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Editor's Summary

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INFORMATION TECHNOLOGY

Geomapping Health-Related Data

Saleem Sayani

In August 2011, scientists and policy-makers held a conference entitled "Using IT to Improve Community Health: How Health Care Reform Supports Innovation." One of the conference sessions was entitled "Geo-mapping: Framing health needs and issues as an individual and community concern." This meeting report describes how geographical information systems can be used to analyze health-related data for medical care and policy making.

INTRODUCTION

The Maryland Department of Health and Mental Hygiene (DHMH) (*1*) is located in downtown Baltimore just a few long blocks from the Camden Yards baseball facility. This juxtaposition spurs the obligatory reference to the "if you build it, he will come" quote from the 1989 film *Field of Dreams*. However, instead of larger-than-life historical sports legends appearing in a cornfield, this "data fields of dreams" has drawn to the inner city a team of seasoned professionals from the information technology (IT), geographical information systems (GIS), and public health arenas who together have scored a health-care home run with their priceless data collection. When expressed in a map display, these seemingly sterile and often isolated statistical health data suddenly become immediately useful, co-relational information systems that health planners can use directly to modify programs that affect community and individual health care in such a way as to improve health outcomes.

Recently, as chief information officer (CIO) of DHMH, I was honored to participate in the U.S. Clinical and Translational Science Awards national conference on IT and community engagement. In the Think Tank session entitled "Geo-mapping: Framing health needs and issues as an individual and community concern," members from a variety of institutions (*2*) showcased their approaches to the geographical mapping of health data. The participants then worked together to synthesize their approaches with the goal of developing strategies to move existing archived health data to useful geocoded display for immediate consumption and use by planners and providers. Here, I describe DHMH's progress in designing an interactive geomapping resource for the analysis of patient data.

DHMH: ENABLING EXPERIENCE

Although GIS has been used in the past to support community development and military and industrial operation, it has only been in the past decade that geocoded health and population data have been widely used in health planning. Historically, the responsibility of GIS has most frequently been vested with highly technical spatial data wonks. DHMH is perhaps an anomaly among this group, with the agency's IT unit taking the lead in GIS to develop partnerships with the data collectors in the program units. This initiative occurred under the direction of the agency's then CIO, Arthur Thacher, an epidemiologist and 30-year veteran county health officer who recognized the translational power inherent in spatial representations of health data.

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When I became the DHMH CIO in 2010, I made use of the unique placement and potential of GIS in the agency and the dedicated resources needed to move from a static display of geographically organized health data to an interactive, spatially organized health data service. Accurate and timely data that could be manipulated in real time empower planners and analysts to move beyond the static display. Dynamic data presentation also significantly increases confidence in the data and projected outcomes as various scenarios are played out (for example, changing clinic location to improve access to health care).

Our first task was to move from a specialist-consultant approach to a full GIS service-based role. Staff worked with owners of patient data, such as our Disease Outbreak and Environmental Health programs, to consume and spatially present their data with myriad variations and enhanced depth. Once envisioned, the GIS unit provided data owners with a core of basic services that include geocoding [(the process of finding geographic coordinates, often expressed as latitude and longitude, that are associated with accurate map location), static maps (via Web pages, view-only data with no animation or interactivity)], geospatial analysis (applying statistical analysis and other analytical techniques to geographically based data to solve a problem or answer a question), and dynamic mapping applications (created on demand, each often from dynamic data sources such as databases).

Within a short period of time, we tested an initial set of GIS products in the field with data from the state of Maryland on HIV infection rates, asthma hospitalizations, cases of rabies, and the "Babies Born Healthy" initiative (birth defects).

Our HIV GIS application, which uses the open source Adobe Flex application development software, plots total adult (age 13+) HIV infection rate test results by county and zip codes (Fig. 1). Data are broken down further at the county level by gender (adult males, adult females) and race (Caucasian, non-Hispanic, black non-Hispanics, and Hispanic). The map also contains active links to information on all current HIV testing sites. With this application, the end user can view data by gender and race at the county level and identify sub–county-level geographical areas in which HIV cases are prominent (as opposed to generalizing an entire county as having an elevated HIV infection rate). Conference attendees expressed interest in the HIV application, and we offer freely the shell of this application to other entities that have similar data that they wish to display on their maps in this spatial venue.

