Mapping Health Disparities in Chicago

A Spatial Analysis of Healthcare Accessibility

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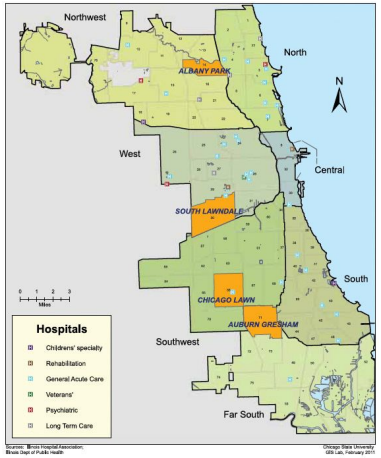
Research Questions

- We would like to discover the challenge of health disparities in the Chicago area.
- How have the spatial and non-spatial factors impacted people's accessibility to healthcare in the past 10 years?
- Are there any policy implications we can draw from a spatial analysis of Chicago hospitals to narrow the health gap?



"A new report shows Chicago to be a bad place to live in terms of health care access, cost, and results. But much depends on where in Chicago you live, and the biggest gaps are on the far south side."

Source: Health Care, Access, and Outcomes In Chicago (and Throughout Chicago) by Whet Moser in 2012

Why is this important?

Health Equity and Health Disparities

In the previous section, the populations at highest risk for cancer or cancer mortality were reviewed, as well as the highest risk groups for priority cancers. In this section, health equity and how health disparities impact cancer screening, early detection, and treatment are discussed.

All Illinoisans deserve to live long, healthy lives, free of modifiable differences in health status and outcomes.

Health inequities affect everyone. Disparities in health status exist between many population groups, with the greatest disparities found between people of different racial or ethnic groups, and between people of different socioeconomic statuses. Significant racial/ethnic and income disparities are observed when examining the rates of illnesses and conditions, such as diabetes, heart disease, depression, lung and breast cancer, and infant mortality. Interventions to reduce health inequities can improve the health of all communities. Health inequities exist for the lesbian, gay, bisexual, transgender, and queer (LGBTQ) communities.

Health disparities are a particular type of health differences closely linked with social, economic,

2022-2027 Illinois Comprehensive Cancer Control Plan

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Dr. Cheryl Rucker-Whitaker *is CEO of Complete Care Management Partners.*

Chicago's 900,000 South Side residents have experienced staggering health disparities for decades compared with North Siders, with a 10 times higher risk of infant mortality and four times the rate of death from diabetes. But to handle its far greater health burden, the South Side has inadequate and deteriorating health care facilities, medical services and infrastructure—including a dangerous shortage of primary care physicians and obstetricians.

More than 50% of South Siders are forced to seek health care outside their communities. Continuing to feed the same system that produced these disparities will net us no measurable progress.

Equally troubling is that Chicago has one of the nation's largest income inequality gaps, a poverty rate of over 60% in some neighborhoods and a huge gun violence issue. Chicago also has the country's widest racial gap in life expectancy given all these issues—30.1 years between white Streeterville and Black Englewood.

Health Disparities across Different Regions in Chicago

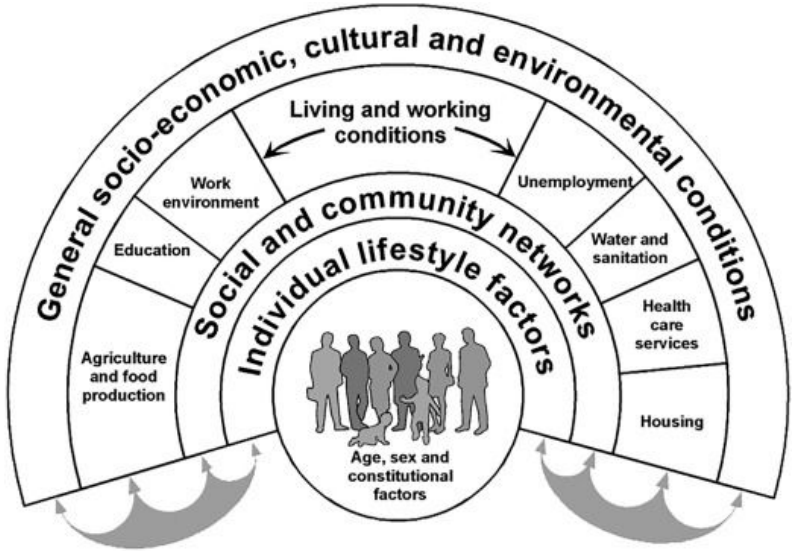
Social Determinants of Health Frameworks

" … now more than ever, we, as a public health community, need to advocate for concerted action on the social determinants of health and the drivers of those determinants that are generating growing inequalities."

Dahlgren and Whitehead's model of the social determinants of health reveals the complex interplay between individual health outcomes and the social and economic factors that shape them.

The model identifies multiple levels of influence on health, ranging from individual factors (such as genetics and behaviors) to societal factors (such as political systems and cultural norms).

