

# Rural-Urban Differences in Acute Stroke Management Practices

## *A Modifiable Disparity*

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**A**cute stroke management practices in rural areas of the United States are suboptimal, which creates an unacceptable health disparity between urban patients with stroke and their rural counterparts. The existing gap between urban and rural stroke care may widen in the future as more urban-tested interventions are incorporated into the treatment of acute stroke. We conducted a PubMed search to identify all the articles published from 1997 to 2007 that addressed acute stroke, paramedics, ambulances, emergency services, and interhospital transportation pertaining to the US rural, urban, or nonurban environment. We review herein the problems and potential solutions that exist in 3 aspects of the current rural stroke care system: prehospital care, rural local hospital emergency department care, and interhospital transfer of patients and subsequent reception at a larger tertiary care institution, which often involve long distances and considerable time. We conclude that the current gap in rural-urban stroke management practices could be overcome with a comprehensive strategy that addresses the existing issues, including further education of rural caregivers, remote support from tertiary care institutions, and implementation of future acute clinical trials that test the rural strategies to stroke care.

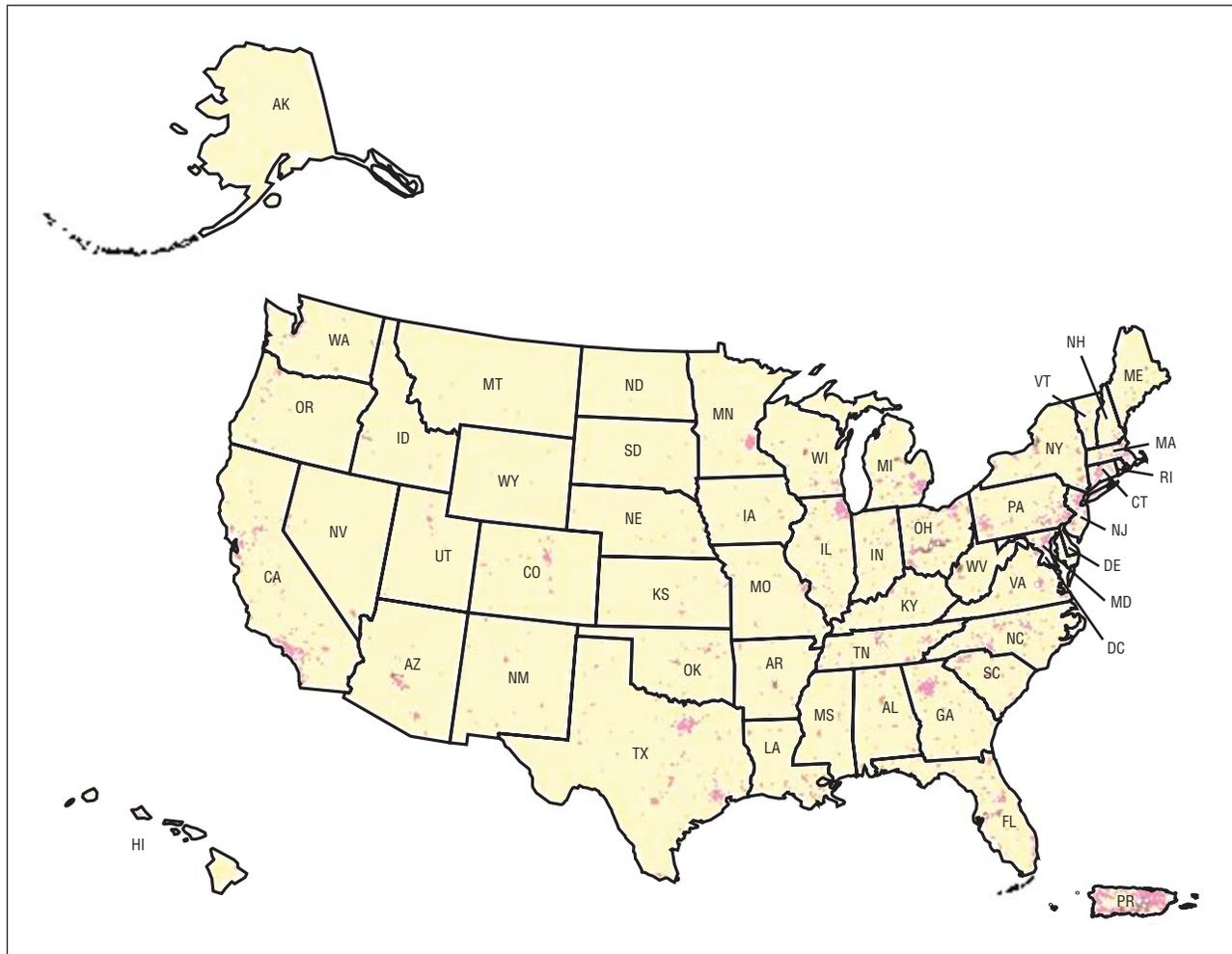
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Approximately 25% of the US population lives in rural areas, defined as places with a population of 2500 or fewer (**Figure**).<sup>1</sup> In many parts of the country, rural populations live in areas that are at considerable distances or are remote from large medical centers. Residents of nonurban areas are at particular risk for stroke for multiple reasons, including more elderly people and a higher prevalence of diabetes mellitus, cardiovascular disease, and smoking.<sup>2,3</sup> Despite being at high risk, rural patients have a shortage of available health care professionals,<sup>2</sup> including specialists such as consultant neurologists.<sup>4</sup> As a result, acute stroke care in rural areas often is provided by primary care physicians who work in small hospitals.<sup>5</sup> This

