



Mobile Stroke Units

Bringing the Hospital to the Patient

Right Care Initiative
Virtual University of Best Practices
October 25, 2022

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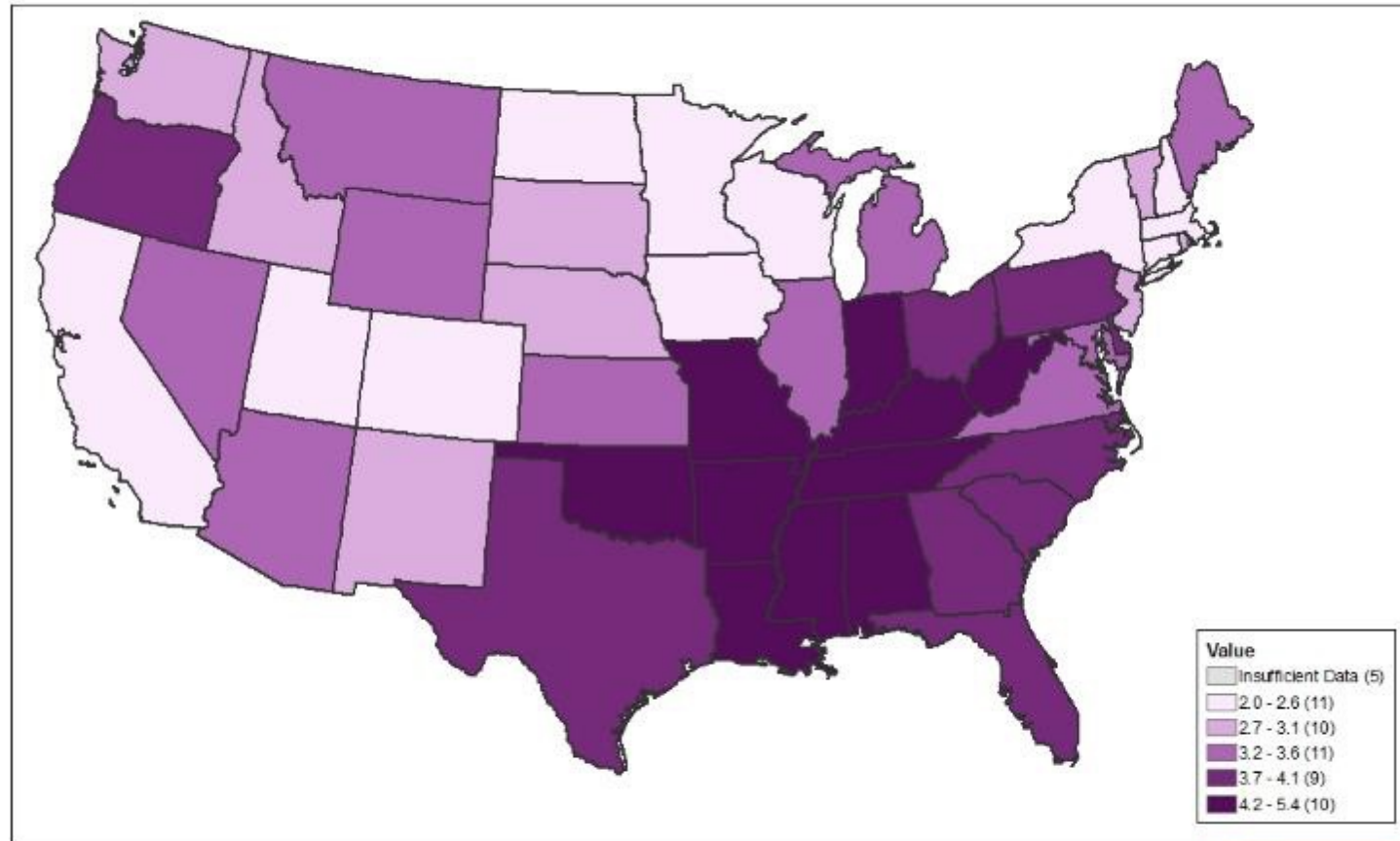
Heart Disease and Stroke Statistics— 2021 Update: A Report From the American Heart Association

What's New This Year?



Stroke every 40 seconds
Stroke Death every 3min 33sec
800,000 strokes per year
405 deaths from stroke each day
#1 cause of adult disability (2-3%)