We would like to incorporate this framework into our analysis, classifying into both non-spatial and spatial factors that influence health outcomes.



Source: adapted from Dahlgren and Whitehead, 1991

Source: Dahlgren, G., & Whitehead, M. (2021, October). The Dahlgren-Whitehead model of health determinants: 30 years on and still chasing rainbows. Public Health, 199, 20–24. https://doi.org/10.1016/j.puhe.2021.08.009

Literature Review

Non-Spatial Factors of Healthcare Access

- **Discrepancy in Social Determinants of Health**

The associations between different measures of social determinants of health and mortality varied across racial and ethnic groups (*Lin et al., 2022*). Therefore, demographic analysis is necessary in our evaluation of healthcare access.

- **Affordable Care Act Medicaid Expansion**

ACA narrowed racial and ethnic disparities in insurance coverage and access to healthcare (*Baumgartner et al., 2020*). Therefore, it is expected that healthcare indicators have improved in the past years with policy interventions on health insurance.

Literature Review

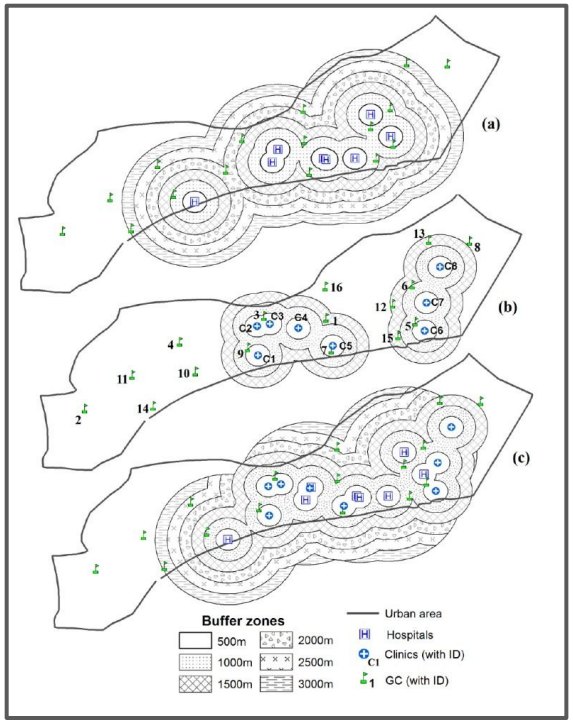
Spatial Factors of Healthcare Access

- **Rural and Urban Disparities**

Children, women, and the elderly residing in rural areas are found to be the most vulnerable groups that lack access to healthcare (*Reshadat et al., 2019*). In this case, we expect to see disparities in rural and urban areas in Chicago.

- **Healthcare Access Buffer Zones**

500 meters radius buffer zones centered on hospitals were applied to measure healthcare access (*Masoodi & Rahimzadeh, 2015*). We would apply this buffer zone threshold in our hospital analysis.



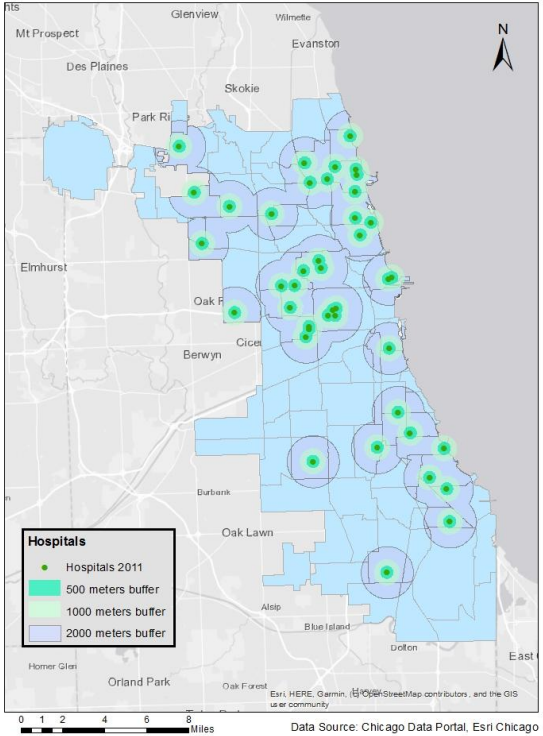
Three buffer zones with 500, 1,000 and 2,000m widths were drawn separately around the hospitals.

