Rural/Urban Disparities in the Management of Stroke

Randy S. Bell, MD, FAANS

Medical Director (elect), Avera Comprehensive Stroke Program

Professor of Surgery, Univ. of SD School of Medicine

Cerebrovascular/Endovascular Neurosurgeon, Avera Mckennan

Avera

Moving Health *Forward.*

Disclosures

- Everyone was thinking it. I'm likely going to say it…

Avera

Agenda

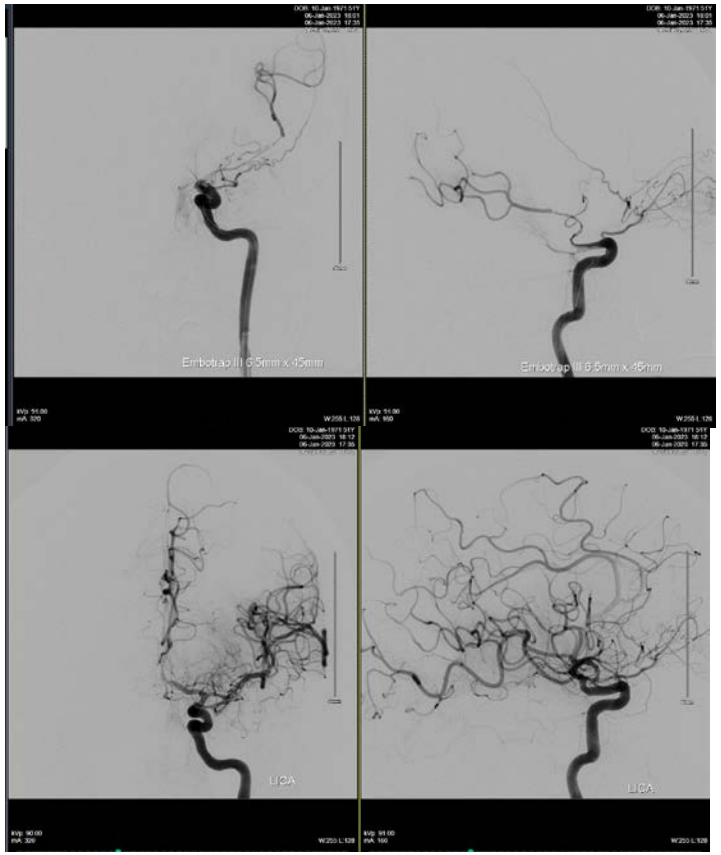
- Background
- Recent studies
- Preliminary South Dakota data
- What needs to happen in South Dakota?

Avera

Large Vessel Occlusion Stroke

- 2015: Mechanical thrombectomy becomes standard of care

3.7.2. 0 to 6 Hours From Onset	COR	LOE	New, Revised, or Unchanged
1. Patients should receive mechanical thrombectomy with a stent retriever if they meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or MCA segment 1 (M1); (3) age ≥18 years; (4) NIHSS score of ≥6; (5) ASPECTS of ≥6; and (6) treatment can be initiated (groin puncture) within 6 hours of symptom onset.	I	A	Recommendation revised from 2015 Endovascular.
2. Direct aspiration thrombectomy as first-pass mechanical thrombectomy is recommended as noninferior to stent retriever for patients who meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or M1; (3) age ≥18 years; (4) NIHSS score of ≥6; (5) ASPECTS ≥6; and (6) treatment initiation (groin puncture) within 6 hours of symptom onset.	I	B-R	Recommendation revised from 2015 Endovascular.
3.7.3. 6 to 24 Hours From Onset	**COR**	**LOE**	**New, Revised, or Unchanged**
1. In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.	I	A	New recommendation.
2. In selected patients with AIS within 16 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.	IIa	B-R	New recommendation.



(*Stroke*. 2019;50:e344–e418.

Avera

What about Stroke Systems of Care?

- South Dakota remains one of the only states in the United States without a legislated stroke system of care.

1. Regional systems of stroke care should be developed. These should consist of the following: (a) healthcare facilities that provide initial emergency care, including administration of IV alteplase, and (b) centers capable of performing endovascular stroke treatment with comprehensive periprocedural care to which rapid transport can be arranged when appropriate.	**I**	**A**	Recommendation reworded for clarity from 2015 Endovascular. COR and LOE unchanged. See Table XCV in online Data Supplement 1 for original wording.
2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols to ensure that patients with a known or suspected stroke are rapidly identified and assessed by use of a validated and standardized tool for stroke screening.	**I**	**B-NR**	Recommendation reworded for clarity from 2013 Stroke Systems of Care. COR and LOE added to conform with ACC/AHA 2015 Recommendation Classification System. See Table XCV in online Data Supplement 1 for original wording.

Avera

Why is this especially important in a Rural State?

- Hammond et. al, Stroke, 2020: (Retrospective Study, National Inpatient sample) – IV thrombolytics (4.2% v 9.2%, $p<0.001$), endovascular therapy (1.63% v 2.41%, $p<0.001$) lower in rural v urban. Mortality (6.87% v 5.82%, $p<0.001$) higher in rural v urban, and increases with rurality.
- Joubert et. al, Stroke, 2008: (Review) Stroke 1.45 times more likely in rural vs. urban areas in United States.

