Chapter 26
Geographic Information System Applications in Public Health:
Advancing Health Research

Sandul Yasobant
Indian Institute of Public Health Gandhinagar, India

Kranti Suresh Vora
Indian Institute of Public Health Gandhinagar, India

Ashish Upadhyay
Indian Institute of Public Health Gandhinagar, India

ABSTRACT

Geographic information systems or geographic information science is a combination of computer-mapping capabilities with additional database management/data analysis tools. GIS is widely used in various sectors such as environmental science, urban planning, agricultural applications etc. Public health is another focus area, where GIS has been used for research and practice areas such as epidemic surveillance and monitoring, among others. The journey of use of GIS in public health spans more than a century and GIS application in public health has evolved from the simple maps to the higher level geostatistical analysis and interactive WebGIS in recent times. GIS is an analytical tool which differs from conventional computer-assisted mapping and any statistical analysis programs in its ability to analyze complex data and visual presentation of spatial data. Specialized GIS techniques such as network analysis, location-allocation models, site selection, transportation models, and geostatistical analysis are well established and used in many developed and developing nations. Unfortunately owing to the high cost of licensed software and specialized skills for advanced data analysis, use of these techniques is limited mainly for the research and by few experts. GIS is proved to be useful for various public health practices and research purposes including epidemiological surveys/investigation, implementation research, program/policy

decision making and dissemination of information. The advantage of using GIS is that maps provide an added dimension to data analysis, which helps in visualizing the complex patterns and relationships of public health issues, thus many unanswered questions in public health, can be understood well through use of GIS techniques. Use of GIS in public health is an application area still in its infancy. Wider use of GIS for public health practice such as program planning, implementation and monitoring in addition to building evidence base for the policy making will help reduce inequities in health and provide universal healthcare. Overall, GIS is a helpful and efficient tool especially for public health professionals working in low resource settings. In the future with inclusion of advanced GIS technology like WebGIS can help reach the goal of optimal health care services globally.

Knowing where things are, and why, is essential to rational decision making. - Jack Dangermond, ESRI

1. INTRODUCTION

Public health is the science of ensuring and improving the health of communities through practice and research. Multidimensional public health data provides useful information to improve planning, implementation and monitoring of programs and evidence based policymaking processes; if analyzed appropriately. A number of quantitative approaches have been used for the complex analysis of these datasets but combining quantitative data with spatial data and visualization of spatial data are limited in public health research. In such circumstances Geographic information systems (GISs) or geographic information science (GIScience) is a powerful analytical tool; which differs from conventional computer-assisted mapping and any statistical analysis programs. Although computer-assisted cartographic systems emphasize map production and presentation of spatial data, they cannot analyze spatially-defined statistical data. GIS blends these different types of data to visualize, analyze, and explore geographically referenced information. Thus, a Geographic Information System can be used to address research questions or practical applications in the field of public health such as: *condition* – what is at …?; *location* – where is …?; *trend* - what has changed since…?; *pattern* – what spatial patterns exist?; and *modeling or scenario-building* – what if…?. In other words, it can be used to track the geographic location of people, places, events, actions, or impacts, to conduct spatial or statistical analysis on the variables of interest, and to create maps that display the spatial/temporal distributions and relationships of those variables (Richards, Croner, Rushton, & Brown, 1999) (Phillips et al., 2000) (Bédard & Henriques, 2002).

Recently, Geographical Information System (GIS) has emerged as an innovative and important component of research and practice in public health. GIS has proved to be useful for various research purposes including epidemiological surveys/investigation, implementation research, program/policy decision making and dissemination of information. The advantage of using GIS is that maps provide an added dimension to data analysis, which helps in visualizing the complex patterns and relationships of public health issues. Relationships among neighboring areas are explicit in maps which allows for the visualization of spatial patterns of disease or health service utilization. Some of the typical questions that can be answered by GIS are shown in Box-1. Despite the first use of GIS in the field of public health and advancement of technologies; GIS techniques has not been used extensively in this field due to difficulty in learning the technology (Sheppard, McMaster, Leitner, & Tian, 1999) (Schlundt, Mushi, Larson & Marrs, 2001) (Ferguson, Maheswaran, & Daly, 2004).

Related Content

Local Government Development in the Czech Republic: Dilemmas and Challenges
Romana Provazníková, Lucie Sobotkováand Martin Sobotka (2021). *Handbook of Research on Global Challenges for Improving Public Services and Government Operations (pp. 151-171).*
www.irma-international.org/chapter/local-government-development-in-the-czech-republic/266101

The Pacific Alliance: An Opportunity of Internationalization for MSMEs
Juan M. Gil-Barraganand Andrés Aguilera-Castillo (2021). *Handbook of Research on Institutional, Economic, and Social Impacts of Globalization and Liberalization (pp. 356-380).*
www.irma-international.org/chapter/the-pacific-alliance/266039

Outdoor Solutions for the Seasonal Concentration of Tourism Demand in Northern Portugal: An Integrated Approach Based on the Gini Index
Paula Odete Fernandes, Alcina Maria Nunes, Cláudia Miranda Veloso, Eleonora Santos, Fernanda A. Ferreiraand Manuel José Serra Fonseca (2020). *Handbook of Research on the Impacts, Challenges, and Policy Responses to Overtourism (pp. 364-379).*
www.irma-international.org/chapter/outdoor-solutions-for-the-seasonal-concentration-of-tourism-demand-in-northern-portugal/250507

Web Healthcare Applications in Poland: Trends, Standards, Barriers and Possibilities of Implementation and Usage of E-Health Systems
Anna Sotysik-Piorunkiewicz, Magorzata Furmankiewiczand Piotr Ziuziaski (2019). *Healthcare Policy and Reform: Concepts, Methodologies, Tools, and Applications (pp. 1004-1029).*
www.irma-international.org/chapter/web-healthcare-applications-in-poland/209167

Convolutional Neural Networks (CNN): Models and Algorithms
Friki Imed Salaheddine (2023). *Advanced Bioinspiration Methods for Healthcare Standards, Policies, and Reform (pp. 97-120).*
www.irma-international.org/chapter/convolutional-neural-networks-cnn/316788