Methods

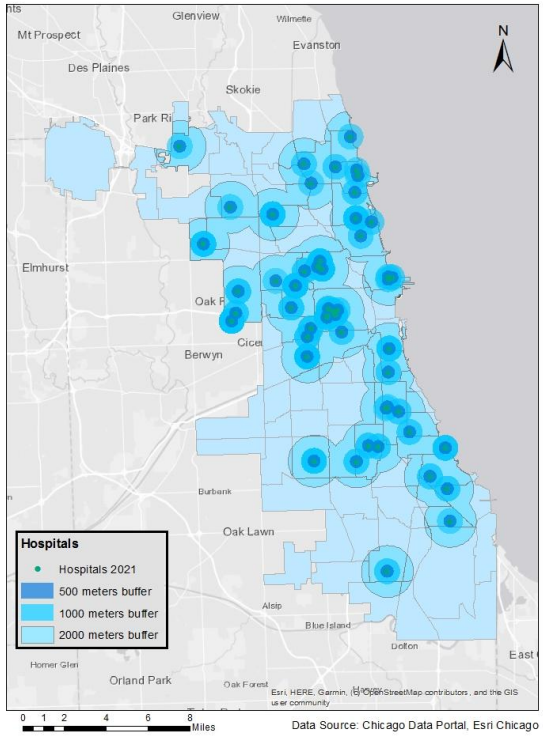
- Compare how hospital distribution and mortality rate changed over the past 10 years.
- Spatially describe demographic information with respect to population, health insurance status, and other social determinants of health in Chicago.
- Spatially determine the relationship between hospital distribution and factors of healthcare access through cluster analysis and OLS regression.

Hospital Distribution Changes Over Time (with 500m/1000m/2000m buffers)

Distribution of Hospitals in Chicago with Buffers (2011)

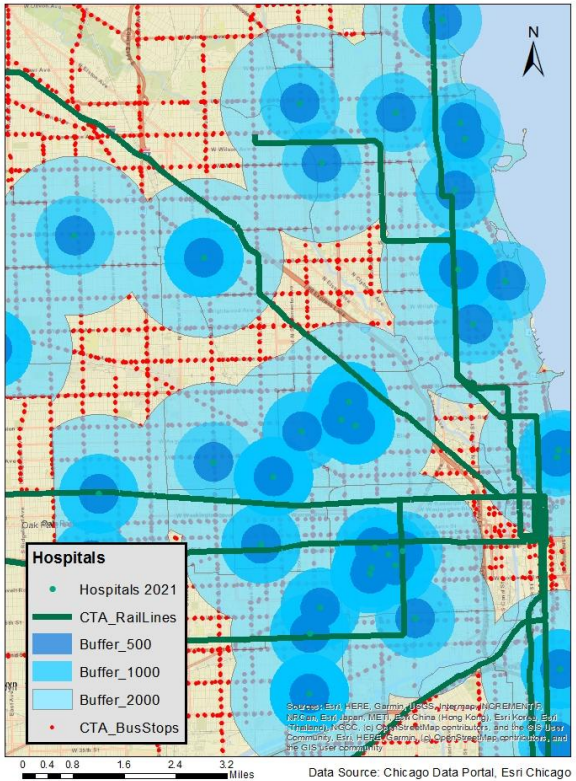


Distribution of Hospitals in Chicago with Buffers (2021)



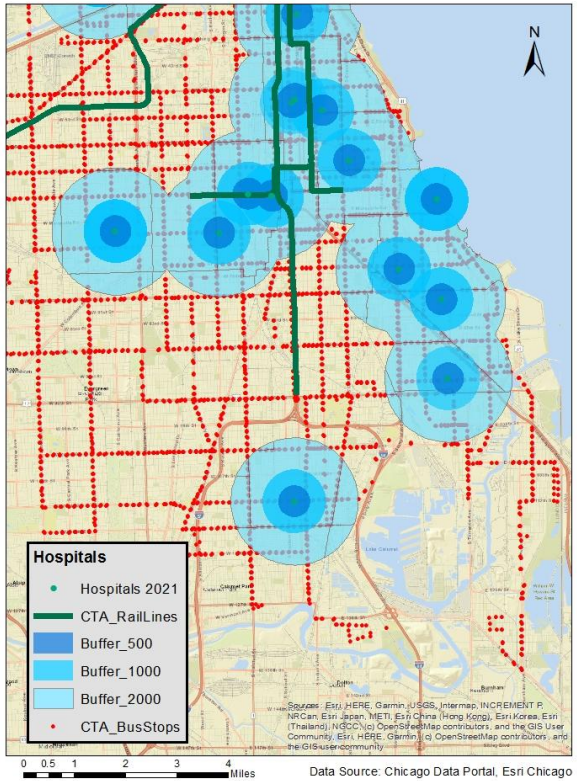
Case Study of Hospital Accessibility

Distribution of Hospitals in Northern Chicago (2021)



Data Source: Chicago Data Portal, Esri Chicago

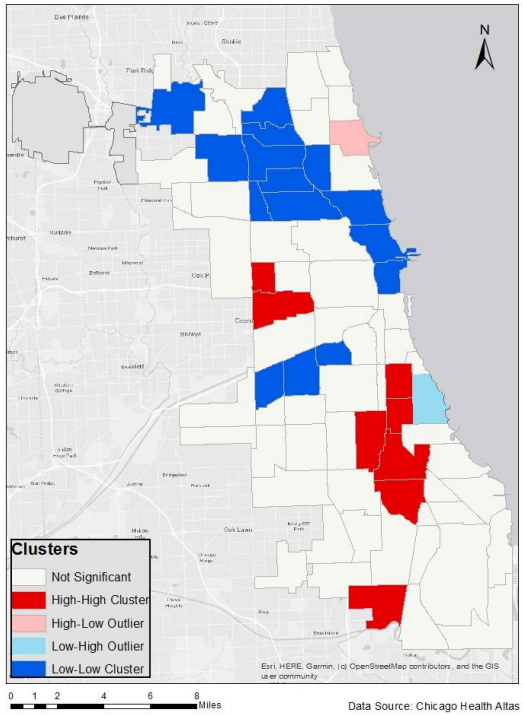
Distribution of Hospitals in Southern Chicago (2021)



