Esri News
for Health & Human Services
Summer 2012

Bug Wars

A Mobile ArcGIS Software-Based Geospatial Application Helps Control Mosquitoes

By Mike Schwartz, Esri Writer

Mosquito-borne diseases pose an ongoing threat to people's health. Worldwide, more than 1 million people die and 700 million more are infected each year by some type of disease that mosquitoes carry. Many of these same illnesses, such as West Nile virus, already exist in the United States, and others may be winging their way stateside aboard the next arriving airliner.

Consequently, city, state, and federal public health officials are constantly on the lookout for the most effective and efficient mosquito-control methods, including those that use Esri ArcGIS technology, to reduce the number of disease outbreaks or aid in an emergency response should an outbreak occur.

Eddie Lucchesi, assistant manager of the San Joaquin County Mosquito and Vector Control District in California's Central Valley, recalls the days before GIS when mosquito control field technicians and their supervisors worked mostly with pencil and paper, hard-copy map books, and spreadsheets to meet operational and regulatory →

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Geographic Information Systems: A Way of Life

From My View . . .

Bill Davenhall, Global Manager,
Esri Health and Human Services

The term *GIS* means many different things, depending on what you actually do with it. Most GIS practitioners know GIS as an information technology that integrates geographic data (or data that is geographically relevant). Like many other types of information technology, GIS requires specialized terminology, methodologies, and techniques. If you're a consumer of information that is generated by a GIS, then you probably know very little about how it works, how maps are made, or how geographic analysis is done. Of course, around the world, there are many more consumers of GIS products and services than GIS practitioners—maybe something like one GIS practitioner to 100 million consumers.

While the use of GIS across all sectors of the health and human services market has steadily increased over the past decade, much of it has been to support research projects and scientific inquiries about the relationships between various factors associated with identifying disparities, measuring variation in health and social outcomes, and tracking disease vectors associated with the spread of infectious disease. The use of GIS in this sense has contributed a great deal to understanding problems, identifying challenges, and informing policy decisions. Not too shabby a contribution, I would say!

But the challenges are changing, and so is geospatial technology itself. GIS is becoming just another part of the larger process—whether it's research, service planning, logistic analytics, policy making, or emergency response. GIS has become the glue that makes the information we get useful and actionable. How we use the information that is generated by a GIS now takes center stage. What a doctor is to disease, GIS is to the context of our lives. Making sure that the GIS is delivering contextually rich information—useful to problem solving, setting health and social policy, making decisions, and increasing the overall value of life—is now the challenge.

But some things never change. GIS changes lives—from children who learn about the technology and decide to make GIS a career to entire communities of people who are warned in advance of an approaching storm. The list is long because it's a technology that invades our thinking about problem solving and feeds our curiosity about the world around us. In 2012, we have seen the four billionth smartphone sold and the 25 billionth Apple Store application downloaded. And amid the tsunami of new information that these smartphones have delivered, the most frequently used information is geographic—ranging from getting maps and directions and locating stores and hospitals to tracking changing weather conditions and managing health and social outcomes.

This is why I like to say that GIS is a way of life and not simply another information technology. GIS has the intrinsic power to change the way we think and act about the world around us as well as help us live better and more meaningful lives. There are many great GIS challenges yet to tackle in the health and human services sector, such as reducing service gaps, predicting human need, preventing fraud, predicting service utilization, and ensuring service accountability. The best and highest use of GIS is yet to come.

This is the last column I will author in my role as the health and human services industry manager at Esri, as I will retire in January 2013, allowing more time for pursuing special projects such as geomedicine and three grandchildren. Christina Bivona-Tellez, RN, MPH (featured on page 8), is currently coleading our team in preparation for this transition. Please welcome her and seek her participation in your GIS journeys, as she will certainly bring a new perspective to helping all of us realize the great promise of GIS to health and human services.

I have appreciated your second opinions over the years.

> "Making sure that the GIS is delivering contextually rich information—useful to problem solving, setting health and social policy, making decisions, and increasing the overall value of life—is now the challenge."
>
> Bill Davenhall

Esri on the Road

Association of State and Territorial Health Officials (ASTHO) Annual Meeting and Policy Summit
September 11–14, 2012
Austin, Texas USA
www.astho.org

American Public Health Association (APHA)
140th Annual Meeting & Exposition
October 27–31, 2012
San Francisco, California USA
www.apha.org/meetings/highlights

Save the Date

Healthy Communities by Design Summit

When	October 1–2, 2012
Host	Loma Linda University School of Public Health
Where	Loma Linda University Centennial Complex (4th floor), 24760 Stewart Street, Loma Linda, CA 92354
Web	www.llu.edu/public-health/hcbd
Highlights	Sponsored by Loma Linda University School of Public Health, the third annual Healthy Communities by Design Summit will bring together a unique cross section of key leadership in policy, industry, and academia. Experts in the fields of health promotion, preventive medicine, environmental health, community planning and design, and policy will discuss the built environment and health. Key outcomes will include discussions on ways to improve existing initiatives and the future of building healthy communities.
Keynotes	Dr. Richard Jackson, MD, MPH, Chair of the Environmental Health Sciences Department, UCLA
Inquiries	Call 909-558-8072, ext. 88072, or e-mail swiafe@llu.edu.

New Manager Joins Health and Human Services Marketing Team

By Bill Davenhall

↑ Christina Bivona-Tellez, RN, MPH

Please help me welcome Christina Bivona-Tellez to Esri. Christina is the newest member of the health and human services marketing team, joining our staff as manager and health team lead. Onboard since early January 2012, Christina already has begun to ramp up and strengthen our team and accelerate our marketing efforts. As many of you already know, I will step out of my role in January 2013 and will be transitioning my team duties and relationships to Christina over the next several months.

Christina joins us after a stunning 20-year career as a health care professional with roles in nursing administration and public health and, most recently, having acted as regional vice president of the Hospital Association of Southern California. She is experienced across many areas including hospital operations, in both for-profit and not-for-profit sectors; nursing administration; community development; government and public relations; and public and behavioral health. She also has experience in many areas critical to our future growth, such as health information exchange, electronic medical records, quality performance, outcome measurement, and workflow management. Christina's extensive experience in the health industry equips her to work effectively with our customers and prospects—physicians, hospital directors, community public health organizations, academic medical center managers, social services, and not-for-profit organizations. She is a leader in an industry that continues to grow.

Christina earned her nursing degree (BSN) from Alfred University, New York, and holds a dual master of public health degree in maternal and child health and public health nursing administration (with a concentration in international and global health) from the University of North Carolina, Chapel Hill.

Before moving to Redlands, California, in 1990, Christina had lived and worked in New York City; Macon, Georgia; Vienna, Austria; Quito and Colta, Ecuador; Vicksburg, Mississippi; and Charlotte and Chapel Hill, North Carolina. Christina resides with her husband, Norb; their two children; and two rescue Labrador retrievers, Molly and Sadie.

Christina can be reached at CBivona-Tellez@esri.com or 909-793-2853, ext. 7940.

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→ requirements for keeping track of how much chemical pesticide was disbursed in different areas and exactly where.

"Of course it was all transcribed into a computer program, which meant job security for some, but it was much more laborious," Lucchesi said.

More Precise Alternative

About five years ago, San Joaquin County Mosquito and Vector Control District joined many other abatement agencies nationwide that had discovered an innovative, time-saving, and more precise technology for combating mosquitoes.

Electronic Data Solutions (Elecdata), a distributor and system integrator of field data collection instruments, has heeded the call for better mosquito control methods. Founded in 1986, the Jerome, Idaho-based company already had been specializing in field data collection solutions for mosquito abatement since 2004.

Sentinel GIS, a system from Elecdata that is based on Esri's ArcGIS, provides state-of-the-art technology to public health agencies nationwide, mainly mosquito and vector control districts charged with getting rid of these dangerous, disease-carrying pests.

Sentinel GIS allows control personnel to take GIS information seamlessly into and from the field via four application modules:

- Larviciding or spraying of standing water bodies with mosquito larvae or pupae present—Field inspectors download previous inspections, maps, and GIS layers into handheld units, then navigate to water bodies needing inspection. The module allows users to map a site, recording spraying applications along with efficacy dates, which they can later use to schedule follow-up visits.
- Adulticiding, used to control adult mosquitoes with ultralow dose spraying—The application manages treatment activities to efficiently schedule personnel and equipment while minimizing chemical usage and costs.
- Surveillance for collecting data on adult mosquitoes—A mosquito disease distribution map layer displayed in Esri ArcGIS helps managers prioritize and schedule mosquito control activities.
- Service Request—This web-based desktop application is used for creating, tracking, and reporting incoming complaints and calls for action about mosquito activity.