- Why? Older than 75 (44% v 40%) and lowest income quartile (59 v 32%).

Stroke. 2020 Jul;51(7):2131-2138. doi: 10.1161/STROKEAHA.120.029318. Epub 2020 Jun 17.
Stroke • Volume 39, Number 6 • https://doi.org/10.1161/STROKEAHA.107.501643

Hagedorn et. al.

Rural and Urban Disparities in Access to Endovascular Thrombectomy for Large Vessel Occlusions in Colorado

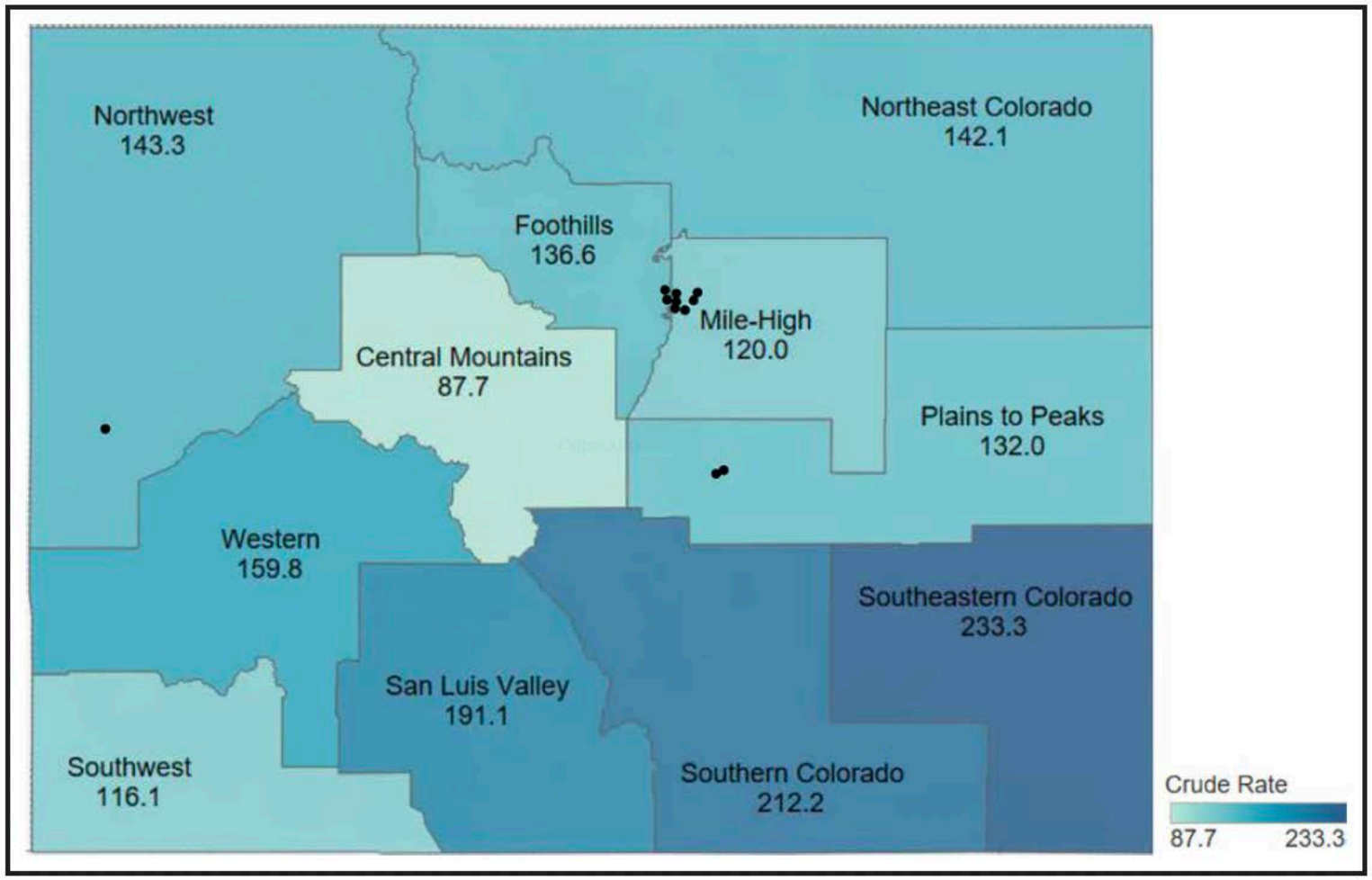
- State of Colorado: Comparison between Rural and Urban patients with LVO, 11 centers, 2015 – 2022
- Primary Outcomes: Time from LKW to groin puncture; Unfavorable outcomes defined by MRS>2
- 3100 patients, 346 rural (11%), 2754 urban (89%)
- Primary Outcomes:
  - 6.0 hours vs. 4.5 hours LKW to groin rural vs. urban (33% longer, p=0.001)
  - Rural patients had 10% higher risk of unfavorable outcome (p=0.016)
  - Secondary measures: Lengths of stay 14% longer (p<0.01) and 11% less likely to discharge home (p=0.007).