environment is not reproduced by current stroke trials, which are conducted by academic vascular neurologists in large urban medical centers.<sup>6</sup> This disconnect has raised concerns about the generalizability of acute stroke research and the quality of stroke care in nonurban parts of the country.<sup>7</sup> Although the impact of such rural-urban differences in stroke practice has not been studied in a systematic randomized way, to our knowledge, ecological studies<sup>8,9</sup> suggest worse outcomes in rural hospitals. Furthermore, the existing gap between urban and rural acute stroke management practices is likely to widen in the future as more urban-tested interventions are incorporated into the treatment of acute stroke.

We conducted a PubMed search to identify all the articles from 1997 to 2007 that addressed the terms *acute stroke*, *paramedics*, *ambulances*, *emergency services*, and *interhospital transportation* pertaining to the US rural, urban, or nonurban environ-

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**Figure.** Distribution of rural areas (yellow) in the United States (downloaded from <http://www.census.gov> on April 23, 2007).

**Table 1. Problems With and Possible Solutions for the Prehospital Management of Acute Stroke in Rural Areas**

Problems	Possible Solutions
Rapid recognition of symptoms and response by patients and their caregivers	Public education and education of caregivers and individuals at risk
Response by 911 rural dispatchers	Targeted education
Expertise and training of rural paramedics	Targeted continuing stroke education and increase in state resources to compensate and improve emergency medical services force
Dispersion of hospitals and increased transit time	Promote helicopter evacuation for those residents living far away from the local emergency department

ment. We found that this topic is clearly 1-sided; no articles suggested a superiority of rural stroke care over urban stroke care and, therefore, this topic was not appropriate for a systematic review. In this narrative review article, we propose possible solutions to the specific problems that affect the different levels of rural stroke care.

## PREHOSPITAL RURAL STROKE CARE

Successful acute stroke management is not possible without an efficient prehospital plan.<sup>10</sup> Specifically, the strategy involves prompt recognition of stroke symptoms by patients and their caregivers, rapid notification of emergency services personnel, and a similar rapid response and transport by paramedics. The special challenges faced by rural stroke patients in the prehospital setting are summarized in **Table 1**. First, although reports<sup>11,12</sup> are conflicting about the degree of recognition of stroke symptoms in rural areas, there is a need for improvement. In addition, the availability and level of response of rural emergency services dispatchers to patients with stroke symptoms are also matters of concern; these limitations may be overcome with educational interventions.<sup>13</sup> Rural patients are also at a disadvantage with regard to ambulance services. Rural paramedics tend to be older, less educated,<sup>14</sup> and volunteers.<sup>15</sup> They have, in general, less training,<sup>16</sup> less experience, and fewer learning opportunities to achieve the proficiency of their urban counterparts.<sup>17</sup> In addition, rural emergency medical services personnel face unique issues of medical direction and supervision.<sup>18</sup>

This problem needs to be overcome through federal and state initiatives to reduce quality gaps in rural emer-

gency medical services, including incentives to recruit professional, well-trained individuals. Long-distance learning<sup>19</sup> is a solution to maintain the proficiency of rural emergency medical services professionals, given their scattered population. The strategy of using paramedics as coinvestigators in acute stroke trials, successful in large urban areas,<sup>20</sup> may be difficult to implement in rural areas given the training and dispersion of human resources. Last, the spatial dispersion of hospitals in rural areas<sup>21</sup> adds logistic challenges to the timely transportation by ground ambulance services. Those stroke patients far away from small, local hospitals could be eligible for a direct field to tertiary stroke center hospital evacuation.<sup>22</sup> Alternative strategies, such as the conception of mobile acute stroke units,<sup>23</sup> may not be feasible in vast areas of North America.