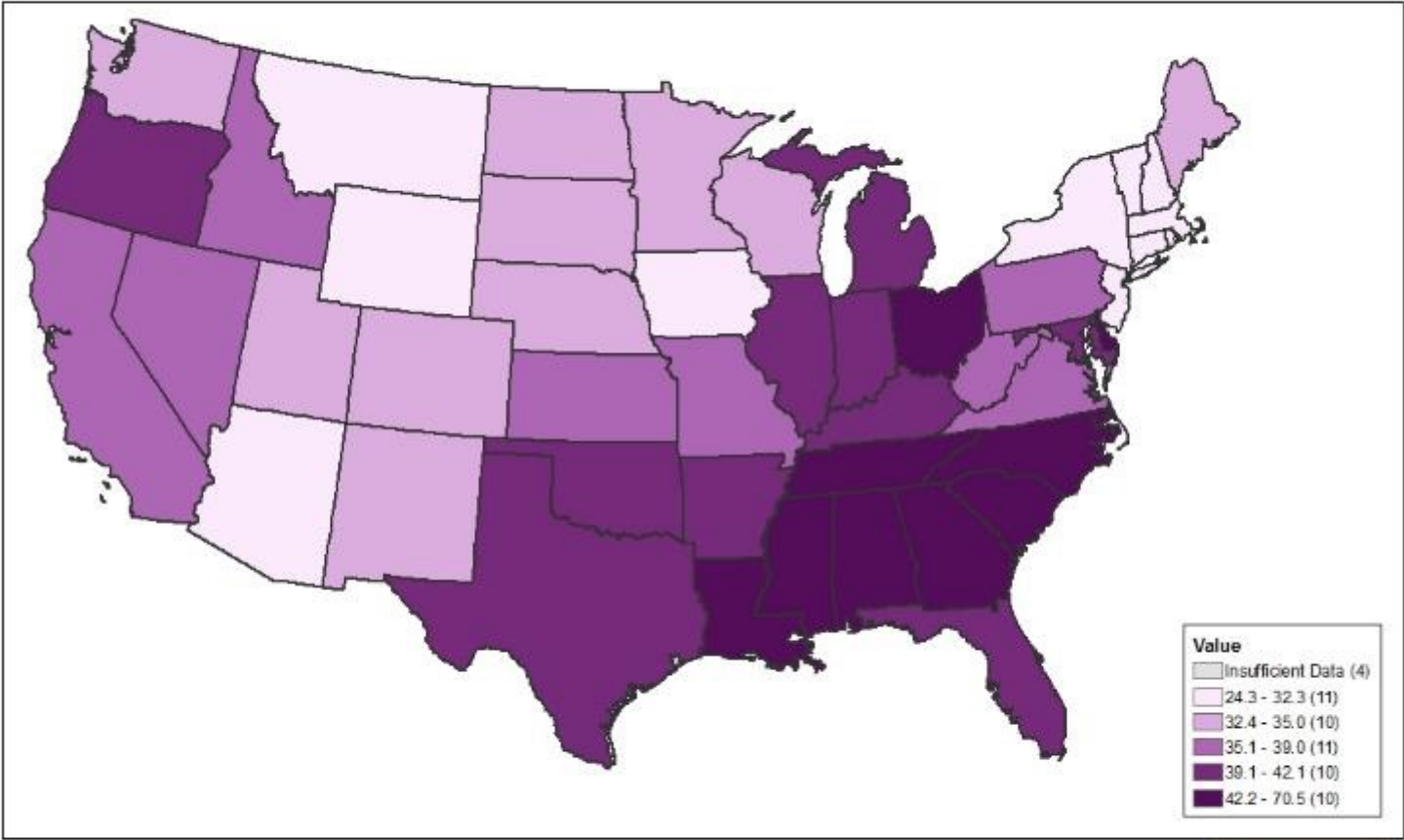
Stroke Among Adults Ages 18+, 2018



This map was created using the Interactive Atlas of Heart Disease and Stroke, a website developed by the Centers for Disease Control and Prevention, Division for Heart Disease and Stroke Prevention. <http://www.cdc.gov/dhdsp/maps/atlas>



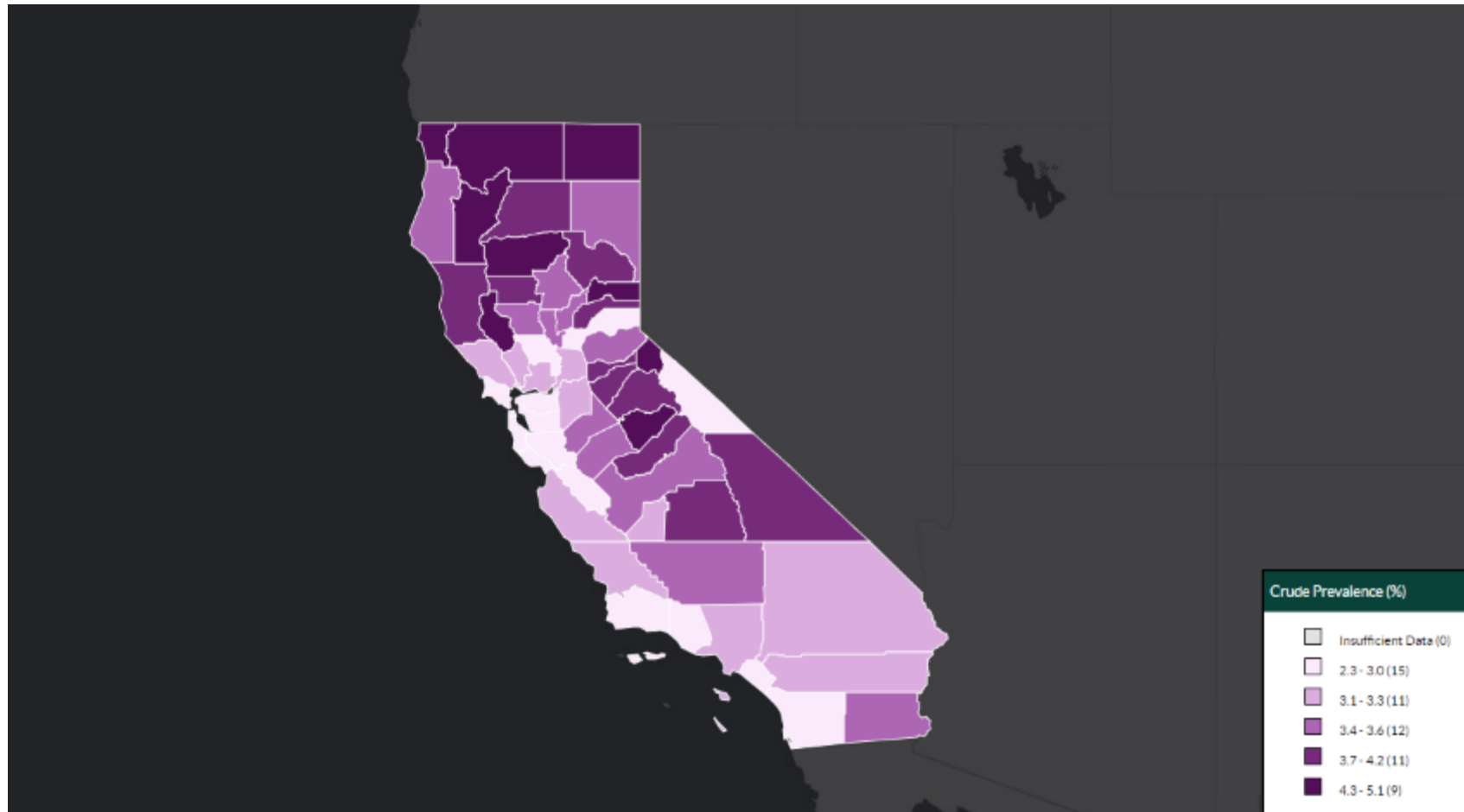
Stroke Death Rate per 100,000, All Races/Ethnicities, All Genders, All Ages,
2018-2020



This map was created using the Interactive Atlas of Heart Disease and Stroke, a website developed by the Centers for Disease Control and Prevention, Division for Heart Disease and Stroke Prevention. <http://www.cdc.gov/dhdsp/maps/atlas>



Stroke Prevalence by County in CA



Time is Brain is Independence is \$\$\$



2 million neurons lost
each minute a stroke goes untreated



Each **30 minute** DELAY in stroke treatment →
15% DECREASED likelihood of a good outcome



Treatment windows expanding as technology improves but...
BETTER outcomes still tied to **EARLIER** treatment

Time is Brain is Independence is \$\$\$

\$103.5 billion annual costs for stroke patients.

Two-thirds attributed to indirect expenditures.

