

healthyGIS

Trauma Center Location Planning Gets Relief

Resource Allocation Model Now Online

Accidents happen, and the difference between a life-or-death outcome can depend on the time it takes to get a severely injured person to a trauma center hospital. The process of choosing optimum locations for these life-saving trauma centers requires consideration of a complex set of variables. When a team of researchers at the University of Pennsylvania and Johns Hopkins University developed a geomathematical model that analyzes trauma center accessibility

in the United States, they wanted to share the results in a way others could use. Using ESRI software, they developed a geographic information system (GIS) application that puts the model's results on a map and displays it on an interactive Web page.

Research shows that patients with severe injuries treated at trauma center hospitals are significantly more likely to survive their injuries than patients treated at other hospitals.

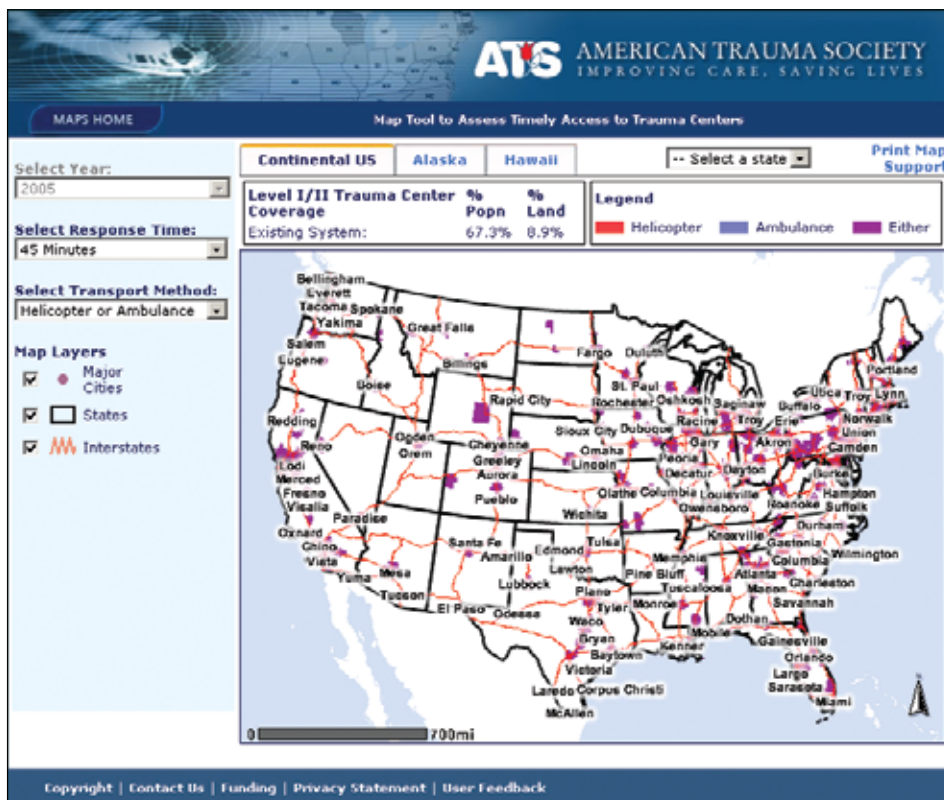
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Therefore, increasing the number of people whose lives are saved may be achieved by maximizing access to trauma centers, which is an important goal of the American Trauma Society (ATS), a nonprofit advocacy agency, and the National Center for Injury Prevention and Control.

Between 1999 and 2003, Charles Branas, Ph.D., associate professor, Department of Biostatistics and Epidemiology, University of Pennsylvania School of Medicine, developed and refined a model for analyzing access to current trauma center locations using an inventory of trauma centers maintained by ATS. Called the Trauma Resource Allocation Model for Ambulances and Hospitals (TRAMAH), the model's output was in a text format that was made for quick interpretation but was not intended for direct consumption by planners. To better use the information, a way was needed to improve understanding of the output and share it with others. Branas also wanted to develop what-if scenarios for locating centers that maximize efficient use of scarce resources so they may save the most lives possible.