> "Sentinel GIS has allowed us to avoid duplicating what's done in the field. We now could download the work of the technician versus having to go through another data entry person back in the office."
>
> Eddie Lucchesi, Assistant Manager, San Joaquin County Mosquito and Vector Control District

Modules can be added when an agency is ready to implement new control methods. All four applications use a similar process to prepare, collect, and report mosquito control data.

Less Paper, More Accuracy Needed

The federal Clean Water Act of 1972, passed to restore and maintain the chemical, physical, and biologic integrity of the nation's waters, spurred the development of safer, integrated pest management programs that include information systems such as Sentinel GIS. Authorized by this law, the National Pollutant Discharge Elimination System (NPDES) permit program called for ever-more stringent reporting to the Environmental Protection Agency and other government bodies of where, when, and how much of these chemicals are disbursed.

By using Sentinel GIS and GPS coordinates corresponding with property ownership boundaries, the county can easily identify exactly where that [spraying] material goes according to Lucchesi. "This meant that technicians not only could better comply with federal and state reporting regulations but also save on chemicals," he said.

Elecdata conceived the Sentinel GIS system as a "complete solution for recording and managing data critical for controlling mosquitoes," said Linda Dean, Elecdata's co-owner and vice president of marketing and sales. "Everything you need is included in an easy-to-use mobile GIS software package that allows you to streamline your mosquito management program, whether your operation is small or large."

Choice of Modules and Mobile Devices

Sentinel GIS's specialized functions and toolbars are embedded within ArcGIS and ArcPad. Maps and GIS databases are immediately updated with information related to the four software modules.

"We use everything they have with regard to larviciding and adulticiding," Lucchesi said.

↑ San Joaquin County mosquito control technician Richard Capuccini sprays mosquito larvae in a dairy pond, a process called larviciding.

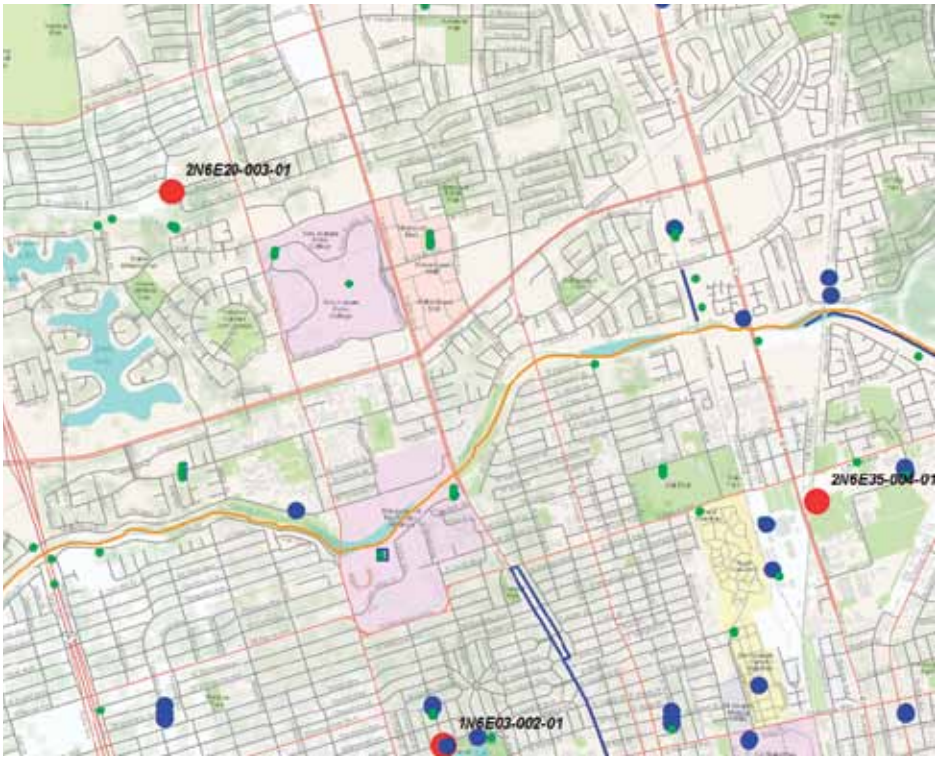
↑ San Joaquin County mosquito control supervisor Brian Heine collects mosquito larvae samples from a lagoon that abuts a subdivision. Obtaining a larval count from water samples is part of surveillance work.

"ArcGIS Supervisory Tools help the supervisor create and manage the forms that field technicians use on mobile GPS devices. The field forms are simple to fill out, yet the power of the ArcPad mobile GIS software remains behind the scenes," said Chad Minteer, Elecdata's mobile GIS software solutions manager.

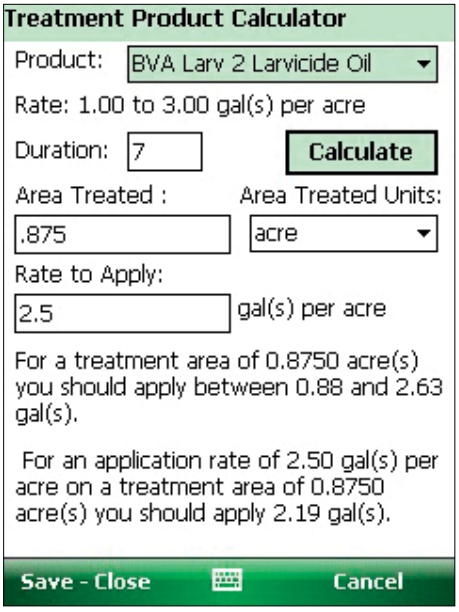
What's more, a handheld GPS with navigational features allows technicians to easily take maps into the field and get to the right location. Transferring the data to and from ArcGIS is streamlined by the automated functions for transferring and merging data provided by DataLink GIS. Back at the office, maps and GIS databases are immediately updated, reports are quickly generated, and important analyses are performed.

A key feature of the system is its ability to tell the technician where not to spray, Minteer said. "These can be areas off-limits due to regulations, organic farms, beehives, or people who just opt out," Minteer said. A mobile device can give a technician—sometimes on foot but most often in a vehicle—an automatic warning to shut off the sprayer.

For more information, contact Linda Dean at Linda@elecdata.com or visit www.elecdata.com/sentinel/sentinel.html.



↑ Mosquito breeding sites in part of San Joaquin County, California. Map indicates mosquito breeding sites in Stockton, California, that need to be inspected or treated. The map is used to plan activities and to visually assess workload, priorities, and resource allocation.



↑ When a larval treatment is necessary, the mobile software has a built-in calculator to assist the field technician in applying the proper amount of product according to the EPA label.

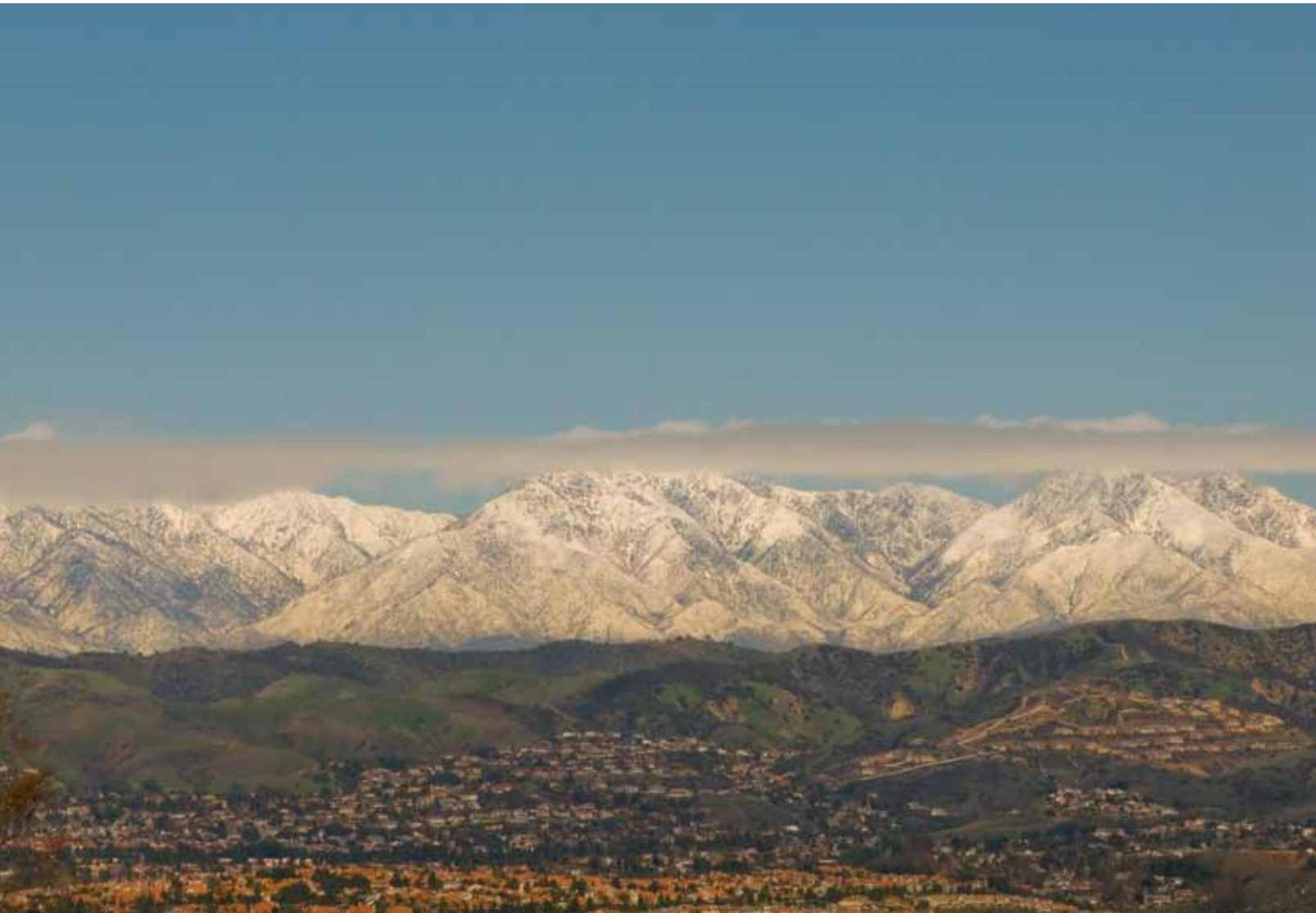
Envisioning a Community of Health, Hope, and Purpose

