

# Dialysis, Doctors, and Other Destinations in Rural Tennessee

**A Comparative Analysis of Demand  
Response Transportation (DRT) Trips  
by Age, Gender, and Disability Status**

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THE UNIVERSITY OF  
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Source: UCHRA.org

# Background

- Transportation in rural areas face specific challenges:
  - Large service areas
  - Low population density
- Fixed-route services in rural areas often can't provide needed level of service due to these factors (*Islam et al., 2022*).
- Demand Response Transportation (DRT) fills this service gap through:
  - Pre-scheduled trips
  - Flexible pick-up and drop-off locations
  - Shared rides
- Seniors, persons with disabilities, and ethnic minorities have been shown to crucially rely on DRT to meet basic needs (*Nie et al., 2022*) such as:
  - Grocery shopping
  - Medical trips
  - Dialysis trips

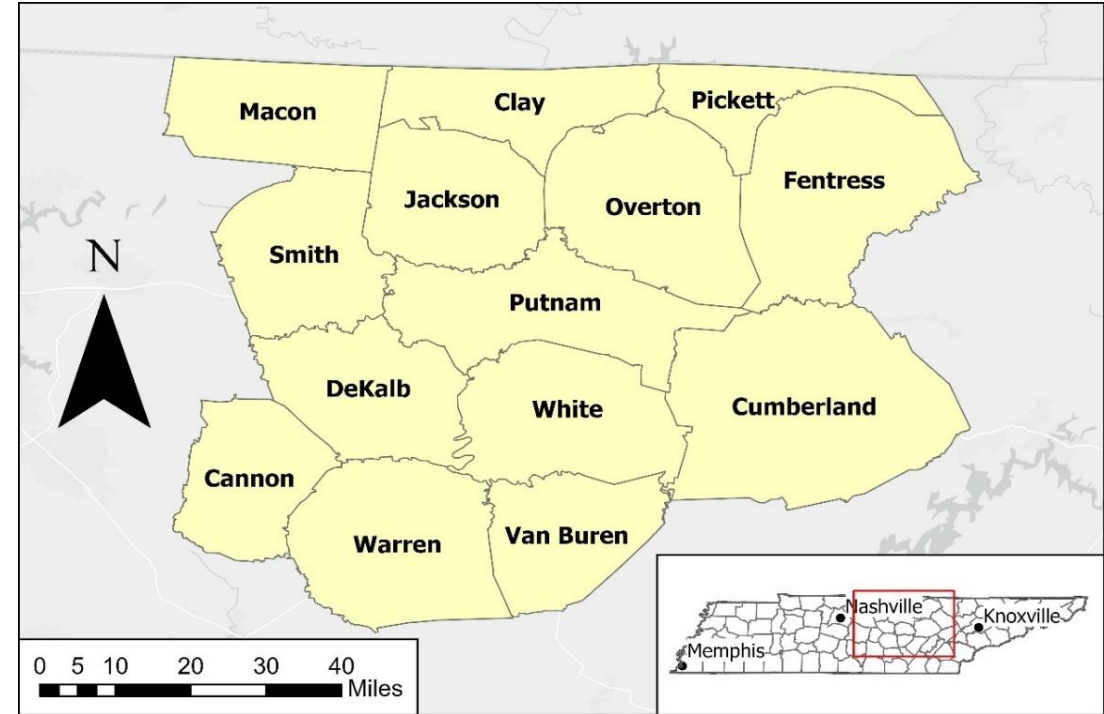


Source: UCHRA.org



# Background on Dataset

- Two years of DRT trip data (>200,000 trips) from the Upper Cumberland Human Resources Agency (UCHRA)
- UCHRA services are available to the general public
- Demographic information (e.g., age, gender, disability status)
- Trip purpose information (e.g., medical, dialysis, employment, social/recreation, shopping, senior center)
  - Notably, dialysis trips are separate from medical trips
- Evaluate the temporal and spatial characteristics of each trip purpose by demographic group



# Literature Review

- Focused on literature evaluating DRT rider travel behavior from the United States over the last 20 years.

Author(s)	Location	Method	Data	Sample Size
Southworth et al., 2005	Statewide Tennessee (Rural)	Benefit and sensitivity analysis	Survey data of trips from 11 transit agencies	n=1,400,000 trips
LaMondia and Bhat, 2010	Brownsville, TX	Microsimulation	Trip records	n=28,751
Nguyen-Hoang and Yeung, 2010	United States	Benefit-cost analysis	NTD and Census data	n=1,176
Yang and Cherry, 2017	Statewide Tennessee (Rural)	Survey and logistic regression	Survey data from 3 deviated fixed route transportation (DFRT) and 8 DRT agencies	n=45 riders (DFRT), n=238 riders (DRT)
Mattson, 2017	United States (Rural)	Ridership demand model	NTD data and survey data	n=731 agencies (NTD), n=68 agencies (survey)
Sultana et al., 2018	Statewide Tennessee	Econometric count data models	Trip records	n=185,500
Arif Khan et al., 2021	Arlington, TX (Urban)	Descriptive statistics and ordinary least squares model	Trip records	n=373,202
Islam et al., 2022	Pickens County, AL (Rural)	Needs assessment and community feedback	Survey data and focus group feedback	n=84 (survey), n=63 (feedback)
Nie et al., 2022	Central Alabama	Impact analysis	Trip records	n=17,904

# Literature Review

- Three studies focused on data from Tennessee, providing more local insight.

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Southworth et al., 2005	Statewide Tennessee (Rural)	Benefit and sensitivity analysis	Survey data of trips from 11 transit agencies	n=1,400,000 trips
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# Literature Review

- Four studies focused on the rural context, which present very different travel behavior compared to urban contexts.

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# Literature Review

- Four studies utilized survey data, and received data from agencies and rider specific trips.

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Nie et al., 2022	Central Alabama	Impact analysis	Trip records	n=17,904

# Literature Review

- Four studies utilized trip record data, but the sample size varied greatly.

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Southworth et al., 2005	Statewide Tennessee (Rural)	Benefit and sensitivity analysis	Survey data of trips from 11 transit agencies	n=1,400,000 trips
LaMondia and Bhat, 2010	Brownsville, TX	Microsimulation	Trip records	n=28,751
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# Research Gaps

Four gaps were identified from the literature review:

- 1) Limited number of DRT studies evaluated **trip records**, only two had >100,000 trips, but both had none to limited demographic information
- 2) Of **rural studies**, only one evaluated trip records. Trips records dovetail some benefits of surveys and big data
- 3) A few studies considered **trip purpose**, but none conducted a deep dive of the temporal and spatial characteristics
- 4) Few studies included **dialysis trips** specifically in their analysis, which warrants further investigation

# Objectives

Question: What are the temporal and spatial trends of each DRT trip purpose?