Caregiving costs for heart disease and stroke survivors projected to soar to \$128 billion by 2035, says American Heart Association

AHA Policy Statement/Circulation Journal Report



Acute Stroke Treatment



Obstacles

- Neuro exam and imaging required to treat
- All treatments not offered at all hospitals

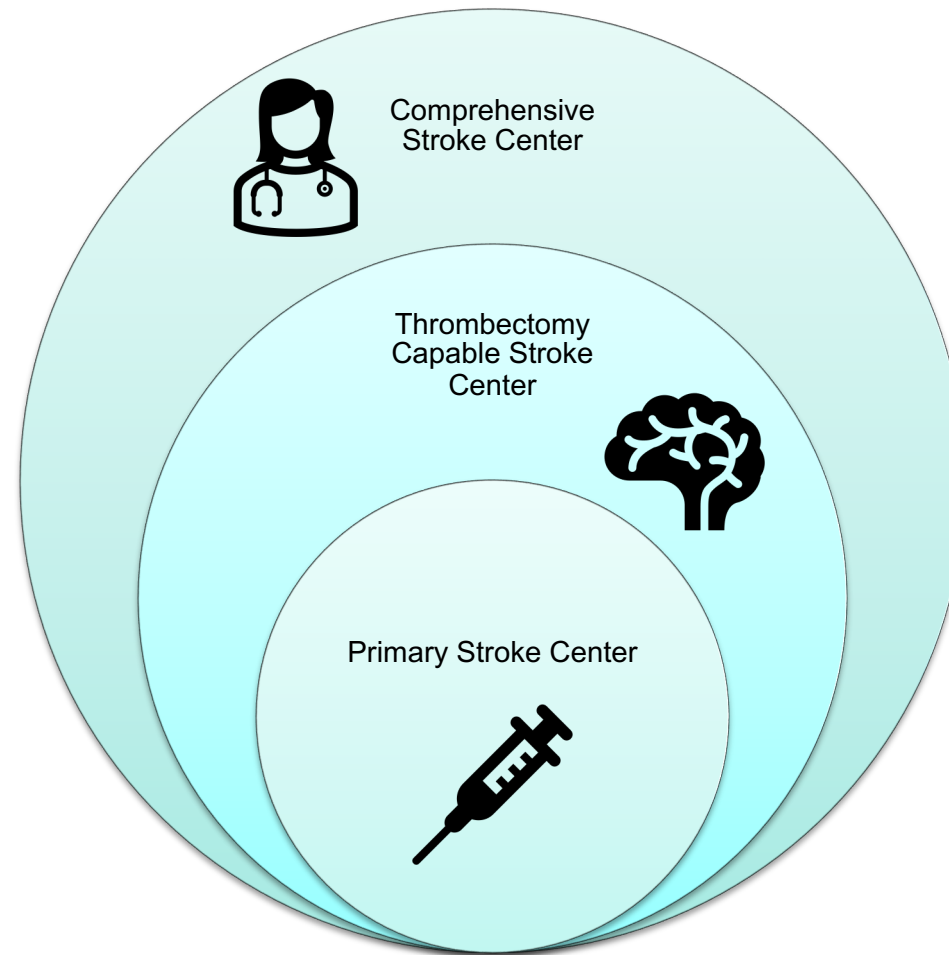


Goals

- Initiate treatment as soon as possible
- Triage to the appropriate level hospital



Stroke Hospital Systems of Care



Acute Stroke Treatment



Systems of Care Improvements

Alert

- Ringdown to ED for incoming stroke codes
- Multi-provider notification of stroke code in ED

Evaluation

- Straight to CT protocol (pit-stop in ED)
- Proceed without lab results unless clinically indicated
- Proceed without chest X-ray unless clinically indicated

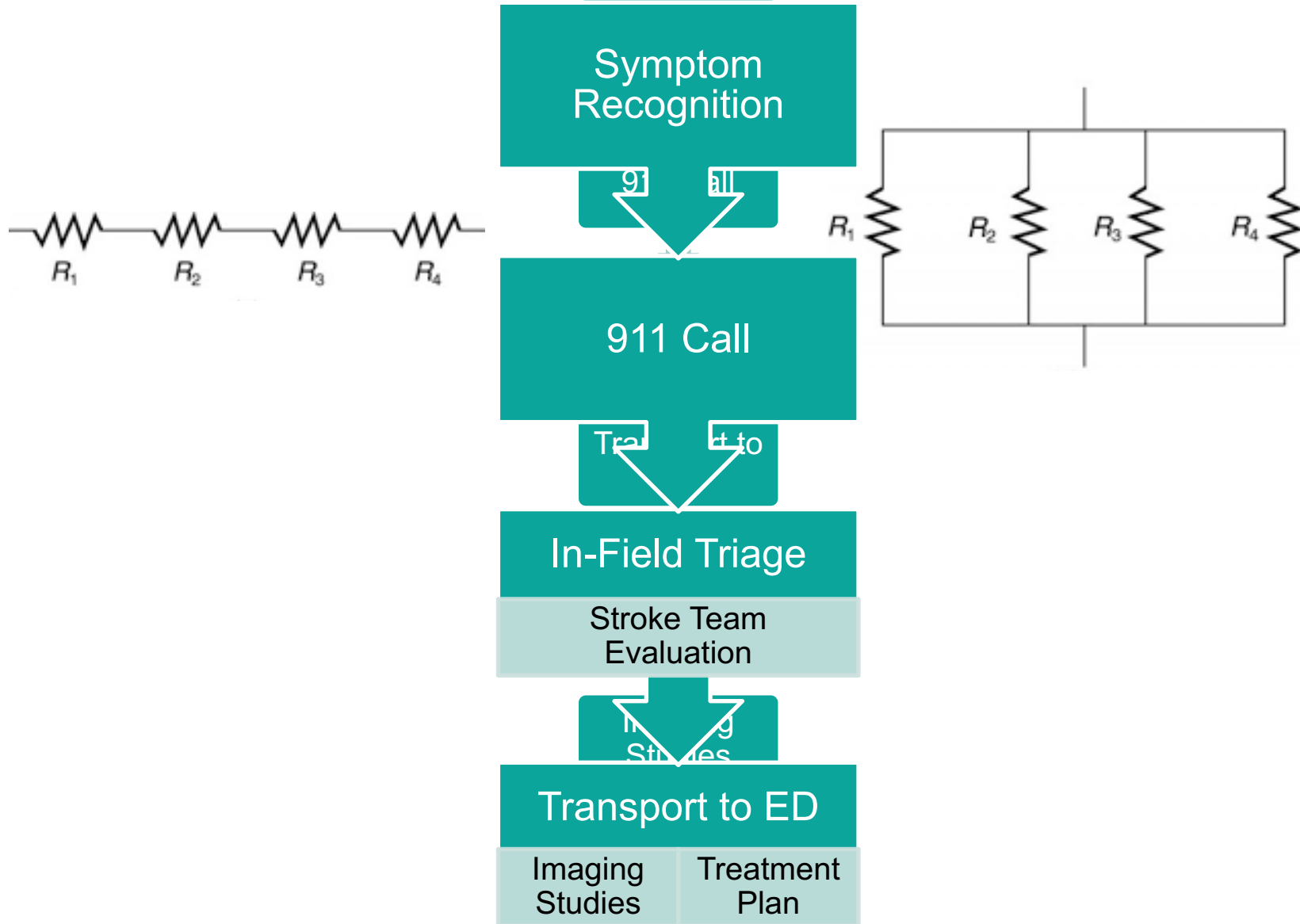
Treatment

- Pre-mixing of IV tPA or keep unmixed tPA/TNK at bedside
- Move to use IV TNK for ease of administration
- No delay for written consent