Civic leaders from Washington, DC, to California face a worsening health crisis publicized by the White House but manifested locally—one spotlighted by a growing epidemic of preventable health conditions linked to how we build our cities. Here's how San Bernardino, California, is facing the problem, aided by GIS.

San Bernardino, the 99th largest city in the United States with a population of 220,000, is ground zero in the battle for improving public health in California. In recent times, San Bernardino has been challenged with tackling high levels of unemployment, violent crime, lack of parks, poor food options, and air pollution. These issues have contributed in part to poor health markers that rival or exceed many other communities in California. They have also led to growing efforts among civic leaders to address underlying social and physical determinants of health.

The challenge is daunting. Mortality rates in San Bernardino far exceed those in other cities in San Bernardino County and the state of California. The average age of death in San Bernardino is 65 years, fully 8 years younger than the average of 73 in California. Preventable disease and injury are the key culprits. Compared to statewide averages, the city's heart disease rate is 70 percent higher, lung disease is 90 percent higher, diabetes is 100 percent higher, and homicide is 150 percent higher. Surveys of San Bernardino school-age children also reveal predictive markers of poor health: a large percentage of overweight students and inferior performance on physical fitness tests.

Although lifestyle choices and socioeconomic factors influence health outcomes, equally important is the quality of the environment—in other words, how we build our cities contributes to the problem, according to Mark Hoffman, senior planner for The Planning Center|DC&E, an Orange



> "We knew there were pressing health conditions facing the city [of San Bernardino]. And we suspected that the environment was a strong contributing factor. But the data needed to be connected in a coherent and compelling manner."
>
> Mark Hoffman, Senior Planner, The Planning Center|DC&E

County, California-based urban planning and environmental firm that recently completed a study of San Bernardino's health issues using Esri ArcGIS.

"We heard complaints of violent crime, lack of healthy food, liquor stores, and not enough parks. Yet the larger question was whether the poor health outcomes among city residents were related to the quality of the built environment in San Bernardino," said Hoffman, principal author of the study, City of San Bernardino Environmental Scan: A Model for Building Communities That Support Healthy Eating and Active Living.

According to Hoffman, not until The Planning Center|DC&E moved these issues out of the realm of the anecdotal and came up with measurable geospatial data was the City of San Bernardino able to correlate poor health outcomes to the quality of the city's built environment.

"Using Esri ArcGIS allowed our team to connect the pieces, tell the story, and visually communicate in a compelling manner to decision makers," said Hoffman. "Our goal was to present a clear and compelling portrait of San Bernardino's challenges that could motivate civic leaders to make bold changes in policy, systems, and the environment."

"This is the first time in San Bernardino County that a community used geographic information systems not only to map the environment but also to analyze what was contributing to the health—or lack of health—of its residents, said Angelica Baltazar, former field representative to chairwoman Josie Gonzales (San Bernardino County Board of Supervisors, Fifth District) and current health and human services industry support specialist at Esri.

New Direction Needed

San Bernardino residents, businesses, health care providers, organizations, and other stakeholders, had long known the city faced a crisis, said Hoffman. Lower quality of life and significantly increased health care costs also detracted from economic competitiveness. San Bernardino sorely needed public policies directed at the built environment and social determinants of health. These included the availability of parks, the food and alcohol environment, and violent crime.

In response to Hoffman's study, in 2010 the San Bernardino Mayor's Office and the Latino Health Collaborative spearheaded an innovative coalition called the Healthy San Bernardino Coalition (HSBC) with seed funding from the County of San Bernardino Healthy Communities Program. HSBC adopted a vision of San Bernardino as an active, engaged, and prosperous community with green and safe public spaces supporting healthy lifestyles.

Working with Claremont, California-based professional facilitators Cynthia Luna and Max Freund, HSBC provided the impetus for a growing and cohesive coalition of community organizations, schools, faith-based groups, residents, hospitals, and other partners. Within a year, HSBC grew into a broad coalition of 75 organizations—all determined to collaborate on ways to address the environmental barriers to health and wellness in San Bernardino.

Community Environmental Scan Commissioned

As a first order of business, HSBC commissioned the community environmental scan from The Planning Center|DC&E to document existing health conditions in San Bernardino and help define its agenda. Hoffman likens the scan to an MRI or other diagnostic tool—it examines the underlying aspects of the environment that influence the health of residents. However, the scan goes a step further and proposes innovative solutions as well.

↑ Framing a Healthy San Bernardino

From the beginning, said Hoffman, it was apparent how the conditions of the built and natural environment, health care access, and social factors had contributed over time to create negative health consequences. HSBC mapped out a course of action to address four key factors as part of its environmental scan.

"We asked ourselves, 'How can we use this document, the mapping, and the charts [see sidebar on page 11] to really illustrate what the problems are, citywide?'" Hoffman recalled. "We also wanted to demonstrate in a very compelling way the issues on a neighborhood scale. If we could get a consensus about the issues and disparities the city faces, it would lend more power and cohesiveness to HSBC as its members formed [its] health agenda."

To that end, the environmental scan had three purposes:

- Help civic leaders understand the health crisis facing the city of San Bernardino
- Identify features of the city's environment that influence health
- Propose evidence-based strategies known to improve the environment and residents' health

