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JOURNAL OF THE AMERICAN HEART ASSOCIATION

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*Stroke* published online Sep 2, 2010;

DOI: 10.1161/STROKEAHA.110.594374

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214

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# Striking Rural–Urban Disparities Observed in Acute Stroke Care Capacity and Services in the Pacific Northwest

## Implications and Recommendations

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**Background and Purpose**—The age-adjusted stroke death rate in adults aged  $\geq 45$  years is significantly higher in the Northwest region than in the rest of the United States. Alaska, Idaho, Montana, Oregon, and Washington have substantial rural and frontier areas with unique characteristics and complexities that pose challenges to timely acute stroke care and ultimately affect the patient.

**Methods**—A regional needs assessment was conducted to assess acute stroke care capacity and services in the Northwest region. Hospitals with an emergency department were surveyed with a standardized online tool based on the Brain Attack Coalition recommendations and developed by stroke neurologists, emergency medical services leaders, state public health professionals, and American Stroke Association members.

**Results**—Approximately 76% of hospitals completed the questionnaire. Striking rural–urban differences were seen with rural hospitals having a much lower capacity to adequately care for patients with stroke. Two thirds lacked the necessary personnel, one third lacked necessary neuroimaging equipment, and one fourth were functioning without written emergency department and tissue plasminogen activator stroke protocols.

**Conclusions**—This survey represents the first comprehensive regional assessment of stroke care capacity and services both in the Northwest region and the whole United States. The findings have confirmed the need to focus on strengthening stroke personnel, increasing access to care, and promoting written protocols, especially in rural settings. Additionally, promoting stroke center certification, increasing the number of stroke registries throughout the region, encouraging use of inpatient stroke care protocols in rural hospitals, and conducting ongoing stroke care capacity and services surveys is highly recommended. (*Stroke*. 2010;41:00-00.)

**Key Words:** capacity ■ Northwest ■ rural ■ stroke

Stroke is the third leading cause of death in the United States.<sup>1</sup> The age-adjusted stroke death rate in adults aged  $\geq 45$  years is higher in the Northwest region at 175 people per 100 000 population than in the rest of the United States at 152 people per 100 000 population ( $P < 0.001$ ).<sup>2</sup> This higher death rate exists despite a lower prevalence of known stroke risk factors than the United States.<sup>2</sup> A potential explanation for the high stroke death rate in the Northwest region is geographic isolation. Over 50% of the population of Alaska and Montana live in frontier communities compared with 3% of the US population overall.<sup>3</sup> Furthermore, only half of the population of Alaska, Montana, and Idaho and one fifth of the population of Washington and Oregon live within a 90-minute road transport window (and thus tissue plasminogen activator

[tPA] treatment-capable transport window) of a Joint Commission certified Primary Stroke Center (PSC).<sup>4</sup>

Nonurban facilities often lack access to specialty neurological care and diagnostic technologies and frequently do not follow evidence-based guidelines for stroke care.<sup>5–9</sup> Access to appropriate expertise is essential to high-quality stroke care. In most cases of ischemic stroke, this means access to a neurologist and, for most hemorrhagic strokes, access to a neurosurgeon. One study found that neurologist care was associated with increased testing but also improved outcomes. Organized stroke care, through the use of stroke units, reduces the frequency of complications, improves outcomes, reduces length of stay, and reduces the cost of acute inpatient ischemic stroke care.<sup>5,8,10</sup>

Received June 23, 2010; final revision received July 30, 2010; accepted August 4, 2010.

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Stroke is available at <http://stroke.ahajournals.org>

DOI: 10.1161/STROKEAHA.110.594374

Researchers have highlighted the importance of addressing rural–urban disparities in stroke care, identifying the 3 areas of rural prehospital care, rural hospital emergency department care, and interhospital transfer to larger tertiary hospitals. Specific problems and potential solutions include telemedicine, ability to transfer, and the expertise and training of rural providers.<sup>5</sup>

Rural areas have unique characteristics and complexities that ultimately affect the patient, with documented gaps in stroke services in the Northwest region. In 2004, acute stroke care capacity was lower in frontier hospitals compared with nonfrontier hospitals in Montana and northern Wyoming.<sup>11</sup> Closer proximity to optimal stroke care (through designated stroke centers) has been shown to be associated with lower mortality.<sup>8</sup> Given the known disparities that exist in rural and frontier areas, the Northwest Regional Stroke Network (NWRSN) wanted to assess the specific needs in our region to ultimately provide targeted and strategic interventions. To our knowledge, no other regional assessments of acute stroke care capacity have been conducted.