Symptom Recognition 911 Call In-field Triage Transport to ED Stroke Team Evaluation Imaging Studies Treatment Plan

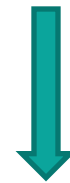
Paradigm Shift: Parallel Processes



Paradigm Shift: Pre-Hospital Systems

- Pre-notification of ED with ringdown for incoming stroke codes
- Technology to communicate with first responders
- Largely untapped potential
 - Rely on first responders for more than transport
 - Activate parallel processes at time of 911 call
 - Determine appropriate destination (and teams) in advance
 - Trauma
 - Cardiac

Symptom Recognition 911 Call In-field Triage Transport to ED Stroke Team Evaluation Imaging Studies Treatment Plan



Mobile Stroke Unit



- Novel and innovative
- Leverages pre-hospital systems of care
- Parallel processes

Mobile Stroke Unit



Fully operational 911 ambulance

- EMT and Paramedic

But that's not all...

- CT Scanner
- CT Technologist
- Critical Care Stroke Nurse
- Vascular Neurologist
- Lab
 - Coags, Chem panel
- Pharmacy
 - IV thrombolytics, anticoagulant reversal agents, anti-hypertensives

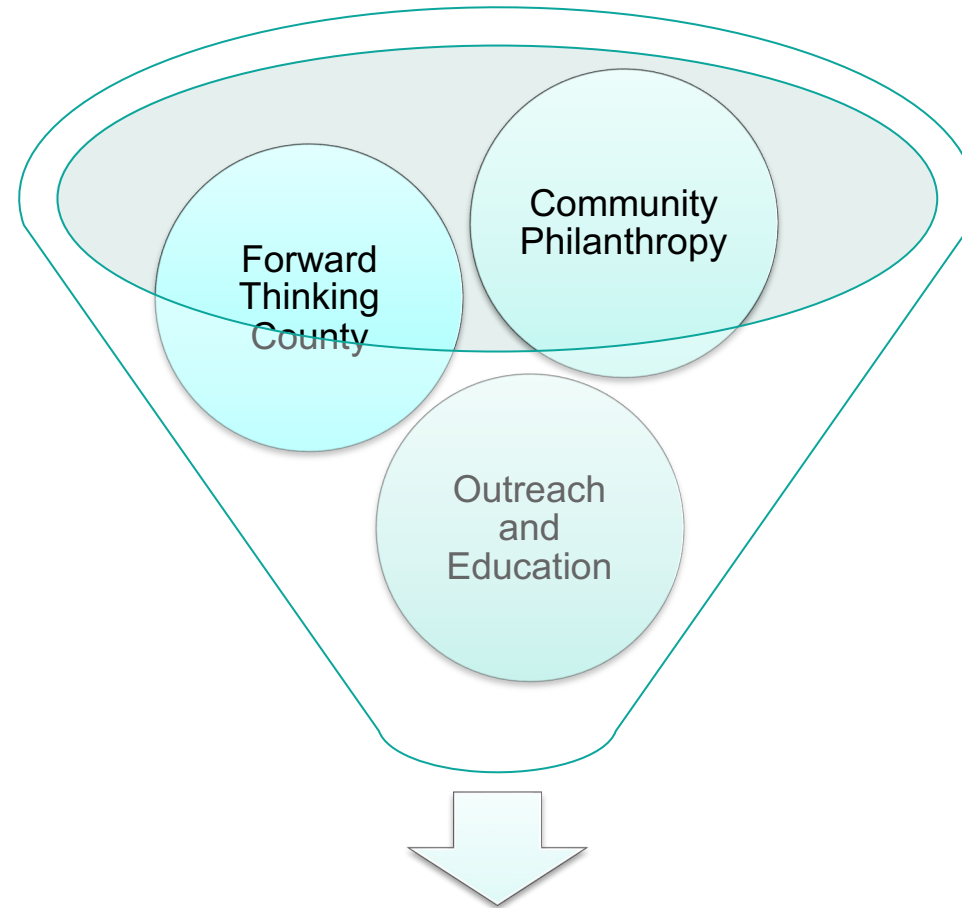


San Mateo County MSU



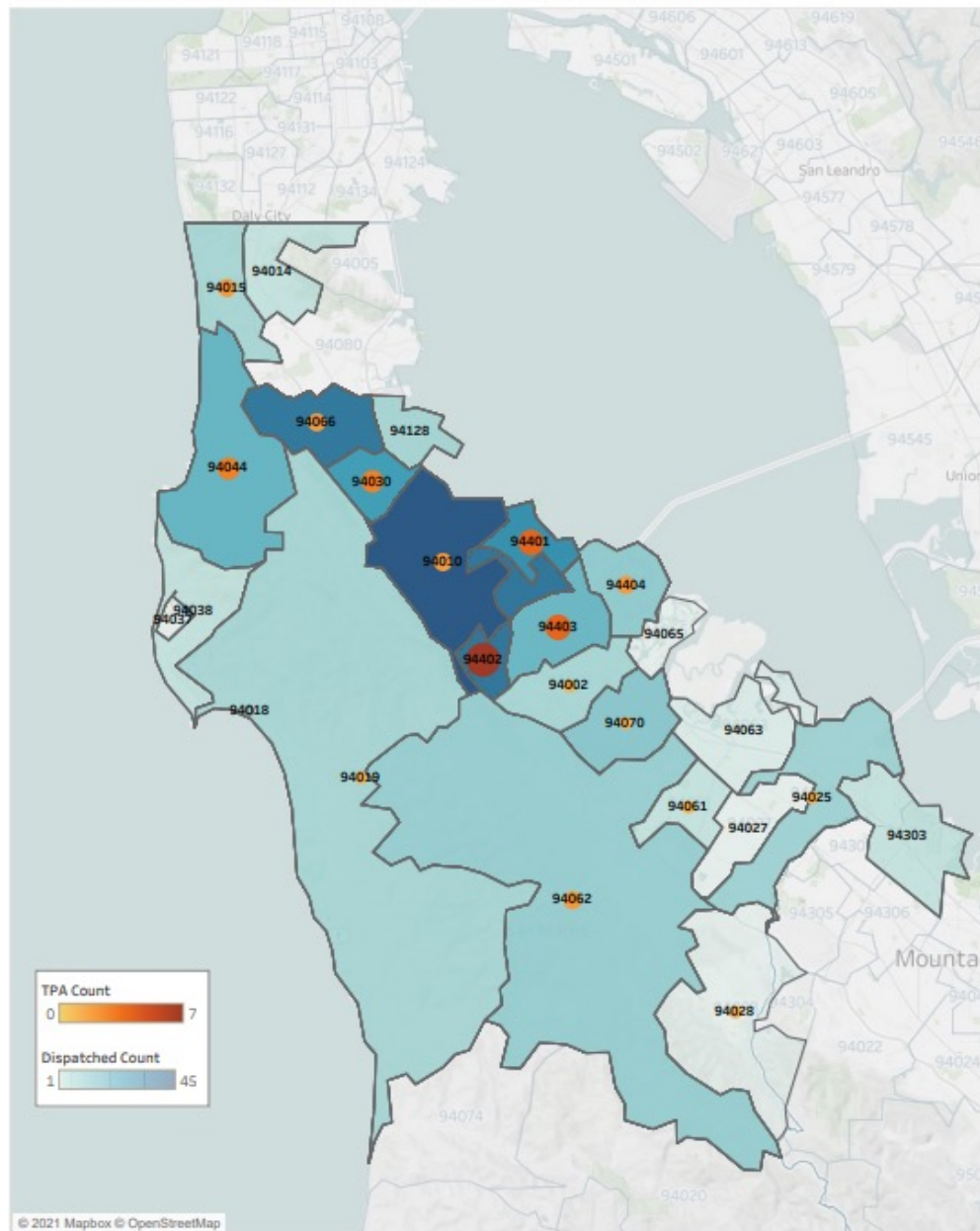
- Philanthropic donations from the community with match by Sutter Health
- Mills Peninsula Medical Center
- San Mateo County EMS
- San Mateo AMR
- SMC Fire Departments
- Public Safety Communications
- San Mateo County Board of Supervisors
- Other hospitals in San Mateo County
- Other MSUs