In just one year, HSBC has achieved tremendous success at raising awareness in →

Envisioning a Community of Health, Hope, and Purpose continued from page 9

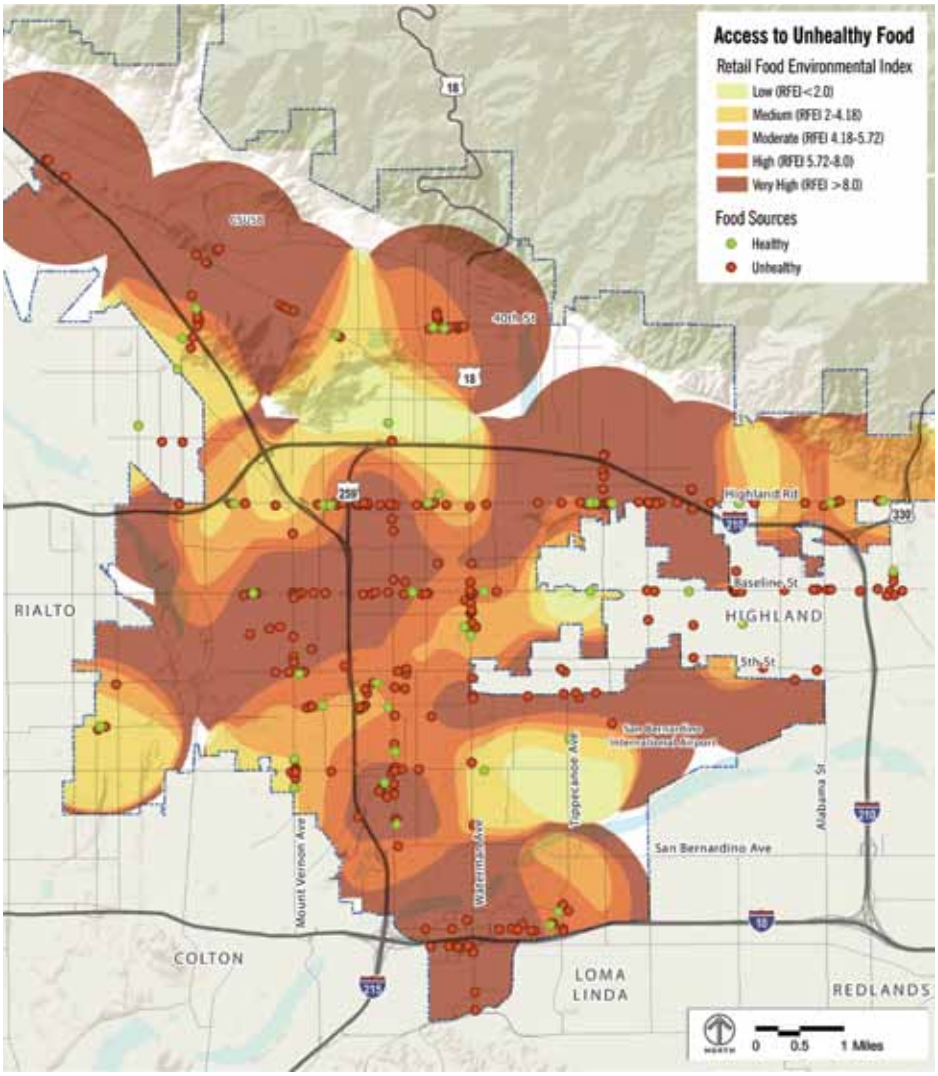
→ San Bernardino and effecting policy, systems, and environmental changes, including the following milestones:

- Creation of two new community gardens in underserved neighborhoods, including one dedicated to training and rehabilitating disabled veterans
- Adoption of city policies supporting community gardens, regulation of retail alcohol outlets, and other ordinances
- Speaking engagements at multiple health and planning conferences, both regional and national

Evelyn Trevino, public health coordinator for San Bernardino County's Healthy Communities Program, stated, "The Planning Center|DC&E has demonstrated exceptional knowledge and leadership in the Southern California healthy communities movement, which exemplifies the multisectorial analysis and collaboration needed to transform communities into places where residents can be healthy and safe."

Major Findings of the Scan

The following updated excerpt from the City of San Bernardino Environmental Scan report, authored by senior planner Mark Hoffman of The Planning Center|DC&E, summarizes key findings regarding the park, recreational, and food environments of this sprawling inland city. All the mapping data was obtained and/or analyzed with the aid of Esri geospatial technology (see sidebar). Future phases of this report will include topics such as public safety, transportation access, and air and water quality.



↑ San Bernardino has nine unhealthy-food stores for every one healthy-food store. This is double the statewide average and four times higher than healthier communities.

Park and Recreation Environment

Residents living at the base of the San Bernardino Mountains have access to broad regional park and open space amenities. Yet within urban parts of San Bernardino, the experience is altogether different. San Bernardino's system of about 40 parks provides about 447 usable acres of parkland, or 2.2 acres per 1,000 residents. However, this is less than half the city's standard of 5 acres per 1,000 residents and below the minimum 3-acre standard in California law. Meeting the state standard will require 185 additional acres of parkland. Because of the current shortage of parks, 8 in 10 residents do not have access to 3 acres of parkland within walking distance (1 mile).

Access to Bike Routes

San Bernardino has one of the smallest numbers of linear miles of bicycle trails in the county. The city's network encompasses 80 miles of planned bicycle routes, yet only 10 percent of the routes are built. Although walking can be an alternative to bicycling along the streets, many neighborhoods either have no sidewalks or the sidewalks are in need of substantial repairs, rehabilitation, or replacement.

Retail Food Environment

San Bernardino's retail food environment has long been a source of concern. Although home to many fast-food eateries, the city lacks complementary grocery stores, produce markets, and so forth. With nine unhealthy-food outlets (e.g., convenience stores, fast food) for each full-service grocery or other healthy-food outlet, San Bernardino has one of the most unhealthy food environments in California. This ratio is conservative; it does not include the city's many donut stores, gas stations, and liquor stores. Still, this is double the statewide average and four times worse than healthier communities.

ArcGIS in Scan—How We Did It

Forging a Health Agenda

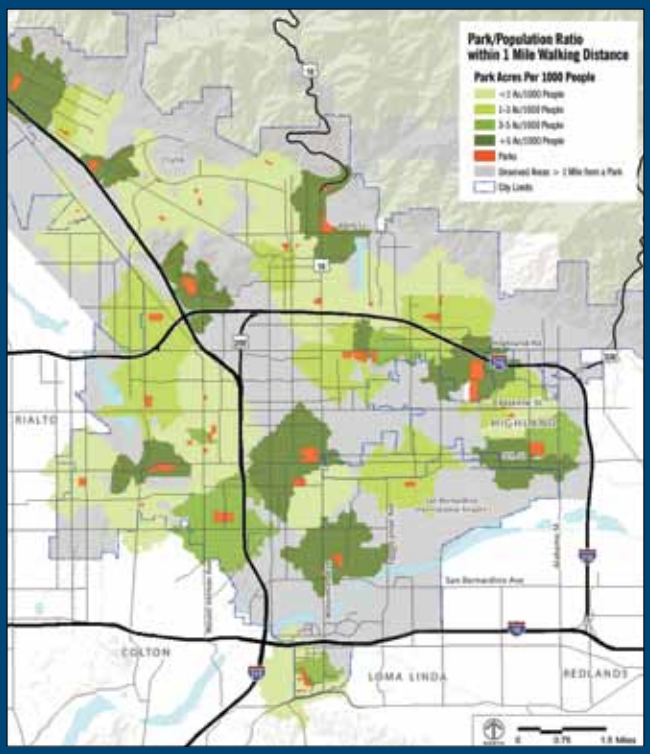
The Environmental Scan documents the answer to a simple yet profound question—Does San Bernardino's environment affect the health of the community? The answer is a resounding yes.

This study found that the city's mortality rates for heart disease, diabetes, liver disease, and other preventable diseases are significantly higher than those for the county and the state.

HSBC is actively working with the San Bernardino Mayor's Office through its policy subcommittee to change policies, systems, and the environment to improve health. Five principles for action guide this effort:

1. Pursue evidence-based strategies. HSBC is addressing all sectors—parks and recreation, active transportation, food environment, and air and water quality—with evidence-based strategies to achieve environmental change.
2. Prioritize initiatives. HSBC is targeting administrative and financial resources to prioritize initiatives consistent with its vision and make the necessary long-term investments to achieve desired change.
3. Advance health equity. HSBC is focusing on improving the health of all residents. This may require reducing health disparities in some neighborhoods, while in other cases it will involve improving the health of everyone.
4. Focus on policy change. To ensure maximum impact, HSBC is focusing on changing system-wide policies that drive local decisions and priorities wherever possible to affect the greatest number of people.
5. Maximize collaboration. HSBC is continuing to collaborate with residents, business leaders, and other stakeholders to collectively solve the challenges facing the San Bernardino community.

Esri News for Health & Human Services asked The Planning Center|DC&E to explain the basic techniques employed in bringing ArcGIS into the City of San Bernardino Environmental Scan project. GIS analyst Robert Mazur and cartographer Kim Herkewitz collaborated on the effort and discuss mapping park acres per 1,000 people:



↑ San Bernardino Park Availability Map

The idea of calculating park acres per unit of population is a well-established method for measuring the adequacy and availability of parks in a community. The original park ratio methodology was derived from early studies of the National Recreation and Parks Association [NRPA] as refined by communities across the country.

Certainly, it is a simple exercise to calculate park acres per 1,000 people for a city as a whole, but showing which neighborhoods are underserved is another story. Mapping this population-to-park-acres ratio is most appropriate for communities with good park coverage (every resident is at least one to two miles from a park). For communities with poor park coverage, a more generalized analysis may suffice.

The mapping process requires detailed park area boundaries and acreage calculations. Having this data is the key to using GIS analysis to clearly illustrate health issues that can inform and drive policy, systems, and environmental change. ArcGIS Network Analyst and ArcGIS for Desktop Advanced tools are used to run detailed analysis and calculations to obtain park-acres-per-1,000-people values for any given location within the study area. In addition to the park's polygon database, a detailed road/walking network and census block population data are needed.

Network Analyst is used to create driving/walking distance buffers around each park, and the park acreage values are migrated to each buffer. Typically, the buffer distance values vary based on park size, purpose, and available recreational amenities. For instance, community parks that draw visitors from a larger area have a larger buffer than pocket parks serving smaller areas. Once created, buffers are intersected using the ArcGIS Union tool, and acreage values are summed for overlap areas. This creates a park access analysis area showing total park acres available from any given location within a community. Areas outside the buffers are considered unserved.

