Small in Size, Selective in Location, Limited on Healthcare Access Improvement

Exploring the Accessibility of micro hospitals in Texas through demographic spatial modeling

Introduction

- What is a micro hospital
  - Most for-profit small healthcare facilities
  - 15,000 -50,000 square feet in size
  - Licensed facilities with emergency, surgical, imaging, and lab
  - Limited (8-12) inpatient short-stay beds

Baptist Emergency Hospital Thousand Oaks in San Antonio. Photo: @Michael Johnson
https://www.bdcnetwork.com/microhospitals-healthcares-newest-patient-access-point

- Business opportunities
  - In metropolitan areas:
    - Ease access congestion in densely populated metro areas
  - In rural areas:
    - Provide hospital access in areas unable to afford full-service hospitals

Scott & White Micro Hospital by Health Facilities Magazine:
https://www.hfmmagazine.com/media/photos/85-microhospital-design

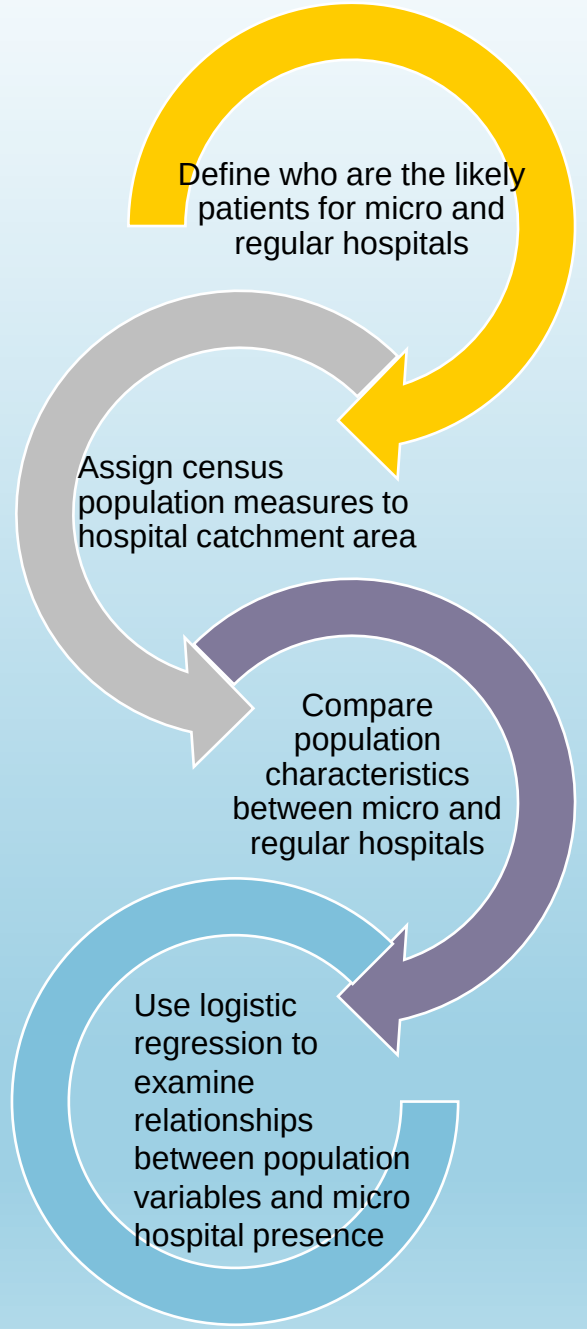
Our Methods

Research question

Do micro hospitals really fill the gap in healthcare access for those disadvantaged?

Research hypothesis

micro hospitals are more likely to be located closer to more affluent population clusters. As a result, their ability to deliver healthcare access to needy populations may be limited.



