India should Tap GIS' Potential to Combat Contagious Diseases

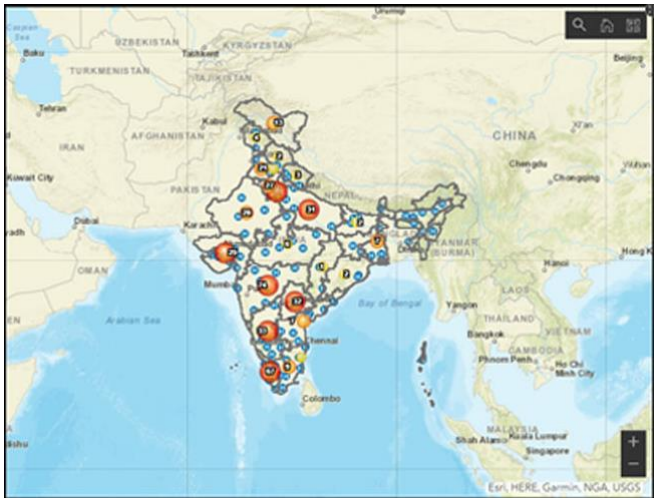

Image source: Indian Express

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With an increased global interconnectedness,any event in one region can have a cascading effect on other economies. The latest case in point isthe novel Coronaviruswhich has spread, from Wuhan to 116different countries around the world,in a short span of two months. One of the greatest fears of an epidemic is its contagion in a region that is poorly equipped to undertake containment procedures. Sophisticated modelling is being used to predict the transmission; scientists are making serious attempts to fight this virus. However, to contain such diseases requires a strong health and integrated data system that many developing nations are bereft of, thereby magnifying the contagion.

Alarming issues like climate change, natural disasters, epidemic outbreak, etc. that mankind is facing today are best understood only spatially. These issues require complex location-based awareness that can come from incorporating Geographic Information Systems (GIS) in their planning process. GIS is a tool that connects data with geography that visually makes it possible for us to better comprehend what belongs where. One field that can harness its potential is the healthcare sector. Medical GIS has a wide scope in public health informatics research, showing great prospect in transforming healthcare management and planning in India. Mapping diseases foster an understanding of environmental and geographic influences that cause certain diseases. In doing so, they can proactively implement preventive strategies and enhance the efficiency and quality of treatments.

In the field of disease surveillance, GIS plays a vital role in the early detection of disease spread. When a new virus breaks out resulting in an increasing number of fatalities, there is a burden on health professionals to identify the origin of the cause. The early diagnosis of the infection is challenging since it involves ruling out several potential cases. If the process of detection gets delayed, waves of an outbreak would exponentially increase fatalities. This follows a sudden increase in the demand for health services with a very limited capacity of hospitals to render them. The earlier the detection, the better is the chance of successful containment of the disease.

The most popular example of medical geography was performed by Dr John Snow in the year 1850, to investigate the source of a cholera outbreak in London. Credited as the father of epidemiology, Dr John Snow used ahand-drawn map to spatially analyse the trends of cholera deaths in London in the 1850s. His map overlaid the locations of death with the information on public water supplies and it was found that death rate was clustered around the broad street pumps and they are the likely source of the cholera outbreak. The subsequent removal of the pump handle significantly reduced the occurrence of death, thereby enabling the medical professionals to investigate and conclude that cholera was a water-borne disease. This is the most celebrated analysis as it is considered to be the first epidemiological analysis of a disease that tried to understand the spread of diseases by factors in the environment. It was also the first geographic analysis of disease data that plotted maps and looked for relationships between informational layers. In doing so, he defined the earliest use of mapping in public health, thereafter, several techniques of geographic analysis emerged in health planning. Although many techniques have evolved from that of John Snow's era, his example provides a distinct understanding of how GIS could benefit public health investigations and other research.

Another prominent case of GIS analysis was done by Stan Openshaw in 1987 to analyse locations of leukaemia clusters. In his paper titled 'Searching for Leukaemia Clusters Using Geographic Analysis Machine', he assessed whether living in close proximity to a nuclear facility pose a higher risk of paediatric cancer. Openshaw successfully demonstrated the clustering effects of leukaemia and other cancer. However, he warned that using geographic information tools alone would not be enough to identify the causes of leukaemia but the visual patterns provide cues for policymakers to undertake further research. This limitation can be addressed if micro-level data can be availed.The analysis can also communicate the ability of the nearest hospitals to tackle the expected increase in the demand for service in the form of medical supply information, availability of hospital bed, human resources, etc. However, progress in this field requires big data, spatial statistics, interoperability, etc.