Once these steps are complete, the park access analysis area is intersected with census block population, and a dissolve is run to sum total population with specific areas. There are multiple steps in this process, but the end result paints a comprehensive picture of park access for any given location within the study area.

Scientists Use GIS to Thwart Epidemic Threats

Application Supports Preparedness at Global Events Including Olympics

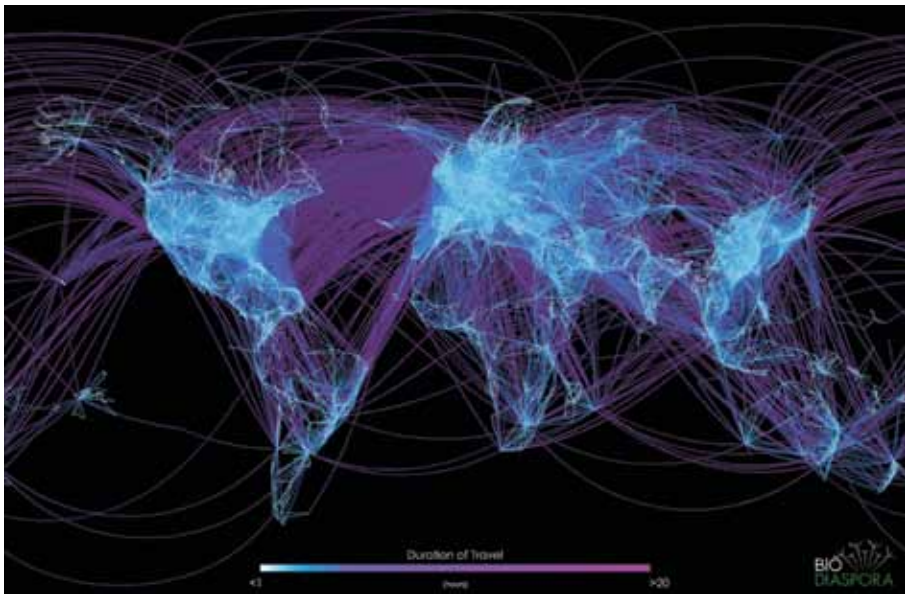
With more than two billion passengers flowing through the global airline transportation network every year, once-localized infectious disease threats can now rapidly transform into worldwide epidemics, compromising global health, security, and prosperity. An innovative research team based at St. Michael's Hospital in Toronto, Ontario, Canada, is striving to prevent infectious disease outbreaks using a novel software platform—Bio.Diaspora—designed to assist in the rapid analysis of worldwide human population movement through commercial air travel and its association with the international spread of infectious diseases. Employing ArcGIS, this high-tech risk assessment platform has aided public health experts in countries around the world and was used to enhance public health preparedness for the 2012 Summer Olympic Games in London, England.

Public health experts warn that mass gatherings such as the Olympics present potential health risks from communicable diseases not only to the host nation but also to the countries from which visiting athletes, spectators, and other travelers originate.

For instance, measles, one of the most highly contagious infectious diseases, was a notable risk at the UEFA, European Football Championships this year, as vaccination rates have dropped across Europe. In 2012 alone, more than 6,000 cases of measles have been reported in the Ukraine, a host country for the quadrennial soccer tournament. A measles outbreak after the Vancouver Olympics in February 2010 resulted in 82 confirmed cases, according to the British Columbia Center for Disease Control. Suboptimal vaccination coverage in the province contributed to transmission, the center reported at the time.

One public health expert who is vigilant in tracking the resurgence of infectious diseases is Dr. Kamran Khan of St. Michael's Hospital in Toronto, Canada. A practicing infectious disease physician and expert in globalization and infectious diseases, Khan and his research team developed and refined Bio.Diaspora, a first-of-its-kind interdisciplinary software system for rapidly generating evidence to support public

health decision making for emergent global infectious disease threats. Combined with HealthMap, an online global disease mapping and tracking tool cofounded by Dr. John S. Brownstein of Boston Children's Hospital, Bio.Diaspora at last gives researchers a real-time system to support and enhance emergency preparedness and response capabilities during large-scale international events such as sporting competitions, religious pilgrimages, economic summits, and global expositions. The system integrates and synthesizes information across a number of scientific disciplines, among them the ability to understand how humans—and, consequently, human infectious diseases—move worldwide.



↑ The global airline transportation network is illustrated by the flight pathways of all commercial flights worldwide. This image shows the interconnectivity between cities and how easy it is for people—and diseases—to get from point A to point B in a matter of hours. St. Michael's Hospital medical geographer/cartographer David Kossowsky used Python, ArcGIS, and Photoshop to create the image.

Urgent Need Born of Disaster

After Khan moved to Toronto in 2003, the local outbreak of SARS inspired him and his colleagues to develop new tools to improve pandemic preparedness and response capabilities on a global scale.

Despite the inevitability of future epidemics and pandemics like SARS and H1N1, research into the role of commercial air travel as a conduit for the spread of infectious disease has been limited. Most national and international pandemic influenza plans do not explicitly account for global patterns of air traffic and their implications on emergency preparedness and response strategies.

Literally meaning "scattering of life," Bio.Diaspora studies how infectious diseases are increasingly able to be dispersed worldwide through the movements of international travelers. A central feature of Bio.Diaspora involves understanding the global airline transportation network and leveraging knowledge of this complex "living" system to better prepare for—and respond to—infectious disease threats. To understand the interaction between global population mobility and infectious disease activity, Khan realized that GIS would be needed.

Early Successes Rewarded

Success came quickly. Bio.Diaspora accurately predicted how the H1N1 swine flu virus would spread worldwide via an analysis of more than 2.3 million international passenger departures from Mexico in early 2009. Published in the *New England Journal of Medicine*, the findings demonstrated that the international destinations of air travelers leaving Mexico were highly predictive of where cases of H1N1 first showed up around the world.

Bio.Diaspora was also used to assess global infectious disease threats during the 2010 Vancouver Winter Games, the World Cup, and the Hajj (the annual worldwide pilgrimage of millions of Muslims to Mecca), as well as infectious diseases around the world.

What is significant about this project is that it has led to the creation of a system that can rapidly integrate and analyze information about global infectious disease threats with numerous complementary data sources, including worldwide air traffic patterns. This capability allows countries to anticipate future events and subsequently adopt proactive measures to prepare for an outbreak before it occurs.

Research findings from Bio.Diaspora's first report in 2009 were compiled into a 122-page document for the Public Health Agency of Canada entitled An Analysis of Canada's Vulnerability to Emerging Infectious Disease Threats via the Global Airline Transportation Network.

St. Michael's Hospital was selected as a 2011 laureate for innovation by the International Data Group's (IDG) Computerworld Honors Program. The annual award program honors visionary applications of information technology promoting positive social, economic, and educational change. Bio.Diaspora was selected from over 1,000 international entries, joining more than 250 others from 23 countries as winners in the 2011 program.

"Bio.Diaspora exemplifies the highest goal of GIS, which is to benefit society," said Alex Miller, president, Esri Canada Limited, of the accomplishment. "The system helps protect the health of the entire global community by allowing countries to get ahead of the curve in detecting and preventing disease outbreaks before they even reach an airport. We commend St. Michael's Hospital for its innovation in using GIS to advance overall human health. We're proud to have provided the hospital with the technology to enable its vision."

As a winner, the Bio.Diaspora case study will become part of the Computerworld Honors International Program archive, which is available to researchers, students, and scholars via cwhonors.org and through digital records housed in national archives in over 350 universities, museums, and research institutions worldwide.

Khan said he was honored by the recognition but quickly noted that the hospital's goal—in collaboration with partners at Ryerson University and Harvard Medical School—has been to leverage GIS technology →

 continued from page 13

"Real-time integration of web-based infectious disease surveillance, combined with knowledge of worldwide patterns of commercial air traffic, could significantly enhance global situational awareness of infectious disease threats."