"We knew that these measures were really important and should be tracked over time," says Anthony Carlini, director of the ATS



The American Trauma Society Web site displays the resource allocation model results for the continental United States, Alaska, and Hawaii and allows users to also look at a single state and choose response time and transportation method parameters.

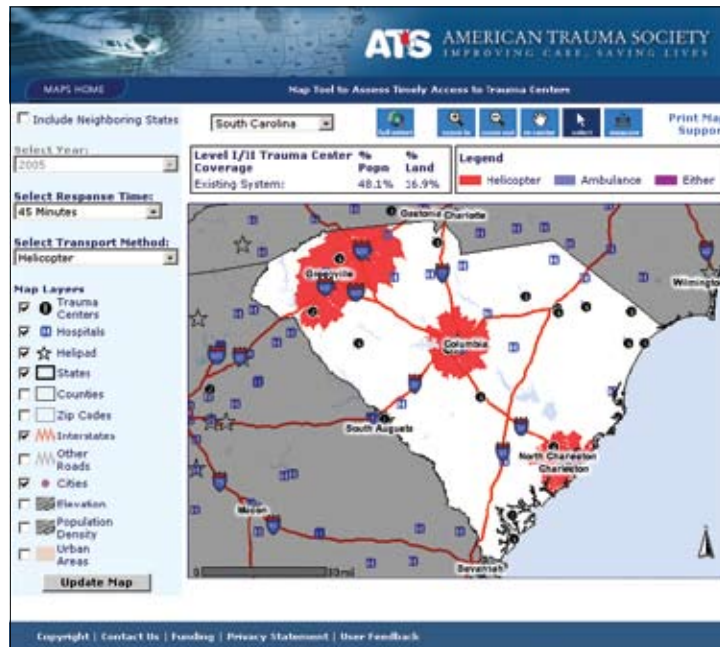
Trauma Center Location Planning Gets Relief

Trauma Information Exchange Program (TIEP) in collaboration with the Johns Hopkins Center for Injury Research and Policy. Carlini adds, “We wanted to get this information into a visual medium that would be usable by more people.”

Branas and a team from the University of Pennsylvania Cartographic Modeling Laboratory (CML) proposed a solution using GIS technology to make the data available on a map. GIS would allow them to combine many kinds of information, such as helicopter and ambulance ranges of operation, trauma center locations, and population density, and view them together on a national, detailed map. The map would provide visualization of the current overall picture, and GIS analysis tools would eventually help them run what-if scenarios to investigate options and support planning.

“Having a rapid, Web-based GIS interface makes our mathematical model real for state and regional trauma systems planners,” says Branas. “We thought about other approaches to reach these planners but settled on the current Web site because it was our most efficient, centralized, and far-reaching option.”

With funding from the Centers for Disease Control and Prevention (CDC) and Agency for Healthcare Research and Quality, leadership from TIEP, and support from CML, the team worked with ESRI business partner Avencia Incorporated to build the GIS system. Based on



This view of South Carolina’s TRAMAH model results shows the extent of helicopter access to trauma centers within 45 minutes (red) and displays trauma center coverage by population (48.1%) as well as area (16.9%).

previous successful collaborations with Avencia, CML chose the company to do the programming work and set up the server and Web site. CML, under GIS director Marlen Kokaz, organized the datasets to ensure that geographic location information was correctly incorporated.

The Web site, active since 2006, enables users to specify time frame (access within 45 or 60 minutes) and transportation mode (ambulance, helicopter, or both) and provides a map and coverage information based on percentages of population and land covered by the existing system. It displays trauma center access based on the most current census, hospital, and helicopter data. TRAMAH is used by state trauma system regulatory authorities to optimize the sites of new trauma centers.

A second phase is now planned that will update data for 2007 and enable state regulators to test different what-if scenarios. “We are currently planning to continue utilizing ESRI software and build on what we established during the first phase of the project,” says Kokaz, adding, “The second phase will enable the end user to be more hands on with scenario development and mapping on the fly.”