Stroke. 2025;56:00–00. DOI: 10.1161/STROKEAHA.125.051542

Avera

Stroke incidence in Colorado

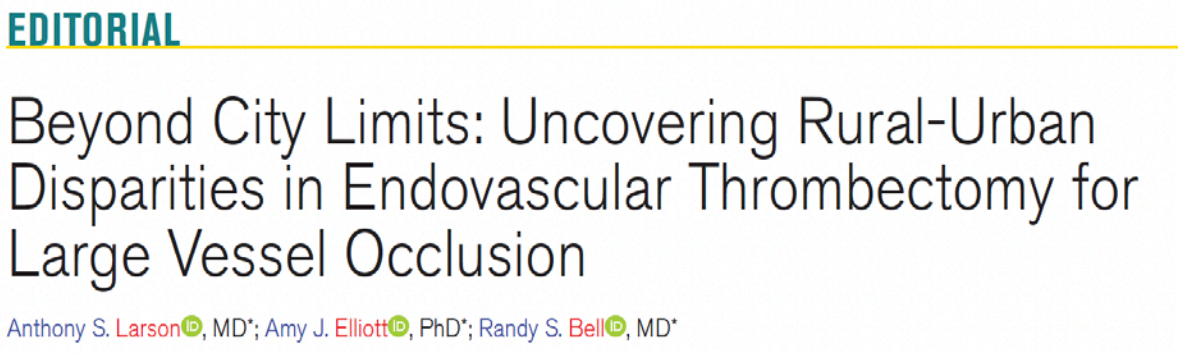
- Rural > Urban incidence



Stroke. 2025;56:00–00. DOI: 10.1161/STROKEAHA.125.051542

Avera

Editorial


EDITORIAL

Beyond City Limits: Uncovering Rural-Urban Disparities in Endovascular Thrombectomy for Large Vessel Occlusion

Anthony S. Larson, MD*; Amy J. Elliott, PhD*; Randy S. Bell, MD*

- This was a good study.
- 11% of patient population was rural (6 million Coloradans)
- Even with this small percentage, the group was able to show a difference.

Stroke. 2025;56:00–00. DOI: 10.1161/STROKEAHA.125.053308

Avera

What does this look like in South Dakota?

- 900,000 residents in South Dakota
- It is estimated that 50% of the state is rural
- Further characterization:
  - Urban: 47%
  - Large rural: 24%
  - Small rural: 3%
  - Isolated: 26%
- 9 tribal nations with some of the worst healthcare disparities in the nation

Avera

Can we replicate this Study in SD?

- YOU BETCHA!

Research Question: Is there a difference in Rural and Urban stroke population in South Dakota? Are we on par with Colorado?

- Hypothesis: There will be rural/urban disparities of stroke outcomes in South Dakota.
- STUDY DESIGN: Retrospective, Multi-center review of data from GWTG 2023 – present (Avera IRB approved)
- Inclusion Criteria: All patients in South Dakota with AIS with large subgroup analysis of those with LVO arriving to comprehensive stroke center or one with thrombectomy capability.
- Primary Outcome Measures: LKW to groin, death or disability (replicates Hagedorn…)
- Participating Institutions: Avera Mckennan, Sanford Sioux Falls, Monument Rapid City.

Avera

Avera Preliminary Data: All ischemic stroke…

- 1927 records (all ischemic and hemorrhagic stroke
  - 667 records 2023
  - 850 records 2024
  - 410 records first half 2025

  - 440 excluded – final diagnosis not related to stroke
  - 12 excluded – missing zip codes
- 1475 records total analytic samples

Avera

Preliminary Data

62.9% v 11%

Table 1. Summary Statistics of Sample Characteristics by Clinical Diagnosis

Characteristic, N (%)	All	Ischemic Stroke	Intracerebral Hemorrhage	Subarachnoid Hemorrhage
Total	1475 (100.0)	1241 (84.1)	165 (11.2)	69 (4.7)
Sex				
Male	772 (52.3)	660 (53.2)	83 (50.3)	29 (42.0)
Female	703 (47.7)	581 (46.8)	82 (49.7)	40 (58.0)
Race				
AIAN	43 (2.9)	36 (2.9)	3 (1.8)	4 (5.8)
Asian/ Asian or PI	12 (0.8)	8 (0.6)	3 (1.8)	1 (1.5)
Black or AA	31 (2.1)	23 (1.9)	4 (2.4)	4 (5.8)
UTD	59 (4.0)	51 (4.1)	5 (3.0)	3 (4.4)
White	1167 (79.1)	982 (79.1)	134 (81.2)	51 (73.9)
Missing	163 (11.1)	141 (11.4)	16 (9.7)	6 (8.7)
Ethnicity				
Hispanic	32 (2.2)	22 (1.8)	5 (3.0)	5 (7.3)
Non-Hispanic	1443 (97.8)	1219 (98.2)	160 (97.0)	64 (92.7)
Rurality				
Rural	928 (62.9)	772 (62.2)	108 (65.5)	48 (69.6)
Urban	547 (37.1)	469 (37.8)	57 (34.5)	21 (30.4)
Year				
2023	528 (35.8)	419 (33.8)	72 (43.6)	37 (53.6)
2024	643 (43.6)	562 (45.3)	60 (36.4)	21 (30.4)
Jan-May 2025	304 (20.6)	260 (20.9)	33 (20.0)	11 (16.0)

