RITMO: Reinventing Urban Transportation a Healthcare Perspective

John Cima
Amy Cohn
University of Michigan

cimajohn@med.umich.edu
CHEPS.engin.umich.edu
Outline

• Background
• Methods
  – Data
  – Analysis
• Results
• Discussions
• Future Work
Background

• Reinventing Urban Transportation and Mobility
  – University wide multidisciplinary team to examine public transportation in Ann Arbor

• Center for Healthcare Engineering & Patient Safety
  – Explore the effects public transportation on healthcare access
Background

• Nonemergency medical transportation is a barrier to healthcare
Background

• If lacking private transportation next option to access care private transportation

• Often public transportation takes longer to get to destination
  – Waiting time
  – Transfers
  – Less optimal routes
Research Questions

• Explore the difference in public and private transportation times for healthcare access

• Explore if there are any significant social factors that lead to a difference in access
Methods - Data

- Records of all visits to University of Michigan ED from 2012 - 2017
  - 500,000 patients records
  - Demographic
  - Address
  - Insurance type
  - Severity
  - Medical diagnosis
Methods-Data

• Filtered out patients that could not feasibly use public transportation
  – Remove people who live too far to use any Ann Arbor public transit
    • Out of state
    • Different cities (8 mile around Ann Arbor)
Methods - Data

All 500,000 Patient Visits

Remove all patients outside of 8 mile radius

162,705 patient visits
Methods-Data

- To find travel times of both public and private transportation ARC GIS and Google Maps API

Via ArcGIS, Patient addresses are geocoded then truncated to retain confidentiality.

Via the Google Distance Matrix API, we obtain driving and public transit travel times for the patient’s latitude-longitude coordinates.
Methods-Data

• The patient address data was matched with Social Vulnerability Index (SVI)
• SVI is a measure of “vulnerability” created by the U.S. government to better utilize resource after a large scale disaster to help underserved communities
Methods - Data

- SVI takes census tract level data and ranks it compared to all other census
- Each variable is ordered from worst to best outcome and given a percentile rank based on the following formula

\[
\text{Percentile Rank} = \frac{\text{Rank} - 1}{N - 1}
\]

N= total number of census tracts (N=65,081)
SVI Data are Grouped into Four Themes

- **Socioeconomic status**
  - % Below Poverty Level
  - Per capita income
  - % No High School Diploma
  - % Unemployment

- **Household composition**
  - % Above 65 y/o
  - % Under 17 y/o
  - % Greater Than 5 Years Disability
  - % Single Parent Households

- **Minority status**
  - % Minority
  - % ESL

- **Housing/Transportation**
  - % Apartment Living
  - % Mobile Homes
  - % Crowding
  - % no vehicles
  - % in Group Quarters
Methods - Analysis

• Metrics
  – Private Travel Time
  – Public Travel Time
  – Travel time ratio
    • Private Travel Time/Public travel time
    • Used with SVI data to find correlations with SVI data
Results

Travel Time Ratio

- 0-1: 27%
- 1-1.5: 24%
- 1.5-2: 17%
- 2-2.5: 16%
- 2.5-3: 13%
- >4: 3%
Results

Distribution of Travel Time Ratios for all Patients
Results

Distribution of Travel Time Ratios for all Patients Flagged under SVI Theme 1
Results

Distribution of Travel Time Ratios for all Patients Flagged under SVI Theme 2
Results

Distribution of Travel Time Ratios for all Patients Flagged under SVI Theme 3
Results

Distribution of Travel Time Ratios for all Patients Flagged under SVI Theme 4
Results

Distribution of Travel Time Ratios for all Patients Flagged under SVI Overall
Research Questions

• Explore the difference in public and private transportation times for healthcare access

• Explore if there are any significant social factors that lead to a difference in access
Discussion

• Private Transportation obviously faster
• Public transportation analysis
  – Huge amount a variability
  – Largely due to routes that are available
  – There seems to be no specific SVI factor that correlates with increased travel time ratio
Discussion

• Ann Arbor has factor that could lead to these results
  – College town might not capture truly accurate census level data
  – Highly educated population due to university
  – Diverse neighborhoods due to university
  – Lower percentage of people living with low SES
Discussion

• Public transportation is not optimized to access care
  – It is optimized to move the most amount of people around a city

• City factors are incredibly important
  – Population density
  – Lay out of a city
  – Population of the city
Discussion

• Results not comparable city to city
  – Different amount of public transit
  – City Factors
  – Number of hospitals available

• But is a viable method to analyze the access to healthcare and some of the social factor that contribute to this
Questions?

Thank You