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Mapping Geographic Disparity in Organ Transplant Allocation

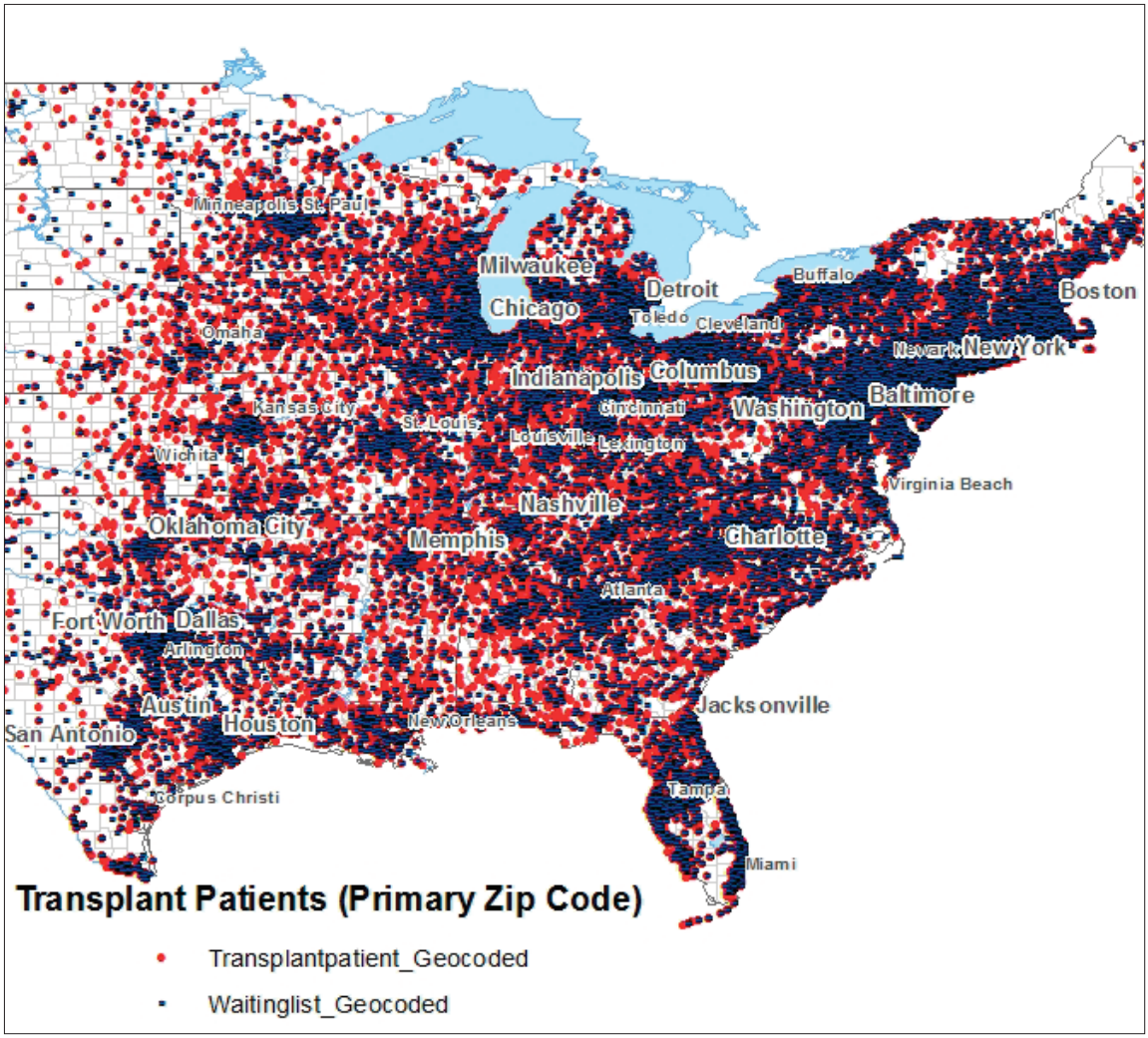
By Jessica Wyland, Esri Writer

An interdisciplinary team of researchers from George Mason University and Inova Health System are using ArcGIS to identify, map, and analyze geographic disparities faced by the more than 100,000 people in the United States who are awaiting organ transplants.