Majority of patients from SD, Iowa, Minnesota

Figure 1. Map of Total Sample, All Records
Based on Zip Code

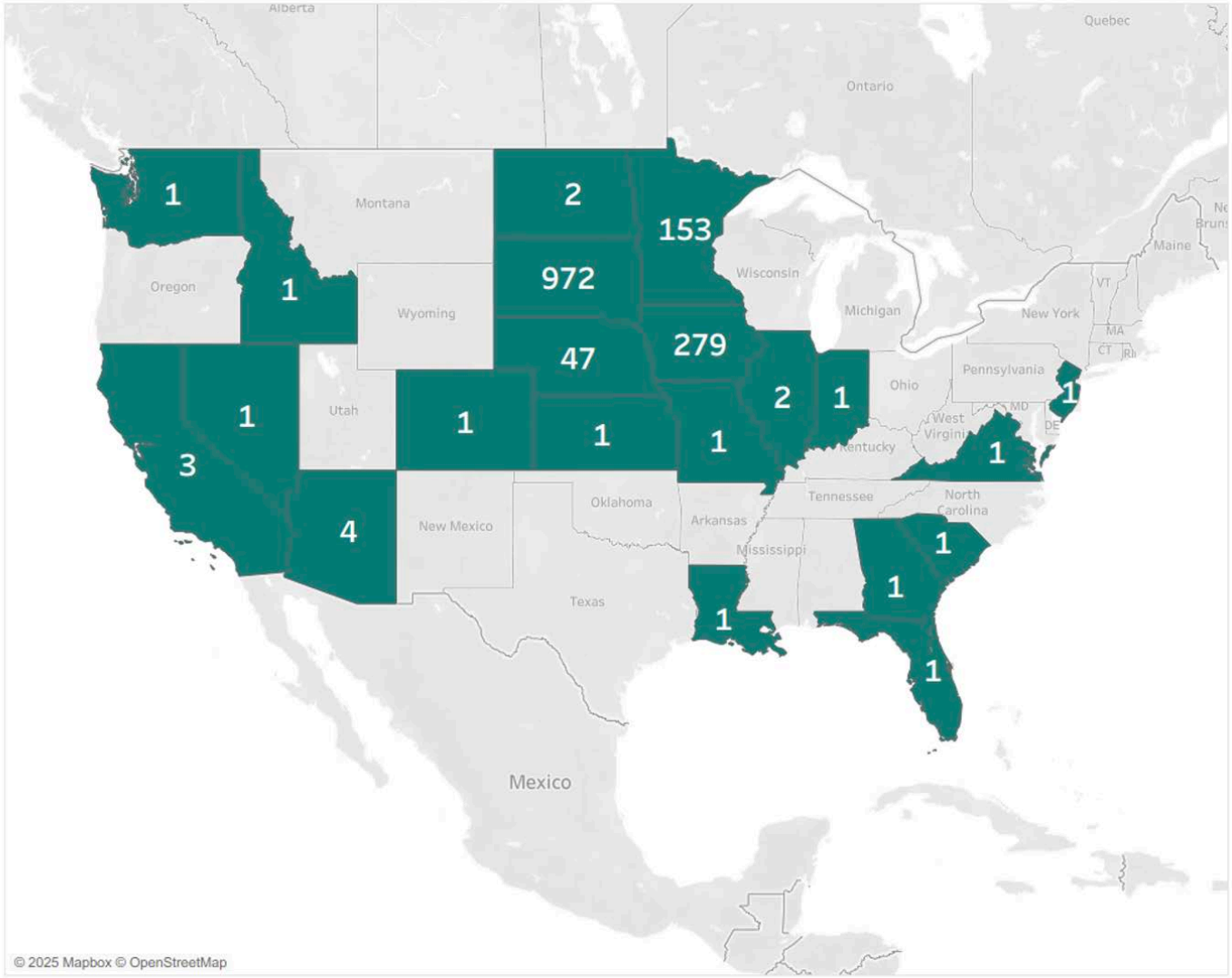
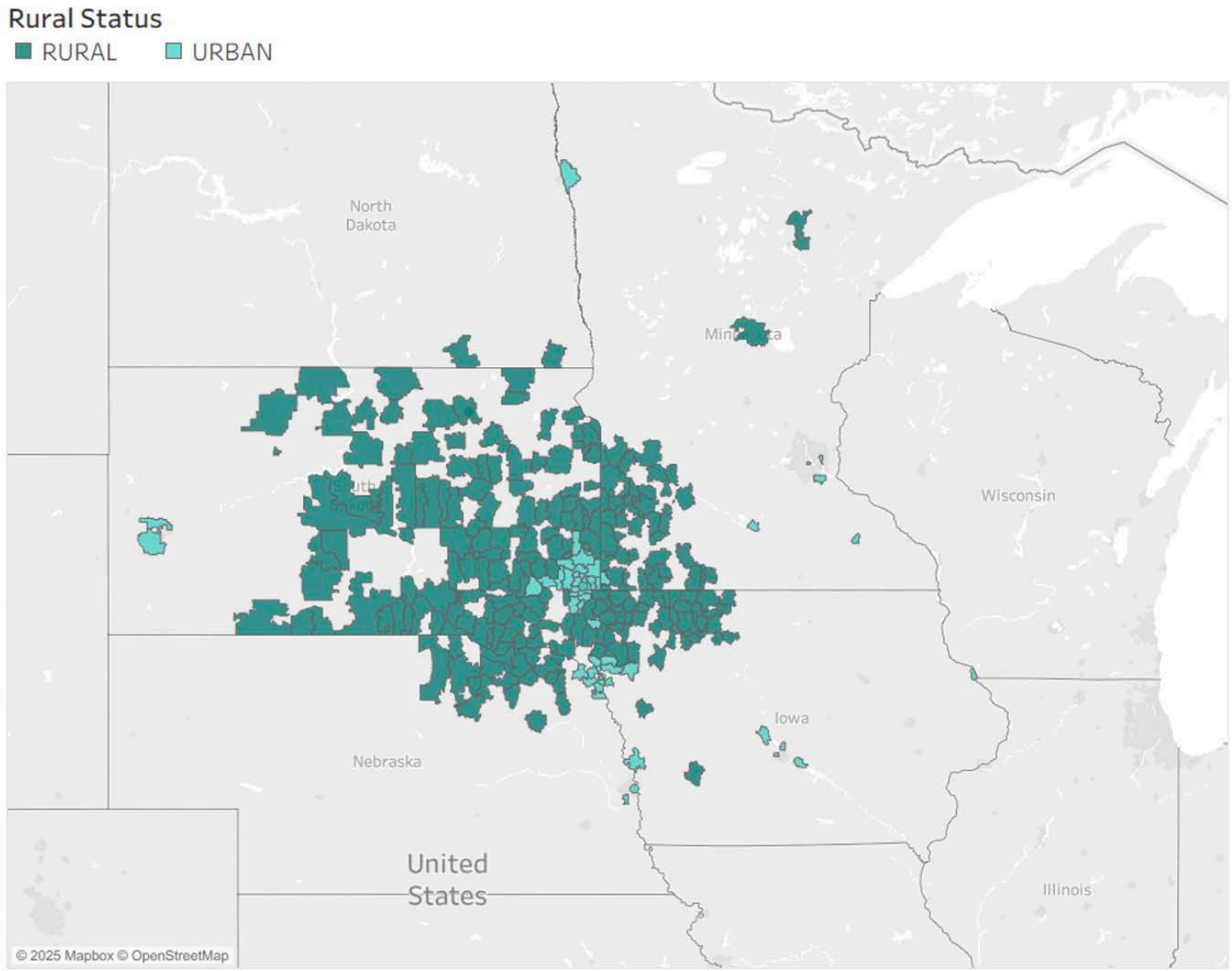


