Curbing Catastrophes With Analytics: How the CDC is using BigData and electronic health records for disaster planning

By Esther Shein HP INPUT/OUTPUT Feature Article: May 02, 2012

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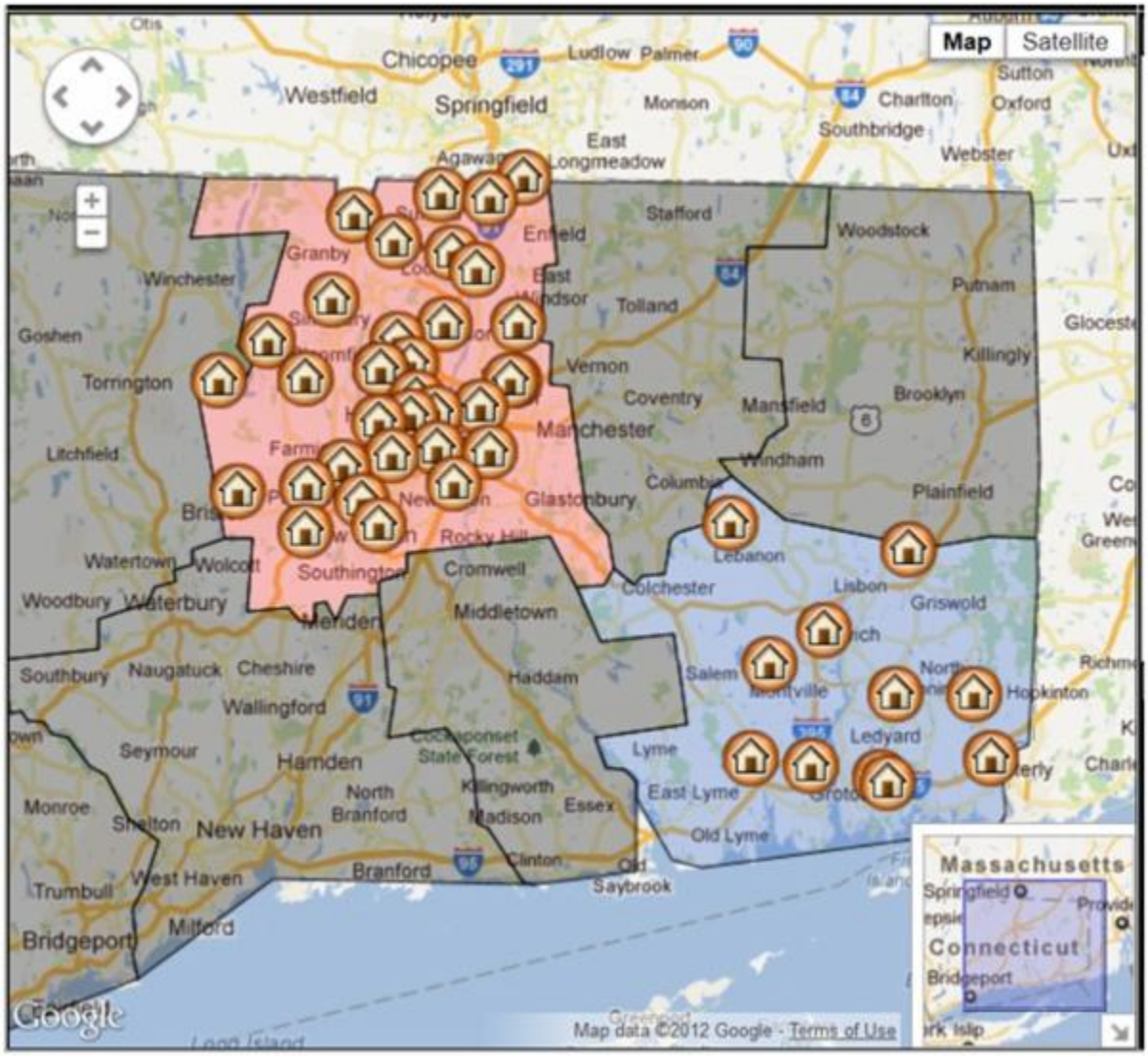
Technology is being used more frequently to save lives, whether in surgery, to safeguard the elderly , or now, in the event of a disease outbreak during a catastrophe. Faced with the potential for mass casualties, emergency managers have to make critical decisions rapidly to assess the affected populations, determine the location and size of treatment distribution facilities, appropriately staff those facilities with adequately trained personnel, and provide them with needed medicines and supplies.



