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# The Impact of Geo-Information Technoloy in Effective Healthcare Delivery

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## Abstract

*The environmental impact on human health is important. According to WHO 2013, environmental hazards are responsible for about 25% of the total burden of disease worldwide and nearly 35% applies to Africa. They also asserted that, millions of deaths would have been avoided if our environment had been healthier and some of the environmental problems that affect human health are properly address through the use of an effective and robust technology. In recent years, there is no doubt that technology has made a significant impact in the medical world. Advancements range from those that improve the comfort of many patients to those that extend their lives. Perhaps one of the most interesting technologies that has emerged onto the scene is one meant to more efficiently address geographical links to illnesses: Geo-information systems, or Geographic Information System (GIS). This paper therefore highlight the role of Geo-information technology in healthcare delivery and advanced some far reaching recommendations for effective management of healthcare services.*

## Introduction

Medical researches as well as the study of the Earth's surface, better still, geography are interlinked with each other; their relationship dates from antiquity. Hippocrates was the first to describe the relationship between the geographical characteristics of a place and the inhabitants' health. Hippocrates described all these in his treatise "On Air, Water and Places". (Hippocrate,1840). As the time goes by, it has become

increasingly apparent that the mapping and the geographic information might be both very useful and vital not only for research but also for understanding the processes of diseases. The study of the English Physician John Snow in 1854 was a milestone towards this direction. It led to the detection of the source of infection in a cholera epidemic that broke out in London. Having mapped the locations of those individuals who were affected, he concluded that contaminated water was the cause of the outbreak. This research laid the foundations for both cartographic and geographic applications as a tool in medical science (McLeod KS, 2000). Nowadays, the rapid development of technology has resulted, among other things, in the creation and deployment of new disciplines that cooperate with both the science of medicine and medical research. The science of Geographic Information Systems and, by extension Geomatics belongs to a discipline which is constantly developing at a global level. This sector has many applications regarding medical / epidemiological research and generally, the social sciences.

**Cencept of Geo-Informatics**

The term Geo-informatics is used globally with varying connotations, though it has its origin and popular use in Europe. According to the International Institute of Geo-Information Science and Earth Observations (ITC), the Netherlands, technologies supporting the processes of acquiring, analyzing, and visualizing spatial data form the core of Geo-informatics (ITC, 2001).

In recent years the term Geo-informatics became popular in the US Earth Science community when the Geo-science Network (GEON), a National Science Foundation funded program, adopted the term to describe a variety of efforts that promoted collaboration between computer science and the geosciences to solve complex scientific questions using advanced information technologies and integrated analysis (GEON, 2003).

Geographic Information Systems (GIS) are spatial data management systems. These data are associated with respective geographic features. They are digital systems that can integrate, store, adjust, analyze and arrange geographically-referenced information. Generally, they could be described as smart maps that offer a simulation of the real world to their users. They can also generate interactive spatial or descriptive questions (research that has been created by the user), analyze spatial data, adapt and adopt them in analogue prints maps and diagrams or digital media records of spatial data, interactive maps on the Internet (Koutsopoulos, 2002)

Geo-informatics can therefore be define as the collection, integration, management, analysis, and presentation of geospatial data, models and knowledge that support disciplinary, multidisciplinary, interdisciplinary and trans- disciplinary research and education. Other researchers consider Geo-informatics as a new discipline integrating elements of various disciplines that deal with geographic or geospatial data, i.e. data linked to some locality on the surface of the Earth. These disciplines include, but are not limited to, surveying, remote sensing, geographic information systems (GIS), cartography, geosciences, informatics, computer science, statistics, and management and of recent in medical health care delivery (Virrantaus and Haggrén, 2000).

**Aim of the research**

The aim of this research is to highlight the impact of Geo-information technology System in Medical Science and the various applications in the field of medicine, either epidemiological or social research and health care, in general. Furthermore, this discipline may act as a decision making tool in health care and it might contribute to the formulation of policies regarding the health sector.

**Material and Methods**

The method of literature review was used in this study. It also included articles and publications that are related to the theme. The study also drew information on researches and publications that are taken from databases such as HEAL-LINK, Google Scholar, Pub-med material. The Key words that were used in the search were: Geographic Information Systems, Applications, Medical research, and public health.

**Application of Geo-information technology in medical healthcare delivery**

**1. Identifying Health Trends**

The software offers healthcare professionals the ability to identify health related trends and more thoroughly target healing efforts based upon those results. One example of this in action comes from the University of Southern California's Public Health Program, which utilizes geographic information systems in many of its different initiatives, including the Cancer Surveillance Program.

