Nationwide Geospatial Analysis of Hospitalization in Diabetes Mellitus Complications

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Diabetes mellitus and complications associated with the disease represent a significant source of morbidity within the United States. Substantial public health efforts have been devoted to understanding the factors that underlie poor outcomes in diabetes. The purpose of this work is to (1) determine whether there exist statistically significant geospatial disparities in the relative rate of diabetic complications in Medicare patients throughout the United States, and (2) if these exist, assess the socioeconomic, cultural, and medical attributes that distinguish communities delineated by these variations. This work utilized multiple public databases, including National Plan and Provider Enumeration System (NPPES), US Department of Agriculture (USDA), US Census, and Center for Medicare Services (CMS) data. Datasets were combined on a county level to quantify 18 socioeconomic, 22 health, and 4 diabetic management attributes of 3061 total counties in the contiguous United States. CMS Prevention Quality Indicators (PQI) #1 (Diabetes Short-Term Complications Admission Rate), #3 (Diabetes Long-Term Complications Admission Rate), and #16 (Lower-Extremity Amputation Among Patients with Diabetes Rate) were used as the main indicators of county-level diabetic control, along with the total number of practicing endocrinologists. These variables were scaled to the number of Medicare members with diabetes in each county. All variables were for the latest available year, 2019, with the exception of the number of practicing endocrinologists (from December 2021). The synthesized database was then exported to GeoDa, a geospatial analysis program, where statistically significant ($p< 0.05$) diabetes complication spatial hotspots, coldspots, and outliers were identified using Moran's I on a national level. ANOVA was then conducted across all Moran's I groupings with a two-tailed t-test between hotspot and coldspot groupings to identify what socioeconomic, health, and diabetic management attributes were statistically significant between complication geostructures. Geospatial visualization revealed an expansive hotspot cluster in the normalized diabetes long-term complication admission rate that encompassed the East Coast and included portions of Florida and Texas (p0.05). Conversely, an expansive coldspot cluster encompassed much of the West and Great Plains region. Similar geospatial patterns were observed in the short-term complication admission rate, with the caveat of a new hotspot cluster that encompassed California and the West Coast ($p< 0.05$). ANOVA using the identified clusters as groupings revealed differences between hotspot and coldspot clusters: Hotspots tended to have greater Hispanic (6.7% to 1.8%) and Black (10.9% to 0.6%) representation compared to coldspots. They tended to have greater population density (2877 to 124 persons/sq. mile). Hotspots also tended to have more endocrinologists per capita (3.0 to 0.87) than coldspots. Variables of interest that did not appear to differ included the percent in poverty and the percent uninsured.

Presentation Type: Poster
Presentation Date: Sunday, June 12
Presentation Time: 12:30-2:30 PM
Location: ENDOExpo