Data Source: Chicago Data Portal, Esri Chicago

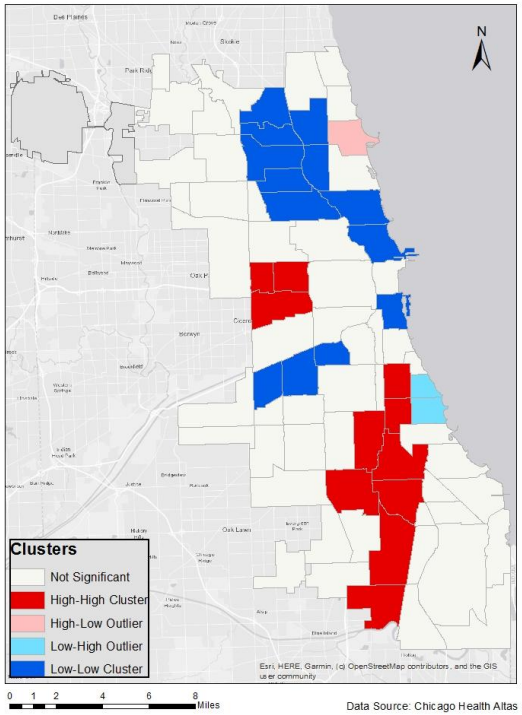
Cluster Analysis of Mortality Rate in Chicago

The Cluster Analysis of Mortality Rate in Chicago in 2011



Data Source: Chicago Health Altas

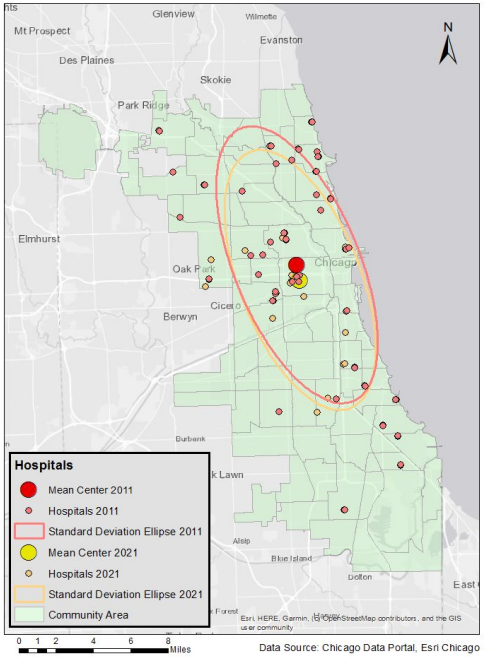
The Cluster Analysis of Mortality Rate in Chicago in 2021



Data Source: Chicago Health Altas

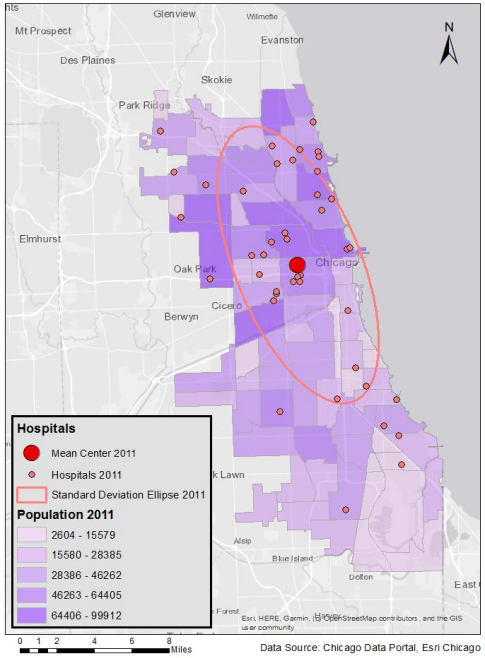
Hospital Distribution & Population Density Changes Over Time

Distribution of Hospitals in Chicago



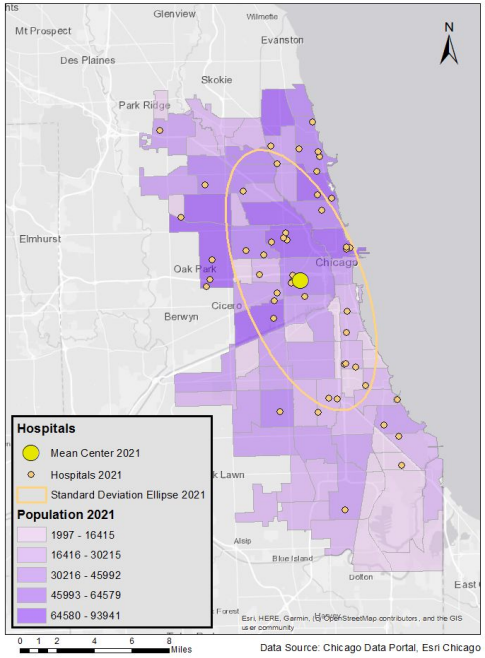
Data Source: Chicago Data Portal, Esri Chicago