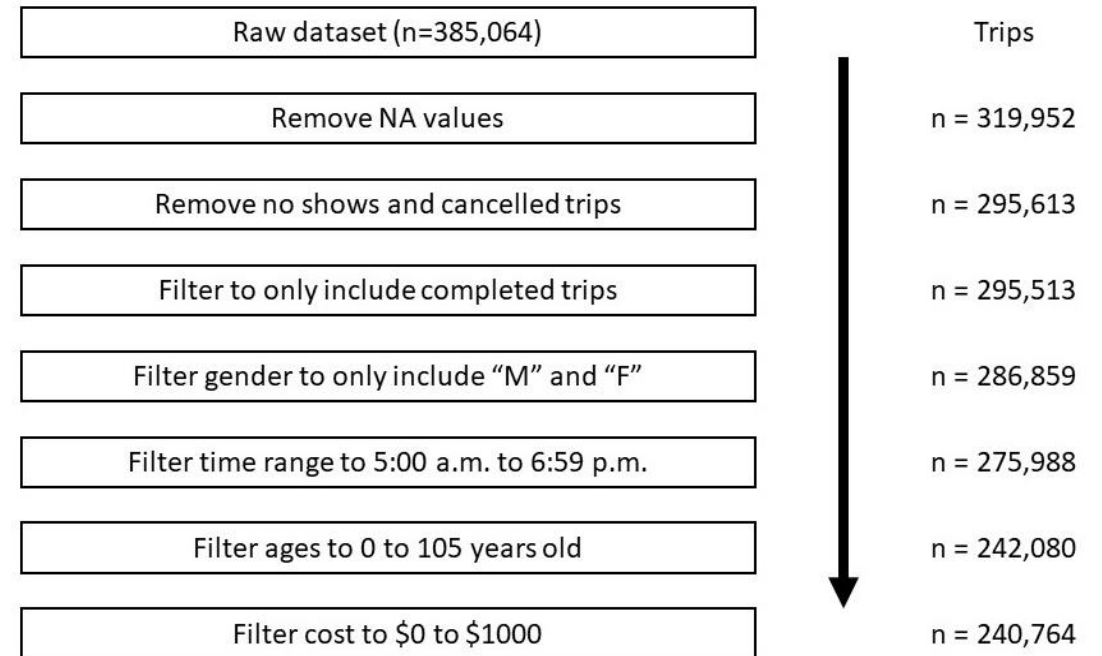
This research analyzes a:

- Unique trip record dataset of over 200,000 trips
- Trip purpose by gender, age, and disability status
- Rural context
- Specific dialysis trip analysis



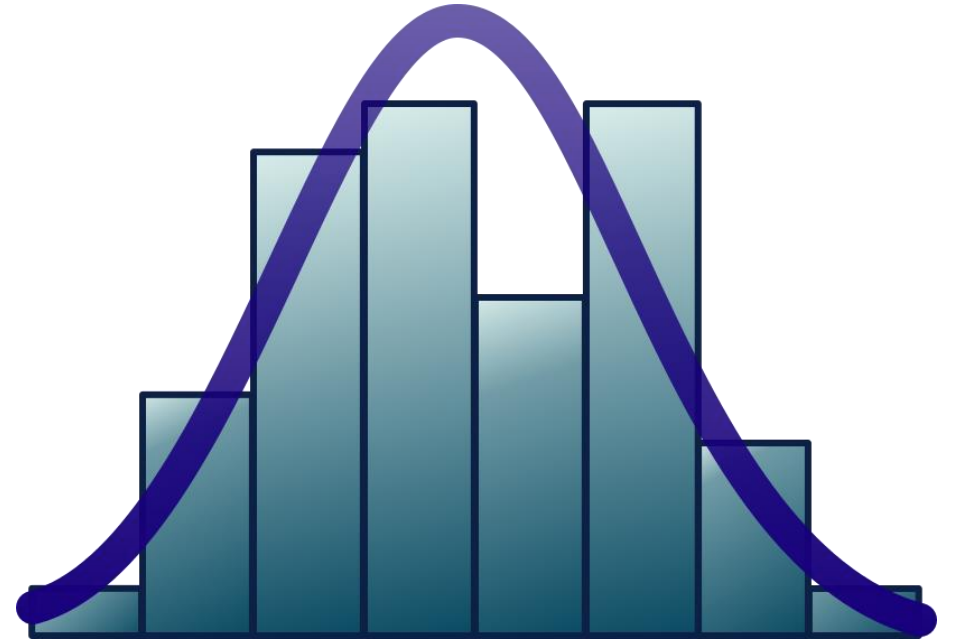
# Data Cleaning

- Two years (July 2021 - June 2023) of anonymized trip records
- Focused on DRT and included some intercity bus trips to Nashville (less than 5% of total trips)
- Rider demographics:
  - Age
  - Gender
  - Disability status
- Trip characteristics:
  - Hour of the day
  - Day of week
  - Estimated trip distance



# Method

- Four statistical tests:
  - One-way ANOVA (hour of the day)
  - Welch's t-test (trip distance)
  - Chi-squared and Cramer's V (day of week)
- Temporal analysis (e.g., Graphs)
- Spatial analysis (e.g., ArcGIS Pro)





# Results

- Summary Statistics
- Analysis by similar trip purposes:
  - Medical v. Dialysis
  - Employment
  - Social/Recreation v. Shopping v. Senior Center



# Summary Statistics

- Most common: Medical and Employment trips (comprise over 60% of all trips)
- Less common: Social/Recreation, Shopping, and Senior Center trips

