

Rapidly Measuring Spatial Accessibility of COVID-19 Healthcare Resources: A Case Study of Illinois, USA

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INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing the coronavirus disease 2019 (COVID-19) pandemic, has infected millions of people and caused hundreds of thousands of deaths. While COVID-19 has overwhelmed healthcare resources (e.g., healthcare personnel, testing resources, hospital beds, and ventilators) in a number of countries, limited research has been conducted to understand spatial accessibility of such resources. This study fills this gap by rapidly measuring the spatial accessibility of COVID-19 healthcare resources with a particular focus on Illinois, USA.

SPATIAL ACCESSIBILITY

“Access” is a complex concept, but put simply we are trying to understand if resources are equitably distributed. We want to answer the question: “are there spatial mismatches between the supply and demand for a given resource?” The most common example is a food desert which is a place where the supply of food is not sufficient for the residents.

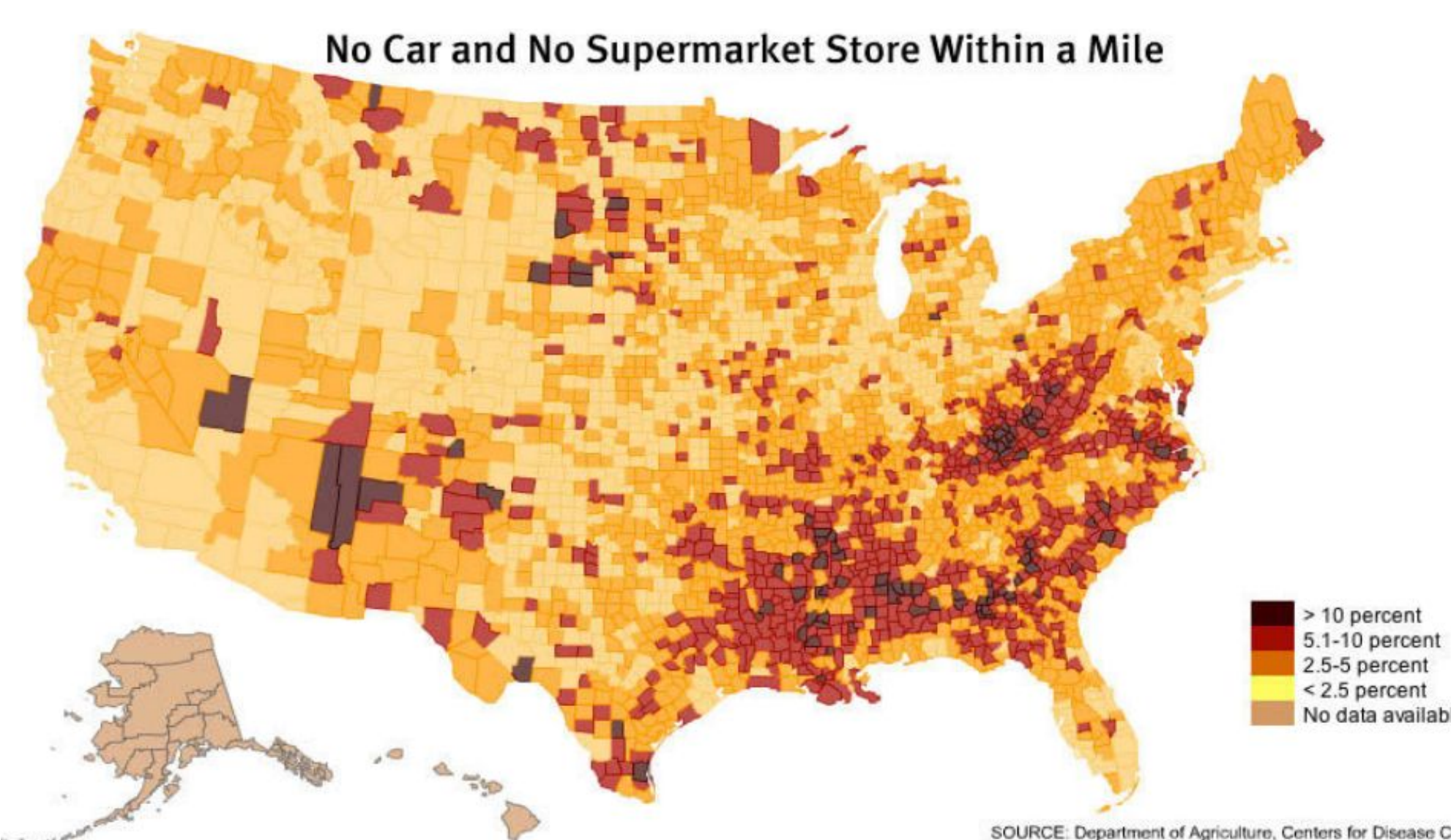
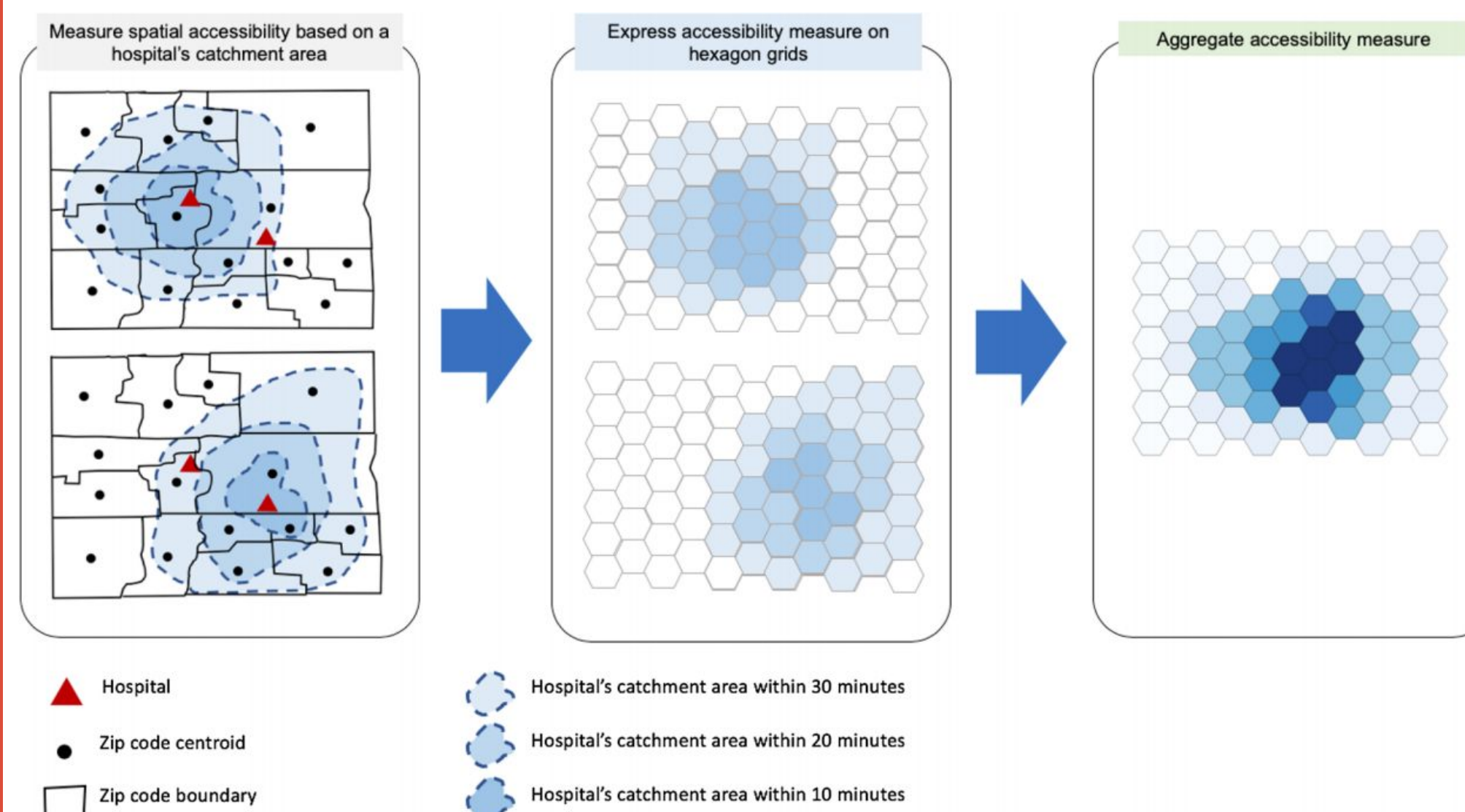