### RURAL EMERGENCY DEPARTMENT CARE

Residents of or visitors to small towns, farms, country roads, and other rural areas often have their strokes at locations that are many miles from a tertiary health care center. This calls for an initial evaluation in small, local emergency departments, a scenario that is critical for the prompt stabilization of the patient, and for consideration of the time-dependent treatment with intravenous recombinant tissue-type plasminogen activator (rtPA).<sup>24</sup> The challenges faced by rural community hospitals in treating stroke patients are summarized in **Table 2**. Although general medical care is crucial to maximize outcome after stroke,<sup>25</sup> such ancillary care is shown to be suboptimal in rural emergency departments.<sup>7</sup> In addition to a lack of experience in treating acute stroke, many emergency physicians in small hospitals have reservations about the use of rtPA, although a trend toward acceptance has been seen since the approval of intravenous thrombolysis.<sup>5</sup> These reservations are not surprising because the rtPA trial was conducted using expert vascular neurologists in large urban academic centers.<sup>6</sup> Generalization of those results to smaller hospitals with limited neurologic expertise is problematic, particularly with a potentially risky therapy in which violations or deviations in a protocol are associated with more complications.<sup>26</sup> As a consequence, the use of intravenous thrombolysis is still limited in rural areas.<sup>27,28</sup> This urban-rural gap is likely to worsen in the future as more complex interventions that require more sophisticated diagnostic capabilities and physician expertise, such as intra-arterial or mechanical thrombolysis, are tested and implemented in urban academic centers.

Several strategies have been proposed to overcome the concerning disparity in the practices regarding acute stroke management between large urban and small rural hospital emergency departments, such as the certification of primary stroke centers aimed to endorse hospitals where patients could be stabilized before transfer to a tertiary care center.<sup>29</sup> Although such an initiative is an important move to promote care, it seems as if such certification was mostly obtained by hospitals with dedicated stroke wards (Joint Commission on Accreditation of Healthcare Organizations Web site [http://www.jointcommission.org], unpublished data, November 2007) rather than by small rural

**Table 2. Problems With and Possible Solutions for the Rural Emergency Department Care Management of Stroke**

Problems	Possible Solutions
Suboptimal general and ancillary care	Targeted continuing stroke education and join a “hub-and-spoke” system
Local physicians’ reservations about recombinant tissue-type plasminogen activator	Targeted educational programs, tertiary support through a “drip-and-ship” paradigm, and telemedicine
Fear of losing revenue from transferring a patient	Education about ethical and legal risks and legislative initiatives
Applicability of stroke trials to rural hospitals	Conduct parallel rural trials, perform telemedicine-based research, use tertiary flight crews as investigators, and adapt consent to rural needs

hospitals that aimed to stabilize patients. Ironically, small hospitals that do not treat patients with rtPA usually have the necessary equipment for such treatment, such as round-the-clock laboratory tests or computed tomography scanners.<sup>5</sup> Instead, the limiting factors for treating patients are the perceptions and concerns of local physicians about rtPA and the lack of available neurologic expertise to support them in this endeavor.<sup>5</sup> The attitudes and knowledge about the treatment are best addressed with educational on-site presentations that reflect local physicians’ preferences.<sup>5</sup>

The lack of available neurologic expertise could be compensated for by the remote assistance of neurologists located at tertiary care stroke centers. A “hub-and-spoke” system, in which a large comprehensive system provides multimodal assistance to a group of rural hospitals, is an efficient way to organize such support.<sup>30</sup> Ideally, every small hospital that provides initial care for stroke patients should be backed up by at least 1 hub. Such assistance can be provided by simple telephone consultation or through a more sophisticated and expensive telemedicine link with video, audio, and neuroimaging review capabilities.<sup>31,32</sup> Telemedicine equipment has the advantage of providing reliable and objective information, including real-time examination of the patient by a neurologist, which should allow safer treatment decisions to be made. With either of these approaches, patients can be treated locally with the remote advice of tertiary care physicians<sup>33</sup> or treated locally with thrombolysis and then transferred to a stroke unit for further care (“drip and ship”). Although rtPA was never tested in a randomized controlled trial through these remote paradigms, the reported experience of limited centers that provide remotely directed thrombolysis has been positive as judged by the increased number of patients treated with rtPA<sup>33</sup> and the reasonable rate of complications.<sup>34,35</sup> Telemedicine may be the only option for extremely remote rural situations<sup>36</sup> (frontier states) in which the long distance would not permit a timely evacuation by ambulance or helicopter.