The aim of this study was to assess acute stroke care capacity and services in the Northwest region defined as Alaska, Idaho, Montana, Oregon, and Washington. Additionally, it was hoped this assessment would indicate why the stroke death rate is higher in the Northwest than in the rest of the United States.

## Methods

The assessment was conducted in Spring 2008 by the US Centers for Disease Control and Prevention-funded NWRSN, which is a partnership of clinicians, emergency medical service (EMS) leaders, state public health departments, the American Heart Association/American Stroke Association, and National Stroke Association with a shared mission to facilitate equal access to high-quality stroke care through collaboration in the Northwest region.<sup>12</sup> All hospitals with an emergency department (ED), excluding psychiatric hospitals, in the Northwest region were eligible. Lists were obtained from state hospital associations and state health departments. The 31-question survey was developed by the NWRSN based on the Brain Attack Coalition recommendations.<sup>13</sup> In Alaska, Idaho, Oregon, and Washington, data were collected using a standardized web-based tool, Catalyst.<sup>14</sup> Using this tool, data were collected from 1 respondent per hospital by Internet, phone, or mail. Eligible respondents in order of preference included a stroke team member, ED medical director, ED physician, and ED nurse. Hospital urban–rural status was self-identified by respondents. The online questionnaire was open for 5 weeks and data compiled into a single Excel spreadsheet.

Due to the concurrent and distinct conduct of another acute stroke care capacity assessment in Montana, data collection methods differed in Montana to that of the rest of the region. The 2 acute stroke care questionnaires were combined into a single questionnaire. Montana questionnaire language was retained for similar questions, and unique NWRSN questions were included verbatim, except for the omission of a postacute stroke rehabilitation question from Montana's questionnaire. In Montana, hospitals in a nonmetropolitan county with a city of >10 000 population were categorized as urban, and those in a nonmetropolitan county without a city of ≥10 000 population were categorized as rural. All data, unless otherwise stated, were self-reported. Data on PSC certification were confirmed using the Joint Commission web site.<sup>15</sup> The Excel spreadsheet downloaded from Catalyst and entered by hand (Montana) was converted to Stata 10 format using Stat Transfer 9 software.<sup>16</sup>

**Table 1. Questionnaire Response Rate by State in the Northwest Region**

State	Respondents (N)	Total Eligible (N)	Response Rate (%)
Alaska	18	24	75
Idaho	37	40	93
Montana	54	60	90
Oregon	32	60	53
Washington	72	95	76
Northwest region	213	279	76

## Statistical Methods

Data sets were cleaned, merged, and analyzed centrally using Stata 10 statistical software. The final data set was checked for >1 respondent per hospital. Duplicate hospital responses (3 identified) were deleted based on the order of preference of eligible questionnaire respondents and the date and time of questionnaire completion (earlier date preferred). Responses of don't know/unsure or no response obtained using the Montana questionnaire were recoded as missing with the exception of the responses of unsure for the EMS questions, which were retained. Where >1 sequential question was asked on the same topic, ad hoc skip patterns were inserted into the responses from hospitals in Alaska, Idaho, Oregon, and Washington, assuming that the response given to the first question in the series was correct. Meanwhile, responses were recoded for Montana's skip pattern questions to force data to align with that collected in the NWRSN questionnaire. Percentages were calculated excluding missing data; therefore percents, of yes, no, and unsure (where applicable) responses will sum to 100%. Differences in proportions between rural and urban hospitals were assessed by  $\chi^2$  test. Rural–urban disparities in EMS capacity and services were not explored due to concerns over the interpretation of a  $\chi^2$  test.

## Results

### Response Rate and Hospital Respondent Characteristics

In total, 213 hospitals out of an eligible 279 hospitals in the Northwest region completed the questionnaire; response rate was 76% (Table 1). Of these 213 hospitals, 58 hospitals (27%) served primarily urban communities and 155 hospitals (73%) served primarily rural communities. The role of respondents were: ED nurse, 45% (N=91); stroke team member, 37% (N=75); ED medical director, 13% (N=26); ED physician, 1% (N=2); and other, 4% (N=7). Respondents in the other category (a category only included in the Montana questionnaire) included Vice Presidents of Patient Care Services, administrators, and Social Services.