The U.S. Centers for Disease Control and Prevention (CDC) has partnered with a research team at Georgia Institute of Technology to produce a modeling tool to help health personnel with the challenge of mass dispensing of medical supplies in an emergency. The software, known as RealOpt , has decision support capabilities for modeling and optimizing the public health infrastructure for hazardous emergency response. It is designed for use in biological and radiological preparedness, for disease outbreaks planning and response, and for natural disasters planning. RealOpt helps officials plan for dispensing facilities locations, to ensure optimal facility staffing and allocation of resources, including routing of the population and dispensing modalities, according to Eva Lee, a professor at the School of Industrial and Systems Engineering at Georgia Tech, and director of the Center for Operations Research in Medicine and Health Care at the school.

Although officials say extensive resources have been devoted to planning for a worst-case scenario on the local, regional, and national scale, the U.S. Government Accountability Office (GAO) found that there are still gaps. While many states have made progress in planning for

mass casualty events, according to the GAO and CDC , many still have concerns. Primarily among these are operational efficiency, system flexibility, and maintaining adequate staffing and accessing resources necessary to respond effectively.

Since the Anthrax attacks in 2001 , the U.S. federal government has spent over $70 billion on population protection, in particular on rapid detection of outbreaks and on mass dispensing of prophylactic medical countermeasures to contain biological/pandemic incidents, according to the CDC. Despite all the money spent, officials say there is little actual experience or first-hand knowledge to call upon when rare (and potentially catastrophic) events occur. The agency knew it was critical to have a powerful and realistic math modeling and real-time decision support system for training and planning.

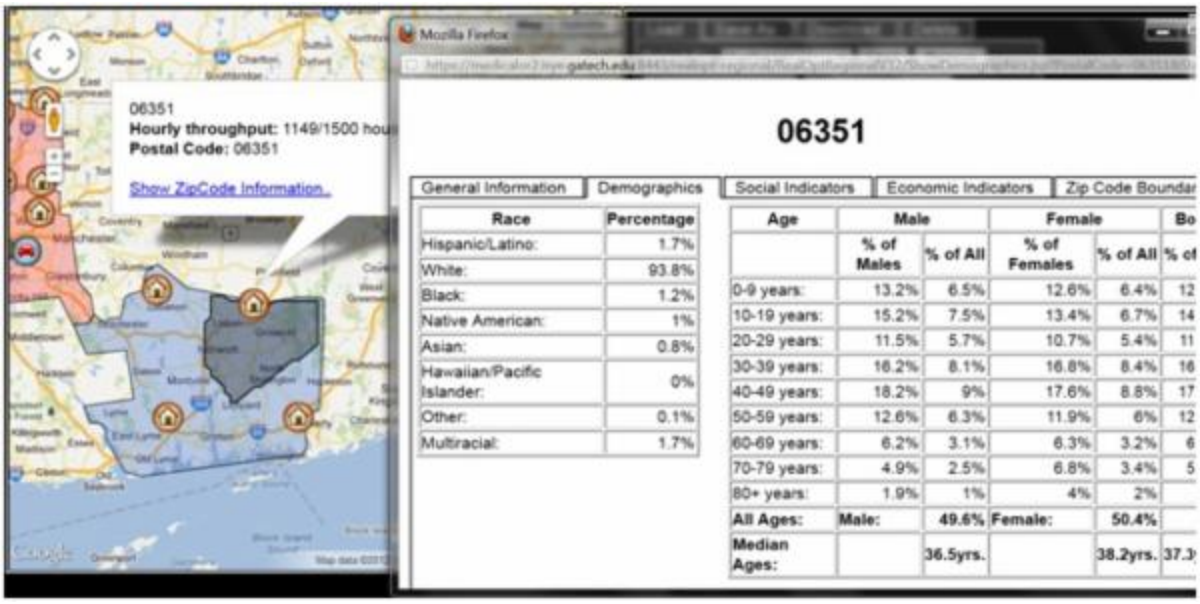
“If you don’t receive treatment within 48 hours of exposure to Anthrax, the mortality rate could be as high as 90%,” depending on how the spores are spread, notes Lee. “It’s a very high and very dangerous biological agent.”

