/2008. Prepared by: State Library of Iowa, State Data Center Program, 800-248-4483, http://www.iowadatacenter.org*

The purpose of this study was to determine the availability of diagnostic and treatment services for acute stroke care in Iowa, both a rural and neurologically underserved area (Fig 1) and to identify factors influencing care.

Materials and Methods

Data Collection

A complete list of all adult acute care inpatient hospitals in Iowa was obtained from the Iowa Hospital Association. After approval by our Institutional Review Board, a 4-page Iowa Stroke Management Survey was sent to each hospital's director of nursing, along with a cover letter requesting the director to forward the survey to the individual best able to complete the survey. Included with each survey was a self-addressed, stamped envelope. Facilities that did not provide a timely response received a second mailing and were called to encourage survey completion.

Despite these efforts, only 56.7% (68/120) of hospitals completed the survey. Review of the surveys from the hospitals that did respond found the majority of surveys to be incomplete. With incomplete survey data, we elected to create an abbreviated version of the survey (Fig 2). The abbreviated survey was conducted by telephone for each of the 118 facilities with emergency departments in Iowa. The telephone survey consisted of 10 questions, focusing on the existence of pre-hospital and emergency room acute stroke protocols, availability of essential personnel, and access to diagnostic and treatment modalities essential for acute stroke care.

Data Analysis

Categorical variables were compared using χ^2 or Fisher exact tests, as appropriate. Continuous variables were compared using *t*-tests or Wilcoxon rank-sum tests, as appropriate. Spearman rank order correlation was used to examine the relationships between continuous and dichotomous variables. Descriptive and frequency statistical analyses were performed and comparisons were made using SPSS for Windows, version 13.0 (SPSS Inc., Cary, NC).

Results

Of the 118 hospitals surveyed via telephone, the response rate was 100%. Hospitals surveyed had a median of 53 beds (range 13-679) and reported seeing a median of 13 patients per day in the ED (range 3-215). Ninety-eight percent (116/118) of hospitals reported emergency medical services (EMS) in their city or town, with 85% (98/115) of EMS certified in advanced life support (ALS). Forty-three percent (50/116) reported having pre-hospital stroke protocols in place. Approximately one-third (35/113) of hospitals reported transfer of patients with signs and symptoms of stroke for a higher level of care after initial assessment. For hospitals transferring stroke patients, the median transport times by ground and air were 45 and 22 minutes, respectively (ground range 5-120, air range 8-120).

Table 1 shows the availability of essential resources for Iowa hospitals. Fig 3 depicts the availability of the essential components for the care of acute stroke care. Of the

1. Do you have EMS in your town/city?	Yes		No	
a. Is it (EMS) "volunteer" or full-time paid?	Volunteer		Full-time	
b. Is it ALS or BLS?	ALS		BLS	
c. Do they have a stroke protocol for rapid transport?	Yes		No	
2. If a patient arrives with the signs & symptoms of stroke, do you immediately transfer them to another facility?	Yes		No	
a. How long does it take to transfer them to the other facility:				
• By ground (minutes)?				
• By air (minutes)?				
3. Is your ER staffed by a physician 24 hours a day, 7 days a week	Yes		No	
4. Do you ever have to call in a physician from home to evaluate a stroke patient? (This includes nights, weekends & holidays.)	Yes		No	
5. Do you have t-PA (aka: Alteplase or Activase) available for stroke 24 hours a day, 7 days a week?	Yes		No	
6. Can you obtain a noncontrast CT of the head on site?	Yes		No	
a. Do you ever have to call in a radiology tech from home in order to get the CT? (This includes nights, weekends & holidays.)	Yes		No	
b. Can you obtain an immediate radiology over-read of the CT? (This includes on-site & teleradiology over-reads.)	Yes		No	
7. Do you ever have to call in a lab tech from home in order to get labs? (This includes nights, weekends & holidays.)	Yes		No	
8. Can you obtain an immediate neurology consult, either in person or by phone?	Yes		No	
9. Who decides whether t-PA is given: physician, PA/NP or other? Please Specify.	MD/DO	PA/NP	other	
10. Does your ER have standing orders or a stroke protocol for treating stroke patients?	Yes		No	
a. Who can initiate the stroke protocol (i.e., standing orders for stroke)?	MD/DO	PA/NP	RN	EMT

Figure 2. *Acute stroke care telephone survey.*

118 hospitals with emergency rooms, 109 (92.4%) had CT available. Of those with CT available, 89.9% (98/109) had intravenous tissue plasminogen activator (IV t-PA) available. Of those facilities with both CT and IV t-PA, 46% (45/98) had a physician in-house 24/7. Further, 31% (14/45) of sites with CT, t-PA, and an in-house physician had a radiology technician on site.

As illustrated in Table 2, there was a significant negative correlation between the number of beds and transfer status; that is, the fewer beds a hospital had, the more likely it was to immediately transfer patients with acute stroke ($P = .001$). Similar significant correlations were found between the number of beds and in-house availability of a physician ($P < .0001$), radiology technician ($P < .0001$), and laboratory technician ($P < .0001$). The negative correlation between the number of beds and CT availability showed a trend toward significance ($P = .071$), while no significant association was found between the number of beds and t-PA availability ($P = .234$).