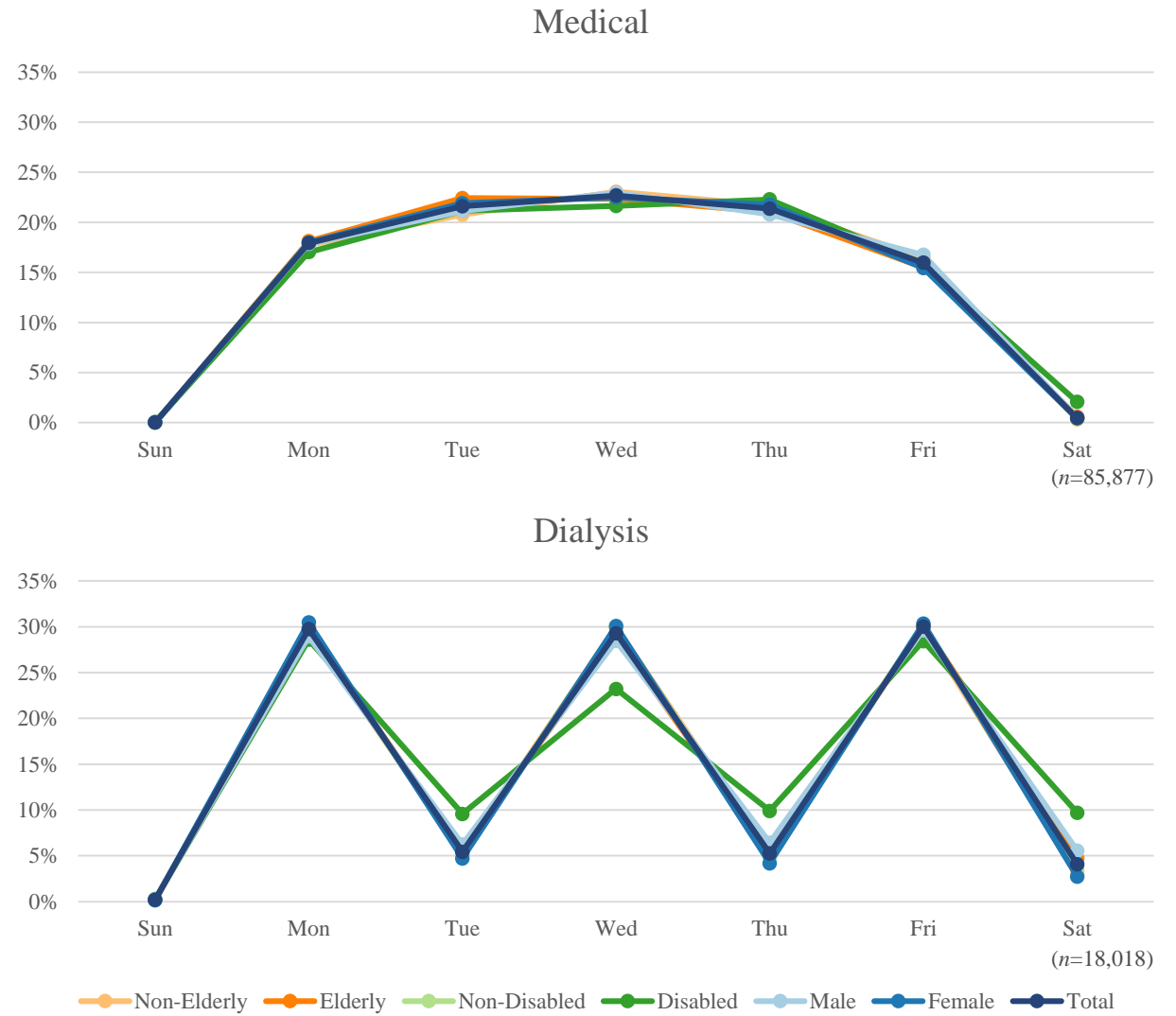
Trip Purpose	Number of Trips per Purpose	Percent of Total Trips
Medical	85,877	35.7%
Employment	61,206	25.4%
Shopping	22,897	9.5%
Dialysis	18,756	7.8%
Senior Center	10,015	4.2%
Social/Recreation	5,300	2.2%
Other	36,713	15.2%
Total	240,764	100.0%

# **Results: Medical v. Dialysis**

# Medical v. Dialysis

## Day of Week

- Medical
  - Spread across weekdays, less on Monday and Friday
  - Consistent across all demographics
- Dialysis
  - Large MWF peaking, subtle TThSa peaking