Distribution of Hospitals in Chicago (2011)



Data Source: Chicago Data Portal, Esri Chicago

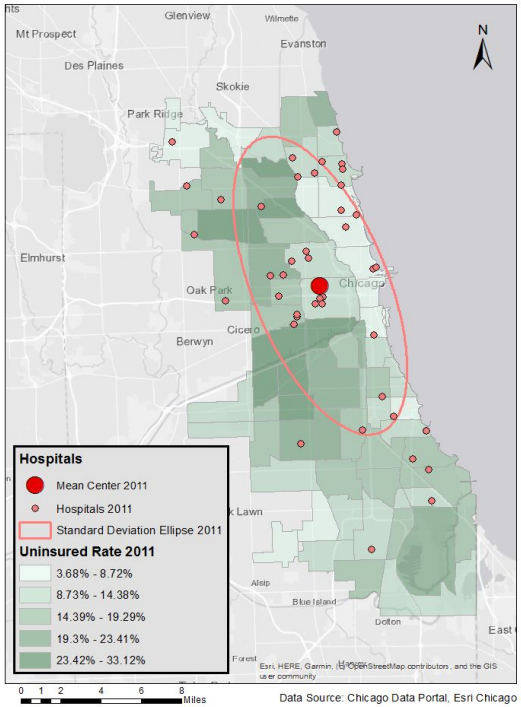
Distribution of Hospitals in Chicago (2021)



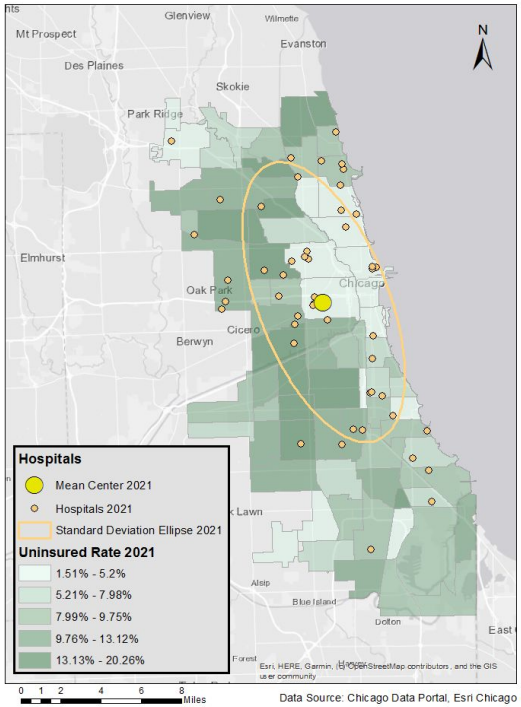
Data Source: Chicago Data Portal, Esri Chicago

Hospital Distribution & Health Insurance Status Changes Over Time

Distribution of Hospitals in Chicago (2011)

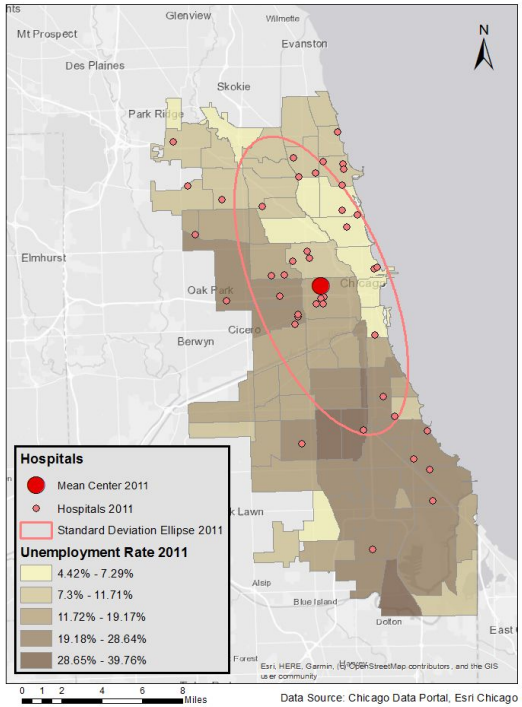


Distribution of Hospitals in Chicago (2021)