Figure 2. Map of Records focusing on Upper Midwest, by Zip Code and Rurality

Figure 2. Map of Records focusing on Upper Midwest, by Zip Code and Rurality



Prelim Results: All Stroke patients

LKW to Arrival:
8.7 v 5.6 hours

LOS: 4.9 v 4.1 days

MRS > 2:
65.3% v 64.2%

Discharge other
Than home:
53.5% v 54.8%

Table 2. Patient Outcomes for Ischemic Stroke

Patient Outcomes	All	Rural	Urban	p-value
Total, N (%)	1241 (84.1)	772 (62.2)	469 (37.8)	
Last Known Well to Arrival, Med (IQR)	463 (224-1141)	520 (278-1188)	340 (115-951)	**<.0001**
Length of Stay, Med (IQR)	4.7 (2.8-8.1)	4.9 (2.9-8.6)	4.1 (2.2-8.0)	**0.0062**
Modified Rankin Scale at Discharge, N (%)				
0: No Symptoms	127 (10.2)	72 (9.3)	55 (11.7)	**<.0001**
1: No significant disability	205 (16.5)	118 (15.3)	87 (18.6)	
2: Slight disability	99 (8.0)	73 (9.5)	26 (5.5)	
3: Moderate disability	147 (11.9)	99 (12.8)	48 (10.2)	
4: Moderately Severe Disability	364 (29.3)	208 (26.9)	156 (33.3)	
5: Severe Disability	101 (8.1)	78 (10.1)	23 (4.9)	
6: Death	82 (6.6)	65 (8.4)	17 (3.6)	
Missing	116 (9.4)	59 (7.6)	57 (12.2)	
Discharge Location, N (%)				
Home	571 (46.0)	359 (46.5)	212 (45.2)	**0.0073**
Hospice – Home	14 (1.1)	8 (1.0)	6 (1.3)	
Hospice – Health Care Facility	41 (3.3)	21 (2.7)	20 (4.3)	
Acute Care Facility	20 (1.6)	11 (1.4)	9 (1.9)	
Other Health Care Facility	499 (40.2)	303 (39.3)	196 (41.8)	
Expired	82 (6.6)	65 (8.4)	17 (3.6)	
Left Against Medical Advice	14 (1.1)	5 (0.7)	9 (1.9)	