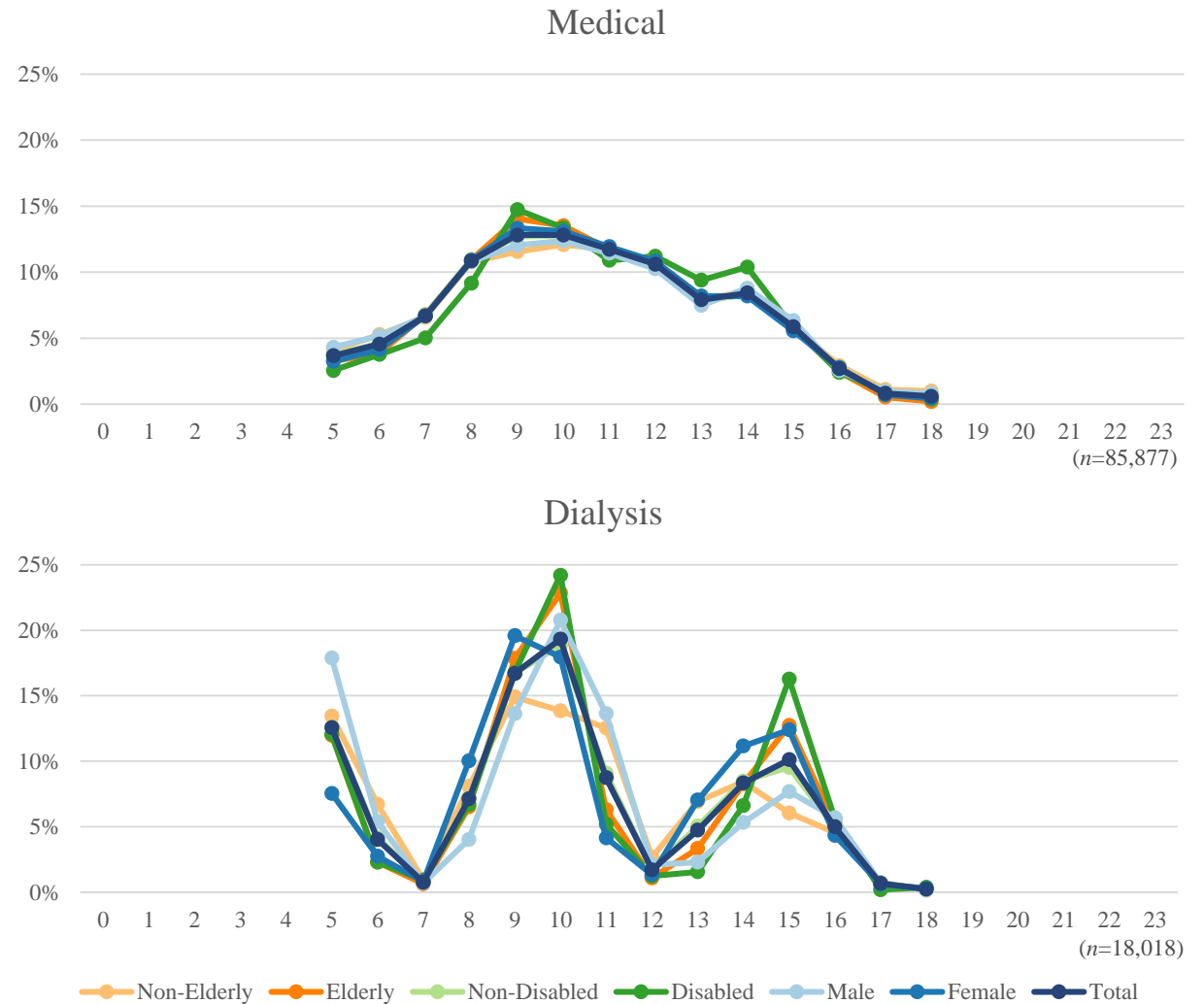




# Medical v. Dialysis

## Hour of Day

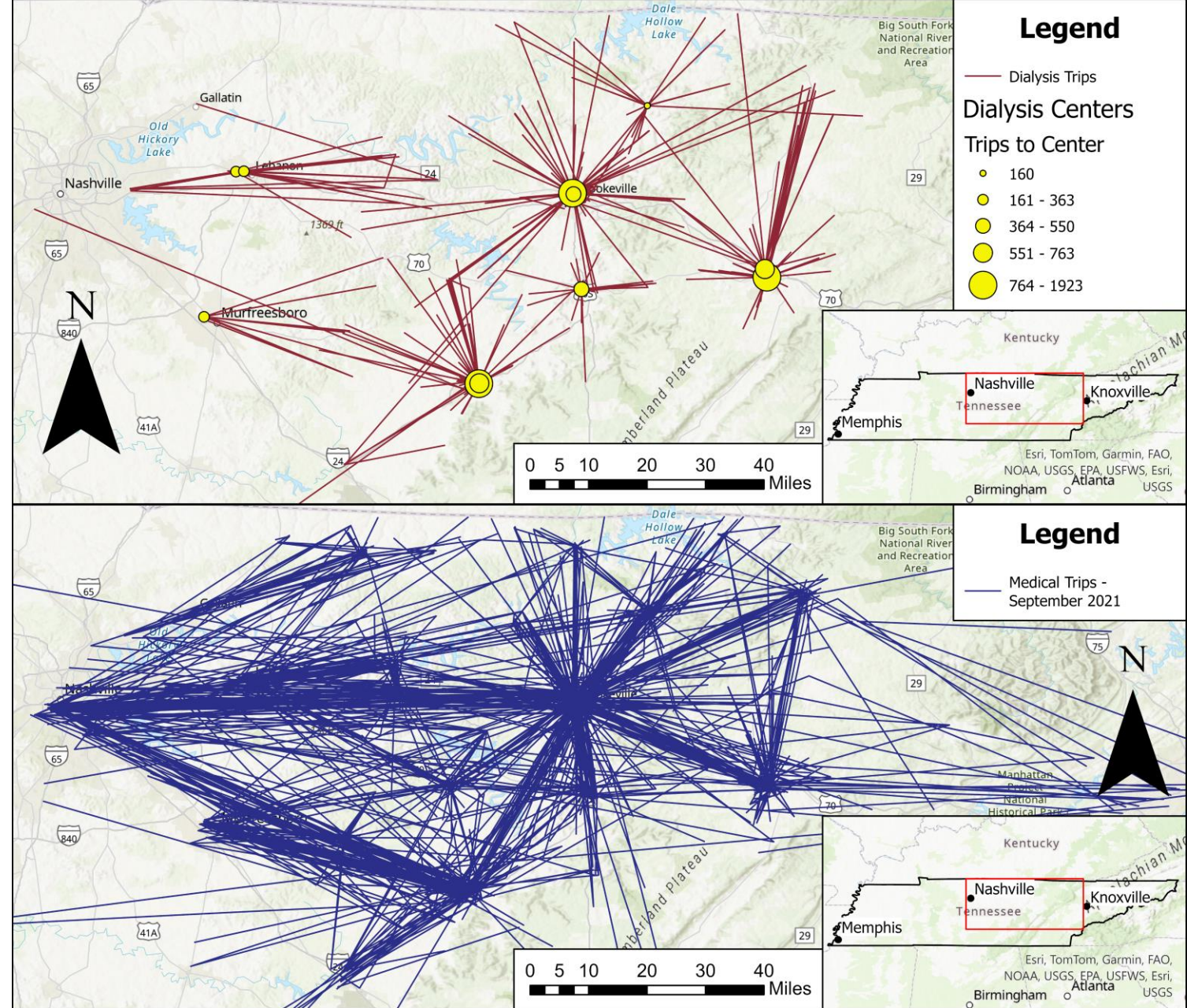
- Medical
  - Slight peaks at 9:00 a.m. and 2:00 p.m., mostly midday
  - Uniform across demographics, riders with a disability have more pronounced peaks (ANOVA  $p=1.802e-06$ )
- Dialysis
  - Three peaks, correlates with typical dialysis schedules (e.g., two appointments per day per machine)
  - Riders with a disability (ANOVA  $p=2.937e-04$ ) had higher peaks, males tended to travel earlier



# Medical v. Dialysis

## Spatial analysis

- Dialysis
  - 18,000 trips but little variation in origin-destination pairs
- Medical
  - Map shows trips from only September 2021
  - Large variability in origin-destination pairs, indicating more variety in destinations

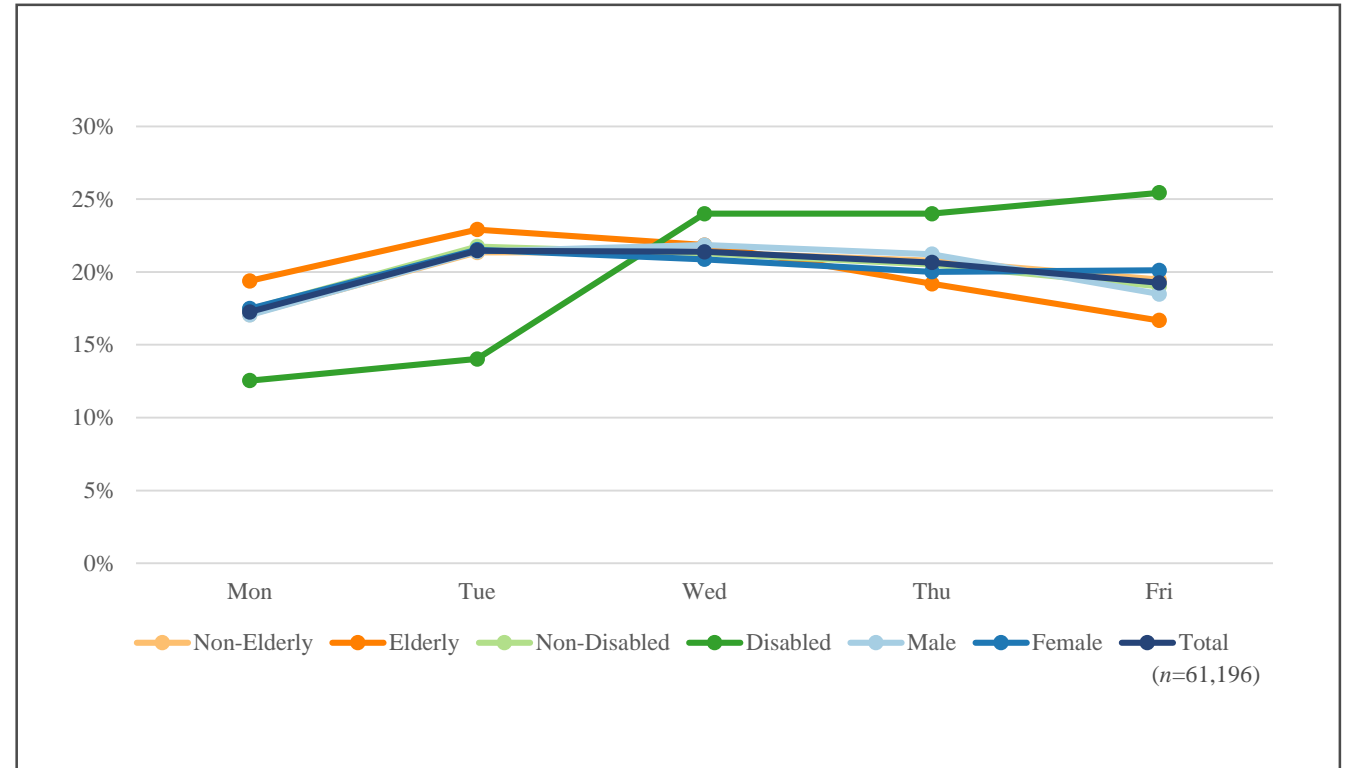


# Results: Employment

# Employment

## Day of Week

- Fairly equally distributed throughout the week, fewer trips on Monday and Friday
- Riders with a disability had higher percentage of trips later in the week, indicating more varied schedules or work fewer days per week