Many additional factors may need to

be taken into consideration in choosing sites for trauma centers, and the TRAMAH system is best used alongside, rather than instead of, the specialized knowledge of trauma systems planners. It does, however, demonstrate the very real value that GIS can add when dealing with limited, life-saving resources that must be allocated over large geographies.

For more information about the TRAMAH system, visit the project’s Web site at <http://maps.amtrauma.org> or contact Megan Heckert of Avencia Incorporated at mheckert@avencia.com or Charles Branas at cbranas@upenn.edu. For more information about Avencia, visit www.avencia.com.

Software Used

ArcGIS Desktop
ArcIMS
Microsoft SQL Server

Hardware Used

Dell PowerEdge 2850 X86-based PC

Data Sources

American Trauma Society Trauma Center Inventory
Atlas and Database of Air Medical Services
U.S. Census Bureau



A view of Columbia, South Carolina, displays ambulance access to trauma centers within 45 minutes (purple) and the location of all hospitals, trauma centers, and helipads.



From My View . . .

*By Bill Davenhall
Global Manager
Health and Human Services
ESRI*

Four Good Reasons for GIS

Hitting the nail on the head for many health and human services organizations means getting the right person to consume the right service in the right location at the right time. The challenge is to score four out of four correctly. Whether in the government or private sector, determining what is “right” often takes as much energy as the actual solution delivery. Success requires a real understanding of the workflows that lead to successful outcomes.

You are probably saying to yourself, “Glad that’s not my job!” But wait a minute—maybe it is. Aren’t you trying to apply research to practice, shorten revenue cycles, make sound health policies, improve service delivery levels, identify a disease outbreak, prepare to distribute vaccines, optimize your supply distribution system, anticipate the health needs of a community, or serve a family or a child? Aren’t you also part of the “right” solution?

Compelling operational requirements now create enormous pressures for change—from how we work to the results expected of our efforts. Health organizations around the globe are already building geographically enabled information systems and data streams in response to the need for better knowledge. Now is the time to move forward and expand GIS use to analysis and thus a better understanding of both the challenge and an action’s results.

Successful delivery of desirable outcomes should not be serendipitous. It should grow from a commitment to understanding how things work (or don’t) and by making sure the right technology is used by those who perform the work and measure the results—be it detecting disease, distributing vaccines, delivering immunizations, selling medical supplies and equipment, deploying health workers into the field, or preparing a nation for a pandemic.

It is time to reach beyond thinking that GIS is just about mapping and inspire others to think about how this unique information system can transform the way an organization analyzes a challenge and creates successful solutions.

As always, I encourage your second opinion.

Regards,

ESRI on the Road

Visit ESRI at the following trade shows and talk to the industry experts.

Healthcare Information and Management Systems Society 2008 Annual Conference and Exhibition

February 24–28, Orlando, FL
www.himssconference.org

Fifth International Congress on Vegetarian Nutrition and Healthy People Summit

(ESRI GIS session held March 2–3)
March 2–6, Loma Linda, CA
www.vegetariannutrition.org

2008 Air Force Environment, Safety, Occupational Health Training Symposium

March 2–7, Reno, NV
www.esympo.com

Association for Community Health Improvement Annual Conference

March 5–7, Atlanta, GA
www.communityhlth.org/communityhlth/join.html

The 47th Navy Occupational Health and Preventive Medicine Conference

March 14–20, Hampton, VA
www.nehc.med.navy.mil/Conference08/Index.htm

2008 ESRI Education User Conference

August 2–5, San Diego, CA
www.esri.com/educ

2008 ESRI International User Conference

August 4–8, San Diego, CA
www.esri.com/luc

2008 ESRI Health GIS Conference

September 28–October 1, Washington, DC
www.esri.com/hug

Save the Date

2008 ESRI Health GIS Conference

September 28–October 1, 2008
Washington, D.C.

Call for Papers

The deadline to submit your paper proposal for the 2008 ESRI Health GIS Conference is April 18, 2008.

For links to the 2007 ESRI Health GIS Conference proceedings, highlights, and podcasts, go to www.esri.com/healthgis.