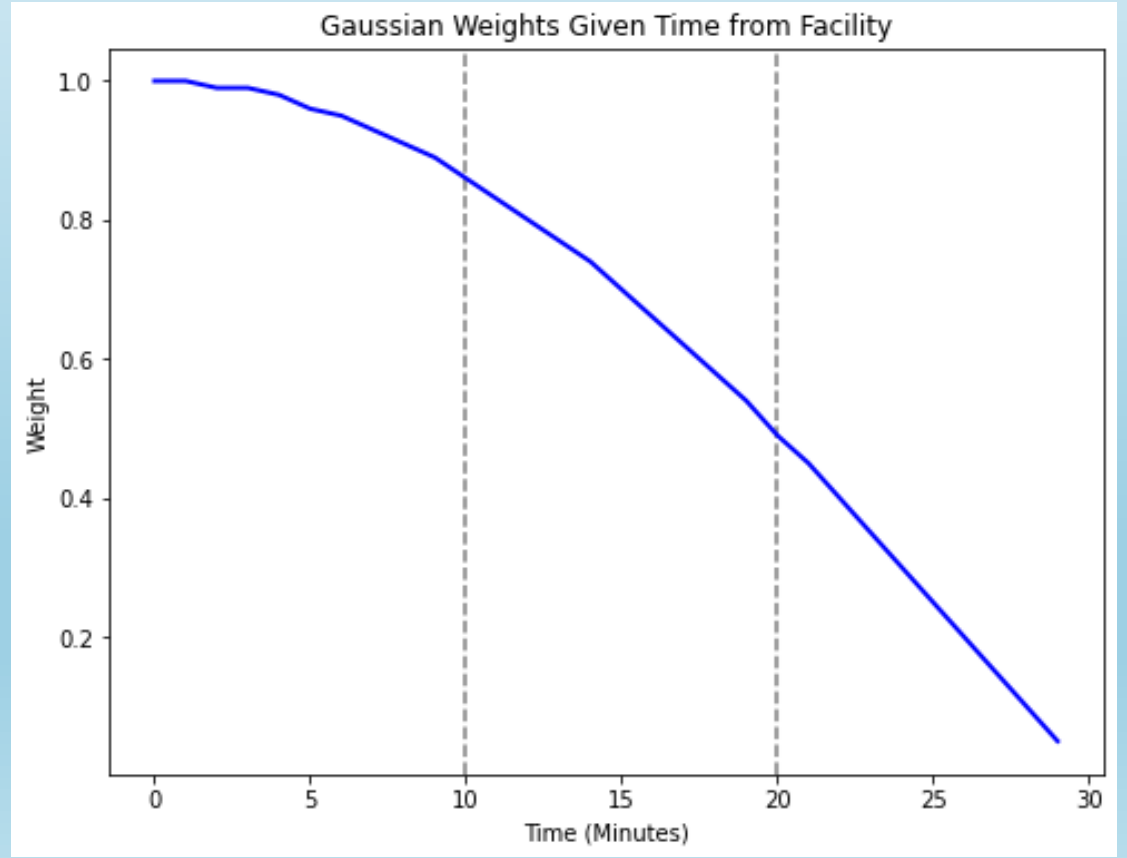
Data

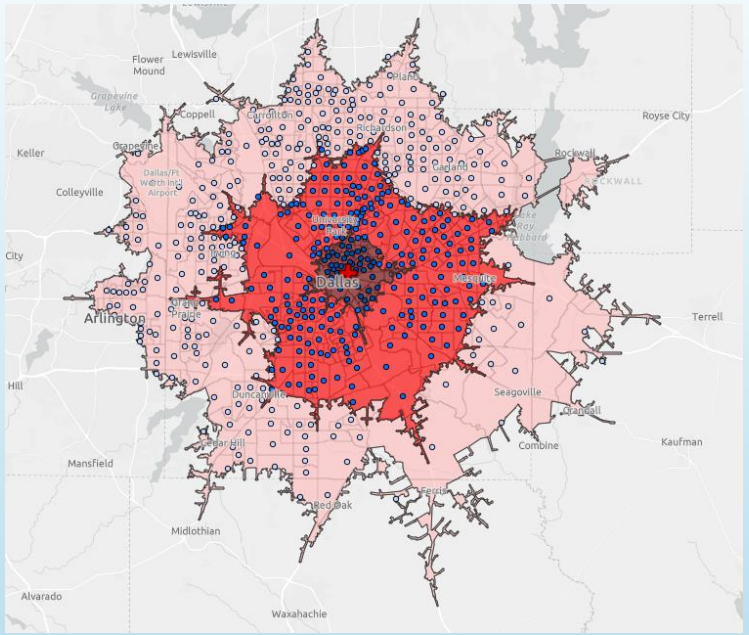
- Hospital list from Texas Department of State Health Services (updated a of May 2019)
- American Community Survey Five-year Estimates (2014-2018)
- ESRI proprietary Streetmap Network Dataset