### Acute Care Capacity and Services

Acute care capacity and services for stroke are lacking in many hospitals with an ED in the Northwest region (Table 2). Of responding hospitals, 13% are certified Joint Commission PSCs, 31% have a neurologist, 63% have a radiologist, 70% have neuroimaging services, 76% have an ED stroke protocol, 75% have a tPA protocol, and 63% have administered tPA at least once in the past year for stroke (Table 2). Moreover, of the 66 hospitals who reported having a neurologist available 24/7 for stroke care, availability was in person in 34 hospitals (53%) and by phone in 30 hospitals (47%). Excluding Montana hospitals, 115 of the 159 responding hospitals reported providing rehabilitation. Of these 115

**Table 2. No. (Percent) of Responding 213 Hospitals With an ED by Acute Stroke Care Capacities and Services in the Northwest Region**

Variable	Yes N (%)	No N (%)	Missing, N
<b>PSC</b>			
PSC-certified	28 (13)	185 (87)	0
If hospitals is not a PSC, is hospital working toward PSC certification	22 (12)	158 (88)	5
<b>Personnel and services available 24/7</b>			
Stroke unit	60 (28)	151 (72)	2
Acute stroke team	61 (29)	148 (71)	4
Radiologist	132 (63)	78 (37)	3
Neurologist	66 (31)	145 (69)	2
Neurosurgeon*	50 (24)	159 (76)	4
Interventional capabilities	36 (17)	174 (83)	3
Neuroimaging services	143 (70)	61 (30)	9
If hospital has neuroimaging services, are PAC (programmable automation controller), or digital imaging available	135 (95)	7 (5)	1
Laboratory services	206 (97)	7 (3)	0
<b>Protocols</b>			
ED care	160 (76)	50 (24)	3
tPA treatment	158 (75)	53 (25)	2
Inpatient care	95 (45)	114 (55)	4
<b>Treatment and care provided</b>			
tPA administration for stroke in ED in past year†	126 (63)	75 (37)	12
Postacute stroke rehabilitation	153 (72)	59 (28)	1
If hospital does not provide rehabilitation, does hospital refer patients to other facilities for care	50 (91)	5 (9)	4
<b>Stroke registry for quality improvement</b>			
Stroke registry	59 (28)	150 (72)	4
If hospital does not have a registry, is hospital working towards a registry	28 (21)	106 (79)	16
<b>Telemedicine</b>			
If hospital is not a PSC, does hospital ED use telemedicine for stroke care‡	65 (37)	109 (63)	11
<b>Stroke education</b>			
Professional educational opportunities for ED, acute stroke team and other staff who care for patients	146 (71)	61 (29)	6
Community education	104 (50)	105 (50)	4

\*In Montana, questionnaire asked about availability of a neurosurgeon but did not specify 24/7 availability.

†In Montana, only hospitals with a tPA protocol were asked if they had administered tPA in the past year.

‡Telemedicine defined as consulting by telephone or video with other hospitals.

hospitals, 96 hospitals (83%) reported providing physical, occupational, and speech therapy. In total, 188 of the 213 responding hospitals (88%) reported that EMS prenotified the ED of the arrival of a patient with suspected stroke and 13 hospitals (5%) were unsure if EMS prenotified the ED. Of the 213 responding hospitals, 111 hospitals (52%) reported EMS

used a prehospital stroke screening tool and 56 hospitals (26%) were unsure if EMS used a screening tool. Finally, 101 of the 213 responding hospitals (48%) reported EMS providers had professional stroke educational opportunities and 87 hospitals (41%) were unsure if educational opportunities were available.