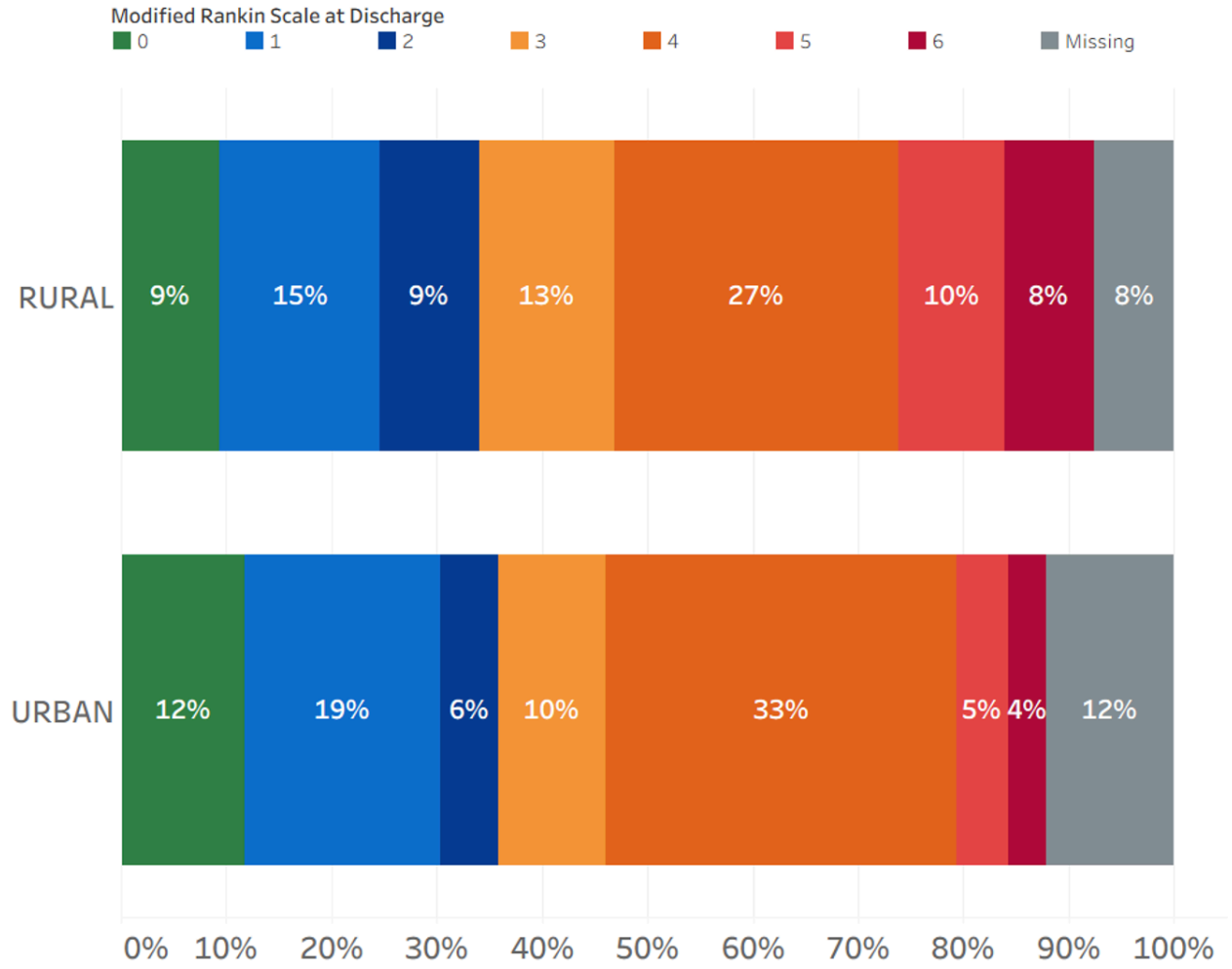
**Last known well to arrival: n=197 Rural and n=140 Urban missing values; total sample=904.*

MRS at Discharge

Main difference may
Be in the proportion of
MRS 0-1:

