Spatial Decision Support Systems for Optimizing Health Services Delivery

Ajit N. Babu[a], Engelbert Niehaus[b], Gerhard Ackermann [b]

[a]*Division of General Internal Medicine, Saint Louis University School of Medicine, St. Louis, MO, USA*
[b]*University of Koblenz-Landau, Campus Landau, Institute of Mathematics, Germany*

Abstract and Objective

Disparities in health services delivery are a world-wide problem. Providing solutions, on the other hand, is a great challenge. Even in the best of circumstances, community needs will outstrip resource availability, not only in developing countries but also in the developed world. Resource optimization is therefore of vital importance. Particularly when considering the problem of infectious diseases, control and response can be greatly enhanced through the creation of an informatics scaffold that would ideally be generalizable and based on open source resources to permit the greatest possible distribution, adoption and sharing of knowledge. This poster will present a description of the methodology and current status of the work on creating a multimodal SDSS which incorporates Geographic Information Systems (GIS), dynamic risk mapping, remote sensing and advanced modeling techniques for addressing mosquito-borne infections in Third World settings. Modeling techniques are currently being refined, variables defined and international collaborative relationships fostered. Pilot sites for data collection have been identified.

Keywords: *Mosquito control; decision support techniques*

Methods

The proposed project is based on the concept that a multidisciplinary informatics scaffold can serve as an Early Warning and Automated Response System (EWARS) for a variety of communicable diseases, in the first instance, those transmitted by mosquitos. It will utilize multiple information resources including Remote Sensing, Global Positioning Systems (GPS) and Geographic Information Systems (GIS) with appropriate methodologies to store, process and visualize the products of these multilevel information sources. Early warning systems for mosquito-borne diseases are not new. However, what is novel is the integration of an adaptive Fuzzy Logic Decision Support System to the early warning component. It also markedly differs from other efforts to provide "decision-support" in the unique degree of detail and process guidance delivered. It would create an automated dynamic risk map followed by the generation of highly specific advice to the public health authorities on which threat(s) to address as the highest priority, and the step by step process that should be followed in terms of allocating human resources, sanitation measures, chemicals or biological agents and so on, tailored to the level of the actor receiving it as well as to a comprehensive database of existing resources within the public health system. The informatics component of the system would be based entirely on open source software, and the software developed during this project will also be in the open source domain, extending the generalizability of the scaffold.

Modeling techniques are based on mathematical measure theory that creates density function as a graph in a GIS layer. Layers of risk and resources are linked by Fuzzy Logic that spatially operates on the GIS layers. GIS layers are generated by variables that are specific to the disease.

The collaborative group includes physicians, mathematicians, logisticians, epidemiologists, computer scientists, entomologists, remote sensing experts and social scientists drawn from the United States, Germany, India, South Africa and Canada. This collaboration has evolved under the umbrella of the United Nations COPUOUS Action Team 6 (AT6) which looks at ways of using space-based technology to improve public health, particularly relating to communicable diseases.

Results

An open source infrastructure based on widely used systems like GRASS, R, Medical and OpenMRS will make the modeling replicable and modifiable without commercial limitations. Modeling techniques are currently being refined, variables defined and international collaborative relationships fostered. Pilot sites for data collection have been identified in Kerala, India. Dengue, Chikungunya and Malaria are the first disorders that will be modeled.

Conclusion

Prophylactic public health interventions to be rapidly deployed based on a real-time, scientifically-based assessment of the threat environment to minimize the risk of even small outbreaks which could presage a full-blown epidemic.