Maps Expand Asthma Hazards Awareness

GIS Helps Policy Makers See Where Childhood Asthma, Schools, and Pollution Sources Collide

By Zvia Segal Naphtali, Ph.D.; Carlos E. Restrepo, Ph.D.; and Rae Zimmerman, Ph.D., Robert F. Wagner Graduate School of Public Service's Institute for Civil Infrastructure Systems, New York University

The South Bronx, New York, has one of the highest asthma rates among school-age children in the United States. Since children spend significant parts of their day at school, an understanding of where schools are located in relation to environmental health hazards that can potentially affect asthma can provide important information for making decisions related to urban land-use planning and environmental policy. GIS provides communities with an important tool for leveraging data for policy-making efforts and improving policy makers' understanding of how different land uses might affect public health.

Approximately 20 to 30 percent of school-aged children in the South Bronx have had asthma at some point in their lives. A number of studies have shown that air pollutants, such as particulate matter and diesel exhaust particles,

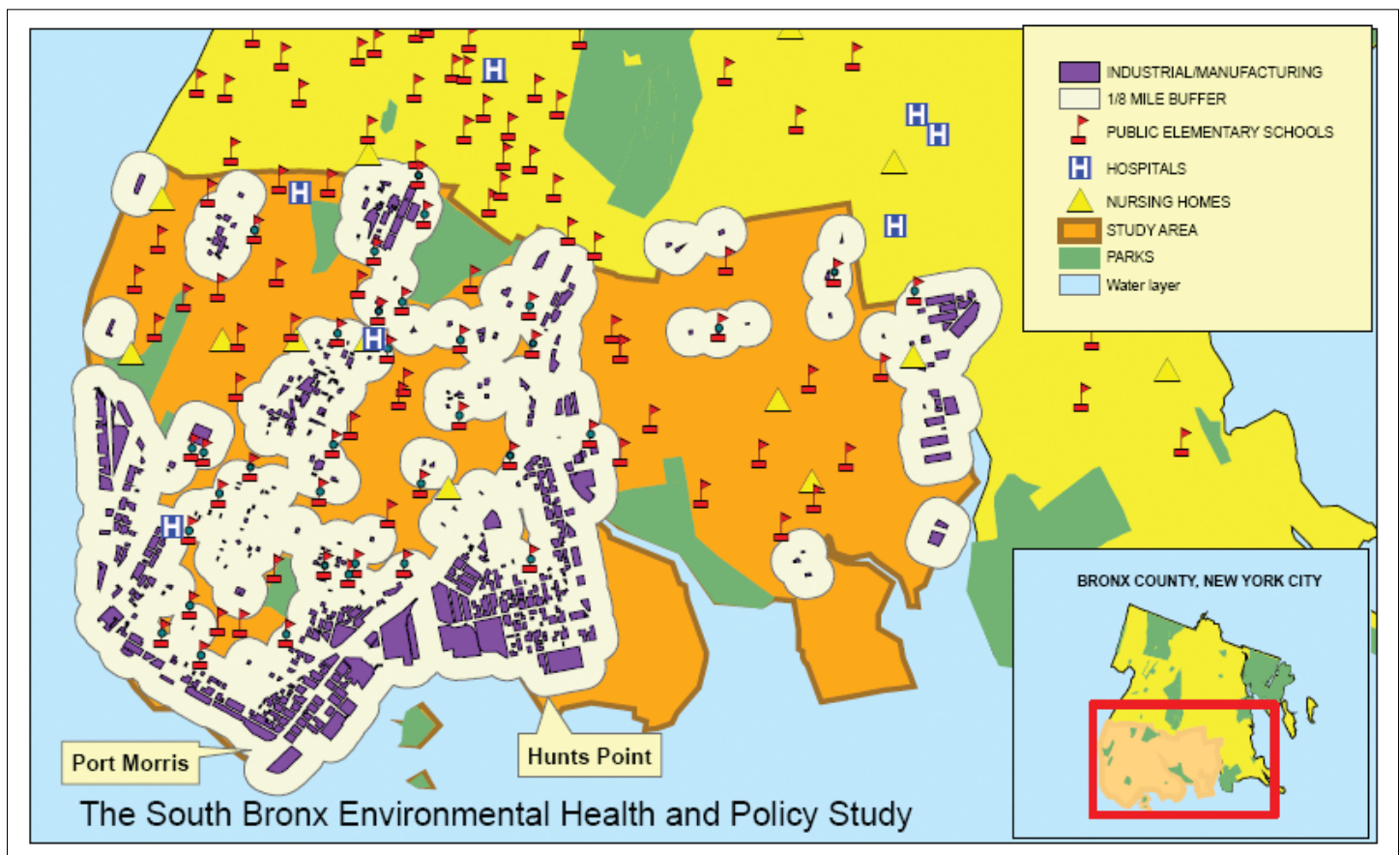
can trigger asthma. The Bronx is a throughway for heavy transportation routes as well as the destination for diesel trucks that serve a number of manufacturing-zoned facilities.