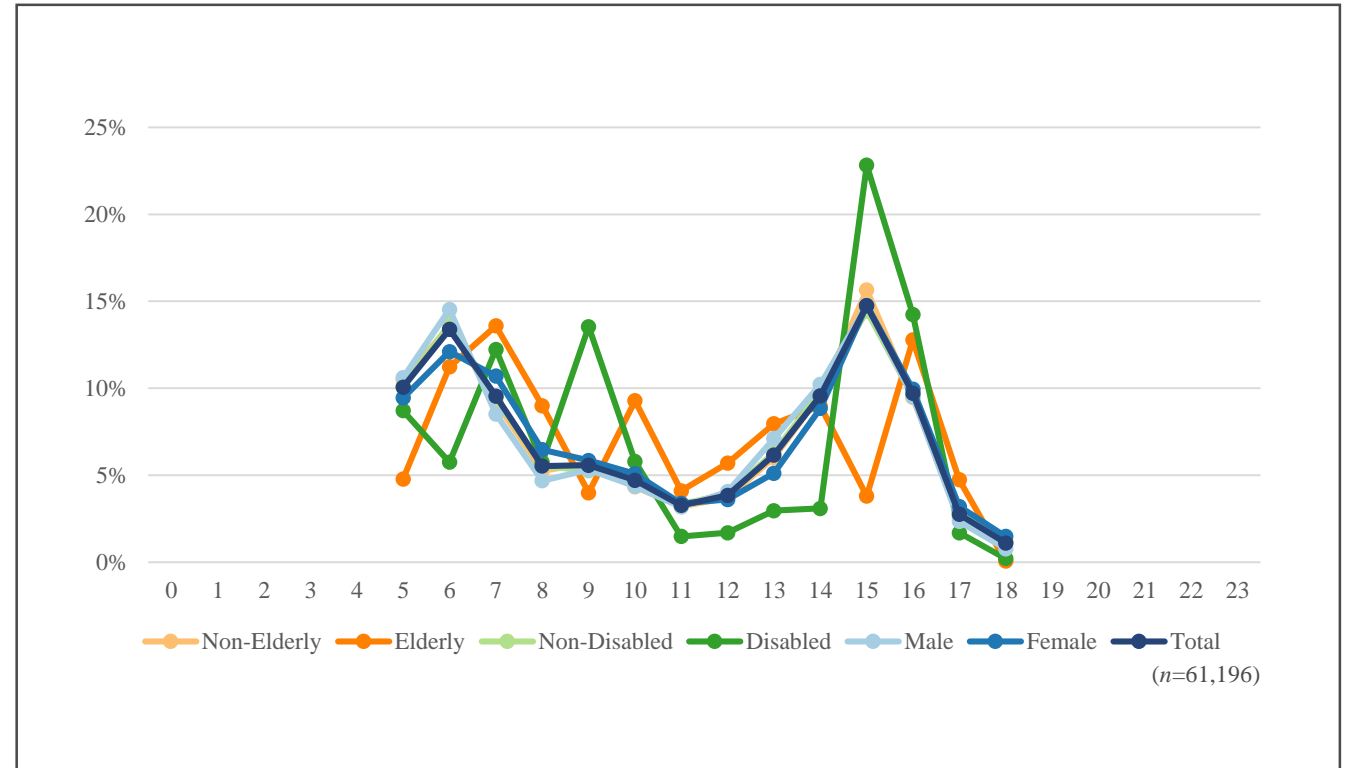




# Employment

## Hour of Day

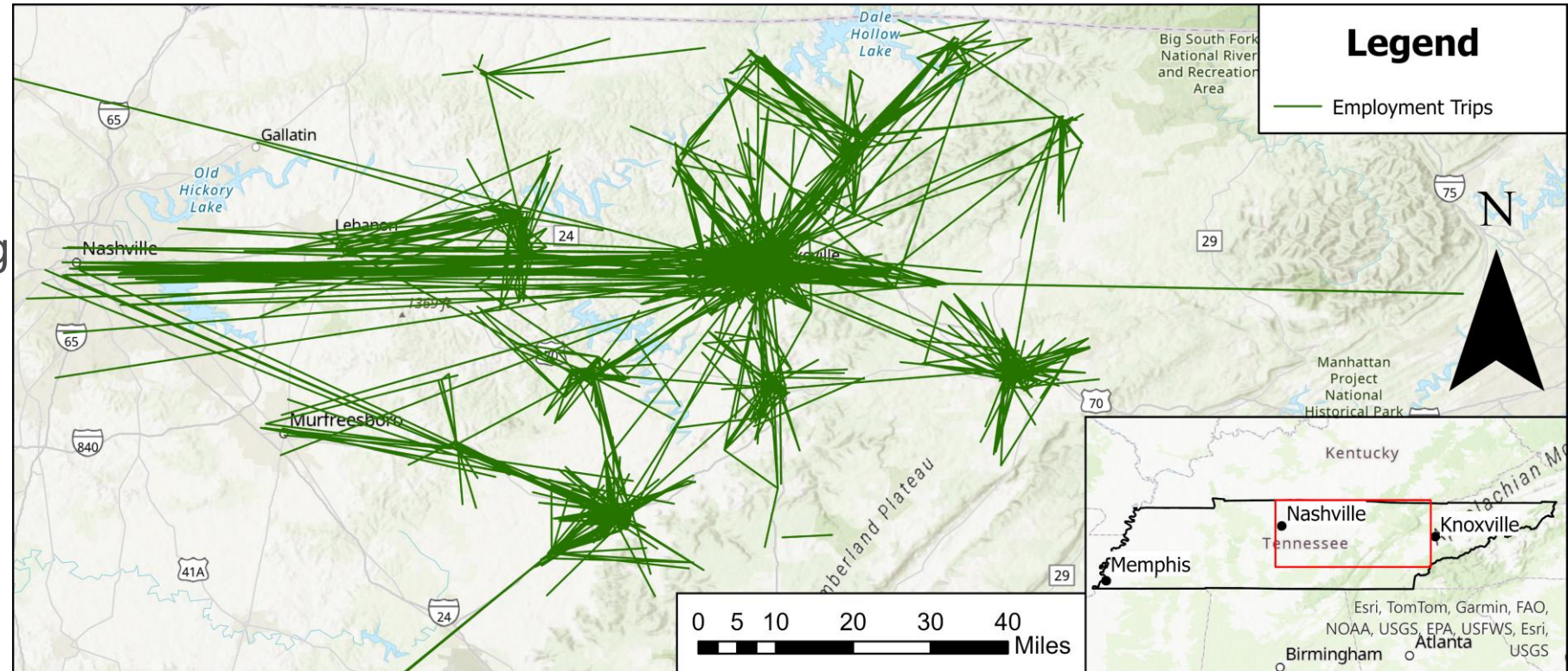
- Overall travel peaks (dark blue) at 6:00 a.m. and 3:00 p.m.
- Age (ANOVA  $p=6.155e-06$ ) was statistically significant
  - Elderly riders had two morning and two afternoon peaks, indicating varied, shorter, or wider ranging shifts
- Notably, gender was not statistically significant