Image: Diaz de Villegas, Carolina; Rodriguez, Kiara. "Medley Food Desert Project". Florida International University Department of Biological Sciences.

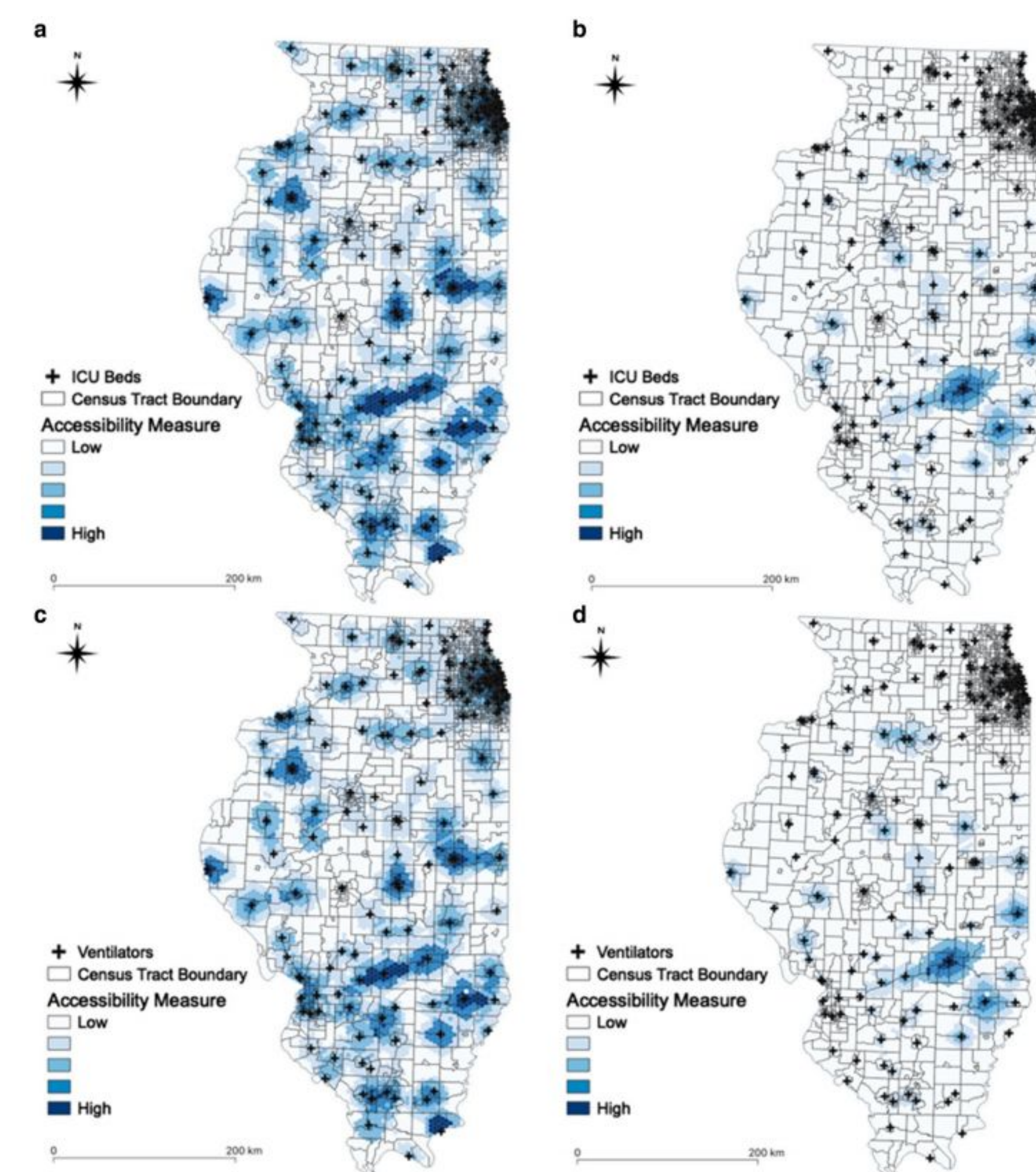
The COVID-19 pandemic has infected millions of people and caused hundreds of thousands of deaths. While COVID-19 has overwhelmed healthcare resources (e.g., healthcare personnel, testing resources, hospital beds, and ventilators) in a number of countries, limited research has been conducted to understand spatial accessibility of such resources. We conducted this study to understand if the spatial distribution of healthcare services is equipped to meet the demands of COVID-19 patients to save people's lives during the COVID-19 pandemic.

METHODS

Our work calculated spatial accessibility using the Enhanced Two-Step Floating Catchment Area method (E2SFCA) and aggregated the measures to a hexagonal grid (Luo & Qi). E2SFCA is a method that computes a weighted supply-to-demand ratio for each supply point which accounts for distance decay and these ratios are aggregated over demand points to produce a measure of spatial accessibility.



Accessibility was computed for both ICU beds and ventilators at hospitals in Chicago, IL and the state of Illinois. We computed the metric for the population most at risk from COVID-19 (those over 50 years of age) and for COVID-19 patients.



A Python implementation is available on CyberGISX!

