When Minutes Matter:

OPTIMIZING ACCESS TO HEALTH CARE

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Karl Dailey - Database Analyst

ESRI User Conference, 2015

Cartographic Modeling Lab
University of Pennsylvania
Access to Stroke Care

1. Conceptual overview
2. Analysis overview
3. Demo:
   - StrokeMaps.org
   - Sandbox Tool
Background: Stroke in the US

- Stroke is a leading cause of serious, long-term disability among Americans
- Every 40 seconds someone experiences a stroke
- Every 3 to 4 minutes someone dies of a stroke
- Fourth leading cause of death in the United States
- Direct and indirect costs totaling $68.9 billion

Stroke is a Major Public Health Priority
Background: tPA for Ischemic Strokes

- About 87% of all strokes are ischemic strokes, when blood flow to the brain is blocked.
- Administering intravenous (IV) recombinant tissue plasminogen activator (tPA) within 3 hours of symptom onset has been associated with a 30% greater likelihood of decreased disability, compared with placebo.
- Commonly referred to as the “clot buster,” tPA works by dissolving the clot and improving blood flow.
- FDA approved tPA in 1996.
- Timely access to proper care at designated stroke centers can vastly improve outcome and reduce mortality.
- Despite its clinical efficacy and cost-effectiveness, only 3% to 8.5% of stroke patients receive tPA.
Background:
The “Golden Hour” of Ischemic Stroke

Stroke is a Highly Time-Sensitive Disease
Background: Stroke Center Certification

• Primary Stroke Center (PSC) Certification recognizes hospitals that meet standards to support better outcomes for stroke care

• PSC certification is provided through a partnership among the American Heart Association, American Stroke Association and The Joint Commission, the nation's largest independent healthcare evaluation body

• Currently, over 1,000 PSCs

• In 2012, added Comprehensive Stroke Center (CSC)
Background: Public Health Relevance

- Effective stroke care requires an integrated system of care bridging public health, emergency medical services (EMS), and hospital-based care
- Existing obstacles include: fragmentation of the delivery system, misplaced patient demand, and responsiveness to legal and economic incentives that are unrelated to health outcomes
- Hospital participation in obtaining SC certification is voluntary, and there are no official guidelines regarding where primary stroke centers should be located
- Time benchmarks are only internal to hospital operations and do not address rapid prehospital delivery of patients to facilities capable of providing the best stroke care
Background: Prehospital Regionalization

• Regionalization is a structured system of care to improve patient outcomes by directing patients to facilities with optimal capabilities for a given type of illness or injury.

• Many of the challenges associated with coordinating regionalized stroke care have parallels in the development of the US trauma care system.

• The stroke system in the US is early in its development, and could benefit from operations research principles that have been successfully applied to the development of regionalized systems of trauma care.

• Examining access to specialty stroke care from the population perspective may inform the development of the US stroke system.
Funding Agency: National Institute of Health (NIH)

PI: Charles Branas

Access Calculations

- Direct access to existing stroke centers
- Access via inter-facility transport
- Optimization modeling of stroke centers
  - Clean slate
  - Optimal add

Application Development

- ArcGIS Server
- Flex API
- Amazon Web Service EC2
Analysis: Data Sources

• Block Group Population data - US Census Bureau
• Urban and Rural Classification - US Census Bureau
• Hospitals - American Hospital Association’s American Hospital Survey (AHS)
• Primary stroke centers - The Joint Commission Certified Stroke Centers
• Air ambulance data - Atlas and Database of Air Medical Services (ADAMS)
Analysis: Access Calculations

Access is calculated by summing either the population or land area of block groups that could reach a SC by helicopter or ground ambulance within the specified prehospital time period

- By ground
- By air
- Crossing state lines
- Not crossing state lines
- 45 mins
- 60 mins
Analysis: Ground Access

- ArcGIS Network Analyst extension
- Service Area Polygons for facilities
- Urban and rural distinctions

Transport: Service Area
Analysis: Air Access

- Euclidian distances from helicopter depots to each Block Group then from the Block Group to receiving stroke centers
- Average cruise speeds of the helicopters reported in the ADAMS database for each base helipad used to calculate flying times

**AIR ACCESS**

Activation Interval + On-scene Interval + Transport

(SC, stroke center - points; HD, helicopter depot - stars)
www.strokemaps.org demo
sandbox demo
Build Your Own Hospital System

Select State: NM
Select Access Time: 60

Existing System
Access: 30.4%
Facilities: 1
Population: 734,013
Population Change: 734,013
Percent Access Change: 30.40%
Total Cost: 50
Total Cost / Population: $0.00

Modified System
Access: 30.40%
Facilities: 1

TOOLs:
- Show Existing System
- Optimal Add (or Remove)
- Add by Name:
- Advanced Add / Remove
- Undo Last

COLOR KEY:

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<tr>
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Build Your Own Hospital System

Select State: NM
Select Access Time: 60

Existing System
Access: 36.4%
Facilities: 1
Population Change: 734,013
Percent Access Change: 36.4%
Total Cost: 80
Total Cost / Population: $0.00

Modified System
Access: 36.40%
Facilities: 1
Population: 734,013
Percent Access Change: 36.40%
Total Cost: 80
Total Cost / Population: $0.00

TOOLS:

COLOR KEY:

Access
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Facilities
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Population Transparency:

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### Annual Operating Cost Estimates for Primary Stroke Centers

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<td><strong>ANNUAL TOTAL</strong></td>
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### Build Your Own Hospital System

**Select State:** NM

**Select Access Time:** 60

**Existing System**
- Access: 36.4%
- Population: 1,204,915
- Facilities: 1

**Modified System**
- Access: 59.75%
- Facilities: 8
- Population: 1,326,512
- Population Change: 32,612
- Percent Access Change: 1.81%
- Total Cost: $1,180,634
- Total Cost / Population: $0.98

**TOOLS:**
- Show Existing System
- Optimal Add (or Remove)
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- Add by Name
  - Advanced Add / Remove
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  - Remove All

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