A Community Resource



First and ONLY Northern California MSU

Mobile Stroke Unit (MSU): Number of Calls Dispatched & TPA Given



Clinical Operations



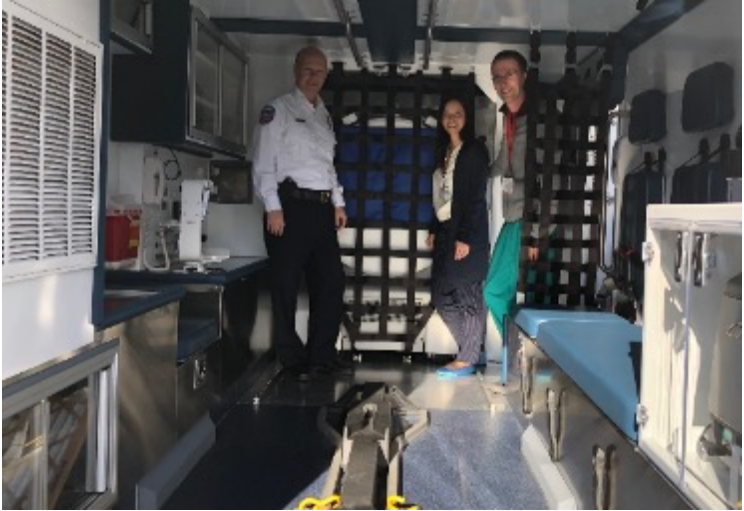
Community Outreach



Community Outreach



Community Outreach



Data Please!

Does treatment of stroke patients in an MSU provide clinical benefit?

Is this a cost-effective way to evaluate acute stroke patients in the pre-hospital setting?

UTHealth introduces nation's first Mobile Stroke Unit

Ambulance equipped with scanner to be part of EMS services for Houston area



BEST-MSU Clinical Trial



- 2014 (1 site) – 2020 (7 sites)
- observational, prospective, multicenter
- alternating-week trial
- 1515 patients, of whom 1047 were eligible to receive t-PA
 - 617 treated on MSU
 - 430 treated with standard approach (EMS/ED)

BEST-MSU Clinical Trial

- **Primary Outcomes:**
 - 3 month functional outcomes (mRS) among tPA-eligible ischemic stroke patients
 - MSU vs. EMS + ED Standard Management
- **Secondary Outcomes**
 - Cost effectiveness
 - Quality of Life

The **NEW ENGLAND**
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Prospective, Multicenter, Controlled Trial of Mobile Stroke Units

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BEST-MSU Results: Treatment Rates

Patients were more likely to be treated.

- Almost all eligible patients (97.1%) in the MSU group received the clot-busting medication tPA, compared to 79.5% of patients in the standard care group.

BEST-MSU Results: Treatment Times

Patients received treatment faster.

- A third of patients (32.9%) in the MSU group were treated within **60 minutes of stroke onset** compared to very few patients (2.6%) in the standard care group.
- The median time from stroke onset to initiation of treatment was 36 minutes shorter in the MSU group compared to the standard care group (72 minutes vs. 108 minutes).

BEST-MSU Results: Independence

Patients were more likely to recover.

- Out of 100 patients treated with clot-busting medication on an **MSU**, 27 will experience **less disability** following their stroke than had they received standard care in the ED, with 11 of those completely **disability free** at 90 days after their stroke.

BEST-MSU Results: Show Me The Money!

MSUs are cost effective.

- MSUs save stroke-related costs downstream and are cost-effective. **ICER: \$33,537/QALY**
 - Highly Cost Effective: <\$63,413
 - Cost Effective: \$63,413-\$190,239
 - Not Cost Effective: >\$190,239
- Pre-existing disability strongly influences the ICER.
 - ICER for pts without baseline disability: **\$10,740/QALY**
- ICER dependent on number of patients treated annually by MSU

Future Research Directions

BEST-MSU Substudies

Golden Hour treatment

Pre-existing Disability

Averted Strokes

Racial Disparities

Time-Dependent Treatments

Hemorrhage treatments (FASTEST)