# Employment

## Spatial analysis

- Most common destinations were warehouse, manufacturing, nursing home, and fast food jobs
- Earlier travel peaks may be related to more shift work jobs

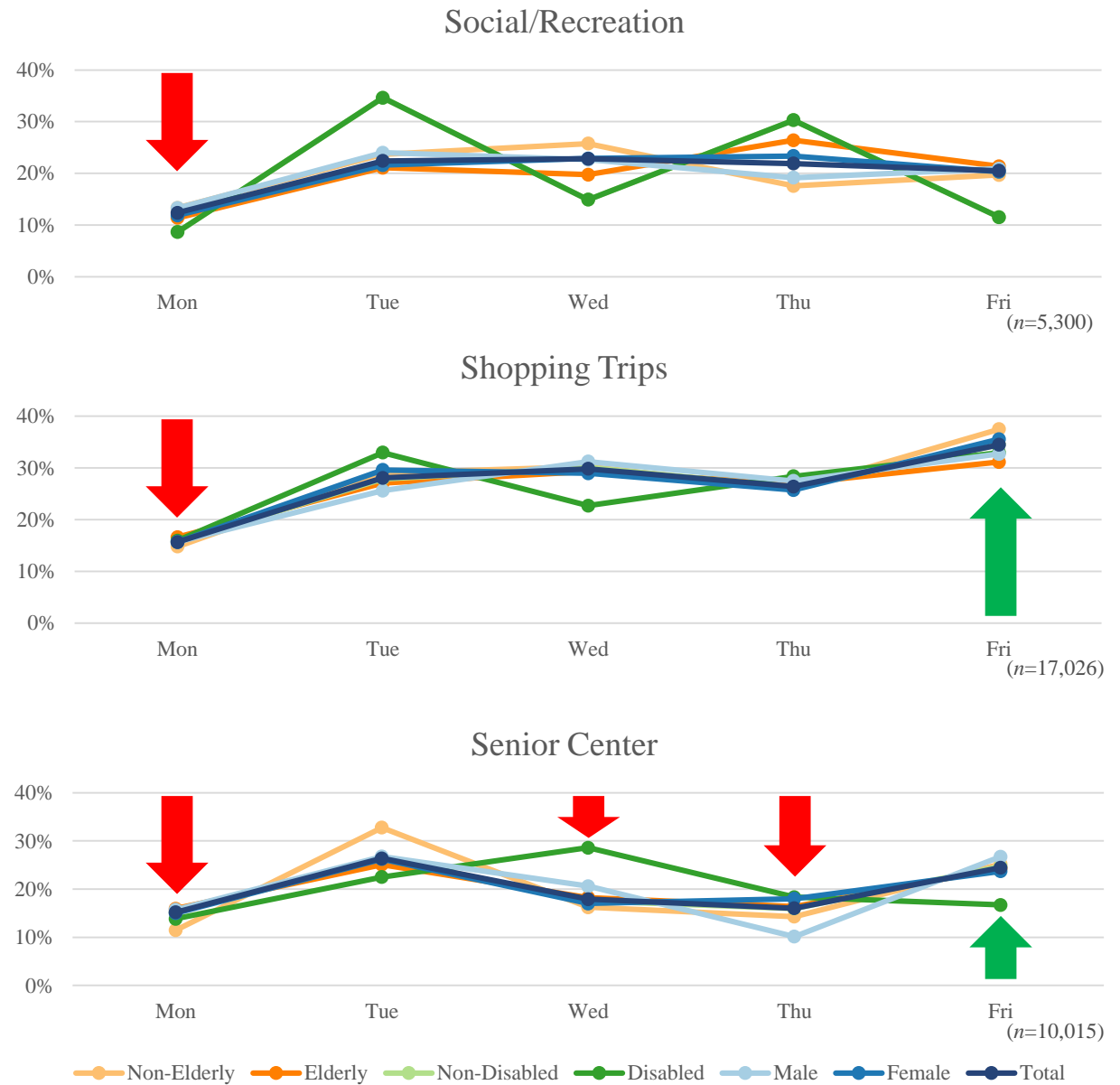


**Results: Social, Shopping, and Senior Center**

# Social, Shopping, and Senior Center

## Day of Week

- Less trips on Mondays overall and more trips on Friday for Shopping and Senior Center
- Midweek varied
  - Social/Recreation and Shopping more consistent
  - Senior Center less on Wednesday and Thursday