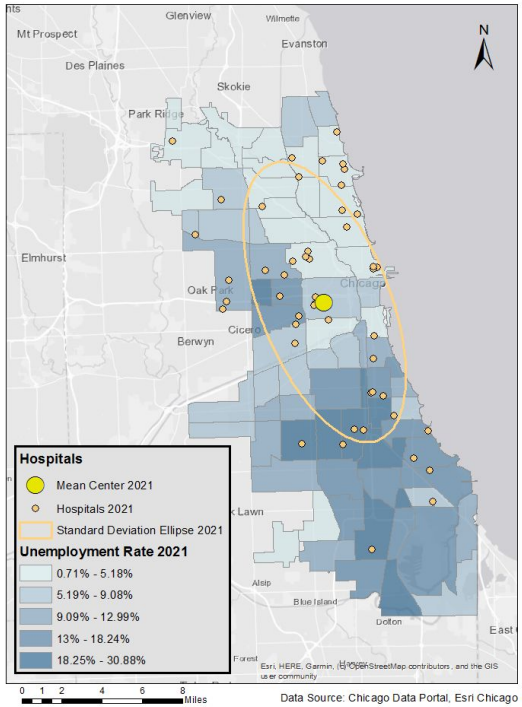


Social Determinants of Health (Unemployment Rate)

Distribution of Hospitals in Chicago (2011)

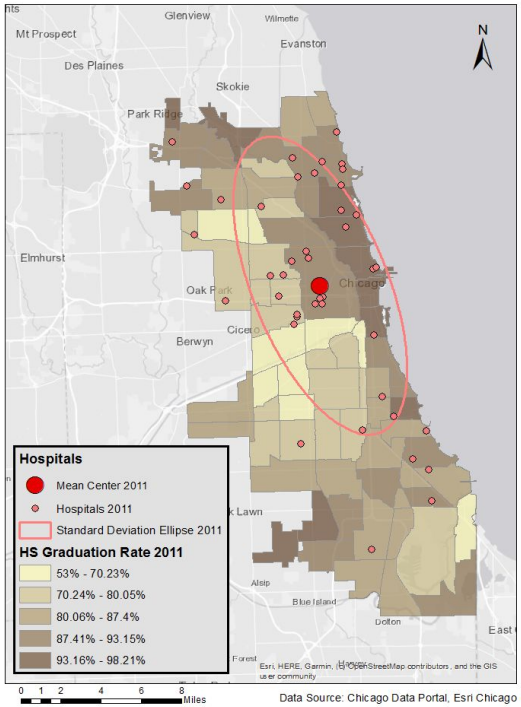


Distribution of Hospitals in Chicago (2021)

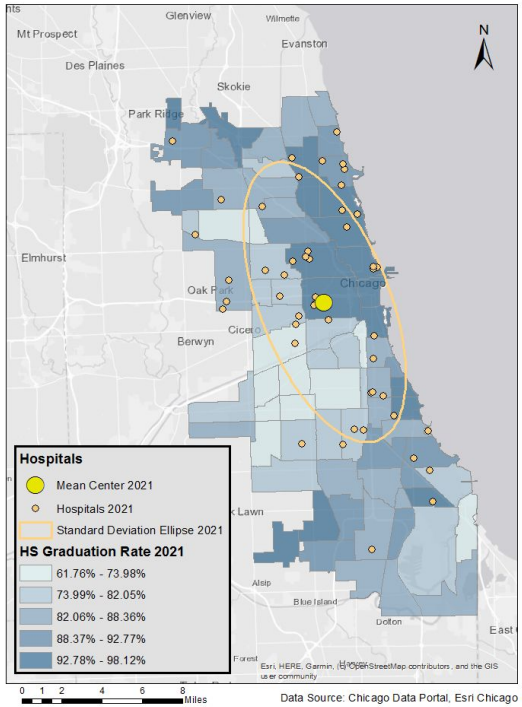


Social Determinants of Health (High School Graduation Rate)

Distribution of Hospitals in Chicago (2011)

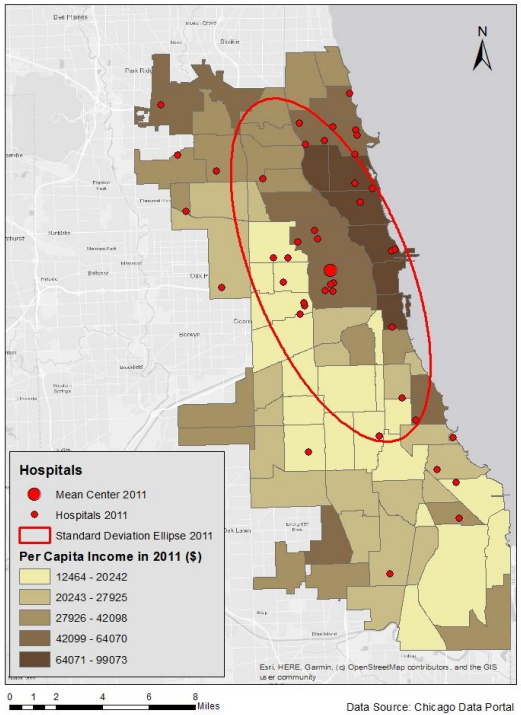


Distribution of Hospitals in Chicago (2021)