### Rural–Urban Disparities

Acute stroke care capacity and services are less robust in rural hospitals than in urban hospitals (Table 3). In brief, Joint Commission PSC certification, neurologist availability, radiologist availability, neuroimaging services, ED stroke protocol availability, tPA protocol availability, and tPA administration for stroke at least once in the past year were less common in rural hospitals than in urban hospitals (Table 3). Moreover, a lower percentage of rural hospitals (8 of 153 [5%]) than urban hospitals (14 of 32 [45%]) not currently certified as a Joint Commission PSC were working toward attaining certification ( $P<0.001$ ). In hospitals with a neurologist, availability in person as opposed to by phone was also less common in rural hospitals (3 of 19 [16%]) than in urban (31 of 47 [69%]) hospitals ( $P<0.001$ ). Of hospitals not currently Joint Commission PSC-certified, use of telemedicine for stroke care was more common in rural (60 of 153 [41%]) than in urban (5 of 32 [18%]) hospitals ( $P=0.02$ ). Excluding Montana hospitals, from which data on type of postacute stroke rehabilitation were not collected, provision of physical, occupational, and speech therapy was less common in rural (52 of 70 [74%]) than in urban (44 of 45 [98%]) hospitals ( $P=0.001$ ).

Meanwhile, in hospitals with neuroimaging services, availability of programmable automation controller or digital neuroimaging services was similarly common in rural (85 of 91 [94%]) and urban (50 of 52 [96%]) hospitals ( $P=0.65$ ). A similar percentage of rural (22 of 130 [19%]) and urban (6 of 20 [30%]) hospitals without a current stroke registry were working towards starting a registry for quality improvement purposes ( $P=0.28$ ), although the number of rural hospitals with missing data were large ( $N=16$ ). Furthermore, of the 59 hospitals that did not provide rehabilitation services, a similar proportion of rural (45 of 54 [90%]) and urban (5 of 5 [100%]) hospitals referred patients to other facilities for services ( $P=0.46$ ). Although interhospital transfers to tertiary hospitals have been shown to be another important area of rural stroke care management,<sup>5</sup> this was not directly assessed in the current hospital survey. However, as previously noted (Table 3), ED stroke and tPA protocols were significantly less common in rural hospitals. Diminished access to stroke personnel and availability of written stroke protocols likely contribute to only 53% of rural Northwest hospitals having administered tPA even once in the past year and thus impact the capability of rural hospitals to “drip and ship.”

### Discussion

The primary aim of this study was to assess acute stroke care capacity and services among states participating in the NWRSN, namely Alaska, Idaho, Montana, Oregon, and Washington. We found that two thirds of responding hospitals lacked the necessary personnel and one third of respond-



**Table 3. No. (Percent) of Acute Stroke Care Capacities and Services by Rural and Urban Hospital Status**

Variable	Rural, N (%)	Urban, N (%)	Missing, N (Rural/Urban)	P*
PSC				
PSC-certified	2 (1)	26 (45)	0/0	<0.001
Personnel and services available 24/7				
Stroke unit	18 (12)	42 (72)	2/0	<0.001
Acute stroke team	21 (14)	40 (70)	3/1	<0.001
Radiologist	79 (52)	53 (91)	3/0	<0.001
Neurologist	19 (12)	47 (81)	2/0	<0.001
Neurosurgeon*	5 (3)	45 (78)	4/0	<0.001
Interventional capabilities	8 (5)	28 (48)	3/0	<0.001
Neuroimaging services	91 (61)	52 (95)	6/3	<0.001
Laboratory services	149 (96)	57 (98)	0/0	0.43
Protocols				
ED care	108 (71)	52 (90)	3/0	0.005
tPA treatment	105 (68)	53 (93)	1/1	<0.001
Inpatient care	48 (32)	47 (81)	4/0	<0.001
Treatment and care provided				
tPA administration for stroke in ED in past year†	76 (53)	50 (88)	11/1	<0.001
Postacute stroke rehabilitation	100 (65)	53 (91)	1/0	<0.001
Stroke registry for quality improvement				
Stroke registry	23 (15)	36 (64)	2/2	<0.001
Professional stroke education				
Educational opportunities for ED, acute stroke team, and other staff who care for patients	93 (62)	53 (93)	5/1	<0.001
Community education	59 (39)	45 (79)	3/1	<0.001

\*P from  $\chi^2$  test of urban versus rural. Missing data excluded.