Who Are The Likely Patients

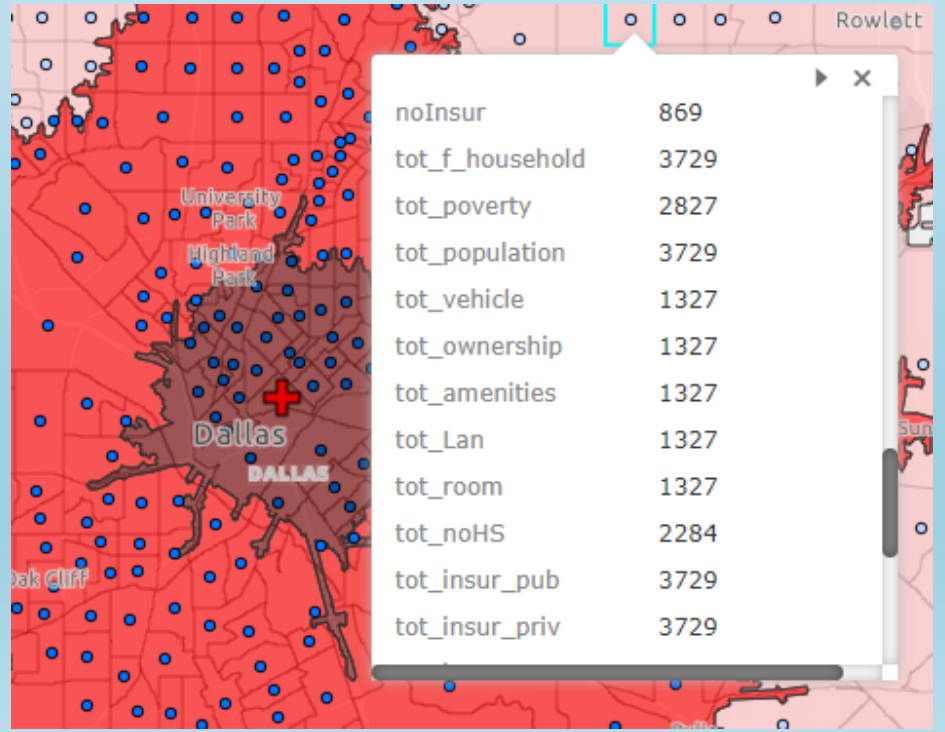
Gaussian Distribution

$$G(t_{kj}, t_0) = \begin{cases} \frac{e^{-(\frac{1}{2})\times(\frac{t_{kj}}{t_0})^2} - e^{-(\frac{1}{2})}}{1 - e^{-(\frac{1}{2})}}, t_{kj} \le t_0 \\ 0, t_{kj} > t_0 \end{cases}$$





Assign census population measures to each hospital catchment areas



Socioeconomic Dimensions of Probable Patient Base

Compare population characteristics between micro and regular hospitals based on hospital catchment areas

Dimension	Variable
Health Needs by Demographics	Percentage of seniors 65 years and older Percentage of children 0-4 years of age Percentage of women 15-44 years of age
Socioeconomic Indicators	Percentage of population with income in the past 12 months below poverty Percentage of population in female-headed households Percentage of population with home ownership Median household income
Living Environment	Percentage of population living in dwellings with more than 1 occupant per room Percentage of population living in dwellings lacking plumbing or kitchen facilities
Linguistic and Awareness Barriers	Percentage of nonwhite minorities Percentage of population without a high school diploma Percentage of household with limited English speaking status
Transportation Mobility	Percentage of households without vehicles
Insurance Coverage	Percentage of population with private insurance Percentage of population with public insurance Percentage of population with no insurance

Do Micro and Regular Hospital Patients Differ

Compare population characteristics between micro and regular hospitals based on hospital catchment areas

- Populations with better access to micro hospitals tend to have higher socioeconomic status.
- They are in areas with higher coverage in insurance, particularly private insurance, and with lower percentages of seniors.
- Population differences between micro and regular hospitals are sharper in shorter distance areas to the hospitals.
- Demographic factors such as being minorities and immigrants (as often indicated by limited English speaking abilities) do not appear to be significantly different between those with access to either type of hospitals.