Neuroprotection

Adjunct treatments to thrombolysis

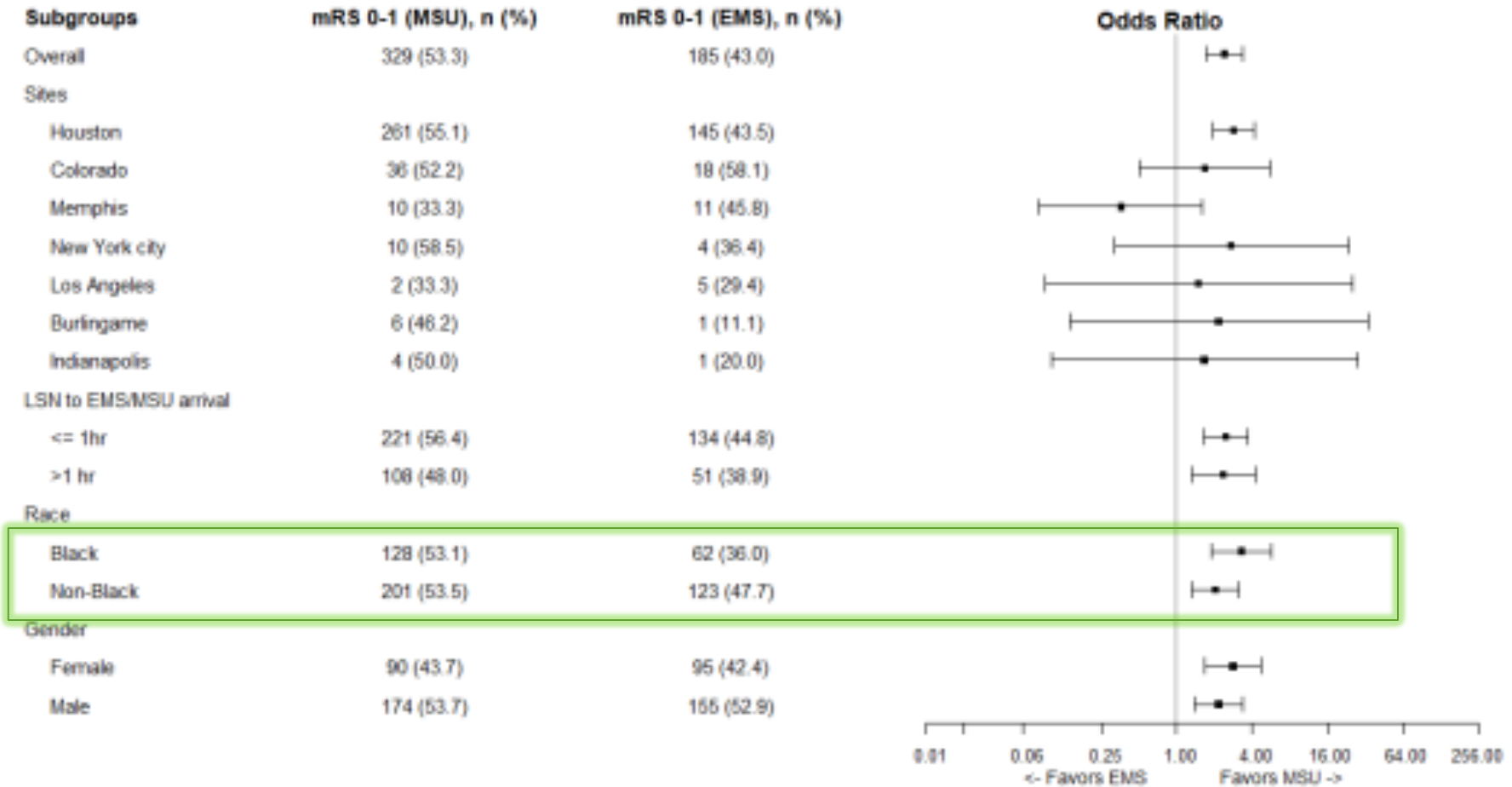
Systems Analyses

Optimal Location for MSUs

Cost Analyses

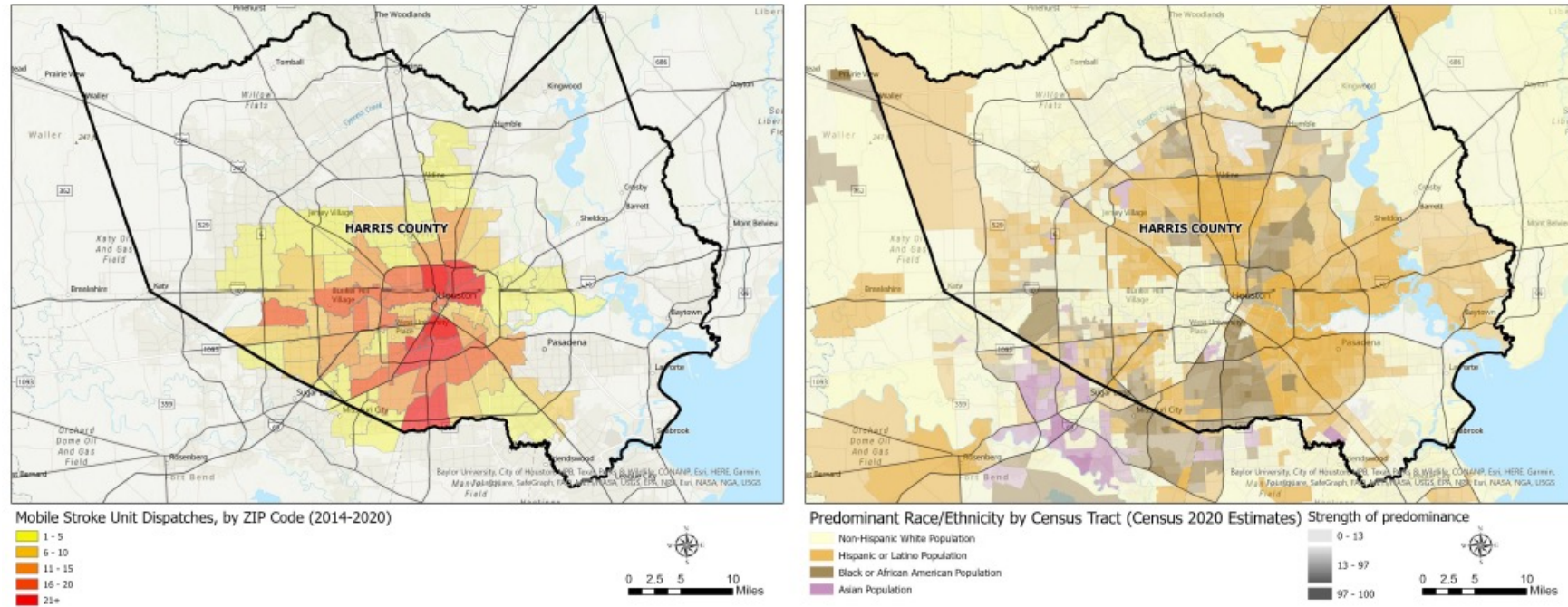
Health Equity

Sub-Study Analyses



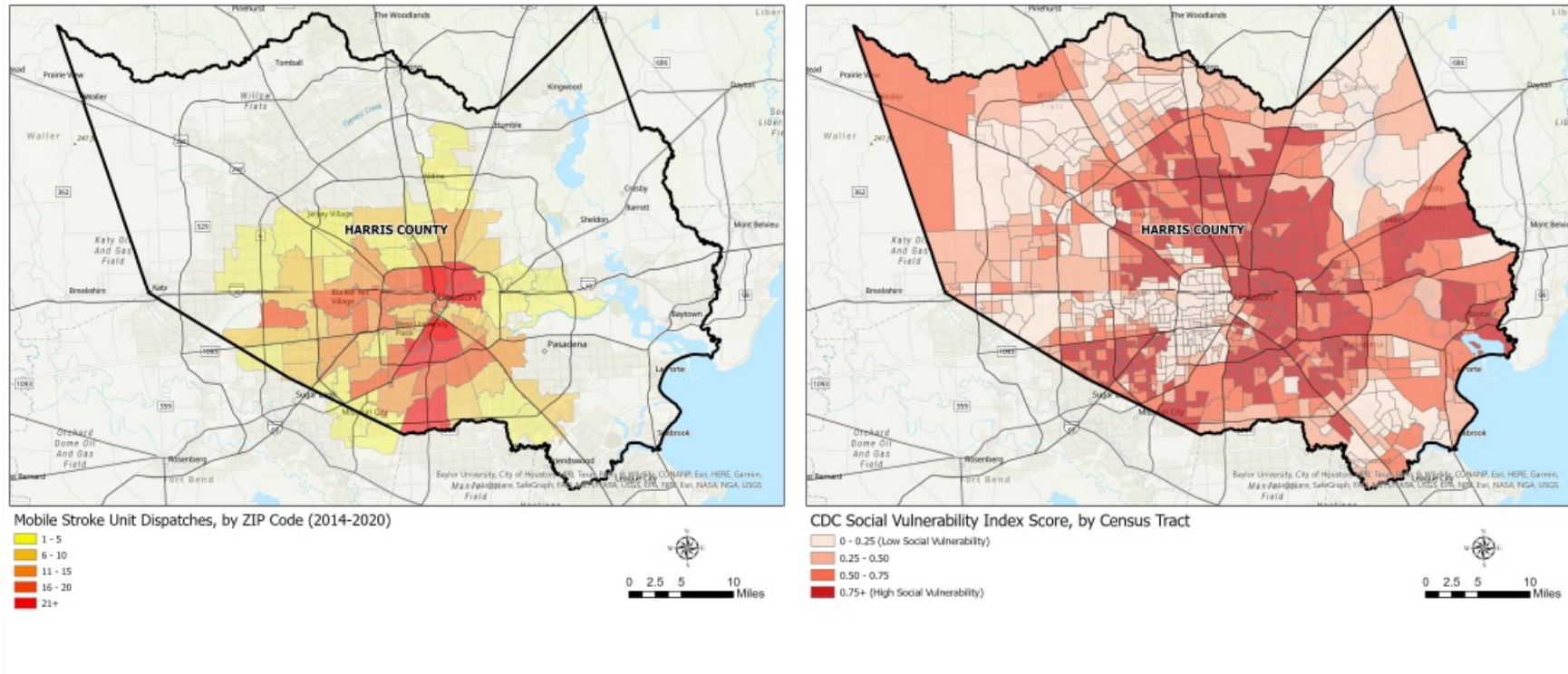