Rabies always holds intense public interest. The rabies tracking application shows the number of cases of rabies in Maryland residents and the percentage of positive rabies tests administered in the state for the years 2000 to 2010 by county. We also show which counties have the most positive cases of rabies in humans and the distribution of animals with positive rabies status. The asthma application shows asthma hospitalization counts, age-adjusted rates, and confidence intervals by

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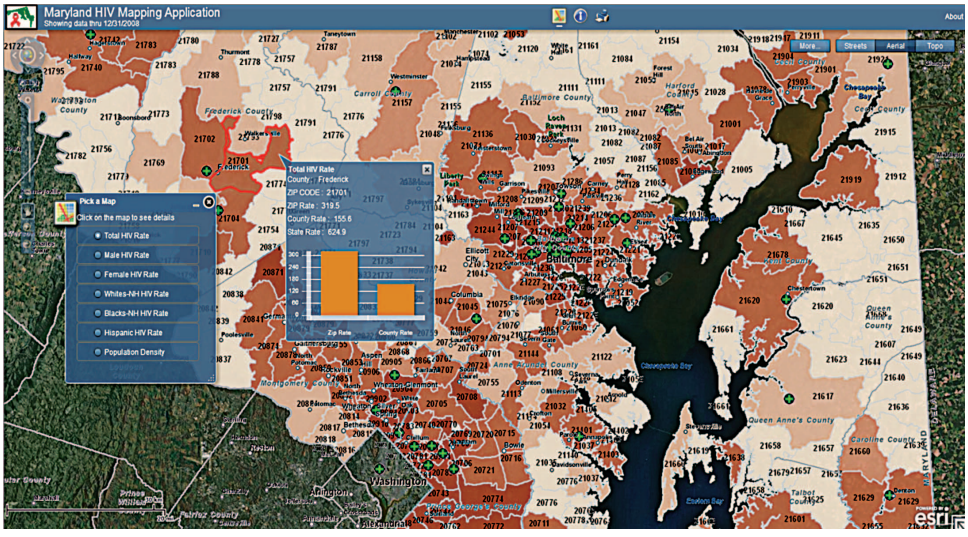

Fig. 1. Mapping Maryland health (Copyright 2010 by Maryland Department of Health and Mental Hygiene).

county for the years 2000 to 2008, with histograms of age-adjusted rates that indicate the asthma status in user neighborhoods.

Our Maryland Health Shortage application gives a heads up to the public and to policy-makers with easily understood graphical depictions of medically underserved areas, underserved populations, and regions with a shortage of primary care, mental health, and dental health professionals. The application also identifies and locates federally qualified health centers and hospitals, local health departments, and facilities with a shortage of health professionals. Our birth defects application depicts the incidence of four birth defects (trisomy 21, anencephaly, spina bifida, and cleft lip) by county and by year.

HITTING IT HOME

Although technology is an enabler, it cannot replace face-to-face discussion in small groups. Indeed, the conference succeeded in identifying questions that remain, concepts yet to be addressed, and problems yet to be solved with respect to GIS applications. A few issues for continued discussion include the following:

Data sourcing: From where are the data drawn?

Data currency: Data are usually not current, and obtaining data is a challenge.

Data quality: Efficient mechanisms for verification and validation of public-provided data are needed.

Funding: Creation of a business case helps in procurement of funding.

Community advocacy: Do community and patient advocates use these services?

Communication: Get the word out on what we are doing and share the applications.

Develop a GIS philosophy: Currently, we depict data by disease. Can we select a disease and display related and confounding factors on the map (for example, in the rabies application, the size of the raccoon population)?

GIS resources: To support a GIS application in-house, an agency needs one or two full-time GIS professionals. Another option is outsourcing to a vendor. A cost-benefit analysis of internal versus vendor-derived GIS services is needed.

Health Insurance Portability and Accountability Act–related issues: All federally defined patient protected health and personal information is redacted. If such geographical applications were applied to a small rural area, different approaches are needed to ensure confidentiality and would have to be approved by an agency review board.

By addressing these issues, we are confident that a closely coordinated GIS program can positively affect health-delivery programs. To meet this goal, the program must be internally marketed to health planners and key decision makers, accommodate user-defined layers, and allow user control over other variables. We are off to a good start. The DHMH infrastructure is built on a sophisticated, scalable, robust, and cutting-edge technology that allows for powerful geospatial analytics online.

In the future, our Office of Information Technology plans to enable more analytical capabilities in its online portals to allow for dynamic predictive analysis and what-if scenarios based on existing data. However, none of our collective technical approaches will be successful if we do not establish a vision for a sustainable and supportable enterprise GIS that is functionally integrated into our state GIS efforts. To this end, scientists and policy-makers must develop and follow project plans and enlist the participation of data owners and custodians as equal partners in a shared GIS strategy with a well-defined end game.

REFERENCES AND NOTES

1. Department of Health and Mental Hygiene, http://www.dhmh.state.md.us
2. Participants in the Think Tank session on geomapping were the U.S. National Institute of Mental Health, University of Kentucky, Children's Medical Center, U.S. Air Force, University of South Carolina, Kaiser Permanente, University of Oregon, Harvard Catalyst, Boston University, College of Wisconsin, Duke Center, University of Minnesota, University of Alabama, and University of Arkansas.

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