The implementation of GIS for improving health has become widespread in advanced economies.However, developing countries like India's adoption of these geospatial technologies are relatively restricted. This is largely due to the budgeted priority given on improving key health indicators. Amidst this, investment in new technologies does not get its due order of preference. With a growing population and ongoing public health changes, the adoption of GIS to understand disease surveillance and implement health policies in India has great potential for both success and efficiency.

Foreseeing a greater penetration of GIS in every field, the Government of India (GoI) mandated the development of a GIS-based database in the country to identifyuntapped potential. This is done through National GIS vision chartered under the 12th five-year plan. The vision report states that despite the benefits that GIS brings as a technology, its potential is yet to be exploited for decision support and planning.Today, with e-governance, smart city mission and digital India initiative, India is on the road to digital transformation. Geospatial technology is undoubtedly a key enabler of this transformation and therefore, a logical requirement.

India has 17 national-level geospatial policies and rules under various ministries.However, there are no clear guidelines regarding data sharing between ministries. The lack of a comprehensive policy on the geospatial data is one of the major hindrances in technological developments.The implementation of spatial technologies in areas like urban planning, disaster management, forest mining and agriculture has gained prominence in the country. That said, India's adoption of GIS in healthcare has been relatively slow despite its demonstrated utility in other fields. The goal of providing equitable

health services to its citizenry notably depends on the quality of decision making. Here, GIS can be a great differentiator in terms of providing effective governance and planning.

Globally, GIS is used as a decision support system assisting governments, private institutions and citizens to arrive at informed decisions. There is a growing need to understand GIS' applicability in India's decision-making process. With the ongoing public health challenges coupled with a growing economy emphasising on innovative technologies, GIS and spatial methods do show a great prospect in India's healthcare planning.

Understandably, there are also challenges associated with its implementation. While many challenges are common to applications of digital geographic methods irrespective of nations, some are particular to India. Its applicability as a management and planning tool is limited due to its inability to integrate datasets. The database available in India is sectoral, without the ability to interact with other sectoral data. Effective governance through GIS is only possible if these sectoral datasets are integrated and a new paradigm is created enabling picturing of various spatial components and its interplay. Health sector stands to benefit the most with this integration. However, for GIS to reach a full-service potential and become an important part of governance in India, new regulatory reforms are a necessary precondition.

The GoI proposed the National e-Health Authority (NeHA) to centralise Electronic Health Records (EHR) repository of all citizens. The limited uptake of EHR in hospitals, the lack of standard software across healthcare institutions and the concern on data privacy remain the main challenges in implementing this. GoI has also been working on a bill called the Digital Information Security in Healthcare Act (DISHA)since 2018 to secure patients' data;however, the bill has not come into effect, stymieing any efforts to digitise and revolutionise healthcare sector.

In public health informatics research, GIS is an essential componentthat can inform practitioners and virologists of the threat of infectious diseases.For such an effective intervention to happen, theprerequisitesinclude the availability of relevant and updated information.For decision support in the health sector, the range of information required must consist of

i. Spatial Information: Depending on the incidence of a disease in a region, the desired spatial information varies. Open access to data such as hydrogeology, wildlife population, climatic conditions, etc. may reveal cues on the origin of zoonotic diseases, thereby assisting researchers in identifying the source of the problem. This requires an integrated data system.

ii. *Operational and logistical information*: Operational and logistical information is important in mapping the demand for services and the capacity of hospitals to meet the demand. In the event of high demand for services, operational information comes handy in diverting patients to the nearest hospital with available facilities. It is important to have information regarding the clinical facilities the healthcare establishments are equipped with. During outbreak emergencies, there is a possibility that health centres may not be readily equipped with facilities such as isolation protocols and appropriate safety equipment. Having information on clinical capabilities of every hospital will enable decision-makers to divulge information to the public regarding hospitals providing required facilities, and thereby avoid large-scale spread of diseases.

These data when put together provides vital information that facilitates informed decisions and intervention. All medical establishments in India operate in individual silos, using databases designed

to serve their operational and strategic interests and requirements. The databases operating in their fragmented silos are not capable of interfacing with other institutional databases in the larger ecosystem. This system prevents transparency of information and obstructs possible synergies in the sector, thereby resulting in the loss of critical information which could potentially yield better medical outcomes. We need a system that standardises operations, enables synergies in the sector alongside a strong data protection regime for India to realise the benefits of technologies on health outcomes.

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