Houston, TX

Mobile Stroke Unit Dispatches Compared to Predominant Race/Ethnicity, by Neighborhood



Houston, TX

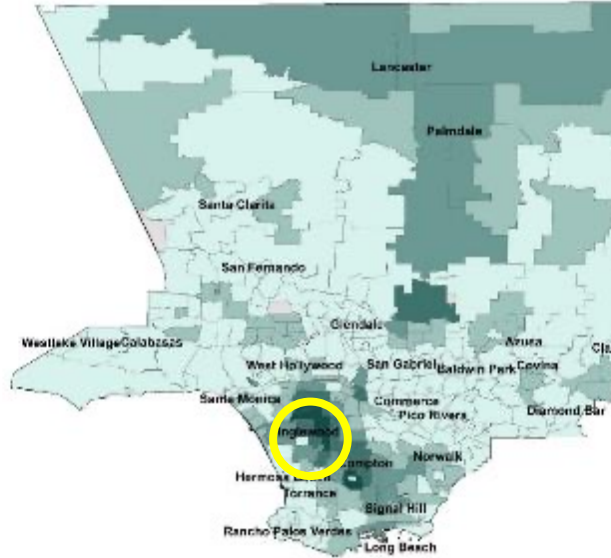
Mobile Stroke Unit Dispatches Compared to Social Vulnerability, by Neighborhood