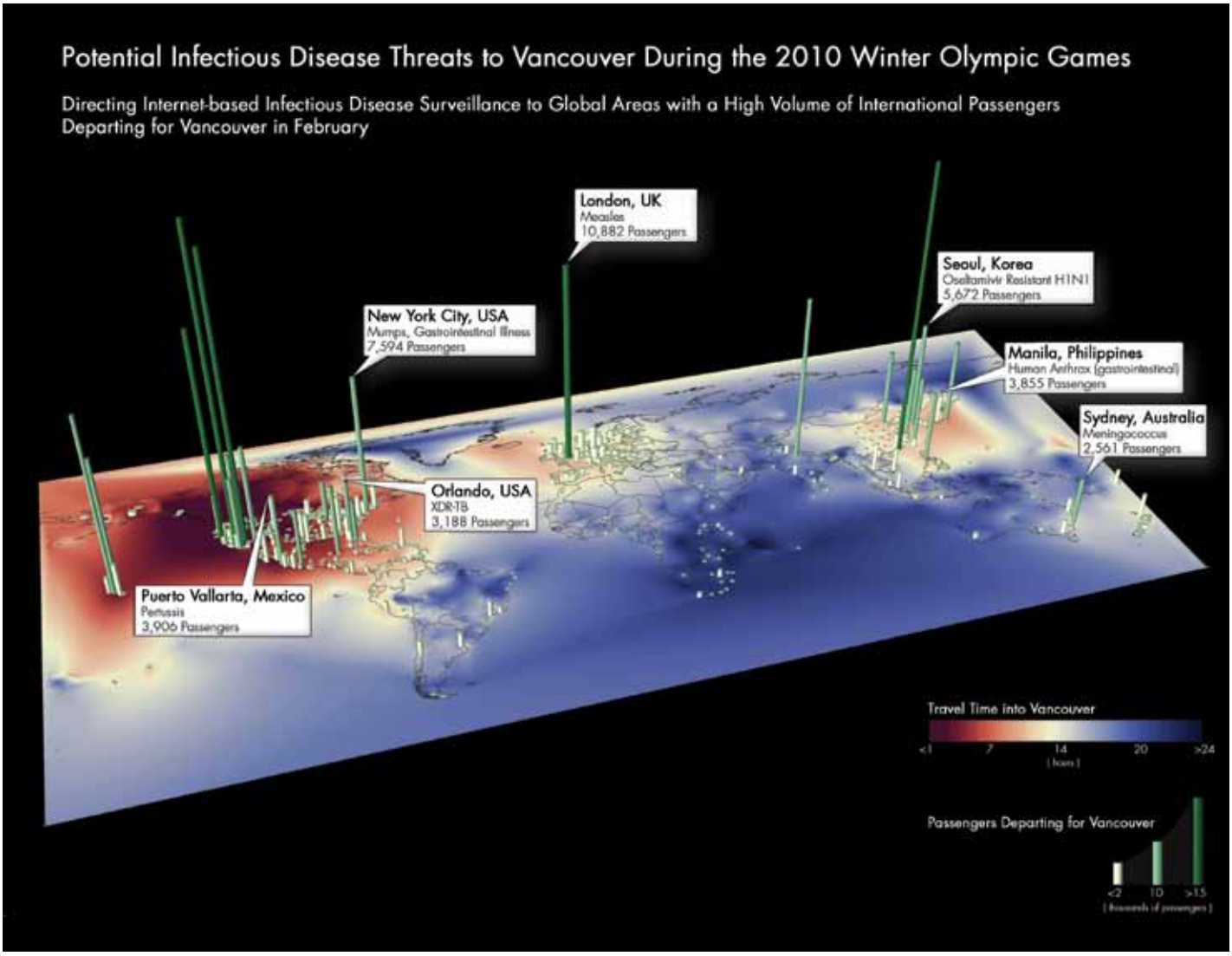
Dr. Kamran Khan, St. Michael's Hospital, Toronto, Canada

→ to offer real-time global situational awareness of infectious disease threats, strengthening public health security throughout the world.

"The Bio.Diaspora architecture enables us to quickly produce maps and put them on the web to seamlessly communicate our research findings," he explained. "We continue to move toward web mapping as a powerful vehicle to communicate our findings around the globe, helping to promote awareness, preparedness, and prevention of infectious disease threats."

Integrated Web-Based System

The Bio.Diaspora architecture consists of three key software components: SAS business analytics software, which integrates and manages data for tasks such as determining passenger flow volumes, identifying routes and transit points used most frequently by international passengers coming to Canada, and examining traffic trends over time;



↑ International air traffic patterns into Vancouver leading up to the 2010 Winter Olympic Games were combined with HealthMap to reveal potential global infectious disease threats during the Winter Olympic Games.

MATLAB technical computing software, which is used for data analysis and numeric computation; and ArcGIS software, which brings data to life through a range of compelling web maps.

For example, ArcGIS provides a way to create heat maps, contour maps, and simulations that could answer key questions such as, Where are the vulnerable points of entry in this province? What is the probability of the spread of infectious disease based on a defined set of criteria? How many international passengers arrived in a particular city in 2012?

Data sources are combined with data on worldwide passenger ticket sales, global flight schedules, and real-time flight status information. Bio.Diaspora facilitates an understanding of how people travel via commercial airlines and uses it as a way to predict how infectious diseases are most likely to spread around the world.

To enhance the application's capability to predict the spread of infectious disease at mass gatherings, the Bio.Diaspora team joined forces with the researchers at Harvard University who developed HealthMap, an online infectious disease surveillance system that uses ArcGIS for Server and monitors reports and warnings of outbreaks on the web at a local or regional level. An automated text-processing system evaluates more than 30,000 sources for disease outbreaks and their associated locations and maps the information on an interactive display.

The current Bio.Diaspora application has an integrated live stream of global epidemic intelligence from HealthMap and is capable of providing end users with valuable insights into where dangerous infectious disease threats are emerging in the world and where they are most likely to spread.

Together, Bio.Diaspora and HealthMap created a conceptual model that was applied to popular events including the 2010 Olympic Winter Games in Vancouver and the 2010 Fedération Internationale de Football Association (FIFA) World Cup.

For the 2010 Winter Olympics, the team members focused their infectious disease surveillance on the 25 cities where the majority of the travelers were predicted to originate. They also performed analyses to estimate the size of any potential surges in international air traffic that might coincide with the Winter Olympics. They accomplished this by analyzing historical trends in international air traffic over the past decade, including how global air traffic patterns changed during the previous Winter Olympics in Torino, Italy. Finally, they used data from flight schedules and network analysis to calculate the time required to travel from all commercial airports worldwide to Vancouver at the time of the opening ceremonies in February 2010. For pathogens with known incubation periods, information on travel times and travel routes to Vancouver could then have been used to assess the public health value of screening travelers upon arrival at Vancouver International Airport.

HealthMap was then leveraged to monitor disease outbreaks in the 25 cities of interest from which the majority of passengers traveled. The team took advantage of Really Simple Syndication (RSS) feeds to construct a dataset of news stories about infectious diseases that would be updated automatically. The analysis was performed on an hourly basis leading up to—and during—the Winter Olympics and identified three specific types of threats: infections with high capability of spreading from person to person through respiratory transmission or direct contact; infections that contained dangerous, drug-resistant pathogens; and threats that could be an act of bioterrorism.

"Real-time integration of web-based infectious disease surveillance, combined with knowledge of worldwide patterns of commercial air traffic, could significantly enhance global situational awareness of infectious disease threats," explained Khan.

This same conceptual model was applied to monitor infectious disease threats in South Africa for the FIFA World Cup. The team created a map that showed the high concentration of passengers traveling from 15 different cities, the time it would take those passengers to travel to South Africa, and the infectious disease threats that were present in those cities. For example, the map revealed that hand, foot, and mouth disease was present in Singapore; measles was present in Harare, Zimbabwe; mumps was present in London, England; and tuberculosis was present in Dakar, Senegal.

In the end, no major infectious disease threats were associated with either the 2010 Winter Olympics or the FIFA World Cup. However, if a serious threat had been identified, health officials from the host country would have known the country where the threat was first identified and therefore which health officials to contact. Health authorities and the public at the site of the gathering could have also been alerted to facilitate early detection of new cases.

Preventing Future Catastrophes

Information gleaned from the Bio.Diaspora and HealthMap conceptual model is now being used to interact with policy makers to improve global preparedness and response strategies. Khan and Brownstein currently have an advisory role with the World Health Organization (WHO).

In July 2012, when the Summer Olympic Games began in London, plans called for using Bio.Diaspora to assist public health officials in the United Kingdom by linking information on global infectious disease outbreaks with knowledge of patterns of travel to London. This integration would help health officials better understand what global outbreaks they needed to pay greatest attention to and subsequently anticipate and prepare for in case any threats were to spread to London. This collaboration represents the first time that such information will have been used in an operational manner to facilitate near real-time risk assessments of global infectious disease.

For more information, contact Dr. Kamran Khan at KhanK@smh.ca or visit www.biodiaspora.com.

Opening Up Health Reform

Riverside County's Public Health Department Takes a New Look at Grant Applications

"It is our vision that the county's residents will engage in active, healthy lifestyles; enjoy good physical and mental health; and have access to appropriate and cost-effective preventive, primary, specialty, and emergency care."