Researchers at New York University are using GIS technology as a valuable analytical tool for gaining a better understanding of the spatial relationships between the locations of Bronx schools and areas zoned for manufacturing. GIS mapping and analysis tools excel at combining many kinds of data to visually reveal a correlation that is difficult to notice when looking at spreadsheets.

Manufacturing land-use zoning in the Bronx includes locations for waste transfer stations, wastewater treatment plants, power generators, and other critical infrastructure services. The Hunts Point neighborhood houses the world's largest wholesale food distribution center,

which relies on trucks for its distribution operations. Traffic patterns associated with the waste transfer stations and other commercial activities are cause for major concern, since it may be that the air pollution associated with traffic generated by these activities is partly responsible for the high asthma rates observed in the South Bronx.

The analysis focuses on schools where pre-kindergarten to eighth-grade children spend a significant part of the day. Layers of information were combined from basemap data available in ESRI's Data & Maps (a set of map data included with ArcGIS software) and publicly available data on Bronx zoning, industrial manufacturing, and municipal sites. Tools in ArcGIS Desktop were used to create 1/8-mile and 1/4-mile buffers around land area zoned for manufacturing and industrial uses to visualize



Proximity of Schools, Nursing Homes, and Hospitals to Areas Zoned for Manufacturing and Industrial Uses Using a 1/8-Mile Buffer

their proximity to schools and identify the number of schools and students that fall within the buffers. Results show that about half of the prekindergarten to eighth-grade students in the South Bronx attend schools located within 1/8 of a mile of an industrial/manufacturing-zoned area. The figure increases to almost 90 percent for the 1/4-mile buffer radius (see table 1).

Although this kind of analysis does not prove a causal relationship between children's asthma rates and proximity to risk factors such as manufacturing land-use areas, it provides an important way to inform policy makers about how different land uses might affect public health. For example, findings can be used to support

requests for long-term monitoring of air quality and asthma symptoms at at-risk schools.

To compare health outcomes in schools located in close proximity to manufacturing land-use areas to those farther away, future research will aim to gather school-specific data on asthma rates, absenteeism due to asthma, and school nurse visits due to asthma.

Bronx County, New York City, the Study Area, Major Highways, Waste Transfer Stations and TRI Sites



A map of Bronx County, which includes the South Bronx, and some of the sources of environmental health hazards in the area. These include highways, waste transfer stations, and Toxics Release Inventory (TRI) sites. (Data for the locations of the waste transfer stations was obtained from the New York City Department of Sanitation.)

This work is part of the South Bronx Environmental Health and Policy Study, a collaborative research project between the South Bronx community and New York University, a project funded with a congressional appropriation sponsored by congressman José E. Serrano and administered through the U.S. Environmental Protection Agency (EPA).

The views expressed in this article are those of the authors and do not necessarily reflect the views of EPA. For more information about the project, visit www.icisnyu.org/south_bronx/index_001.html on the Internet or contact Zvia Segal Naphtali by e-mail at zvia.naphtali@nyu.edu.