Lee was first contacted by the CDC in 2003 for her expertise on large-scale math and systems modeling and scientific computing after an unsuccessful effort on its part to integrate various commercial systems into “a cohesive planning system.”

RealOpt combines several modeling techniques. It has novel and large-scale computational engines, sophisticated graph-drawing tools, 3D geographical spatial information, including census data, demographic and socio-economic data and policy analysis. Almost all of the data are real-time feeds fetched from online sources, such as the 3D geographical spatial information and the real-time traffic. The density of population and the 2010 census data is stored by Georgia Tech on its server, and includes information including demographics, socio-economics, and language.

The project addresses the Department of Homeland Security’s presidential directive requiring plans, procedures, and policies to recover from major events and render appropriate public health and medical response to mitigate the effects of illness and injury, and limit morbidity and mortality to the maximum extent possible, Lee says.

The system’s two main components for biological and pandemic responses are RealOpt-POD (Point of Dispensing), used by emergency response coordinators, and RealOpt-Regional, for regional response commanders, says Lee. RealOpt-POD has a large-scale simulation engine, rapid optimization solvers, and an interactive, analytical graphical user interface so public health emergency planners can design a clinic layout the way they want it to look. Then the system automatically translates the various processes inside the clinic into mathematical models on the back end, where the simulation and optimization engine are integrated together, says Lee.



“We simulate the movement of all the people inside the clinic,’’ explains Lee. “So if you have 100,000 people you have to treat, the model simulates the patient flow inside and then it optimizes the worker usage” in order to get the highest possible number of people receiving medication, thereby saving lives. With RealOpt-Regional, users can select their state and counties and enter addresses as well as the population coverage to determine such information as travel distance to potential POD sites, physical capacity limits of each POD, and the time it takes to complete the dispensing of medication to the entire region.

Lee says users can enter different parameters into the system, which analyzes “what-if” scenarios and “runs in seconds” before returning results. Data is input into the system manually as well as received in real-time feeds, she says.

“RealOpt has been used in hundreds of drills and dispensing events, including anthrax preparedness events and seasonal flu/H1N1 vaccination events, and has accurately predicted staffing needs and dispensing operations,’’ wrote Lee, in a summary on the technology, which was a finalist for the INFORMS 2012 Franz Edelman Award for Achievement in Operations Research and the Management Sciences. Before–and-after studies were conducted by the agency and George Tech researchers on a sample of 12 events, with populations ranging from 128,000 to 4,023,000. Two events included dispensing medical countermeasures for H1N1, four involved seasonal flu vaccination, and six involved dispensing oral antibiotics. Data was collected to determine how many workers were used and how many people were processed. “With the use of RealOpt, throughput efficiency was improved by 175% to 1,000%, while staffing needs were reduced by 31.6% to 84.5%,’’ according to Lee’s summary.

Currently there are over 4,000 sites using RealOpt. Lee believes the system’s potential significance is profound, since it removes the operator-dependent aspect of planning, and has the ability to establish standard quality assurance guidelines for emergency response. CDC officials credit the system with providing better overall coordination, resulting in reduced staffing needs

and helping policy makers better prepare for a catastrophic event and more efficiently deploy available resources.

With RealOpt, “We will see 90% fewer people die as a result of certain biological events in the United States,’’ said Greg Burrel, director of the CDC’s Division of Strategic National Stockpile, speaking at the recent Edelman event. “I think the fact that we have created a system that allows people to save lives impacts society on an incredible level.”