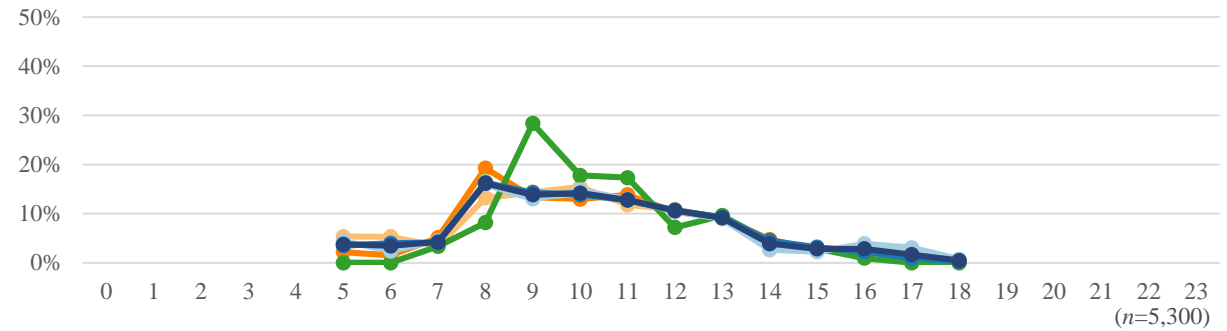


# Social, Shopping, and Senior Center

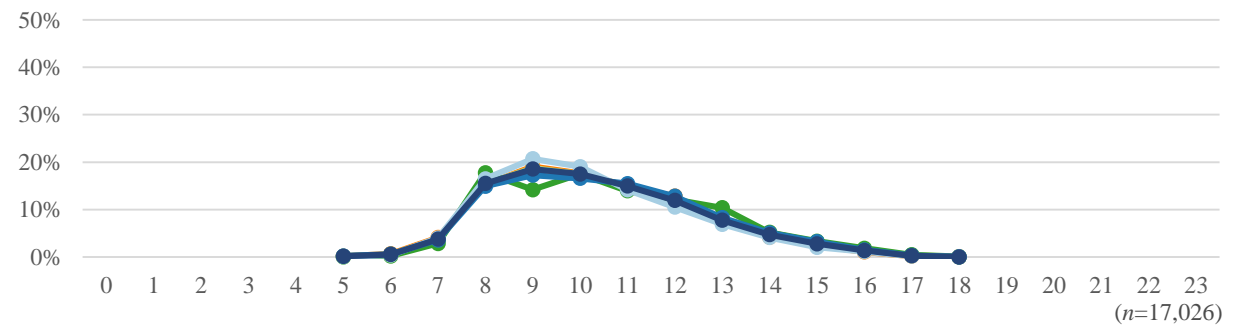
## Hour of Day

- Social/Recreation
  - Morning peak (8:00 a.m.) with midday trips ending by 1:00 p.m.
  - Riders with a disability (ANOVA  $p=5.211e-04$ ) had slightly later peak
- Shopping
  - Very consistent across demographics
  - May be influenced by personal opinion on best time to go shopping
- Senior Center
  - Three peaks (8:00 a.m., 12:00 p.m., 5:00 p.m.)
  - No demographic groups statistically significant to 95%

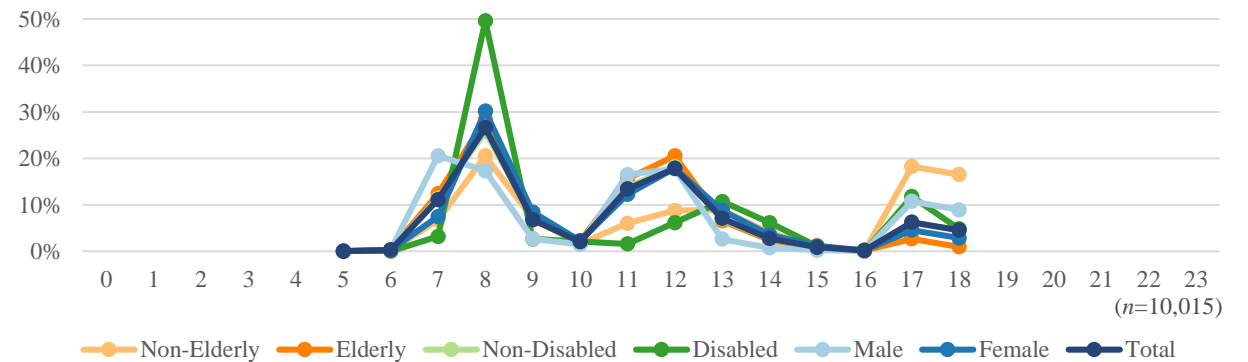
Social/Recreation



Shopping Trips



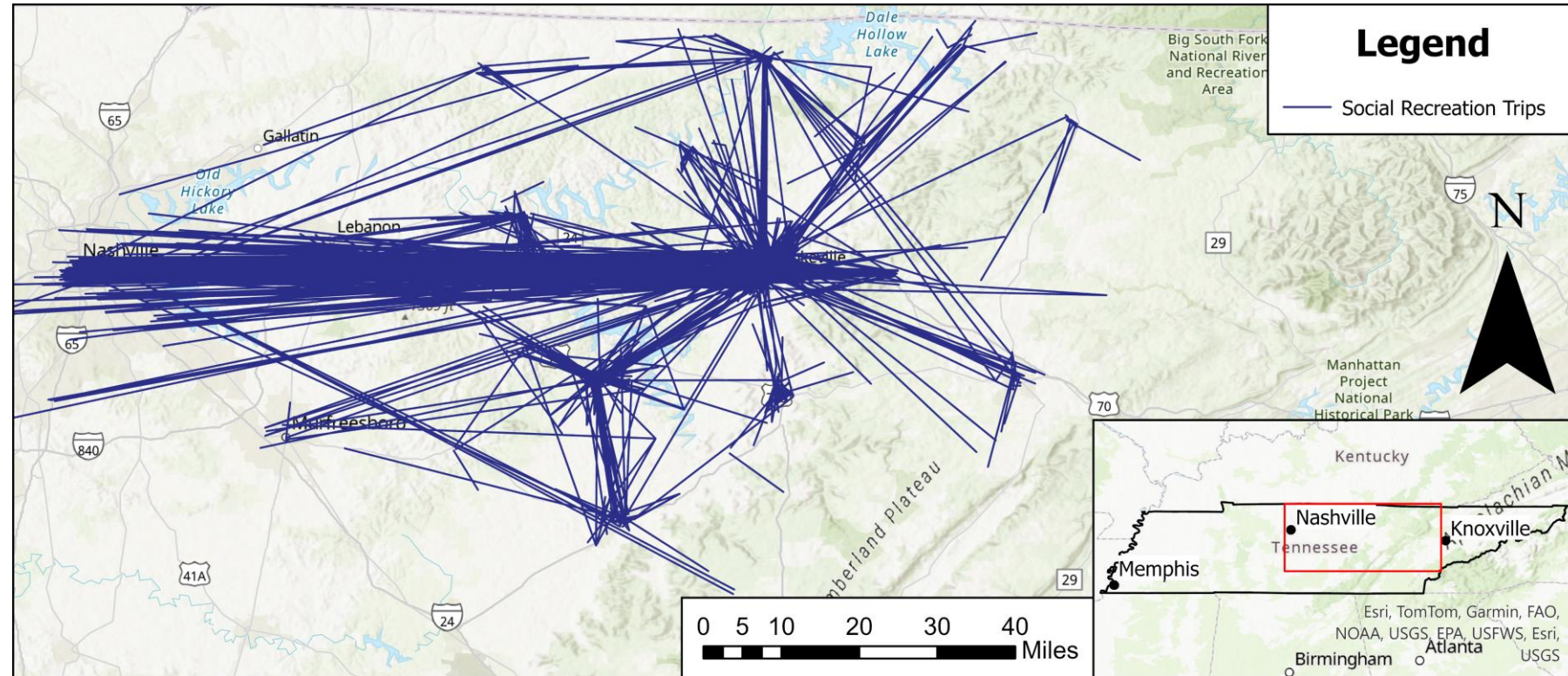
Senior Center



# Social, Shopping, and Senior Center

## Spatial analysis

- Social/Recreation
  - Most social recreation trips were to Nashville
  - Most common destination was the Nashville International Airport