Table 2 Means of Population Characteristics by Hospital Type and Catchment Window

Variables	0 -10 Minute		10-20 Minute		20-30 Minute		Combined 0-30 Minute	
	Micro	Regular	Micro	Regular	Micro	Regular	Micro H	Regular
female -headed households (%)	11.3	11.4	11.3	11.5	11.3	11.6	11.3	11.5
population in poverty (%)	10.9 ***	15.3 ***	12.8	13.6	12.6	13.4	12.1 ***	14.1 ***
nonwhite minorities (%)	51.3	55.2	57.1	54.0	56.5	53.9	55.0	54.3
households without vehicles (%)	4.7 ***	6.8 ***	5.5	5.4	5.1	5.2	5.1 **	5.8 **
home ownership (%)	62.1 ***	56.0 ***	59.7 **	63.3 **	61.3 **	64.6 **	61.0	61.4
housing units lack of basic amenities (%)	1.1 ***	1.5 ***	1.1 **	1.4 **	1.1	1.3	1.1 ***	1.4 ***
households with linguistic isolation (%)	5.9	7.3	8.4	7.6	8.4	7.3	7.6	7.4
households with more than one person per room (%)	3.7 **	4.5 **	4.7	4.7	4.6	4.8	4.3 *	4.7 *
population without high school diploma (%)	12.3 ***	16.9 ***	16.1	17.7	16.6	17.8	15.0 ***	17.5 ***
Population with high healthcare needs - seniors with ages above 65 (%)	12.1 **	13.3 **	11.2 ***	13.4 ***	11.4 ***	13.1 ***	11.56 ***	13.3 ***
Population with high healthcare needs - children with ages 0-4 (%)	6.9	6.9	7.2	7.0	6.9	7.0	7.0	7.0
Population with high healthcare needs - women with ages 15-44 (%)	21.9	22.0	21.9 **	20.8 **	21.5 *	20.8 *	21.8 **	21.2 **
Probable patient population	112,191 **	86,571 **	387,191 ***	257,943 ***	222,646 ***	143,572 ***	241,166 ***	162,842 ***
Annual median income in dollar	75,281 ***	59,966 ***	66,612 **	60,705 **	66,991 ***	60,221 ***	69,551 ***	60,298 ***
Health insurance coverage - Public insurance (%)	25.6 ***	29.9 ***	27.8 **	30.5 **	27.2 ***	30.3 ***	26.9 ***	30.2 ***
Health insurance coverage - Private insurance (%)	69.0 ***	62.1 ***	62.7	61.6	63.8	61.7	65.1 ***	61.8 ***
Health insurance coverage - No insurance (%)	14.2 ***	17.2 ***	17.2	17.4	17.1	17.4	16.2 ***	17.3 ***

*** p<0.01, ** p<0.05, * p<0.1

Logistic Regressions Results

Use logistic regression t
examine relationships
between selected
population variables and
the associated odds of
micro hospital presence

Table 4. Logistic regression results estimates associating the presence of micro hospital versus that of regular hospital in the service area, Texas 2014-2018

VARIABLES	(1) hospital_type	(2) hospital_type	(3) hospital_type
Minority	0.00740***	-0.00876	-0.00585
	(0.00262)	(0.00555)	(0.00821)
Language Isolation	0.0716***	0.0844***	0.0860***
	(0.0132)	(0.0190)	(0.0182)
More Than One Person in a Room	-0.0865**	-0.137**	-0.135**
	(0.0391)	(0.0596)	(0.0579)
No Insurance	-0.111***	-0.0569*	-0.0285*
	(0.0282)	(0.0327)	(0.0163)
Children	0.112	-0.0837	-0.0983
	(0.0798)	(0.0915)	(0.0960)
Female Headed household		0.145***	0.133***
		(0.0152)	(0.0176)
Senior		-0.224***	-0.180**
		(0.0609)	(0.0885)
Women		-0.0519***	-0.00439
		(0.0192)	(0.0448)
Home Ownership		0.00343	0.00328
		(0.0126)	(0.00789)
No Vehicle			0.00465
			(0.0553)
Poverty			-0.0537**
			(0.0258)
Constant	-1.604***	1.891	0.596
	(0.385)	(2.151)	(2.737)
Observations	1,304	1,304	1,304

Note: Standard errors allow for intragroup correlation within catchment areas. Robust standard errors are reported in parentheses. * Significant at p<0.10; ** Significant at p<0.05; *** Significant at p<0.01
Source: ESRI traffic network; 2014–2018 American Community Survey 5-Year Estimates