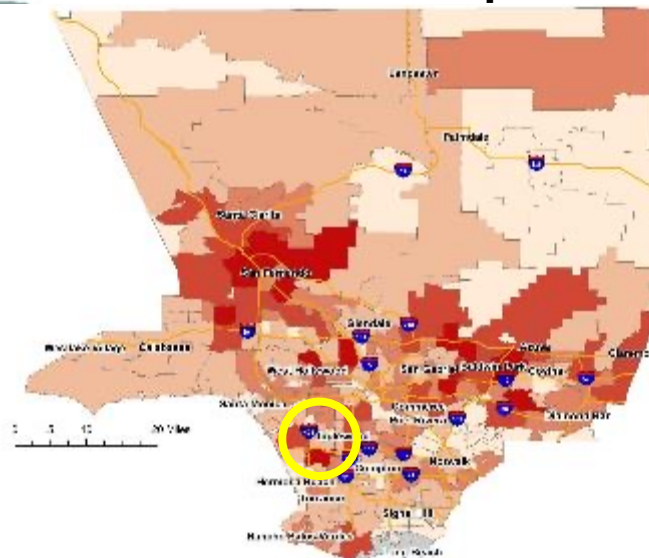
Los Angeles, CA

Stroke Incidence at Younger Age in Black/African American

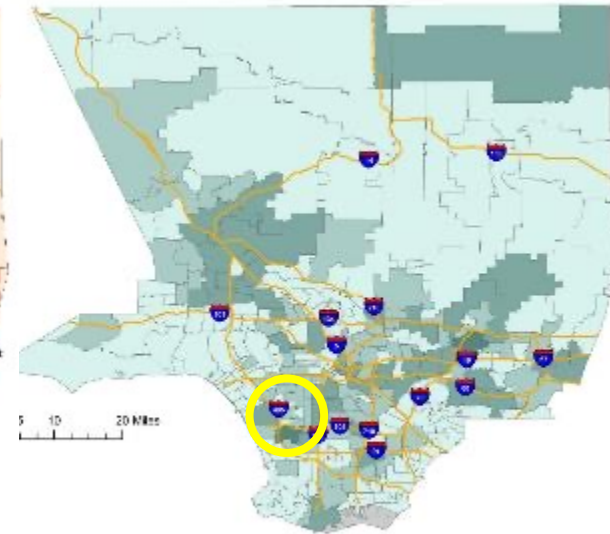
Black/African American



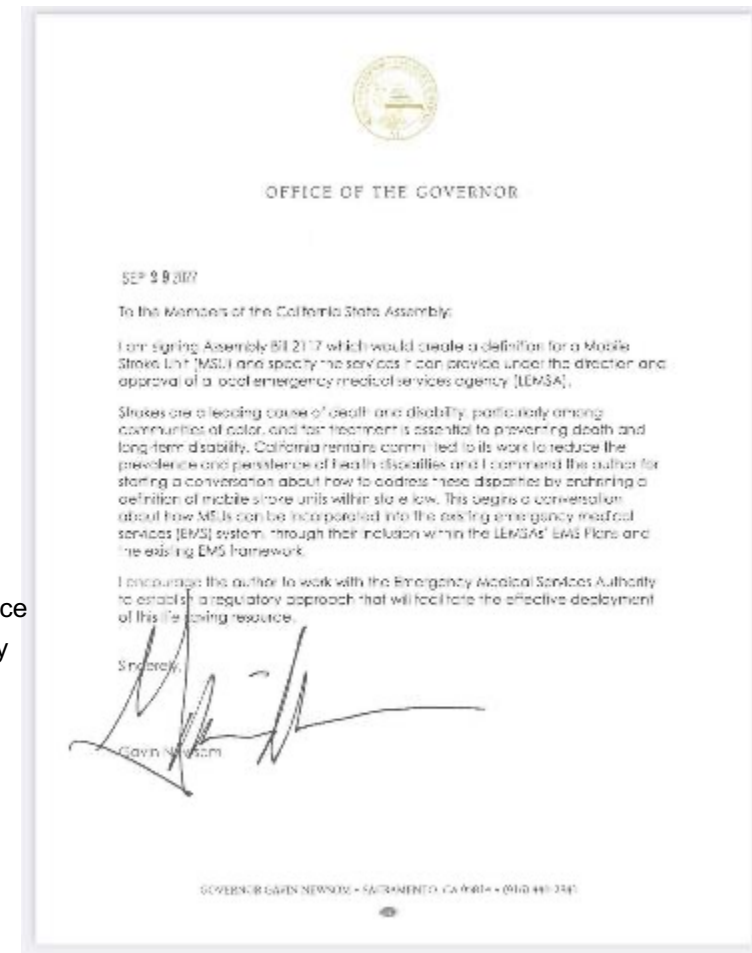
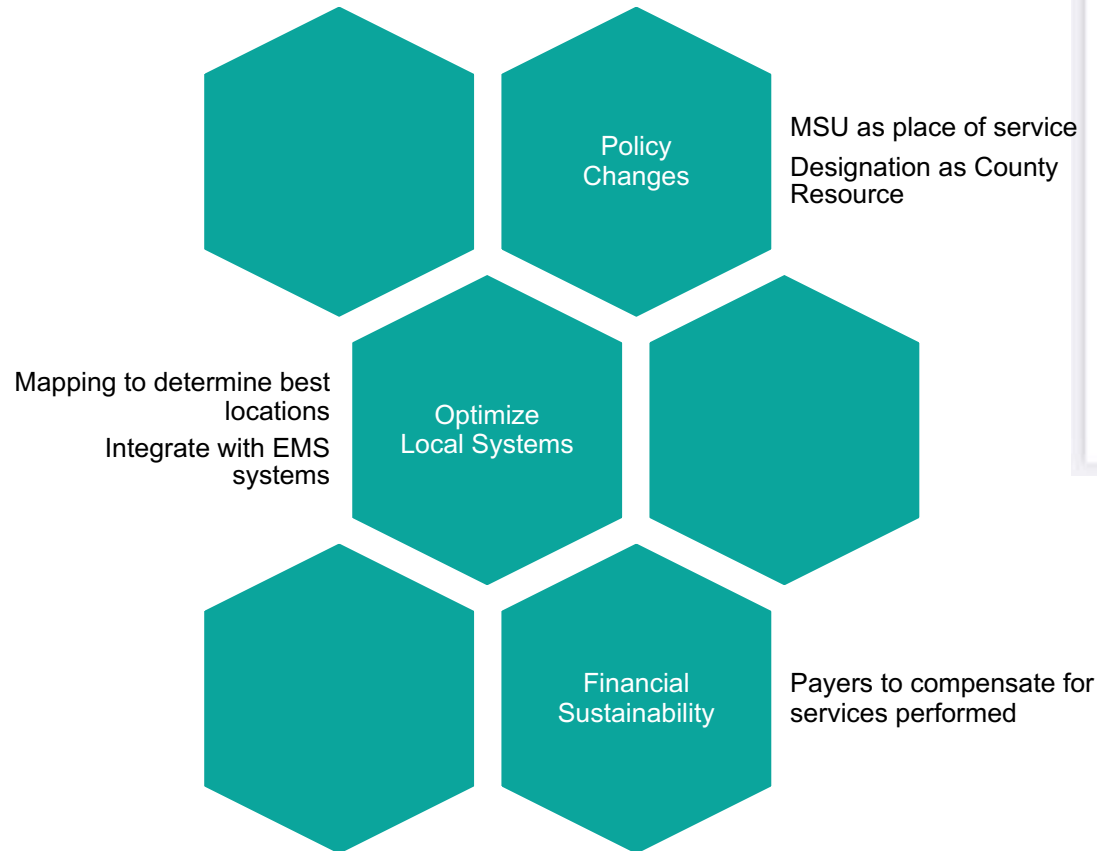
Stroke Heat Map



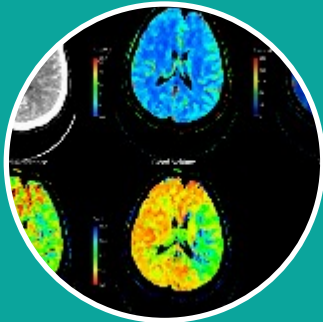
Age 50–64 (27%)



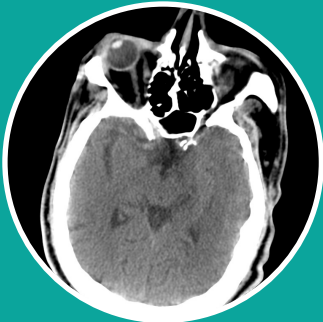
Legislation and Advocacy



MSU Expansion



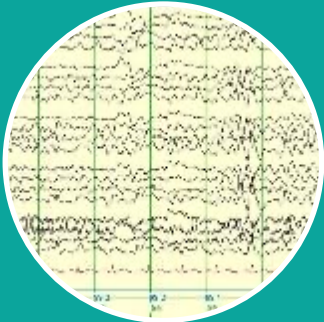
**CT Angiography
and Perfusion**



**Pre-hospital
triage**



**Expansion to
wider catchment
areas, hours of
operation**



**Other neurologic
emergencies that
would benefit
from early
diagnosis,
treatment, triage**



Thank You



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