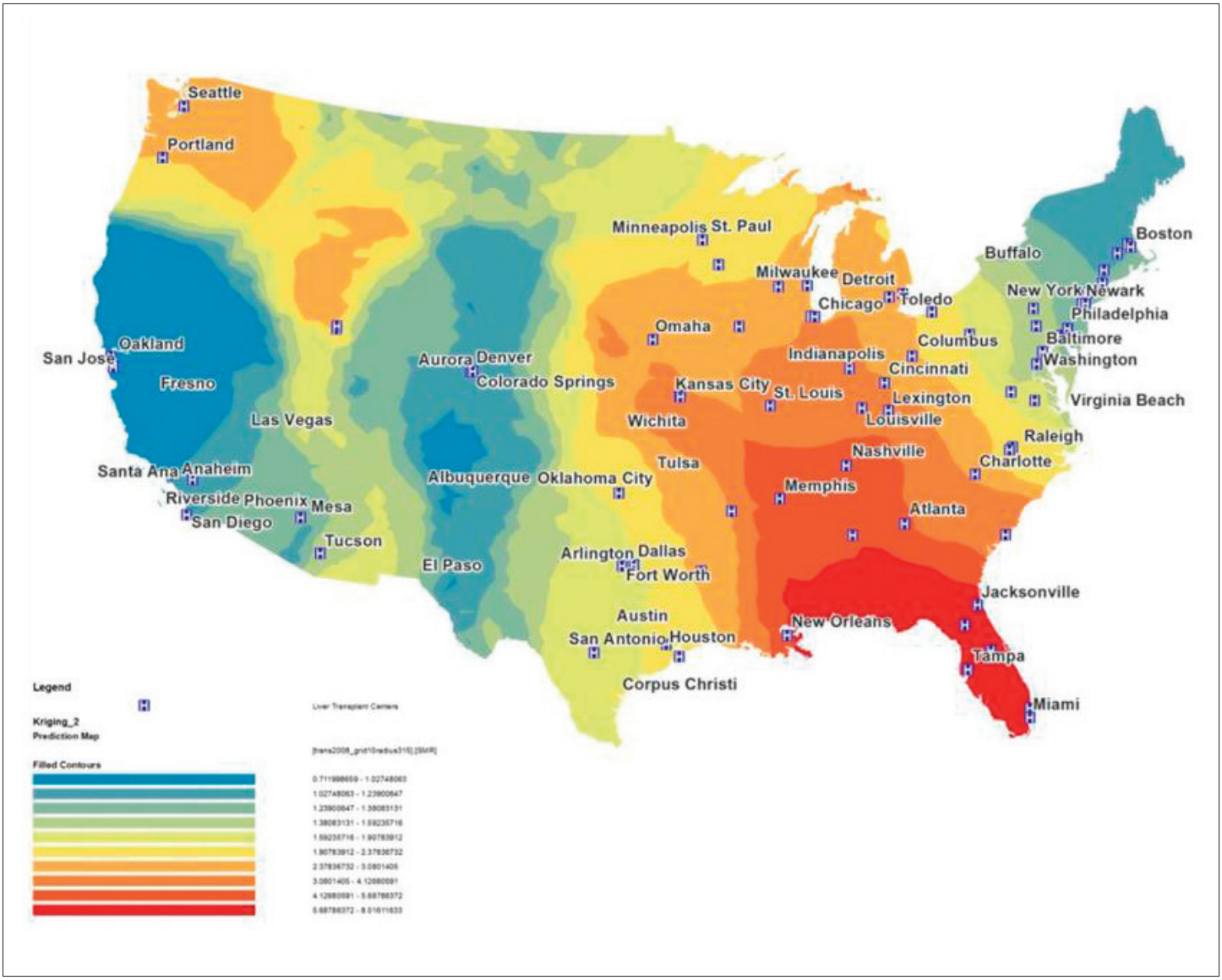
The team consists of Naoru Koizumi, associate professor of public policy; Chun-Hung Chen, professor of systems engineering and operations research; Nigel Waters, professor of geography and geoinformation science; and Zobair Younossi, vice president for research, Inova Health System, and executive director of the Center for Liver Diseases at Inova Fairfax Hospital.

"The disparity analysis is our first step to really understand where the areas with a high likelihood of receiving a transplant are and why," said Koizumi, who is the primary investigator of the research. "Geographic disparity has more serious implications. Our study intends to identify the existence, the trend, and the mechanism of such disparity as well as possible remedies to it."

In addition to the descriptive spatial analyses, the researchers plan to integrate GIS and stochastic simulation to analyze how the pattern of geographic disparity may vary if the existing protocol for organ sharing between regions is changed. They will also look into the impacts of using different modes for organ transportation on the spatial pattern of



↑ Geocoded Transplant Patients at the ZIP Code Level



↑ A kriging map shows regional differences in access to liver transplants.

disparity. Through these analyses, they hope to identify some effective ways to alleviate the existing geographic disparities.

"So far, we have been observing some consistent results to show that where we live does matter in terms of getting good access to a liver transplant, even after controlling for socioeconomic variables such as racial and age compositions and median income measured at the county level," Koizumi said.

To create the disparity analysis maps, Koizumi and her team started with the five-digit primary residence ZIP Code for each transplant candidate and recipient in the United States between 2005 and 2008. This data was provided by United Network of Organ Sharing (UNOS), the organization that administers organ transplant issues in the United States.

The team used ArcGIS to geocode more than 90,000 transplant recipients and more than 70,000 candidates at the ZIP Code level. Next, they created grid points, spaced evenly across the map, and calculated a location-quotient-like indicator called Standardized Transplant Ratio (STR) for each grid point. The radius around each grid point was determined to cover a sufficient number of transplant candidates and recipients.

To create a smooth map of STR, they applied universal kriging using the ArcGIS Geostatistical Analyst extension. As an alternative approach, they also used indicator kriging with the value 0 for a candidate and 1 for a recipient to predict the likelihood of receiving a liver transplant at any given location.

"We hope that our proposed framework will eventually lead to an improved and fairer decision-making process for the allocation of organs to people awaiting lifesaving transplants," Koizumi said.

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