Region	Number of schools	Schools as percent of Bronx total	Number of students	Students as a percentage of all students in Bronx County	Students as a percentage of all students in the South Bronx
Bronx County	153	100%	114,514	100%	
South Bronx	68	44.4%	49,791	43.5%	100%
1/8-mile buffer for industrial and manufacturing zones	34	22.2%	25,084	21.9%	50.4%
1/4-mile buffer for industrial and manufacturing zones	59	38.5%	44,248	38.6%	88.9%

Table 1: Proximity of Schools to Industrial/Manufacturing-Zoned Areas in the South Bronx

Software

ArcGIS Desktop

Data Sources

ESRI Data & Maps

New York City Department of City Planning Web site (www.nyc.gov/html/dcp).

New York City Department of Sanitation (www.nyc.gov/html/dsny/downloads/pdf/pubnrpts/cwms-ces/ces.pdf)

New York State Department of Environmental Conservation (www.dec.ny.gov/imsmaps/facilities/viewer.htm)

Health Leaders Explore the Power of Place

Health professionals received a challenge to use GIS technology to incorporate social, economic, and cultural contexts into a network of health-related information during the 2007 ESRI Health GIS Conference. “New settings require new science, and they require finding ways into those settings to find out where the need for public health is the greatest,” said Stephanie Bailey, MD, MSHSA, chief, Public Health Practice, U.S. Centers for Disease Control and Prevention (CDC). “The geographic information system approach is one of those emerging technologies that will move us toward success.”

Bailey made the comments to an audience of more than 300 health leaders, innovators, and health and human services practitioners who attended the event in Scottsdale, Arizona. During the conference, more than 60 presenters spoke on a wide range of GIS technology contributions that enable health and human service organization work around the globe.

Raymond Aller, MD, director, Automated Disease Surveillance Section, Division of Communicable Disease Control, Los Angeles County Department of Public Health, concurred with Bailey in his Keynote Address on the power of place in medicine. Aller said, “Developing digital place histories has important potential in helping physicians to fully comprehend the impact of where a person lives, works, and plays and can enable physicians to make more enlightened diagnoses. Getting accurate geographic information into the electronic medical record will take serious dedication by GIS practitioners. The place history must be timely, context sensitive, and immediately understandable by the physician if it is to become an important part of medical diagnosis.”

Public Health: Privacy and Communication

Addressing the privacy challenges and issues of using patient place-history data, Gerard Rushton, Ph.D., geography professor, University of Iowa, identified several technical methods for masking data while retaining



GIS users from the Arizona Department of Health Services stand outside their office building after hosting a site visit during the 2007 ESRI Health GIS Conference.

the information useful for spatial analysis. Rushton stated, “The collection and use of such wide-ranging information must come with assurances of privacy and confidentiality.”

Communication with the public was also identified as an important role for GIS. Stanley Scheyer, MD, former medical director of the Peace Corps, shared a conceptual framework for broader use of existing human health and environmental data at the community level. Donna Garland, chief, CDC Office of Enterprise Communications, encouraged the audience to use Web-enabled GIS to improve public access to important information. “Communication is more important now than ever before, and not because there is too little, but because there is so much,” said Garland, adding, “Today we have a more complex responsibility to ensure information sharing that is timely, accurate, and useful.” Elizabeth West, CPHIMS, vice president of corporate relations for the Health Information Management Systems Society (HIMSS), echoed the importance of communication through her discussion on the standardization of health information exchanges with clinical information systems and the impact of these standards on community, state, and national health information networks.

Health GIS Innovations

Addressing a current priority issue, Abel Kho, MD, assistant professor of medicine at Northwestern University, described a new ap-

proach to using GIS within the hospital setting to help battle increases in hospital-acquired infections. Kho used GIS to track patient-provider contact in hospitals and identify caregiver workflows that might be improved, with the goal of reducing hospital-acquired infection and infection transmission.

Several presenters described GIS application to other current issues. Jared Shoultz, director, Division of Public Health Informatics, South Carolina Department of Health and Environmental Control, explained how his state health department incorporates GIS technologies into its everyday workflows across the agency. Fazlay Faruque, Ph.D., PG, and director, GIS and Remote Sensing Department, University of Mississippi Medical Center, demonstrated the use of GIS technology to power a real-time disease surveillance system aimed at improving the understanding of the public health challenges of pediatric asthma. Chris McInnish, deputy commissioner, Alabama Department of Children’s Affairs; Dave Gruber, senior assistant commissioner, Division of Health Infrastructure Preparedness and Emergency Response, New Jersey Department of Health and Senior Services; and Shiloh Turner, MPA, director, Health Data Improvement, Health Foundation of Greater Cincinnati, demonstrated specific uses of GIS technologies that directly serve health challenges within communities.

