

GeoHealth: Geographic Information System for Health Management and Clinical, Epidemiological and Translational Research

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Abstract

This project aims to develop a system for clinical, epidemiological and translational research capable of associating contextual variables and geospatial data with clinical patient information. The GeoHealth system will include a section to perform exploratory analysis that will help identify risk factors to optimize clinical decision making.

Keywords:

Geographic Information System, OpenData, Asthma

Introduction

Open Data is defined as data that are made available for anyone to access, use, and share. [1] Associated with this formalization, various government agencies and institutions have embraced this initiative as an appropriate mechanism to promote transparency, reuse of public information, economic development and smart government. To facilitate the search for data offered by different institutions, there are portals of the European Commission, the Government of Spain and the Andalusian Government that offer catalogs of available and applicable data in their environment. This project aims to facilitate the incorporation of data in open format in order to integrate them into health management and research, reducing the time required for the development of research studies.

Geographic Information Systems: GIS are systems designed for the storage, processing, management, and analysis of geographic data and spatial references. These systems have revolutionized environmental health research by connecting environmental and population data with their geographic location [2]. The emergence of open initiatives such as OpenStreetMap, a collaborative project to create free and editable maps, has favored the generation of a large number of free software projects such as GeoServer, MapServer, GeoNetwork that facilitate the management of geographically distributed information. Several recent reviews show the benefits of applying these systems for public health, health services management and research [3]. The development of a scalable system through which researchers can define, search, use and share maps with data on the geographic distribution of factors (risk and protective) relevant to the health of patients, which are integrated with the systems used for both patient care and research will favor the development of studies to understand the health impact of these environmental conditions in the population. The GeoHealth project aims to develop a scalable infrastructure that allows researchers to run real-time analysis of large volumes of patient data in combination with geolocated data (openData) [4].

Methods

The proposed methodology has been designed for the development of a system to support epidemiological and public health studies that can be applicable in multiple national and international health centres through the application of interoperability standards. The data integrated into the system must provide demographic information and the environmental conditions associated with the location of the patient. The system has a section to perform analyzes that can range from simple correlations between variables to other more complex analyzes such as clustering analysis, linear and logistic regressions.

Results

Observation module: The data come from different sources and all have been integrated into the same representation system. Using the free mapping system "OpenStreetMap" and the "Plotly" Python library, both the demographic data of the patients and their contextual variables are represented in a Dashboard, containing a single map.

The system offers the possibility to deploy different heat-maps using different regions (Census Regions, Postal Code Regions and Health Districts) and different demographic variables for each type of region (Population density, percentage of males and females, average income, etc.). Moreover, it is possible to choose between the different regions of Andalusia and a range of dates for the environmental (Pollution, pollen and meteorological data) and patient's data. Other places locations are deployed on the map as hospitals, clinics, roads and parks.

Analysis module: GeoHealth allows to carry out exploratory analysis of both clinical and open data to support the identification of relationships between patients and their environment conditions. As it can be observed in figure 1, the patients included in the allergology study are distributed among the four clusters of the segmentation. Most of them fall into the "Young and Low Density", corresponding to the majority of the towns of the province of Seville, and some external areas of the city where the majority of the population are young people, the population density is low and in general, people have medium studies. Virgen Macarena Hospital attends the population living in the north of the city of Seville and the whole north of the province. Therefore, the large number of patients living in this cluster can be related to this fact. Moreover, it is the cluster with the largest population.

The second highest cluster is the "No Studies & Low Density" cluster. The most remarkable characteristic of this group is the

large presence of elderly and the low level of education presented in its population. The fact that it is the second-largest cluster of the segmentation and the characteristics and location (rural areas of the north of the province) of the census sections make it the second-largest cluster of patients.

The cluster with the lowest number of patients is the “Old & Studies” cluster. The population of this cluster is old and with high studies. The reason why it has a low number of patients may be because is one of the two clusters with the lowest population and most of the census sections fall into the area of the other big hospital of the city of Seville.

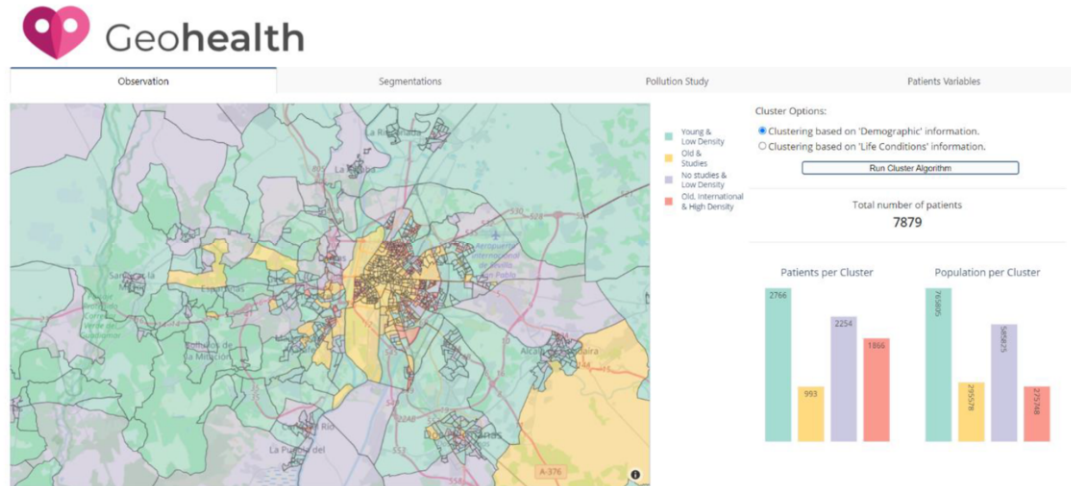


Figure 1. Overview of the Demographic segmentation module.

Conclusions

The GeoHealth system allows clinical researchers to understand better how the patient is affected by his environment and perform analysis to discover patterns in the data avoiding efforts in collecting and processing openData from multiple national and regional sources.

All these aspects make GeoHealth an innovative platform with a potential impact on the development of clinical studies related to the location and environment of the patients.

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