Questions that remain unanswered through the drip-and-ship strategy are whether this strategy is generalizable to multiple rural areas and practice settings, whether enough tertiary resources are available to support all stroke

**Table 3. Problems With and Possible Solutions for Interhospital Transfer to a Tertiary Care Institution**

Problems	Possible Solutions
Lack interventions during interhospital aerial transfer	Perform clinical trials during tertiary flight crews as coinvestigators
Coordination of arrival of patient	Adapt code stroke systems to coordinate reception of in-bound aerial crew
Communication gaps between local emergency department and tertiary care receiving hospital	Adapt code stroke systems to facilitate communication, use telemedicine for transfer of information, and use neuroradiology data links

rural care, what the compensation for and liability of distant advisers for stroke treatment should be, how cost-effective telemedicine equipment is, and what the uncertainties are regarding the minimal degree of technical sophistication that is required. An additional limitation to the use of the drip-and-ship system is economic: smaller hospitals could fear a loss of inpatient revenues by such practices. Such concerns should be addressed with educational campaigns that explain the ethical and legal risks<sup>37</sup> of suboptimal stroke care and are backed up by legislative initiatives that promote excellence in stroke care.

Although improving the use of thrombolysis in rural emergency departments remains an important issue, we should learn from past mistakes. The long-term goal of reducing the gap in acute stroke care should include strategies to implement future stroke therapies. This goal implies finding ways to simultaneously test future acute stroke interventions in urban and rural settings before their implementation. Serious logistic and regulatory issues limit the performance of acute stroke research in rural settings. The dispersion of potential local investigators, each with limited exposure to stroke patients, is a major impediment.<sup>38</sup> Before acute stroke research can be implemented in rural areas, major adjustments in trial logistics and consent regulations are needed. For example, one solution could be well-trained flight nurses as coinvestigators who could initiate acute stroke management trials at multiple outside emergency departments.<sup>38</sup> The informed consent process needs to be adopted to the rural setting by either being waived<sup>39,40</sup> or allowing ways of remote consent elicitation through telephone lines<sup>41</sup> or telemedicine systems.<sup>42</sup>

#### INTERHOSPITAL TRANSFER AND RECEPTION OF THE STROKE PATIENT AT THE TERTIARY CARE INSTITUTION

The strategy of comprehensive stroke centers<sup>35</sup> supporting small hospital stroke care calls for an expeditious transport of the stroke patient. Given the urgency and the distance involved, an aerial transfer is preferred because it has been shown to be safe<sup>43</sup> and has been deemed appropriate for the circumstances.<sup>44</sup> Helicopters can be used for most areas except extremely remote areas (frontier states), where a fixed-wing evacuation may be needed (**Table 3**).<sup>36</sup> No specific interventions are known to be useful during this critical early period, so research is needed in that setting

using the flight crews as coinvestigators.<sup>38</sup> The arrival of inbound flight crews needs to be carefully coordinated with the receiving tertiary care stroke team.

Code stroke systems have been shown to decrease intrahospital delays for patients presenting to urban emergency departments,<sup>45</sup> but the same coordinated response is needed for aerially evacuated strokes to tertiary care centers. Such a response includes fluent communication among all the stakeholders in this challenging multihospital operation, including local paramedics, rural hospital emergency department personnel, transporting flight crew and receiving tertiary care center nurses, emergency physicians, and dedicated code stroke teams. In addition, communication with family members who could provide consent for invasive procedures needs to be maintained during the rapid transfer of care among institutions. Family members typically arrive by ground later than the patient and helicopter crew, and the unavailability of consenting family members often impedes the tertiary care team's efforts to consider invasive therapies. Similarly, locally obtained medical ancillary data, including imaging studies and laboratory tests, need to be readily available by electronic or material means.

#### CONCLUSIONS

Acute stroke management practices in rural areas are suboptimal, which creates an unacceptable health disparity between urban stroke patients and their rural counterparts, who constitute 25% of the US population. Such a gap, which is likely to widen as new and more complex interventions become available, can be solved by comprehensively addressing the existing problems at the following levels: prehospital; in the small, local hospital emergency department; and during interhospital transfer to tertiary care institutions. This includes testing future stroke interventions through an arm rural research paradigm.

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