Table 5. Percentage changes in odds for logistic regression model 3 estimates associating the presence of micro hospital versus that of regular in the service area, Texas 2014-2018

	b	z	P>|z|	%	%StdX	SDofX
Minority	-0.0059	-0.713	0.476	-0.6	-10.9	19.777
Language Isolation	0.0860	4.719	0.000	9.0	64.1	5.759
More Than One Person in a Room	-0.1347	-2.326	0.020	-12.6	-27.5	2.388
No Insurance	-0.0285	-1.748	0.081	-2.8	-13.4	5.054
Children	-0.0983	-1.025	0.306	-9.4	-11.8	1.275
Female Headed household	0.1327	7.528	0.000	14.2	20.7	1.417
Senior	-0.1802	-2.035	0.042	-16.5	-54.0	4.304
Women	-0.0044	-0.098	0.922	-0.4	-1.4	3.283
Home Ownership	0.0033	0.416	0.677	0.3	4.0	12.071
No Vehicle	0.0047	0.084	0.933	0.5	1.3	2.775
Poverty	-0.0537	-2.084	0.037	-5.2	-25.6	5.492
Constant	0.5963	0.218	0.828			

b = raw coefficient

z = z-score for test of b=0

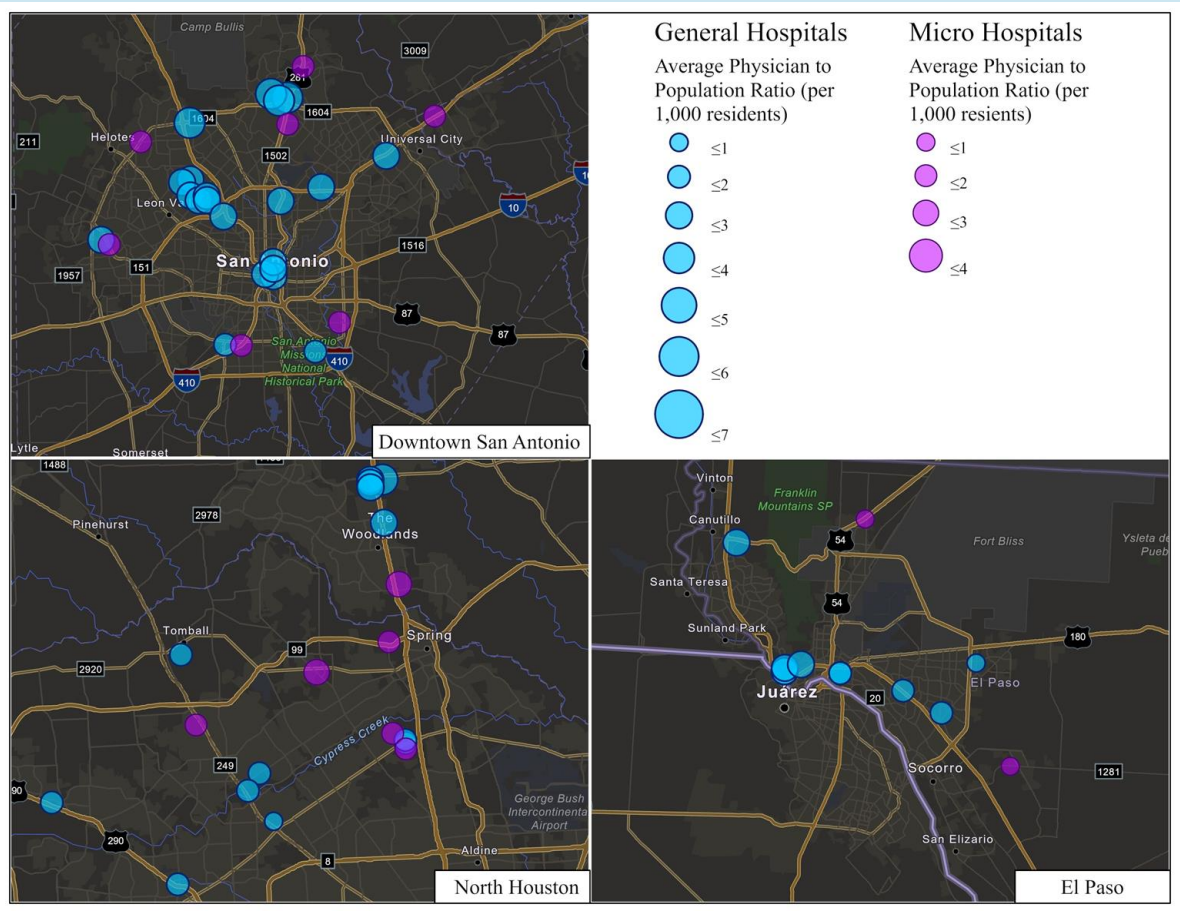
P>|z| = p-value for z-test

Note: Percentage calculations using SPost13 command by J. Scott Long and Jeremy Freese (2005, *Regression Models for Categorical Outcomes Using Stata*. Second Edition. College Station, TX: Stata Press).