24% rural v. 31% urban

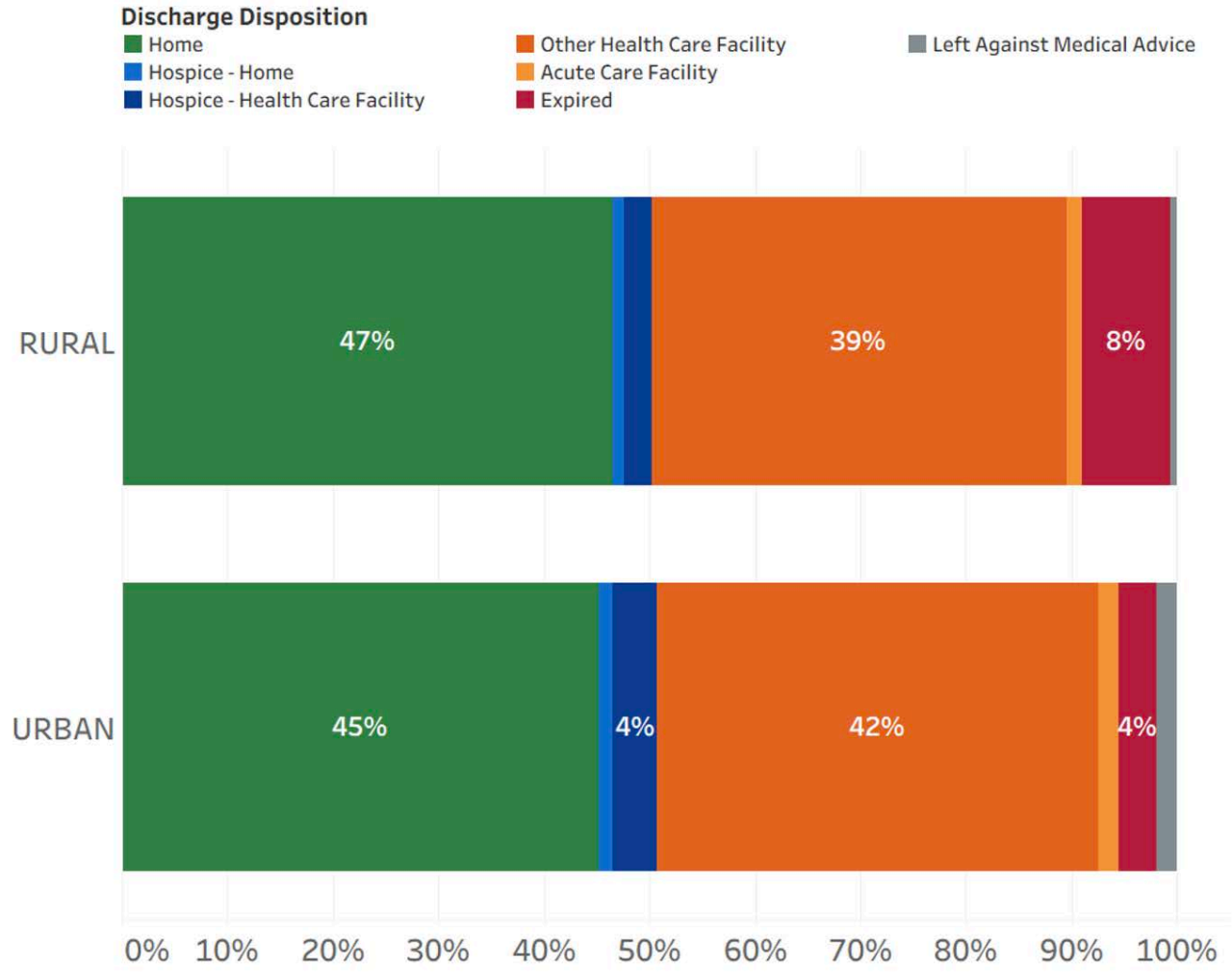
Figure 5. Modified Rankin Scale at Discharge among those with Ischemic Stroke by Rurality



Avera

Discharge status

Figure 6. Discharge Location among those with Ischemic Stroke by Rurality



Avera

Basic Preliminary Conclusions

- Our data for global AIS within a large, single center rural healthcare system seem to mirror the data from Colorado
- There is a transfer time disparity between Rural and Urban in our system. Our transfer times for all stroke are skewed long. Need to see what the transfer times for the subgroup of LVO patients is.
- There is an outcomes disparity between Rural and Urban patients in our system. Difference appears to be in the MRS 0 and 1 category.
- Rural patients tend to discharge home more often than urban in our system.

