Geospatial Modeling of Asthma Population in Relation to Air Pollution
A Decision Support for Health Administration

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Abstract

Current observations indicate that asthma is growing every year in the United States, specific reasons for this are not well understood. This study stems from an ongoing research effort to investigate the spatio-temporal behavior of asthma and its relation to air pollution. The association between environmental variables such as air quality and asthma related health outcomes in Mississippi are investigated using Geographic Information Systems (GIS) tools and applications. Health data concerning asthma obtained from Mississippi State Department of Health (MSDOH) for 9-year period of 2003-2011, and data of air pollutant concentrations (PM2.5) collected from USEPA web resources, are analyzed geospatially to establish the impact of air quality on human health, specifically related to asthma. Disease mapping using geospatial techniques provides valuable insights into the spatial nature, variability, and association of asthma to air pollution. Asthma patient hospitalization data of Mississippi has been analyzed and mapped using quantitative Choropleth techniques in ArcGIS. Patient have been geocoded to their respective zip codes. Potential air pollutant sources of interstate highways, and industry are also used to establish common geospatial platform to understand their adverse contribution on human health. Existing hospitals and emergency clinics are being injected into analysis to further understand their proximity and easy access to patient locations. At the current level of analysis and understanding, spatial distribution of Asthma is observed in the populations of zip code regions in Gulf Coast, along the interstates of south, and in counties of Northeast Mississippi. It is also found that asthma is prevalent in most of the urban population. The GIS-based project would be useful to make health risk assessment and provide information support to administrators and decision makers for establishing satellite clinics on future.

Introduction

Current health and economic problem. It’s an expensive disease. Costs the United States $56 billion each year (CDC, 2009)

1. Adverse impact on health and economic problem. It’s an expensive disease. Costs the United States $56 billion each year (CDC, 2009).
2. A cooperative project conducted by Rob., 2003 has found that there is a good correlation between Asthma and poverty. They also found that inner-city population have higher prevalence e of Asthma than those live in suburb regions.
3. Foody, 2006 has pointed that the long term focus on disease surveillance is focused on spatial cluster of disease (SpC), which is significant to plan and provide health care needs to a cluster of diseased population, he also said that time and space are important factors of dimension for health service delivery.
4. Relationships between Disease and Environmental Factors: A critical review on public health and GIS. Rushton., 2003 concludes that establishing associations between disease rates and exposures to environmental factors is an area of increased interest in GIS and spatial analysis of health data.
5. Al-Hamdan et al., 2009 has estimated daily PM2.5 levels combining both observations and remotely sensed data: Potential use for environmental public health surveillance. J.of Air and waste management association, 59:865-881.

Main objectives for this research were, (1) Identify the Asthma disease spatial patterns, (2) Geocoding existing data for analyzing spatial distribution of Asthma, (3) Investigate the correlation between poverty and geographic distribution of Asthma, (4) Identify the number of patients are over served or underserved, (5) Investigate the correlation between poverty and geographic distribution of Asthma, (6) The percent increase in air pollution lead to what percent increase in hospitalization.

Observations and Results

Study Region: Mississippi

Project Partners

Mississippi State Department of Health

Methods

Asthma Patient Hospitalisation Data

Hospital Network Data and Number of Patient Beds

Geocoded to Zip dyCode Boundaries

Data Integration and Analysis

Geocoded to Sreet lines

Quantitative Choropleth Mapping of Diseased Population

ArcGIS

Kriging Technique

PM2.5 Ground data

Spatio-temporal pattern of Pollution

Understand the spatio-temporal nature of disease and it’s relation to air pollution.

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Conclusions

• At any point of a year between 2003 -2011, zip code regions of Jackson urban area have at least 500 to 700 Asthma related hospital admissions, and this is the highest rate when compared to rest of state.
• Along with increase in population count, the spatial prevalence of Asthma is also increased in state over the years and can be inferred from above data.
• Asthma is observed in the populations of zip code regions in Gulf Coast, along the interstates of south, and in counties of Northeast Mississippi. It is also found that asthma is prevalent in most of the urban population.
• The GIS-based project would be useful to make health risk assessment and provide information support to the administrators and decision makers for establishing satellite clinics on future.

Future Work

1. Identify seasonal patterns in pollution and hospital admissions.
2. Establish a quantitative relationship between PM2.5 and Asthma related Hospitalizations.
3. Find the underserved and over served clusters of diseased population.
4. Use remotely sensed data (MODIS/AQUA) to estimate ground monitor, and estimate the accurate level of pollutant over study region.

References

1. Asthma’s impact on the nation, data from CDC national Asthma control program.

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