Templates from ArcGIS Server Grant Winners Available Online

Innovative applications and data delivery templates from the winners of the ESRI and Stratus Technologies ArcGIS Server Demonstration Project Grant Program are now available. These reusable applications are based on server GIS technology and can be used with similar projects. Through these public domain templates, ESRI and Stratus Technologies hope to encourage government agencies to share applications.

The 10 winners of the 2006 ArcGIS Server grants received software, hardware, and training valued at more than \$800,000. Recipients include the Cabell-Huntington Health Department of West Virginia submission, EIRGIS.

EIRGIS Mobile Application for Windows Mobile

This application will allow you to display several layers through your Pocket PC device. It



The EIRGIS application allows you to display several layers through your Pocket PC device.

also has GPS functionality in that the application will zoom to your location on the map if you turn GPS on and display the surrounding data. Those who are not programmers should

keep checking back for an application installer that should make the installation process a little easier. To see some screen shots of the application, go to www.giswv.com/mobile.html.

Downloading

All 10 award-winning templates are described and can be downloaded at www.esri.com/servertemplates. To download the EIRGIS template directly from the ESRI scripts page, go to <http://arcscripts.esri.com> and search for EIRGIS.

To learn more about the ESRI and Stratus Technologies ArcGIS Server Demonstration Project Grant, visit www.esri.com/grants and select Past Grants.

Awards Recognize Outstanding Contributions to Health GIS

Winners of the 2007 ESRI Vision, Service, and Communication awards received recognition for achievements in using GIS technology in the health and human services fields during the 2007 ESRI Health GIS Conference.

The Vision Award was presented to Niigata University, Graduate School of Medical and Dental Sciences (Japan). The medical school recently established two technical centers, one for human health GIS and the other for environment and disaster mitigation GIS. In addition, the institution is utilizing GIS for national and international health applications and hosting annual health GIS symposia as well as implementing GIS courses in the medical school's curriculum.

The Service Award recognized the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics and Charles Croner, geographer and survey statistician for the center and editor of its *Public*

Health GIS News and Information newsletter.

The Communication Award for the best map in the conference's Map Gallery went to Gerald Curtis, consultant to the CDC's Lead Poisoning Prevention Branch, and the team of collaborators who submitted the poster. The map conveyed the results of CDC's research on possible environmental causes of childhood lead poisoning.

New this year, the People's Choice Award was selected by conference attendees. The winning poster by Riju Stephen, GIS analyst for the City of Houston Health and Human Services, explained the use of spatial analysis to discern new patterns in sexually transmitted disease outbreaks. Stephen commented, "My hope is that this poster would inspire others working in pandemics to use the same techniques to look at cases in a different way and formulate their intervention methods."



Hiroshi Suzuki, vice director of Niigata University, Graduate School of Medical and Dental Sciences (Japan), accepts the Vision Award from Bill Davenhall, global manager, ESRI Health and Human Services.



Gerald Curtis, consultant to the CDC's Lead Poisoning Prevention Branch, accepts the Communication Award from Peggy Harper, professional health education specialist, ESRI Health and Human Services.



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Health and Human Services Solutions Group

William F. Davenhall, Manager

E-mail: bdavenhall@esri.com

Tel.: 909-793-2853, ext. 1-1714

Peggy Harper, Health Education Specialist

E-mail: pharper@esri.com

Tel.: 704-541-9810, ext. 8677

Ann Bossard, Hospital and Health Systems Specialist

E-mail: abossard@esri.com

Tel.: 909-793-2853, ext. 1-2328

Chris Kinabrew, Public Health Specialist

E-mail: ckinabrew@esri.com

Tel.: 909-793-2853, ext. 1-2382

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