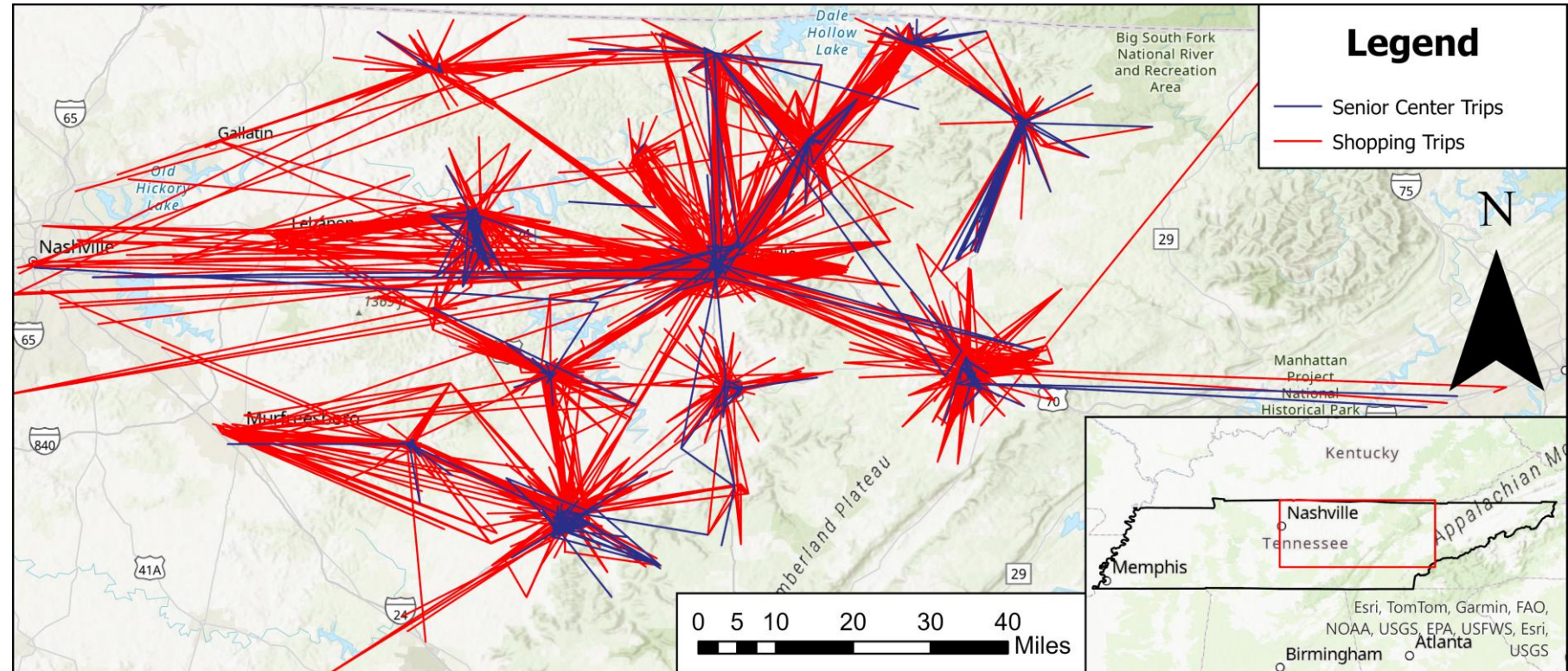




# Social, Shopping, and Senior Center

## Spatial analysis

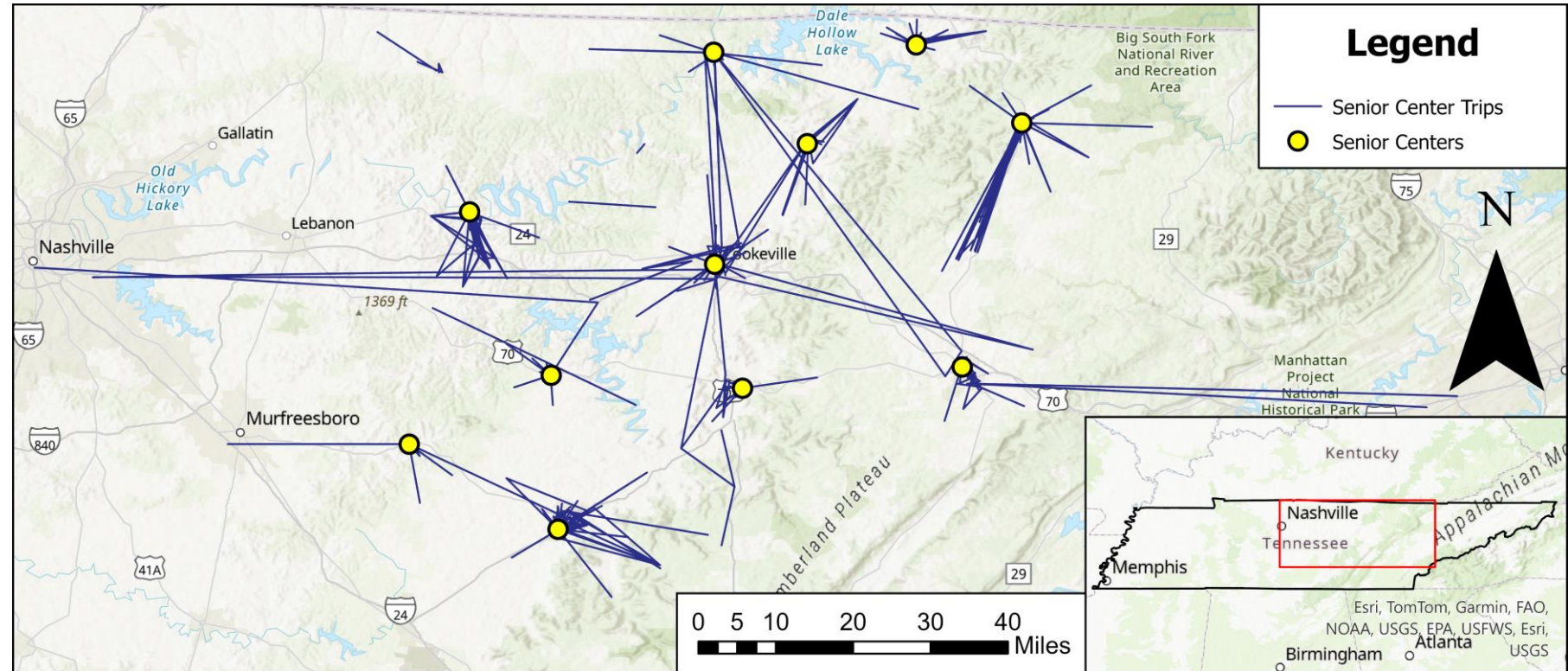
- Shopping
  - Shopping trips had large destination variety
  - Most common destination was regional supercenters
    - Lower prices, single destination, located in hub cities



# Social, Shopping, and Senior Center

## Spatial analysis

- Senior Center
  - Map shows the 11 of the most popular senior centers
  - Located in larger communities, serve the rural surrounding areas





# Key Findings

- Dialysis and Medical trips differed temporally
- Employment trips destinations and travel peaks most related to shift work
- Social/Recreation, Shopping, and Senior Center trips varied temporally
  - Most shopping trips taken to regional supercenters
- Overall
  - Gender did not have much of an effect on when a rider traveled
  - Riders with a disability had unique temporal trends compared to riders without a disability



Source: UCHRA.org



# Thank you!

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# Citations

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