The program assess the demographic data, such as home address, workplace, cancer type, and even data collected from wearable health tech of all patients entered into the system. Data is then georeferenced and mapped. Healthcare professionals can visualize the locations of patients and determine if there are clusters of specific types of cancer associated with similar working conditions or residential areas. One University Southern California (USC) study found an association between homes downwind of heavily sprayed fields and higher incidences of prostate cancer.

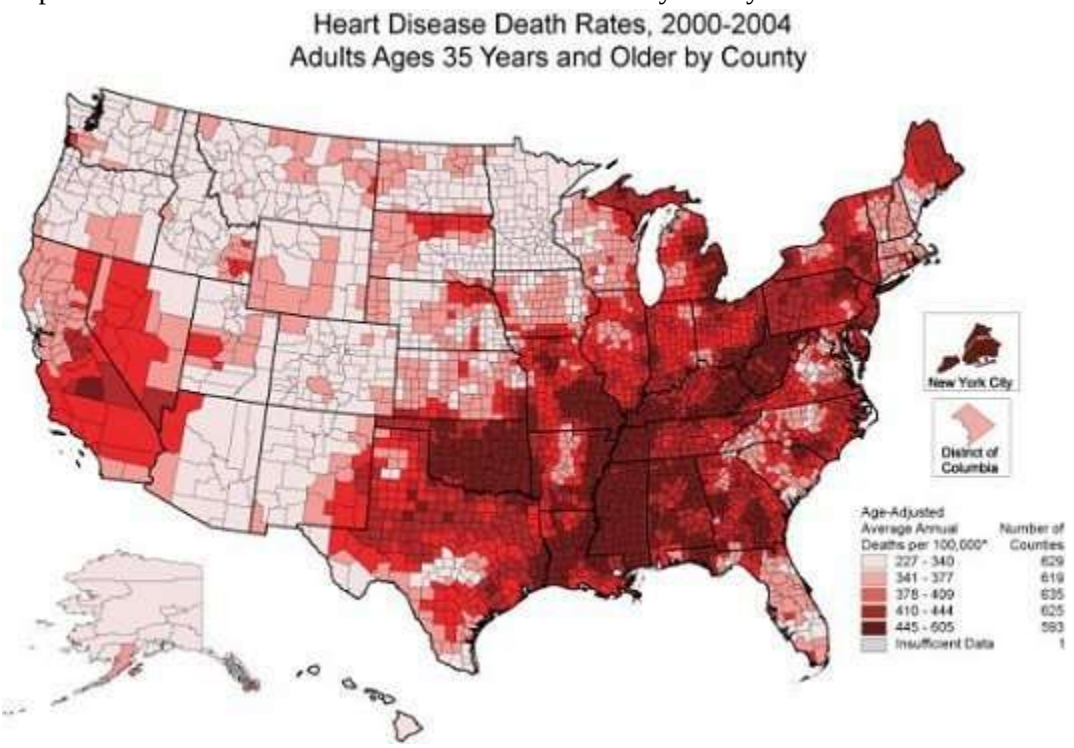
With the number of chronic diseases such as cancer, diabetes, and cardiovascular disease rising rapidly, GIS may provide a method in which healthcare professionals can systematically address where certain diseases are more likely to or already have become prevalent and begin proactively implementing preventative strategies or staffing healthcare professionals skilled in specific medical specialties.

**2. Tracking the Spread of Infectious Disease**

The role of GIS systems should not be limited simply to tracking occurrences of diseases though. One of its most powerful aspects is its ability to use geography and other inputs to identify where diseases are most likely to spread next. Data such as this can be essential to on-the-ground personnel working to save lives because it enables them to prepare in advance for a disease and can severely limit the impact.

Maps such as these are beginning to play a significant role in the management of disease outbreaks such as Ebola and measles. For instance, during the Disneyland measles outbreak in December of 2014, GIS-based maps were created to help visualize where infected children

lived and the potential spread of the disease. Furthermore, it was used to gain a better understanding of vaccination rates and laws in differing counties throughout the US to determine which locations could be hit the hardest given a serious outbreak. Fig 1 shows a map of heart diseases and death rates from 2000-2004 by county.




**3. Utilizing Personal Tech**

The collection of large quantities of accurate personal data is expected to reveal a great deal about personalized healthcare, but it can also greatly impact broad regional treatment plans. Personal healthcare technologies represent a powerful tool for information input into GIS due to their ability to inform statistical studies. It has the potential to uncover long-term geographic trends in the health of certain demographics of people or of individuals living within certain regions of the United States.

Wearable technology is capable of collecting a very broad amount of healthcare information such as average heart rate, sleeping patterns, and exposure to the sun. Adding this data to a GIS could help determine if the average heart rate or sleeping patterns of individuals varies over geographic areas. If such patterns do exist, discovering why could open new realms of healthcare research.