†In Montana, only hospitals with a tPA protocol were asked if they had administered tPA in the last year.

ing hospitals lacked the necessary neuroimaging equipment to effectively evaluate and treat patients with stroke. Furthermore, one fourth of responding hospitals were functioning without written ED and tPA stroke protocols, there was a general lack of awareness of the resources and tools available to local EMS agencies, and more than one third of responding hospitals had not administered tPA even once in the past year. We found striking differences in acute stroke care capacity and services associated with rural–urban status with rural hospitals having a much lower capacity to adequately care for patients with stroke. Similar findings have been reported in Montana and northern Wyoming.<sup>11</sup>

The implications of these findings for stroke outcomes in the Northwest region are sobering. Following the stroke continuum of care model, without use of EMS prehospital stroke screening tools and advance notification of ED arrival, medical staff and equipment cannot be prepared for timely evaluation and treatment of patients; without the availability of written stroke protocols in the ED and hospital, personnel may not provide timely and appropriate care to patients with stroke; and ultimately without timely and appropriate acute care, patients with stroke are not eligible for appropriate interventions. Without appropriate and timely treatment, stroke can be disabling and fatal.

A secondary aim of this study was to provide insight into the higher stroke mortality rates found in the Northwest when

compared with the United States. No data were available to compare acute stroke care capacity and services in the Northwest region and the rest of the United States. However, this assessment supports the notion that the higher stroke death rates in the Northwest region may be in part due to the geographic isolation of considerable segments of this region's population given rural hospitals had a lower acute stroke care capacity and service capability than urban hospitals. Timely access to quality acute care is likely not the only contributor to rural stroke mortality given rural areas also have a higher prevalence of the elderly, pertinent comorbidities (such as diabetes and cardiovascular disease), and risk behaviors like smoking.<sup>5</sup> However, quality of acute care is an important factor in deciding stroke outcome and one that we have the ability and responsibility to address.

### Strengths

This study has several unique strengths. To our knowledge, this is the first comprehensive assessment of acute stroke care capacity and services in the Northwest region, and we suspect it is the first regional assessment of its kind in the United States. Additionally, this study's very high response rate (76% of surveyed hospitals) demonstrates that a high response rate in a regional coordinated effort is indeed possible. Furthermore, data were almost exclusively reported by stroke team members, ED medical directors, ED physicians, and

nurses, so data should accurately reflect typical acute stroke care. The methodology used may be replicated in the region and other areas of the country, which can increase awareness of the acute stroke capacity and services, and guide future interventions.

### Limitations

Potential limitations include potential information bias (self-report, recall, and nonresponse). Addressing self-report bias, the NWRSN verified self-reported data on PSC certification using the Joint Commission web site, and finding these data to be accurate, did not pursue additional verification. Hospitals that infrequently treated stroke would have an increased likelihood of inaccurate reporting.<sup>8</sup> Additionally, it is acknowledged that although hospital staff may not have known about EMS capacity and services, these data do reflect the visibility and communication by EMS to the hospital staff that care for patients with stroke, which is what we were trying to capture. There is likely a nonresponse bias in hospital response rate given hospitals actively working to improve stroke care were more likely to respond to the questionnaire; however, due to a lack of information on nonresponding hospitals, we cannot attempt to assess this bias.<sup>9</sup>

### Conclusion

Although some states have completed statewide surveys, our survey represents the first comprehensive regional assessment of stroke care capacity and services in the Northwest region as well as within the whole United States, and has already proven to be a valuable tool for highlighting rural–urban disparities in stroke care capacity and suggesting multiple areas for improvement. The findings have confirmed the need for networks within our Northwest region to focus on critical stroke care issues of access to acute stroke personnel (primarily through telemedicine) and the provision of stroke trainings to EMS and other stroke care providers (especially those in rural settings). A key component of these strategies will involve targeting of nonneurologist rural physicians given these physicians are often the ones ultimately responsible for determining tPA use and obtaining consent.<sup>17</sup> In addition, the survey suggests future areas of work around promotion of stroke center certification, increasing the number of stroke registries throughout the region, and encouraging the use of inpatient stroke care protocols in rural hospitals. The use of regional periodic and ongoing surveys of stroke care capacity and services is highly recommended.

### Acknowledgments

We thank the Steering Committee members of the Northwest Regional Stroke Network for their support, with particular thanks to Juanita Carbaugh (Washington), Andrea Fenaughty (Alaska), Ying Han (Oregon), Beth Gebstadt (Oregon), Rachel Saunders (Washington), Paul Rostykus (Oregon), Richard Leman (Oregon), Crystelle

Fogle (Montana), Nicole Mauerman (Idaho), and Jane Spencer (Idaho).

### Sources of Funding

Funding provided by the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC.

### Disclosures

None.

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