Wendy Betancourt, Public Health Program Chief of Epidemiology and Program Evaluation, Riverside County Department of Public Health

Staff at the Epidemiology and Program Evaluation branch of Riverside County, California, Department of Public Health understand the power of a map. This branch performs most of the data profiling for anyone who needs map-level data at the department.

The maps are used to promote and protect the health of county residents and visitors as well as ensure that services promoting the well-being of the community are available. From grant work for funding health programs to ensuring that people across the county have fair and equitable access to emergency medical services, maps provide insight like no other tool.

Riverside County Department of Public Health oversees the health of almost two million people located in more than two dozen cities. Issues the department faces in this culturally diverse population include high rates of cardiovascular disease, obesity, and physical inactivity.

"It is our vision that the county's residents will engage in active, healthy lifestyles; enjoy good physical and mental health; and have access to appropriate and cost-effective preventive, primary, specialty, and emergency care," explains Wendy Betancourt, public health program chief of Epidemiology and Program Evaluation, Riverside County Department of Public Health. "This can be achieved through a high level of public and environmental health services and mental health programs where these services are most needed."

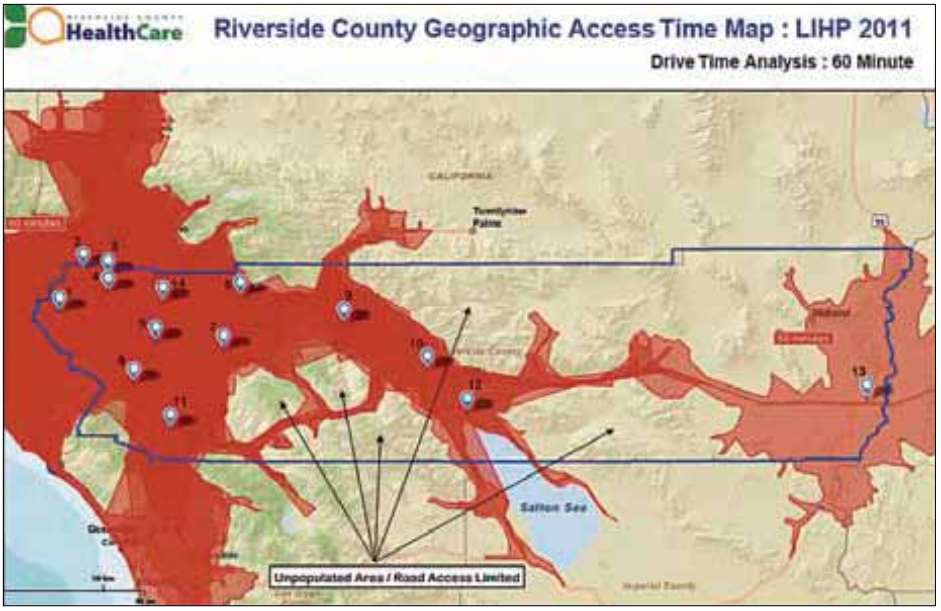
To target these areas and manage a finite arsenal of resources and government funds, Riverside County Department of Public Health turned to GIS. The department has been a user of ArcGIS for Server and ArcGIS for Desktop for about eight years. It uses ArcGIS to share data easily with other Riverside County departments and the federal government, whose staff are also trained on the software.

Easy Drive-Time Analysis for Health Reform Law

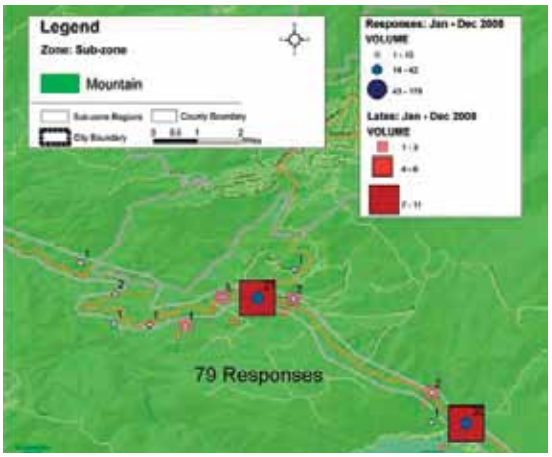
Staff at the Epidemiology and Program Evaluation branch found out about a new software solution—Esri Community Analyst—through a list service and decided to explore its possibilities. Epidemiologist Kevin Meconis and research specialist Wayne Harris have put the web-based mapping and reporting solution to work analyzing data. They are specifically using the solution to help the county adhere to a new health care reform law that requires the county to ensure that its clinic system serves low-income community members and the uninsured.

The federal health reform act includes $11 billion for nationwide expansion of community clinics, and California is gearing up to receive $1 billion of that money. Riverside County is looking forward to securing some of this funding for its community clinics. The law will take effect in 2014, but Meconis and Harris are using Community Analyst to research a preparatory grant application that, in essence, gives them a head start to this process.

The grant application requires a map product displaying a 60-minute drive time of the catchment area surrounding each clinic; Meconis was able to easily mark on the map the exact locations of the clinics based on their addresses and then calculate drive times for each clinic.



↑ Riverside County, California, is using Community Analyst to apply for grants for low-income community clinics, analyzing how long it takes for members of these communities to travel to the clinics.



← This ArcGIS analysis allowed branch staff to make sure ambulance services were in compliance with county regulations for response times to incidents.

"There was no other way to do this that was as convenient," says Meconis. "I don't think we would have been able to perform this function any other way."

And even though this particular feature of the software was new to Meconis, in less than a day, he understood how to use the software and created a customized drive-time analysis on a dynamic map. This analysis was then easily output in the format he needed to submit for the grant.

The Latest Data at Users' Fingertips

The ability to generate profiles was another feature of this GIS solution that the epidemiologists and researchers appreciated. Before using this solution, staff members would have to find the area on a map that they were interested in and then ferret out tabular data from multiple sources, such as the American Community Survey (ACS) and the federal finance and population estimates.

Once the raw data is found, it must be put into the proper format to be seen and searched through a mapping interface. That process could be drawn-out and cumbersome, and while Meconis says that he and his colleagues are pretty good at hunting for data, the time it takes to find it could certainly be used on more valuable efforts.

All this information became available to them. From ACS data contained in one-, three-, and five-year databases to data from the 2010, 2000, and 1990 censuses, Esri offers current-year demographic estimates that are included in the licensing of the solution. Geographies not supplied by the Census Bureau are available through Community Analyst and include ZIP codes, designated market areas, rings, drive times, and hand-drawn areas. Data for states, counties, tracts, block groups, places, core based statistical areas, congressional districts, and county subdivisions is also provided.

"One of the requests we always get is to find the latest data that is available," says Meconis. "Before, the most up-to-date data we had to work from was usually several years out-of-date; now, we have the 2010 estimates right at our fingertips."

Branch staff help with several grant applications each year. Sometimes, depending on the nature of the grant, the department must also apply for many certifications for federally qualified health centers. This means the county routinely has to provide documentation to its funding sources that it does indeed serve the communities it claims it's serving.

Part of this process requires the ability to create custom profiles from more than one ZIP code and aggregating the data. Now, the staff members select the appropriate areas around each of these clinics as well as parse the included data with their own.

"This is incredibly convenient because all the data is in one place, and we don't have to look elsewhere for information on race, ethnicity, age structure, economic indicators, and other information," says Meconis.

Managing Workflows for Greater Efficiency

Community Analyst integrates well into the workflow of the branch staff members. They support more than 10 departments in the Riverside County Department of Public Health using ArcGIS in many different capacities.

Currently, branch staff members are working on a grant program for the Healthy Homes Initiative funding that helps people remediate older houses that might contain dangerous substances, such as mold, insects, or lead paint. GIS is used to find and identify locations for at-risk housing across the county to help target services. Since this information is all available from the county databases—which are maintained in geodatabases—ArcGIS can be used to easily find and analyze the information, such as identifying older neighborhoods and specific homeowners.

GIS is also helpful for supporting the emergency medical services program. By looking at ambulance service areas on a map, branch staff are able to ensure that ambulance companies are in compliance with county regulations for response times to incidents.

"Anytime there is an issue with a provider about where a call is located and whether it is inside a particular boundary or not, maps are used to resolve the dispute," says Meconis.

The county also works with schools and law enforcement to obtain grants for education programs promoting safe walking to and from school. Detailed maps show the community where schools with high pedestrian traffic are located, as well as areas that have had incidents, and help residents plan routes that are safer.

> "One of the requests we always get is to find the latest data that is available. Before, the most up-to-date data we had to work from was usually several years out-of-date; now, we have the 2010 estimates right at our fingertips."
>
> Kevin Meconis, Epidemiologist, Epidemiology and Program Evaluation Branch, Riverside County Department of Public Health

For more information, contact Wendy Betancourt, Riverside County Department of Public Health, at wbetanco@rivcocha.org.

