Four Ways Geographic Information Systems Can Help to Enhance Health Service Planning and Delivery for Infectious Diseases in Low-Income Countries

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Abstract: Focusing specifically on infectious diseases in low-income countries, this paper discusses four ways Geographic Information Systems (GIS) can facilitate health service planning and delivery: (1) deeper insight into where health care services should be located; (2) improved health surveillance and real-time planning for disease control and population health; (3) stronger accountability and evidence-informed dialogue between funders and the service providers and; (4) greater opportunities to translate complex data into more accessible formats which policymakers can quickly interpret and act on. Taking its use beyond just a research instrument, GIS is a way to undertake multidisciplinary work and improve health service planning and delivery.

Key words: Geographic Information Systems (GIS), access, accountability, health service delivery, health surveillance, infectious disease, knowledge translation.

Geographic Information Systems (GIS) may be defined as technologies that allow for the capture, storage, and analysis of spatially referenced data. These systems lend themselves to a multidisciplinary approach to problem solving because they can integrate and analyse various data, including population health data, health services and infrastructure data, environmental, social, and topographical data.

By mapping health data to geographically-referenced data, GIS help to visualise, explore, and explain particular research questions. In the control and response of...
infectious diseases for example, GIS technologies have been used to predict the risks posed by malaria, Rift Valley fever, visceral leishmaniasis, and tick-borne encephalitis while tools such as the World Health Organization's (WHO) Health Mapper and Global Health Atlas have enabled better health surveillance, case-detection, and disease response. Yet, even now, infectious diseases remain major causes of mortality in low-income countries, with poor and marginalized communities and children under five disproportionately affected. Despite improvements in public health and health research, there remain significant gaps in knowledge about the incidence and prevalence of the infectious diseases, particularly where patterns of reporting and surveillance are poor. This is one of the barriers that impede timely and effective service delivery and disease control initiatives.

A rigorous spatial analysis can help address challenges by identifying the aetiology of diseases; the environmental factors contributing to disease burden; predictors of changed disease prevalence; disease magnitude by sub-groups, regions, and time periods; where and how to distribute meagre resources; and the factors determining communities’ access to health services. By dissecting all the factors influencing disease epidemiology into different layers and overlaying them on each other, it is possible to identify which factors are associated with the occurrence of diseases and to predict the occurrence and trend of certain diseases. Thus, GIS can be a powerful mediator of spatial knowledge, social and political power, and intellectual knowledge in health research.

While the relevance of a GIS will vary by health conditions, its potential to contribute to health service planning and delivery in infectious disease control is significant. However, this potential has not been fully realised. In this Commentary, we put forward four ways in which GIS can contribute to improved service delivery in the control and response to infectious diseases in low-income countries: (1) deeper insight into where health care services should be located, (2) improved health surveillance and real-time planning, (3) stronger accountability mechanisms and (4) better knowledge translation. We discuss each point in turn, advancing the case for GIS to offer interdisciplinary and powerful new ways of presenting data and monitoring interventions.

**Enhanced Understandings of Access**

Access, a core concept in health service delivery and policy implementation, is shaped by geographic conditions. By access we mean the degree of fit between a client and a health service as determined by the availability, affordability, accessibility, accommodation, and acceptability of a service. Social and geographic conditions are implicit in all five dimensions, framing the logistics of using a health service and the capacity of the service to offer high quality care.

Two dimension of access—availability and accessibility—are directly addressed by GIS. Availability refers to the location of health services, accessibility to geographical barriers such as travel time, transportation, travel costs, and distance. In term of availability, GIS can be use to visualize the location of health services to identify appropriate locations for health services. For accessibility it can measure distance or travel time between available health services and the consumers. These measures can incorporate factors such as topography, weather patterns, availability of transport vehicles, distance to the health service, and state of transport infrastructure, which are especially salient
capacity building and training, cross-country and global collaborations for infectious disease surveillance are some of the ways in which a GIS is being implemented within and across low-income countries.

To conclude, there is increasing need for tools such as GIS to be integrated into health systems and used by multidisciplinary teams. This helps to ensure that technologies such as GIS do not become novelties in themselves restricted only to the research domain. As was called for at the Global Ministerial Forum on Research for Health in Bamako, Mali, there is need to "harness the potential of research by drawing on new sciences, emerging technologies, and social and technological innovations to address priority health challenges" to reduce health inequalities and create effective and responsive health systems in practice.

Competing Interests

The authors declare that they have no competing interests.

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