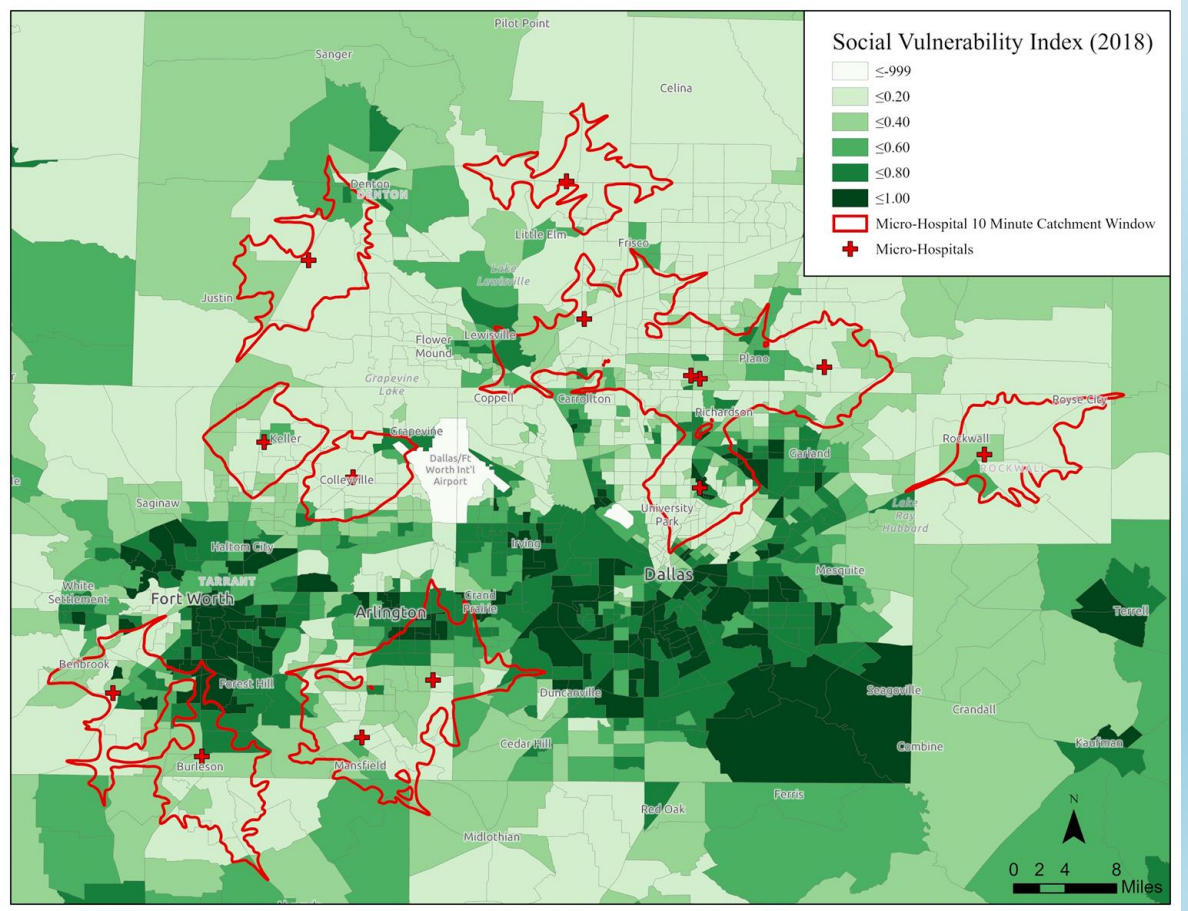
Two Tales of “equal opportunity”

“Equal opportunity” in healthcare access is important -- but “equal” can be interpreted differently:

Geographically and market orientated “equal opportunity”



Population vulnerability defined “equal opportunity”



Our Innovations

- Use advanced GIS techniques and spatial modeling to dynamically capture the potential patient basis
- Take into account travel time when creating service area boundaries
- Integrate both nonspatial and spatial dimensions of healthcare access by generating, mapping and illustrating patterns that regression alone cannot.

Our Limitations

- Cross-sectional population characteristics may not reflect the neighborhood composition changes over time
- Access to patient data with geographic information will greatly enhance the estimation of healthcare access

THANK YOU

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