Avera

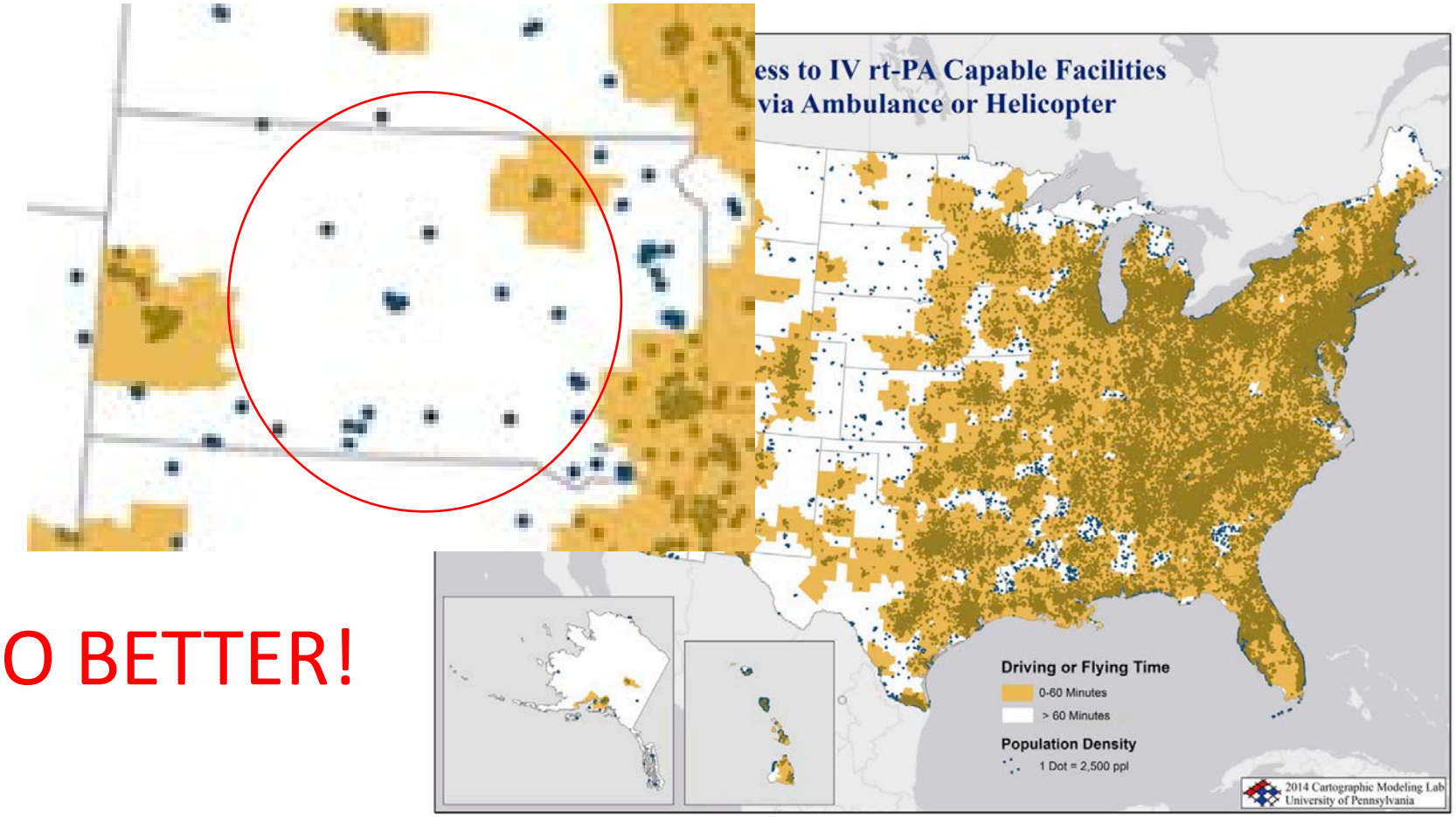
Discussion

- Subgroup analysis of LVO patients is pending
- We need the data from our sister hospital systems.
  - Protocols delivered
- Get with the Guidelines: Will they slow us down or provide the data?
  - Contractual issues?

- Preliminary assessment: We are hampered by an absence of official legislative support in our state.
  - Does our Secretary of Health understand our need? Are they properly read in?

Avera

A fixable problem…



WE NEED TO DO BETTER!

Stroke • Volume 50, Number 7 • https://doi.org/10.1161/STR.0000000000000173

Avera

How can we do better?

1. Public health leaders along with medical professionals and others should design and implement public education programs focused on stroke systems and the need to seek emergency care (by calling 9-1-1) in a rapid manner. These programs should be repetitive and designed to reach diverse populations. Further research is needed to establish the most effective programs for diverse populations. (New)
2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols that ensure that all patients with a known or suspected stroke are rapidly identified and assessed with a validated and standardized instrument for stroke screening such as FAST (Face, Arm, Speech, Time), Los Angeles Prehospital Stroke Screen, or CPSS. (Revised)

Stroke • Volume 50, Number 7 • https://doi.org/10.1161/STR.0000000000000173

Avera

Stop Messing Around!

- We need a supportive legislated stroke system of care with defined metrics and funding support. This may include a legislated mandate for hospitals of a certain size to achieve some type of stroke certification.
- Data support the strong link between good patient outcomes and stroke systems of care that prioritize cooperation between elected public health officials and medical personnel.
- Each hospital system should ensure that its larger critical access hospitals have a designated stroke certification

- THE HIGHEST QUALITY CARE IS ALSO THE CHEAPEST CARE!
  - This system and its requirements will pay for itself

Avera

Thank You

- Special thanks to Dr. Elliot, Dr. Larson, Dr. Angal, Katie Ziegler (statistician), and the Avera Research institute for their support

Avera