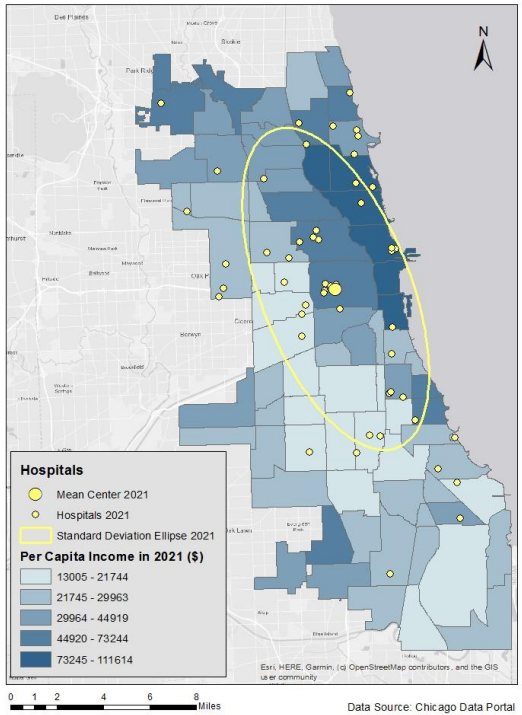
Social Determinants of Health (Per Capita Income)

Distribution of Hospitals in Chicago (2011)



Data Source: Chicago Data Portal

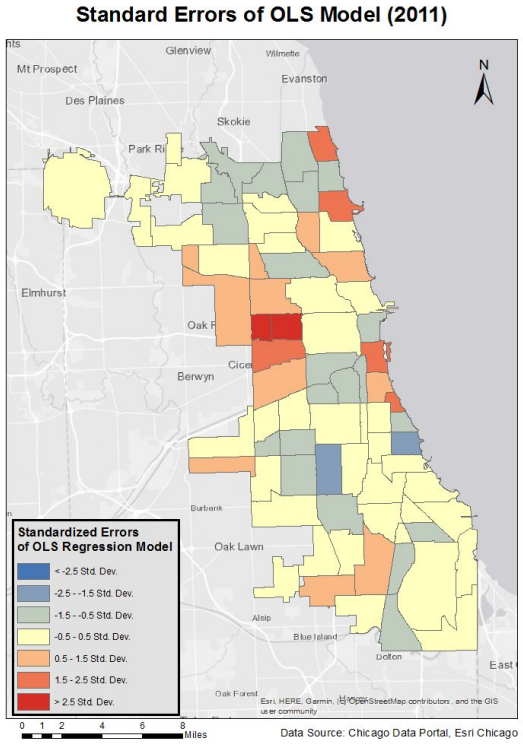
Distribution of Hospitals in Chicago (2021)



Data Source: Chicago Data Portal

Regression Analysis (2011)

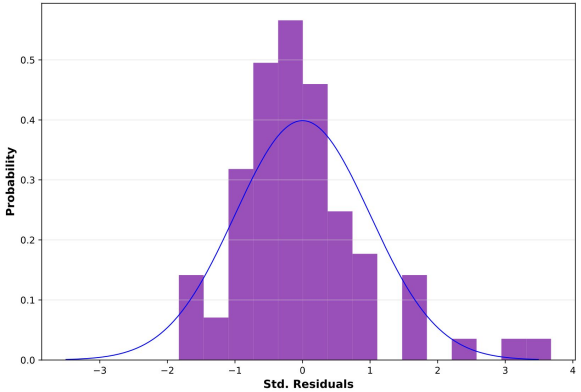
$$\text{Mortality} = \beta_0 + \beta_1 \text{population} + \beta_2 \text{unemployment} + \beta_3 \text{income} + \beta_4 \text{graduation} + \beta_5 \text{uninsured}$$



Variable	Coefficient [a]	StdError	t-Statistic	Probability [b]	Robust_SE	Robust_t	Robust_Pr [b]	VIF [c]
Intercept	20.038963	105.499636	0.189943	0.849895	50.415204	0.397479	0.692212	--------
POP_2010_2	0.001391	0.000714	1.948107	0.055356	0.000558	2.494567	0.014936*	1.475132
UMP_2010_2	17.050129	2.168256	7.863521	0.000000*	1.771736	9.623400	0.000000*	2.075727
PCI_2014_2	-0.006808	0.001409	-4.831182	0.000008*	0.001297	-5.247659	0.000002*	4.600704
EDB_2014_2	10.136725	1.406575	7.206672	0.000000*	0.917070	11.053380	0.000000*	2.151275
UNS_2014_2	-6.965726	3.888854	-1.791203	0.077526	2.179834	-3.195530	0.002087*	2.031701