Table 1. *Availability of resources*

24/7 CT availability	94.0% (109/116)
24/7 t-PA availability	89.5% (102/114)
24/7 in-house physician	42.2% (49/116)
24/7 in-house radiology technician	15.5% (17/110)
24/7 in-house laboratory technician	38.8% (45/116)
Written pre-hospital stroke protocol in place	43.1%, (50/116)
Written hospital stroke protocol in place	31.0% (35/113)
Neurology consult immediately available (via phone or in person)	95.6% (109/114)
Radiology over-read immediately available	91.9% (102/111)

Discussion

In this study, 31% of Iowa hospitals reported stabilizing and immediately transferring acute stroke patients, even with 88% of hospitals not providing all of the essential components (ie, CT, IV t-PA, 24-hour physician, and radiology coverage). In contrast to centers where magnetic resonance imaging (MRI) is the initial brain imaging, 6% of Iowa emergency departments are without a CT scanner, and 10.5% are without IV t-PA. Further, only 31% of Iowa hospital EDs reported having a stroke protocol in place. These findings support the concerns of the American Heart Association (AHA) taskforce, suggesting that rural or neurologically underserved areas may be more prone to fragmented care.[7]

While it is understood that different hospitals will be equipped to provide different levels of care for stroke patients, a developed stroke network needs to be able to provide care to patients presenting to any of the hospitals within the network.[5] One approach would be to assist facilities not currently capable of managing acute stroke patients in acquiring the essential components. Another option would be to facilitate necessary patient transfer. Either option could assist hospitals to meet national recommendations and certifying standards.

Although 98% of Iowa hospitals reported having emergency medical services (EMS), only 43% reported having pre-hospital stroke protocols in place. Prior studies have shown stroke protocols to be beneficial in coordinating pre-hospital and ED care, as well as decreasing pre-

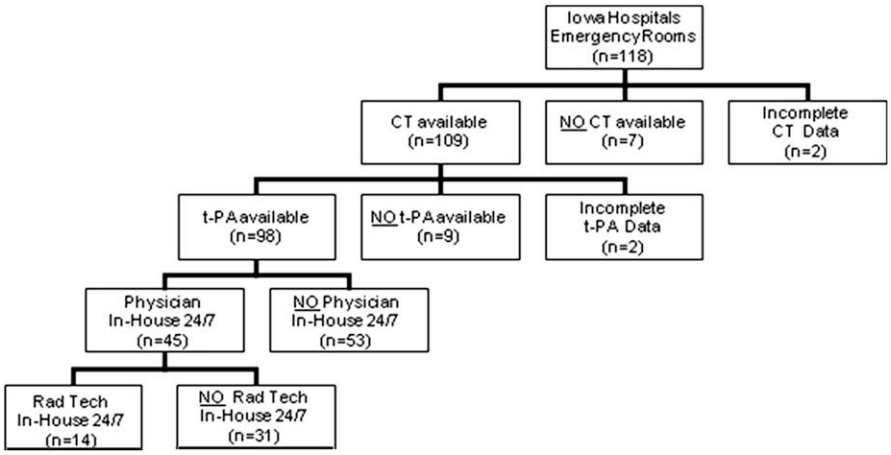

Figure 3. *Essential components for acute stroke care.*

hospital and in-hospital delays.[8,9] Adopting established pre-hospital stroke protocols might permit earlier notification of out-of-house radiology and laboratory technicians, alleviating potential in-house delays. Ideally, the creation of statewide pre-hospital protocols could direct patients to hospitals certified to care for acute stroke patients. This may prove challenging as currently only 6 Iowa hospitals in 5 cities have been certified by The Joint Commission as primary stroke centers.[10]

Limitations

Our study is limited by its design. While simplification of our original written survey to a 1-page telephone survey improved the response rate, reported availability of resources may differ from those actually available. Although our survey was answered directly by an ED physician, the head ED nurse, or both, it did not collect information on utilization of resources available, patient outcomes, or physicians' attitudes toward treatment of acute stroke patients.

Summary

Compared with prior state level stroke surveys that assessed diagnostic and treatment capabilities, our study focused on the essential components of acute stroke treatment.[11-16] Whereas the availability of each of the essential components varied tremendously among hospitals, few hospitals were able to provide all of the essential components. This underscores the need for a state-wide stroke network in Iowa. Collaborative efforts are needed to address barriers in rural Iowa and assist facilities in providing the best possible care. Further evaluation of barriers to providing comprehensive stroke evaluation and treatment specific to Iowa is needed. These results suggest that similar investigations to identify resource availability in other states may be warranted.

Table 2. *Hospital size and availability of essential components*

	Number of beds
Transfer status (n = 109)	r = -0.326, $P = .001$
24/7 CT availability (n = 112)	r = -0.171, $P = .071$
24/7 t-PA availability (n = 110)	r = -0.114, $P = .234$
24/7 in-house physician (n = 112)	r = -0.559, $P < .0001$
24/7 in-house radiology technician (n = 107)	r = -0.347, $P < .0001$
24/7 in-house laboratory technician (n = 112)	r = -0.608, $P < .0001$

Acknowledgment: The authors thank Carla Tarrant for her assistance editing this manuscript. They also acknowledge Kendall Reed, DO, and Bryan Larsen, PhD, along with the staff at Mercy Ruan Neurology Clinic and Des Moines University for their support of this project.

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