Christina's Conference Corner

Esri's new health and human services manager, Christina Bivona-Tellez, has been globe-trotting in recent months to participate in key conferences that will inevitably impact health care and human services (HHS) not only in the United States but worldwide. Esri News for Health & Human Services hopes to offer highlights of meetings attended by Bivona-Tellez and other Esri HHS team members in future issues. Here are notes and impressions of several meetings she attended last spring:

Dates	April 3–5, 2012
Title	GIS for the United Nations and the International Community Conference www.gisfortheun.com
Organizers	Esri, United Nations Institute for Training and Research (UNITAR), and United Nations Operational Satellite Applications Programme (UNOSAT)
Venue	World Meteorological Organization (WMO) Headquarters, Geneva, Switzerland

The conference was organized to bring GIS professionals together to realize the potential of working and capitalizing on the synergy they are able to achieve on global issues—whether they are in an office in Geneva or a refugee camp in Africa. These issues may range from natural disasters and climate change to development planning and humanitarian assistance. GIS facilitates better collaboration and visualization, as well as rapid dissemination of critical information when and where it's needed most. Empowering action in territorial planning and response operations calls for a true geographic understanding of the complex challenges being faced.

The meeting's workshops focused on several goals:

- Understanding how to make critical information more accessible and actionable
- Developing and directing strategies on how to best apply geographic information science to devise better responses to regional and global challenges
- Discovering how to better organize and manage information, resources, and people through improved visibility, communication, and collaboration
- Participating in building a community to expand capacity and understanding at all levels
- Developing cross-agency geohealth collaborations and envisioning a common data-sharing policy for health planning

Bivona-Tellez moderated the seminar GIS—Improving the Impact of Global Health Investments. Panelists included Richard W. Steketee, MD, MPH, science director, Malaria Control Program, PATH (Seattle, Washington); Nicholas Bidault, team leader, Monitoring and Evaluation, Global Fund to Fight AIDS, TB, and Malaria (Geneva, Switzerland); and Swiss GIS expert Steeve Ebener, a project manager with the World Health Organization (WHO) e-health team.

The panel discussed how—in a time of world economic downturn and resource scarcity—to make better use of GIS, thus empowering decision makers to more effectively use public health investments to reduce inequities, understand the resources available to them, and communicate and share the impacts of these investments and their decisions more broadly. Steketee talked about implementing malaria control programs using tents, mosquito netting, and indoor spraying and how GIS could show the program's impact on surrounding households.

"I'm sure that in those [mosquito infested] parts of the world, anything that would help would be considered a breakthrough and very exciting," Bivona-Tellez said.

Dates	April 10–13, 2012
Title	TEDMED www.tedmed.com
Organizers	TED Conferences, LLC, for which sponsors have included General Electric, Cleveland Clinic, Johnson & Johnson, Siemens, Panasonic, and Esri
Venue	The John F. Kennedy Center for the Performing Arts, Washington, DC

Bivona-Tellez joined nearly 2,000 adventurous pioneers, thought leaders, and achievers from 300 medical and nonmedical fields for a four-day interdisciplinary brainstorming and networking celebration. They explored the issues, challenges, and innovations that will help shape the future of health and medicine for millions of Americans and the world. TEDMED's audience included people from every realm of science, business, technology, government, religion, law, military, media, and the arts.

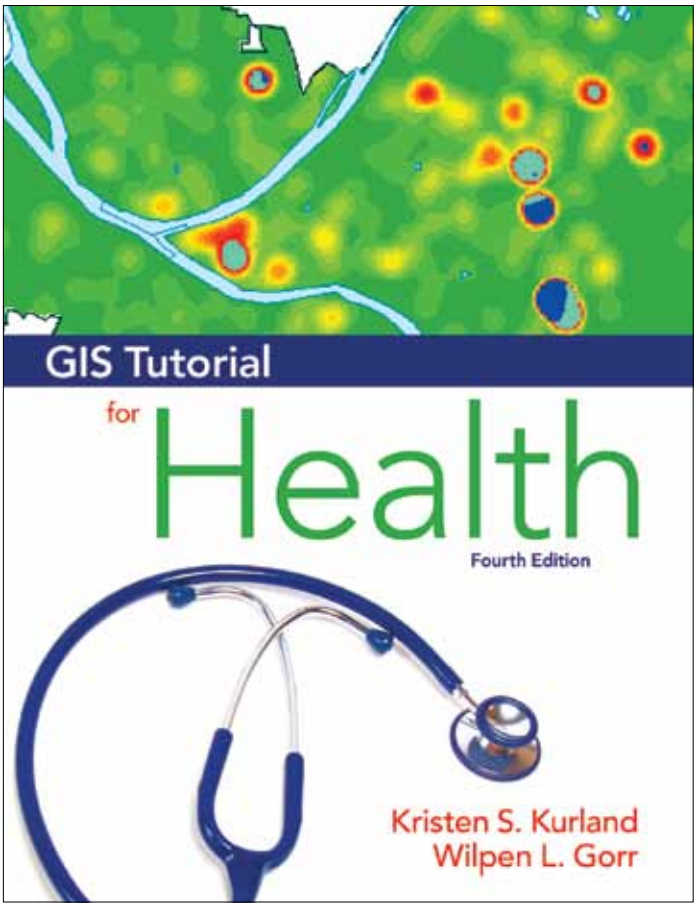
"All are interested in newer ways for us to move ahead and improve the health of humanity—whether it's looking at organic foods, how we slow down the use of antibiotics, or how we educate future health care providers," Bivona-Tellez said. "We need to have the richness, diversity, and creativity to keep us thinking bigger and more broadly to bring in new ideas to deal with old problems. And people are very interested in how a geospatial, analytical approach will facilitate this."

The conference had no breakout sessions but rather consisted of nearly 70 brief talks that combined the very cutting edge of health information and technology, gripping personal stories, and tantalizing peeks into the future of health care.

This year's topics included the following:

- From Discovery to Health: Does It Have to Be a Long and Winding Road?
- Do Cells Have a Midlife Crisis?
- Want a DocBot at Home?
- Can We Treat Alzheimer's 20 Years Early?
- Is the Disease Model Sick or Just Exhausted?

GIS Tutorial for Health, Fourth Edition, by Kristen S. Kurland and Wilpen L. Gorr



From simple map generation to advanced spatial analysis for disease investigation, this new health tutorial from Esri Press provides detailed, colorful step-by-step guides.

Reviewer

Chris Goranson, director, Parsons Institute for Information Mapping, The New School; adjunct lecturer, Epi/Biostats Program, Hunter College; and lecturer, preventive medicine program, Mount Sinai School of Medicine, New York City, New York

Pub Date: 8/10/2012
Price: $79.95 USD/$91.95 CAD
ISBN: 978-1-58948-313-2

Kurland and Gorr's *GIS Tutorial for Health*, Fourth Edition, is a well-thought-out introduction to and tutorial for geographic information systems, suited for public health students and practitioners alike.

As the title implies, this text is first and foremost a tutorial. The book does not assume its readers have any previous experience using GIS and is structured so that more advanced students can quickly skip ahead to sections they find more useful. The text itself is well organized and thought out; the authors have clearly worked hard to introduce concepts in a way that builds students' understanding of the software without overwhelming them.

Like earlier editions, the fourth edition provides a significant amount of data for students to work with; good data management skills are stressed, the value of which really can't be underestimated. The tutorial also comes with a 180-day trial version of ArcGIS software. For instructors, significant resources are provided, including a sample syllabus, grading rubrics, optional midterm and final projects, and slides for every chapter.

The writing is clear and easy to understand, and the authors do not bury the analytical techniques in jargon-laced descriptions that would only serve to confuse students. As practiced professionals know, ArcGIS often provides more than one way to access tools and functions. The book encourages students to explore the various settings and options without fear, and instructors should do the same. Steps are outlined with a significant number of graphics and illustrations that largely account for the book's volume. These graphics are much preferred to textual descriptions, as they provide a handy visual reference for students to explore topics on their own, skip ahead, and later return to particularly challenging steps without penalty.

The text is well suited for undergraduate- and master's-level programs alike. There are times when the book hints at correlations seen in the data that are indicative of causation, so a good supplement would be a further reading section citing literature examples that would help students understand the strengths and limitations of GIS in public health research. For example, a GIS in public health course situated in an epidemiology track would benefit from supplementary reading on cluster analysis techniques, ecological fallacy, and reverse geocoding.

For those wanting to dig further into advanced spatial statistics, a text like David O'Sullivan and David Unwin's *Geographic Information Analysis* would be a good complement.

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