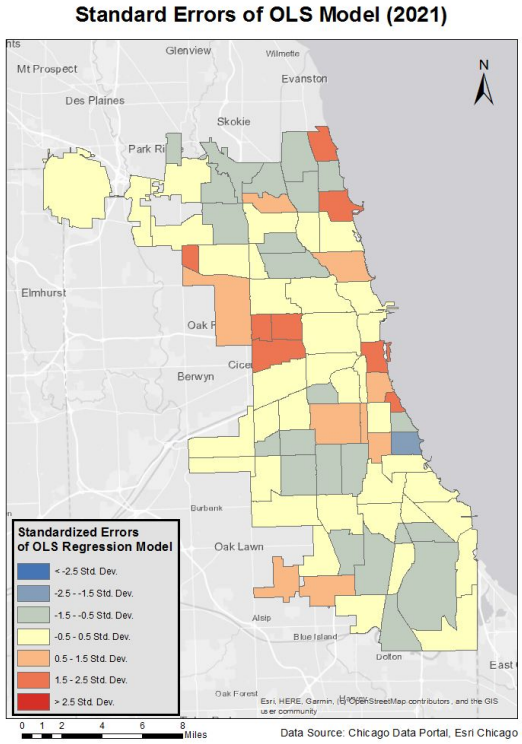
Input Features:	Export_Output	Dependent Variable:	VRDTHR_201
Number of Observations:	77	Akaike's Information Criterion (AICc) [d]:	956.667485
Multiple R-Squared [d]:	0.806014	Adjusted R-Squared [d]:	0.792353
Joint F-Statistic [e]:	59.001102	Prob(>F), (5,71) degrees of freedom:	0.000000*
Joint Wald Statistic [e]:	913.613299		
Koenker (BP) Statistic [f]:	1.809241		
Jarque-Bera Statistic [g]:	48.599626		

Partially contradict our spatial analysis with hospital distribution



Regression Analysis (2021)

$$\text{Mortality} = \beta_0 + \beta_1 \text{population} + \beta_2 \text{unemployment} + \beta_3 \text{income} + \beta_4 \text{graduation} + \beta_5 \text{uninsured}$$

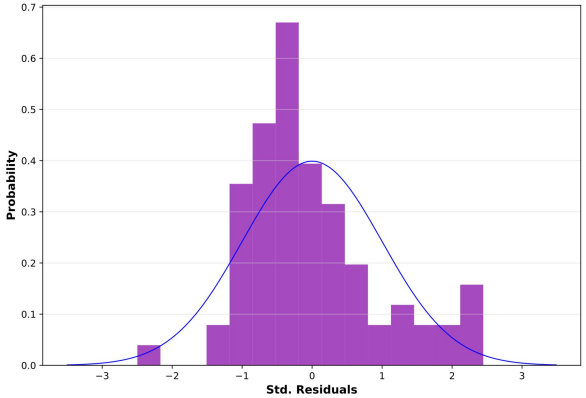


Variable	Coefficient [a]	StdError	t-Statistic	Probability [b]	Robust_SE	Robust_t	Robust_Pr [b]	VIF [c]
Intercept	36.889768	86.008484	0.428908	0.669293	47.246981	0.780786	0.437520	--------
POP_2015_2	0.001128	0.000597	1.890894	0.062721	0.000514	2.196908	0.031289*	1.509622
UMP_2015_2	18.277450	2.174074	8.407006	0.000000*	1.976287	9.248380	0.000000*	1.921586
PCI_2015_2	-0.005728	0.001003	-5.712670	0.000000*	0.000918	-6.239027	0.000000*	4.132494
EDB_2017_2	10.112700	1.140336	8.868178	0.000000*	0.865769	11.680604	0.000000*	1.877792
UNS_2017_2	-8.144798	3.342284	-2.436896	0.017319*	2.614073	-3.115750	0.002650*	1.878316

Input Features:	Export_Output
Number of Observations:	77
Multiple R-Squared [d]:	0.826260
Joint F-Statistic [e]:	67.531529
Joint Wald Statistic [e]:	577.338079
Koenker (BP) Statistic [f]:	4.180523
Jarque-Bera Statistic [g]:	8.772855

Dependent Variable:	VRDTHR_202
Akaike's Information Criterion (AICc) [d]:	929.080050
Adjusted R-Squared [d]:	0.814025
Prob(>F), (5,71) degrees of freedom:	0.000000*

Partially contradict our spatial analysis with hospital distribution



Conclusions

- In Chicago, hospitals are mainly concentrated in the downtown area and some of the surrounding neighborhoods. The distribution of hospitals is **not evenly spread** across the city, with **some areas experiencing a lack** of healthcare facilities.
- Over the past 10 years, hospital distribution in Chicago shows that there has been a slight shift in the **centroid of hospitals towards the south** of the city.
- This lack of accessibility to healthcare facilities and services may be due to the lower income and education levels, higher unemployment rates, a lack of health insurance.
- The distribution of hospitals can impact mortality rates in the city. A comparison of hospital distribution and mortality rates over the past 10 years shows that areas with a **higher concentration of hospitals generally have lower mortality rates**.

Improvements

- We could conduct **improve our OLS regression model** to better understand the relationship between healthcare access and social determinants of health.
- **We could include more variables in our data** to provide a more comprehensive view of how hospital distribution and healthcare access have evolved over time.
- We could **compare the findings with other cities** with similar demographics and healthcare systems to determine if the disparities are unique to Chicago or are more widespread.
- We could delve deeper into the **potential policy implications** for mitigating health disparities in the Chicago area, and explore the feasibility and potential impact of specific policy interventions.

References

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