Mapping and Testing Spatial Clusters of Diabetes in the U.S.

Authors: Ronald E. Cossman[1], Ph.D; Jeralynn S. Cossman[1], Ph.D; Wesley L. James[1], M.S; Troy Blanchard[1], Ph.D; Richard Thomas[2], Ph.D; Louis Pol[3], Ph.D. and Erdenechimeg Eldev-Ochir[1], M.S.

1 Social Science Research Center (SSRC), Mississippi State University
2 University of Tennessee Health Science Center
3 College of Business, University of Nebraska, Omaha

The Problem:

Measures of the prevalence of diabetes at a sub-state level are not available from existing health surveys. We use diabetes prescriptions-filled at the county level as a proxy for diabetes prevalence rates. When we map these rates, there are geographic clusters of high and low diabetes prescription rates. That means diabetes prescription rates in the U.S. have an underlying geographic pattern of spatial autocorrelation. In other words, counties with high diabetes prescription rates, and counties with low diabetes prescription rates, are geographically clustered together. This would have fundamental implications for current non-geographic analysis techniques, because the data violates the classic a-spatial assumption for data to be independently random. These results could have implications for health researchers and health policy makers.

Map 1: County-Level Percentage of the Adult Population Who Filled Diabetes Prescriptions, 2003.

This map shows the county-level rates of diabetes prescriptions-filled. Using the number of diabetes prescriptions filled at the county-level from the year 2003 and dividing this by the resident adults, we calculated a crude prescription-fill rate per 100 residents. Diabetes drugs were chosen based on the National Disease and Therapeutic Index. The drug classes were Sulfonylureas, Biguanides and Insulin sensitizers. Despite the varying geographic size of the counties, which lends more visual weight to the large Western counties, there is evidence of clusters of high and low rate counties, in other words, in some parts of the country, high rate counties tend to be located near other high rate counties and vice versa.

Table 1: State-Level and County-Level Rx Rates

Table 1: State-Level and County-Level Rx Rates	1999	2000	2001	2002	2003
Prescriptions-Filled: Mean (State-level)	3.38%	3.55%	3.76%	3.99%	4.13%
Prescriptions-Filled: Standard Deviations (State-level)	0.70%	0.73%	0.74%	0.78%	0.79%
N (50 states plus the District of Columbia)	51	51	51	51	51
Prescriptions-Filled: Mean (County-level)	2.22%	2.33%	2.47%	2.62%	2.73%
Prescriptions-Filled: Standard Deviation (County-level)	1.34%	1.41%	1.49%	1.59%	1.64%
N (counties)	3,103	3,103	3,103	3,103	3,103

Map 2: Testing for Spatial Autocorrelation Between Counties Using the Global Moran's I .

We test for spatial autocorrelation within the diabetes prescription rates for all counties across the nation. The Global Moran's I is 0.603 (-1 = perfect negative correlation, 0 = zero geographic correlation, 1 = perfect positive correlation). We map the counties in which their rates are statistically significantly correlated to the rates of their neighbors. There are large clusters in the West and a few clusters in the Mid-Atlantic of low diabetes prescription rates, which clearly cross state boundaries. Less obvious are clusters of relatively high prescription rates in Appalachia and the Upper Great Plains. This map suggests where clusters of counties with rates significantly different from the national mean are located, but it does not identify self-defining hot and cold spots.

Map 3: Test for Hot and Cold Spots Between Counties Using the Local Moran's I

We test for self-defining clusters of high and low diabetes prescription rates using the Local Moran's I. The diabetes prevalence rate in each county is compared to adjacent counties and fall into five categories: dark brown = high rate adjacent to high rate, dark green = low rate adjacent to low rate, light brown = high rate adjacent to low rate, light green = low rate adjacent to high rate, and white = not significant. We see multiple clusters of low/low rates in the West and portions of the Great Plains and Texas. Low/low rate clusters are virtually absent east of the Mississippi River. In contrast, there are diverse clusters of high/high rates. One cluster extends from the Canadian border in Minnesota south and then east through Iowa and Illinois. A separate cluster occupies the Upper Peninsula of Michigan. The largest cluster extends from Southwest Alabama, north through Mississippi, and east into Tennessee, West Virginia and Pennsylvania. Another large cluster virtually covers North and South Carolinas.

General Conclusions:

We used diabetes prescriptions filled at the county level as a proxy measure of diabetes prevalence in the adult population, as validated in previous research. When we mapped the rates, it appeared that there were systematic geographic patterns of high and low diabetes rates. We used two spatial statistics to confirm that these apparent patterns were statistically significant. These results have implications for two groups. Given the high degree of spatial autocorrelation in these data, the results of a-spatial models will be biased. For health policy-makers and managers, the recognition and identification of geographic clusters can guide the allocation of health interventions and resources.

The design, layout and production of this poster are the work of Dallas Breen, Media Lab Coordinator, Social Science Research Center, Mississippi State University.

Acknowledgement:

Original funding was made possible by a grant from the Office of Rural Health Policy, Department of Health and Human Services (Grant 1-R04RH03598-01-00) to the Social

Science Research Center at Mississippi State University. Subsequent funding was made possible by a grant from the Office of Rural Health Policy, Department of Health and Human Services (Award #1 U1FRH07411-01) conducted in partnership with the Delta Health Alliance, a 501c3 non-profit organization. The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official views of the Office of Rural Health Policy or the Delta Health Alliance.