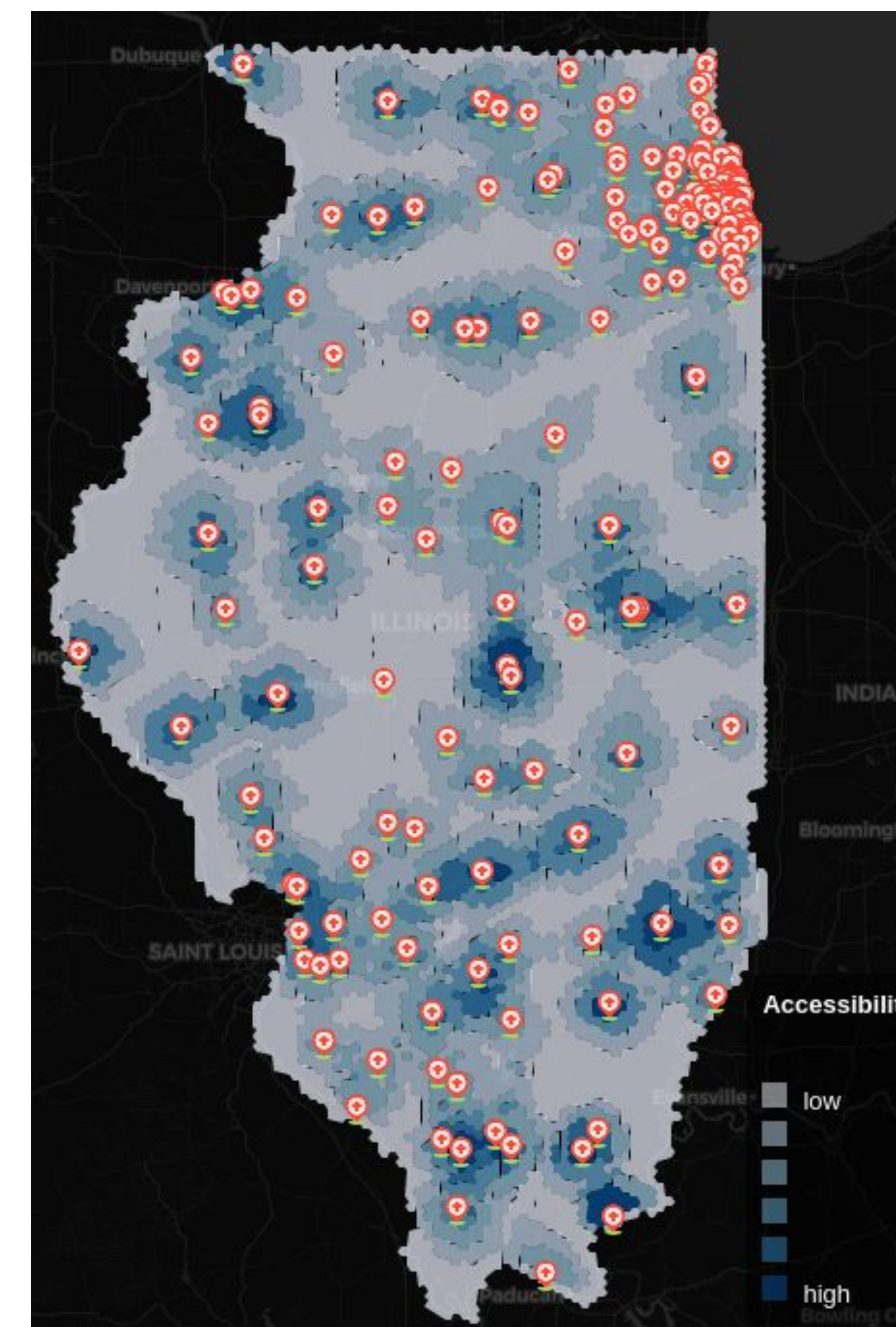
<https://cybergisxhub.cigi.illinois.edu/notebook/rapidly-measuring-spatial-accessibility-of-covid-19-healthcare-resources-a-case-study-of-illinois-usa>



RESULTS

With our spatial accessibility measure calculated, we were able to identify areas in Chicago and Illinois that had abundant resources and others that were lacking. We also compared the spatial accessibility metric to the CDC Social Vulnerability Index (SVI) and our results indicate that people living in areas with low accessibility are more vulnerable in terms of socioeconomic status, housing type and transportation, and household characteristics and disability.

We wanted to ensure that our measures stayed updated as COVID-19 cases evolved, so we parallelized the code and are currently re-computing the metric daily with the results available on the WhereCOVID-19 platform. There you can explore how accessibility has changed over time. You can see a snapshot of the site below:



Check out the latest measures and temporal explorer at:

<https://wherCOVID19.cigi.illinois.edu/spatialAccess.html>



CONCLUSION

Rapidly measuring spatial accessibility of healthcare resources is critical to the fight against the COVID-19 crisis, particularly for better understanding how well the healthcare infrastructure is equipped to save people's lives. As U.S. federal and state governments (e.g., HHS, IDPH) have been strongly committed to improving spatial accessibility of healthcare services, measuring spatial accessibility and identifying areas with a shortage of important public health resources in the context of COVID-19 is critical for policymakers and public-health officials' preparedness and response actions. At the same time, strict quarantine, social distancing, and isolation of known cases by individuals and communities are important to slow down the spread of COVID-19, which in turn, help to address the important spatial accessibility issues.

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