**4. Incorporating Social Media**

In a similar manner to wearable tech that can be used to gather input data, social media can also play a significant role. For instance, during the 2012-2013 flu season, researchers queried Twitter for tweets indicating sickness. They used terms such as ‘flu,’ ‘influenza,’ and ‘medication’ and geographically located where the tweet was sent from. By adding this data to a GIS map, researchers were able to visualize the status of the flu in the US for that year. Additional studies and data collection hope to predict where the flu will have the greatest effect into the future.

**5. Improving Services**

Finally, the use of GIS technology can enable community leaders and developers to work more closely with hospitals to take larger steps in addressing national healthcare needs. The system can help identify which neighborhoods are in greater need of specific health services such as more rehab centers or senior care facilities. Analysis of patient demographic data can help answer these questions. Also, The ground as well as soil contamination might also cause serious health problems within a population. It is very important the soil texture with all the additional chemical information be recorded. This is another field in which GIS have found application (Briggs and WHO, 2000; Joseph, Wang, Wang, 2014).

An example of how this has been done is through veteran's service improvements. The Planning Systems Support Group, a field unit in the Veteran's Affairs office, used GIS to determine where there were significant gaps in their service. They did so by mapping the known distribution of veterans in the United States alongside the distribution of veteran service offices and healthcare facilities. The maps revealed a number of areas where veterans were forced to travel significant distances to receive treatment and, using the data, were able to successfully lobby for 20 new mobile veteran care stations across the US.

Many agencies, which supervise the environment as well as environmental changes and disasters that have impact on population's health, use primarily GIS so as to understand their repercussions and promote health of the population. These agencies promote the use of such systems to operate effectively regarding monitoring, restoration and planning policies in development even in safeguarding the environment. As time goes by, a lot of environmental researches have been carried out using GIS in fields such as disease mapping, investigation of epidemics like cholera; areas under investigation where appear high rates of spontaneous diseases. Also, studies regarding accessibility to clean drinking water or even mortality rates by region may be explored (Glass, Aaron, Ellis, Yoon, 1993).

## Historical development of GIS in medical health care services

In 1854, Dr. John Snow identified the Broad Street pump as the source of an intense cholera outbreak by plotting the location of cholera deaths on a dot-map. He had the pump handle removed and the outbreak ended...or so one version of the story goes. In medical geography, the story of Snow and the Broad Street cholera outbreak is a common example of the discipline in action. While authors in other health-related disciplines focus on Snow's "shoe-leather epidemiology", his development of a water-borne theory of cholera transmission, and/or his pioneering role in anaesthesia, it is the dot-map that makes him a hero in medical geography. The story forms part of our disciplinary identity. Geographers have helped to shape the Snow narrative: the map has become part of the myth. Many of the published accounts of Snow are accompanied by versions of the map, but which map did Snow use? What happens to the meaning of our story when the determinative use of the map is challenged? In his book On the Mode of Communication of Cholera (2nd ed., John Churchill, London, 1855), Snow did not write that he used a map to identify the source of the outbreak. The map that accompanies his text shows cholera deaths in Golden Square, the sub district of London's Soho district where the outbreak occurred from August 19 to September 30, a period much longer than the intense outbreak.

## Summary

Geo-Information technology in a Health Management Information System (HMIS) has become a powerful tool to make health care delivery more effective and far more efficient. Technological advances keep up also with medical advances. Their common and consistent

goal is to secure human existence. We can say with absolute certainty that Geo-Information technology is known to be an important tool in relation to the investigation of health sciences and have many applications. This technology enables health-related information to be displayed. Hence, the multidisciplinary work is more efficient. Geo-Information technology enables the visualization and monitoring of infectious diseases. Additionally, this technology record and display the health care needs of the community as well as the available resources and materials. Hence the need to embrace it.

## Conclusion

GIS is a powerful tool that has been successfully implemented to help address a number of significant health issues ranging from disease management to improved services. As more and more healthcare professionals begin to adopt and integrate the program, the number of benefits is likely to continue to rise including the connectivity between hospitals and the communities they serve – which is perhaps the most important connection to be made.

### Recommendations

1. Since Geo-information technology has proven to be an effective tool in healthcare delivery, government should encourage the funding and usage of Geo-information technology in Nigeria hospitals.
2. It is not enough to write and make suggestions on the usage of Geo-information technology. Practical approach, training and orientation need to be carried out for the personnel.
3. Geo-information experts in healthcare delivery are scarce, More personnel should be recruited to assist the available ones.

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